Informational Leaflet 144

FORECAST OF THE 1970 CHIGNIK SYSTEM RED SALMON RUN

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ERRATA SHEET FOR INFORMATIONAL LEAFLET #144

p. 3 (last paragraph)

> "Note that (N + 1)-ocean fish (K + 1) and N-ocean fish (K) both eminate from the same brood year."

should read:

> "Note that (N + 1)-ocean fish (K + 1) and N-ocean fish (K) both eminate from the same brood year, provided both are of the same freshwater age class."

Also add (after the above sentence)

> "In the following discussion, when (N + 1)-ocean fish (K + 1) are compared to N-ocean fish (K) it will be assumed that both are of the same freshwater age class unless specified otherwise."

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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 1950-69 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 peaking toward the end of June, with these fish being bound primarily for the spawning grounds of Black Lake and Black River tributaries. In the past, the majority of Black Lake fry reared only one year in freshwater, however, in recent years the number of fry remaining to rear two years in freshwater has increased. A late run enters the Lagoon late in June and peaks about the middle of July, the majority of these fish spawning 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 freshwater. The two separate runs overlap in their time of entry, and an annual tagging program is carried out for the purpose of separating the two runs.

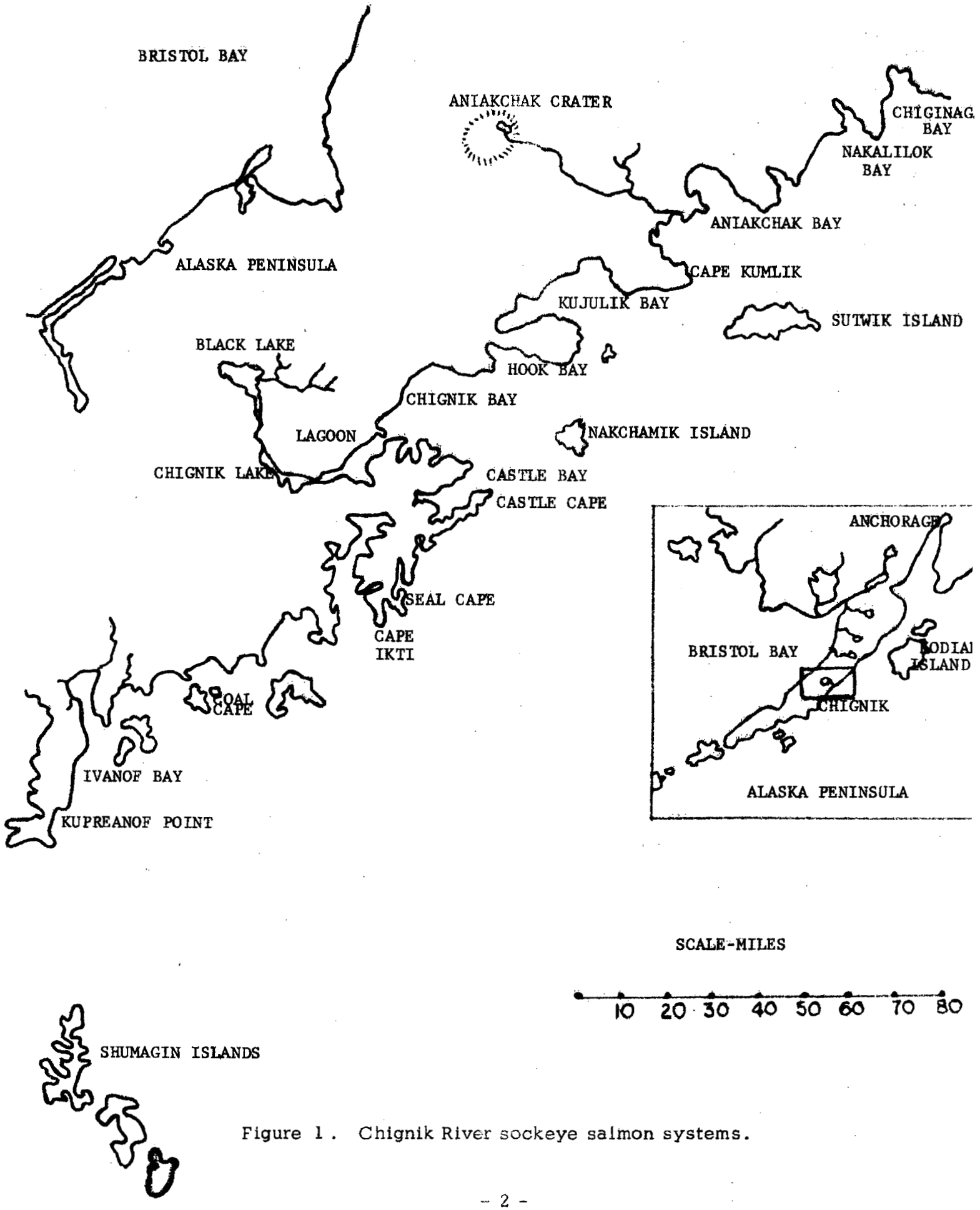


Figure 1. Chignik River sockeye salmon systems.

Due to the absence of extensive smolt or outmigrant sampling programs on the Chignik System, information on the freshwater maturity schedule for a given brood year is not available until after the salmon have returned as mature fish. Consequently, freshwater maturity schedule data for a particular brood year return is not available for forecasting purposes.

During the annual spawning migration the Alaska Department of Fish and Game (Department) 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, considered to be the total number of fish returning before July 1, and the Chignik Lake or late run, considered to be those fish returning after July 1, have been forecasted separately. The assumption required for this approach is that the number of early run or Black Lake fish that arrive after June 30 is approximately equal to the number of late run or Chignik Lake fish that arrive prior to July 1. Past tagging data indicates that in general this assumption is reasonably well satisfied.

Special Remarks

1) The European age class designation is used in this report. In this method an "i.j" red salmon refers to a fish which migrates from freshwater to saltwater at an age of (i + 1) years and then rears in the ocean for j years. Consequently, the total age of an "i.j" fish is (i + j + 1) years. As an example, a "1.2" fish has spent (1 + 1) or two years in freshwater and two years in the ocean to return as a mature four-year fish.

2) To facilitate the discussion of the return of (N + 1)-ocean fish in one year and the return of N-ocean fish the preceding year, the following notation is introduced.

   "R fish (S)" refers to "the return of age class R fish in year S".

   As an example, "2.3 fish (K + 1) refers to the "return of 2.3 fish in year (K + 1)". Note that (N + 1)-ocean fish (K + 1) and N-ocean fish (K) both eminate from the same brood year.

3) The majority of red salmon returning to the Chignik System are of the following 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 class fish contributing to the forecast only to the extent that they affect the escapement-return relationship by their inclusion in the total returns.

4) Extensive use is made of the historic date on Chignik red salmon presented in

Dahlberg, M.L. 1968

Analysis of the dynamics of sockeye salmon returns to the Chignik Lakes, Alaska. Ph.D. thesis, Univ. of Washington, Seattle, Wash. 337 pp.

FORECAST OF THE 1970 BLACK LAKE (EARLY) RETURN

Preliminary Remarks

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. The forecast of 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 in most years 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 return of .2 ocean fish has not varied greatly -- relative to the total return of .2 ocean plus .3 ocean fish -- the average return of .2 ocean fish has generally been used in the past as the forecast of .2 ocean fish returns. However, a method which results in a slightly better hindcast of .2 ocean fish consists of applying an average maturity schedule to estimated total returns from individual brood year escapements. Total production from

brood year escapements are estimated from fitted spawner-recruit curves. Returns from the brood years 1950-63 have averaged approximately five percent 1.2 and four percent 2.2 red salmon. The 1.2 and 2.2 fish returning in 1970 will eminate from the 1966 and 1965 brood years respectively. On the basis of the fitted spawner-recruit curve shown in Figure 2, total returns of 600,000 and 550,000 salmon respectively are expected from these two brood years. Consequently, returns of 30,000 1.2 fish and 22,000 2.2 fish are expected from the brood years 1966 and 1965 respectively, resulting in an estimated 52,000 .2 ocean fish return to the Black Lake system in 1970.

Estimate of the .3 Ocean Fish Return

The major problem encountered in developing a forecast of the .3 ocean fish return in 1970 consists of interpreting the exceptionally large return of .2 ocean fish in 1969. The large .2 ocean fish return in 1969 can be interpreted as either indicating an exceptional survival rate for the progeny of the brood years 1964-65 -- this would suggest the possibility of a large .3 ocean fish return in 1970 -- or the existence of marine environmental conditions which induced an exceptionally large proportion of the fish to mature as .2 ocean fish. The latter phenomena, in the absence of exceptionally good survival rates, would suggest a small .3 ocean fish return in 1970. A combination of these two factors may have affected the progeny of the 1964-65 brood years.

The forecast of .3 ocean red salmon has generally been based on the relationship between the number of .3 ocean fish returning in one year (.3 ocean fish (N + 1))and the number of .2 ocean fish returning the previous year (.2 ocean fish (N)). This data is graphed in Figure 3 and the fitted regression line is shown. The return of 199,000 .3 ocean fish in 1964, following an exceptionally large return of 117,000 .2 ocean fish in 1963, deviates significantly from the pattern existing in other years and, hence, was omitted from the analysis. On the basis of the fitted line a return of 1,026,000 .3 ocean fish would have been expected in 1964 when, in fact, the .3 ocean return was only 199,000. Two possible reasons for the apparent large .2 ocean return in 1963 are sampling error -- the estimate of the age structure of the 1963 early run was based on limited sampling data -- and/or an exceptional maturity schedule for the 1958 brood year progeny. On the basis of the 1963 sampling the estimated 117,000 .2 ocean fish was composed primarily of 82,000 2.2 ocean fish eminating from the 1958 brood year. Normally, 2. freshwater fish do not occur in this magnitude in the Black Lake returns.

The 1969 return was similar to the 1963 return in two aspects. First, the 203,000 .2 ocean fish return in 1969 was the largest .2 ocean fish return to the Black Lake system during the period 1950-69, replacing 1963 as the

Figure 2. Escapement-Return Relationship for Black Lake Red Salmon, 1950-63 (Number of Fish in Thousands).

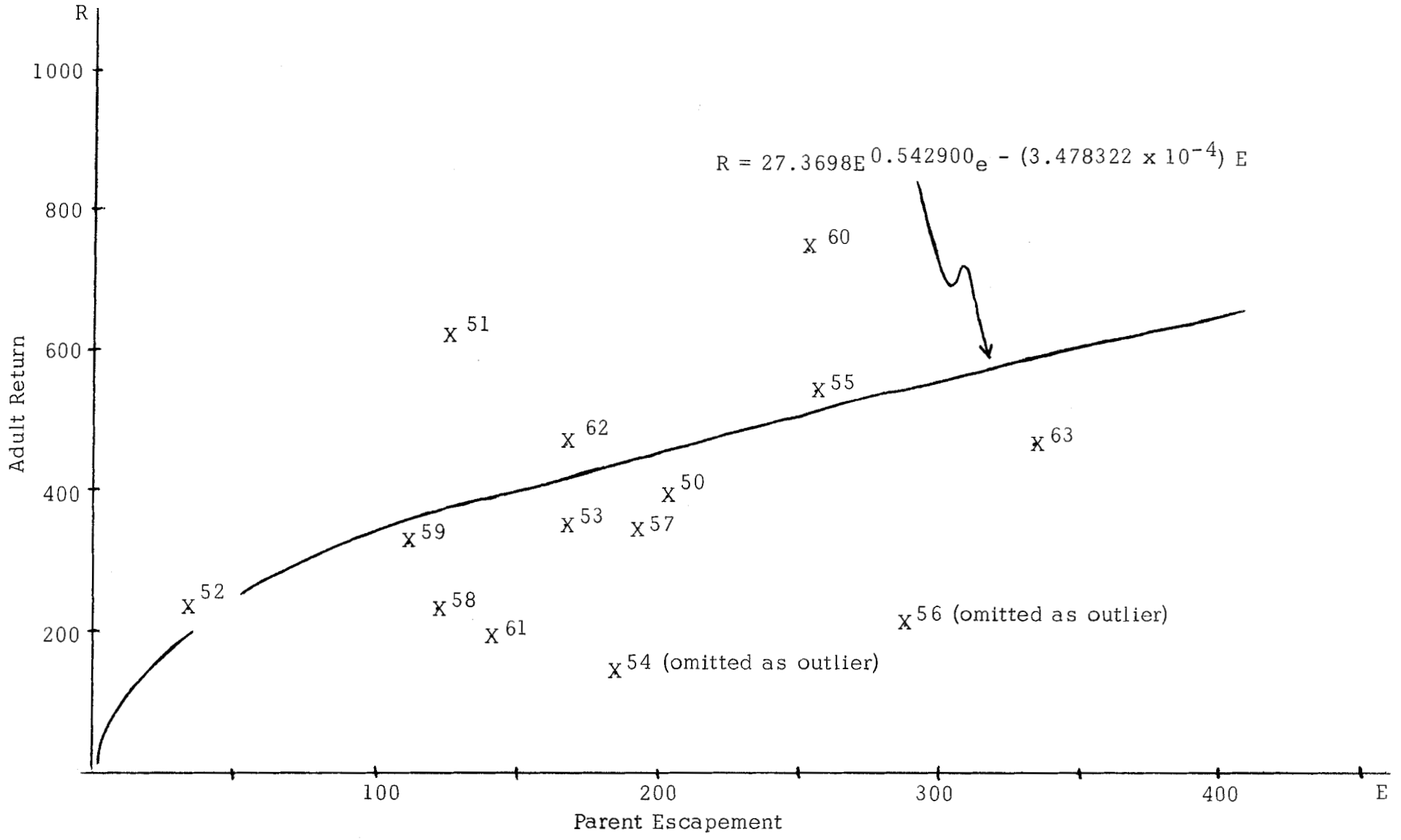
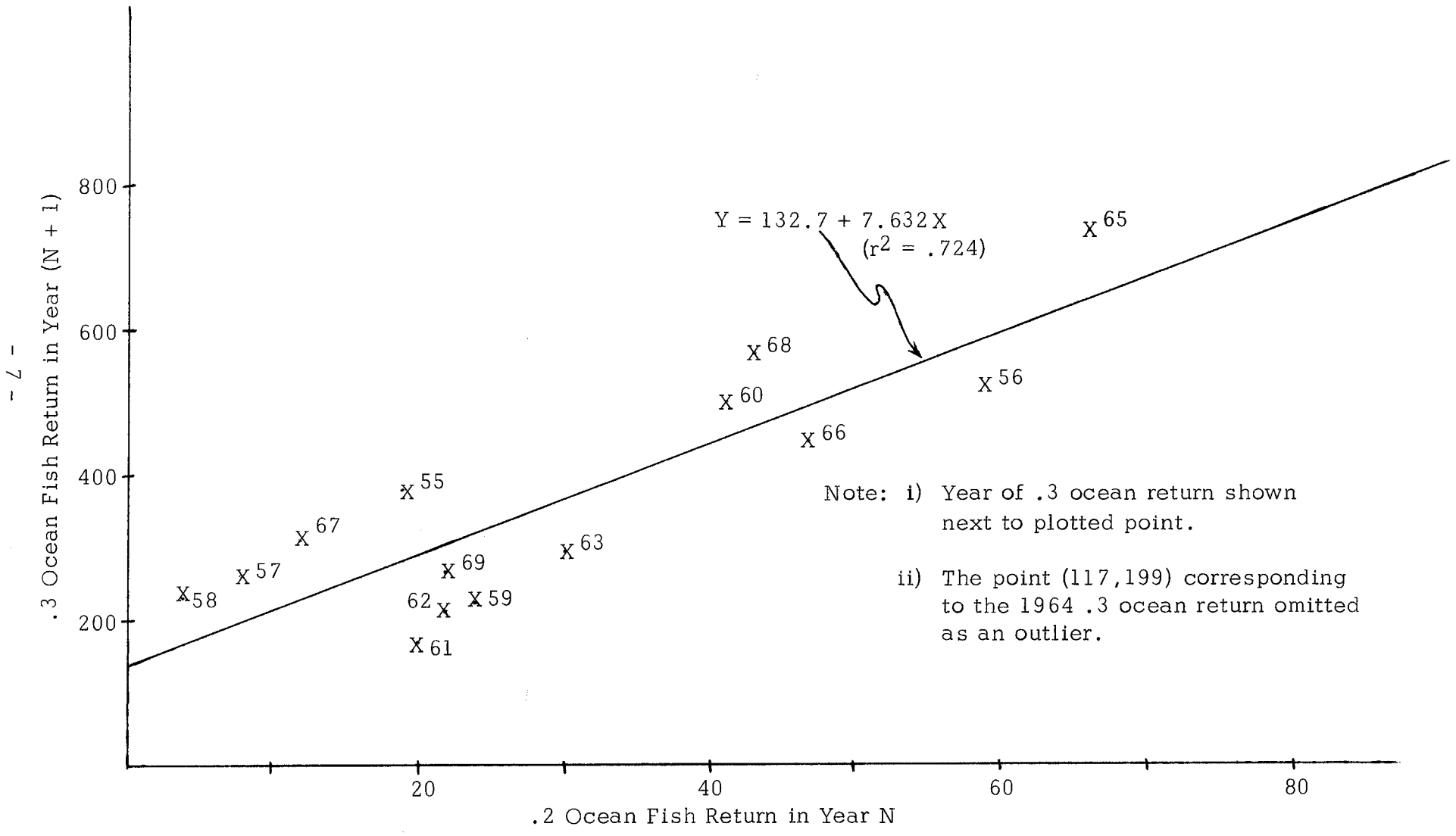


Figure 3. Black Lake (Early Run) Red Salmon, Relationship Between the Return of .2 Ocean Fish in Year N and the Return of .3 Ocean Fish in Year (N + 1). (Numbers of Fish in Thousands).



previous high year. Second, both years experienced large 2. freshwater fish returns, the 1969 return including approximately 106,000 2.2 ocean fish while the 1963 .2 ocean return included 82,000 2.2 ocean fish. Because of the similarities between the 1963 and 1969 .2 ocean returns, and since the relationship between the .3 ocean return in 1964 and the .2 ocean return in 1963 deviated significantly from the relationship previously observed, one would be very hesitant to use the relationship shown in Figure 3 to forecast the .3 ocean return for 1970. In fact, use of this relationship indicates a 1970 .3 ocean return of 1.7 million whereas the largest previously observed return of .3 ocean fish for this system for the period 1960-69 was 737,000 in 1965.

Because of the exceptionally large return of 2.2 fish in 1970 and the tendency in recent years of more Black Lake fry to leave the freshwater rearing areas as 2. freshwater fish, the return of 1.3 and 2.3 fish will be estimated separately for the 1970 forecast.

On the basis of the spawner-recruit curve shown in Figure 2, a total return of approximately 550,000 salmon is expected from the 1965 brood year which will produce the 1.3 fish returning in 1970. Returns from the brood years 1950-63 have consisted of, on the average, 59 percent 1. freshwater fish. This leads to an estimated return of approximately 324,000 1. freshwater fish from the 1965 brood year, of which approximately 92,000 returned in 1969 as 1.2 fish leaving an estimated 232,000 1.3 fish to return in 1970. Of the 376,000 total return predicted from the 1964 brood year escapement of 137,000 spawners, approximately 277,000 fish have already returned in 1968 (1.2 fish) and 1969 (1.3 and 2.2 fish), leaving approximately 99,000 2.3 fish expected in 1970.

On the basis of the regression of 1.3 fish (N + 1) on 1.2 fish (N) as shown in Figure 4, a return of approximately 814,000 1.3 fish is estimated for 1970. It should be noted that this estimate is based on the assumption that the apparent linear relationship exhibited for the data observed will remain valid for larger returns of 1.2 fish. As indicated below, there is some question regarding this assumption.

The evidence supporting the two 1.3 fish estimates of 232,000 (based on a spawner-recruit curve and an average maturity schedule) and 814,000 (based on the relationship between 1.3 fish (N + 1) and 1.2 fish (N))will be discussed in a later section.

As seen from Figure 5, it is not immediately apparent what basic underlying relationship exists between the 2.3 fish (N + 1) and 2.2 fish (N). For 2.2 fish returns in the range of 0-20,000 fish, the relationship appears to be roughly linear, however, for 2.2 fish returns in excess of

Figure 4. Relationship Between 1.3 Fish Return in Year (N + 1) and 1.2 Fish Return in Year N for Red Salmon, Black Lake System, 1950-69. (Number of Fish in Thousands).

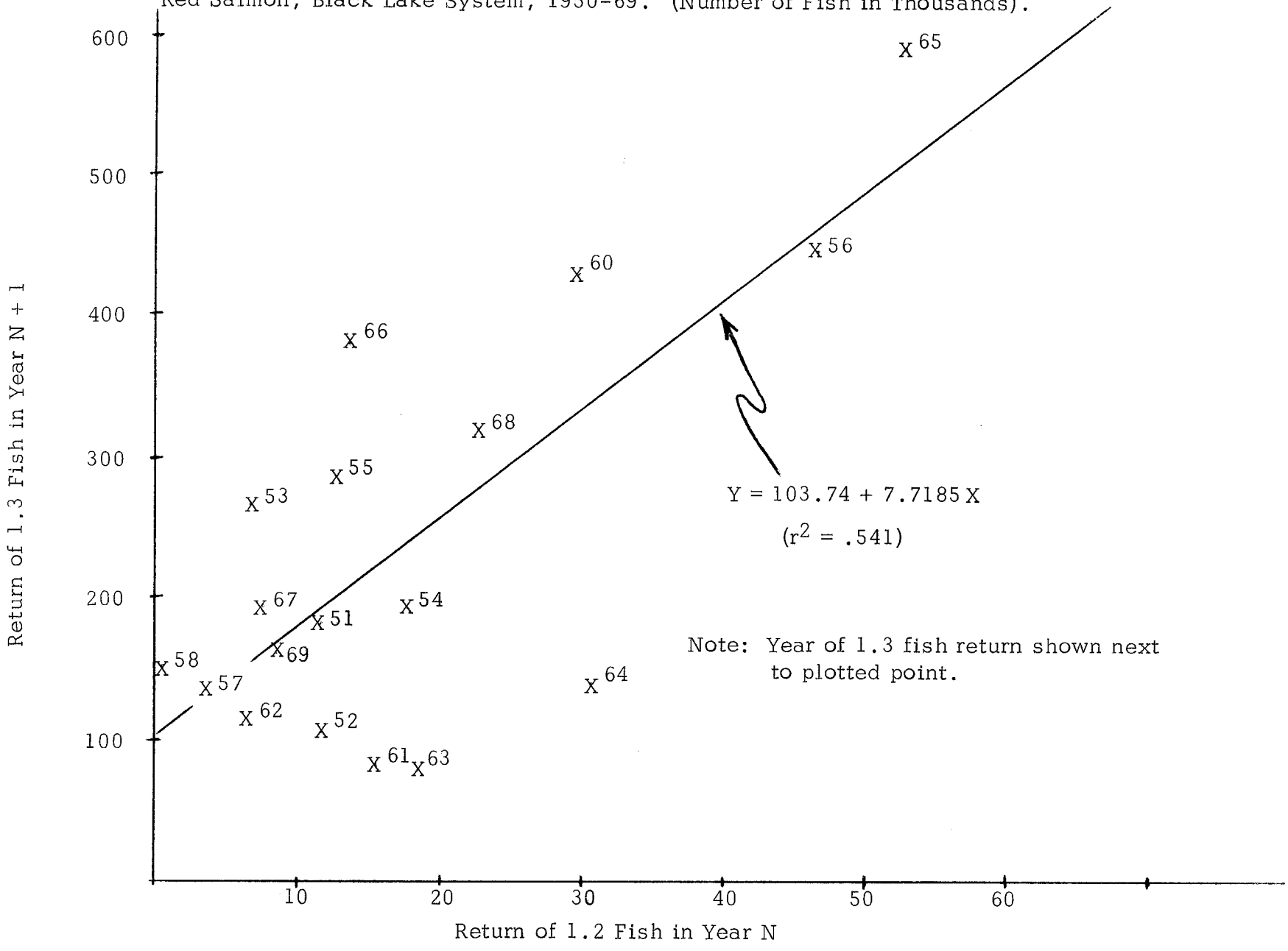
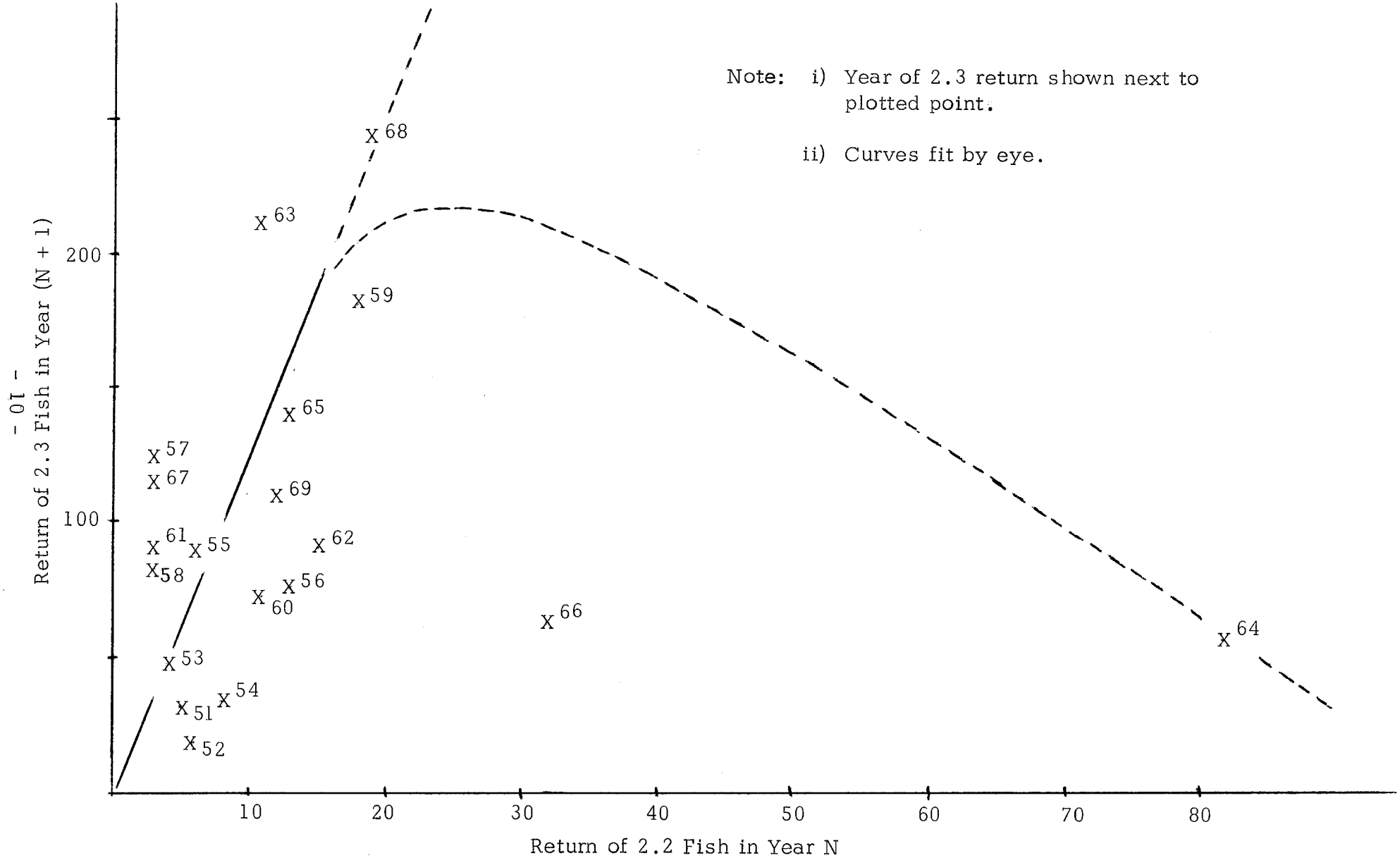


Figure 5. Relationship Between 2.3 Fish Return in Year (N + 1) and 2.2 Fish Return in Year N for Red Salmon, Black Lake System, 1950-69. (Number of Fish in Thousands).



20,000 fish the observations to date suggest that decreasing numbers of 3.2 fish (N + 1) occur with increasing numbers of 2.2 fish (N). If the observations corresponding to the 1964 and 1966 2.3 fish returns are interpreted as outliers and the linear relationship is accepted, a 2.3 fish return of approximately 900,000 fish would be indicated for 1970, whereas the largest 2.3 fish return for the period 1950-69 was 241,000 in 1968. A prediction of 900,000 2.3 fish return to the Black Lake system in 1970 does not appear reasonable. The dome-shaped curve in Figure 5 indicates a 1970 2.3 fish return of approximately 90,000 fish. This compares favorably with the 99,000 2.3 fish return estimated above from the spawner-recruit curve and an average maturity schedule. The average of these two estimates, viz. 94,000 fish will be used for the 1970 forecast of the return of 2.3 fish to the Black Lake system.

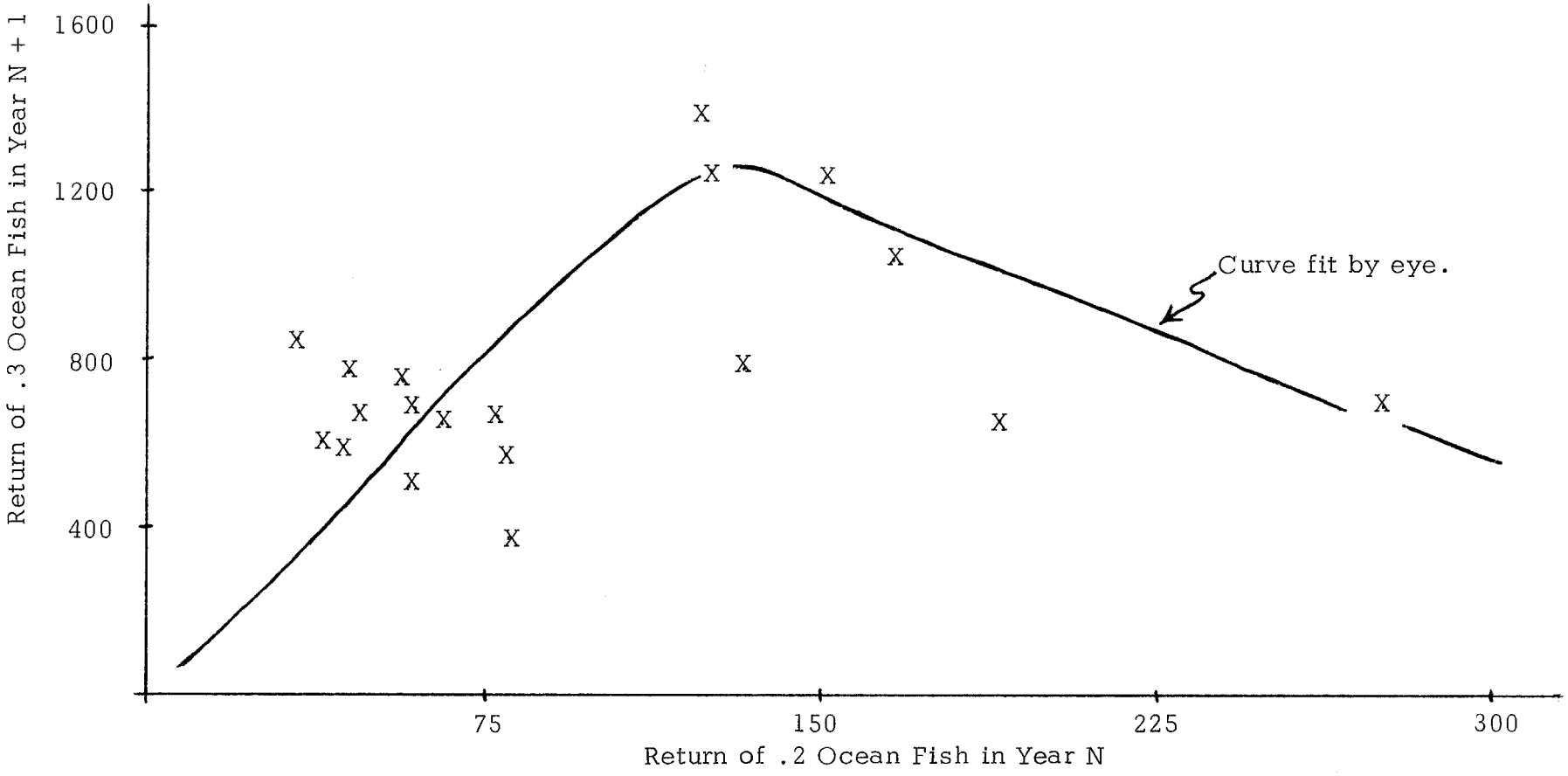
Discussion

The two estimates of 232,000 (based on a spawner-recruit curve and an average maturity schedule) and 814,000 (based on the relationship between 1.3 fish (N + 1) and 1.2 fish (N)) represent the probable range of magnitude of the 1.3 fish return in 1970. In terms of total return to the Black Lake system, these two estimates correspond to predictions of 378,000 and 960,000 fish for 1970. Realizing that this wide range of estimates almost precludes the use of this information for planning purposes, the evidence supporting the two estimates will be evaluated and the estimates combined accordingly to arrive at a point estimate of the 1970 early run.

During the 20 year period 1950-69, twelve of the annual returns to the Black Lake system have been less than the lower estimate of 378,000 salmon. The last previous early run which exceeded the larger prediction of 960,000 was the 3.7 million return in 1947 (Dahlberg, 1968).

With the exception of the 1963 .2 ocean fish return and the subsequent .3 ocean fish return in 1964, the data in Figure 3 indicates that the return of .3 fish (N + 1) is roughly proportional to the return of .2 fish (N) -- at least for .2 fish (N) returns less than 80,000 fish. However, the deviation of the 1963-64 returns from this pattern (in view of the large 117,000 .2 fish return in 1963) and the fact that the 1969 .2 fish return was approximately 198,000 dictates that some caution should be used in making the assumption that the observed relationship is valid over all ranges of .2 fish returns. In an attempt to obtain more information regarding the relationship between .3 fish (N + 1) and .2 fish (N), the data from both Black Lake and Chignik Lake was combined and is shown in Figure 6. This data suggests that the .3 fish (N + 1) return increases with increasing .2 fish (N) return only over the lower to intermediate levels of .2 fish (N) returns, with the .3 fish (N + 1) return decreasing with increasing .2 fish (N) returns beyond the intermediate levels. On the basis of

Figure 6. Relationship Between .3 Ocean Return in Year (N + 1) and .2 Ocean Return in Year N for Red Salmon, Chignik River System (Black Lake and Chignik Lake Data Combined), 1950-69. (Number of Fish in Thousands).



this data alone, the large 1969 .2 fish return of approximately 297,000 to both systems suggests the possibility of a small .3 fish return in 1970.

Two past observations which present evidence for the possibility of a large return in 1970 were:

1) Phinney and Lechner (1967) reported that the FRI tow net sampling in Black Lake in 1966 resulted in a higher than average fry per tow. The majority of these fry would have been the progeny of the 1964-65 brood years and .3 fish from these two brood years would return primarily in 1969-71.

2) Lechner (personal communications) reported that exceptionally large numbers of smolt were observed in the Chignik River and Lagoon in the spring of 1967. These smolt would return as adults primarily in the years 1969-70.

In view of the above evidence, it appears that neither of the two estimates obtained should be rejected completely. Furthermore, the relative evidence supporting each of the two estimates appears to be about equal, with perhaps slightly more evidence existing in the favor of the smaller estimate. For the purpose of presenting a single point estimate of the 1970 early return, each of the two estimates are given equal weighting, with the resulting forecast being 670,000 red salmon.

FORECAST OF THE 1970 CHIGNIK LAKE (LATE) RETURN

Preliminary Remarks

The techniques used in the past to forecast the late or Chignik Lake runs have been basically the same as those used for the early or Black Lake run, viz. an average .2 ocean return has been added to a .3 ocean return predicted on the basis of a relationship between .3 ocean fish (N + 1) and .2 ocean fish (N). These methods have been modified for the 1970 forecast. The basic data used to forecast the Chignik Lake return in 1970 is presented in Appendix Table No. 3.

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 1970 Black Lake forecast, the 1970 .2 ocean

fish return to the Chignik Lake system will be based on the application of an average maturity schedule to total returns from brood years estimated from a fitted spawner-recruit curve.

As shown in Figure 7, a spawner-recruit curve has been fit to the escapement-return data for the years 1950-63. On the basis of this curve, the total returns from the brood years 1966 and 1965 are estimated to be 450,000 and 431,000 red salmon respectively. The 1.2 and 2.2 salmon returning in 1970 will be the progeny of the 1966 and 1965 brood year escapements respectively. Adult returns from the brood years 1950-63 has consisted of, on the average, 2.2 percent 1.2 fish and 7.1 percent 2.2 fish. Therefore, the expected return of 1.2 fish in 1970 is approximately 10,000 while approximately 31,000 2.2 fish would be expected.

Combining the two estimates obtained above yields a predicted 1970 .2 ocean return of approximately 41,000 fish.

Estimate of the .3 Ocean Fish Return

In past years, the return of .3 ocean fish has been predicted primarily on the basis of the .2 ocean fish return the previous year. From Figure 8 it is apparent that no significant (coefficient of determination $r^2 = 0.02$) linear relationship exists between the .3 ocean fish (N + 1) and the .2 ocean fish (N) for the Chignik Lake system. Although a high degree of correlation is indicated between the natural logarithm of the ratio, say R, of .3 ocean fish (N + 1) to .2 ocean fish (N) and the number of .2 ocean fish (N), this correlation is apparently induced when the original dependent variable of interest, viz. the .3 ocean fish (N + 1) is divided by the independent variable, viz. the .2 ocean fish (N) and the natural logarithmic transformation is performed. The relatively high correlation between ln (R) and the .2 ocean return (N) should not be interpreted as indicating -- necessarily -- that the number of .2 ocean fish (N) is a "good" basis for predicting the number of .3 ocean fish (N + 1). In fact, the use of ln (R) versus the .2 ocean return (N) does not significantly reduce the error in hindcast over that associated with the use of .3 ocean fish (N + 1) versus .2 ocean fish (N). Because of the poor correlation between the .3 ocean fish (N + 1) and the .2 ocean fish (N), this method is not used to forecast the .3 ocean return to the Chignik Lake system in 1970.

The prediction of the .3 ocean fish return to the Chignik Lake system in 1970 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 shown in Figure 7.

Figure 7. Escapement-Return Relationship for Chignik Lake Red Salmon, 1950-63. (Number of Fish in Thousands).

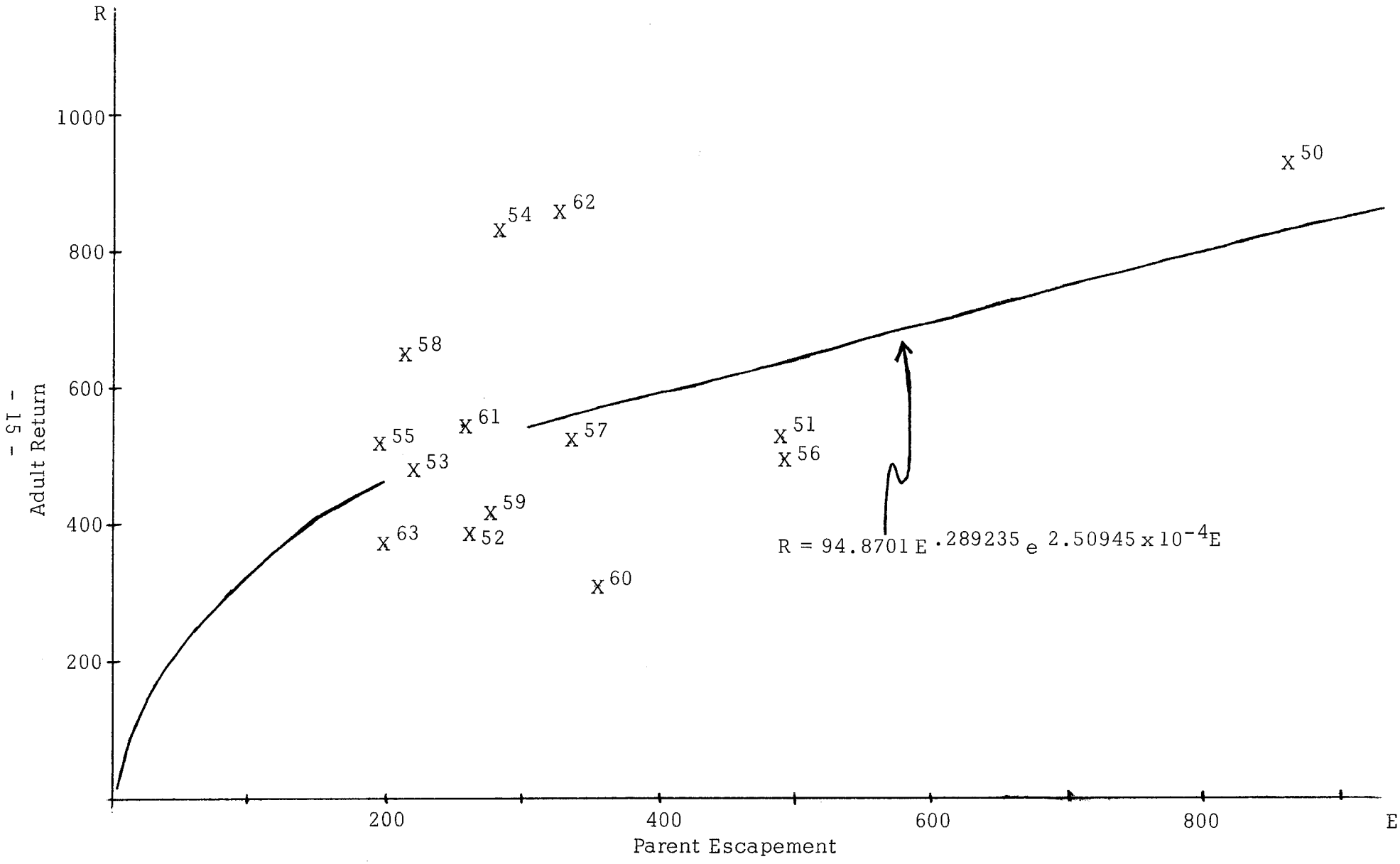
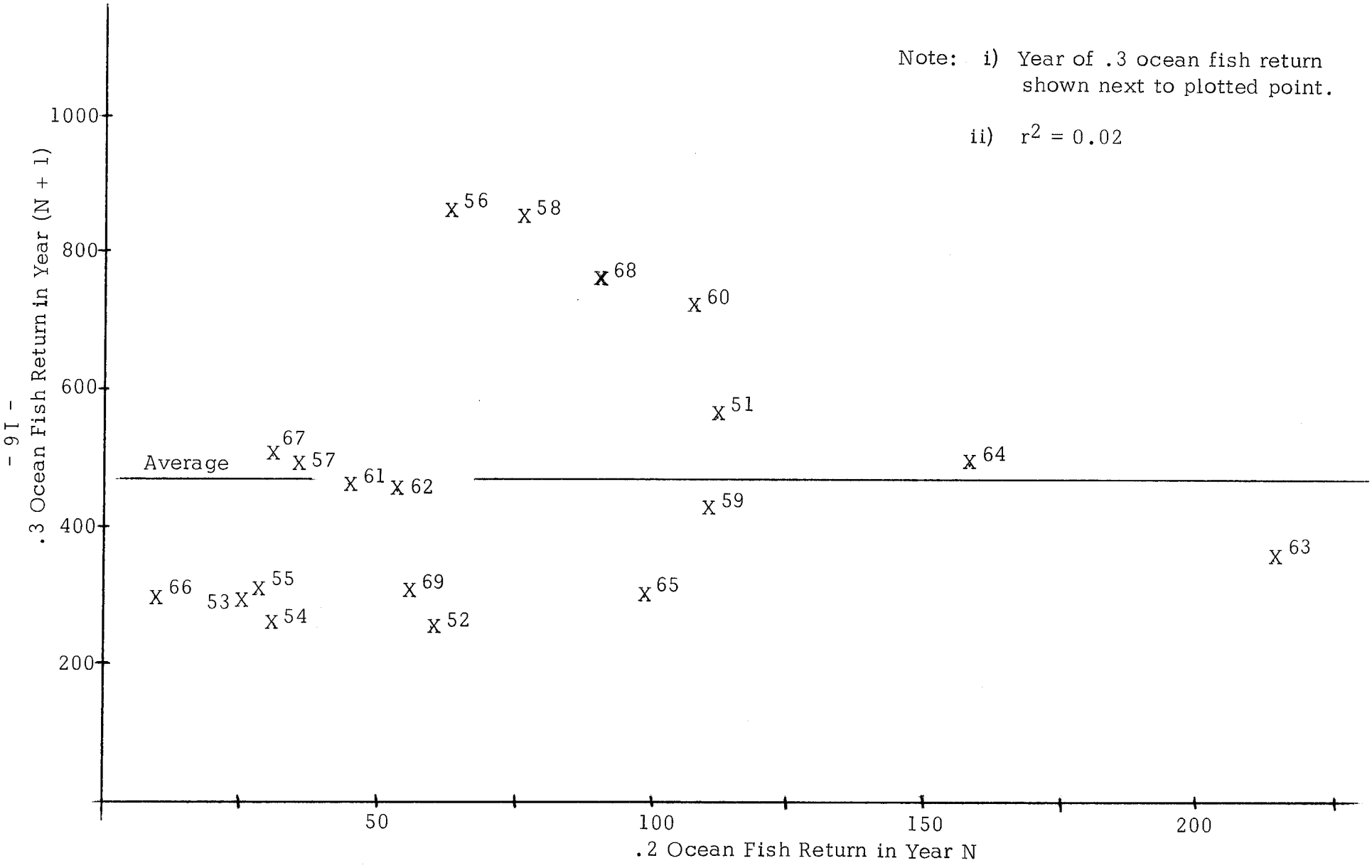


Figure 8. Relationship Between .3 Ocean Fish Return in Year (N + 1) and .2 Ocean Fish Returns in Year N for Red Salmon, Chignik Lake System, 1950-69. (Number of Fish in Thousands).



Adult returns from the brood years 1950-63 have consisted of, on the average, approximately 28 percent 1. freshwater fish. Of the total return of 431,000 fish expected from the 1965 brood year, 28 percent or 121,000 should be 1. freshwater fish. In 1969, an estimated 25,000 1.2 fish returned to the Chignik Lake system, leaving an estimated 96,000 1.3 fish to return in 1970.

The 2.3 fish returning in 1970 will be the progeny of the 1964 brood year. On the basis of the fitted spawner-recruit curve, an estimated 435,000 fish are expected from the 1964 brood year escapement of 184,000. To date, 108,000 fish -- 6,000 1.2 fish in 1968 and 102,000 2.2 and 1.3 fish in 1969 -- have returned from the 1964 brood year. This leaves an estimated 327,000 2.3 fish expected to return in 1970 to the Chignik system.

Combining the estimates of 96,000 1.3 fish and 327,000 2.3 fish yields a total estimated .3 ocean return of 423,000 fish in 1970.

Discussion

Combining the .2 ocean prediction of 41,000 and the .3 ocean prediction of 423,000 yields a total Chignik Lake or late run forecast of 464,000 red salmon for 1970. This forecast is approximately 100,000 fish less than the 1950-69 average return of 553,000 fish.

SUMMARY

The total 1970 return to the Chignik River system is expected to be approximately 1,134,000 red salmon. This forecast exceeds the previous ten-year average of one million fish. Of the total forecast of 1,134,000 red salmon, 670,000 fish, bound for Black Lake, are expected to arrive at the Chignik fishery prior to the end of June. The remaining 464,000 fish are expected to reach the fishery after July 1, and will be bound for the Chignik Lake spawning grounds.

The past ten-year average for the early or Black Lake run is 472,000 red salmon with the 1970 forecast of 670,000 exceeding this average by approximately forty percent. The escapement goal established by the Department for the Black Lake system is 400,000 spawners, consequently a harvest of approximately 270,000 red salmon is expected prior to July 1. It should be re-emphasized that conflicting evidence exists regarding the magnitude of the 1970 Black Lake or early return. The two conflicting estimates obtained, viz. 378,000 and 960,000, indicate the possible range of the early return. A significant deviation of the actual return from the forecast of 670,000 will necessitate an adjustment in the harvest rate.

The late or Chignik Lake forecast of 464,000 red salmon is slightly below the past ten-year average of 529,000. In order to achieve the Department's escapement goal of 200,000 spawners, a commercial harvest of approximately 264,000 fish is anticipated after July 1.

If the total Chignik system 1970 return approximates the forecast of 1,134,000 red salmon, a total commercial harvest of approximately 534,000 fish will be allowed.

Tagging studies (Lechner, 1969) have shown that the majority of red salmon intercepted by the cape fisheries in the vicinities of Cape Igvak and Aniakchak Bay are bound for the Chignik River system. It can, therefore, be expected that substantial numbers of Chignik bound red salmon may be harvested prior to reaching the more concentrated fishing effort in Chignik Lagoon.

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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.

Phinney, D. E. and J. Lechner. 1967. Forecast of the Chignik sockeye salmon run in 1967. Alaska Dept. of Fish and Game, Informational Leaflet No. 97. 9 pp.

APPENDIX

Appendix Table No. 1. Chignik System Red Salmon Runs, 1950 - 1969.

Year	Black Lake (Early) Run[1] Catch	Escapement	Total	Chignik Lake (Late) Run Catch	Escapement	Total	Chignik System Total Run Catch	Escapement	Total
1969[3][4]	207,811	366,589	574,400	186,324	132,055	318,379	394,135[2]	498,644	892,779
1968[4]	447,800	342,343	790,143	529,528	244,836	774,364	977,328[2]	587,179	1,564,507
1967[4]	141,000	328,000	469,000	321,000	189,000	510,000	462,000	517,000	979,000
1966	76,696	382,546	463,242	143,099	183,526	326,625	222,795	567,072	789,867
1965	447,032	307,192	784,224	152,522	163,152	315,674	629,554	470,344	1,099,898
1964	128,950	137,072	266,022	427,940	166,624	594,564	556,890	303,696	860,586
1963	80,259	332,535	412,794	323,080	200,312	523,392	403,339	532,847	936,186
1962	71,562	167,603	239,165	292,527	324,861	617,387	364,089	492,464	856,553
1961	53,853	140,715	194,569	278,609	254,971	533,580	332,462	395,686	728,148
1960	274,048	251,567	525,615	418,357	357,229	775,586	692,405	608,796	1,301,201
1959	162,000	94,000	256,000	229,295	288,607	517,902	391,295	382,607	773,902
1958	139,000	108,000	247,000	186,322	213,127	399,449	325,322	321,127	646,449
1957	155,000	172,000	327,000	147,079	336,545	483,624	302,079	508,545	810,624
1956	186,000	266,000	452,000	482,522	491,099	973,621	668,522	757,099	1,425,621
1955	166,000	248,000	414,000	182,646	198,576	381,222	348,646	446,576	795,222
1954	52,000	170,000	222,000	11,298	281,675	292,973	63,298	451,675	514,973
1953	185,738	168,375	354,113	109,450	221,408	330,858	295,188	389,783	684,971

(Continued)

Appendix Table No. 1. Chignik System Red Salmon Runs, 1950 - 1969 (Continued).

	Black Lake (Early) Run 1/			Chignik Lake (Late) Run			Chignik System Total Run		
Year	Catch	Escapement	Total	Catch	Escapement	Total	Catch	Escapement	Total
1952	106,675	34,155	140,830	20,393	260,540	280,933	127,068	294,695	421,763
1951	115,494	125,126	240,620	143,521	490,899	634,420	259,015	616,025	875,040
1950	34,742	206,270	241,012	318,450	861,070	1,179,520	353,192	1,067,340	1,420,532

Data Sources:

i) 1950-66. Dahlberg (1968)

ii) 1967-69. 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 data used to separate Black Lake and Chignik Lake stocks.

Appendix Table No. 2. Black Lake Red Salmon Return by Age Class, 1950-69.

Year	Age Class 1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	Total
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 2/	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

Data Sources:

i) 1950-66. Dahlberg (1968)

ii) 1967-69. 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, 1950-69.

Year	Age Class 1.1	2.1	3.1	1.2	2.2	3.2	1.3	2.3	3.3	1.4	2.4	Total
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

Data Sources:

i) 1950-66. Dahlberg (1968)
ii) 1967-69. 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.