SOUTHEAST ALASKA PINK AND CHUM SALMON INVESTIGATIONS, 1991-92

FINAL REPORT FOR THE PERIOD JULY 1, 1991, TO JUNE 30, 1992

By

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ABSTRACT

Data collection, preparation, and analysis continued to be the primary activity of the Pink and Chum Salmon Investigations Project during the period July 1, 1991, through June 30, 1992. The 1991 pink salmon (*Oncorhynchus gorbuscha*) return to southern Southeast Alaska was 61.7 million which was 11.0 million below the forecast midpoint (72.7 million) but within the forecast's 80% prediction interval of 38.0 to 107.4 million. The northern Southeast return in 1991 of 31.5 million was 7.3 million above the forecast midpoint (24.2 million) but within the forecast's 80% prediction interval of 16.9 to 34.6 million. The 1992 return to southern Southeast was 36.4 million which was 9.4 million below the forecast midpoint (45.8 million) but within the forecast's 80% prediction interval of 27.2 to 77.4 million. The northern Southeast return in 1992 was 29.5 million, which was 19.6 million above the forecast midpoint (9.9 million) and outside of the forecasts 80% prediction interval of 7.0 to 13.9 million. Return, as used above, is defined as catch plus the escapement index times 2.5. This change was made last year to provide a more accurate representation of the spawner: recruit relationship.

Early marine studies continued in Tenakee Inlet. The relationship between northern Southeast pink survival (return per index spawner) and fry size provided a reliable estimate of the 1991 return but greatly underestimated the strength of the 1992 return.

INTRODUCTION

The Southeast Alaska pink salmon forecast research project was initiated in 1963. This report describes project activities during the period July 1, 1991, through June 30, 1992. The general scope of this project involves collection, analysis, and reporting of data useful for making preseason and inseason forecasts, and evaluating escapement goals.

The primary objective of the forecast research project is to improve sampling and analytical techniques and to collect background data to provide accurate annual preseason forecasts of pink salmon returns to northern and southern Southeast Alaska. A new phase of this project, initiated in 1990, was designed to provide an inseason forecast based on the most current inseason harvest, and catch per unit effort (CPUE) information. Annual pink salmon forecasts are of importance to the fishing industry, both fishermen and processors for operational planning, and to fisheries managers for regulatory decision making.

Pink salmon returns to Southeast Alaska have been forecast with variable success since 1967. The forecast was initially based on the abundance of fry in the gravel, just prior to outmigration, as measured by preemergent pumping. In 1965 preemergent fry sampling was initiated on selected streams regionwide. In 1970 the program was expanded to include 12 new sample areas in seven new streams. In 1984, the entire southern area preemergent program was deleted as a result of budget reductions and, in 1986, the entire northern area preemergent sampling program was deleted, also as a result of budget reductions.

Forecasts made since the elimination of the preemergent programs have been based on escapement estimates, fry size during their early marine residence, and environmental parameters thought to reflect freshwater and/or early marine survival. In southern Southeast Alaska numerous environmental parameters have been found which exhibit a correlation with survival as measured by return-per-index-spawner. These include: the average daily temperature over the November through February time period following spawning (colder temperatures result in lower survival); coldest 14-day moving average of minimum daily temperature over this same time period (again colder temperatures reduce survival); and the last day of the coldest 14-day temperature noted above (early season cold spells result in lower survival than equally cold periods later in the winter). Predictions to southern Southeast Alaska during the 1987 through 1990 time period were made by utilizing the environmental parameters which provided the highest overall correlation coefficient when combined with the brood year escapement index in a linear regression to predict return. Although this method provided reliable hindcasts from 1967 through 1986, it did not provide reliable forecasts from 1987 through 1990. The actual return was below the lower end of the 80% prediction interval in 1987 and 1988, and above the upper end of the 80% prediction interval in 1989 and 1990. Consequently, a modified 3-parameter Ricker model (Geiger and Savikko 1991) was used for the 1991 prediction. This model provided a successful forecast of the 1991 return, and will be used again for the 1992 prediction.

In northern Southeast Alaska the relationship between environmental parameters and the brood year escapement index does not provide reliable predictions. Consequently, returns to northern Southeastern are forecast utilizing the relationship between the size of fry collected during the early marine program in Tenakee Inlet and their subsequent adult return.

In addition to preseason predictions, an attempt was made to provide weekly inseason predictions of the southern Southeast harvest. The weekly prediction updates were based on the historical relationship of the cumulative catch and weekly CPUE in the seine fishery to the season's total harvest of pink salmon. Lack of consistent seine openings in northern Southeast Alaska prevented use of the model for the northern area.

This report describes the 1991 return, presents the 1992 pink salmon forecast, and summarizes the data collected during the Early Marine program in the spring of 1992 . Since it was prepared after the 1992 pink salmon returned, an evaluation of the performance of the 1992 preseason and inseason forecasts is also presented. Specific project objectives were to:

1. Continue adding to a historical database to be used for developing techniques for reliable preseason forecasts of the pink salmon returns to the benefit of the resource, fishermen, processors, and fisheries managers.

2. Measure abundance, and growth of pink and chum salmon fry in marine nursery areas in Tenakee Inlet and Peril Strait and relate these data to abundance of returning adults.

3. Evaluate the use of preliminary inseason harvest data for providing weekly inseason predictions of the southern Southeast pink salmon harvest.

PINK SALMON FORECASTS

Methods

Preseason Forecasts

Returns to the southern and northern areas of Southeast Alaska are forecast separately. Adult tagging studies (Verhoeven 1952; Hoffman et al. 1983) have shown little overlap in migration routes for returns to these two areas and production appears to vary independently. While there are differences in the odd and even year returns, all years were included in the forecast models because neither southern nor northern Southeast Alaska has ever exhibited a long term "odd" or "even" year cycle (Figures 1 and 2). The southern area encompasses Districts 101 through 108, and the northern area encompasses Districts 109 through 115 (Figure 3).

Escapement estimates for northern and southern Southeast Alaska are obtained by summing the individual district escapement indices in each area. The district escapement indices are calculated by summing the highest escapement count made on each stream surveyed in the district and adjusting for the number of streams not surveyed within that district. The number of streams in each district is defined as the number of streams for which an escapement count is available at least once during the 1960 through 1992 time period. The number of streams not surveyed in each district is multiplied by the average escapement count to all streams within that district with a peak escapement count under 10,000 pinks. The escapement index estimates for each district are recalculated for all years each year to insure that the expansion factor used to correct for unsurveyed streams is consistent between years. The majority of escapement counts are made by management biologists during routine aerial surveys. Weir counts are not included in the calculation since the data are only available for a few years, and the counts represent total escapements rather than index counts. When an estimate of the total escapement is required, the index is multiplied by 2.5 to convert the index to an estimate of the total escapement. The expansion factor of 2.5 was obtained from a study by Dangel and Jones (1988) in which they determined that aerial observers were counting an average of only 40% of the fish present in a stream. This is considered a minimum estimate since it does not include an expansion for stream life; consequently, fish which have died and drifted out of the river and those which have not yet entered the river on the date of the peak count are not accounted for.

The prediction for southern Southeast's return in 1992 was made using the same model which was used for the 1991 prediction, e.g., a "generalized" 3-parameter Ricker model (Paulik 1973):

$$R = \alpha E e^{-\beta E^{\gamma} + \delta_1 WT + \delta_2 PE + \epsilon}$$

where: R is the return (return = harvest + escapement index * 2.5)

E is the escapement index

WT is the winter temperature index

PE is the sum of the previous 2 brood year escapement indices

ε is the error term

In contrast to last year's forecast when this model was fit by variance-weighted non-linear least squares regression (Carroll and Ruppert 1988), we chose this year to fit the model by log-transforming both sides and using multiple linear regression, e.g.,

$$\log(R) = \alpha' + \log(E) - \beta E^{\gamma} + \delta_1 WTemp + \delta_2 PE + \epsilon$$

The 80% prediction interval for log(R) was calculated as follows:

$$\log(\hat{R}) \pm t_{1-\frac{\alpha}{2},21} * STDI$$

where α=.2, $t_{.9,21}$=1.323 is the 90th percentile of a Student's t-distribution with 21 degrees of freedom, and STDI is the standard error of the prediction from the model fit. The 80% prediction interval for return was then obtained by taking the antilog of both ends of the interval for log(R).

The northern Southeast prediction was made using the model:

$$\log(Y) = \alpha + \beta_1 \log(E) + \beta_2 Weight + \epsilon$$

where: Y is catch or return

E is brood year escapement

Weight is the average weight of fry collected in Tenakee Inlet

ε is an error term

A log transformation was used because the residuals from a linear fit showed curvilinearity. An 80% prediction interval was constructed in a similar fashion to the method used for southern Southeast (using $t_{.9,9}$= 1.383).

Inseason Forecasts

The first inseason prediction is prepared after preliminary seine catch statistics from the first opening of the season are available. The catch information is generally available within three days after the first week's seine fishery closes. The first 1991 inseason prediction model was a variance-weighted linear regression of total harvest on the predicted value from the preseason model and current CPUE (Statistical Week 28). (Note that the dependent variable used in the regression was total return in 1990 and total harvest in 1991). Subsequent weekly inseason predictions regressed total harvest on the previous week's inseason predictions (rather than the preseason prediction) and the current week's CPUE. By midseason (Statistical Week 32) cumulative catch replaces the previous week's prediction.

Historic CPUE data is obtained from the Department's Integrated Fisheries Data Base (IFDB) program. It is calculated by including only those seiners who made deliveries from a single district within a single opening. Seiners who made deliveries from more than one district during an opening are excluded from the CPUE calculation. The above restriction was made because it was not possible to determine what portion of an opening a seiner had spent fishing in each district when more than one district was fished. Consequently, the effort for that seiner in each district was an unknown. The current year's CPUE data is obtained from the Area Management Biologists' estimates. Their estimates are based on information provided by the local processors and from interviews with fishermen. The Area Management Biologists' estimates are updated continually throughout the season as fishtickets are entered into the IFDB program.

PRESEASON FORECASTS

Results and Discussion

Southern Southeast Alaska 1991 Preseason Forecast Evaluation

The pink salmon return to southern Southeast Alaska in 1991 was 61.7 million fish, which was 11.0 million below the forecast midpoint (72.7 million) but within the 80% prediction interval of 38.0 to 107.4 million (Geiger and Savikko 1991). The 1991 pink salmon harvest was 43.5 million, which was 6.7 million below the harvest midpoint (50.2 million) but within the 80% prediction interval of 15.5 to 84.9 million. The escapement index in southern Southeast in 1991 was 7.3 million (Table 1), which was within the escapement index goal range of 6.0 to 9.0 million. The escapements were well distributed, with all districts except District 101 and 106 exceeding their minimum goal levels (Table 2).

Southern Southeast Alaska 1992 Preseason Forecast

Because of the success of the southern Southeast return prediction in 1991, it was decided to use the same model to predict the 1992 return to southern Southeast Alaska. However, unlike 1991 when the model was solved using variance weighted non-linear least squares regression, the 1992 model was fit by log-transforming both sides and using multiple linear regression. The decision to change the method of calculation was based on the belief that the log-transformed method might provide a more appropriate interval estimate. Unlike the non-linear regression intervals, the log-normal intervals are naturally constrained to be positive. In addition, the log-normal intervals are asymmetric, becoming wider as the predicted return increases. This agrees with an intuitive belief that there is more uncertainty associated with record and near record predictions.

The above model resulted in a midpoint return prediction for southern Southeast Alaska of 45.8 million, with a range of 27.2 to 77.4 million (Geiger and Savikko 1992). Subtracting the escapement goal of 18.8 million leaves an estimated harvest in southern Southeast in 1992 of 27.0 million. Figure 4 shows the results of using the above model to predict the return to southern Southeast Alaska during the 1967 through 1992 time period.

Southern Southeast Alaska 1992 Preseason Forecast Evaluation

The pink salmon return to southern Southeast in 1992 was 36.4 million which was 9.1 million below the forecast midpoint but within the 80% prediction interval of 27.2 to 77.4 million (Figure 4). The 1992 harvest was 19.0 million, which was 8.0 million below the prediction midpoint but within the 80% prediction interval of 8.4 to 58.6 million (Geiger and Savikko 1992). The escapement index in southern Southeast in 1992 was 7.0 million, which was within the escapement goal range of 6.0 to 9.0 million (Figure 5). The escapement was not well distributed, however, since streams in the Ketchikan Management Area (Districts 101 through 103) were all above escapement index goal levels, while those in the Petersburg management area (Districts 105 through 107) were all below escapement index goal levels (Figure 5). The escapements to Districts 105 and 106 were especially weak, being the fourth and seventh lowest escapements achieved since statehood (Table 2). This, in spite of the fact that restrictive openings during the 1992 seine season in Districts 105 and 106 resulted in a combined harvest of less than 10,000 pink salmon.

Northern Southeast Alaska 1991 Forecast Evaluation

The pink salmon return to northern Southeast Alaska in 1991 was 31.5 million fish, which was 6.9 million above the forecast midpoint (24.2 million) but within the 80% prediction interval of 16.9 to 34.6 million (Geiger and Savikko 1991). The harvest in northern Southeast in 1991 was 18.4 million (Table 1), which was 6.2 million above the forecast midpoint (12.2 million) but within the 80% prediction interval of 4.9 to 22.6 million. The escapement index in northern Southeast in 1991 was 5.2 million, which was very close to the overall escapement index goal of 4.8 million (Figure 6).

Northern Southeast Alaska 1992 Forecast

The majority of the variation in the pink salmon run to northern Southeast prior to 1992 was explained by the size of the fry collected during the May 15 through May 31 time period from the Early Marine Program in Tenakee Inlet. The average size of pink fry during the 1979 through 1991 study period was 613 milligrams, whereas fry collected in 1991 only weighed 455 milligrams.

Harvest rather than return was used as the dependent variable in the 1992 prediction. The change was made because the return model forecast a return of only 9.9 million pinks, which is below the escapement goal for northern Southeast of 12 million. Using harvest rather than return as the dependent variable in the regression model was deemed appropriate because the escapement goal for northern Southeast had been met or exceeded only twice in the last 32 years (Table 3). In addition, the lowest harvest which occurred over the study period (1979 through 1991) was 1.1 million (Table 1). The harvest model predicted a total harvest in northern Southeast of 2.2 million. The 80% prediction interval for harvest was 1.1 to 4.5 million (Geiger and Savikko 1992). The estimated escapement was obtained by subtracting the harvest estimate of 2.2 million from the total return estimate of 9.9 million, which left an escapement estimate of 7.7 million.

Northern Southeast 1992 Forecast Evaluation

The pink salmon return to northern Southeast in 1992 was 29.5 million, which was 19.6 million above the forecast midpoint (9.9 million) and outside of the 80% prediction interval of 7.0 to 13.9 million (Geiger and Savikko 1992). The 1992 pink salmon harvest was 15.8 million (Table 1), which was 13.6 million above the forecast midpoint (2.2 million) and outside of the 80% prediction interval of 1.1 to 4.5 million. The 1992 escapement index in northern Southeast was 5.5 million which was the second highest index achieved since 1960 (Table 3). The escapement was well distributed compared to recent years with Districts 109, 110, 111, and 112 all exceeding their minimum escapement index goal levels (Figure 6). District 113's escapement index was only 78% of its goal. However, District 113 has an odd-year dominance and 1992's escapement index was the second highest even-year escapement index since 1960. The 1992 escapement index in District 114 was only 38% of the desired goal level; however, this district has only reached the desired goal level twice in the last 33 years (Figure 6).

The relationship between fry size in Tenakee Inlet and the adult return to northern Southeast has provided a relatively accurate forecasts from the first year of the study (1979) through the 1991 return (Figure 7). However, the 1992 forecast was an extreme underestimate of the actual return. There has always been a concern that predicting the return to an area as large as northern Southeast Alaska, based on the size of fry from only one estuary, was very risky. Although the 1992 forecast was for a very small return, it was recognized that the forecast interval was probably overly restrictive (Geiger and Savikko 1992) because the model was based on a small number of years, and we were not confident that it wasn't missing variables which were important to the forecast.

SOUTHERN SOUTHEAST INSEASON FORECASTS

The first inseason predictions were made in 1990. The first week's inseason prediction for that year accurately indicated that the preseason prediction was too low (Figure 8). The midpoints of the preseason and inseason prediction models in 1991 were very similar. However, the 80% prediction interval on the first inseason prediction made in 1991 (Statistical Week 28) was approximately 10 million narrower than the 80% prediction interval of the preseason prediction (Figure 8).

EARLY MARINE SURVIVAL STUDIES

The Early Marine Survival study in northern Southeast Alaska continued in 1992. The fry size parameter which had provided reliable pink salmon return predictions from 1980 to 1991 severely underestimated the 1992 return (Figure 7).

Methods

Fry abundance in Tenakee Inlet was monitored once each week, weather permitting, by conducting visual surveys along marked shoreline transects at Cannery Point, Corner Bay, Tenakee Boat Harbor, and Trap Bay (Figure 9). Three additional sites were added to the study in 1990. The three sights are located in Peril Strait, the first major estuary south of Tenakee Inlet (Figure 9). Fry were counted by a person wearing polarized sun glasses and standing in the bow of a 4 meter skiff. The skiff was piloted along the shoreline in water as shallow as possible at speeds less than 3 knots. Numbers and locations of fry were recorded directly in field notebooks at the time of observation. Fry samples for weight and length analysis were collected with a beach seine. The seine measured 38.5 meters long by 1.8 meters deep and had a uniform rectangular mesh of 3.2 x 6.4 millimeters. Fry samples collected for length-weight analysis were preserved in a 10% buffered (sodium borate) formalin solution.

Temperature and salinities measurements were taken at the surface and 5 meter depth increments from 1 meter to 15 meters, with a model 33 Yellow Springs temperature/salinity meter. Water clarity was measured with a 20 cm. diameter secchi disc.

Results and Discussion

The average length and weight of pink salmon fry collected in Tenakee Inlet and Peril Strait for the entire month of May and during the May 1 through May 15 and May 15 through May 31 time period is presented in Table 4. The average size of chum salmon fry is presented in Table 5. These tables represent the total number of fry collected using all gear types (beach seine, purse seine, lampara seine, and dip net). Fry from the earliest years were collected primarily with dip nets, while those from the later years were collected mainly with beach seines. As indicated in the Northern Southeast 1992 Forecast Evaluation section, the fry size parameter had been providing reliable forecasts of the northern Southeast pink salmon return between 1980 and 1991 but greatly underestimated the 1992 return.

The number of pink salmon observed at Cannery Point in Tenakee Inlet, and in Peril Strait, by statistical week, by year, is shown in Table 6. In 1992, the Cannery Point peak count and mean count during Statistical Weeks 18-22 were the highest for the study period (1979 through 1992). No correlation has been found between the number of fry observed and the subsequent return of pink salmon adults to Tenakee Inlet or northern Southeast Alaska as a whole. The lack of correlation may be the result of an inability of the observers to accurately estimate the numbers of fry present in large schools. Both "within" and "between" observer variability detracts from the accuracy of abundance estimates. However, the same employee made the abundance estimates during the 1990 through 1992 time period. Consequently, the "between" observer variability factor was not present during the last three years. Considering only the last three years, the abundance indices for 1992 at Cannery Point (peak survey and mean counts during Statistical Weeks 18 through 22) were approximately double those of 1990 and 1991 (Table 6). The counts from transects located in Peril Strait are shown in Table 7. Temperature and salinity data have been collected in Tenakee Inlet at the same location near Hill Point at the outer entrance of the inlet. Table 8 lists the temperature, salinity, and secchi disk measurements taken at that location.

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Table 1. Southern and northern Southeast Alaska harvest, escapement index, and return per index spawner, 1960-1992.

	SOUTHERN SOUTHEAST				NORTHERN SOUTHEAST			
Year	Harvest	Escapement Index	Return Index	Return/ Index Spawner	Harvest	Escapement Index	Return Index	Return/ Index Spawner
1960	1,439,571	2,365,702	3,805,273		1,259,569	1,420,651	2,680,220	
1961	3,771,149	2,455,446	6,226,595		7,624,490	2,835,296	10,459,786	
1962	10,740,325	4,317,476	15,057,801	6.4	489,299	1,956,921	2,446,220	1.7
1963	5,136,034	3,881,712	9,017,746	3.7	13,901,101	4,032,966	17,934,067	6.3
1964	11,257,947	4,843,443	16,101,390	3.7	7,281,428	2,742,440	10,023,868	5.1
1965	5,710,458	3,470,090	9,180,548	2.4	5,158,660	2,878,989	8,037,649	2.0
1966	15,561,555	5,108,869	20,670,424	4.3	4,786,158	3,098,186	7,884,344	2.9
1967	641,540	1,856,452	2,497,992	0.7	2,429,189	2,011,352	4,440,541	1.5
1968	15,193,876	4,863,482	20,057,358	3.9	9,870,885	3,210,611	13,081,496	4.2
1969	1,196,783	2,005,560	3,202,343	1.7	3,608,161	2,419,983	6,028,144	3.0
1970	5,411,666	4,113,616	9,525,282	2.0	5,239,804	2,560,864	7,800,668	2.4
1971	6,250,201	4,880,091	11,130,292	5.5	3,012,359	2,908,001	5,920,360	2.4
1972	9,153,111	3,990,294	13,143,405	3.2	3,242,218	2,828,835	6,071,053	2.4
1973	4,555,118	3,369,313	7,924,431	1.6	1,880,185	2,281,929	4,162,114	1.4
1974	4,220,580	3,697,657	7,918,237	2.0	661,067	1,880,077	2,541,144	0.9
1975	3,330,208	4,683,138	8,013,346	2.4	615,444	1,567,009	2,182,453	1.0
1976	5,157,420	5,306,438	10,463,858	2.8	139,209	1,373,364	1,512,573	0.8
1977	11,242,198	6,176,873	17,419,071	3.7	2,521,312	4,152,532	6,673,844	4.3
1978	18,424,066	5,454,511	23,878,577	4.5	2,758,306	2,965,407	5,723,713	4.2
1979	6,951,820	4,744,621	11,696,441	1.9	3,750,011	5,053,140	8,803,151	2.1
1980	12,892,193	6,242,499	19,134,692	3.5	1,392,794	2,648,845	4,041,639	1.4
1981	13,496,789	5,916,179	19,412,968	4.1	5,328,069	3,894,084	9,222,153	1.8
1982	12,945,018	6,006,014	18,951,032	3.0	11,232,924	3,923,265	15,156,189	5.7
1983	31,445,116	8,221,654	39,666,770	6.7	6,052,575	4,283,016	10,335,591	2.7
1984	19,675,931	8,991,136	28,667,067	4.8	4,973,720	3,975,761	8,949,481	2.3
1985	30,707,636	12,439,628	43,147,264	5.2	21,211,551	8,040,038	29,251,589	6.8
1986	45,003,089	14,258,909	59,261,998	6.6	1,142,808	2,856,004	3,998,812	1.0
1987	4,623,169	5,591,371	10,214,540	0.8	5,627,965	4,285,144	9,913,109	1.2
1988	9,047,083	4,426,317	13,473,400	0.9	2,013,961	2,892,340	4,906,301	1.7
1989	45,762,036	8,678,979	54,441,015	9.7	13,638,326	4,481,819	18,120,145	4.2
1990	26,681,469	7,103,240	33,784,709	7.6	5,659,362	3,810,264	9,469,626	3.3
1991	43,496,007	7,287,814	50,783,821	5.9	18,419,117	5,253,906	23,673,023	5.3
1992	18,998,852	6,982,411	25,981,263	3.7	15,836,450	5,479,422	21,315,872	5.6

Table 2. Southern Southeast Alaska pink salmon escapement by district and year.

Year	District 101	102	103	105	106	107	108	SSE Total
1960	726,020	210,776	928,350	156,136	69,119	239,301	36,000	2,365,702
1961	611,341	127,287	677,952	265,630	483,585	178,751	110,900	2,455,446
1962	1,220,747	355,825	1,273,828	468,526	518,150	421,000	59,400	4,317,476
1963	1,065,132	271,115	1,122,225	424,052	369,775	468,913	160,500	3,881,712
1964	1,273,469	532,704	1,253,950	547,965	663,449	453,203	118,703	4,843,443
1965	687,106	279,820	1,078,362	614,122	485,500	290,350	34,830	3,470,090
1966	1,496,930	616,668	1,315,405	537,150	647,696	495,020	0	5,108,869
1967	563,241	94,037	384,967	412,298	166,842	154,067	81,000	1,856,452
1968	1,837,225	544,322	1,094,890	499,324	406,259	388,769	92,693	4,863,482
1969	726,072	328,862	333,985	218,013	161,858	168,864	67,906	2,005,560
1970	1,508,615	264,761	1,439,322	229,459	248,866	348,733	73,860	4,113,616
1971	1,353,991	649,546	1,604,638	385,944	369,310	476,658	40,004	4,880,091
1972	1,651,100	354,146	915,956	283,570	229,440	442,248	113,834	3,990,294
1973	911,847	512,260	853,001	281,731	350,016	393,633	66,825	3,369,313
1974	1,293,850	480,440	1,155,955	201,088	201,353	325,146	39,825	3,697,657
1975	1,439,667	664,546	1,449,408	291,394	352,581	467,228	18,314	4,683,138
1976	1,523,782	706,470	1,556,397	154,703	663,544	685,745	15,797	5,306,438
1977	2,252,755	690,351	1,616,768	263,381	358,462	949,824	45,332	6,176,873
1978	2,157,453	569,293	1,685,581	292,617	289,082	439,422	21,063	5,454,511
1979	1,062,770	675,036	1,607,025	459,211	381,886	467,305	91,388	4,744,621
1980	2,360,089	686,073	2,506,575	147,830	156,533	358,830	26,569	6,242,499
1981	1,862,171	641,621	2,460,622	394,647	244,402	281,105	31,611	5,916,179
1982	2,199,570	582,615	2,098,555	256,100	341,520	457,980	69,674	6,006,014
1983	2,789,250	998,214	3,230,366	535,809	266,990	374,643	26,382	8,221,654
1984	3,685,157	956,239	3,334,059	266,360	311,923	409,202	28,196	8,991,136
1985	3,854,308	1,167,087	4,791,491	699,921	866,369	976,802	83,650	12,439,628
1986	4,528,205	1,761,475	5,841,107	676,983	820,020	590,321	40,798	14,258,909
1987	2,249,846	518,155	1,998,696	174,317	216,341	337,638	96,378	5,591,371
1988	1,558,852	573,143	1,506,894	171,101	250,399	300,444	65,484	4,426,317
1989	2,850,941	883,842	2,954,216	406,398	575,122	882,604	125,856	8,678,979
1990	2,171,659	1,107,557	2,362,241	397,298	519,436	431,244	113,805	7,103,240
1991	1,989,096	606,060	2,764,874	660,180	478,714	631,436	157,454	7,287,814
1992	3,108,745	942,285	1,909,209	168,650	239,364	525,059	89,099	6,982,411
Goal	2,000,000	600,000	1,700,000	500,000	600,000	600,000		6,000,000

Table 3. Northern Southeast Alaska pink salmon escapement by district and year.

Year	District 109	110	111	112	113	114	115	NSE Total
1960	116,507	258,417	339,325	192,005	365,565	128,931	19,901	1,420,651
1961	473,110	382,484	465,385	514,959	711,835	215,163	72,360	2,835,296
1962	477,778	425,495	290,287	194,470	349,166	196,235	23,490	1,956,921
1963	545,565	319,735	436,413	844,901	1,311,416	549,286	25,650	4,032,966
1964	705,460	497,550	400,373	470,200	532,286	125,771	10,800	2,742,440
1965	670,900	238,048	322,578	472,466	768,328	406,669	0	2,878,989
1966	750,891	549,500	513,337	642,936	529,276	109,546	2,700	3,098,186
1967	436,847	196,146	270,465	335,281	577,923	179,435	15,255	2,011,352
1968	708,606	966,116	476,213	546,877	310,460	155,089	47,250	3,210,611
1969	397,370	288,980	218,931	465,749	770,712	255,344	22,897	2,419,983
1970	472,550	522,020	448,846	518,715	379,789	164,774	54,170	2,560,864
1971	533,133	576,473	306,941	499,233	600,106	392,115	0	2,908,001
1972	451,761	690,421	594,141	553,541	345,027	193,944	0	2,828,835
1973	309,487	285,872	268,037	487,909	600,917	258,157	71,550	2,281,929
1974	291,744	272,527	429,787	321,228	441,701	123,090	0	1,880,077
1975	211,056	74,037	139,149	296,644	669,543	146,830	29,750	1,567,009
1976	223,739	163,536	107,967	231,489	520,796	125,810	27	1,373,364
1977	560,841	247,957	328,991	644,740	2,082,431	237,325	50,247	4,152,532
1978	447,360	413,769	181,865	819,664	908,571	194,070	108	2,965,407
1979	813,719	729,235	485,602	717,218	1,995,662	239,716	71,988	5,053,140
1980	460,143	397,892	319,117	550,499	610,970	227,954	82,270	2,648,845
1981	427,685	370,093	244,688	612,112	1,960,006	234,140	45,360	3,894,084
1982	757,824	590,506	451,872	738,340	1,139,190	195,932	49,601	3,923,265
1983	577,412	358,403	422,663	687,269	1,913,146	261,587	62,536	4,283,016
1984	732,250	409,358	465,771	479,698	1,605,190	213,129	70,365	3,975,761
1985	1,135,524	1,050,671	1,074,865	1,168,254	2,759,386	568,571	282,767	8,040,038
1986	738,965	270,377	245,369	659,601	767,532	170,350	3,810	2,856,004
1987	600,852	1,085,859	889,285	517,383	948,355	160,508	82,902	4,285,144
1988	624,615	469,130	326,043	641,769	576,384	195,269	59,130	2,892,340
1989	809,257	991,768	632,277	787,499	996,507	192,689	71,822	4,481,819
1990	596,405	1,058,618	369,370	607,486	870,923	187,760	119,702	3,810,264
1991	1,176,295	1,051,421	306,833	1,037,528	1,436,044	220,886	24,899	5,253,906
1992	995,780	1,094,130	780,425	1,077,513	1,254,790	191,384	85,400	5,479,422
Goal	600,000	1,000,000	500,000	600,000	1,600,000	500,000		4,800,000

Table 4. Average length and weight of pink salmon fry captured in Tenakee Inlet and Peril Strait.

	May 1 through May 15			May 16 through May 31			May 1 through May 31		
Length	Weight	Sample	Length	Weight	Sample	Length	Weight	Sample	
Year	MM	MG	Size	MM	MG	Size	MM	MG	Size
Tenakee Inlet									
1979	36.2	380	845	38.1	448	861	37.2	415	1,706
1980	35.0	327	1,028	40.0	578	1,042	37.5	453	2,070
1981	37.5	438	1,006	46.0	873	763	41.2	625	1,769
1982	36.0	362	893	38.2	448	1,059	37.2	409	1,952
1983	38.0	415	3,542	44.0	653	2,449	40.5	512	5,991
1984	38.5	409	656	47.7	911	2,740	45.9	814	3,396
1985	35.7	295	3,628	38.8	431	1,920	36.7	342	5,548
1986	34.3	294	3,710	38.3	450	1,211	35.3	333	4,921
1987	34.9	323	2,815	41.0	582	3,749	38.4	471	6,564
1988	36.5	392	3,224	44.7	799	2,782	40.3	581	6,006
1989	35.4	342	2,282	41.1	641	1,715	37.8	470	3,997
1990	36.3	364	2,437	44.4	741	967	38.6	471	3,404
1991	35.1	336	2,030	38.1	455	3,079	36.9	408	5,109
1992	35.8	337	1,923	39.7	548	2,406	38.0	454	4,329
Peril Strait									
1990	39.2	487	286	41.8	612	1,422	41.3	591	1,708
1991	33.6	275	591	35.6	358	774	34.8	322	1,365
1992	35.0	329	614	43.8	742	518	39.0	518	1,132

Table 5. Average length and weight of chum salmon fry captured in Tenakee Inlet and Peril Strait.

	May 1 through May 15			May 16 through May 31			May 1 through May 31		
	Length	Weight	Sample	Length	Weight	Sample	Length	Weight	Sample
Year	MM	MG	Size	MM	MG	Size	MM	MG	Size
Tenakee Inlet									
1980	41.3	665	4	41.3	665	4			
1981	51.5	1,377	271	51.5	1,377	271			
1982	40.6	560	11	44.7	844	4	41.7	635	15
1983	45.1	783	7	44.4	759	22	44.5	765	29
1984	36.1	352	1	57.2	1,705	132	57.1	1,695	133
1985	40.2	476	260	49.9	1,227	128	43.4	724	388
1986	39.8	534	112	49.4	1,163	69	43.4	774	181
1987	39.5	550	178	48.8	1,207	164	44.0	865	342
1988	41.7	654	27	48.6	1,192	122	47.4	1,095	149
1989	39.2	561	466	47.9	1,227	348	42.9	846	814
1990	38.6	490	145	53.1	1,584	170	46.4	1,080	315
1991	36.6	426	34	43.0	778	244	42.2	735	278
1992	36.1	374	12	47.3	1,092	54	45.2	962	66
Peril Strait									
1990	41.5	661	13	55.8	1,789	132	54.5	1,688	145
1991	35	297	2	56.4	1,785	85	55.9	1,751	87
1992	37.1	436	8	46.5	976	13	42.9	770	21

Table 6. Tenakee Inlet early marine fry surveys at Cannery Point in thousands of fish.

Year	15	16	17	18	19	20	21	22	23	24	Peak Survey	Mean Weeks 18-22
					Statistical Week							
1980	3		5	127	59	86	23				127	73.8
1981	2		7	42	81	8	8	13	8	2	81	30.4
1982			10	20	500	400	200	25	31	15	500	229.0
1983	9	2	16	48	130	141	155	120			155	118.8
1984		185	185		58		221	74			221	117.7
1985				123	756	1,036	516	1			1,036	486.4
1986				39	188	221	95	319	145		319	172.4
1987			51	45	166	43	37	166	47		166	91.4
1988					171	103	41	75	278		278	97.5
1989			232	206	64	745	83	68			745	233.2
1990				211	298	286	78	140			298	202.6
1991				279	489	605	201	294	144		605	373.6
1992					1,220	1,102	78	136	22		1,220	633.9
mean	4.7	62.3	63.3	114.0	321.5	398.0	133.5	119.2	96.4	8.5	442	178.8

Table 7. Peril Strait early marine fry surveys in thousands of fish.

Year	15	16	17	18	19	20	21	22	23	24	Peak Survey	Mean Weeks 18-22
					Statistical Week							
1990	Area #1				263	11	143	6			263	105.8
	Area #2				43	16	13	8			43	20.0
	Area #3				170	167	22	21			170	95.0
1991	Area #1			3	19		10	1	1		19	8.3
	Area #2						43				43	43.0
	Area #3				1		5	2			5	2.7
1992	Area #1					39	120	62	121		121	73.5
	Area #2					37	12	64	54		64	37.7
	Area #3					39	7	5	1		39	16.8

Table 8. Water temperature, salinity, and secchi disk reading from Hill Point in Tenakee Inlet.

Date	Secchi in Meters	One Meter Temperature in C	One Meter Salinity in 0/00	Two Meters Temperature in C	Two Meters Salinity in 0/00	Five Meters Temperature in C	Five Meters Salinity in 0/00
05/03/83	4.5	6.9	30.7	6.9	30.8	5.9	32.2
05/06/83	6.5	8.1	30.5	7.6	30.7	6.6	31.9
05/09/83	7.5	9.0	27.6	8.6	29.1	6.9	31.5
05/14/83	8.5	11.0	27.4	10.1	28.6	10.0	29.7
05/17/83	5.5	9.0	28.4	8.3	30.0	7.9	31.1
05/19/83	9.0	8.4	30.3	7.4	31.2	6.8	32.0
05/23/83	13.0	8.5	27.2	8.1	28.1	6.2	31.6
05/26/83	14.0	7.8	29.3	7.6	29.4	7.1	30.1
05/31/83	4.5	10.7	24.7	9.1	27.9	8.1	31.2
mean	8.1	8.8	28.5	8.2	29.6	7.3	31.3
05/08/84	6.0	8.5	29.7	8.1	30.6	7.9	31.7
05/17/84	7.5	9.9	29.1	10.0	29.3	7.9	31.6
05/31/84	20.0	9.4	28.2	8.6	29.8	7.0	31.3
mean	11.2	9.3	29.0	8.9	29.9	7.6	31.5
05/01/85	4.0	5.3	31.8	5.5	31.9	4.9	31.9
05/06/85	7.0	6.3	29.6	5.9	29.6	5.0	30.6
05/13/85	9.0	3.5	32.2	4.5	32.3	4.4	32.2
05/20/85	8.6	6.1	28.9	6.2	28.9	5.4	29.4
05/29/85	6.0	11.4	21.8	9.5	23.1	7.0	24.4
mean	6.9	6.5	28.9	6.3	29.2	5.3	29.7
05/07/86	5.5	8.8	25.9	10.8	22.9	7.2	28.9
05/14/86	7.2	7.6	28.0	7.3	28.4	5.8	29.8
05/21/86	4.5	7.7	29.9	7.3	30.1	5.9	31.3
05/27/86	5.5	9.8	27.1	9.1	28.7	8.2	29.9
mean	5.7	8.5	27.7	8.6	27.5	6.8	30.0
05/05/87	6.6	7.3	27.9	6.9	28.1	6.2	28.9
05/12/87	4.0	7.8	29.3	7.8	29.3	7.2	29.9
05/19/87	4.9	9.7	22.8	9.5	23.6	8.0	28.8
05/28/87	6.1	8.7	27.8	8.1	28.1	7.3	28.9
05/26/87	4.9	9.7	24.3	8.9	25.8	7.9	26.7
mean	5.3	8.6	26.4	8.2	27.0	7.3	28.6
05/03/88	4.0			6.9	29.2		
05/11/88	8.0			9.8	28.1		
05/17/88	7.5			10.1	23.3		
05/24/88	7.5			9.1	24.9		
mean	6.8			9.0	26.4		
05/02/90	4.5	8.5	23.5	8.0	24.3	6.0	27.5
05/07/90	4.8	8.0	26.1	7.7	27.2	7.5	27.5
05/14/90	5.4	9.0	25.3	8.5	27.4	7.2	28.9
05/22/90	4.4	10.0	26.2	7.6	29.0	6.5	29.6
05/28/90	5.1	10.6	25.3	9.1	27.6	7.9	29.6
mean	4.8	9.2	25.3	8.2	27.1	7.0	28.6
05/02/91	5.6	7.5	27.0	7.0	28.5	5.5	30.0
05/07/91	4.8	8.0	28.5	8.0	28.5	6.0	30.0
05/11/91	5.8	8.0	24.0	7.5	26.0	7.0	30.0
05/15/91	6.8	7.0	26.5	7.0	29.0	6.5	29.0
05/17/91	7.1	10.0	23.5	9.0	25.0	7.0	29.0
05/20/91	6.0	9.0	24.5	8.0	27.0	7.0	30.0
05/24/91	5.9	10.0	24.0	10.0	27.0	9.5	29.0
05/27/91	10.1	10.5	25.0	10.0	26.0	9.5	28.0
mean	6.5	8.8	25.4	8.3	27.1	7.3	29.4
05/05/92	18.2	7.0	19.5			7.0	22.0
05/08/92	13.2	7.0	19.0			6.0	22.5
05/11/92	13.0						
05/13/92		9.0	16.5			7.5	21.0
05/17/92	4.6	8.5	24.0			7.5	26.5
05/20/92	5.3	9.0	26.0			8.0	26.5
05/26/92	6.3	10.0	25.0			8.0	27.5
05/28/92	9.2	10.0	25.0			8.5	27.0
mean	10.0	8.6	22.1			7.5	24.7

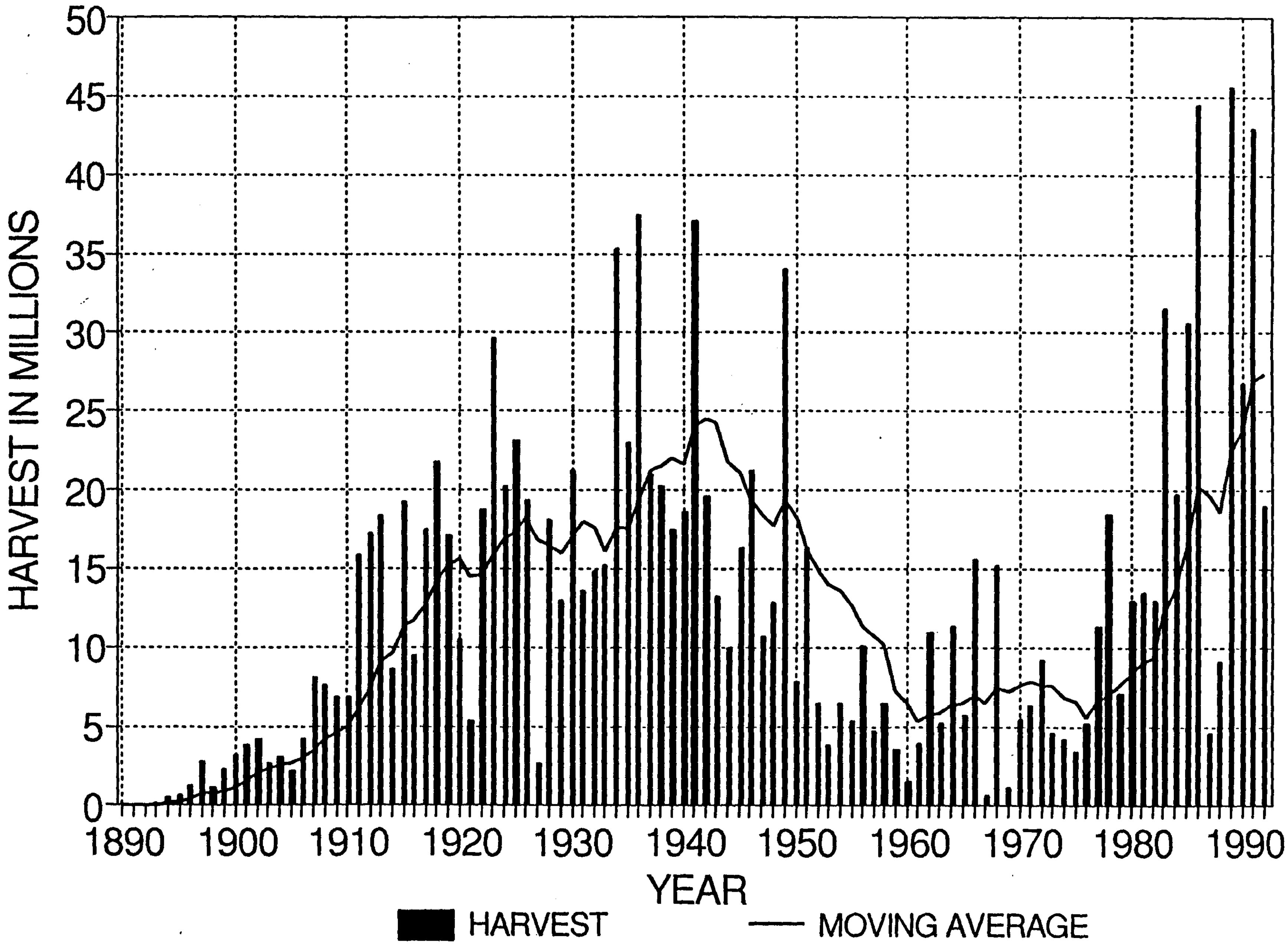


Figure 1. Southern Southeast pink salmon harvest with ten year moving average.

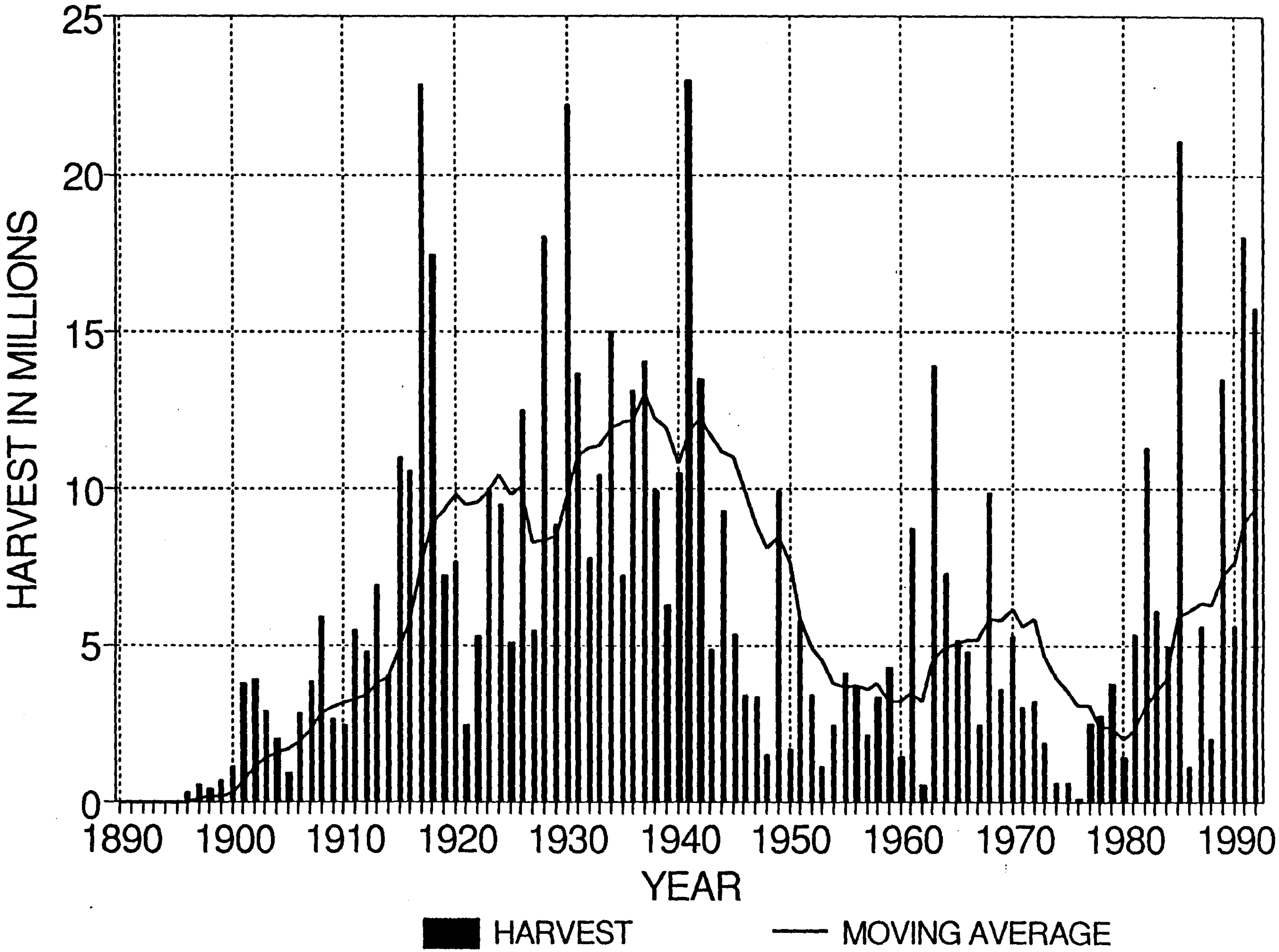


Figure 2. Northern Southeast pink salmon harvest with ten year moving average.

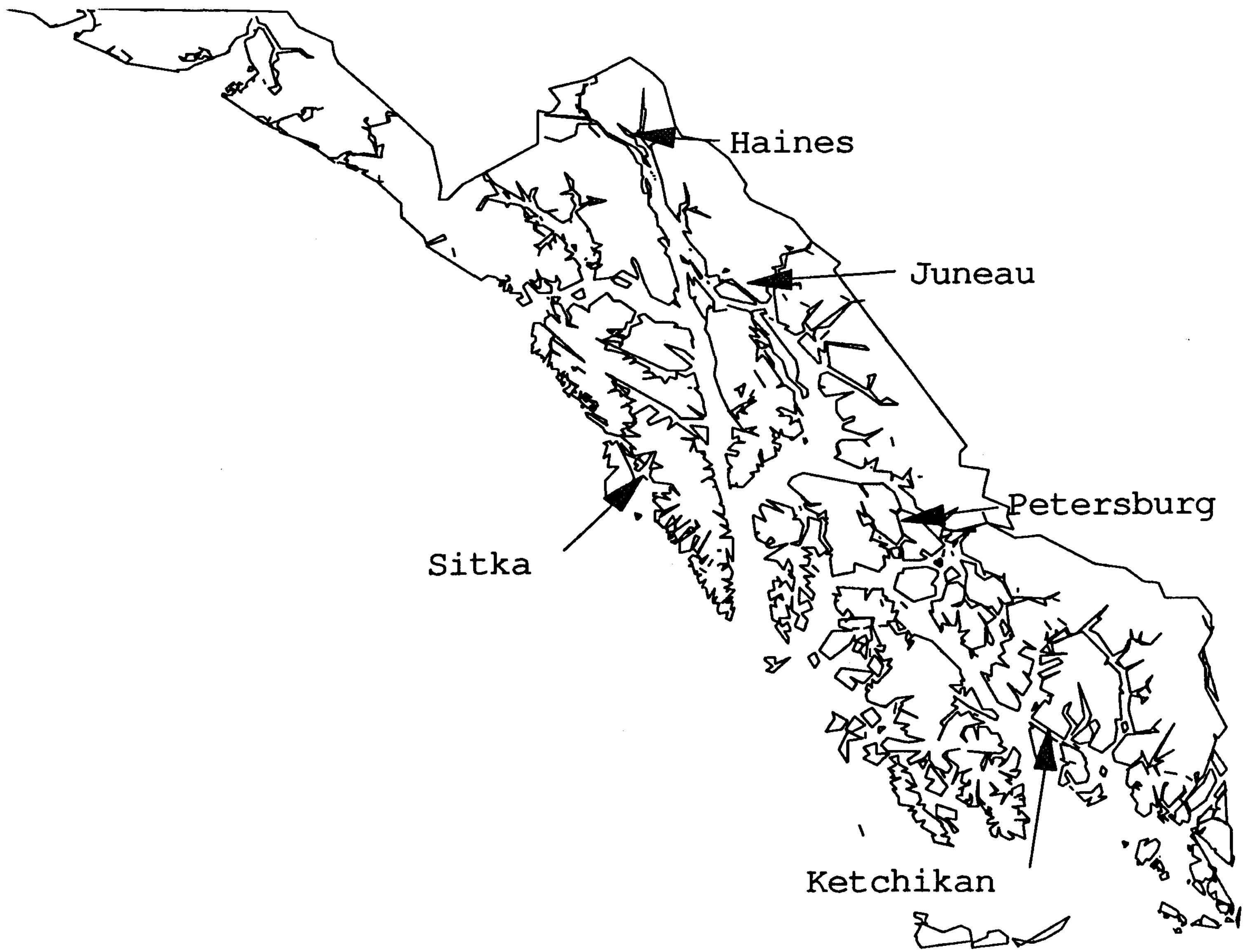


Figure 3. Northern Southeast Alaska pink salmon escapement index and escapement goals by district and year.

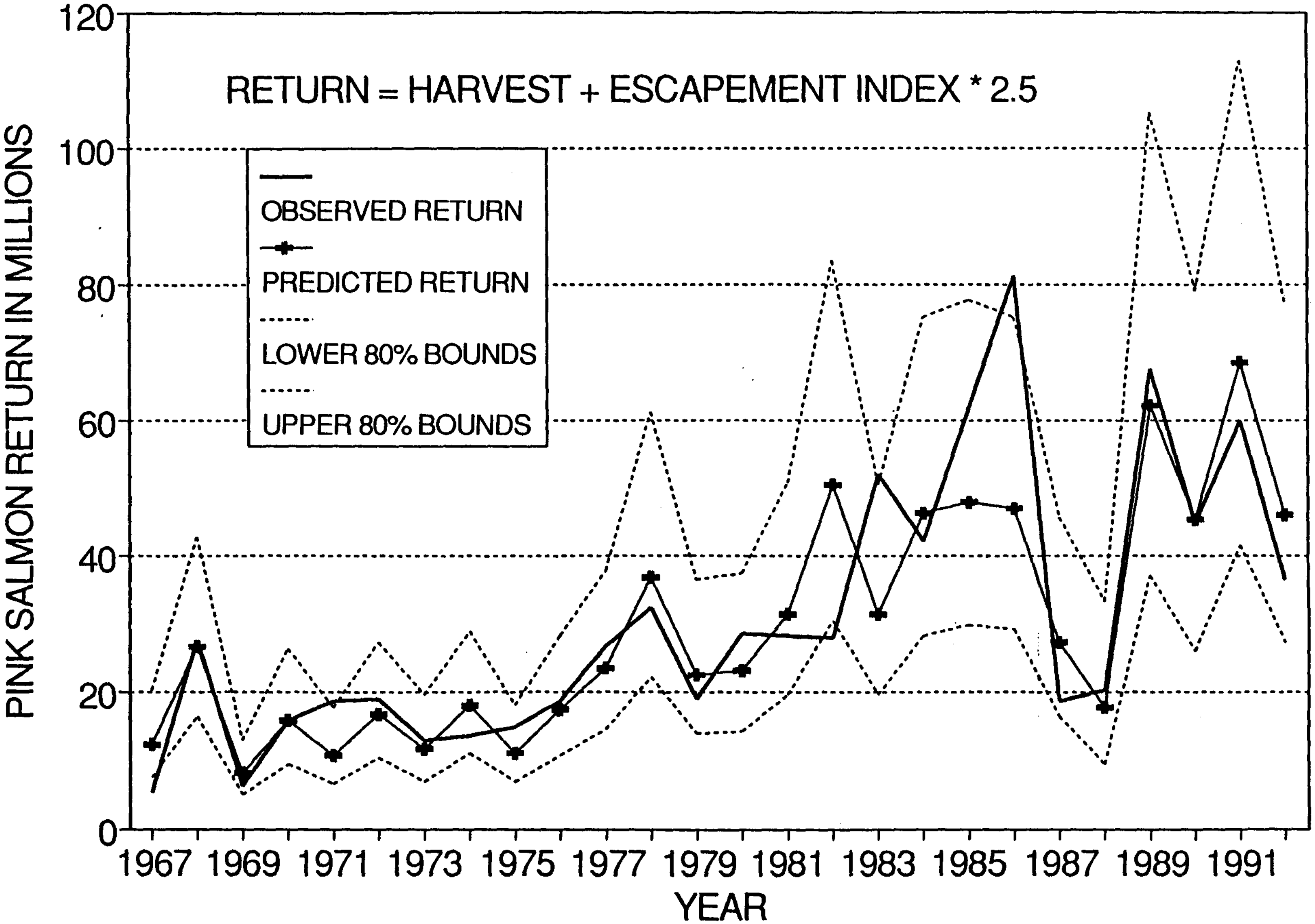


Figure 4. **Performance of southern Southeast's prediction model.**

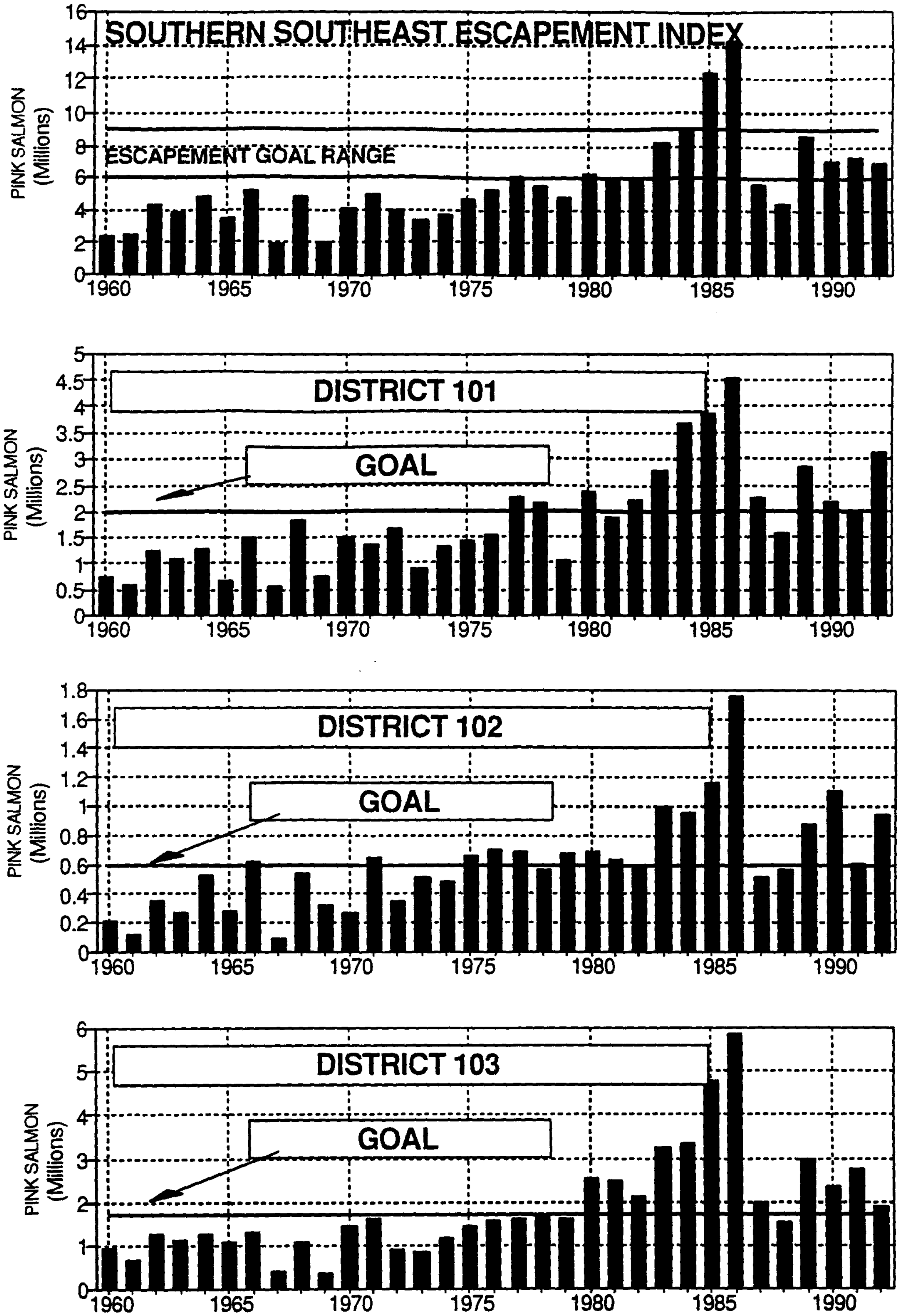


Figure 5. Southern Southeast Alaska pink salmon escapement index and escapement index goals by district and year.

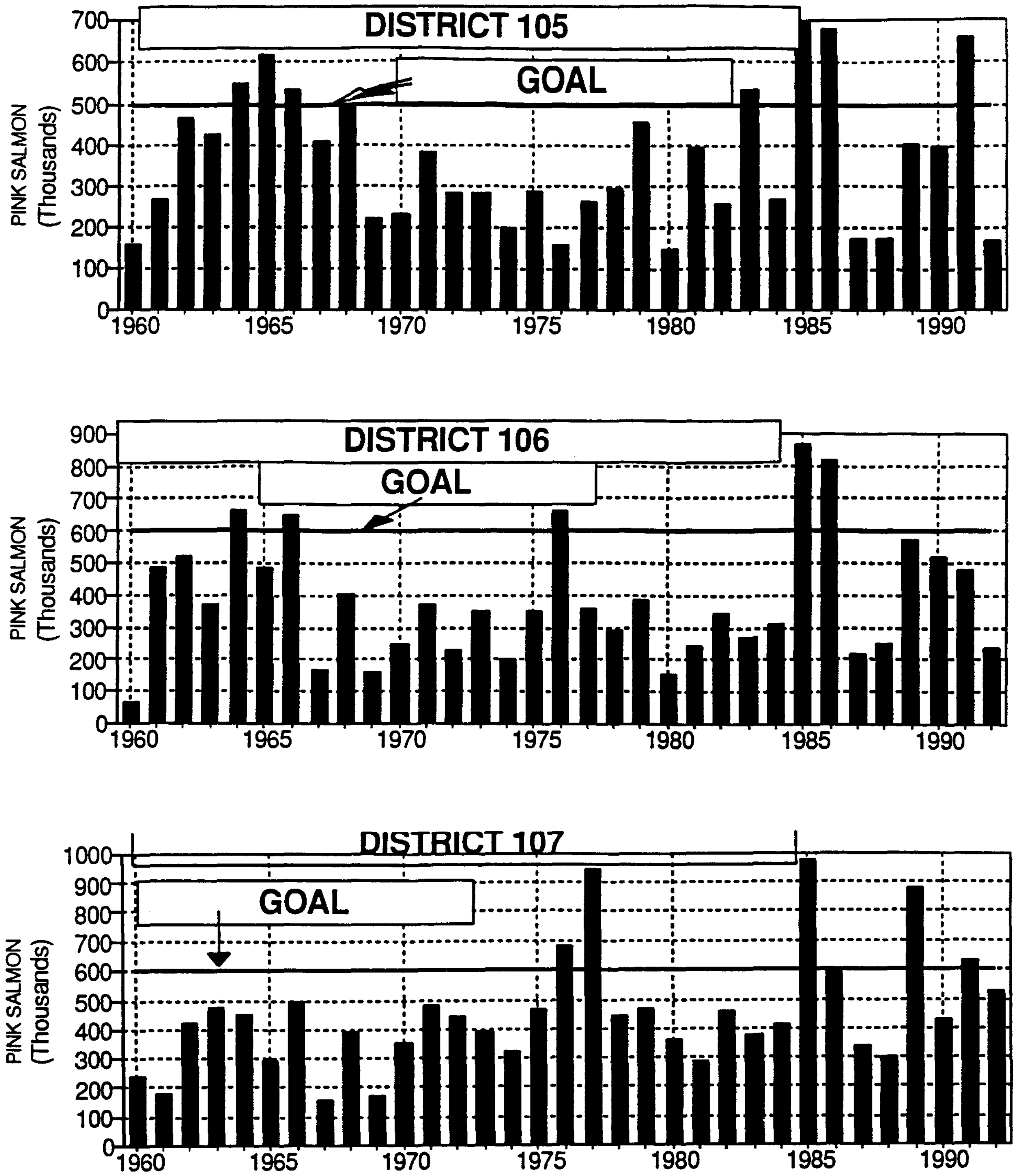


Figure 5. (page 2 of 2)

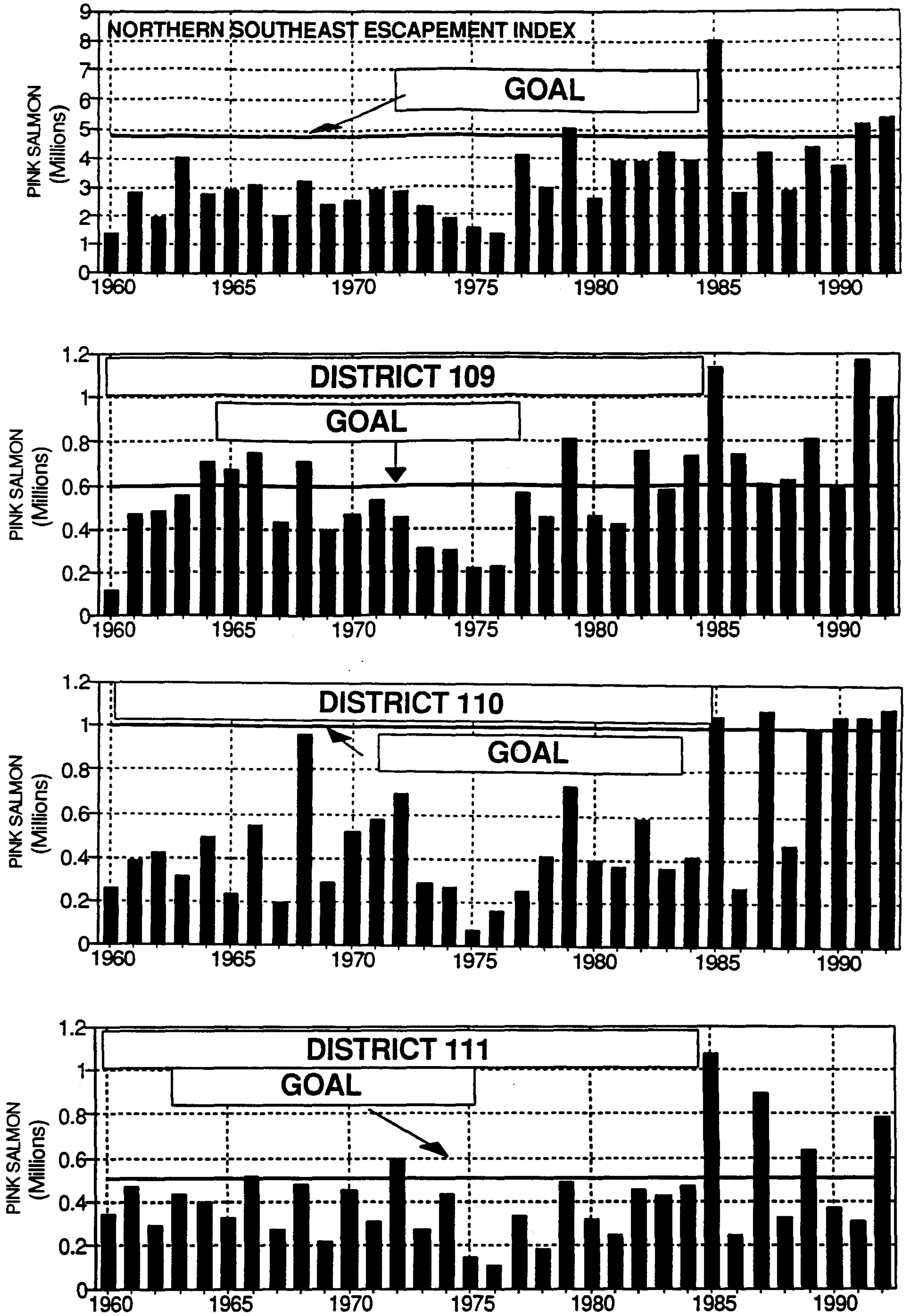


Figure 6. Northern Southeast Alaska pink salmon escapement index and escapement index goals by district and year.

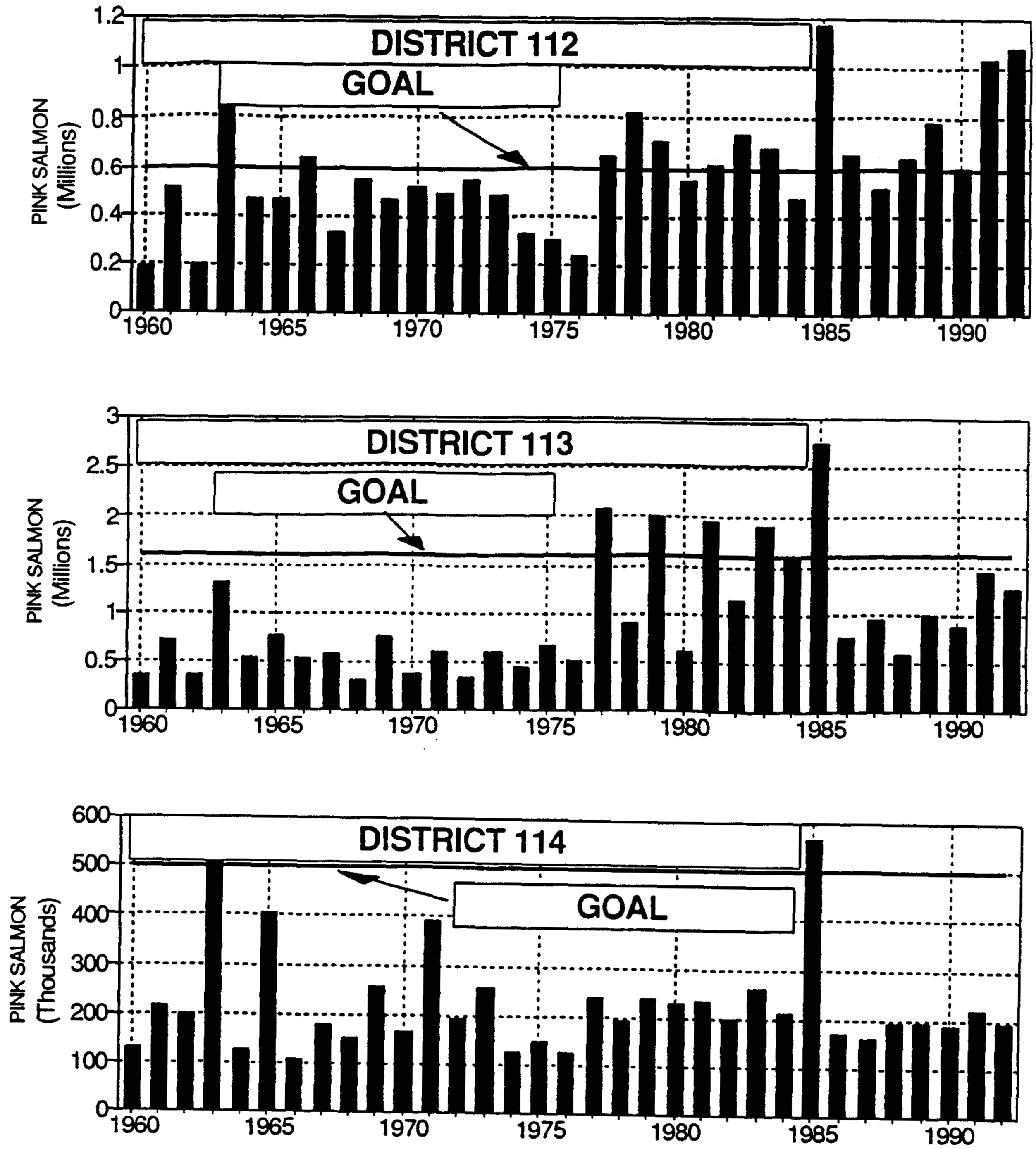


Figure 6. (page 2 of 2)

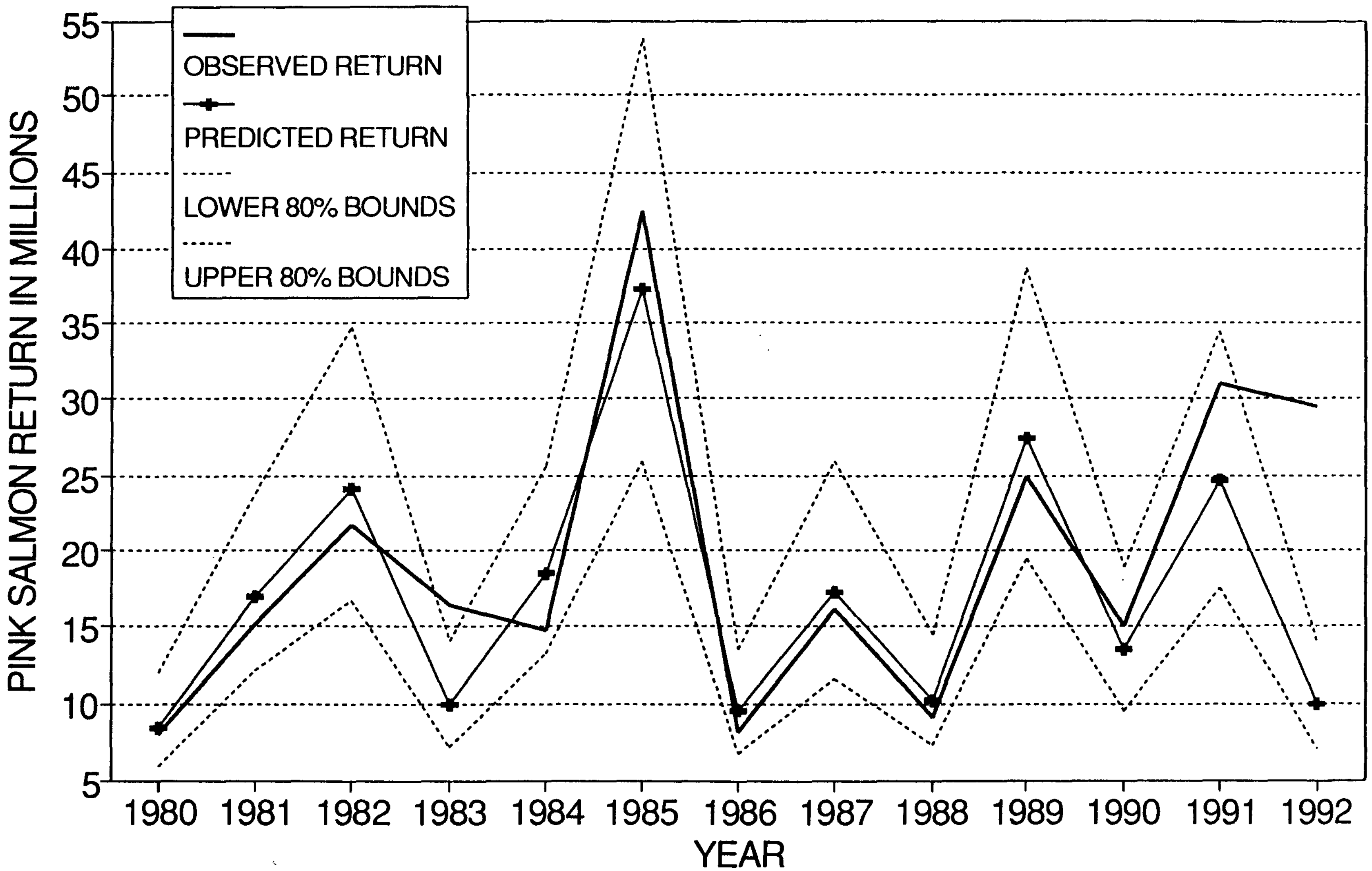
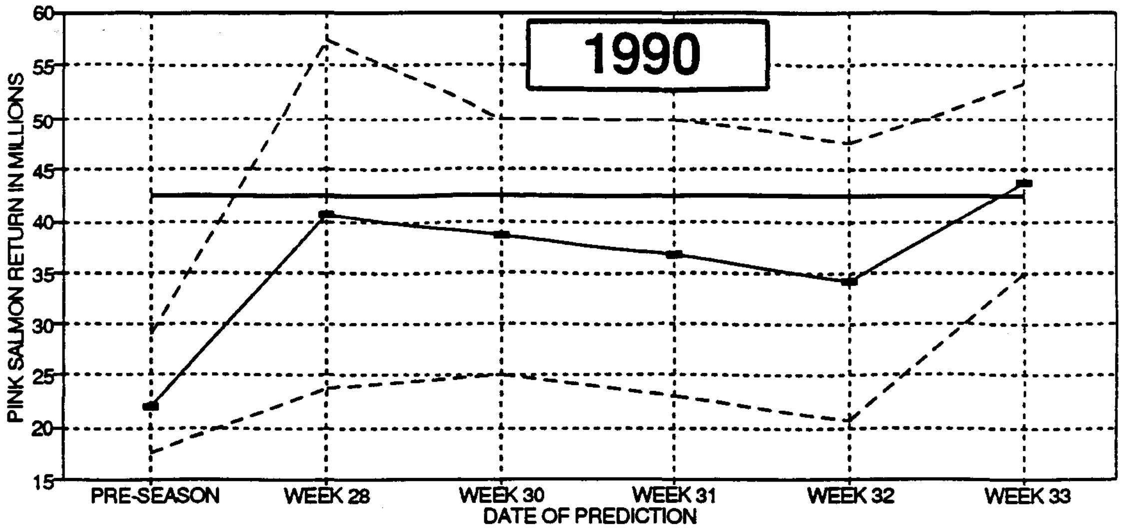


Figure 7. Performance of northern Southeast prediction model.



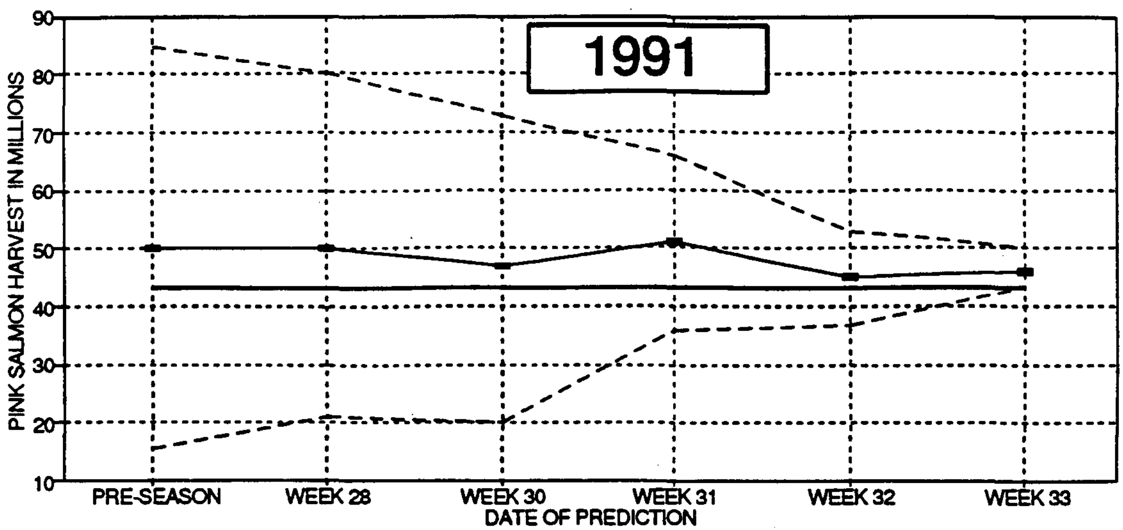


Figure 8. Preseason and inseason predictions of southern Southeast pink salmon 1990 and 1991.

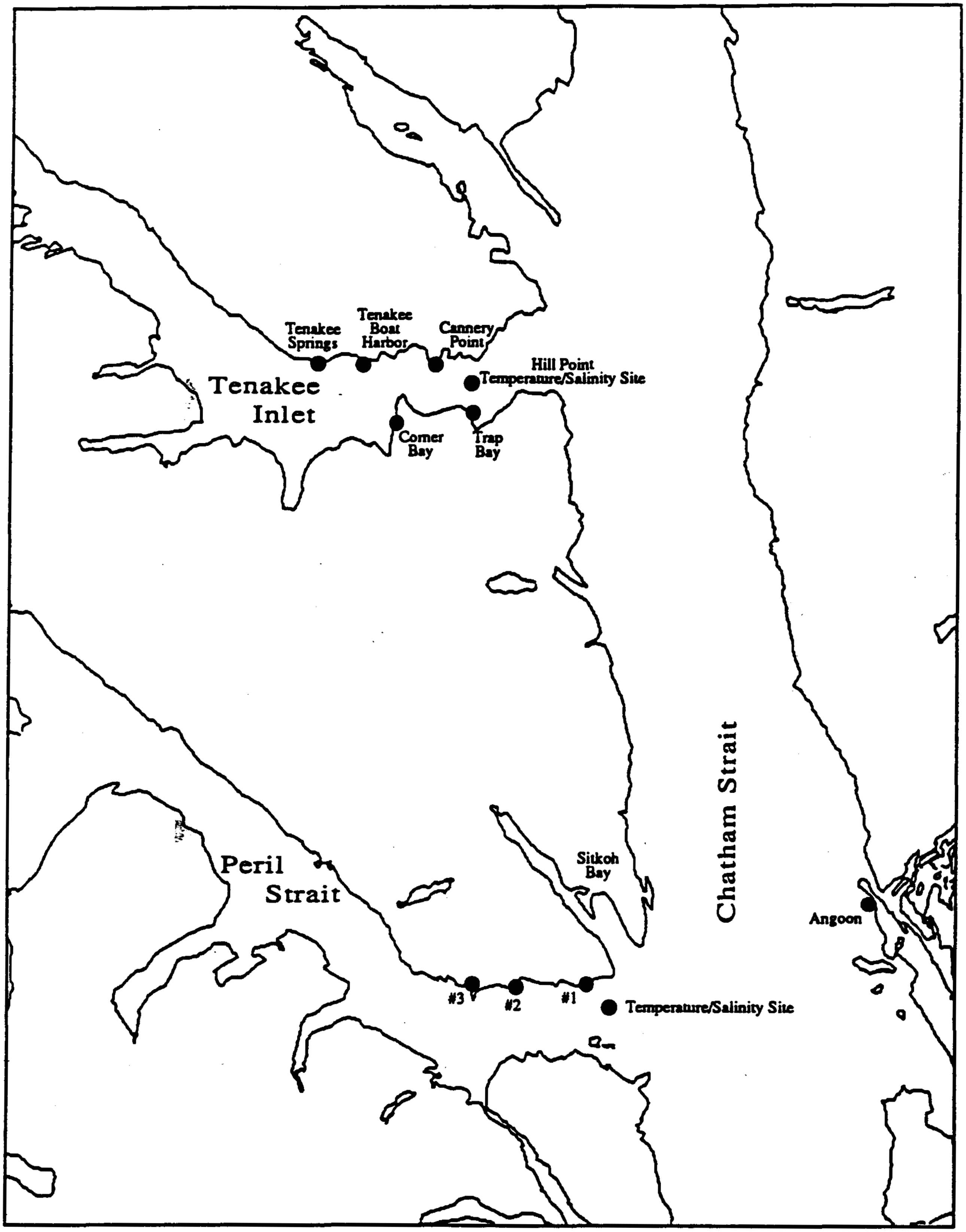


Figure 9. Major fry collection sites and oceanographic stations in Tenakee Inlet and Peril Strait in 1990.