

Informational Leaflet 25

ENUMERATION OF RED SALMON SMOLT MIGRATION

By:

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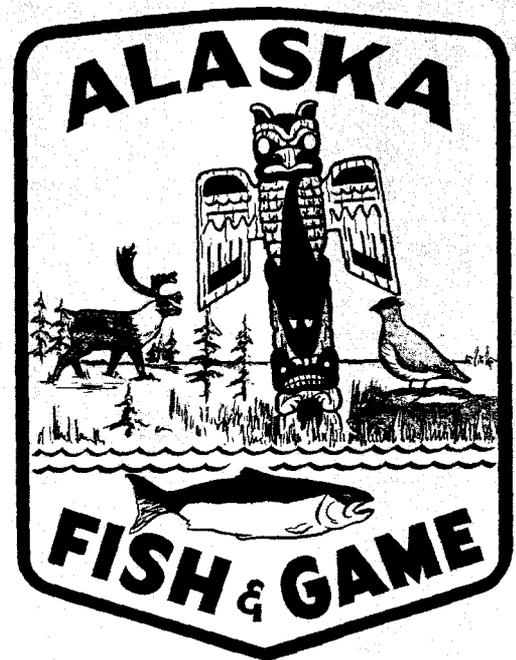
and

R. A. Marriott
Division of Biological Research
Juneau, Alaska

March 26, 1963

STATE OF ALASKA
WILLIAM A. EGAN - GOVERNOR

DEPARTMENT OF
FISH AND GAME
WALTER KIRKNESS - COMMISSIONER
SUBPORT BUILDING, JUNEAU



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ALASKA DEPARTMENT OF FISH AND GAME
WILLIAM A. EGAN, GOVERNOR - WALTER KIRKNESS, COMMISSIONER

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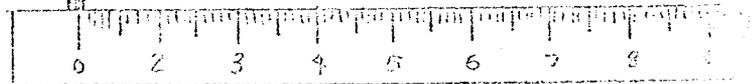
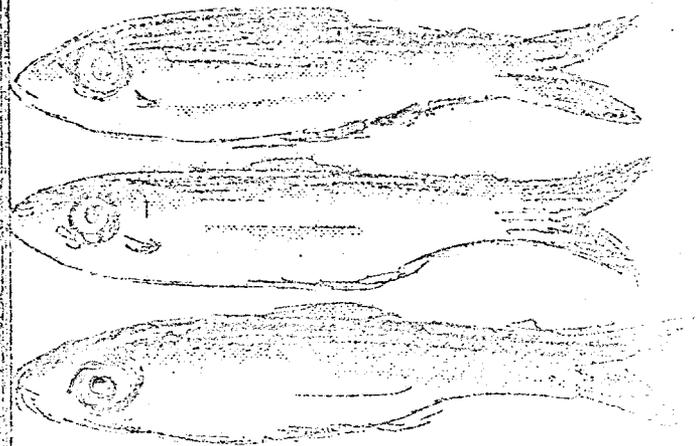
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MARCH 26, 1963

ENUMERATION OF RED SALMON SMOLT MIGRATION

Final Report

INTRODUCTION

The Kvichak system is the largest producer of red salmon in the Bristol Bay area of Alaska and has been under study by the Fisheries Research Institute since 1955. Until 1960 smolt studies have been conducted by the Institute under Saltonstall-Kennedy funds administered by the Bureau of Commercial Fisheries (Kerns, 1961)¹.

Abundance, size, age, and condition of red salmon smolts, determined over a period of years, provide one basis for predicting return runs on which regulations can be made. The magnitude of smolt migrations provides estimates of the highly variable freshwater survival, a necessary element in determining optimum escapement.

In 1961 the Alaska Department of Fish and Game conducted Kvichak smolt studies resulting in an unpublished report from which the authors have taken freely and without reference. In 1962 the Fisheries Research Institute conducted the smolt studies under contract to Alaska Department of Fish and Game. This report summarizes results of the 1962 studies and provides some recommendations for the future.

The basic objectives of the 1962 studies have been: (1) to determine the index of abundance and (2) to determine age, size, and condition of the fish.

SMOLT ABUNDANCE

Methods and Equipment

The smolt index has been based on catches of a single fyke net fished during the hours 2200 to 0100, at a fixed site in the river and at the same water depth and velocity each year. The index fyke net site is located in the Kvichak River four miles downstream from the outlet of Iliamna Lake.

¹ Kerns, O.E., Jr. Abundance and age of Kvichak River red salmon smolts. Fish. Bull. 189. Vol. 61. U.S. Fish and Wildlife Service, Bur. of Comm. Fish.

In 1962 photo-electric counters ^{2,3} were used for two reasons: (1) large numbers of fish could be enumerated with the minimum of handling and injury to the fish, and (2) the migration could be monitored 24-hours a day with no increase in number of crew members.

Counting equipment included a sheet metal tunnel tapering from 18 inches in diameter (attached to the body of the fyke net) to 4 by 18 inch rectangular aperture (Figure 1) adapted for attachment of a cod-end (Figure 2). Two photoheads (Veeder-Root model PCW) were mounted in the counting aperture. Each photohead, with its own adjustable light source, was connected to a separate Veeder-Root electronic counter (series A180707, model N). Light adjustment was accomplished by a rheostat installed by Institute personnel just prior to the fishing season. Both counters were operated from a single 150 amp-hour 12-volt battery and a single model MP-10 Heathkit power converter (12-volt DC to 110-volt AC).

The photo-electric counters tally only a fraction of the total number of fish passing through the net. Therefore, counter tallies must be multiplied with a factor to give actual numbers of fish passing. Determination of the conversion factor was carried on during three one-hour periods of the day starting at 0900, 1700, and 2300 hours. At this time the sensitivity of the photoheads was standardized by increasing the brightness of the light source until a testing rod (1/4 inch thick covered with a single layer of aluminum foil) would activate the counters. Then the cod-end was attached to the aperture and the unit lowered into the water. After three seconds, both counters were reset to zero and a stopwatch started. The delay before zeroing counters was necessary to eliminate counts that occurred as photoheads broke the water's surface. When combined counter tally reached 200, the timer was stopped and the counting aperture pulled above the water level while the cod-end was removed. The open tunnel was emerged again and the counters reset to zero. Thus, the net remained fishing while the previous catch was weighed and released, and the number of smolts in a one-pound sample was determined giving the factor converting total weight of catch into numbers of smolts. During the peak of migration, up to eight calibration checks per hour were made. When counters were operated on a 24-hour basis, counter tallies outside the calibration hours were recorded every two hours on the odd-numbered hour.

² Martin, J.W. and O.E. Kerns, Jr. 1960. Photo-electric counting of red salmon smolts in the Kvichak River, Alaska. Univ. of Wash., Fish. Res. Inst., Circular No. 114.

³ Kerns, O.E., Jr., T.S.Y. Koo, and C.O. Junge, Jr. 1961. Summary report on photo-electric counting of red salmon smolts, 1960. Univ. of Wash., Fish. Res. Inst., Circular No. 141.

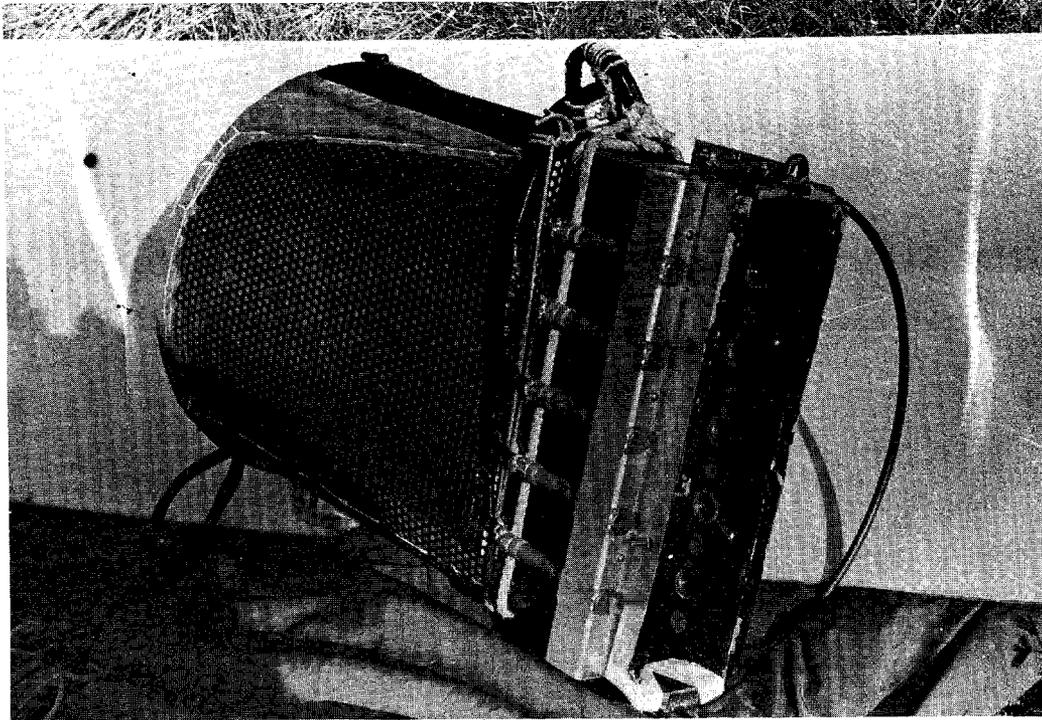


Fig. 1. - Photo-electric counter tunnel section.

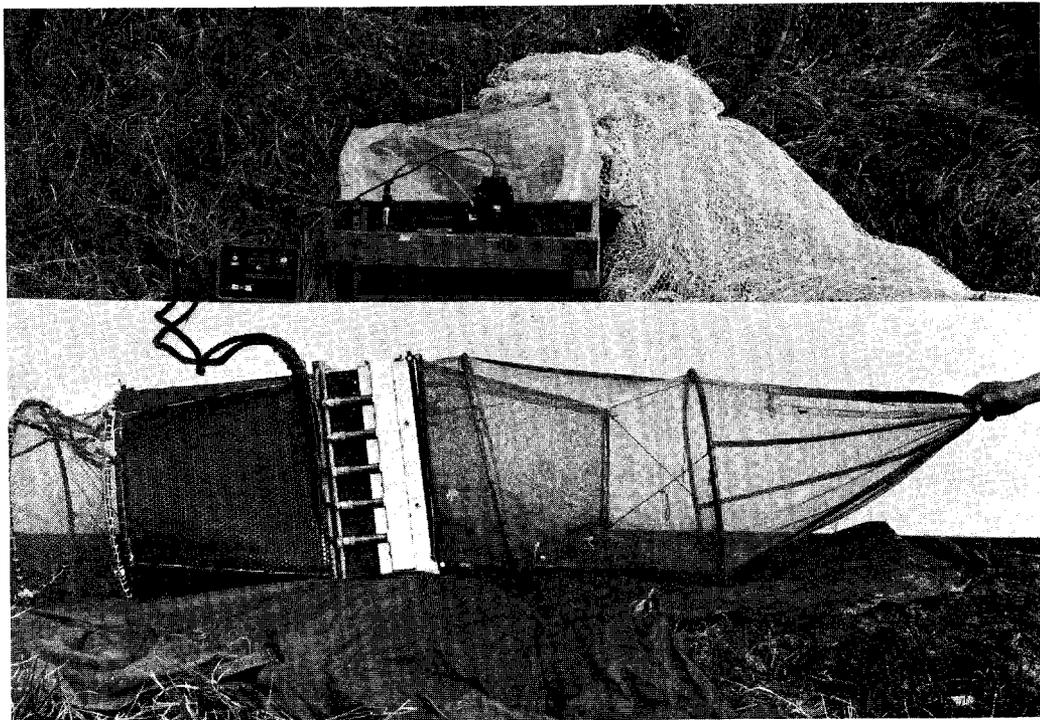


Fig. 2. - Photo-electric counter tunnel connected to fyke net and cod-end.

Smolt Index

The smolt enumeration crew arrived at the fyke net site on May 23 but fykenetting did not begin until May 27. During the period May 23 to 26 much of the lower half of Iliamna Lake was covered with ice. Ice was moving continuously down the Kvichak River preventing fishing, and the river water temperature was less than 33° F. Predatory terns and gulls were present but were not observed actively fishing. On May 27 most of the ice flow ceased in the river, the water temperature increased to above 36° F and the predatory birds began fishing. The peak of smolt migration has never started in the Kvichak River at a water temperature less than 36° F (Table 1). This evidence indicates no appreciable migration took place during ice breakup during 1962.

Table 1. Dates and water temperatures of Kvichak River smolt migration peaks, 1955-1962.

Year	Beginning date of migration peak	Kvichak River water temperatures, °F
1955	June 4	38
1956	June 1	36
1957	May 28	42
1958	May 22	45
1959	May 26	42
1960	May 26	41
1961	May 23	36
1962	June 1	37

Fykenetting was started on May 27 and conducted nightly until July 4 except on May 29 when ice flow again curtailed operations. No distinct peak of smolt abundance developed, but a fluctuating higher level of migration extended from June 1 to June 16, 1962.

The 3-hour index catch for 1962 amounted to 301,413 or an index value of 15.74 (one index point is equivalent to 19,130 smolts) (Table 2, Figure 3). Index values for the years since 1955 are presented in Table 3. (Adjusted smolt index values will be discussed later under "24-Hour Fishing".)

The 3-hour index catches from May 27 to June 3, June 11, and from June 18 to July 4 were derived entirely from actual counts of catches or from weighings with appropriate fish-per-pound conversions. Index hour catches from June 4 to June 10 and June 12 to 17 were calculated on the basis of counter tallies.

From cursory examination of simultaneous counter tallies and catches (Table 4), it was apparent that counter efficiency changed during the season. Therefore, individual catch to count ratios were plotted by time to exemplify these changes. As seen in Figure 4, the ratios from three general strata occurred during the season: June 4-6 with a ratio of 5.93, June 7-13 with a ratio of 4.72 and June 14-16 with a ratio of 8.38. Causes for changing efficiency between the first two strata are not known, however, the altered ratio in the last strata was

Table 2. Kvichak River smolt catches by day and hour, 1962¹.

Date	2200- 2300	2300- 2400	0000- 0100	Total	Index Point	Cumulative Index
May 27	131	1,760	987	2,878	0.15	0.15
" 28	115	1	4	120	0.01	0.16
" 29 ²				162 ²	0.01	0.17
" 30	63	75	66	204	0.01	0.18
" 31	20	3	88	111	0.01	0.19
June 1	1,241	1,170	1,419	3,830	0.20	0.39
" 2	22,119	3,199	3,472	28,790	1.50	1.89
" 3	1,836	1,531	1,799	5,166	0.27	2.16
" 4	19,231	17,185	10,484	46,900	2.45	4.61
" 5	5,545	7,045	4,424	17,014	0.89	5.50
" 6	7,821	18,413	963	27,197	1.42	6.92
" 7	2,667	2,487	2,582	7,736	0.40	7.32
" 8	1,685	1,123	2,124	4,932	0.26	7.58
" 9	23,293	4,951	3,304	31,548	1.65	9.23
" 10	5,291	15,803	769	21,863	1.14	10.37
June 11	995	634	1,680	3,309	0.17	10.54
" 12	2,133	3,068	1,534	6,735	0.35	10.89
" 13	9,591	5,206	911	15,708	0.82	11.71
" 14	218	2,003	1,651	3,872	0.20	11.91
" 15	4,198	15,989	23,682	43,869	2.29	14.20
" 16	1,760	2,832	59	4,651	0.24	14.44
" 17	0	486	310	796	0.04	14.48
" 18	86	272	1,044	1,402	0.07	14.55
" 19	115	0	104	219	0.01	14.56
" 20	1,081	7,049	5,312	13,442	0.70	15.26
June 21	120	1,633	477	2,230	0.12	15.38
" 22	255	479	357	1,091	0.06	15.44
" 23	216	1,044	1,756	3,016	0.16	15.60
" 24	66	23	18	107	0.01	15.61
" 25	0	5	13	18	0.00	15.61
" 26	172	39	4	215	0.01	15.62
" 27	2	1	1	4	0.00	15.62
" 28	6	2	280	288	0.02	15.64
" 29	33	17	1	51	0.00	15.64
" 30	0	0	1	1	0.00	15.64
July 1	0	46	288	334	0.02	15.66
" 2	62	24	118	204	0.01	15.67
" 3	183	300	913	1,396	0.07	15.74
" 4	1	2	1	4	0.00	15.74

-Continued-

Table 2. Kvichak River smolt catches by day and hour, 1962¹(continued).

Date	2200- 2300	2300- 2400	0000- 0100	Total	Index Points	Cumulative Index
Total	112,405	115,954	73,054	301,413	15.74	
Percent	37.29	38.47	24.24	100.00		

¹ Estimates from June 4 through June 10 and June 12 through June 17 are based on counter tallies, and remainder are based on actual counts or weights of catches.

² Index net not fished on May 29 due to ice; "total" estimated as the average of catch on preceding and following days.

Table 3. Indices of Kvichak smolt abundance, 1955 through 1962 based on 3-hour index and 24-hour fishing periods.

Year	3-hour index catch	Ratio ¹	Estimated catch outside index period (ratio x index catch)	Total (index catch and estimate outside index period)	Original index ²	Revised index ³
1955	213,868	(0.2156) ⁴	46,110	259,978	11.2	7.8
1956	63,886	(0.2156) ⁵	13,774	77,660	3.3	2.3
1957	25,425	0.2156	5,482	30,907	1.3	0.9
1958	1,912,767	0.7430	1,421,186	3,333,953	100.0	100.0
1959	1,643,073	(0.7430) ⁶	1,220,803	2,863,876	85.9	85.9
1960	454,783	0.3501	159,220	614,003	24.4	18.4
1961	29,750	(0.2156) ⁵	6,414	36,164	1.6	1.1
1962	301,413	2.9912	901,587	1,203,000	15.7	36.1

¹ Ratio of 3-hour index catch (1) to non-index hour catch during periods of 24-hour fishing.

² The number of smolts caught during the 3-hour index period in 1958 has been arbitrarily assigned the base value of 100.0.

³ The number of smolts estimated passing during 24-hour periods in 1958 has been arbitrarily assigned the base value of 100.0.

⁴ From visual observations it is believed minimum migration occurred outside the index hours, therefore, the minimum "ratio" obtained in 1957 was used to estimate non-index hour migration.

⁵ 1956 and 1961 index catches were similar in number and age composition to those made in 1957. Therefore, the "ratio" established in 1957 from 24-hour fishing was used to estimate the non-index hour migration in 1956 and 1961.

⁶ 1959 index catch was similar in number to that made in 1958 and day migration was observed in 1959. Therefore, the "ratio" established in 1958 from 24-hour fishing was used to estimate the non-index hour migration in 1959.

Table 4. Counting rate and passage rate and their ratios of Kvichak River smolts, 1962.

Date	Hour	Elapsed time of calibration (Min.)	Counter Tally	Catch	Ratio, Tally to Catch	Counting Rate (Counts Per Min.)	Passage Rate (Catch Per Min.)
June 4	2300	4.0	200	1,218	6.09	50	305
		0.5	200	1,107	5.54	400	2,214
		4.5	200	1,008	5.04	44	224
		3.5	200	1,175	5.88	57	336
		2.5	200	1,275	6.38	80	510
		7.5	180	1,094	6.08	24	146
		June 5	0900	31.5	220	1,980	9.00
23.0	135			720	5.33	6	31
1700	75.5		200	1,094	5.47	3	15
	37.5		200	1,131	5.67	5	30
2300	16.0		200	1,036	5.18	13	65
	15.0		200	1,148	5.74	13	77
	3.0		200	1,148	5.74	67	383
	11.5		200	1,185	5.93	17	103
Average ratio 5.93							
June 6	0900	56.5	200	1,204	6.02	4	21
		30.0	200	1,080	5.40	7	36
	2300	22.0	189	851	4.50	9	39
		1.5	210	1,094	5.21	140	729
		2.5	207	860	4.15	83	344
		2.0	200	869	4.35	100	435
		5.0	200	860	4.30	40	172
		3.0	200	1,001	5.01	67	334
		3.5	200	1,204	6.02	57	344
		1.5	200	570	2.85	133	380
4.0	200	646	3.23	50	162		
June 7	0900	33.5	62	287	4.63	2	9
		2300	20.5	200	1,000	5.00	10
		32.5	200	1,218	6.09	6	38
June 9	1700	4.5	200	943	4.72	44	210
		0.5	210	1,066	5.08	420	2,132
		5.0	200	920	4.60	40	184
		1.0	210	828	3.94	210	828
		1.5	200	809	4.05	133	539
		6.5	200	1,027	5.14	31	158

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Table 4. Counting rate and passage rate and their ratios of Kvichak River smolts, 1962 (continued).

Date	Hour	Elapsed time of calibration (Min.)	Counter Tally	Catch	Ratio, Tally to Catch	Counting Rate (Counts per Min.)	Passage Rate (Catch per Min.)	
June 9 (cont'd.)	2300	4.5	200	1,044	5.22	44	232	
		12.0	200	924	4.62	17	77	
		26.0	200	765	3.83	8	29	
June 10	0900	8.0	200	743	3.72	25	93	
		9.0	200	1,023	5.12	22	114	
	1800	49.5	137	559	4.08	3	11	
		2300	4.0	200	1,157	5.79	50	289
			7.0	200	865	4.33	29	124
			2.7	200	817	4.09	74	303
			1.3	200	918	4.59	154	706
			4.5	200	843	4.22	44	187
			4.5	200	931	4.66	44	207
June 11	0000 1000	55.5	135	570	4.22	2	10	
		60.0	152	624	4.11	3	10	
		21.3	200	1,008	5.04	9	47	
June 12	2300	30.0	200	873	4.37	7	29	
		20.0	200	1,049	5.25	10	53	
		23.0	210	1,015	4.83	9	44	
June 13	0000	25.0	200	1,276	6.38	8	51	
		30.0	113	694	6.14	4	23	
Average ratio					4.72			
June 13	2300	10.1	200	1,344	6.72	20	133	
		10.7	210	2,165	10.31	20	202	
		4.9	200	1,950	9.75	41	398	
		7.3	200	1,926	9.63	27	264	
		20.2	200	1,760	8.80	10	87	
June 14	0000 2300	20.0	102	778	7.63	5	39	
		54.3	171	1,261	7.37	3	23	
June 15	2300	11.7	200	1,290	6.45	17	110	
		16.0	200	1,804	9.02	13	113	
		2.2	200	1,684	8.42	91	765	
		1.5	200	1,784	8.92	133	1,189	

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Table 4. Counting rate and passage rate and their ratios of Kvichak River smolts, 1962 (continued).

Date	Hour	Elapsed time of calibration (Min.)	Counter Tally	Catch	Ratio, Tally to Catch	Counting Rate (Counts per Min.)	Passage Rate (Catch per Min.)
June 16	0000	3.3	200	1,691	8.46	61	512
		1.7	220	2,232	10.15	129	1,313
		3.3	200	1,674	8.37	61	507
		22.2	200	1,038	5.19	9	47
	1100	120.0	148	1,500	10.14	1	13
	2300	12.3	200	2,046	10.23	16	166
		40.7	84	582	6.93	2	14
	June 18	0100	30.0	29	194	6.69	1
Average ratio					8.38		

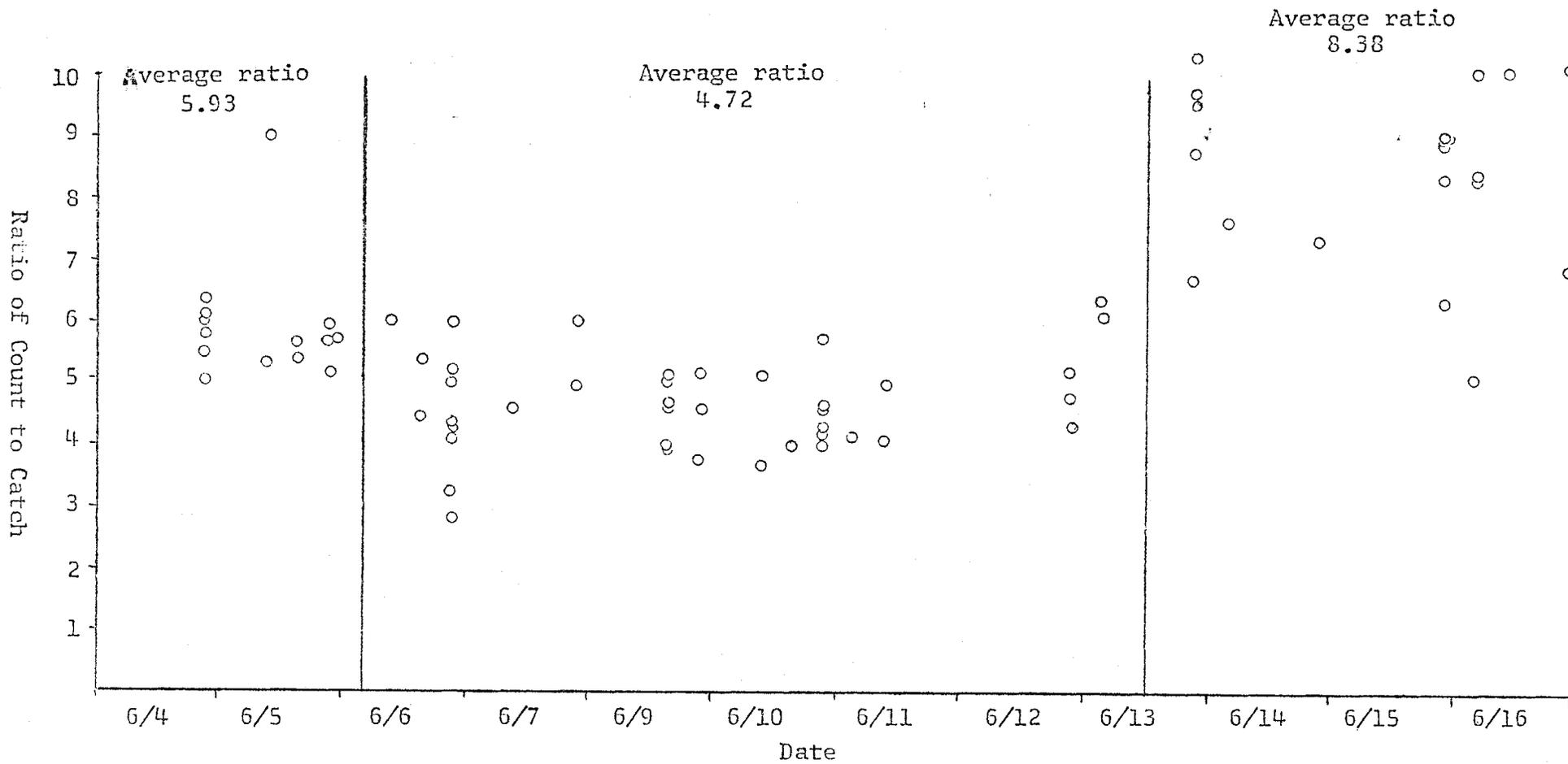


Figure 4. Seasonal change of photo-electric count - catch ratios of Kvichak River smolts, 1962.

associated with defective rheostats in the counters which prevented proper adjustment of the light source. Counter data were thus grouped by these three seasonal strata and appropriate ratios applied to convert counter tallies to numbers of fish passing.

When using the counter equipment it is necessary to determine catch (passage rate) to count (counting rate) relationships at different migration densities of fish. Such relationships could be expected to become curvilinear (fewer counts per numbers passing) during heavy migration due to aperture clogging and subsequent lowered efficiency of the photoheads. As seen in Table 4 and Figure 5, count per minute values for each seasonal strata did not appear to approach a lowered efficiency. This eliminated the need for stratification by magnitude of fyke net catches in 1962. However, during years of high migration rates, the changing of counter efficiency must be considered in interpreting counter tallies.

24-Hour Fishing

To 1962, indices of smolt abundance were obtained on the assumption that only minor migration took place during daylight hours. Fishing during 24-hour periods in 1957, 1958, and 1960 supported this assumption. Around the clock fishing was expensive in that at least five instead of the usual three crew members were necessary to operate fyke nets and handle catches outside the index hours and was therefore prohibitive for all years. It was not until the photo-electric counters were satisfactorily developed for use in 1962 that extensive 24-hour fishing could again be conducted and with a minimum crew size.

In 1962 numerous checks bracketing the index hours were made and seven continuous 24-hour observations were completed during the higher level of migration, Table 5. The catch outside the 2200 to 0100 hour index interval was nearly three times that of the index interval for the sampling periods. Table 6 shows the results of 24-hour fishing in all years and illustrates the large variability of daylight fyke net catches ranging from one-quarter that of the 1957 index catch to the three-fold daytime catch of 1962. It is now apparent that index fykenetting in the future should be conducted continuously 24-hours a day at least through the peak period of migration and that previous indices of abundance must be adjusted to a 24-hour basis.

Adjusted indices for each year since 1955 appear in Table 3. The ratios of catch inside and outside of the three-hour index period during 24-hour sampling periods of 1957, 1958, 1960, and 1962 have been used as a basis to estimate seasonal daytime migration. Around the clock sampling was conducted during some peak and non-peak days of migration each year, however no clear relationship between peak index catch and increased daytime catch was evident so all 24-hour sampling for each year was combined to provide seasonal ratios. After more data of 24-hour fishing becomes available, a definite relationship may become apparent, and if so additional adjustment of indices may be warranted. No quantitative data are available to estimate day migration for 1955, 1956, 1959, and 1961. However, no smolts were observed in the Kvichak River during the daytime in 1955, and therefore a minimum day migration is believed to have occurred. On the other hand, considerable day migration was observed in 1959, a year of large migration like 1958, so the same ratio of day migration was

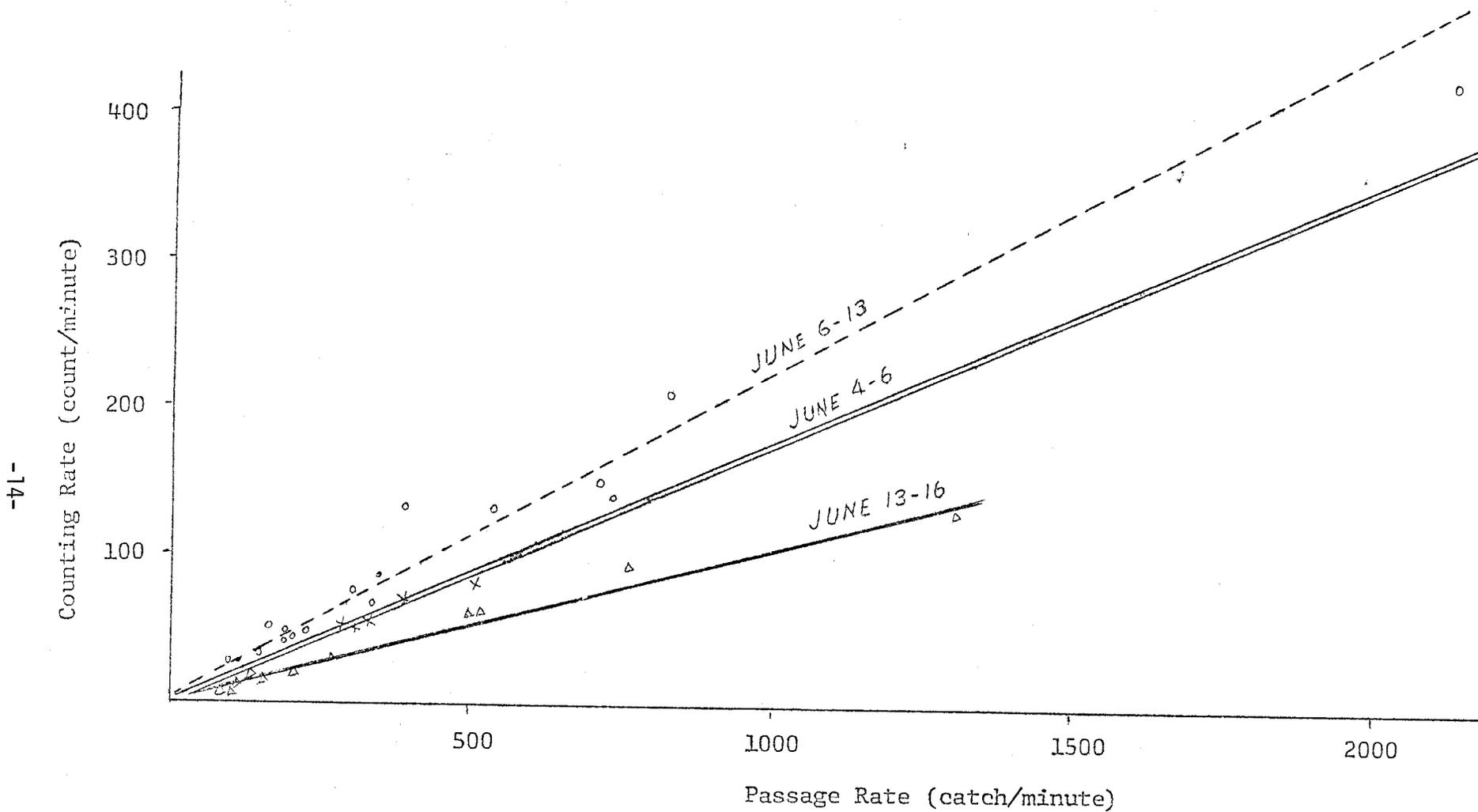


Figure 5. Comparison of counting rate and passage rate of Kvichak River smolts during three time periods of 1962.

Table 5. Estimated Kvichak River smolt catches for seven days of 24-hour fishing, 1962.

Date	1300- 1700	1700- 2100	2100- 0100	0100- 0500	0500- 0900	0900- 1300	Total
June 5-6	19,848	28,428	23,631	24,651	4,572	6,594	107,724
June 6-7	2,582	2,808	30,255	6,660	24	765	43,094
June 7-8	66	236	7,755	8,307	57	1,548	17,969
June 9-10	23,737	37,123	47,512	55,965	11,729	19,786	195,852
June 10-11	15,047	3,356	22,798	37,562	38,916	4,333	122,012
June 14-15	218	184	3,880	897	25	17	5,221
June 15-16	168	59	43,878	64,911	5,715	3,872	118,603
Total	61,666	72,194	179,709	198,953	61,038	36,915	610,475
Percent	10.10	11.83	29.44	32.58	10.00	6.05	100.00

Table 6. Kvichak River smolt catches during 24-hour periods, 1957, 1958, 1960, and 1962.

Date	Catch during 3-hour index period	Catch outside index period
<u>1957</u>		
May 30-31	69	806
June 1-2	6,108	1,122
3-4	599	287
5-6	3,426	52
6-7	473	61
7-8	3	0
12-13	1	5
13-14	2	0
14-15	0	1
22-23	216	4
29-30	321	81
Totals	<u>11,218</u>	<u>2,419</u> ratio = 0.2156
<u>1958</u>		
May 13-14	259	1,015
24-25	13	634
28-29	75,175	18,504
30-31	7,032	151,760
31-1	121,563	15,317
June 1-2	132	2,414
2-3	30,358	26,039
3-4	141,717	60,086
4-5	5,723	8,042
Totals	<u>381,972</u>	<u>283,811</u> ratio = 0.7430
<u>1960</u>		
May 24-25	7	41
June 2-3	102,426	35,820
Totals	<u>102,433</u>	<u>35,861</u> ratio = 0.3501
<u>1962</u>		
June 5-6	17,014	90,710
6-7	27,197	15,897
7-8	7,736	10,233
9-10	31,354	164,304
10-11	21,863	100,149
14-15	3,872	1,349
15-16	43,869	74,734
Totals	<u>152,905</u>	<u>457,376</u> ratio = 2.9912

applied to 1959 was found in 1958. The index catches of 1956 and 1961 were quite similar to 1957 in number and in age composition of fish, and the proportion of day migration found during 1957 was extended to these two years.

SMOLT, AGE, SIZE, AND CONDITION

Sampling for size, age, and condition in 1962 was conducted in a manner similar to previous years. One-pound samples were taken from the catches made during 2200 to 2300 and 2400 to 0100 hours (index hours), and from 0900 to 2000 and 1700 to 1900 hours. Each sample was made up of four one-quarter pound subsamples taken each 15 minutes. This sampling design was used to determine differences in size and condition between day and night migrants. Sample fish were collected in the closed cod-end or in a dip net held immediately downstream from the counting aperture. All fish were processed in the live-anesthetized state and one complete sample was preserved each day.

The Kvichak system has two age groups of smolts, those having spent one and those having spent two winters in fresh water. These two age groups can be separated by length alone. Scales from preserved specimens were used to verify age of length frequency samples. For size and age determination, all fish in the daily index hour samples were measured from snout to fork of tail, daily samples weighted by magnitude of index hour catches and then combined to provide the season composite length frequency. Samples taken during daylight hours were processed the same as index hour samples.

Every third night of large migration a condition sample was taken of fish in the two index hour samples. The total weight of the fish in each five mm length group was determined by first weighing a container of water, adding the fish of a single length group and reweighing. The average weight of fish in each group was then calculated. All lengths and weights were taken of live-anesthetized fish.

Ninety-four percent of the smolts in 1962 were age I (fish having spent one winter in fresh water) and had an average length of 82 mm while the year older smolts had an average length of 110 mm (Figure 6, Table 7). These fish were the progeny of the large 1960 adult escapement. Kvichak smolt ages and average lengths for the years 1955 through 1962 are presented in Table 8. The average length of the predominant age I smolts in 1962 was at least 7 mm less than any year since 1955, except 1958 and 1959, and all three were years of high density in the freshwater rearing areas. The larger age II fish migrated at the beginning of the season as in the years 1957, 1958, and 1961 with a dominance of age I smolts (Kerns, 1961).

During five 24-hour periods, samples were obtained for comparison of age among day and night migrants (Figure 7). No differences in age composition were apparent.

The condition of the 1962 smolts, as expressed by the weight per average length of age I and age II smolts, was 4.3 and 9.9 grams respectively (Table 8). The 1962 age I migrants which dominated the run were lighter in weight per average length than any yearling smolts on record.

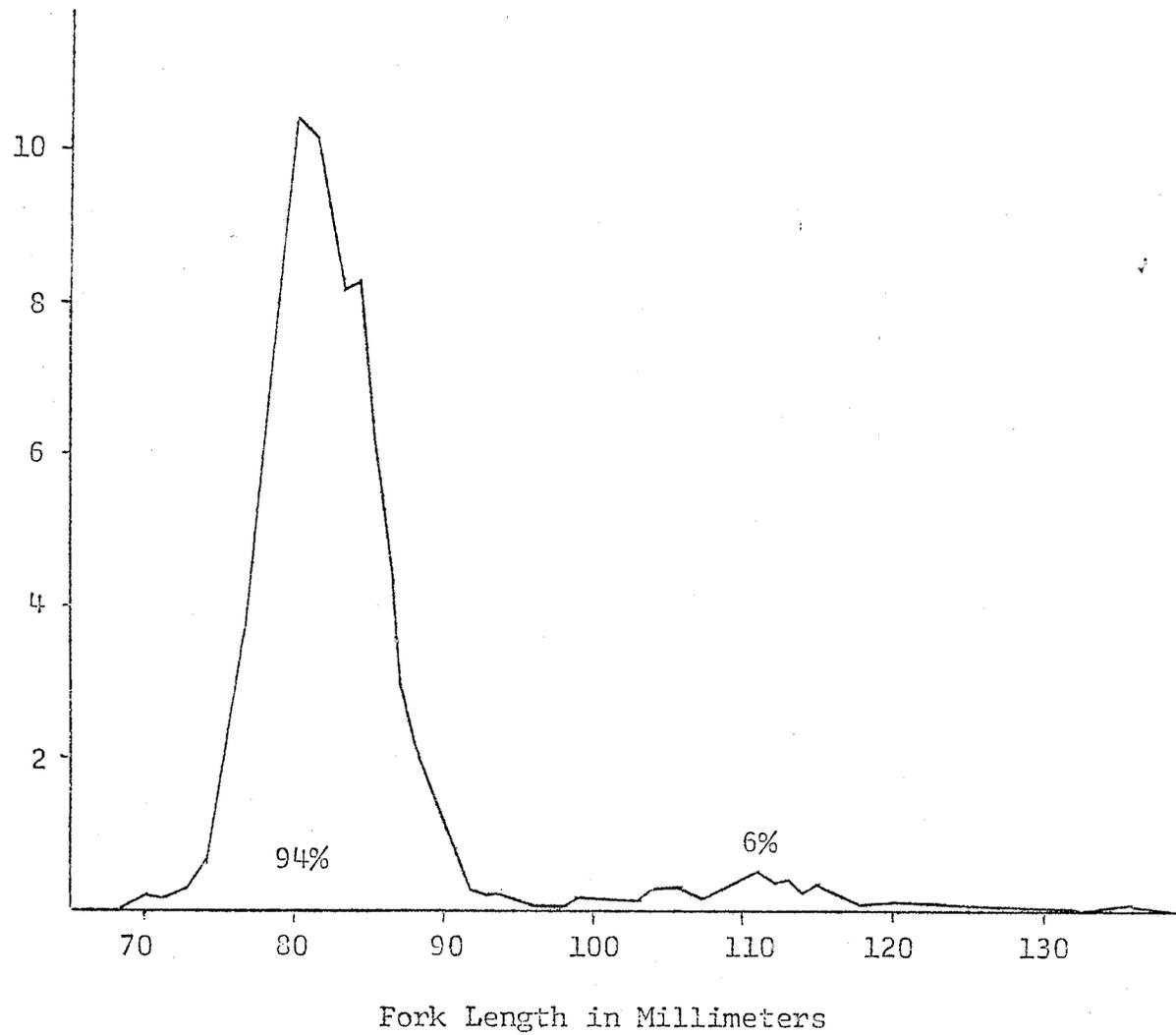


Figure 6. Composite of Kvichak smolt length frequencies, 1962. (Each daily sample is weighted by magnitude of fyke net catches for that day. Total frequency smoothed by moving average of threes. Arrow indicates division point between age groups, as verified by scale samples.)

Table 7. Weighted age composition of Kvichak River smolts, 1962.

Date	No. of samples	No. of fish	Age I	
			Percent in samples ¹	Index catch
May 27	1	69	87.0	2,504
" 30	2	111	80.2	164
" 31	1	42	57.1	63
June 1	2	103	67.0	2,566
" 2	2	145	85.5	25,831
" 3	2	158	93.0	4,804
" 4	2	165	92.7	41,685
" 5	2	168	91.7	15,022
" 6	1	85	97.6	24,350
" 9	2	174	97.1	31,882
" 10	1	94	95.7	20,346
" 11	1	84	97.6	3,230
" 12	2	195	98.5	7,206
" 13	2	199	98.0	30,071
" 19	1	100	99.0	217
" 20	2	191	99.0	13,308
" 21	1	88	97.7	2,179
" 23	1	90	96.7	2,916
July 3	1	83	96.4	1,346
Total	29	2,344		229,690 (or 94.0%)

¹Determined from daily unweighted length frequencies and scale samples.

Table 8. Kvichak smolt age, size, and weight, 1955 through 1962.

Year	AGE I			AGE II		
	% of total run	Average length (mm)	Weight per average length (grams)	% of total run	Average length (mm)	Weight per average length (grams)
1955	7	89	- -1	93	109	- -1
1956	39	92	- -1	61	116	- -1
1957	72	96	7.3	28	120	14.4
1958	98	84	4.6	2	114	- -2
1959	3	80	- -2	97	99	7.6
1960	10	91	6.3	90	108	10.3
1961	72	93	6.8	28	118	13.1
1962	94	82	4.3	6	110	9.9

- 1 No weight measurements of live-anesthetized fish were taken.
- 2 Sample size was inadequate (less than 10 fish for the season).

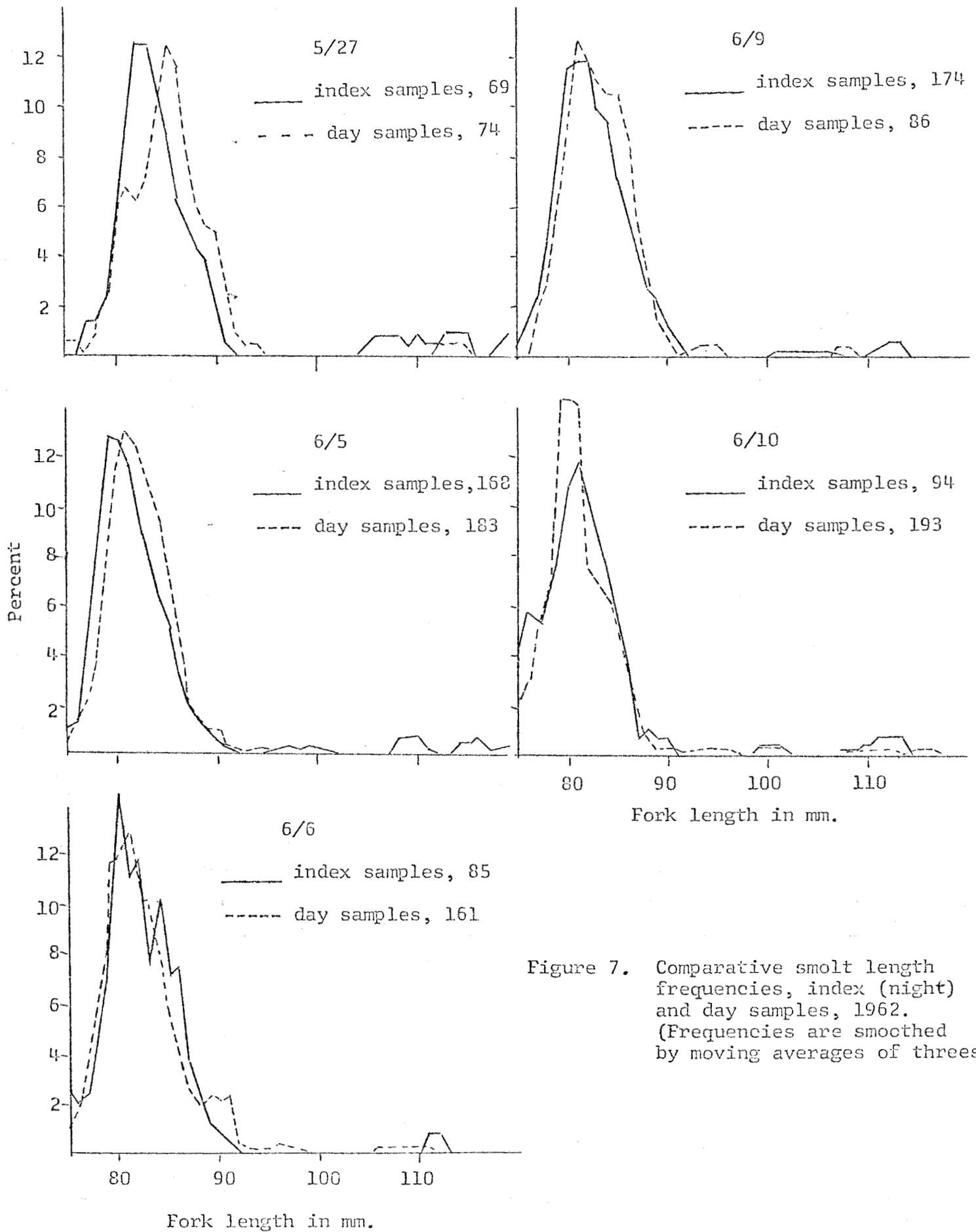


Figure 7. Comparative smolt length frequencies, index (night) and day samples, 1962. (Frequencies are smoothed by moving averages of threes).

The small size of the dominate age I fish and the condition of nets used in 1962 gave rise to a source of error in that an unknown portion of the fish passed through the worn and excessively stretched mesh (originally one-inch stretch measure) of the old fyke net body instead of the counting aperture. This condition was also observed infrequently in 1958, and thus the index values of these two years are underestimated.

DISCUSSION AND RECOMMENDATIONS

On the basis of past parent escapement and smolt relationships, an unprecedented smolt migration of age I fish was expected in 1962 from the nearly 15 million salmon spawning in 1960. However, the adjusted smolt index in 1962 was only the third largest in the eight years of monitoring and nearly three times smaller than the previous smolt cycle year of 1958. Because of the large expected run, fykenetting in 1962 was extended more than two weeks beyond normal. During the fykenetting season there was no indication of a record migration even though the adjusted index value of 62.9 is believed minimal because of unestimated numbers passing through fyke net webbing. Based on early season ice conditions, water temperatures and predator bird activities, and on insignificant smolt sitings in the Kvichak River and very low tow net catches in the outlet end of Iliamna Lake after the fykenetting season, no appreciable migration took place outside the fykenetting period. The estimate of freshwater survival of progeny from the 1960 escapement must await the smolt studies of 1963.

The smolt migration in 1963 may be the largest on record, and therefore, the use of photo-electric counters to assess abundance is recommended. Methods and equipment used in 1962 have proven satisfactory and should be used in 1963 with three exceptions. First and most important, the index of smolt abundance must be based on 24-hour fykenetting. Evidence indicates that the magnitude and time of day-migration is unpredictable but can be important. This extended fishing using photo-electric counters can be accomplished at little or no additional cost and will provide a more reliable index of abundance. Second, more dependable and properly installed rheostats or other means of adjusting photo-head sensitivity should be used. Frequent checks of photohead sensitivity by voltmeter and/or testing rod each day of the season is necessary. Third, fyke nets without excessively stretched webbing should be used to prevent passage of small-sized fish through the mesh.

SUMMARY

The objectives of 1962 smolt studies were to determine an index of smolt abundance and age, size, and condition of the fish.

The index method used since 1955 to assess smolt abundance has been based on season-long catch for a single fyke net set at the index site throughout the same daily fishing period (2200 to 0100 hours) and under similar depth and water velocity conditions. In 1962 two photo-electric counters each with a

single photohead located in the fyke net cod-end were used to estimate fyke net catches. Stratification of photo-electric counts for conversion of counter tallies to numbers of fish passing during three periods of the season, each with different counting efficiency, was necessary but stratification due to fish density was not.

The three-hour index smolt catch was 301,413 or 15.7 index points and the estimated 24-hour index catch was 1,203,000 or 62.9 index points. Early and late season observations indicate that no appreciable smolt migration was missed. The index is believed to be minimal because of fish passing through webbing of the fyke net.

Ninety-four percent of the migration was age I fish with a mean length of 82 millimeters. No difference in the length of day and night migrants was noted. Weight of average age I and II smolts was 4.3 and 9.9 grams respectively, the smallest weight on record for the dominating age I fish.

Around the clock fykenetting is necessary in the future to obtain accurate indices of smolt abundance. Other recommendations for 1963 include improved rheostats to balance photohead sensitivity and use of new fyke nets with unstretched webbing.

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