AGE AND LENGTH COMPOSITION OF THE COLUMBIA BASIN SPRING CHINOOK SALMON RUN SAMPLED AT BONNEVILLE DAM IN 1987

Technical Report 88-1

Matthew Schwartzberg

January 15, 1988

COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
975 S.E. Sandy, #202, Portland, OR 97214, (503) 238-0667

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INTRODUCTION

The Columbia River Inter-Tribal Fish Commission (CRITFC) stock identification project is a part of the U.S.-Canada Pacific Salmon Treaty spawning escapement monitoring program (Pacific Salmon Treaty 1985). The project is designed to develop and apply techniques for identification of individual stocks or groups of stocks of Columbia Basin salmon populations originating above Bonneville Dam. Scale pattern analysis (SPA) is currently the primary method being used for stock identification.

To improve the accuracy of stock composition studies using SPA, estimates need to be made of the age and length composition of stocks. This report presents summaries of the age and length composition of spring chinook salmon, Oncorhynchus tshawytscha (Walbaum), sampled at Bonneville Dam in 1987. Bonneville Dam is located on the Columbia River at river mile 146. At this sampling location, the spring chinook salmon population is composed of an aggregated mixture of stocks of both hatchery and natural origin.

METHODS

Sampling

To collect a representative sample of the spring chinook salmon population, fish were trapped at the Fisheries Engineering and Research Laboratory (FERL) located beside the Second Powerhouse (north side) at Bonneville Dam. This work was done with the assistance and cooperation of the U.S. Army Corps

of Engineers, the National Marine Fisheries Service, and the Oregon Department of Fish and Wildlife.

The desired sample size was 384 fish (Table 1) and was based on expected levels of precision and accuracy (p = .Ø6, c.i. = 9Ø%; Bernard 1982). Weekly sample sizes reflected the average weekly proportion of the total annual run based on counts made at Bonneville during the previous 1Ø years (CRITFC 1987). The total number of fish sampled and analysed was 363. The desired sample size was not obtained because of the unavailability of fish toward the end of the run (statistical week 22) and because a small number of scales collected were of poor quality and thus could not be analysed.

Fish were anesthetized, quickly sampled for scales and biological data, and after recovery returned to the exit fishway leading to the main fish ladder. Scales were collected and measurements recorded, as were observed mark(s) or tag information. Sex of fish could not be determined from external characteristics because of the early stage of maturation of individuals sampled. Field sampling procedures followed guidelines established for this project (Schwartzberg 1987).

Age Determination

Scales were collected and mounted according to methods described in Clutter and Whitesel (1956) and INPFC (1963). Scales were read by CRITFC staff, and individual samples were categorized by age using well-established scale aging procedures dating back to 19Ø5 (Johnston) and chronicled by Gilbert (1913) and Van Oosten (1929). Fish scale reading was validated by personnel at

Table 1. Cumulative and weekly sample sizes for Columbia Basin spring chinook salmon sampled at Bonneville Dam in 1987.

Date	Statistical Week	10 yr. Avg.[1] Cum.%	Cumulative Samp. No.	Samp./Wk. (Desired)	Samp./Wk. (Actual)[2]
4/08,10/87	15	5.9	23	23	23
4/14/87	16	16.7	64	41	41
4/21/87	17	32.5	125	61	61
4/29/87	18	50.6	194	69	68
5/06/87	19	69.5	267	73	72
5/13/87	20	83.6	321	54	54
5/18/87	21	92.4	355	34	33
5/29/87	22	97.1-100.0	384	29	11
Total				**384**	**363[2]**

1. The cumulative percentage is the weekly proportion of the ten-year average of previous years' spring chinook counts at Bonneville Dam.
2. A lack of available fish (statistical week 22) or occasional regenerated scale samples accounted for the differences between the number of samples desired and the actual number of samples collected and analysed.

the Columbia River Management Division of the Oregon Department of Fish and Wildlife.

The descriptive method used for presentation of fish age is that recommended by Koo (1955), which is sometimes referred to as the European method. The number of winters the fish spent in fresh water (not including the winter the egg was in the gravel) is shown as an Arabic numeral followed by a dot. The second numeral following the dot indicates the number of winters the fish spent in the ocean. The total age of the fish is equal to one plus the sum of both numerals.

Length Measurements

Fork lengths were measured to the nearest Ø.5 cm from the tip of the fish's snout to the fork of its tail. Mean lengths and standard errors were calculated by age class, by sampling period, and for the total sample.

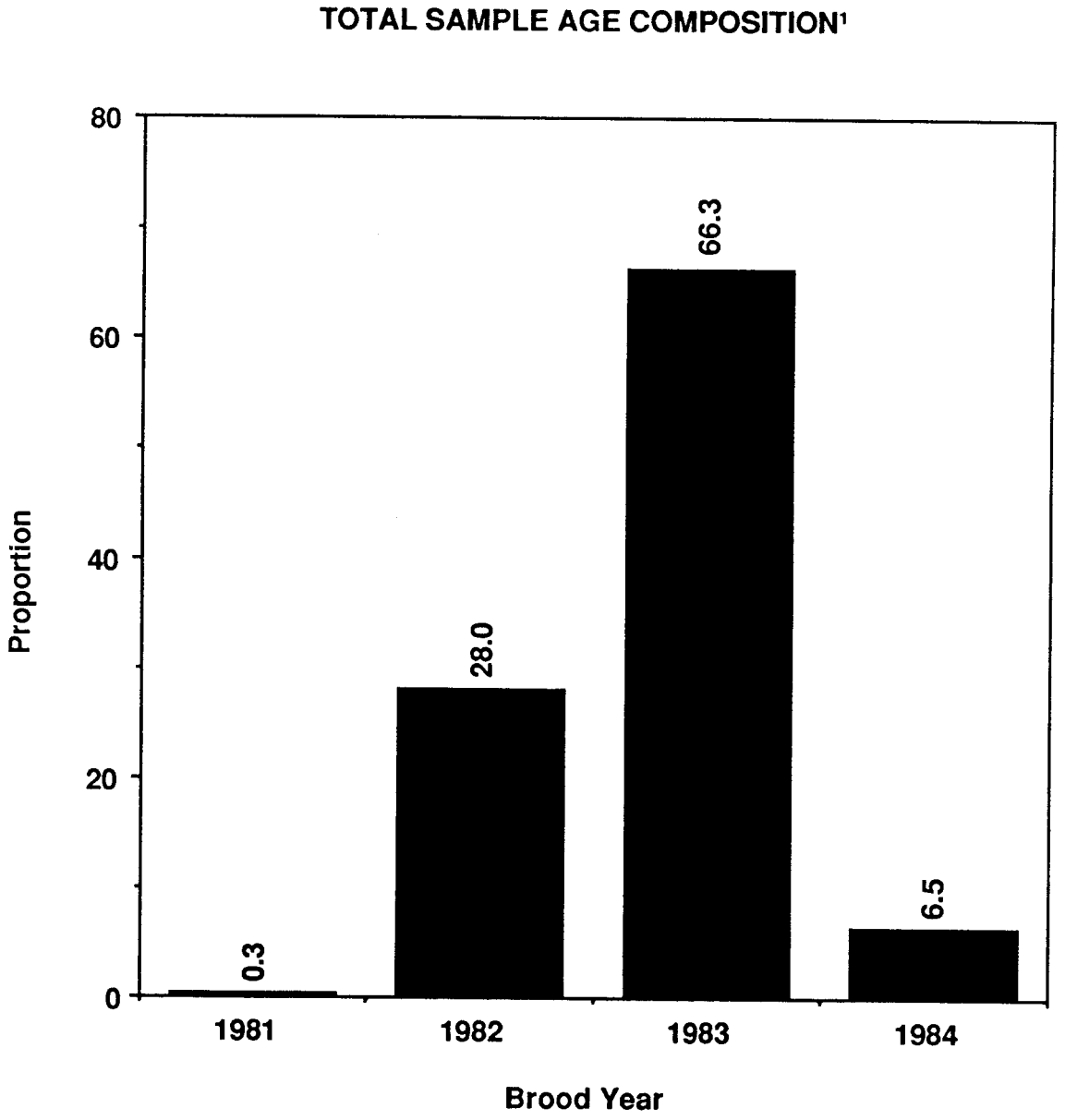
RESULTS AND DISCUSSION

Age Composition

Four-year-old fish (age 1.2 and Ø.3 - 1983 brood) represented 66% of the total sample (Figure 1). This age class was also predominant in each weekly sample, ranging between 55% (statistical week 22) and 79% (statistical week 18) (Table 2; Figure 2).

Five-year-old fish (age 1.3 - 1982 brood) were second in abundance, comprising 28% of the total sample (Figure 1). Weekly proportions of five-year-old fish (Table 2; Figure 2) ranged between 18% (statistical week 18) and 43% (statistical week 15).

Figure 1. **Total age composition of Columbia Basin spring chinook salmon sampled at Bonneville Dam in 1987.**



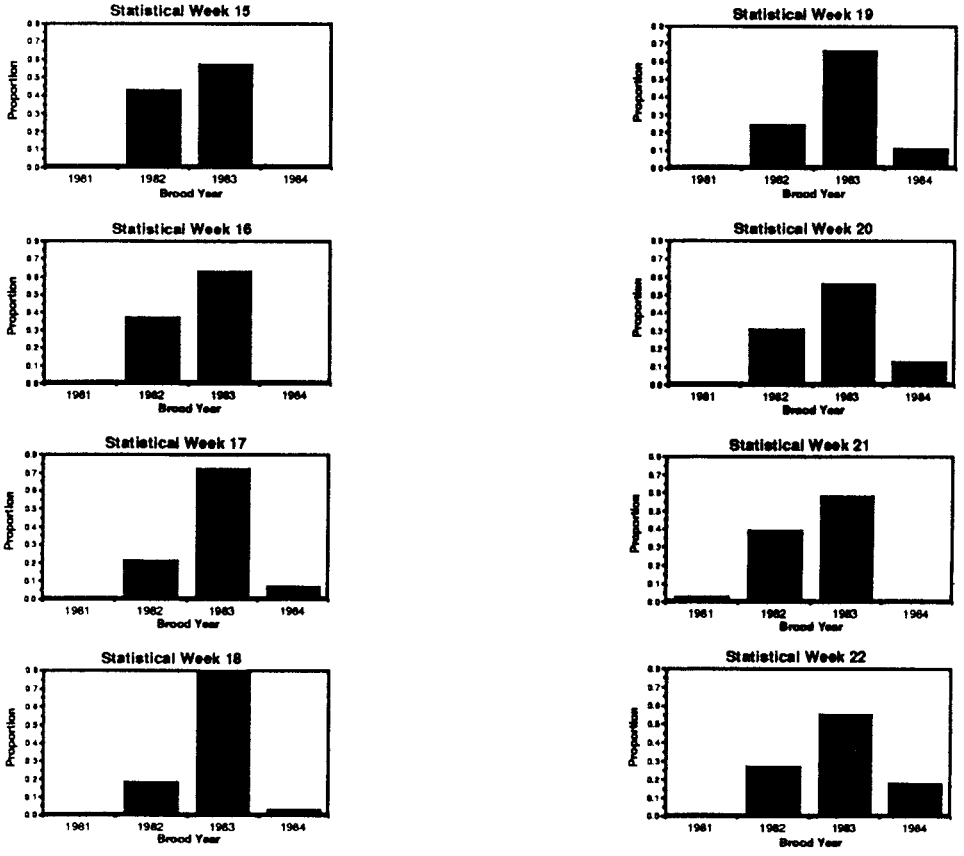
1. Note that rounding errors cause age class proportions to not total 1.0.

Table 2. Weekly age composition of Columbia Basin spring chinook salmon sampled at Bonneville Dam in 1987.

Statistical Week	Brood Year and Age Class[1] 1984 0.2	1984 1.1	1983 0.3	1983 1.2	1982 1.3	1981 1.4
15				0.57	0.43	
16				0.63	0.37	
17		0.07		0.72	0.21	
18		0.03		0.79	0.18	
19	0.01	0.10		0.66	0.24	
20		0.13	0.02	0.55	0.31	
21				0.58	0.39	0.03
22	0.09	0.09		0.55	0.27	

1. Note that rounding errors may cause weekly sample proportions to not total 1.0.

Figure 2. Weekly age composition of Columbia Basin spring chinook salmon sampled at Bonneville Dam in 1987.



Three-year-old fish (age 1.1 and Ø.2 - 1984 brood) made up 6.5% of the total sample (Figure 1). Weekly proportions (Table 2; Figure 2) ranged between Ø% (statistical weeks 15, 16, and 21) and 13% (statistical week 2Ø).

One six-year-old fish (age 1.4 - 1981 brood) was observed in statistical week 21 (Table 2; Figure 2).

Three fish were judged to be age Ø-plus (two age Ø.2 and one of age Ø.3) (Table 2). These fish are believed to have originated at the Little White Salmon National Fish Hatchery and to have been a result of that hatchery's accelerated rearing program. Age Ø-plus fish are combined with their respective brood-year cohorts in the above summaries.

Twenty-two percent of the scales analysed had freshwater zones of unreadable quality.

Length Composition

Three-year-old fish (1984 brood) in the total sample averaged 52.4 cm in length, with a 9Ø% confidence interval of 49.5 to 55.4 cm (n = 23) (Table 3; Figure 3).

The average length of four-year-old fish (1983 brood) was 72.7 cm, and the 9Ø% confidence limits fell between 72.2 and 73.2 cm (n = 239).

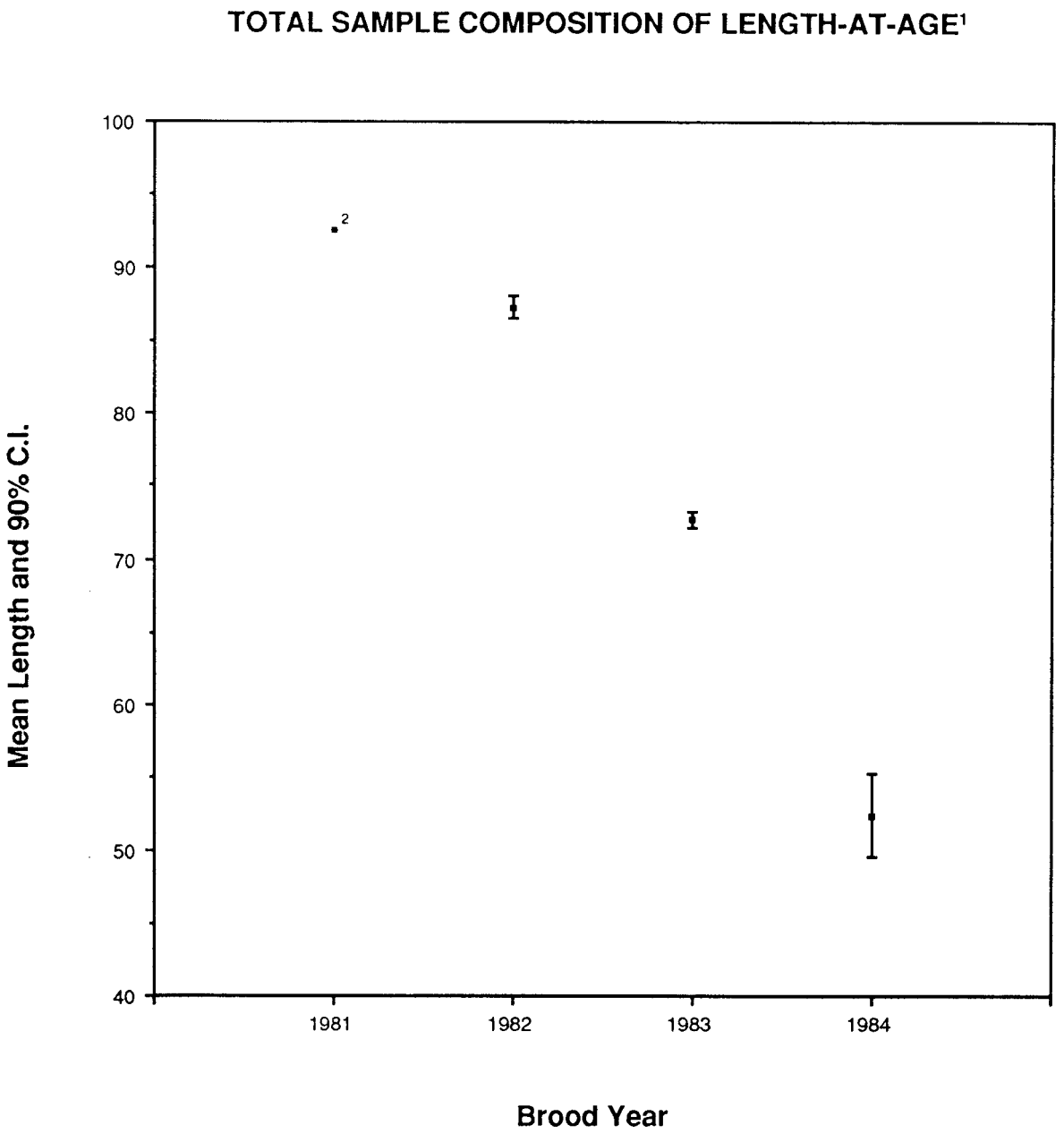
The average length of five-year-old fish (1982 brood) in the sample was 87.3 cm. The 9Ø% confidence interval for five-year-old fish was 86.5 to 88.2 cm (n = 1ØØ). No trends in the relationship between fish length and migratory timing were apparent.

The three age Ø-plus fish fall well outside the 9Ø% confidence intervals for their brood-year cohorts and are closer in

Table 3. Total and weekly length (cm) composition of Columbia Basin spring chinook salmon sampled at Bonneville Dam in 1987.

Statistical Week		Brood Year and Age Class 1984 0.2	1984 1.1	1983 0.3	1983 1.2	1982 1.3	1981 1.4
15	(April 5 - 11)						
	Avg. Fork Length				70.8	88.6	
	Minimum				63.5	80.0	
	Maximum				75.5	98.5	
	Std. Error				1.0	1.6	
	Sample Size				13	10	
16	(April 12 - 18)						
	Avg. Fork Length				72.7	85.9	
	Minimum				60.0	77.5	
	Maximum				83.0	92.0	
	Std. Error				0.9	1.1	
	Sample Size				26	15	
17	(April 19 - 25)						
	Avg. Fork Length		50.4		71.1	88.0	
	Minimum		48.5		59.5	84.0	
	Maximum		53.5		79.0	93.5	
	Std. Error		1.1		0.7	0.8	
	Sample Size		4		44	13	
18	(April 26 - May 2)						
	Avg. Fork Length		43.8		73.4	86.7	
	Minimum		43.5		59.5	81.5	
	Maximum		44.0		85.5	93.0	
	Std. Error		0.2		0.6	1.1	
	Sample Size		2		54	12	
19	(May 3 - 9)						
	Avg. Fork Length	79.5	49.1		73.5	85.7	
	Minimum	79.5	36.0		66.5	72.0	
	Maximum	79.5	55.5		82.0	96.5	
	Std. Error	--	2.5		0.5	1.7	
	Sample Size	1	7		47	17	
20	(May 10 - 16)						
	Avg. Fork Length		53.5	80.0	72.8	88.1	
	Minimum		44.5	80.0	60.0	81.5	
	Maximum		59.0	80.0	84.0	100.0	
	Std. Error		1.7	--	1.0	1.4	
	Sample Size		7	1	29	17	
21	(May 17 - 23)						
	Avg. Fork Length				73.5	88.2	92.5
	Minimum				65.5	79.5	92.5
	Maximum				81.0	97.5	92.5
	Std. Error				1.3	1.6	--
	Sample Size				19	13	1
22	(May 24 - 30)						
	Avg. Fork Length	60.5	58.5		71.8	91.0	
	Minimum	60.5	58.5		63.0	83.5	
	Maximum	60.5	58.5		78.5	101.0	
	Std. Error	--	--		2.2	5.2	
	Sample Size	1	1		6	3	
Total	Avg. Fork Length	70.0	50.7	80.0	72.7	87.3	92.5
	Minimum	60.5	36.0	80.0	59.5	72.0	92.5
	Maximum	79.5	59.0	80.0	85.5	101.0	92.5
	Std. Error	9.5	1.2	--	0.3	0.5	--
	Sample Size	2	21	1	238	100	1

Figure 3. **Total length composition of Columbia Basin spring chinook salmon sampled at Bonneville Dam in 1987.**



1. Age 0-plus fish (two age 0.2 and one age 0.3) are included with their respective brood-year cohorts.
2. Only one fish (age 1.4) sampled.

length to fish with an additional year's fresh-water growth (Table 3).

The age composition of the 1987 spring chinook population estimated in this study was compared to results obtained from fish sampled in the Corbett spring chinook test gillnet fishery (n = 467 in 1987). The Corbett test fishery is conducted annually by the Washington Department of Fisheries. It is located approximately 20 miles downstream of Bonneville Dam and uses 8-inch mesh gear.

In 1987, age 1.2, 1.3, and 1.4 fish were estimated to represent (respectively) 64, 35, and 0.2% of the spring chinook salmon sampled in the Corbett test fishery (Dammers 1988). It is difficult to make comparisons between age composition estimates derived from the Corbett test fishery and those made in this study because sampled populations differ; the Corbett sample does not accurately represent age 1.1 fish because of the large-mesh nets used. When age 1.1 fish are removed from the sample used in this study (#88-1), a population composition estimate was obtained of 70% age 1.2, 29% age 1.3, and 0.2% age 1.4 fish. Differences between both estimates may reflect a tendency of the Corbett test fishery to disproportionately sample larger and older fish.

More than 20% of the scales collected in our study were found to be regenerated or otherwise unreadable. Sample size and/or the number of scales collected from each fish will be increased in experiments conducted in 1988 so as to reduce any bias associated with inter-stock differences in scale regeneration (Knudsen 1988).

This program will be continued in future years to develop a data base of the age and length composition of the Columbia Basin spring chinook population. The data base will aid fisheries managers in detecting changes in the composition of stocks. Changes in the age composition or the length-at-age composition of the population will assist managers in monitoring the effects of ocean harvest restrictions imposed by the Pacific Salmon Treaty. The data base will also provide valuable data for use in the development of future run size prediction models.

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