

Informational Leaflet 85

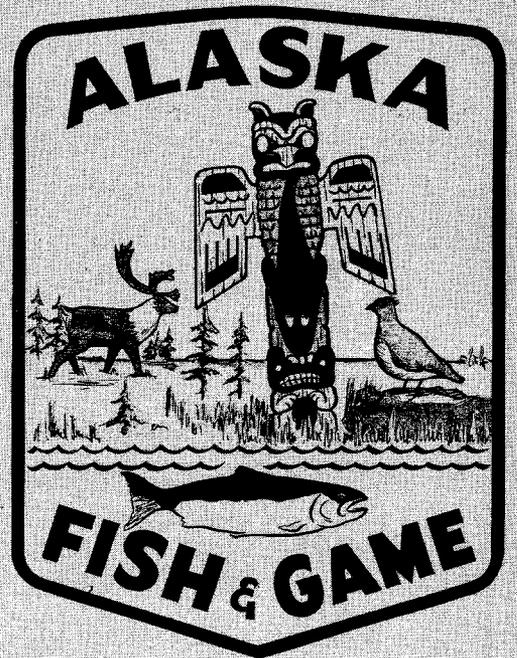
ABUNDANCE, SIZE, AGE AND SURVIVAL OF RED SALMON
SMOLTS FROM THE UGASHIK LAKES SYSTEM, BRISTOL BAY,
1965

By:

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June 30, 1966

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INTRODUCTION AND BACKGROUND

A series of standard winged fyke nets were fished in the spring of 1965 at the outlet of the Lower Ugashik Lake (Figure 1), for the eighth consecutive year to determine an estimate of the total number of red salmon (Oncorhynchus nerka) smolts migrating to sea and the age and size composition of the outmigration.

The program was initiated in 1955 by the Bureau of Commercial Fisheries to provide an annual estimate of relative abundance of smolts migrating to sea. In 1958 a random sampling scheme was employed to obtain an estimate of the total smolt outmigration from the Ugashik Lakes System. The Alaska Department of Fish and Game assumed responsibility for the smolt program in 1963 and have continued the program in 1965 without major modification in sampling methods.

The primary objective of the project is to measure the abundance of red salmon smolts migrating seaward from the Ugashik Lakes. In addition, information collected on diurnal and nocturnal fluctuations and seasonal timing, age and size composition, condition index, relationship of smolt production and adult escape-ment levels and freshwater and marine survival are obtained. Information gained from the smolt studies are then used in making forecasts of adult salmon returns to the Ugashik Lakes system.

Fyke net operations began on May 13 and terminated on June 20 when catches had diminished to insignificant numbers. Fishing was conducted every evening during the season except on May 28, when operations were suspended because of high winds and equipment failure. Catches made from 10 p.m. to 1 a.m. each evening were totaled to yield the seasonal index catch. Catches made from 9 p.m. to 2 a.m. each evening were totaled to give the random sampling catch. Periodic 24-hour index sampling was conducted to determine the diurnal and nocturnal fluctuation of the migration pattern throughout the season.

For structure and dimensions of the fyke net, the fyke netting procedure and the methods for collection of field data the reader is referred to Nelson (1965).

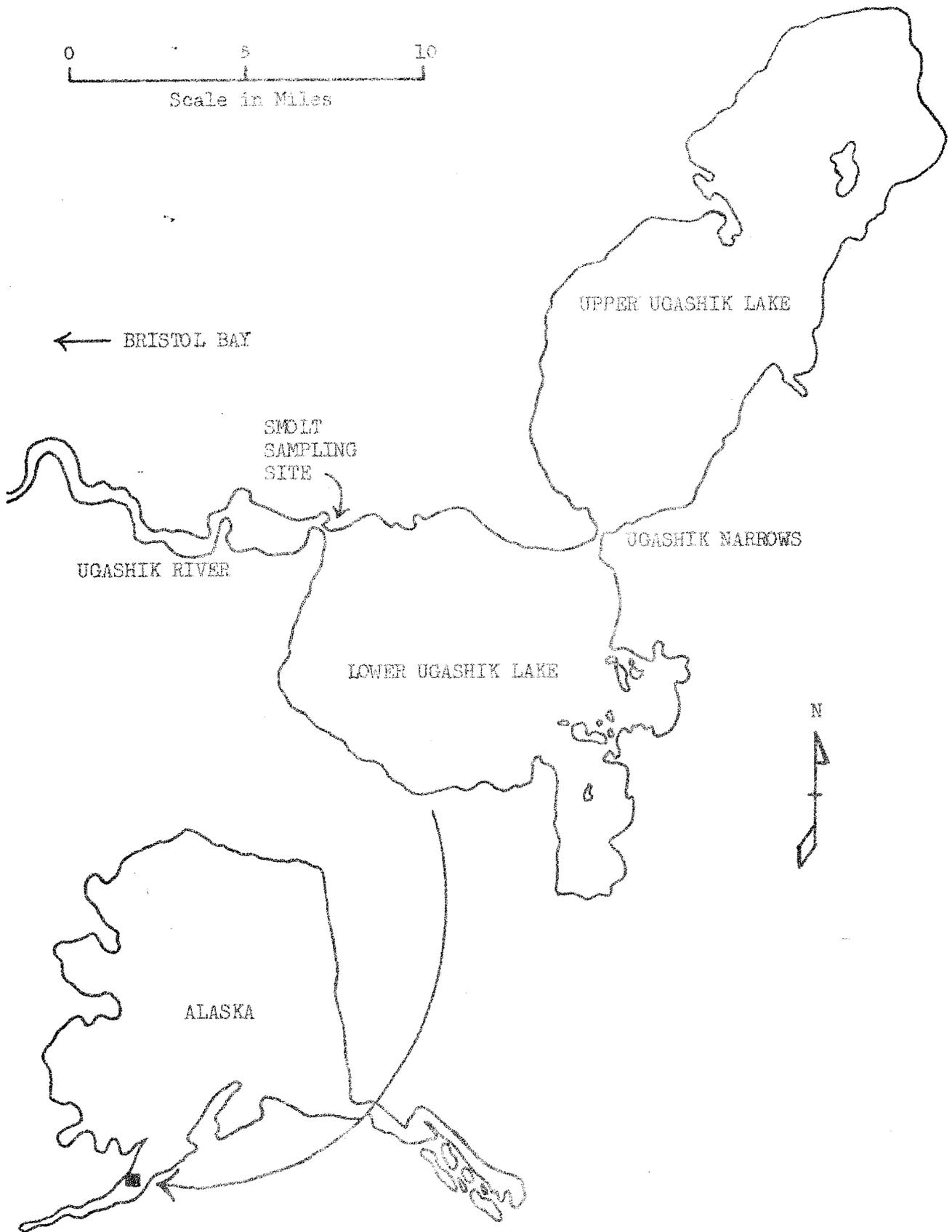


Figure 1.--Ugashik Lakes system, Bristol Bay, Alaska.

The work in 1965 was under supervision of the writer. Participants in the program were Messrs. Bert King, Thomas Schroeder and Donald Whelan.

CLIMATOLOGICAL DATA

Climatological data has been collected since the inception of the program in 1955. Collection of this data has been continued and, in addition, data has been gathered on velocity, flow and river bottom contour since 1963. Severe weather conditions in 1965 may have caused a delay in timing of the seaward outmigration of red salmon smolts.

Water Level Recording

Comparable water level recordings are not available for the past two years. The relative water level and its changes during the smolt enumeration season are illustrated in Figure 2.

A large snow pack on the west side of the Aleutian Mountain range and below average air temperatures in May and June resulted in a slow buildup of the water level, which peaked on June 19 at 11.8 inches.

The high water level and almost constant high winds in 1965 resulted in difficulty in setting and retrieving the fyke nets. On several occasions gale force winds of 60 to 70 mph made adherence to the evening fishing schedule impossible. More fishing hours were missed in 1965 than the previous two seasons combined.

Velocity and Flow

Measurements of current velocity were made throughout the season at each of the five fyke net fishing sites. It was found that current velocity was greatest at fishing sites No. 2 and 3 and least at site No. 5. Current velocity data for two comparable years are shown below:

	<u>1962</u>	<u>1965</u>
Fishing Site - 1	3.5	3.8
Fishing Site - 2	4.6	4.2
Fishing Site - 3	4.6	4.0
Fishing Site - 4	3.6	3.4
Fishing Site - 5	2.4	2.7

River flow in cubic feet per second was recorded once per week. Maximum

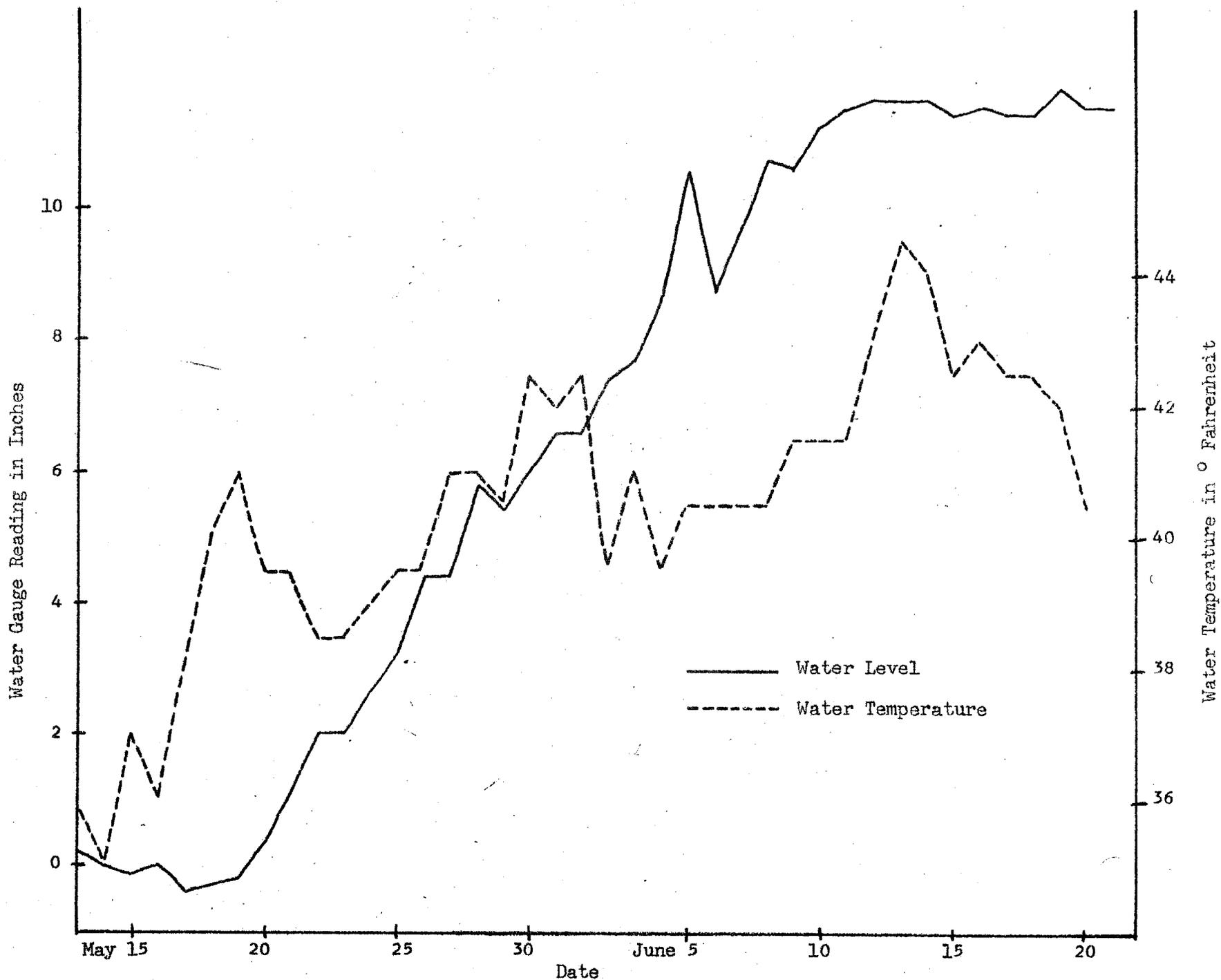


Figure 2.--Ugashik River water level and water temperature in °F., 1965.

flows reached approximately 4,650 cubic feet per second on June 14 of 1965 while the minimum flow of 1,870 cubic feet per second was recorded on May 22 of 1964. Comparisons of flows for 1964 and 65 are not possible because different water level base markers were used each year.

Water Temperature

Daily water temperatures have been recorded at the index net site since 1960. In 1965 the smolt outmigration did not begin until the lake outlet water temperature reached 40^o F on May 18 (Figure 2). Past records indicate a significant correlation between the beginning of the seasonal outmigration and water temperatures at the lake outlet (Table 1).

OUTMIGRATION RESULTS

Timing of the Outmigration

Smolt catches during the index hours (10 p.m. to 1 a.m.) followed the same pattern as in previous years (Table 2). Migration was highest during the first hour (41.9 percent) and decreased during the second and third index hours (36.1 and 22.0 percent respectively).

The 24-hour sampling count conducted throughout the season revealed that over 44 percent of the smolts were caught during the index hours, 10 p.m. to 1 a.m. and that 79 percent of the smolts were caught during the random sampling hours, 9 p.m. through 2 a.m. (Table 3). These percentages closely parallel the data obtained in 1964 (Nelson, 1965).

Daily index net catches indicated an erratic migration pattern (Figure 3). The peak index net catch was made on June 1 when 26,163 smolt were caught (Table 2).

Abundance of Smolt

The total index net catch of red salmon smolts during the index hours for the entire season was 172,893 (Table 2). Using 1958 as the base year with the assigned value of 100.00 index points, the 1965 season index net catch was equivalent to 57.40 index points (Tables 2 and 7).

The random sampling smolt catch for the entire season was 62,917 (Table 4). As in previous years the majority of the fish taken in the random sampling scheme were caught in site numbers 3 and 4 (Table 4). Site 4 caught 43.5 percent of the random catch while site 3 caught 26.6 percent (Table 4).

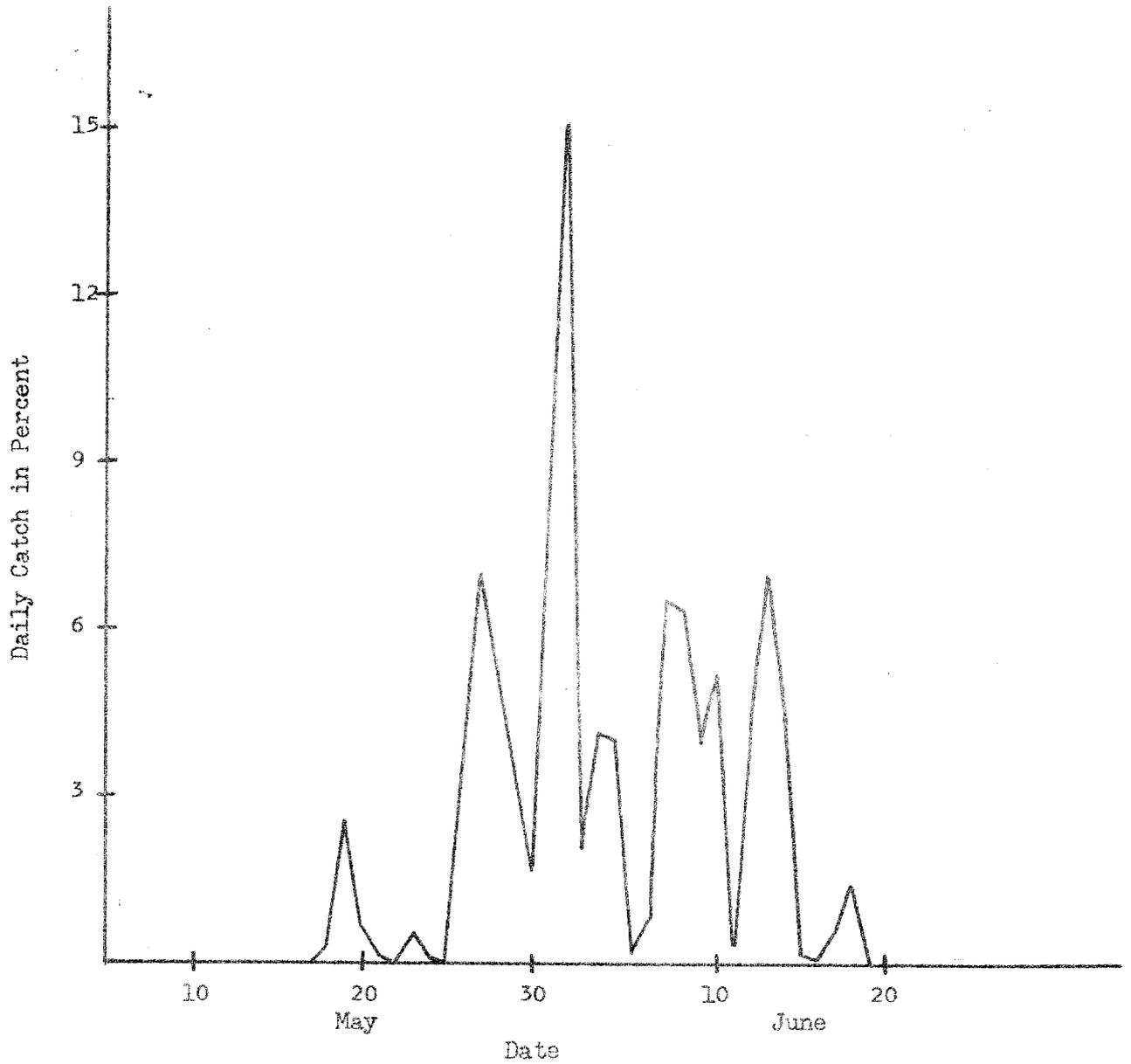


Figure 3.--Daily index net catches of red salmon smolt in percent of total index net catch, Ugashik River system, 1965.

Applying the method of determining estimates of total outmigration (Nelson, 1965), the estimate of the total smolt outmigration for 1965 was calculated to be 3,640,115 (Table 7). The index smolt catch and the total outmigration estimate are compared in Figure 4.

Size and Age Composition

Length frequencies, weight and age data were grouped into 5-day periods (except for the first period) extending from May 13 through June 20. The number of smolt caught in the index net 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 5.

Size composition was determined from length measurements of 3,296 smolts contained in 71 one-pound samples. Age determination was based on readings of 520 scales contained in 26 daily scale samples (Table 5).

The season's unweighted length frequency is shown in Figure 5.

The percentage and mean length and weight of each age group were calculated for each period then for the entire season by weighting the daily samples by the daily catches they represented to adjust for changes during the season in the magnitude of the catches (Table 6). Age I smolt (fish that have spent one winter in freshwater) comprised 28.8 percent of the total run and averaged 93.7 mm in length and 6.9 grams in weight; Age II smolt (fish that have spent two winters in freshwater) comprised 71.2 percent of the run and averaged 114.1 mm in length and 12.5 grams in weight (Table 6).

Table 7 summarizes the comparative age, length, index points, index net catches and outmigration estimates for the years 1956 through 1965.

Condition Index of Smolt

The condition index of the 1965 smolt run was calculated on the basis of weight per fish of a given length. Eight 2 to 3 pound condition samples totaling 799 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 average weight per fish was calculated and compared to similar data taken in 1965 (Table 8).

Average length and weight of both smolt age groups, as compared to the previous 7 years, is shown in Table 9. The 1965 smolt were larger and weighed considerably more than the 8-year mean (Table 9).

The relationship between the length and weight of the 1964-65 smolt is shown in Figure 6.

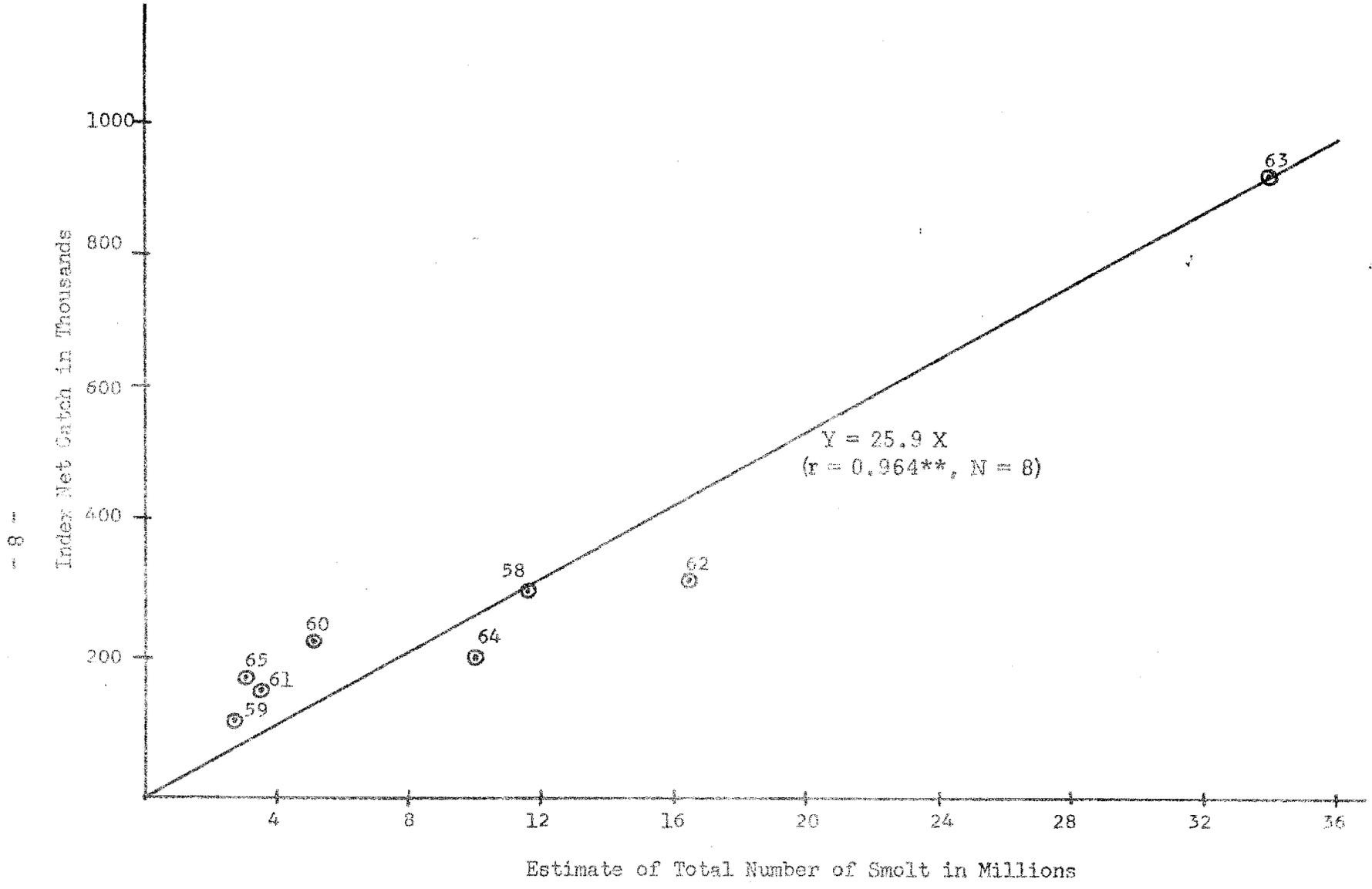


Figure 4.--Annual index net catch and estimate of total smolt outmigration, Ugashik River system, 1958-65.

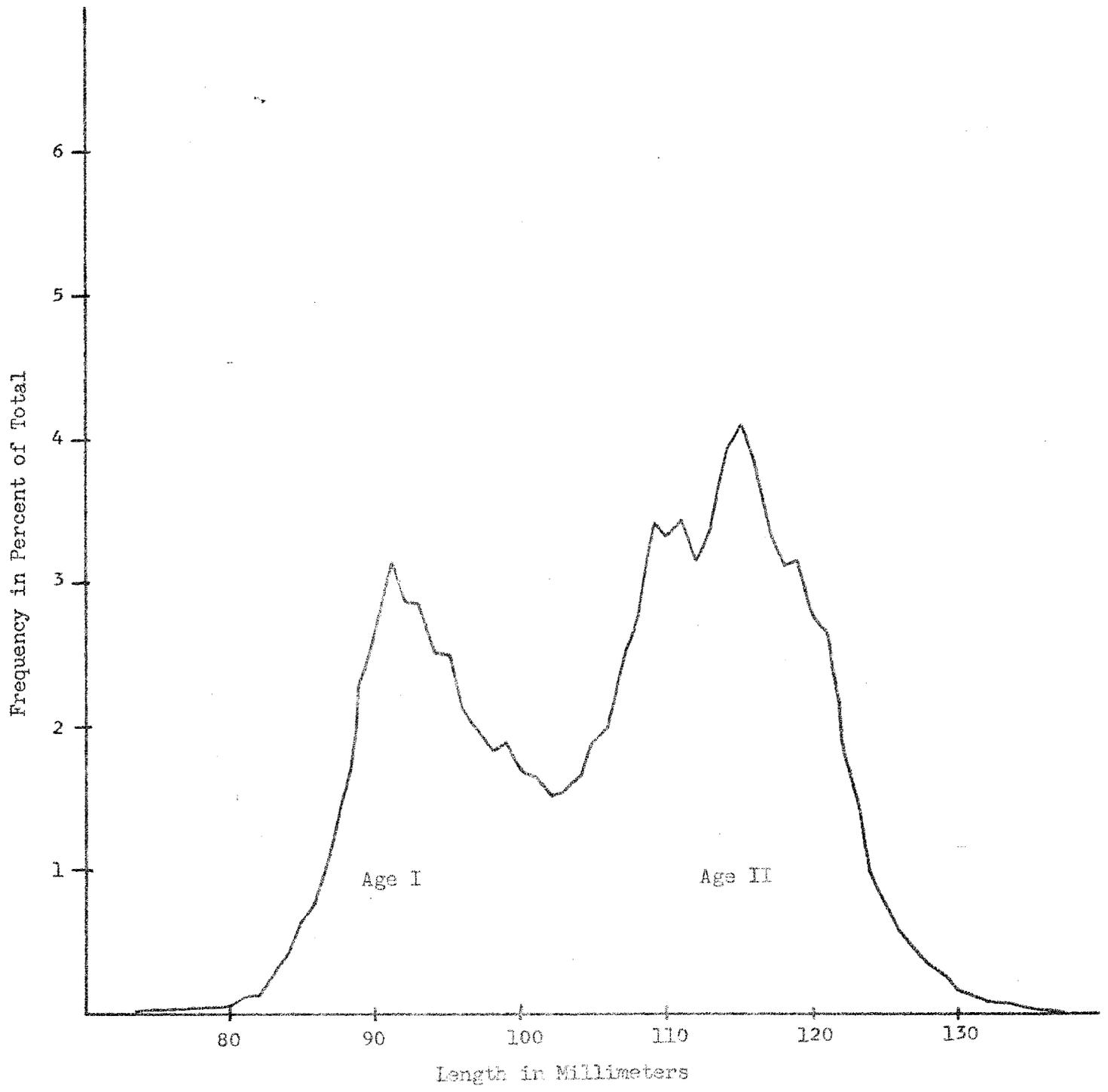


Figure 5.--Season's unweighted length frequency of red salmon smolt from the Ugashik River system, 1965. (Frequencies smoothed by moving averages of threes.)

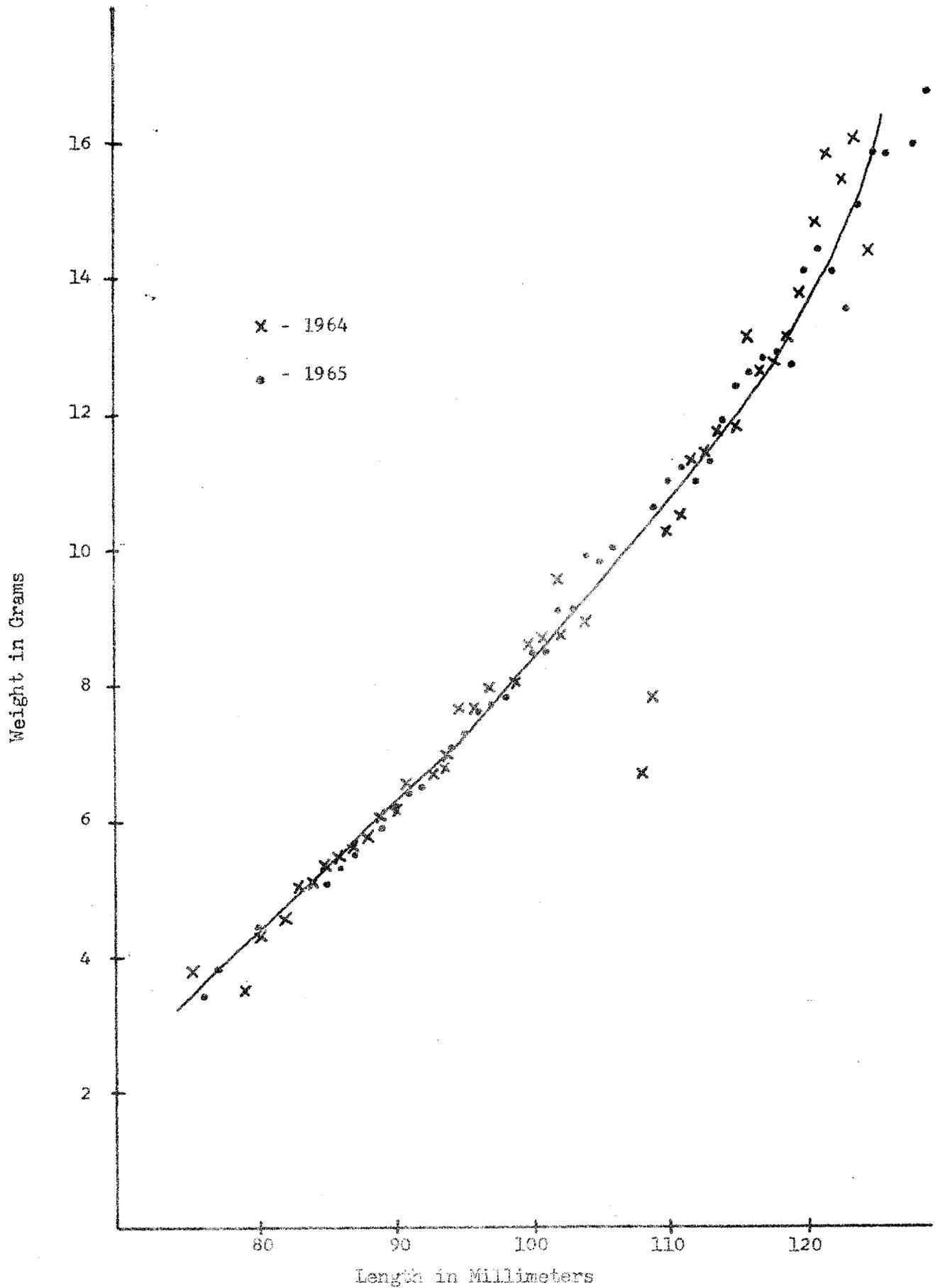


Figure 6.--Length-weight relationship of red salmon smolt from the Ugashik River system, 1964-65.

Smolt Production Versus Escapement Levels

The 1965 smolt run originated from adult spawning escapements of 255,426 in 1962 and 388,254 in 1963.

The 1962 escapement of 255,426 produced 71.2 percent of the outmigration, with the remainder being derived from the 1963 escapement. The number of smolt arising from specific brood years has varied from 4.0 million smolt from a parent 1959 escapement of 219,228 to 31.6 million smolt from a parent escapement of 2,304,200 in 1960 (Table 10).

SURVIVAL

Freshwater and marine survival rates were first included in the Ugashik smolt series by Nelson (1965). These data were of a preliminary nature because of lack of egg fecundity data for the Ugashik system. Egg fecundity data collected in 1965 has been used in the data interpretation for this report and all preliminary figures have been revised.

Tables 11, 12 and 13 present the freshwater and marine survival data. Figure 7 shows the relationship between the average length of smolt at outmigration and the consequent marine survival. With the exception of the Age I smolt from the 1956 brood year, the larger Age II smolt consistently show better marine survival than the smaller Age I smolt.

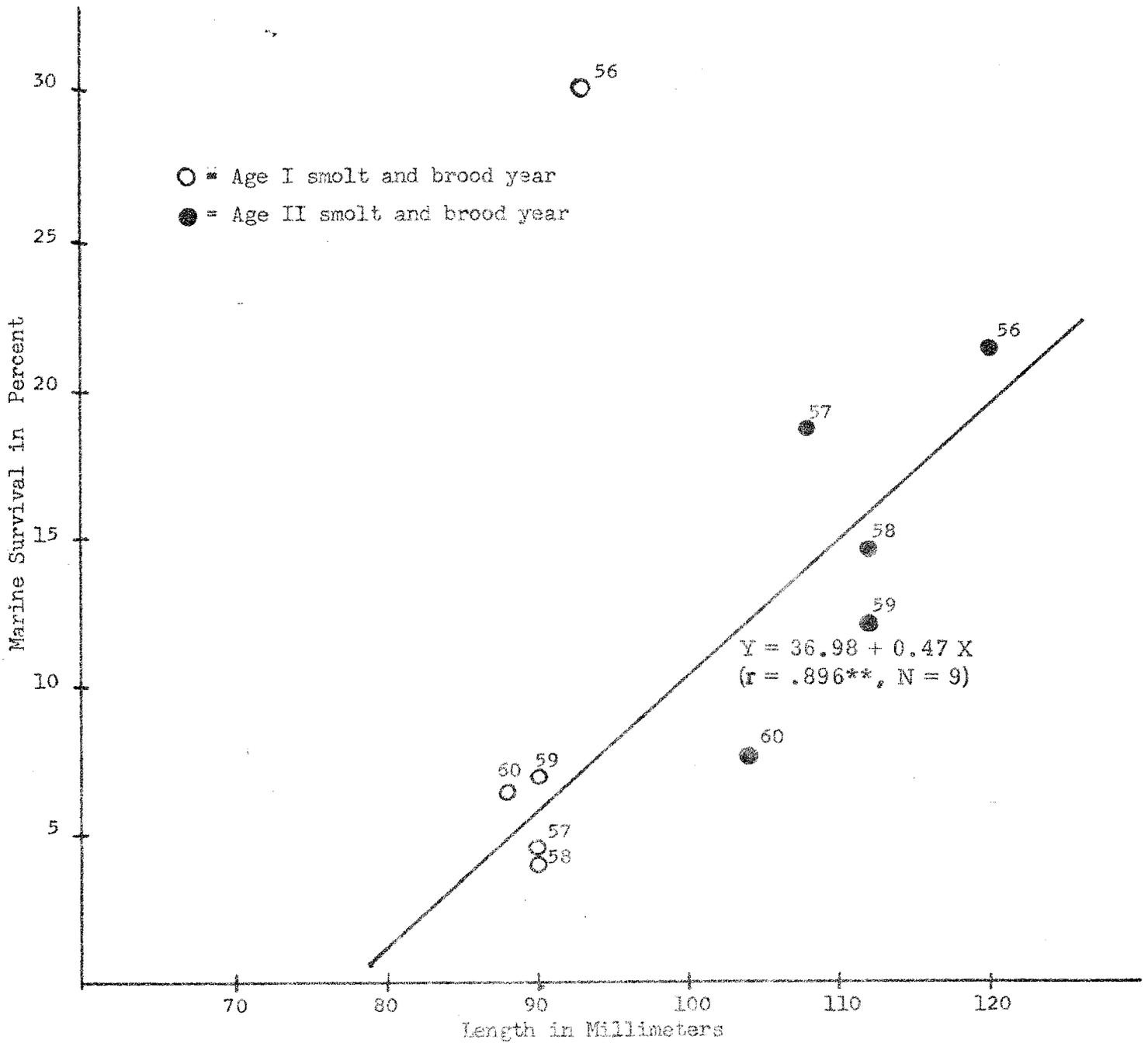


Figure 7.--Marine survival of red salmon smolts by freshwater age group in the Ugashik River system, 1956-60.

LITERATURE CITED

Alaska Department of Fish and Game. 1966a. Bristol Bay Red Salmon, 1965. A Compilation of the Catch and Escapement Data. Informational Leaflet #75, 115 p.

----- . 1966b. Annual Management Report for 1965. Division of Commercial Fisheries, Bristol Bay.

Nelson, Michael L. 1965. Abundance, Size, Age and Survival of Red Salmon Smolts from the Ugashik Lakes System, Bristol Bay, 1964. Alaska Department of Fish and Game, Informational Leaflet #62, 34 p.

APPENDIX

Table 1. Water Temperature and Date of Beginning of Ugashik River Red Salmon Smolt Migration Peak, 1960--65.

Year	Beginning Date of Migration Peak	Ugashik River Water Temperatures, °F
1960	May 22	40°
1961	May 15	39°
1962	May 14	41°
1963	May 16	38°
1964	May 25	38°
1965	May 18	40°

Data source: Nelson, 1965

Table 2. Ugashik River Red Salmon Smolt Catch in Index Net
By Hour and Day, 1965.

Date	Index Hours			Total Index Catch		Index Points	
	10-11 p.m.	11 p.m.-12 mn.	12 mn.-1 a.m.	Daily	Cumulative	Daily	Cumulative
May 13	0	0	0	0	0	0.00	0.00
14	0	0	1	1	1	0.00	0.00
15	0	0	1	1	2	0.00	0.00
16	0	0	0	0	2	0.00	0.00
17	4	4	9	17	19	0.01	0.01
18	51	365	284	700	719	0.23	0.24
19	1,821	1,742	952	4,515	5,234	1.50	1.74
20	496	291	464	1,251	6,485	0.42	2.16
21	47	42	185	274	6,759	0.09	2.25
22	9	10	3	22	6,781	0.01	2.26
23	304	372	406	1,082	7,863	0.36	2.62
24	196	43	6	245	8,108	0.08	2.70
25	60	39	26	125	8,233	0.04	2.74
26	3,455	2,671	796	6,922	15,155	2.30	5.04
27	3,598	5,146	3,648	12,392	27,547	4.11	9.15
28	(1,982) <u>2/</u>	(3,596) <u>2/</u>	(3,224) <u>2/</u>	(8,802) <u>2/</u>	36,349	2.92	12.07
29	366	2,045	(2,799) <u>2/</u>	5,210	41,559	1.73	13.80
30	8	938	2,288	3,234	44,793	1.07	14.87
31	6,954	1,896	1,839	10,689	55,482	3.55	18.42
June 1	11,783	8,840	5,540	26,163	81,645	8.68	27.10
2	1,062	971	1,680	3,713	85,358	1.23	28.33
3	1,844	3,707	1,729	7,280	92,638	2.42	30.75
4	3,060	2,872	1,237	7,169	99,807	2.38	33.13
5	167	59	163	389	100,196	0.13	33.26
6	145	537	869	1,551	101,747	0.51	33.77
7	5,809	4,193	1,225	11,227	112,974	3.73	37.50
8	4,051	4,825	2,080	10,956	123,930	3.64	41.14
9	2,560	3,662	864	7,086	131,016	2.35	43.49
10	7,252	1,171	880	9,303	140,319	3.09	46.58
11	10	226	324	560	140,879	0.19	46.77
12	2,403	3,027	2,128	7,558	148,437	2.51	49.28
13	7,000	3,722	1,560	12,282	160,719	4.08	53.36
14	3,423	3,933	691	8,047	168,766	2.67	56.03
15	185	77	16	278	169,044	0.09	56.12

Table 2. Ugashik River Red Salmon Smolt Catch in Index Net
By Hour and Day, 1965 (Continued)

Date	Index Hours			Total Index Catch		Index Points ^{1/}	
	10-11 p.m.	11 p.m.-12 mn.	12 mn.-1 a.m.	Daily	Cumulative	Daily	Cumulative
June 16	1	30	1	32	169,076	0.01	56.13
17	738	342	35	1,115	170,191	0.37	56.50
18	1,617	1,008	73	2,698	172,889	0.90	57.40
19	0	3	0	3	172,892	0.00	57.40
20	0	0	1	1	172,893	0.00	57.40
Total	72,461	62,405	38,027	172,893	172,893	57.40	57.40
Percent	41.91	36.10	21.99	100.00			

^{1/} One index point = 3,012.32 smolt

^{2/} Figures appearing in parenthesis are interpolated estimates

Table 3. Ugashik River Red Salmon Smolt Catch in Index Net Over 24-Hour Period, 1965.

Time Period	Date											Total	Percent
	May 15-16	May 20-21	May 25-26	May 27-28	May 30-31	June 2-3	June 8-9	June 9-10	June 12-13	June 14-15	June 19-20		
10-11 p.m.	0	496	60	3,598	8	1,062	4,051	2,560	2,403	3,423	0	17,661	14.31
11-12 mn.	0	291	39	5,146	938	971	4,825	3,662	3,027	3,933	3	22,835	18.50
12 mn.-1 a.m.	1	464	26	3,648	2,288	1,680	2,080	864	2,128	691	0	13,870	11.24
1 - 2 a.m.	0	1,226	31	3,310	1,186	1,365	959	459	1,586	355	1	10,478	8.49
2 - 3:30 a.m.	0	1,013	12	787	347	400	217	163	451	89	1	3,480	2.82
3:30 a.m.-5 a.m.	0	58	0	3	8	45	28	15	4	28	0	189	0.15
5 - 6:30 a.m.	0	0	1	3	0	14	0	6	70	0	0	94	0.08
6:30 a.m.-8 a.m.	0	1	1	1	464	359	150	13	1,857	4	0	2,850	2.31
8 - 9:30 a.m.	0	0	0	0	233	10	5	594	(299) ^{1/}	4	0	1,145	0.93
9:30 a.m.-11 a.m.	0	1	2	26	2	3	81	490	(261)	31	0	897	0.73
11 a.m.-12:30 p.m.	0	0	90	231	96	7	88	(59) ^{1/}	(59)	22	0	652	0.53
12:30 p.m.-2 p.m.	0	0	0	24	146	0	0	(19)	(19)	0	0	208	0.17
2-3:30 p.m.	0	0	0	140	334	7	45	(26)	7	25	0	584	0.47
3:30 - 5 p.m.	0	0	0	106	975	148	78	(41)	4	0	0	1,352	1.10
5 - 6:30 p.m.	0	0	0	38	44	85	180	(165)	150	0	0	662	0.54
6:30 - 8 p.m.	0	0	0	616	95	272	322	(1,552)	2,782	0	0	5,639	4.57
8 - 9 p.m.	0	7	0	347	1,796	310	3,007	(2,078)	1,148	0	0	8,693	7.04
9 - 10 p.m.	0	7	453	6,065	4,004	13,299	3,600	2,397	1,697	592	0	32,114	26.02
Total	1	3,564	715	24,089	12,964	20,037	19,716	15,163	17,952	9,197	5	123,403	100.00

^{1/} Figures appearing in parenthesis are interpolated estimates.

Table 4. Ugashik River Red Salmon Smolt Catches
in the Random Sampling Scheme by Fishing
Site, 1965.

Date	Random Sampling Sites					Total Catch
	1	2	3	4	5	
May 13	0	0	0	0	0	0
14	0	0	0	0	0	0
16	0	0	0	0	0	0
17	0	3	3	8	0	14
18	5	11	62	196	230	504
19	164	247	520	566	975	2,472
21	8	37	100	47	25	217
22	0	2	192	3	5	202
23	28	16	97	473	213	827
24	1	1	167	43	2	214
26	26	700	186	453	1,233	2,598
27	43	1	9,534	3,648	585	13,811
28	-	-	-	-	338	338
29	1	-	-	366	348	715
31	1	53	139	1,896	1,625	3,714
June 1	32	43	665	2,752	1,800	5,292
2	3	3,572	1,341	971	823	6,710
3	7	5	11	811	4,004	4,838
6	0	7	28	869	56	960
7	2	5	7	1,225	341	1,580
8	2	2	529	4,825	211	5,569
10	4	2	258	2,397	198	2,859
11	0	8	260	60	69	397
12	2	0	20	2,403	30	2,455
13	2	-	762	1,560	614	2,938
15	0	0	-	16	0	16
16	5	4	1,460	1	2	1,472
17	0	0	77	738	0	815
18	1	0	312	1,008	9	1,330
20	0	56	2	0	2	60
Total	337	4,775	16,732	27,335	13,738	62,917
Percent	0.54	7.59	26.59	43.45	21.83	100.00

Table 5. Ugashik River Red Salmon Smolt Sampling Data, 1965.

Period Number	Date	Index Smolt Catch	Percent of Season's Total	No. of 1 lb. Samples Measured	No. of Fish Measured	No. of Scales Read
1	May 13-21	6,759	3.91	9	427	80
2	May 22-26	8,396	4.86	6	239	40
3	May 27-31	40,327	23.32	8	321	60
4	June 1-5	44,714	25.86	15	634	100
5	June 6-10	40,123	23.21	15	655	100
6	June 11-15	28,725	16.61	13	716	100
7	June 16-20	3,849	2.23	5	304	40
Total		172,893	100.00	71	3,296	520

Table 6. Age, Length and Weight of Red Salmon Smolts by Sampling Period from the Ugashik River System, 1965.

Period No.	Date	Line Dividing Age I & Age II	Mean Length in mm		Mean Weight in grms.		Percentage of Age Group	
			I	II	I	II	I	II
1	May 13-21	99.5	94.0	110.4	7.6	11.4	16.0	84.0
2	May 22-26	99.5	95.1	112.2	6.8	12.3	11.7	88.3
3	May 27-31	100.5	94.8	114.4	6.7	12.1	15.0	85.0
4	June 1-5	100.5	93.8	114.1	6.7	12.5	16.3	83.7
5	June 6-10	102.5	93.4	115.1	7.1	13.3	32.7	67.3
6	June 11-15	103.5	93.3	114.3	7.1	12.2	63.1	36.9
7	June 16-20	104.5	92.7	112.3	7.3	12.7	83.2	16.8
Season's Weighted Total			93.7	114.1	6.9	12.5	28.8	71.2

Note: Age I and II denotes number winters in freshwater. Season total weighted by index net catch.

Table 7. Comparative Age, Length, Index Net Catches and Outmigration Estimates of Red Salmon Smolt from the Ugashik River System, 1955-65.

Year of Seaward Migration	Age I		Age II		Index Points	Index Net Catch	Outmigration Estimate
	Percent	Mean Length in mm.	Percent	Mean Length in mm.			
1956	11.0	-	89.0	-	-	-	-
1957	4.0	-	96.0	-	-	-	-
1958	98.1	93.0	1.9	112.0	100.0	301,232	11,659,905
1959	87.3	90.0	12.7	120.0	36.5	109,982	2,887,002
1960	59.7	90.0	39.3 ^{1/}	108.0	75.1	226,317	5,503,646
1961	20.4	90.0	79.6	112.0	52.3	157,441	3,802,079
1962	80.7	88.0	19.3	112.0	103.1	310,616	16,692,089
1963	46.3	89.8	53.7 ^{1/}	104.3	305.2	919,451	33,750,496
1964	80.1	92.2	19.8 ^{1/}	118.3	68.1	205,145	9,990,048
1965	28.8	93.7	71.2	114.1	57.4	172,893	3,640,115
Average	51.6	90.8	48.3	112.6	97.1	300,385	10,990,673

Data Source: Nelson, 1965

Note: Age Group I and II denotes number winters in freshwater.
Age and length weighted by index catch.

^{1/} 1.0 percent Age III in 1960; 0.1 percent Age III in 1963 and 1964.

Table 8. Condition Index of Red Salmon Smolt from the Ugashik River System
Using 3 mm. Length Groups, 1964-65.

Mid-Point of 3 mm. Groupings	Grams Per Fish - 1965							Mean Average	
	May 13-21	May 22-26	May 27-31	June 1-5	June 6-10	June 11-15	June 16-20	1964	1965
70	-	-	-	-	-	-	-	2.96	-
73	-	-	-	-	-	-	-	3.15	-
76	-	-	-	-	-	-	-	3.98	-
79	-	-	-	-	3.85	-	-	4.10	3.85
82	-	-	3.85	-	-	-	-	4.72	3.85
85	-	-	-	4.65	5.28	5.59	5.40	5.32	5.34
88	-	5.50	5.18	5.87	5.95	5.77	6.29	5.77	5.92
91	5.60	-	6.24	6.18	7.53	6.43	6.90	6.03	6.70
94	7.04	6.86	6.97	6.89	7.24	6.95	7.55	6.88	7.19
97	7.85	7.83	10.03	7.60	7.48	7.80	8.15	7.47	7.79
100	10.39	8.79	8.17	7.96	8.68	8.66	8.93	8.11	8.96
103	8.49	8.74	9.14	9.47	9.24	9.25	9.87	9.53	9.06
106	10.25	9.37	9.53	10.00	9.62	9.80	9.34	9.62	9.84
109	12.76	10.51	10.64	10.52	12.80	10.47	10.65	10.29	11.15
112	11.17	11.42	11.30	11.52	11.54	11.85	13.30	10.84	11.51
115	12.20	11.22	11.96	12.49	12.97	12.46	13.70	11.65	12.23
118	12.96	13.26	13.14	13.42	13.51	13.44	13.82	13.63	13.34
121	14.00	17.08	14.42	14.41	13.93	14.34	14.14	14.10	14.52
124	-	15.28	15.21	15.56	15.05	15.10	-	15.07	15.30
127	-	15.95	16.60	16.46	15.96	16.17	15.80	15.80	16.22
130	-	19.65	-	-	-	16.83	-	17.96	18.25
133	-	-	-	-	18.74	-	-	19.11	18.74
136	-	-	-	-	18.70	-	-	-	18.70

Table 9. Average Length and Weight of Ugashik River Red Salmon Smolts by Freshwater.

Age Group, 1958-65^{1/}

Year of Seaward Migration	Age I		Age II	
	Length	Weight	Length	Weight
1958	93.0	6.4	112.0	11.7
1959	90.0	6.1	120.0	13.5
1960	90.0	6.6	108.0	11.0
1961	90.0	6.7	112.0	12.2
1962	88.0	6.1	112.0	12.3
1963	89.8	6.1	104.3	9.6
1964	92.2	6.9	118.3	12.7
1965	93.7	6.9	114.1	12.5
Mean Average	90.8	6.5	112.6	11.9

Data Source: Nelson, 1965

^{1/} Weighted by index catch

Table 10. Ugashik River Red Salmon Escapements and Smolts Produced, 1956-1963.

Brood Year	Ugashik River Escapement	Millions of Smolts Produced			
		Age I	Age II	Age III	Total
1956	425,295	11.4	0.4	.01	11.9
1957	214,802	2.5	2.2	-	4.7
1958	279,546	3.3	3.0	-	6.3
1959	219,228	0.8	3.2	-	4.0
1960	2,304,200	13.5	18.1	-	31.6
1961	348,639	15.6	2.0	-	17.6
1962	255,426	8.0	2.6	-	10.6
1963	388,254	1.0	<u>1</u> / ₁	-	

Data Source: Nelson, 1965

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

Table 11. Egg Potential in Millions by Small and Large Adult Red Salmon in the Ugashik River System, 1956-62.

Brood Year	Spawning Escapement	Percent Females	No. Females	Percent Females		No. Females		Av. Egg Fecundity		Egg Potential		Millions Total
				Small	Large	Small	Large	Small	Large	Small	Large	
1956	425,295	52.0	221,153	90.9	9.1	201,028	20,125	3,820	4,580	767.9	92.2	860.1
1957	214,802	53.0	113,845	54.8	45.2	62,387	51,458	3,820	4,580	238.3	235.7	474.0
1958	279,546	53.1	148,512	64.1	35.9	95,196	53,316	3,820	4,580	363.6	244.2	607.8
1959	219,228	61.3	134,280	52.9	47.1	71,034	63,246	3,820	4,580	271.3	289.7	561.0
1960	2,304,200	52.2	1,202,792	99.5	0.5	1,196,778	6,014	3,820	4,580	4,571.7	27.5	4,599.2
1961	348,639	67.3	234,775	6.8	93.2	15,965	218,810	3,820	4,580	61.0	1,002.1	1,063.1
1962	255,426	48.3	123,389	86.4	13.6	106,608	16,781	3,820	4,580	407.2	76.9	484.1

Data Source: A.D.F.G., 1966a., 66b.

Note: "Small" designates fish that have spent 1 or 2 winters in ocean; "Large" designates fish that have spent 3 or more winters in ocean.

Table 12. Freshwater and Marine Survival of Red Salmon Smolts from the Ugashik River System, 1956-62.

Brood Year	Spawning Escapement	Egg Potential (Millions)	Smolts Produced (Millions)	Freshwater Survival % Egg to Smolt	Total Adult ^{1/} Salmon Return	Marine Survival % Smolt to Adult	Total Survival % Egg to Adult
1956	425,295	860.1	11.9	1.38	3,575,144	30.14	0.42
1957	214,802	474.0	4.7	0.99	527,438	11.26	0.11
1958	279,546	607.8	6.3	1.04	591,382	9.37	0.10
1959	219,228	561.0	4.0	0.71	445,593 ^{2/}	11.05	0.08
1960	2,304,200	4,599.2	31.6	0.69	2,260,792 ^{3/}	7.15 ^{3/}	0.05
1961	348,639	1,063.1	17.6	1.66			
1962	255,426	484.1	10.6	2.19			
Average	578,162	1,235.6	12.4	1.25 ^{3/}		12.05 ^{3/}	0.11 ^{3/}

Data Sources: Nelson, 1965 and A.D.F.G., 1966a., 66b.

^{1/} Catch and escapement

^{2/} Preliminary pending adult return of 7 year-old fish in 1966.

^{3/} Preliminary pending adult return of 6 year-old fish in 1966 and 7 year-old fish in 1967.

Table 13. Marine Survival of Red Salmon Smolts by Freshwater Age Group in the Ugashik River System, 1956-1960.

Brood Year	Millions of Smolts Produced		Mean Length in mm.		Total Adult Return ^{1/} by Freshwater Age		Marine Survival % Smolt to Adult	
	Age I	Age II	Age I	Age II	Age I ^{2/}	Age II ^{3/}	Age I	Age II
1956	11.4	0.5	93	120	3,485,037	90,107	30.47	21.37
1957	2.5	2.2	90	108	119,713	407,725	4.75	18.85
1958	3.3	3.0	90	112	146,148	445,234	4.45	14.71
1959	0.8	3.2	90	112	50,616	394,977 ^{4/}	6.53	12.13 ^{4/}
1960	13.5	18.1	88	104	866,442 ^{5/}	1,394,350 ^{5/}	6.43 ^{5/}	7.69 ^{5/}
Average	6.3	5.4	90	111			7.71 ^{6/}	14.09 ^{6/}

Data Sources: Nelson, 1965. A.D.F.G., 1966a., 66b.

Note: Age Group I and II denotes number winters in freshwater.
Age III smolts included with Age II.

- ^{1/} Includes both catch and escapement.
- ^{2/} Includes Age 0 fish.
- ^{3/} Includes Age III fish.
- ^{4/} Preliminary pending adult return of 7 year-old fish in 1966.
- ^{5/} Preliminary pending adult return of 6 year-old fish in 1966 and 7 year-old fish in 1967.
- ^{6/} Geometric mean.

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