

Informational Leaflet 76

ABUNDANCE, SIZE AND AGE OF RED SALMON SMOLTS

FROM THE WOOD RIVER LAKES SYSTEM, 1965

By:

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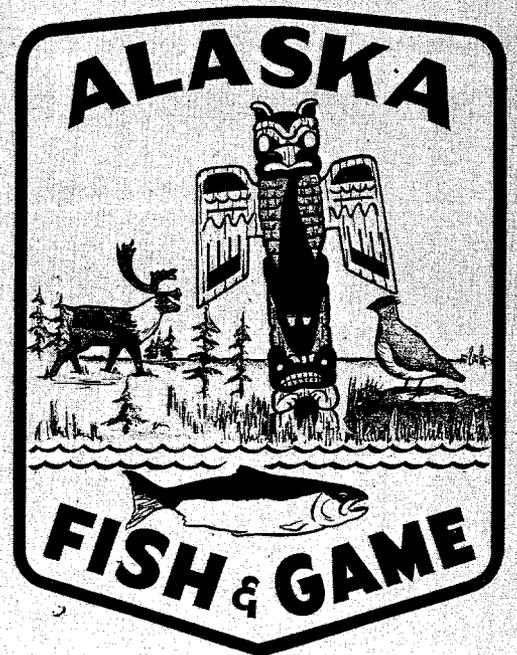


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INTRODUCTION AND BACKGROUND

A standard winged fyke net was fished in the summer of 1965 at Mosquito Point, Lake Aleknagik (Figure 1), for the fifteenth consecutive year to determine abundance, age and size composition of the red salmon (Oncorhynchus nerka) smolt outmigration. The smolt program, which was initiated in 1951 by the Fisheries Research Institute of the University of Washington, has been continued by the Alaska Department of Fish and Game since 1961 without major modification in sampling methods.

The primary objective of the project is to measure the relative abundance of red salmon smolts migrating seaward from the Wood River Lakes by establishing a numerical index which is comparable from year to year. In addition, information on diurnal fluctuations and seasonal timing, age and size composition, condition factor of the smolt, relationship of smolt production and adult escape-ment levels are collected. The relative smolt abundance as expressed in index points is used to predict the size of future adult returns to the Wood River Lakes system.

Fyke net operations began on May 28 and terminated on July 20 when the catches had diminished to insignificant numbers. Fishing was carried out every evening during the season except on June 5, and July 7, when operations were suspended because of high winds. Catches were made from 9 to 11 p.m. and were totaled to yield the seasonal index catch. Periodic 24-hour sampling was conducted to determine the diurnal fluctuation of the migration pattern through the night hours. The 24-hour sampling data will be used as a basis for comparison with coming years to provide a test of reliability for the 9 to 11 p.m. enumeration period and at the same time to furnish a more representative index.

For the structure and dimensions of the fyke net, the fyke netting procedure and the method for collection of field data the reader is referred to Nelson (1965b). Some improvements were made in the collection of field data

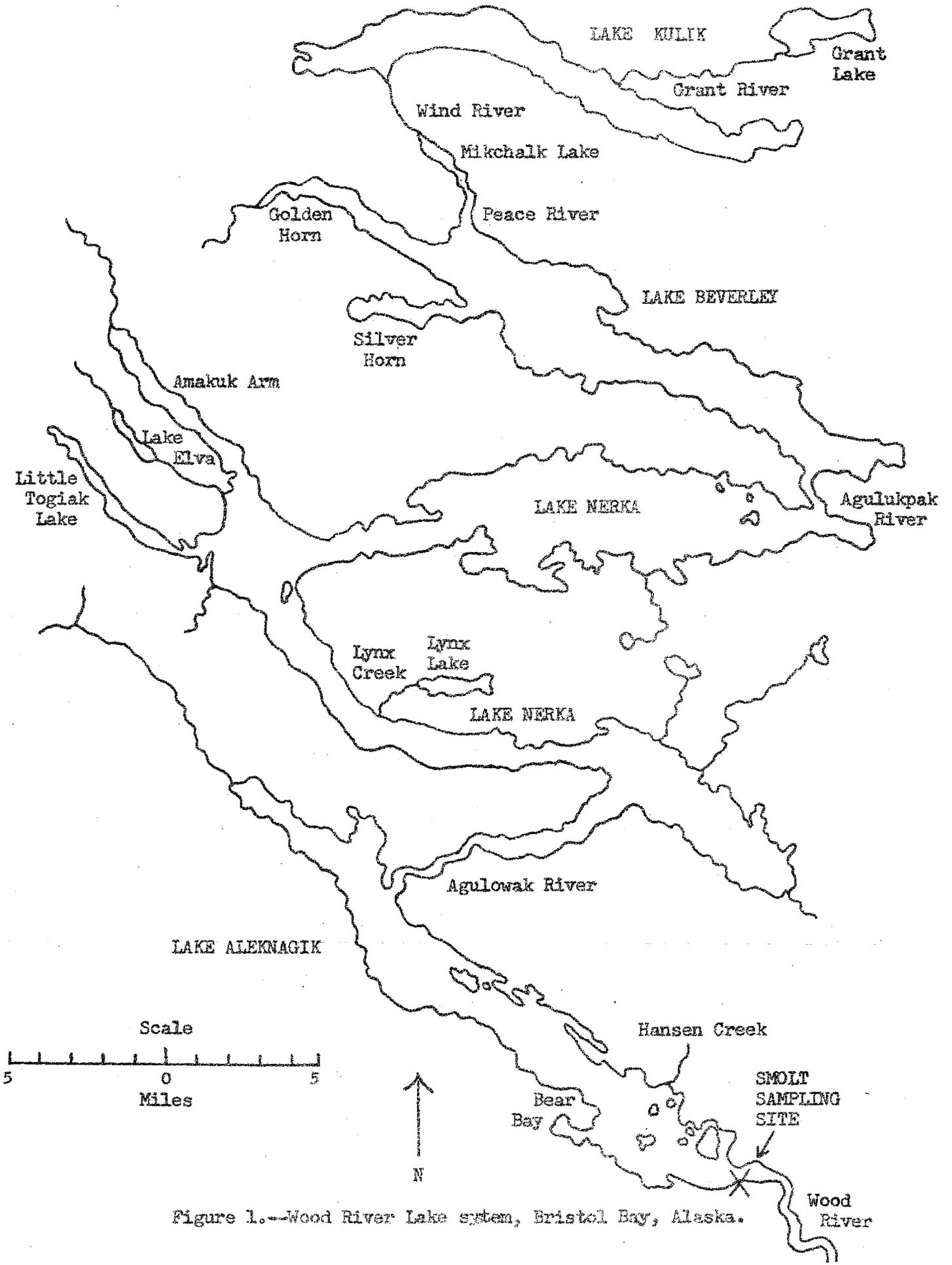


Figure 1.--Wood River Lake system, Bristol Bay, Alaska.

by revising the method of acquiring scale samples; all other methods remained similar to those employed in 1964.

The work in 1965 was under the supervision of the writer. Participants in the program were Mr. Gerald McDonald who served as crew leader and Messrs. Robert Lackey, Wendell Smith, Malcolm Stickley and David Sutherland.

CLIMATOLOGICAL DATA

Climatological conditions in the spring of 1965 were unusual in several respects and might conceivably have had an effect on the seaward outmigration of the red salmon smolts. Especially notable were the low air temperatures in June, the large amount of snow left on the ground and the abnormally high water level of the lake.

Breakup of Lake Ice

Breakup of lake ice occurred on June 5, which is 5 days later than the mean date for breakup on Lake Aleknagik (Table 1). There is no standard criteria for ice breakup of a lake, however, the criterion adopted at Lake Aleknagik is that breakup has occurred when there is open water in the middle portion of the lake between Hansen Creek and Bear Bay (Figure 1). Normally this section of the lake is the last to breakup as the remainder of the lake ice remains in the lake and melts.

Ice floe in the river usually hinder fishing operations, however a strong 55 mph east wind on June 5, drove all of the remaining ice up on the lake shore where it melted.

Lake Water Level Recording

There was an unusually large amount of snow left on the ground in the Wood River area in the spring of 1965. The heavy snow cover and the almost continuous precipitation from May 28 until June 18 resulted in much higher water levels than measured in 1964 (Figure 2).

A water level gauge has been installed and daily readings recorded for the past two years. The relative height of the water level and its changes during the smolt enumeration season are illustrated in Figure 2. In 1965 the total rainfall during the smolt enumeration season was 11.34 inches, a considerable increase over the 1964 total of only 1.82 inches. The water level peaked on June 11 at 51.9 inches, 7 days earlier and 25.5 inches higher than in 1964.

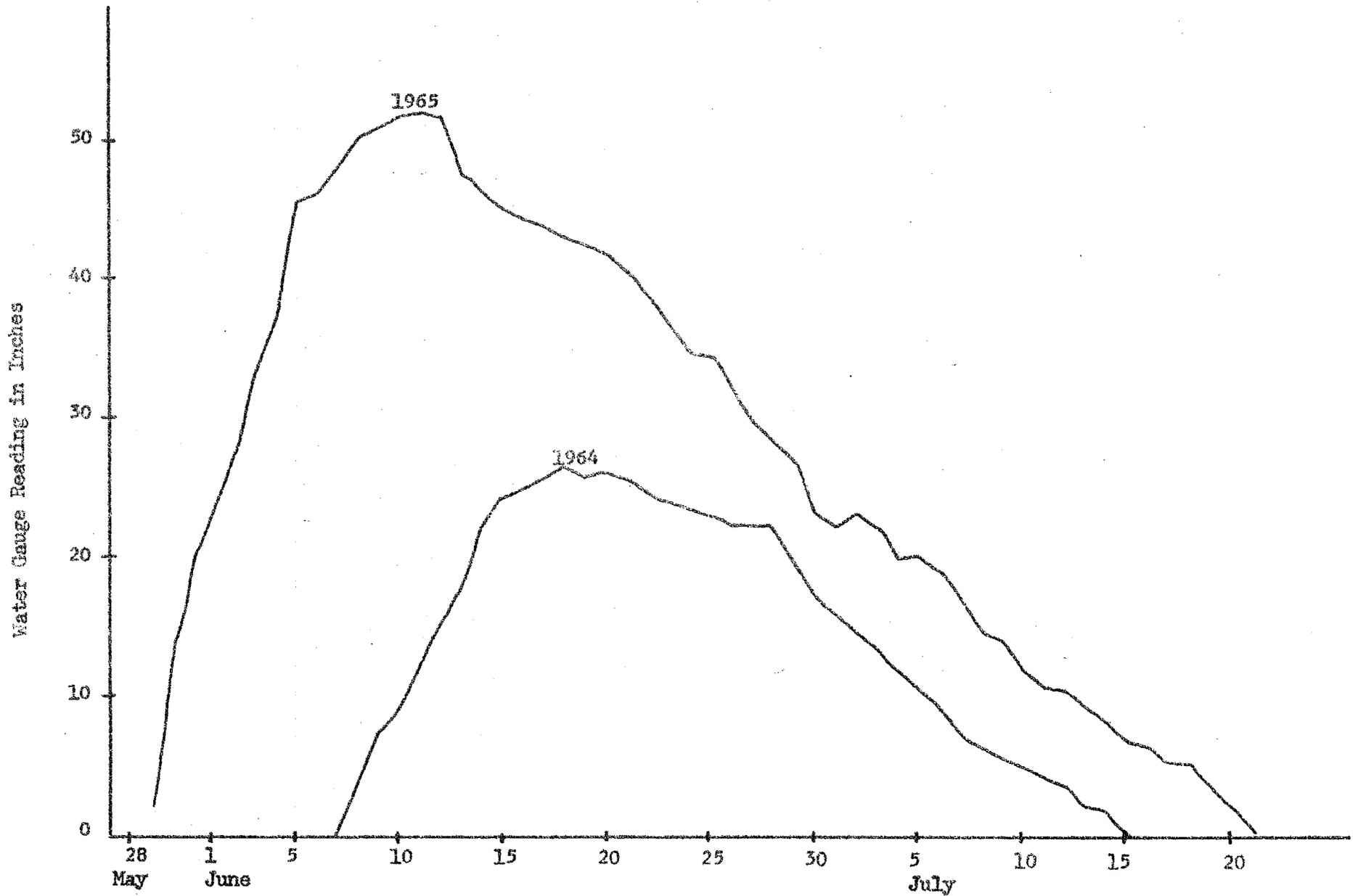


Figure 2.--Wood River water gauge readings, 1964-65. (Water level measured in inches and tenths of inches from a fixed bench mark on the bank).

The high lake level in 1965 resulted in daily readjustment of the fyke net fishing position to maintain optimum fishing depth of just under four feet. During a portion of the season the net was completely out of the normal fishing area. However, this occurred during the early part of the smolt run when no significant outmigration was observed. When the smolts began to run in good numbers of June 9, the net was moved back out to the position it usually occupies during the major part of the season. At this position the frame of the net was 1/2 to 1-1/2 feet under the surface of the water. During a 13 day period, from June 9 until June 21, smolts, which normally would have been caught were observed swimming over the fyke net wings. Twenty-five percent of the seasonal index net catch was trapped during this 13 day period, consequently the total index value in 1965 is a minimum estimate.

Velocity and Flow

Measurements of current velocity at both the fyke net site and in Wood River were made periodically throughout the season. It was found that velocity at the fyke net site was rather constant, from 3.1 to 4.2 feet per second. However, current velocity in Wood River ranged from 4.1 to 6.3 feet per second. Since tidal influence extends to the mouth of Wood River and occasionally to the fyke net site, all velocity and flow measurements were made to coincide with low water. Random checks of current velocity were made across the 600 foot wide outlet and it was determined that maximum velocity occurs at locations where the fyke net normally is set for enumeration purposes.

River flow in cubic feet per second was recorded once per week and the 1964-65 data is presented in Figure 3. Maximum flows reached approximately 14,440 cubic feet per second in 1965 while the minimum flow of 4,812 cubic feet per second was recorded on July 23, 1964. The maximum flow recorded in 1965 is a minimum estimate because of the difficulty encountered in obtaining river depths and widths. Actual maximum river flow probably approached 16 or 18,000 cubic feet per second.

Water Temperatures

Daily water temperatures have been recorded at the fyke net site since 1961 and are available in (Nelson, 1965a). In 1965 the first two weeks of index net fishing produced only 1,757 smolt and the water temperature never rose above 37° F. (Table 2). On June 11, the water temperature rose to 39° F. and the first significant outmigration of smolts occurred. This same pattern of delayed smolt outmigration until the water temperature reached 38-39° F. has occurred repeatedly in the past. The relatively late breakup, heavy snow cover and precipitation plus overcast skies, all contributed to lower water temperatures, which did not rise above 40° F. until June 19. Cessation of heavy seaward outmigration occurred on July 13, when the water temperature rose to over 50° F. for the first time.

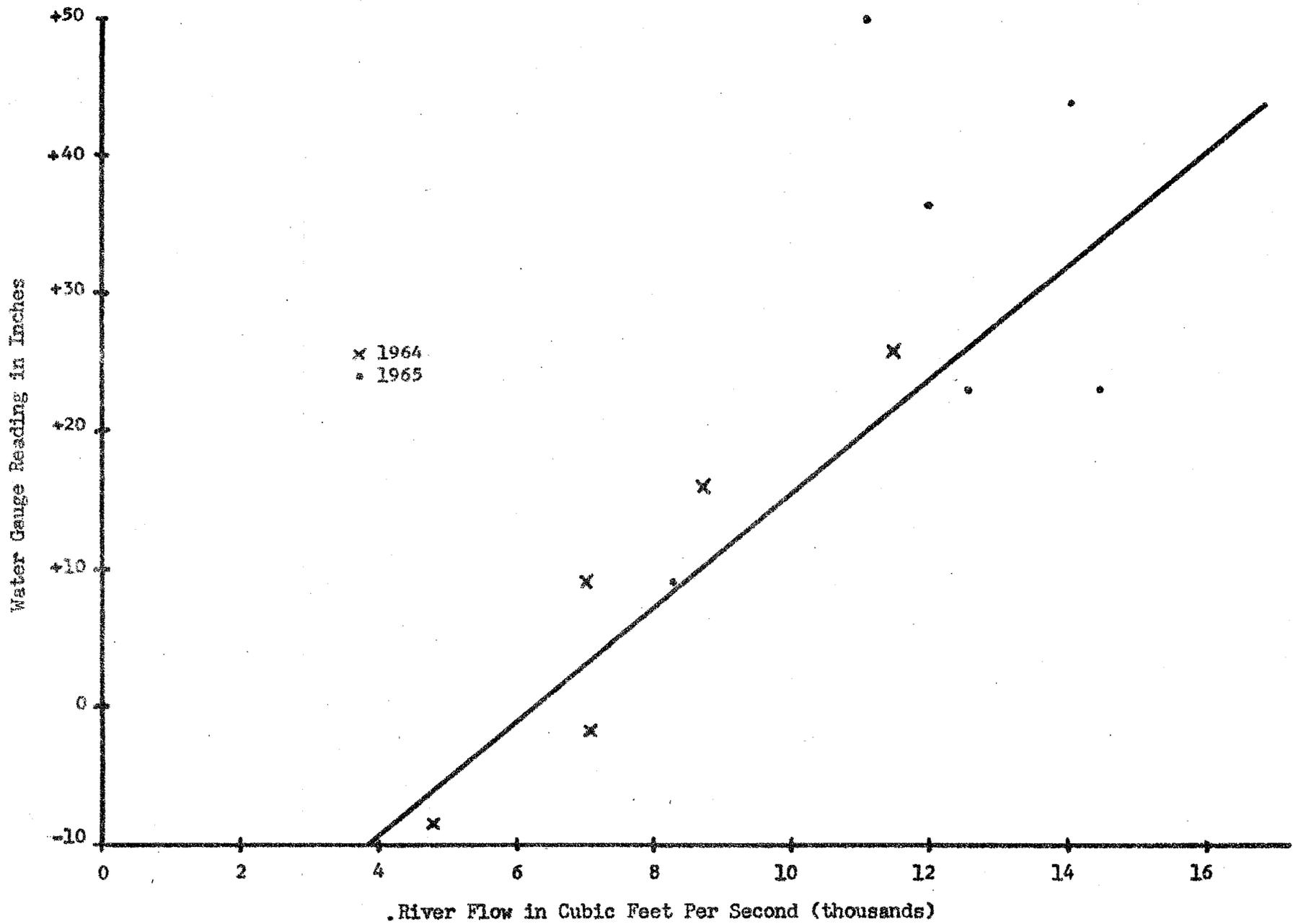


Figure 3.--Wood River flow in cubic feet per second, 1964-65.

OUTMIGRATION RESULTS

Timing of the Outmigration

Index net fishing began well in advance of ice breakup in Lake Aleknagik and evidence showed that smolt outmigration did not begin until well after break-up. It is apparent that climatological conditions as discussed earlier play a significant role in timing of the smolt outmigration in Wood River.

The most distinctive feature of the 1965 smolt outmigration lies in the unusually late appearance of the main part of the run and the three separate outmigration peaks (Figure 4).

The 1965 smolt outmigration was expected to be late in appearance as over 61 percent of the parent year escapement, 1963, were from the upper Wood River Lakes (Nelson, 1965c). Assuming that the smolt outmigration from the upper lakes was begun at the same time, smolts from these lakes would be the last to arrive at the fyke net site. Late season peaks after June 30, accounted for over 51 percent of the migration with the peak of the run occurring on July 10 when 92,689 smolts were caught during the index hours. This was the latest daily migration peak, along with 1955, on record (Table 1). Heavy migration occurred throughout the season from June 14 to July 11 (Figure 4).

Smolt catches during the index hours (9 to 11 p.m.) followed the usual pattern. Migration was lowest during the first hour (41.3 percent) and increased during the second hour (58.7 percent). In 1964, 24-hour sampling was initiated to show the relationship between diurnal and nocturnal smolt outmigration and to prove a basis for a more representative index.

In 1964 over 67 percent of the season's migration passed the fyke net site during the index hours (Nelson, 1965b). However, in 1965 only 22 percent of the smolt passed the site during the 2-hour index period (Table 3). To further illustrate the dissimilarity of the 1964 and 1965 outmigrations, the 24-hour sampling in 1964, showed that 91 percent of the smolts were caught during the evening period from 9 p.m. to 2 a.m. (Nelson, 1965b) while only 71 percent were taken during the same hours in 1965 (Table 3).

Index of Abundance

The total catch of red salmon smolts during the index hours for the entire season in 1965 was 370,112 (Table 2). Using 1952 as the base year with the assigned value of 100.00 index points, the 1965 season catch was equivalent to 217.66 index points (Table 2).

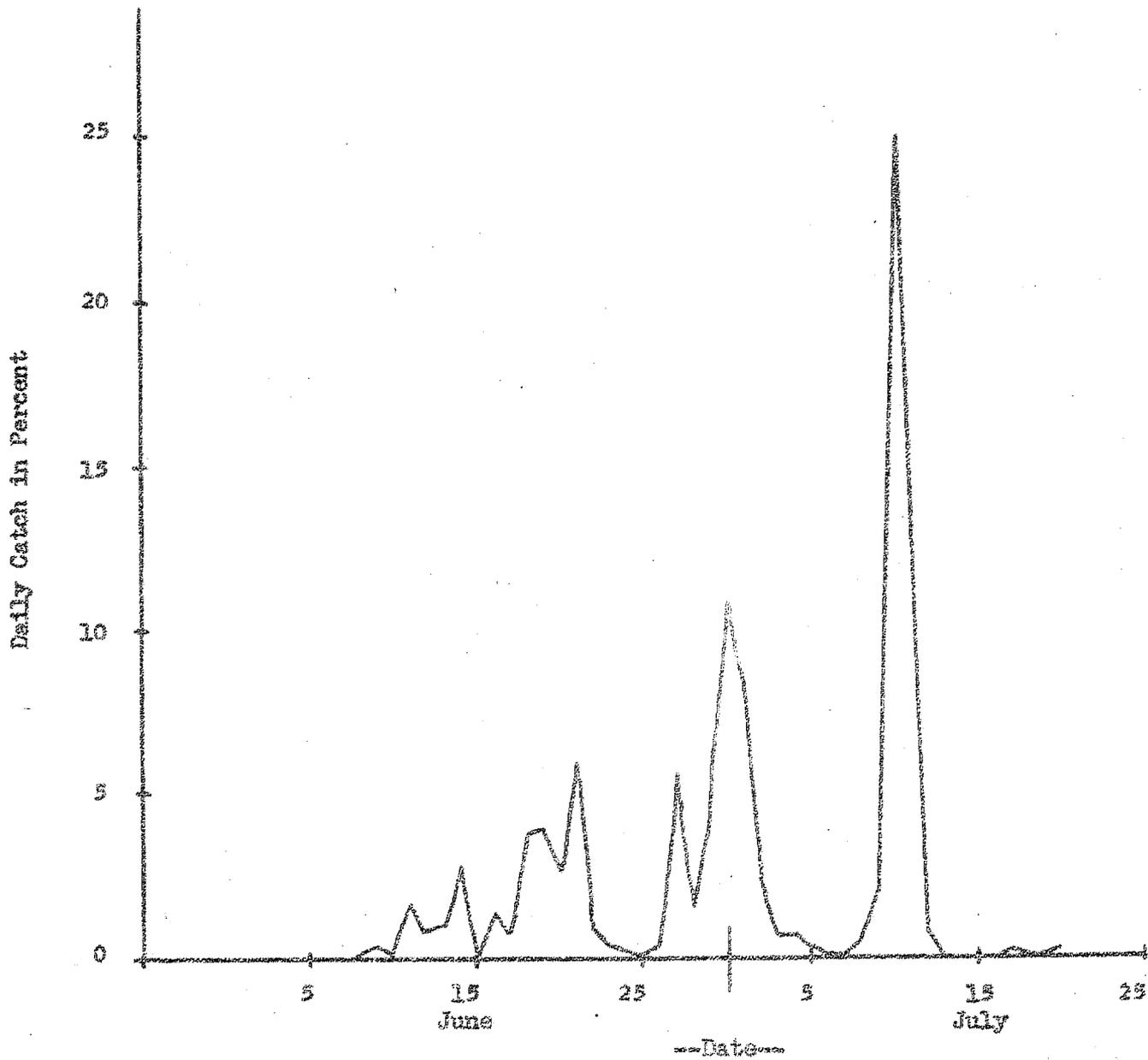


Figure 4.--Daily catches of red salmon smolt in percent of total catch from the Wood River system, 1965.

It was determined from earlier studies (Burgner, 1962. Nelson, 1965b) that 86 to 99 percent of the 24-hour smolt catch was made during the 5-hour period from 9 p.m. to 2 a.m. In addition, the percentage of the catch in the 9 to 11 p.m. period versus the 9 p.m. to 2 a.m. period varies from year to year as seen from the data presented below.

The large fluctuations in migration timing of the 1964 and 1965 out-migrations resulted in atypical index values. As a result of the apparent differences in timing of the smolt run between years, adjustments in the index value were made to eliminate some of these fluctuations that may occur from year to year. The Fisheries Research Institute (Koo, 1959) also adjusted index values for certain years to improve the accuracy of the smolt index method.

The 1964 adjusted index is nearly a 71 percent decrease from the unadjusted index and is due to the relatively high percentage of the 9-11 p.m. catch. Likewise the 1965 adjusted index is a 27 percent increase due to low percentage of the catch during the regular index hours.

The 5-hour fishing period from 9 p.m. to 2 a.m. normally represents the time of day when the majority of the smolt run. For this reason, past adjustments in the index were made from the 5-hour fishing period. Five hour fishing was first carried out in 1955 and hence has been used as the base year for the calculation of the adjusted index.

The method of adjustment can be expressed by the following equation:

$$I = I_1 \times \frac{43.0}{P}$$

Where:

I = is the adjusted index value,

I_1 = is the unadjusted index, or index value for the 9 - 11 p.m. period for the current season,

P = is the seasonal percentage of the 2-hour catch (9 - 11 p.m.) of the 5-hour catch (9 p.m. - 2 a.m.),

43.0 = is the seasonal percentage of the 9-11 p.m. catch obtained during the 1955 experiment, the first year in which the 5-hour fishing occurred.

The percentage of the catch taken during the 2 hours of index sampling as compared to the 5 hour sampling period is shown below for the years in which data is available:

1955	43.0
1956	43.4
1957	37.4
1958	46.4
1959	42.0
1964	73.6
1965	31.6

The 5-hour sampling data needed to make adjustments in the 1965 index were extracted from Table 3. The adjusted seasonal index points for 1964 and 1965 are 332.18 and 296.19, respectively.

To keep present index values comparable with past data the adjusted indices were listed separately to show that in certain years the present 2-hour index method does not always present a reliable index of the smolt outmigration (Table 6). Adjusted index values derived by the Fisheries Research Institute for 1956-59 were also revised to the 2-hour index method (Table 6).

The 1965 index is well above the average unadjusted index value of 175.0 obtained over a 15-year period (Table 6). Figure 5 shows in graph form the relative magnitude of the smolt runs in the Wood River system from 1951 through 1965.

Size and Age Composition

Length frequencies, weight and age data were grouped into nine periods extending from May 28 through July 20. All were 5-day periods with the exception of the first period. The number of smolts caught in each period, percentage of the season's catch by period, number of samples taken, number of fish measured and the number of scales read are shown in Table 4.

Size composition was determined from length measurements of 4,809 smolts contained in 60 one-pound samples. Age determination was based on readings of 700 scales contained in 35 daily scale samples (Table 4).

In computing length frequency curves, daily samples were weighted by the daily catches they represented to adjust for changes during the season in the magnitude of catches. The age composition was also obtained by weighting the age samples by magnitude of the catches which they were to represent.

Combined weighted length frequencies for each period are shown in Figure 6, with the dividing line between Age I and Age II smolts as determined from scale readings indicated by vertical dashes. These frequencies were calculated in percentages.

The season's weighted length frequency distribution is shown in Figure 7.

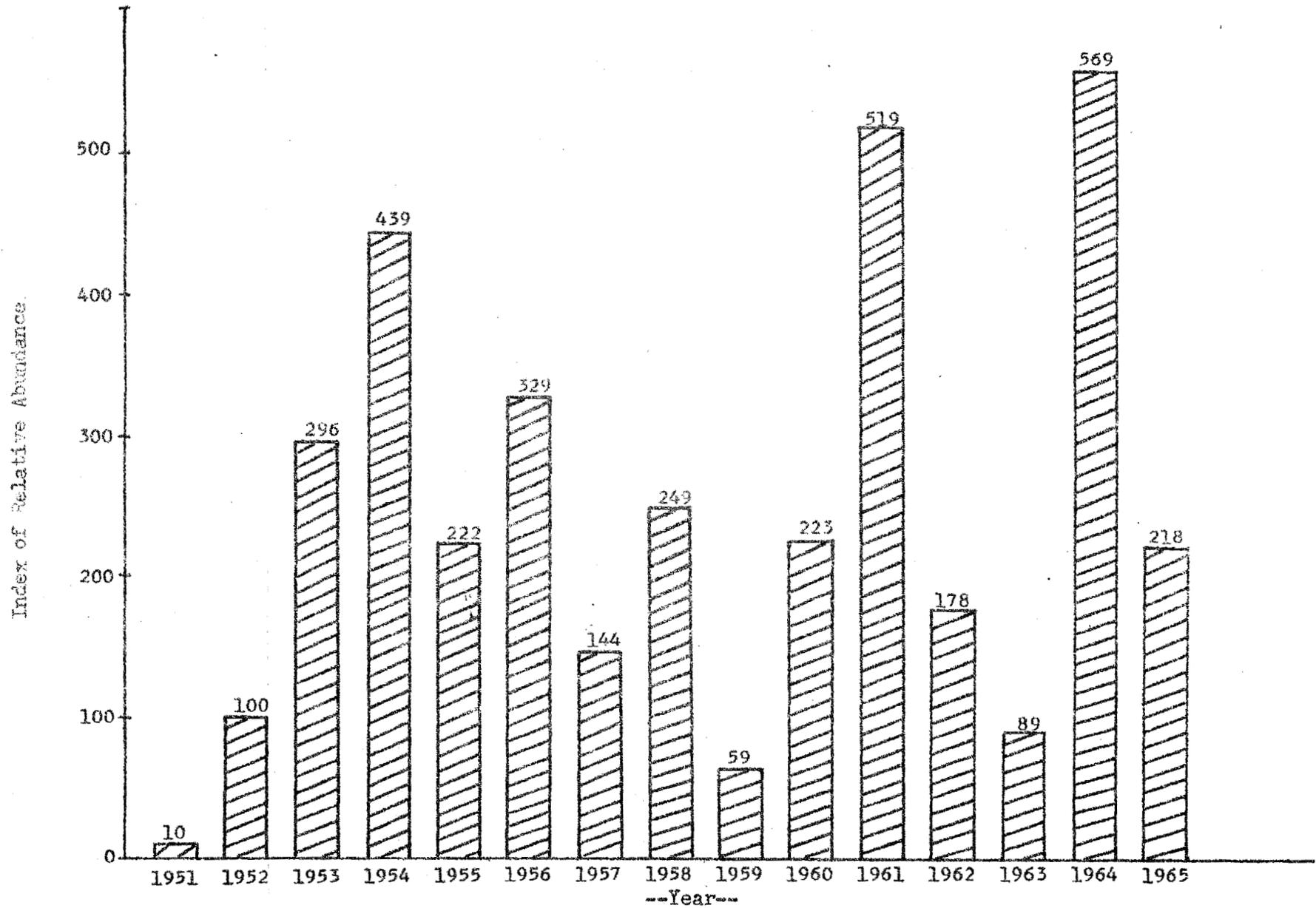


Figure 5.--Relative magnitude of red salmon smolt outmigrations from the Wood River system, 1951-65.

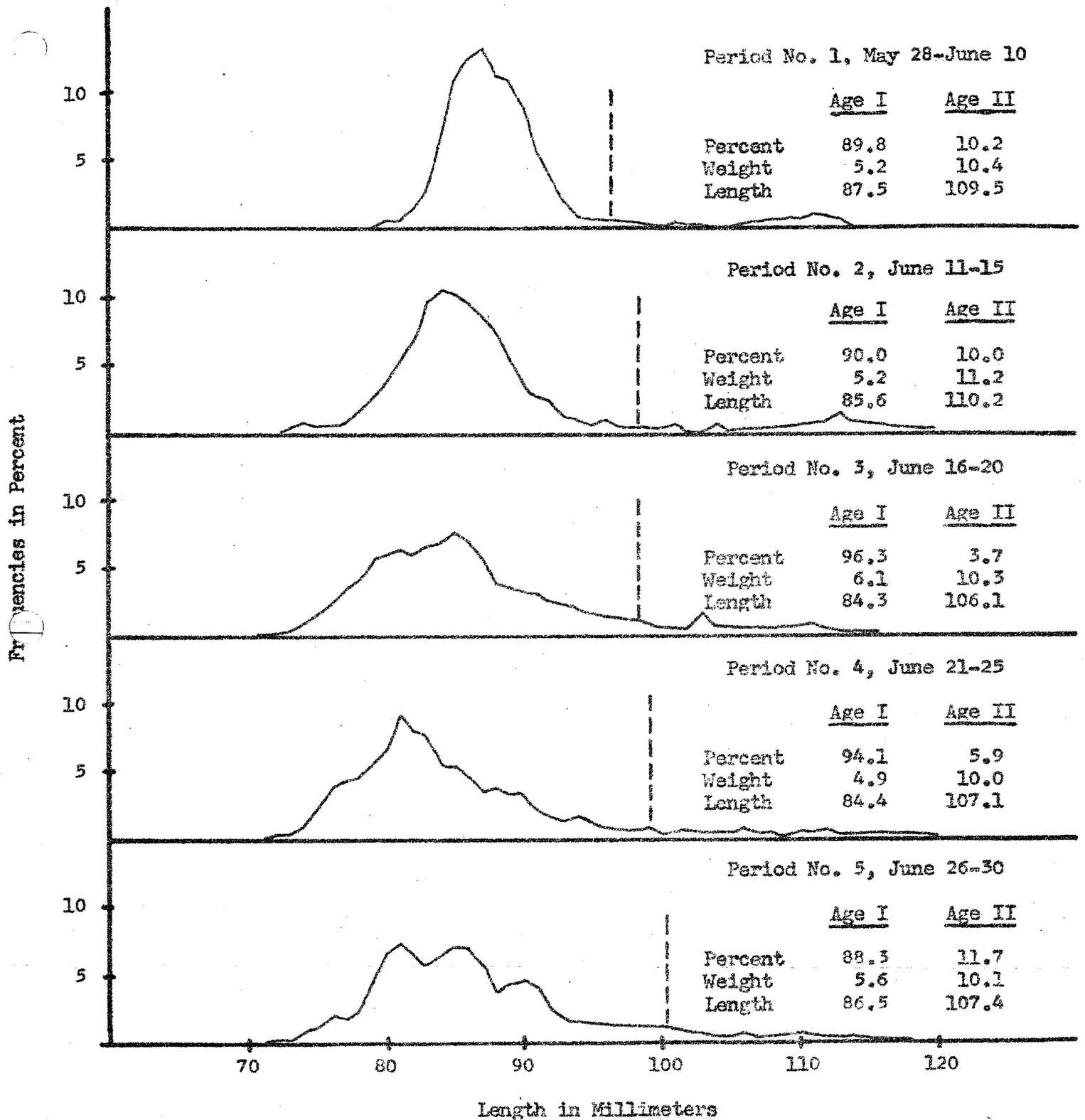


Figure 6.--Weighted length frequencies by period of red salmon smolt from the Wood River system, 1965. (Vertical dash lines divide Age I and Age II). (Frequencies smoothed by moving averages of threes)

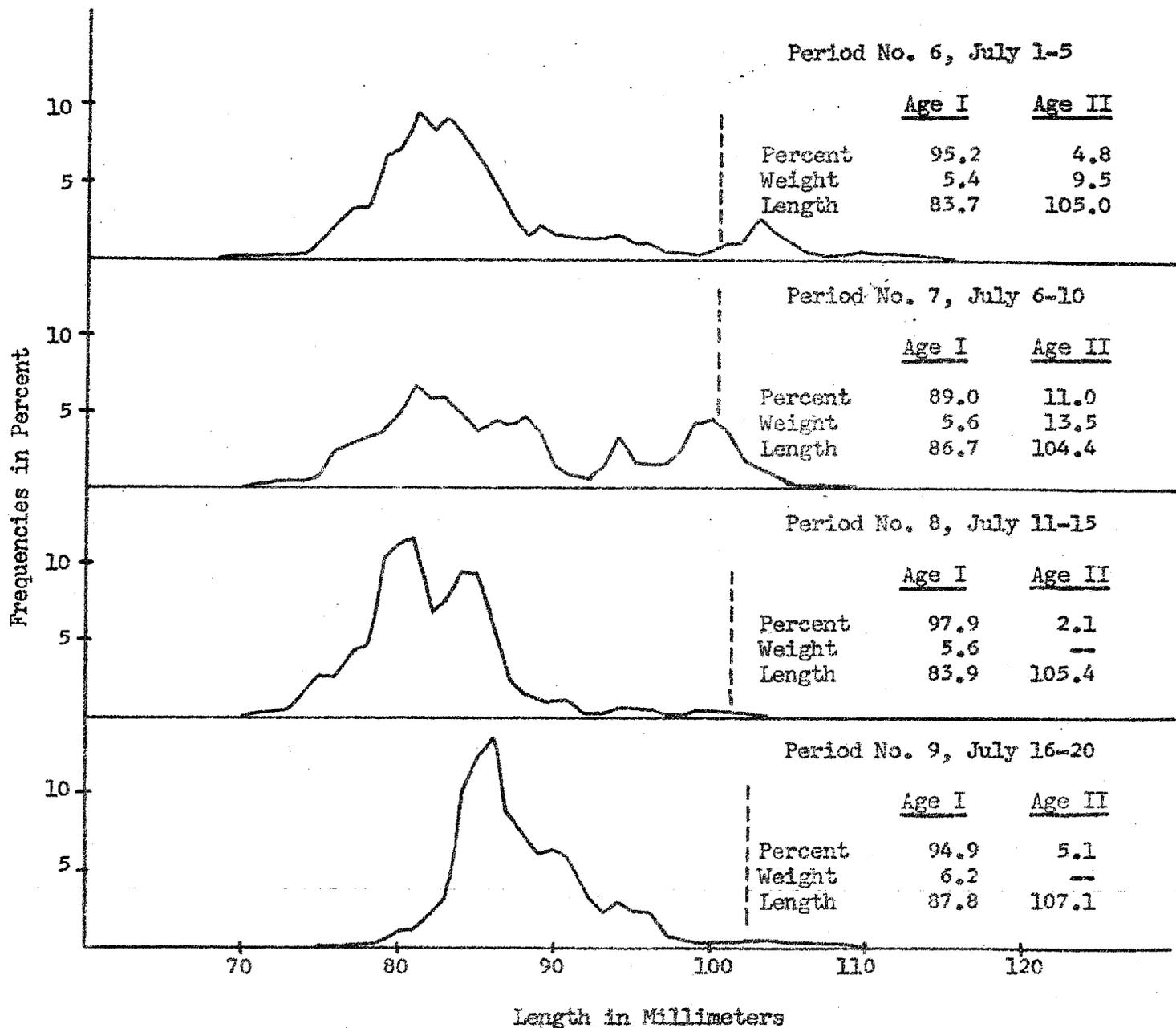


Figure 6 (continued). --Weighted length frequencies by period of red salmon smolt from the Wood River system, 1965.

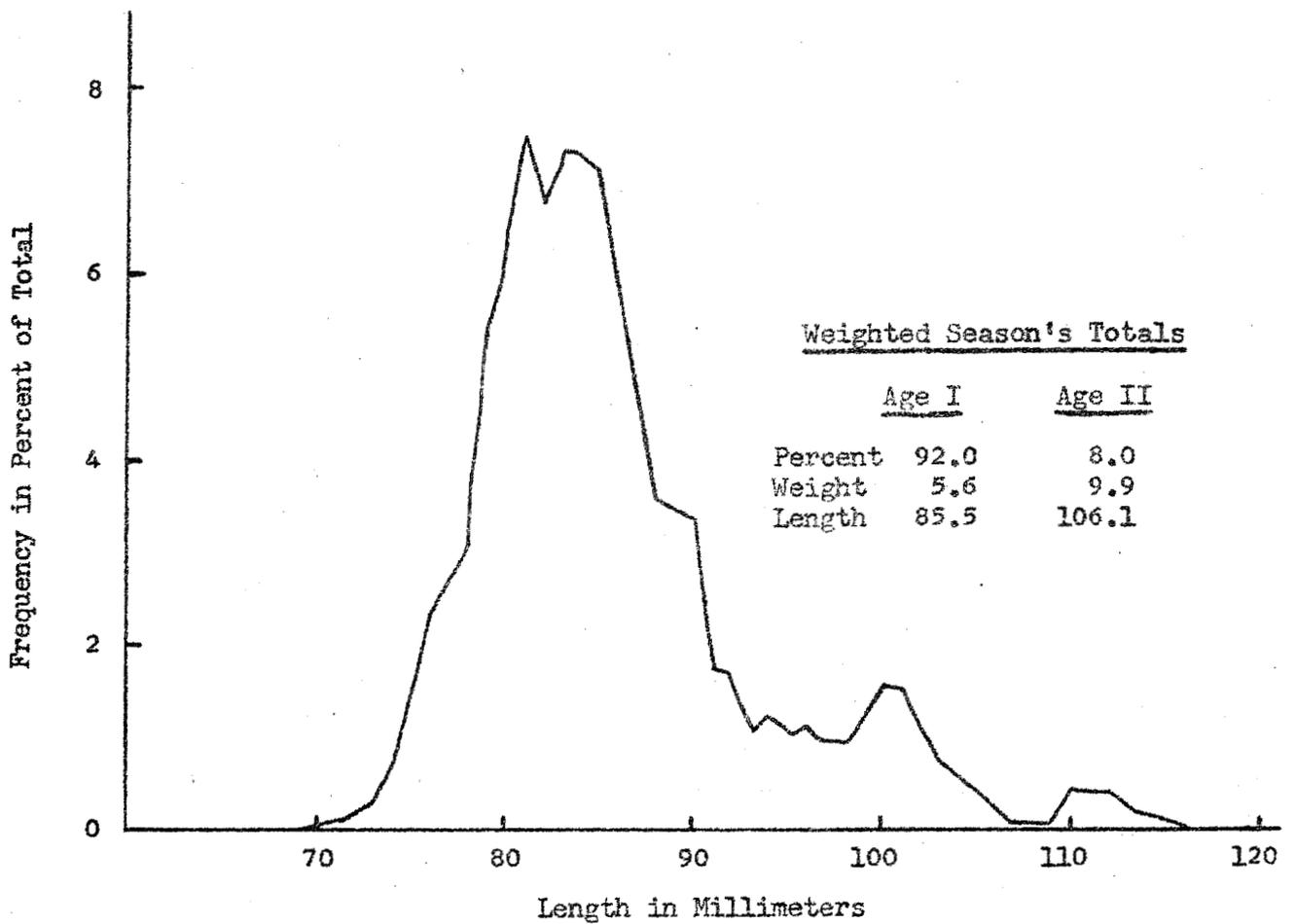


Figure 7.--Season's weighted length frequency of red salmon smolt from the Wood River system, 1965. (Frequencies smoothed by moving average of threes)

Size fluctuations of Age I smolt, by period, might be explained by the hypothesis that the migrations are composed of numerous groups of smolts which have experienced different growing conditions in different parts of the Wood River Lake chain (Table 5).

The percentage and length and weight of each age group were calculated for each period and for the entire season (Table 5). Age I smolts (fish that have spent one winter in freshwater) comprised 92.0 percent of the total run and averaged 85.5 mm. in length and 5.6 grams in weight; Age II smolts (fish that have spent two winters in freshwater) comprised 8.0 percent of the run and averaged 106.1 mm. in length and 9.9 grams in weight (Table 5).

Table 6 summarizes the comparative age, length and index catches for the years 1951 through 1965.

Condition Index of Smolt

Condition index of the 1965 smolt run was calculated on the basis of weight per fish of a given length. Ten 1- to 4-pound condition samples totaling 2,407 smolts were taken randomly throughout the season. Fish were measured in millimeters and collected in 3 mm. groupings. Each group of fish was weighed in grams and weight per fish was calculated and compared to similar data taken in 1964 (Table 7).

The average length and weight of both smolt age groups, as compared to the previous 4 years, is shown in Table 8. Both Age I and Age II smolt in 1965 were longer and weighed more than smolt of the previous 4 years.

The relationship between the length and weight of the 1964-65 smolt is shown in Figure 8.

The annual incidence of smolts parasitized by the cestode, Triaenophorus crassus, has been determined by external observation since 1961 and by internal observation from 1948 to 1958 (Burgner, 1962). All of the smolts anesthetized and measured for length frequency and age studies (4,809) were examined for the cestode cyst. In 1965, 29.2 percent of the smolts examined were infested with the parasite (Table 9).

Smolt Production versus Escapement Levels

The 1965 smolt run originated from adult spawning escapements of 874,000 in 1962 and 721,000 in 1963, with the major portion of the outmigration (92.0 percent) from the 1963 escapement.

Table 10 gives the relationship between parent escapements of red salmon to the spawning grounds of the Wood River Lakes and relative numbers of smolts produced. The rate of reproduction is represented by the number of smolt-index

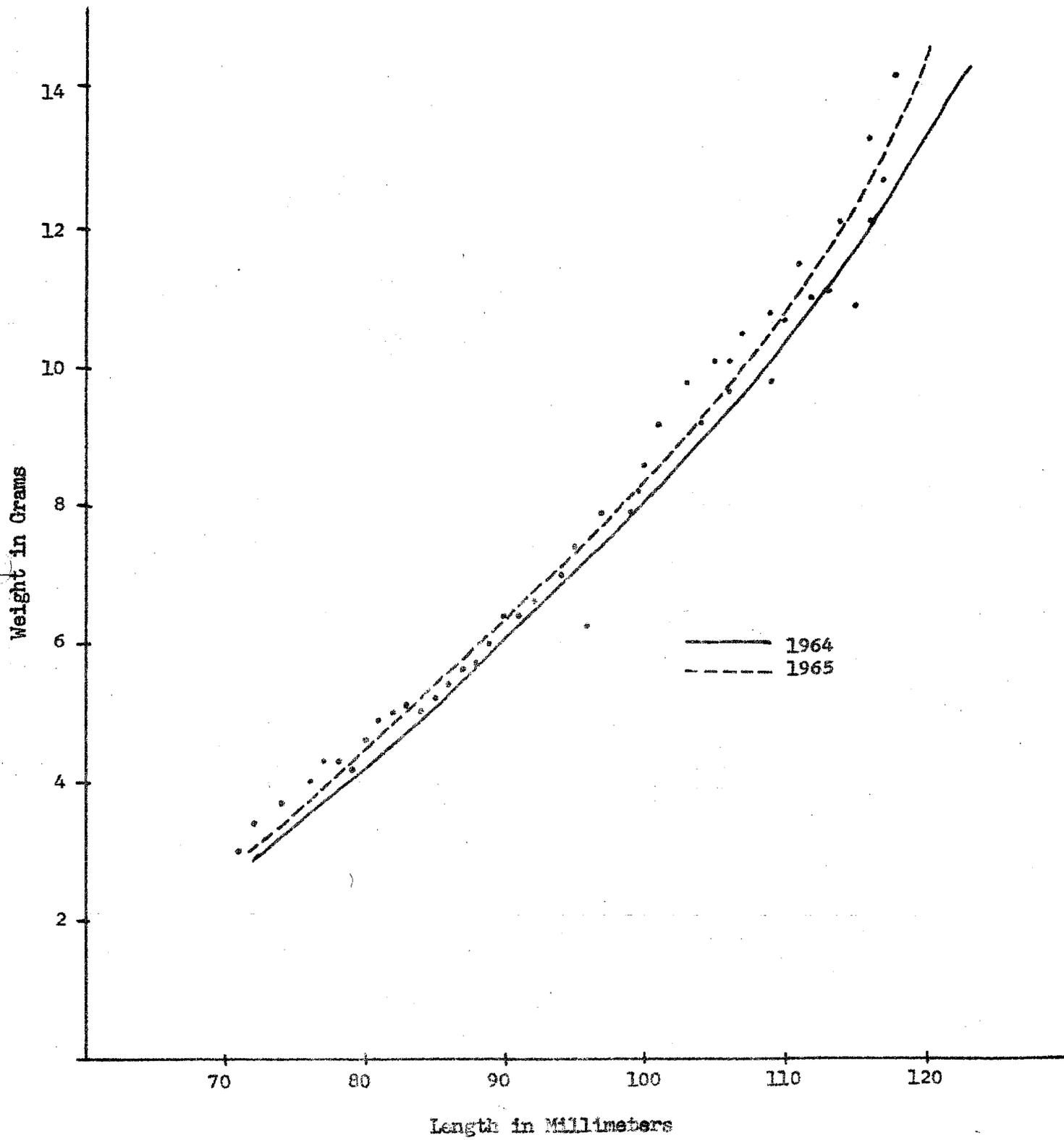


Figure 8.--Length-weight relationship of red salmon smolt from the Wood River system, 1964-65.

units per 1,000 parent spawners.

The best reproduction rates were from 1951 through 1954 and in 1962, all of which were produced by escapements of under 1,000,000 spawners. On the other hand the three largest escapements, in 1955, 1959 and 1960 produced the lowest reproduction rates. The data suggests that maximum smolt production results from escapements of under 1,000,000 fish.

In summary, the relationship between size of escapements and smolts produced is extremely variable. It appears that natural conditions for survival are more important than abundance of spawners in determining abundance of smolts.

SUMMARY

1. The Alaska Department of Fish and Game conducted the smolt enumeration and sampling program for the fifth consecutive year in 1965. The program was initiated in 1951 by the Fisheries Research Institute and 1965 marked its fifteenth consecutive year of operation.

2. The index of smolt abundance was obtained by use of a standard wing-type fyke net and other equipment comparable with previous years.

3. Breakup occurred on June 5 at Lake Aleknagik which was 5 days later than the mean date for breakup of lake ice.

4. Velocity and flow measurements were taken regularly throughout the season and compared with past data.

5. Comparable water level recordings were kept for the second year. The high lake level in 1965 resulted in minimum estimates of the smolt out-migration between June 9-21.

6. The fyke net was fished during the previously established index hours of 9 to 11 p.m. each night from May 28 through July 20. In addition, several 24-hour counts were made to establish a basis for comparing the daily and seasonal variation outside the index hours.

7. Twenty-four samples in 1965 showed that 22 percent of the smolt passed the fyke net site during the 2-hour index period.

8. The unusually late appearance of the main part of the run and three separate outmigration peaks were the most distinctive features of the 1965 smolt migration.

9. The total catch of 370,112 smolts was equal to 217.66 index points.
10. Adjustments of the index to compensate for some of the fluctuations in migration outside of index hour sampling that occur from year to year resulted in an adjusted index value of 296.19 for 1965.
11. Size composition was determined from length measurements of 4,809 smolts contained in 60 one-pound samples. Age determination was based on readings of 700 scales contained in 35 daily scale samples.
12. Age I smolts comprised 92.0 percent of the total run and averaged 85.5 mm. in length and 5.6 grams in weight. Age II smolts comprised 8.0 percent of the run and averaged 106.1 mm. in length and 9.9 grams in weight.
13. Ten condition samples totaling 2,407 smolt were taken throughout the season and gave evidence that the 1965 smolts were longer and weighed more than smolt of the previous 4 years.
14. The parasitic cestode, Triaenophorus crassus, was found in 29.2 percent of the 4,809 smolts examined.
15. The 1965 smolt run originated from adult spawning escapements of 874,000 in 1962 and 721,000 in 1963.
16. The relationship between spawning escapements and smolts produced is variable, however the data suggests that optimum smolt production results from escapements of under 1,000,000 fish.

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APPENDIX

Table 1. Relationship between dates of breakup of ice on Lake Aleknagik and season migration of red salmon smolts at Wood River index site, 1951-65.

Year ^{1/}	Breakup Date Lake Aleknagik	Percent of Total Index Catch Accounted For							Migration Peak
		10%	20%	30%	40%	50%	60%	70%	
1958	May 14	June 9	June 13	June 14	June 15	June 15	June 16	June 17	June 15
1954	May 26	June 2	June 2	June 7	June 8	June 10	June 11	June 13	June 10
1953	May 27	June 3	June 11	June 16	June 17	June 17	June 18	June 22	June 17
1957	May 28	June 11	June 17	June 22	June 23	June 24	June 24	June 26	June 26
1951	May 30	June 7	June 9	June 11	June 21	June 23	June 24	July 1	June 23
1961	May 30 ^{2/}	June 5	June 8	June 9	June 13	June 15	June 18	June 20	June 18
1960	May 31	June 3	June 7	June 11	June 16	June 18	June 21	June 29	July 7
1959	June 1 ^{2/}	June 6	June 7	June 16	June 18	June 18	June 19	June 21	June 18
1956	June 1-3	June 16	June 24	July 1	July 6	July 6	July 6	July 12	July 6
1962	June 1-3	June 13	June 15	June 17	June 20	June 21	June 23	June 30	June 15
1963	June 3	June 11	June 11	June 15	June 16	June 16	June 17	June 20	June 15
1965	June 5	June 18	June 21	June 27	June 30	July 1	July 4	July 10	July 10
1952	June 7	June 12	June 14	June 22	June 24	June 25	June 26	July 3	June 24
1955	June 10	June 26	June 30	July 10	July 10	July 10	July 12	July 14	July 10
1964	June 15-16	June 21	June 23	June 27	June 29	June 30	July 1	July 1	July 1
Mean	May 31	June 14	June 16	June 24	June 24	June 25	June 27	June 29	June 25

^{1/} Years listed in order at breakup date.

^{2/} Approximate date.

Table 2. Wood River red salmon smolt catch by hour and day, 1965.

Date	Index Hour Catch		Total Index Catch		Index Points $\frac{1}{2}$	
	9-10 p.m.	10-11 p.m.	Daily	Cumulative	Daily	Cumulative
May 28	0	0	0	0	0.00	0.00
29	0	0	0	0	0.00	0.00
30	0	1	1	1	0.00	0.00
31	0	4	4	5	0.00	0.00
June 1	2	11	13	18	0.01	0.01
2	0	1	1	19	0.00	0.01
3	0	2	2	21	0.00	0.01
4	1	0	1	22	0.00	0.01
5	-	-	-	22	----	0.01
6	0	0	0	22	0.00	0.01
7	0	0	0	22	0.00	0.01
8	0	254	254	276	0.15	0.16
9	326	905	1,231	1,507	0.72	0.88
10	1	249	250	1,757	0.15	1.03
11	1,284	4,507	5,791	7,548	3.41	4.44
12	633	1,995	2,628	10,176	1.55	5.99
13	27	3,643	3,670	13,846	2.16	8.15
14	448	10,300	10,748	24,594	6.32	14.47
15	281	17	298	24,892	0.18	14.65
16	3,266	1,867	5,133	30,025	3.02	17.67
17	1,375	1,420	2,795	32,820	1.64	19.31
18	10,581	3,150	13,731	46,551	8.08	27.39
19	8,701	5,800	14,501	61,052	8.53	35.92
20	4,759	4,451	9,210	70,262	5.42	41.34
21	4,227	17,913	22,140	92,402	13.02	54.36
22	1,980	1,007	2,987	95,389	1.76	56.12
23	779	218	997	96,386	0.59	56.71
24	0	395	395	96,781	0.23	56.94
25	0	23	23	96,804	0.01	56.95
26	1	1,037	1,038	97,842	0.61	57.56
27	13,891	6,738	20,629	118,471	12.13	69.69
28	505	5,257	5,762	124,233	3.39	73.08
29	9,680	5,895	15,575	139,808	9.16	82.24
30	24,683	15,506	40,189	179,997	23.64	105.88

Table 2. Wood River red salmon smolt catch by hour and day, 1965.
(Continued)

Date	Index Hour Catch		Total Index Catch		Index Points ^{1/}	
	9-10 p.m.	10-11 p.m.	Daily	Cumulative	Daily	Cumulative
July 1	9,669	21,402	31,071	211,068	18.27	124.15
2	5,638	3,092	8,730	219,798	5.13	129.28
3	1,785	423	2,208	222,006	1.30	130.58
4	2,158	365	2,523	224,529	1.48	132.06
5	284	485	769	225,298	0.45	132.51
6	4	5	9	225,307	0.01	132.52
7	-	-	-	225,307	----	132.52
8	0	1,642	1,642	226,949	0.97	133.49
9	1,190	6,050	7,240	234,189	4.26	137.75
10	36,576	56,113	92,689	326,878	54.51	192.26
11	6,112	33,068	39,180	366,058	23.04	215.30
12	2,028	468	2,496	368,554	1.47	216.77
13	3	21	24	368,578	0.01	216.78
14	9	45	54	368,632	0.03	216.81
15	0	55	55	368,687	0.03	216.84
16	2	5	7	368,694	0.00	216.84
17	0	228	228	368,922	0.13	216.97
18	0	280	280	369,202	0.16	217.13
19	34	189	223	369,425	0.13	217.26
20	48	639	687	370,112	0.40	217.66
TOTALS	152,971	217,141	370,112	370,112	217.66 ^{2/}	217.66 ^{2/}
PERCENT	41.33	58.67	100.00			

^{1/} One index point = 1,700.34 smolt.

^{2/} Unadjusted index.

Table 3. Wood River red salmon smolt catch in index net over 24-hour period, 1965.

Time Period	DATE										Total	Percent
	June 11-12	June 14-15	June 17-18	June 19-20	June 21-22	June 24-25	June 26-27	June 28-29	July 1-2	July 10-11		
9-10 p.m.	1,284	448	1,375	8,701	4,227	0	1	505	9,669	36,576	62,786	7.56
10-11 p.m.	4,507	10,300	1,420	5,800	17,913	395	1,037	5,257	21,402	56,113	124,144	14.95
11 p.m.-12 mn.	16,815	82,196	205	4,024	8,204	1,130	1,155	28,923	4,641	29,085	176,378	21.24
12 mn.-1 a.m.	9,493	4,716	1,105	4,901	3,869	893	4,503	11,479	837	60,299	102,095	12.29
1-2 a.m.	783	6,814	304	1,637	5,989	270	8,154	245	1,886	100,125	126,207	15.20
2-3 a.m.	19	326	3	349	2,528	62	4,500	8	1,743	12,480	22,018	2.65
3-4 a.m.	7	1	2	38	1,210	4	6	1	369	479	2,117	0.25
4-5 a.m.	29	0	1	6	8	1	2	2	5	11	65	0.01
5-6 a.m.	20	1	0	4	6	0	2	0	7	1	41	0.01
6-7 a.m.	5	3	159	0	0	0	0	1	0	0	168	0.02
7-8 a.m.	0	2	2	1	3	0	1	0	2	0	11	0.00
8-9 a.m.	2	0	0	2	1	0	1	1	1	0	8	0.00
9-10 a.m.	0	0	1	0	1	0	0	1	0	0	3	0.00
10-11 a.m.	1	0	1	542	1	0	0	1	0	0	546	0.07
11 a.m.-12 n.	0	8	125	29	189	0	0	0	0	115	466	0.06
12 n.-1 p.m.	0	3	3	0	4	0	0	14,924	0	1,674	16,608	2.00
1-2 p.m.	0	3	2	1,403	9	1	1	14,101	0	185	15,705	1.89

Table 3. Wood River red salmon smolt catch in index net over 24-hour period, 1965.
(Continued)

Time Period	DATE										Total	Percent
	June 11-12	June 14-15	June 17-18	June 19-20	June 21-22	June 24-25	June 26-27	June 28-29	July 1-2	July 10-11		
2-3 p.m.	0	26	0	5,483	259	0	290	3,873	0	782	10,713	1.29
3-4 p.m.	1	387	0	13,354	393	0	548	3,329	1,971	23	20,006	2.41
4-5 p.m.	1	1,339	1,221	25,441	15	0	239	2,285	1,731	193	32,465	3.91
5-6 p.m.	2	2,757	8,209	20,077	8	0	1,274	376	291	26	33,020	3.98
6-7 p.m.	125	1,585	4,155	8,788	38	0	3,655	697	801	159	20,003	2.41
7-8 p.m.	77	2,072	1,403	8,587	872	0	2,236	8,413	46	400	24,106	2.90
8-9 p.m.	0	5,765	672	10,434	4,664	0	203	12,470	3,307	3,199	40,714	4.90
Totals	33,171	118,752	20,368	119,601	50,411	2,756	27,808	106,892	48,709	301,925	830,393	100.00

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Table 4. Wood River red salmon smolt sampling data, 1965

Period No.	Date	Smolt Catch	Percent of Season's Total	No. of 1 lb. Samples Measured	No. of Fish Measured	No. of Scales Read
1	May 28-June 10	1,757	0.47	4	293	60
2	June 11-15	23,135	6.25	8	608	100
3	June 16-20	45,370	12.26	10	894	100
4	June 21-25	26,542	7.17	7	591	80
5	June 26-30	83,193	22.48	9	647	100
6	July 1-5	45,301	12.24	10	869	100
7	July 6-10	101,580	27.45	5	335	60
8	July 11-15	41,809	11.30	4	339	40
9	July 16-20	1,425	0.38	3	233	60
		<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
		370,112	100.00	60	4,809	700

Table 5. Age^{1/}, length^{2/} and weight^{3/} of red salmon smolts by period from the Wood River system, 1965.

Period No.	Date	Line Dividing Age I & Age II	Mean Length of Age Group		Mean Weight of Age Group		Percentage of Age Group	
			I	II	I	II	I	II
1	May 28-June 10	96.5	87.5	109.5	5.2	10.4	89.8	10.2
2	June 11 - 15	98.5	85.6	110.2	5.2	11.2	90.0	10.0
3	June 16 - 20	98.5	84.3	106.1	6.1	10.3	96.3	3.7
4	June 21 - 25	99.5	84.4	107.1	4.9	10.0	94.1	5.9
5	June 26 - 30	100.5	86.5	107.4	5.6	10.1	88.3	11.7
6	July 1 - 5	100.5	83.7	105.0	5.4	9.5	95.2	4.8
7	July 6 - 10	100.5	86.7	104.4	5.6	13.5	89.0	11.0
8	July 11 - 15	101.5	83.9	105.4	5.6	-----	97.9	2.1
9	July 16 - 20	<u>102.5</u>	<u>87.8</u>	<u>107.1</u>	<u>6.2</u>	<u>-----</u>	<u>94.9</u>	<u>5.1</u>
Season's Weighted Total ^{4/}			85.5	106.1	5.6	9.9	92.0	8.0

1/ Number winters in freshwater

2/ Length in mm.

3/ Weight in grams

4/ Weighted by index catch

Table 6. Comparative age, length and index net catches of red salmon smolt from the Wood River system, 1951-65^{1/}

Year of Seaward Migration	Age I ^{2/}		Age II ^{2/}		Index Points ^{5/}		Two-Hour Index Net Catch	Five-Hour Index Net Catch ^{7/}
	Percent	Mean Length ^{3/}	Percent	Mean Length ^{3/}	Unadjusted	Adjusted		
1951	80.0	91.0	20.0	----	9.9	-----	16,809	<u>8/</u>
1952 ^{4/}	99.0	87.0	1.0	----	100.0	-----	170,034	<u>8/</u>
1953	95.3	86.0	4.7	103.0	296.1	-----	503,444	<u>8/</u>
1954	95.8	87.0	4.2	107.0	438.6	-----	745,832	<u>8/</u>
1955	98.0	85.0	2.0	102.0	221.7	-----	377,032	777,665
1956	78.4	82.0	21.6	95.0	329.3	326.6	559,932	1,099,782
1957	80.7	77.0	19.3	93.0	144.0	165.5	244,831	541,521
1958	65.0	82.0	35.0	102.0	249.1	230.9	423,580	868,293
1959	93.5	87.9	6.5	105.0	59.1	60.5	100,450	174,647
1960	99.4	88.0	0.6	114.0	223.3	-----	379,668	<u>8/</u>
1961	93.0	81.7	7.0	102.1	518.7	-----	881,911	<u>8/</u>
1962	86.0	80.1	14.0	97.6	177.6	-----	301,892	<u>8/</u>
1963	84.3	82.6	15.7	102.1	88.9	-----	151,206	<u>8/</u>
1964	98.8	83.7	1.2	104.2	568.6	332.2	966,807	1,318,558
1965	92.0	85.5	8.0	106.1	217.7	296.2	370,112	1,171,358
Average	89.3	84.4	10.7	102.5	175.0 ^{6/}	-----	412,903	-----

^{1/} Weighted by index catch

^{2/} Number winters in freshwater

^{3/} Mean length in mm.

^{4/} Base year assigned value of 100.00

^{5/} One index point = 1,700.34 smolt

^{6/} Geometric mean

^{7/} Five-hour index net catch obtained from following proportion:

$$\frac{\text{Two-hour Index Catch in 24-hour Sampling}}{\text{Five-hour Index Catch in 24-hour Sampling}} = \frac{\text{Seasonal Total 2-hour Index Catch}}{\text{Seasonal Total 5-hour Index Catch}}$$

^{8/} Five-hour sampling not available for these years.

Table 7. Condition index of red salmon smolt from the Wood River system using 3 mm. length groups, 1964-65.

Mid-Point of 3 mm. Groupings	Grams per Fish - 1965						Mean Average	
	June 6-10	June 11-15	June 16-20	June 21-25	June 26-30	July 6-10	1964	1965
70	-----	-----	-----	3.15	-----	-----	3.18	3.15
73	-----	-----	3.80	2.96	3.81	3.81	3.09	3.76
76	-----	-----	3.30	4.53	3.87	4.31	3.76	4.10
79	4.15	4.15	5.60	3.90	4.38	4.61	4.06	4.40
82	4.64	4.74	5.72	4.25	5.03	4.97	4.75	4.94
85	5.01	4.95	5.76	4.84	5.45	5.17	5.05	5.24
88	4.86	5.51	6.30	5.36	5.96	6.02	5.56	5.66
91	5.95	5.90	7.47	5.85	6.66	6.46	6.17	6.52
94	6.70	7.39	8.74	6.58	7.44	7.59	6.52	7.46
97	6.97	7.08	8.15	7.19	7.89	8.22	7.44	7.76
100	-----	8.32	8.48	7.73	8.93	9.01	7.52	8.87
103	-----	8.90	8.59	8.29	9.33	10.05	8.71	9.44
106	9.50	7.90	11.55	9.43	9.95	9.97	9.73	10.02
109	-----	10.60	10.40	8.00	10.62	10.76	9.64	10.16
112	-----	10.80	-----	10.14	10.76	12.61	12.35	10.68
115	-----	12.04	12.50	11.60	13.73	-----	11.70	12.49
118	-----	13.21	-----	13.24	-----	-----	12.70	8.79
121	-----	14.02	-----	13.90	-----	-----	-----	13.94

Table 8. Average length and weight of Wood River red salmon smolts by freshwater age group, 1961-65 ^{1/}

Year of Seaward Migration	Age I		Age II	
	Length	Weight	Length	Weight
1961	81.7	4.3	102.1	7.7
1962	80.1	4.2	97.6	7.9
1963	82.6	5.1	102.1	9.3
1964	83.7	4.8	104.2	8.5
1965	<u>85.5</u>	<u>5.6</u>	<u>106.1</u>	<u>9.9</u>
Mean Average	82.7	4.8	102.4	8.7

^{1/} Weighted by index net catch.

Table 9. Percentage of Wood River red salmon smolt parasitized by the cestode, Triaenophorus crassus, 1961-65.

Year	Total Number of Smolt Examined	Number of 1 lb. Samples Examined	Range of 1 lb. Sample Size	Percent Smolt Parasitized All Samples	Range Between Samples in Percent Parasitized
1961	5,467	60	59-129	11.9 ^{1/}	0-27.3
1962	4,789	58	47-125	22.8	2.4-46.2
1963	4,091	55	44-99	26.9	0-61.7
1964	5,984	68	64-118	54.4	29.7-84.1
1965	<u>4,809</u>	<u>60</u>	<u>50-109</u>	<u>29.2</u>	<u>12.8-50.8</u>
Mean Average	5,028	60	53-116	25.9 ^{2/}	9.0-54.0

^{1/} Parasitized smolt were not counted during first week of seaward migration when percentage is highest. Consequently, percent parasitized all samples, is a low estimate.

^{2/} Geometric mean

Table 10. Wood River red salmon escapements and smolts produced, 1951-63.

Year	Wood River Escapement	Index Values of Smolts Produced		Total	Index Units Per 1,000 Spawners
		Age I	Age II		
1951	458,000	282.2	18.4	300.6	.66
1952	227,000	420.2	4.4	424.6	1.87
1953	516,000	217.3	71.1	288.4	.56
1954	571,000	258.2	27.8	286.0	.50
1955	1,383,000	116.2	87.2	203.4	.15
1956	773,000	161.9	3.8	165.7	.21
1957	289,000	55.3	1.3	56.6	.20
1958	960,000	222.0	36.3	258.3	.27
1959	2,209,000	482.4	24.9	507.3	.23
1960	1,016,000	152.7	13.9	166.6	.16
1961	461,000	74.9	6.8	81.7	.18
1962	874,000	561.8	17.4	579.2	.66
1963	721,000	200.3	<u>1/</u>		

1/ The Age II smolts from the 1963 escapement will not leave freshwater until 1966.

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