

Informational Leaflet **151**

FORECAST OF THE 1971 CHIGNIK SYSTEM RED SALMON RUN

By:

Paul C. Pedersen
Division of Commercial Fisheries
Kodiak, Alaska

and

Duane Petersen
Division of Commercial Fisheries
Kodiak, Alaska

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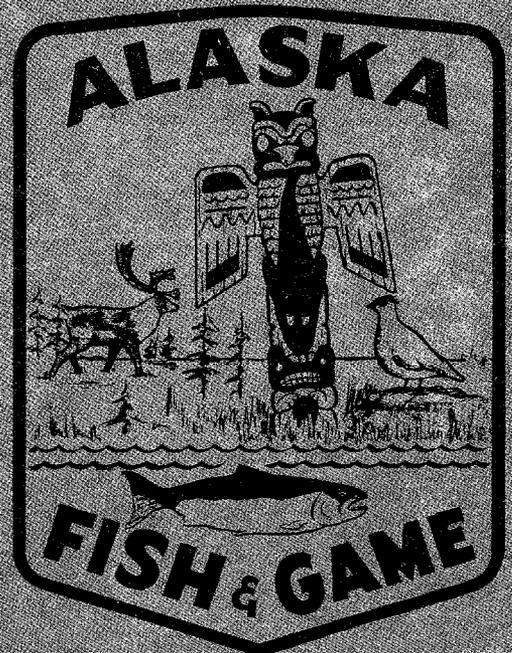


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By

Paul C. Pedersen, Area Management Biologist
Alaska Department of Fish and Game
Division of Commercial Fisheries
Kodiak, Alaska

and

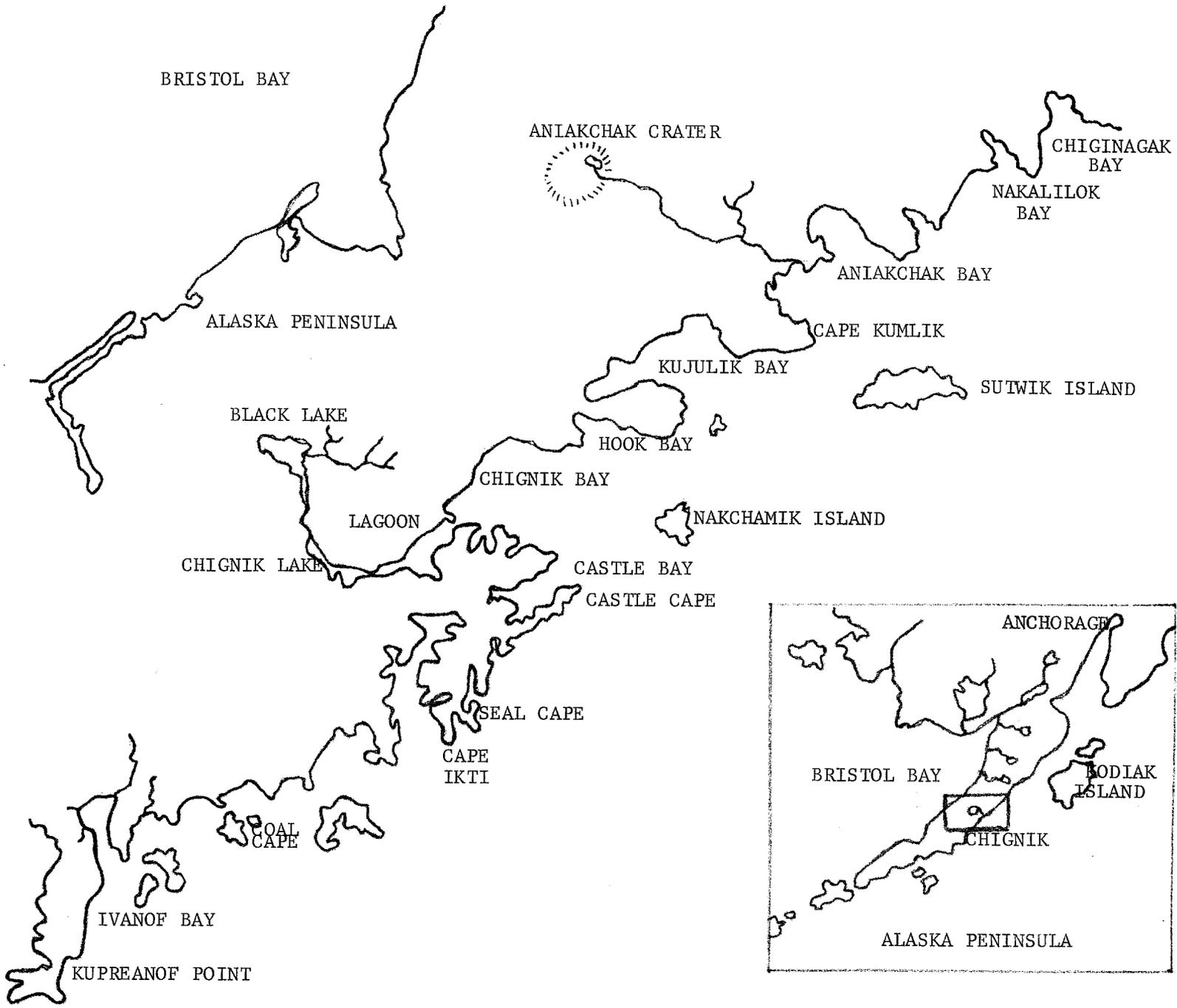
Duane Petersen, Assistant Area Management Biologist
Alaska Department of Fish and Game
Division of Commercial Fisheries
Kodiak, Alaska

INTRODUCTION

The Chignik River system, located on the south side of the Alaska Peninsula, consists of two lakes which drain into Chignik Lagoon (Figure 1). Black Lake, Chignik Lake and their tributaries have, in the past, provided spawning and rearing areas for total annual runs in excess of four million red salmon. During the past ten years, however, the returns have averaged approximately one million fish. Total annual returns, commercial harvests and escapements for the period 1950-70 are presented in Appendix Table 1.

The red salmon run into this system is composed of two distinct runs. An early run enters the Lagoon starting in early June and peaks toward the end of June. These fish are bound primarily for the spawning grounds of Black Lake and Black River tributaries. The majority of the Black Lake fry normally stay one year in fresh water. A late run enters the Lagoon late in June and peaks toward the end of July. The majority of these fish spawn on the shoals of Chignik Lake with the remainder spawning in the Chignik Lake and Black River tributaries. Chignik Lake red salmon normally spend two years in fresh water.

In order to separate the two distinct runs, an adult tagging program was carried out from 1962 to 1969. Figure 2 shows an average time of entry curve for the Chignik River system. The daily percentage of early and late run fish obtained from this tagging is used as an aid in managing the fishery.



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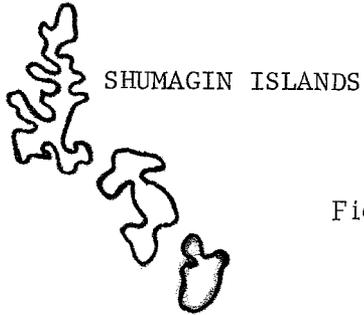


Figure 1. Chignik River sockeye salmon systems.

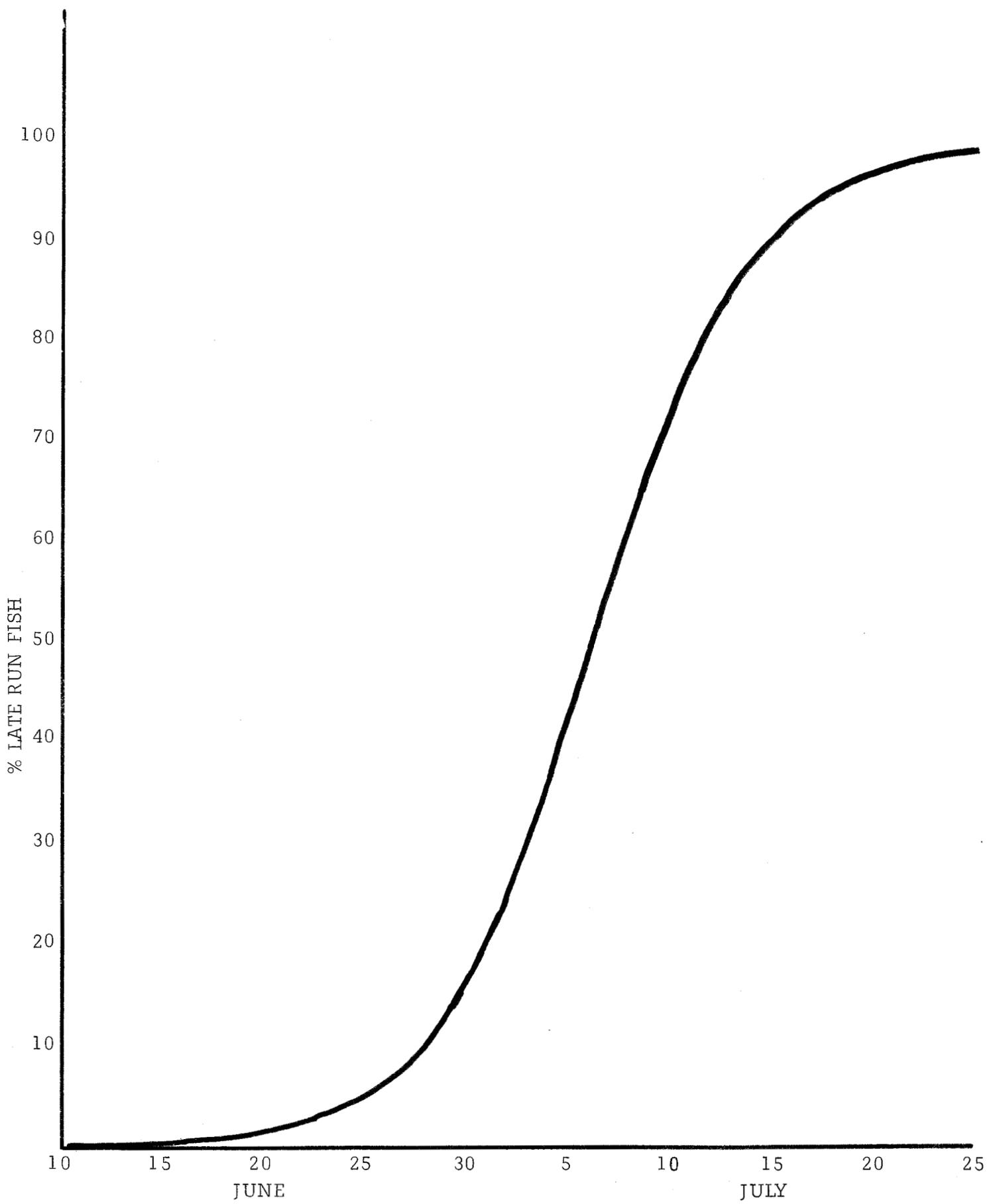


Figure 2. Chignik River red salmon average time of entry curve 1962-1969 tagging data.

During the annual spawning migration the Alaska Department of Fish and Game monitors daily escapements with the aid of a weir which is constructed across the Chignik River. Sampling of the commercial catch provides age-weight-length data. The majority of the commercial harvest occurs in Chignik Lagoon, however, at times very substantial catches are made in the vicinities of Cape Kumlik and Cape Igvak (Lechner, 1969).

The Department, in cooperation with the Fisheries Research Institute (FRI), University of Washington, has been forecasting Chignik system red salmon runs since 1960. Prior to 1964, the total system run was forecast as one run. However, since 1964, the Black Lake or early run, and the Chignik Lake or late run, have been forecasted separately.

The European system is used for age classification in this report. For example, a 1.2 fish has spent one year in fresh water and two years in salt water. Its total age is four years, as it spent one winter as an egg in the gravel. A 2.2 fish is five years old having spent one winter in the gravel, two years in fresh water and two years in salt water.

The majority of red salmon returning to the Chignik system are of the age classes 1.2, 1.3, 2.2 and 2.3. Fish of the minor age classes 1.1, 2.1, 3.1, 3.3, 1.4 and 2.4 generally contribute less than five percent to the total run. For the purpose of forecasting, only the returns of the primary age class fish are predicted. The minor age classes contribute to the forecast only to the extent that they affect the escapement-return relationship by their inclusion in the total returns.

FORECAST OF THE 1971 BLACK LAKE (EARLY) RETURN

For the purpose of forecasting red salmon returns to the total Chignik system, the Black Lake run (i.e. the early run) is considered to consist of those salmon returning prior to July 1. Some error is introduced by using this method since the two runs overlap in their time of entry. July 1st is chosen as the approximate date when the run changes from being predominantly Black Lake fish to Chignik Lake fish. The assumption is made that the number of early run fish arriving after June 30 is approximately equal to the number of late run fish arriving prior to July 1. This assumption is reasonably well satisfied when the two runs are approximately the same magnitude.

The forecast for the total early run is obtained by estimating the number of .2 ocean fish (fish having reared two years in the ocean) and combining this with the estimate of .3 ocean fish (fish having reared three years in the ocean). Since the .2 ocean fish generally represent only about ten percent of the return,

the accuracy of the total forecast depends primarily on the accuracy of the .3 ocean fish forecast. The basic data used for forecasting these returns is presented in Appendix Table No. 2.

Estimate of the .2 Ocean Fish Return

Because of the relatively small contribution of .2 ocean fish in most years, and because the percentage of .2 ocean fish in the run had not varied greatly, the average return of .2 ocean fish was used in past years as the forecast of .2 ocean fish returns. However, a more accurate result may be obtained by applying an average maturity schedule to estimated total returns from individual brood year escapements.

Total production from brood year escapements is estimated from the spawner-recruit curves in Pedersen and Seibel, 1970. The 1.2 and 2.2 fish returning in 1971 will emanate from the 1967 and 1966 brood years respectively. On the basis of the fitted spawner-recruit curve, total returns of 567,000 and 600,000 salmon respectively are expected from these two brood years. Returns from the brood years 1950-64 have averaged approximately five percent 1.2 and four percent 2.2 red salmon. Therefore, returns of 28,000 1.2 fish and 24,000 2.2 fish are expected from the brood years 1967 and 1966 respectively, resulting in an estimated 52,000 .2 ocean red salmon return to the Black Lake system in 1971.

Estimate of the .3 Ocean Fish Return

The forecast for the return of .3 ocean red salmon has generally been based on their relationship to the number of .2 ocean fish returning the previous year. This data is graphed in Figure 3 and the fitted regression line is shown. 1,137,000 .3 ocean fish are predicted to return to the early system. The preliminary forecast for the 1970 return of .3 ocean fish based on this regression curve called for an unusually high return of approximately 1.7 million fish. A return of such a magnitude had not occurred since 1947. The 1969 return of .2 ocean fish was slightly over two hundred thousand compared with an average of about 30,000. It was thought that possibly this large return of .2 ocean fish was due to an earlier than usual ocean maturation of these fish. The forecast was revised downward considerably, but the return of age .3 fish in 1970 did in fact exceed the original forecast by over a hundred thousand. The fact that the actual return was so close the forecast suggests that the relationship between .2 ocean fish one year and .3 ocean fish the following year does exist even for high returns. The sampling data obtained from the early run in 1963 showed an unusually high return of .2 ocean fish. However, only a small number of samples were taken and the data has been omitted from the regression analysis.

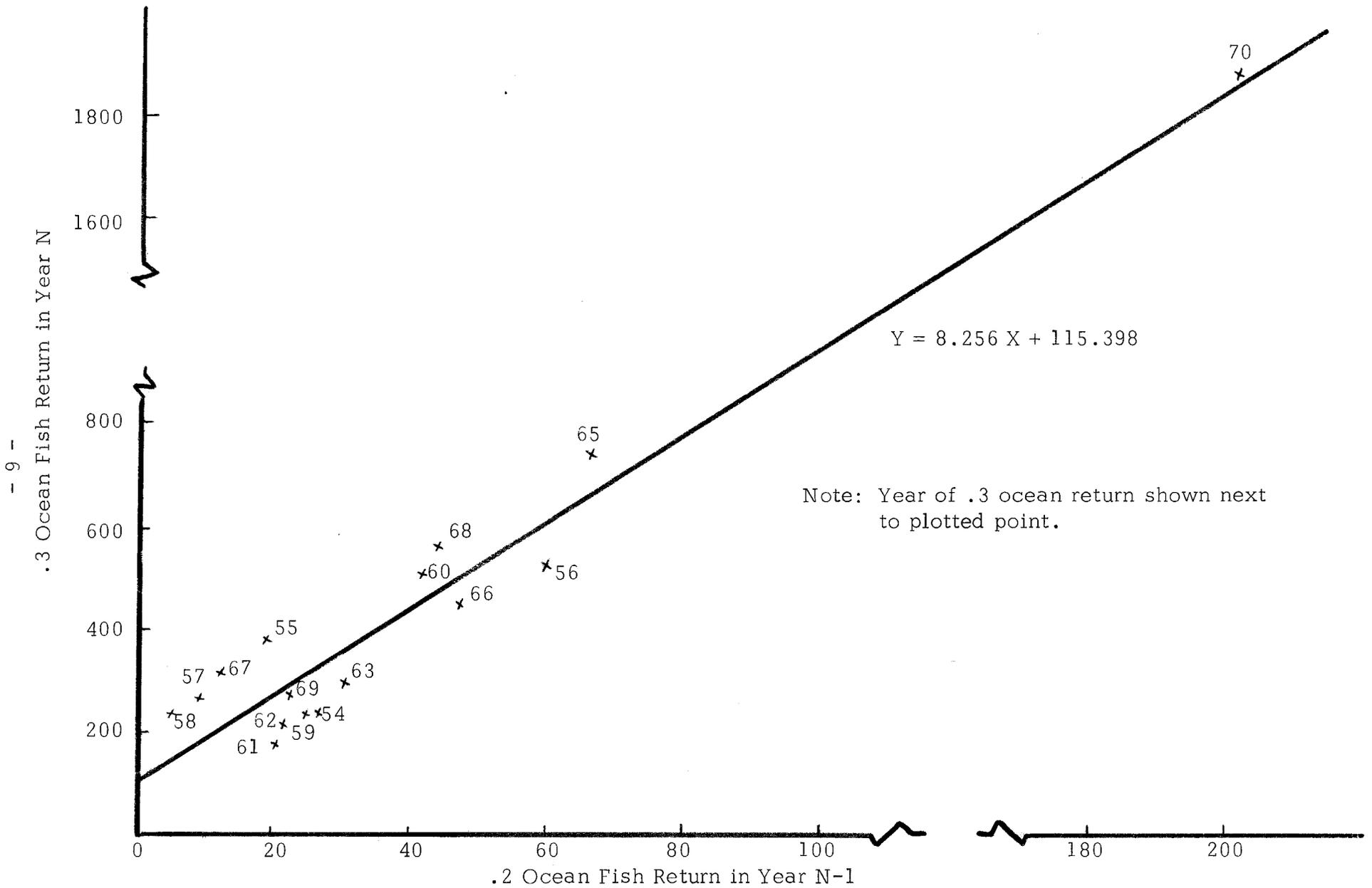


Figure 3. Black Lake (early run) red salmon, relationship between the return of .2 ocean fish in year N-1 and the return of .3 ocean fish in year N. (Number of fish in thousands).

Discussion

The forecast for a return of 1,137,000 .3 ocean and 52,000 .2 ocean fish indicates a probable total return to the Black Lake system of 1,189,000 fish.

FORECAST OF THE 1971 CHIGNIK LAKE (LATE) RETURN

Estimate of the .2 Ocean Fish Return

Red salmon which have reared for two years in the ocean generally constitute approximately ten percent of the total red salmon returns to the Chignik Lake system. As in the Black Lake forecast, the .2 ocean fish returning to the Chignik Lake system will be based on the application of an average maturity schedule to total returns from brood year escapements estimated from a fitted spawner-recruit curve.

The 1.2 and 2.2 salmon returning in 1971 will be the progeny of the 1967 and 1966 brood year escapements respectively. On the basis of the spawner-recruit curve presented in Pedersen and Seibel, 1970, total returns from these two brood years are estimated to be 412,000 and 450,000 red salmon respectively. Adult returns from the brood years 1950-64 have consisted of, on the average, two percent 1.2 fish and seven percent 2.2 fish. Therefore, the expected return of 1.2 fish in 1971 is 8,000 while approximately 32,000 2.2 fish are expected. This yields a predicted return of approximately 40,000 .2 ocean red salmon in 1971.

Estimate of the .3 Ocean Fish Return

There is no apparent correlation between the return of .3 ocean fish in one year to that of .2 ocean fish the previous year as is displayed in the Black Lake run.

The prediction of the .3 ocean fish return to the Chignik Lake system in 1971 is obtained by estimating separately the returns of 1.3 and 2.3 fish. Again the basic method employed is the application of an average maturity schedule to total returns from brood years estimated on the basis of the fitted spawner-recruit curve. Because of the exceptionally large early run in 1970, the average time of entry curve rather than the July 1 date was used to separate the early and late runs. The number of late run fish arriving prior to July 1 was probably much less than the number of early run fish arriving after July 1.

Adult returns from the brood years 1950-64 have consisted of, on the average, approximately 28 percent 1. freshwater fish. A total estimate return of approximately 450,000 fish from the 1966 brood year escapement would thus result in an expected production of 126,000 1. freshwater fish. In 1970, an estimated 15,000 1.2 fish returned, leaving approximately 111,000 1.3 fish to return in 1971.

The 2.3 fish returning in 1971 will be the progeny of the 1965 brood year escapement from which a total production of 431,000 fish is expected. To date, 218,000 fish -- 25,000 1.2 fish in 1969 and 193,000 2.2 and 1.3 fish in 1970 -- have returned from the 1965 brood year. This leaves an estimated 213,000 2.3 fish expected to return in 1971 to the Chignik system.

Combining these two estimates yields an estimated return of approximately 324,000 .3 ocean fish in 1971.

Discussion

Estimated returns of 324,000 .3 ocean fish and 40,000 .2 ocean fish yields a total forecasted 1971 return of 364,000 red salmon to the Chignik Lake system. The majority of these fish are expected to return after July 1. The forecasted return of 364,000 is approximately 200,000 fish less than the 1950-1970 average return of 550,000.

SUMMARY

A total of 1,553,000 red salmon are expected to return to the Chignik River system in 1971. Of this total the Black Lake system should receive 1,189,000 by the end of June. The remaining 364,000 are expected to enter the system after July 1, and will be bound for Chignik Lake.

The past ten-year average for the early run is approximately 573,000. The escapement goal for this part of the run has been established at 400,000 spawners. The remaining 789,000 would then be left for a commercial harvest.

The late run is expected to produce approximately 364,000 which is below the average for the last ten years of 550,000. The Department escapement goal of 250,000 into this late system will allow a commercial catch of approximately 114,000.

A commercial harvest of approximately 900,000 fish can be anticipated from the 1971 Chignik system return.

LITERATURE CITED

- Dahlberg, M. L. 1968. Analysis of the dynamics of sockeye salmon returns to the Chignik Lakes, Alaska. PhD. thesis, Univ. of Washington, Seattle. 337 pp.
- Lechner, J. 1969. Identification of red salmon stocks taken in the Cape Kumlik-Aniakchak Bay fishery, Chignik area, 1967. Alaska Dept. of Fish and Game, Informational Leaflet No. 133. 32 pp.
- Pedersen, Paul C. and Melvin C. Seibel. 1970. Forecast of the 1970 Chignik system red salmon run. Alaska Dept. of Fish and Game, Informational Leaflet No. 144. 24 pp.

Appendix Table No. 1. Chignik System Red Salmon Runs, 1950-1970.

Year	Black Lake (Early) Run ^{1/}			Chignik Lake (Late) Run			Chignik System Total Run		
	Catch	Escapement	Total	Catch	Escapement	Total	Catch	Escapement	Total
1950	34,742	206,270	241,012	318,450	861,070	1,179,520	353,192	1,067,340	1,420,532
1951	115,494	125,126	240,620	143,521	490,899	634,420	259,015	616,025	875,040
1952	106,675	34,155	140,830	20,393	260,540	280,933	127,068	294,695	421,763
1953	185,738	168,375	354,113	109,450	221,408	330,858	295,188	389,783	684,971
1954	52,000	170,000	222,000	11,298	281,675	292,973	63,298	451,675	514,973
1955	166,000	248,000	414,000	182,646	198,576	381,222	348,646	446,576	795,222
1956	186,000	266,000	452,000	482,522	491,099	973,621	668,522	757,099	1,425,621
1957	155,000	172,000	327,000	147,079	336,545	483,624	302,079	508,545	810,624
1958	139,000	108,000	247,000	186,322	213,127	399,449	325,322	321,127	646,449
1959	162,000	94,000	256,000	229,295	288,607	517,902	391,295	382,607	773,902
1960	274,048	251,567	525,615	418,357	357,229	775,586	692,405	608,796	1,301,201
1961	53,853	140,715	194,569	278,609	254,971	533,580	332,462	395,686	728,148
1962	71,562	167,603	239,165	292,527	324,861	617,387	364,089	492,464	856,553
1963	80,259	332,535	412,794	323,080	200,312	523,392	403,339	532,847	936,186
1964	128,950	137,072	266,022	427,940	166,624	594,564	556,890	303,696	860,586
1965	447,032	307,192	784,224	152,522	163,152	315,674	629,554	470,344	1,099,898

(Continued)

Appendix Table No. 1. Chignik System Red Salmon Runs, 1950-1970 (continued).

Year	Black Lake (Early) Run ^{1/}			Chignik Lake (Late) Run			Chignik System Total Run		
	Catch	Escapement	Total	Catch	Escapement	Total	Catch	Escapement	Total
1966	76,696	382,546	463,242	143,099	183,526	326,625	222,795	567,072	789,867
1967 ^{4/}	141,000	328,000	469,000	321,000	189,000	510,000	462,000	517,000	979,000
1968 ^{4/}	447,800	342,343	790,143	529,528	244,836	774,364	977,328 ^{2/}	587,179	1,564,507
1969 ^{3/4/}	207,811	366,589	574,400	186,324	132,055	318,379	394,135 ^{2/}	498,644	892,779
1970 ^{3/4/}	1,594,025	536,257	2,130,282	259,897	119,952	379,849	1,853,922 ^{2/}	656,209	2,510,131

Data Sources:

- i) 1950-66. Dahlberg (1968)
- ii) 1967-70. Alaska Department of Fish and Game, Chignik Fisheries Management Records (Unpublished)

^{1/} Includes early Black River stocks.

^{2/} Includes red salmon harvested at Cape Igvak.

^{3/} Preliminary data.

^{4/} Average time of entry data used to separate Black Lake and Chignik Lake stocks.

Appendix Table No. 2. Black Lake Red Salmon Return by Age Class, 1950-70.

Year	Age Class											Total
	1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	
1950	7	2	0	11,775	5,143	203	183,734	31,664	38	7,947	499	241,012
1951	7	2	0	11,988	5,644	216	182,835	31,784	43	7,619	482	240,620
1952	4	1	0	7,129	3,550	133	106,718	18,686	27	4,307	275	140,830
1953	11	4	0	17,688	8,407	320	268,953	46,809	64	11,150	707	354,113
1954	8	3	0	12,671	5,713	223	195,878	33,877	43	8,346	525	257,287
1955	0	0	0	46,798	12,644	0	287,407	89,095	0	0	352	436,296
1956	0	0	0	4,390	3,404	648	448,360	76,722	152	1,862	0	535,538
1957	143	32	0	1,024	3,423	0	137,957	124,345	286	2,319	373	269,902
1958	783	0	0	6,468	17,848	0	154,589	81,691	0	208	455	262,042
1959	17	0	0	30,302	10,720	252	50,272	180,887	2,512	1,625	639	277,226
1960	0	0	0	16,499	3,476	9	430,793	72,973	1,350	515	0	525,615
1961	905	161	0	6,559	14,910	109	81,569	88,693	1,009	339	312	194,566
1962	1,522	0	0	19,146	10,507	0	117,979	90,001	0	9	0	239,164
1963	124	142	0	31,039	81,992	3,641	79,955	210,686	4,967	52	196	412,794
1964	263	210	52	52,866	13,203	73	141,243	57,231	862	0	20	266,023
1965	681	1	0	13,946	31,788	852	594,417	140,988	100	392	59	784,224
1966	0	0	0	8,246	3,428	48	380,908	64,379	53	6,122	57	463,241
1967	15	90	0	23,453	18,942	361	197,595	116,946	2,088	398	437	360,326
1968 ^{1/}	407	2,772	0	9,372	12,120	719	321,396	240,973	77	2,855	407	591,099
1969 ^{1/2/}	876	0	0	91,577	106,115	0	161,524	110,200	0	864	438	471,594
1970 ^{1/2/}	3,011	0	0	57,910	71,885	0	1,499,247	310,620	0	2,230	0	1,944,903

Data Sources:

- i) 1950-66. Dahlberg (1968).
- ii) 1967-70. Alaska Department of Fish and Game, Chignik Fisheries Management Records (Unpublished).

^{1/} Preliminary data. July 1 separation date used to separate Black Lake and Chignik Lake stocks.

^{2/} Includes fish harvested at Cape Igvak.

Appendix Table No. 3. Chignik Lake Red Salmon Return by Age Class, 1950-70.

Year	Age Class											Total
	1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	
1950	147	183	0	40,246	72,138	4,101	652,782	385,087	1,321	18,110	5,405	1,179,520
1951	80	98	0	21,549	38,531	2,186	351,541	207,054	711	9,784	2,886	634,420
1952	36	42	0	9,390	16,644	16,644	156,343	91,579	315	4,401	1,246	280,933
1953	41	52	0	11,360	20,430	1,165	182,792	108,068	371	5,048	1,531	330,858
1954	38	45	0	9,924	17,581	989	165,402	96,858	333	4,658	1,316	297,144
1955	0	0	0	33,082	31,411	0	199,966	103,345	0	1,766	826	370,396
1956	0	0	0	22,213	13,748	407	618,729	245,826	650	2,206	496	904,275
1957	547	428	0	9,167	30,836	0	258,747	242,042	1,820	7,046	2,903	553,536
1958	369	0	0	2,848	32,350	0	125,399	229,563	0	986	1,028	392,543
1959	1,330	0	0	32,187	75,361	1,935	39,658	396,916	8,403	470	3,932	560,192
1960	0	0	0	12,515	32,708	804	303,988	418,442	5,424	771	934	775,586
1961	1,459	622	0	17,746	36,113	1,252	106,327	363,162	5,069	168	1,661	533,579
1962	3,286	0	0	50,630	109,475	0	232,393	221,169	0	435	0	617,388
1963	146	907	0	18,094	139,797	2,104	23,204	332,661	4,781	351	1,349	523,394
1964	668	457	211	22,741	75,947	912	101,552	389,744	1,227	0	1,106	594,565
1965	117	758	0	1,802	7,849	700	116,010	187,827	410	111	88	315,672
1966	0	0	0	4,069	17,646	133	103,729	198,980	176	1,240	650	326,623
1967	85	2,724	0	13,678	68,207	2,499	110,951	405,488	11,803	1,872	0	617,307
1968 ^{2/}	1,224	3,880	0	6,436	50,928	1,142	150,195	613,714	1,868	2,200	0	831,587
1969 ^{1/2/}	2,120	5,190	0	25,206	74,066	0	27,913	285,284	0	0	1,406	421,185
1970 ^{1/2/}	261	1,320	0	22,904	68,687	1,376	218,080	244,767	1,437	2,340	4,056	565,228

Data Sources:

- i) 1950-66. Dahlberg (1968)
- ii) 1967-70. Alaska Department of Fish and Game, Chignik Fisheries Management Records (Unpublished)

^{1/} Preliminary data. July 1 separation date used to separate Black Lake and Chignik Lake stocks.
^{2/} Includes fish harvested at Cape Igvak.

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