

# **INFORMATIONAL LEAFLET NO. 190**

## PRELIMINARY FORECASTS AND PROJECTIONS FOR 1981 ALASKAN SALMON FISHERIES

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## ABSTRACT

In 1980 commercial fishermen harvested 110 million salmon in Alaska. The catch was the largest since 1936, despite lengthy price negotiations between fishermen and processors in Bristol Bay, Kodiak, Cook Inlet, and Prince William Sound which extended well into the fishing season. State-wide, the salmon harvest increased for the sixth consecutive year.

A commercial harvest of 75 million salmon is projected for Alaska in 1981. The catch is not expected to be less than 60 million, nor to exceed 95 million fish. Based on projection experience since 1970, only 1 of 4 realized harvests would fall outside this range.

Pink salmon harvests are expected to decline sharply from 1980 levels in almost all areas of the state in 1981. Little change is anticipated in catches of other salmon species.

## INTRODUCTION

This report reviews Alaska's 1980 commercial salmon season and presents preliminary salmon return forecasts and harvest projections for 1981 commercial salmon fisheries. The report is released in December, before final catch figures are available, to provide preliminary information to the Board of Fisheries, the fishing industry, and the public well before the season begins.

Projections of statewide commercial salmon harvests have been published yearly by the Alaska Department of Fish and Game since 1969 (ADF&G; 1969-1980). Table 1 summarizes the accuracy of these projections. On the average, the projections have been too low by 3.6 million fish, or 7% of the average harvest of 54 million fish. Without regard to sign, the mean error is 12 million fish; 22% of the average harvest. Projection errors stem primarily from inadequate knowledge of salmon escapements, numbers of juveniles produced, and early marine survival.

The Department's salmon harvest projections have fallen short of realized harvests every year since 1974, when the statewide salmon catch dropped to 22 million fish. Beginning in 1975, every year's harvest has been an improvement over the last; the 1980 statewide catch of more than 110 million salmon, the sixth consecutive catch increase, was also the largest since 1936. Because of the high natural variability in salmon abundance, and the periodicity inherent in Bristol Bay sockeye and pink salmon returns, consistent harvest trends are rare. In fact, until 1980, there had never been more than five consecutive salmon catch increases, even during the development of Alaskan salmon fisheries near the turn of the century. The 1981 harvest projection of 75 million is considerably above the average since 1970 of little more than 50 million fish. A 1981 harvest exceeding the 110-million 1980 catch is considered highly unlikely.

### Glossary

Salmon return or run:	The total number of mature salmon returning in a given year from ocean rearing areas to coastal waters.
Escapement, spawning population or brood stock:	That portion of a salmon run which is not harvested and survives to reach the spawning grounds.
Forecast:	Forecast harvests and returns are calculated using information such as parent-year escapements, subsequent fry abundance, spring sea water temperatures, and escapement requirements.

Harvest projections:

Harvest projections are averages of recent harvests. They may be modified subjectively when qualitative escapement or other relevant information is available. Only harvests are projected, and harvest projections are given only for salmon runs which have no forecast.

Table 1. Projected and realized Alaska commercial salmon harvest, with absolute and relative errors, 1970-1980.

Season	Millions of fish			(4) Relative error (% of actual harvest) (3)/(2) X 100%
	(1) Projected harvest	(2) Actual harvest	(3) Error (1) - (2)	
1970	91.5	68.5	23.0	34%
1971	41.5	47.5	-6.0	-13%
1972	46.7	32.0	14.7	46%
1973	30.0	22.3	7.7	35%
1974	15.6	21.9	-6.3	-29%
1975	19.9	26.2	-6.3	-24%
1976	37.1	44.4	-7.3	-16%
1977	34.7	50.8	-16.1	-32%
1978	62.9	81.6	-18.7	-23%
1979	72.0	88.9 <sup>1</sup>	-16.9	-19%
1980	102.6	110.3 <sup>1</sup>	-7.7	-7%
TOTAL	554.5	594.4	-39.9 (130.7) <sup>2</sup>	
1970-80 average	50.4	54.0	-3.6 (11.9) <sup>2</sup>	-7% (22%) <sup>2</sup>

<sup>1</sup> Preliminary data, through October 15. Compiled November 24, 1980.

<sup>2</sup> Values in parentheses are the sum or average of errors without regard to sign.

## Alaska Pacific Salmon Species

<u>Common Name</u>	<u>Scientific Name</u>
chinook, king	<i>Oncorhynchus tshawytscha</i>
sockeye, red	<i>Oncorhynchus nerka</i>
coho, silver	<i>Oncorhynchus kisutch</i>
pink, humpy, humpback	<i>Oncorhynchus gorbuscha</i>
chum, dog	<i>Oncorhynchus keta</i>

Brood years of salmon returning to spawn in 1981, by species and age<sup>1</sup>

Species	Age of Returning Salmon in Years				
	2	3	4	5	6
Pink	1979				
Chum		1978	1977		
Coho		1978	1977		
Sockeye			1977	1976	1975
Chinook			1977	1976	1975

<sup>1</sup> The brood years listed for each species generally comprise more than 90% of the run.

The boundaries of and major fishing areas within the Southeastern, Central, and Western statistical regions are shown in Figure 1. These regions and areas are the ones used in the Department's statistical leaflet series and in prior statistical reports.

### Acknowledgments

Information on which this report is based was contributed by Division of Commercial Fisheries biologists located in field offices throughout the state. Area biologists, not individually identified, supplied reviews of the 1979 fishing season. Individual credit for forecast material is given with the area forecast discussions in the Appendix.

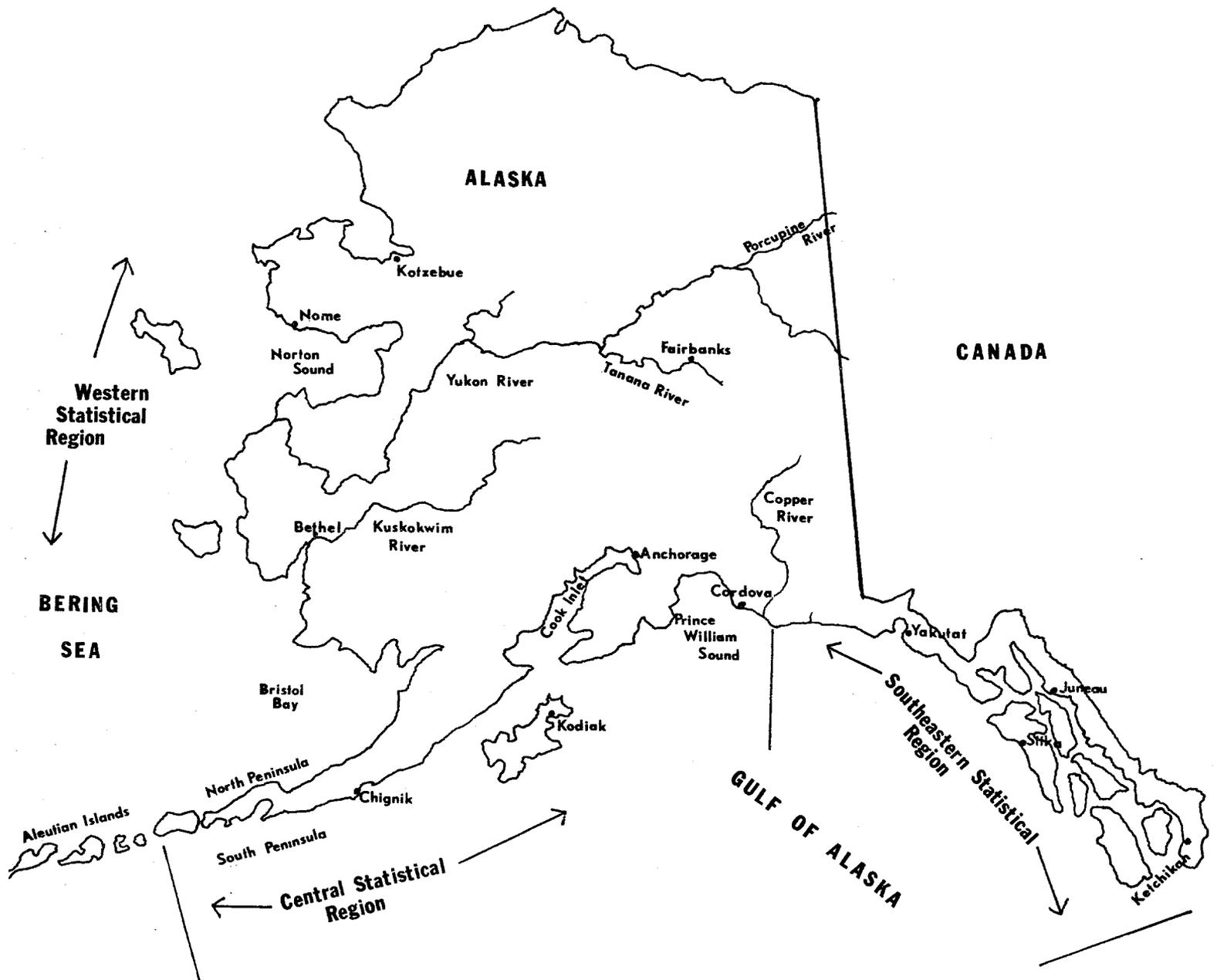


Figure 1. Alaska Department of Fish and Game Commercial Fisheries Statistical Regions.

## REVIEW OF THE 1980 SEASON

A preliminary estimate of the 1980 commercial salmon harvest in Alaska is 110 million fish, just above the Department's projection of 103 million. The 1980 catch was the largest since 1936, the sixth in an unbroken series of increases begun in 1975.

Statewide, catches of all species except sockeye and chinook salmon were larger than anticipated. The chinook harvest was close to the projection. Because price negotiations between fishermen and processors in the Bristol Bay area did not conclude until the first week of July, the statewide sockeye catch was only about three quarters of that expected. Sockeye catches in Central and Southeastern Alaska were more than twice those projected. The coho harvest was also better than expected almost everywhere, especially in central areas. Pink salmon returns to Bristol Bay, while impressive, were less numerous than forecast. Pink harvests in southern Southeastern Alaska, Prince William Sound, and Kodiak were all larger than expected, however, which resulted in a statewide total about 25% over the projection. The chum catch was up markedly in Southeastern Alaska, and was moderately higher in other regions. Table 2 compares actual and forecast 1980 salmon returns for selected fisheries, and Table 3 details preliminary estimates of the 1980 salmon harvest by species and area.

Table 2. Comparison of actual<sup>1</sup> and forecast 1980 salmon returns, with errors and relative errors, for some major Alaskan salmon fisheries.

Area	Species	Thousands of Fish					(6) Relative error: (5)/(3) X 100%
		(1) Harvest <sup>1</sup>	(2) Escapement	(3) Return <sup>1</sup> (1) + (2)	(4) Forecast return	(5) Error: (4) - (3)	
Southern Southeastern	Pink	12,900	6,630	19,530	9,500	-10,030	-51%
Northern Southeastern	Pink	1,600	2,100	3,700	4,500	800	22%
Southeastern Total	Pink	14,500	8,730	23,230	14,000	- 9,230	-40%
Prince William Sound	Pink	14,200	1,580	15,780	5,600	-10,180	-65%
	Chum	478	85	563	230	-333	-59%
Cook Inlet-Southern and Outer Districts	Pink	610	289	899	1,300	401	45%
Kodiak	Pink	17,300	6,300	23,600	17,600	- 6,000	-25%
Chignik	Sockeye <sup>2</sup>	958	664	1,622	2,100	478	29%
	Pink	1,050	742	1,792	2,900	1,108	62%
South Peninsula <sup>3</sup>	Pink	6,500	2,600	9,100	11,000	1,900	21%
Bristol Bay	Sockeye <sup>4</sup>	23,700	38,700	62,400	54,500	- 7,900	-13%
	Pink <sup>5</sup>	2,310	2,800	5,110	15,700	10,590	207%
<b>Total</b>		<b>81,606</b>	<b>62,490</b>	<b>144,096</b>	<b>124,930</b>	<b>-19,166</b>	<b>-13%</b>

<sup>1</sup> Preliminary data, compiled November 24, 1980.

<sup>2</sup> The harvest includes estimated interceptions of Chignik-bound sockeye taken at Cape Igvak, Aniakchak, Hook Bay, and Stepovak Bay.

<sup>3</sup> The harvest does not include 1.5 million pink salmon taken near False Pass, South Unimak, and the Shumagin Islands in June. These fish were returning to other areas.

<sup>4</sup> Inshore harvest only.

<sup>5</sup> Harvest in Nushagak District only.

Table 3. Preliminary 1980 Alaska commercial salmon harvest by species and fishing area<sup>1</sup>.

(Number of fish in thousands)

MANAGEMENT AREA	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	All
Southern Southeast						
Portland Canal gill net	1.6	124.6	22.7	866.9	193.9	1,209.7
Prince of Wales Island gill net	.6	107.4	16.6	45.6	26.3	196.5
Stikine River gill net	.6	14.1	2.9	7.2	6.9	31.7
Southern districts seine	12.0	487.9	181.4	11,422.5	611.4	12,715.2
Annette Island trap and misc.	.6	8.4	2.8	454.0	2.5	468.3
Southern Southeast total	15.4	742.4	226.4	12,796.2	841.0	14,621.4
Northern Southeast						
Taku-Snettisham gill net	2.4	123.1	41.5	295.6	192.8	655.4
Lynn Canal gill net	.4	53.2	28.8	81.8	168.9	333.1
Yakutat gill net	2.8	159.2	119.6	142.0	20.2	443.8
Northern districts seine	.5	39.6	12.9	899.8	415.7	1,368.5
Northern Southeast total	6.1	375.1	202.8	1,419.2	797.6	2,800.8
Southeast Region troll	299.1	2.9	706.5	267.5	12.2	1,288.2
SOUTHEASTERN STATISTICAL REGION TOTAL	320.6	1,120.4	1,135.7	14,482.9	1,650.8	18,710.4
Cordova area						
Copper River	8.4	18.5	212.5	3.9	0.0	243.3
Bering River			108.5		0.0	108.5
Prince William Sound	.3	211.7	4.0	14,219.1	477.7	14,912.8
Cordova Area total	8.7	230.2	325.0	14,223.0	477.7	15,264.6
Cook Inlet area						
Upper Cook Inlet						
Northern District	1.1	111.2	102.8	499.3	18.5	732.9
Central District	11.4	1,473.2	180.8	1,371.8	368.6	3,405.8
Upper Cook Inlet total	12.5	1,584.4	283.6	1,871.1	387.1	4,138.7
Lower Cook Inlet						
Southern District	.4	41.6	10.1	480.6	4.4	537.1
Kamishak District		2.2	2.0	127.7	41.8	173.7
Outer District	0.0	22.6	.1	129.7	27.9	180.3
Eastern District		0.0	.4	156.8	.8	158.0
Lower Cook Inlet total	.4	66.4	12.6	894.8	74.9	1,049.1
Cook Inlet area total	12.9	1,650.8	296.2	2,765.9	462.0	5,187.8
Kodiak Island	.5	651.4	140.3	17,290.5	1,075.4	19,158.1
Chignik	2.2	848.6	119.2	1,047.0	309.0	2,326.0
South Peninsula	5.0	3,588.0	272.0	7,816.0	1,346.0	13,027.0
CENTRAL STATISTICAL REGION TOTAL	29.3	6,969.0	1,152.7	43,142.4	3,670.1	54,963.5
Bristol Bay						
Naknek, Kvichak, and General District	8.7	15,404.4	7.4	266.6	210.7	15,897.8
Nushagak District	64.3	4,403.7	148.2	2,310.7	782.0	7,708.9
Egegik District	4.9	2,406.1	19.8	2.6	71.2	2,504.6
Ugashik District	5.4	852.0	2.5		34.2	894.1
Togiak District	12.4	607.9	123.6	69.7	308.3	1,121.9
Bristol Bay total	95.7	23,674.1	301.5	2,649.6	1,406.4	28,127.3
North Peninsula	17.0	1,395.0	127.0	303.0	699.0	2,541.0
Aleutian Islands		9.2		2,611.9	4.9	2,626.0
Arctic-Yukon-Kuskokwim						
Kuskokwim area	48.3	42.1	314.0	29.6	548.1	982.1
Yukon River						
Lower Yukon River area	143.9		7.5		950.4	1,101.8
Upper Yukon River	9.0		1.2		407.9	418.1
Yukon River area total	152.9		8.7		1,358.3	1,519.9
Norton Sound	6.3	0.0	30.2	226.7	182.4	445.6
Kotzebue area					367.3	367.3
Arctic-Yukon-Kuskokwim total	207.5	42.1	352.9	256.3	2,456.1	3,314.9
WESTERN STATISTICAL REGION TOTAL	320.2	25,120.4	781.4	5,820.8	4,566.4	36,609.2
ALL ALASKA TOTAL	670.1	33,209.8	3,069.8	63,446.1	9,887.3	110,283.1

<sup>1</sup> Preliminary, through October 15. Compiled November 24, 1980.

## Southeastern Alaska

Southern Southeastern Alaska pink salmon returns were more than twice as strong as forecast, allowing a harvest of nearly 13 million fish. However, run strength was limited to Districts 1, 2, and 3. Returns to central districts (5, 6, and 7) were weak. Northern pink runs were also somewhat weaker than expected, when returns to Tenakee Inlet and Peril Strait did not materialize at forecast levels. Sockeye catches were strong in nearly all areas, although Lynn Canal harvests were below average, as had been expected. Chum harvests were much better than projected, after several years of declines.

Despite a slow start and a 10-day closure of the troll fishery in mid-July, the chinook salmon harvest reached the upper limit of the optimum yield range set by the Board of Fisheries and the North Pacific Fishery Management Council, and the troll fishery was again closed September 21. The region's coho catch was also a little higher than had been projected. The troll fishery was reopened in October to allow a winter fishery.

## Cordova Area

As expected, Copper River sockeye runs were weak, and the Copper and Bering River Districts were closed for much of the season. Sockeye escapement to interior Copper River systems was adequate, and Copper River delta and Bering River sockeye escapements were very good. A closely-managed quota fishery for chinook in the Copper River District resulted in a catch of 8,400, below the 10,000 fish quota, but up-river chinook escapement appeared above average. Bering and Copper River coho catches were larger than anticipated, and coho escapements into Copper River delta streams were the largest ever documented.

Pink salmon returns to Prince William Sound far exceeded forecast levels; the harvest was an even-numbered year record and escapements were the strongest since the 1964 earthquake. Chum escapements were less than desired, except in the Northern District, although returns exceeded the forecast. Coghill and Eshamy Lake sockeye runs were also strong, and escapements were exceptional. Sockeye harvests would have been larger if price negotiations had concluded earlier.

## Cook Inlet Area

Although pink salmon returns to the Southern and Outer Districts were not as strong as forecast, run strengths continued to improve in 1980. Record pink catches were made in Resurrection Bay near Seward, and pink runs were also strong in Bruin Bay in the Kamishak District. Kamishak chum returns were weak, however. Excellent pink salmon escapements were achieved in all major spawning streams in the lower Cook Inlet area, with the exception of Rocky River. Harvests were allowed on some returns for the first time since 1970. Sockeye salmon returns to Delight and Desire Lakes in the Outer District and to China Poot Bay in the Southern District were good, aided by a lake stocking program. The sockeye harvest of nearly 70,000 was 50% above average for lower Cook Inlet.

Commercial harvests of all species except sockeye were near projected levels in upper Cook Inlet. Sockeye returns were above those anticipated, and the realized catch was about twice the projection. All major sockeye systems received healthy escapements.

### Kodiak Area

More than 19 million salmon of all species were harvested in the Kodiak management area in 1980, a record catch. Pink salmon runs were very strong, as forecast, and the 17.3 million catch would have been higher, but a price agreement was not reached until July 24. Both harvest and escapement were records, however. A few systems in the Mainland District received only poor to fair escapements, and low water in late July and August may have affected spawning success in a number of areas.

Record sockeye escapements were obtained in Red River, Fraser Lake, Afognak Lake, and Pauls Lake, due to the extended price negotiations. Karluk River sockeye returns were poor. Catches of coho salmon were about four times average, the best since 1941. The chum harvest was very high, largely due to the long fishing periods allowed for the pink salmon fishery. Chum salmon escapements appeared good in most areas.

### Chignik

The early sockeye run proved to be much weaker than forecast, and the escapement goal was achieved only by restricting the commercial catch to 33,000, in Stepovak and Balboa Bays. The late run, however, was very strong, and provided a harvest of about 900,000 sockeye.

Chignik pink salmon returns totaled 1.8 million, a little weaker than forecast, but well within the range. Pink escapements were average or better. Chinook, coho, and chum harvests were all surprisingly large. The coho catch of 119,000 was the largest ever recorded, and chinook and chum catches were the best since 1971.

### South Peninsula

The South Unimak-Shumagin Islands fishery was delayed until June 15 by price negotiations. Sockeye and pink salmon catches were exceptionally good, but the fish were small, and processors had difficulty with the pinks.

South Peninsula pink runs were stronger west of Volcano Bay. Both chum and pink salmon escapements were generally good in most streams.

As in 1979, unusually large numbers of coho were taken near the Shumagin Islands in July and early August.

### Aleutian Islands

Pink salmon returns to Unalaska reached record levels, and purse seine deliveries exceeding 25,000 fish were common. The bulk of the catch was taken in Makushin Bay, although pink runs were heavy throughout the area.

## North Peninsula

Chinook, sockeye, coho, and chum runs were very strong in all North Peninsula systems. Escapements ranged from good to excellent.

Most of the sockeye catch came from the Bear River area and Nelson Lagoon. The Izembek-Moffet Bay section provided a majority of the chum harvest, and the early chinook fishery was centered at Port Heiden. Jack chinooks were common in Nelson Lagoon.

## Bristol Bay

The 1980 Bristol Bay salmon harvest exceeded 28 million fish, a record. Lengthy sockeye price negotiations lowered the sockeye catch to 23.7 million, only one million less than the record set in 1938. Sockeye escapement to Bristol Bay systems was the highest ever recorded.

Although Nushagak escapements were very high, the chinook harvest was only about half that expected. Continued late season effort and strong coho returns pushed the catch over 300,000, another record. Chum salmon harvests and escapements were also exceptionally high.

While the Nushagak pink salmon run was only about one-third as strong as forecast, the total return was the second largest ever recorded.

## Arctic-Yukon-Kuskokwim

Record chum returns to Yukon, Kuskokwim, and Kotzebue fisheries helped to produce the largest commercial catch ever in the Arctic-Yukon-Kuskokwim region. A total of 3.3 million salmon were harvested; a million fish more than the most recent 5-year average of 2.2 million.

Chinook returns to the Yukon River system were the largest ever documented, based on comparative catches and escapement indices.

Summer chum salmon harvests were the largest ever recorded in the Yukon and Kuskokwim Rivers and significantly above average in Kotzebue Sound. Chum returns to Norton Sound were above average.

Record harvests of coho salmon were taken in the Quinhagak, Goodnews Bay, and Kuskokwim River fisheries.

PRELIMINARY FORECASTS OF 1981 SALMON RETURNS TO  
SELECTED ALASKAN FISHERIES

The Department's salmon management program includes a number of salmon return forecast projects. Forecast fisheries are selected using several criteria, including economic importance, feasibility, compatibility with existing programs, and management needs. Forecast fisheries are:

Southern Southeastern	-	pink salmon
Northern Southeastern	-	pink salmon
Prince William Sound	-	pink and chum salmon
Cook Inlet: Southern and Outer Districts	-	pink salmon
Kodiak	-	pink salmon
Chignik	-	pink and sockeye salmon
South Peninsula	-	pink salmon
Bristol Bay	-	pink and sockeye salmon
Kotzebue	-	chum salmon

In 1980 about three quarters of the total statewide harvest was taken in these fisheries.

A variety of information is used to make salmon return forecasts, including escapement magnitudes and distribution, survival to intermediate life stages, environmental conditions, and population age composition. The return, with upper and lower limits, is predicted for each forecast fishery. In general, based on past experience, the actual return can be expected to fall within the range (between the lower and upper limits) about 50% of the time. In 1980, 4 of the 10 returns forecast were within their forecast ranges. The 1981 forecasts and ranges are summarized in Table 4.

Southeastern Alaska Pink Salmon

Pink salmon returns to Southeastern Alaska in 1981 are expected to allow moderate harvests. In the southern part of the region water levels were low in a number of areas, and escapements were not uniformly distributed. Pink salmon catches will probably decline considerably from 1980. In northern districts, where parent-year pink escapements were the best since statehood, an increase is anticipated. The total Southeastern pink salmon catch is expected to be about 11 million fish.

Table 4. Preliminary forecasts of salmon returns and commercial harvests for some major Alaskan fisheries in 1981  
(Number of fish in thousands)

Area	Species	Forecast return	Escapement goal	Estimated harvest	Forecast <sup>1</sup> return range	Estimated harvest range
Southern Southeastern	Pink	14,600	6,000	8,600	11,300 - 18,600	5,300 - 12,600
Northern Southeastern	Pink	6,800	4,800	2,000	3,800 - 11,900	500 - 7,100
Southeastern Total	Pink	21,400	10,800	10,600	15,100 - 30,500	5,800 - 19,700
Prince William Sound	Pink	13,000	1,600	11,400	5,700 - 20,200	4,100 - 18,600
	Chum	660	270	390	240 - 1,100	100 - 850
Cook Inlet-Southern and Outer Districts	Pink	3,000	350	2,650	2,400 - 3,600	2,050 - 3,250
Kodiak	Pink	6,200	1,600	4,600	4,700 - 8,000	3,100 - 6,400
Chignik <sup>2</sup>	Pink	1,900	700	1,200	1,800 - 2,100	1,100 - 1,400
	Sockeye	1,700	650	1,050	1,400 - 1,800	800 - 1,200
South Peninsula <sup>3</sup>	Pink	3,600	1,500	2,100	2,500 - 4,800	1,000 - 3,300
Bristol Bay, Nushagak District <sup>4</sup>	Pink					
Bristol Bay <sup>5</sup>	Sockeye	26,700	5,500	21,200	15,000 - 38,400	9,500 - 32,900
Kotzebue	Chum	340	85	230	220 - 750	150 - 300
TOTAL		78,500	23,055	55,420		

<sup>1</sup> The forecast return and harvest ranges are estimated by several techniques. Based on past experience, about half of the realized returns and harvests can be expected to fall within their respective ranges.

<sup>2</sup> Including estimated interceptions in Cape Igvak, Aniakchak, Hook Bay, and Stepovak Bay fisheries.

<sup>3</sup> Not including pink salmon taken in June near False Pass, South Unimak, and the Shumagin Islands, which are returning to other areas.

<sup>4</sup> Pink salmon returns to Bristol Bay are negligible in odd-numbered years.

<sup>5</sup> Inshore harvest only.

### Prince William Sound Pink and Chum Salmon

Record pink salmon escapements in 1979 and favorable winter and spring environmental conditions are expected to result in a return of 13 million pinks in 1981, allowing a harvest of 11 million. Harvestable surpluses of chum salmon are also expected in the Eastern, Northern, and Coghill Districts.

### Cook Inlet (Southern and Outer Districts) Pink Salmon

Southern and Outer District pink salmon escapements in 1979 were the largest ever documented, and all forecast equations investigated gave return estimates exceeding 2 million fish. Including Tutka Lagoon hatchery returns, a harvest of from 2 to 3 million pink salmon is expected in 1981.

### Kodiak Pink Salmon

Although there were record pink salmon escapements in the Kodiak area in 1979, heavy rainfall and subsequent streambed scouring in the fall reduced fry survival. A pink salmon catch of from 3 to 6 million, including some Kitoi Bay hatchery fish, is anticipated in 1981.

### Chignik Sockeye and Pink Salmon

Again in 1981, the early sockeye run is expected to be too small to support a commercial harvest. A catch of from 800,000 to 1.2 million sockeye from the late run is forecast. Pink salmon pre-emergent fry densities were near recent averages, and a harvest of 1.2 million is expected.

### South Peninsula Pink Salmon

Probably because the 1979-1980 winter was severe, pre-emergent fry densities over much of the South Peninsula area were below average, and a catch of from 1 to 3 million pink salmon is anticipated in 1981, sharply down from 1980.

### Bristol Bay Sockeye Salmon

A forecast return of from 15 to 38 million sockeye to Bristol Bay systems is expected to allow a harvest of from 10 to 33 million in 1981.

### Kotzebue Chum Salmon

Moderate chum salmon returns to the Kotzebue area are forecast in 1981. The commercial chum harvest is expected to range from 150,000 to 300,000.

## PROJECTED 1981 ALASKAN COMMERCIAL SALMON HARVESTS

Projections of the 1981 Alaskan commercial salmon harvest by statistical region and species are presented in Table 5. The projections are composed of forecast harvests and harvest projections (recent harvest averages,

sometimes modified if additional information is available), for fisheries without forecasts. Chinook and coho returns are not forecast in any region. Only Prince William Sound and Kotzebue have chum salmon forecasts. All regions have pink salmon forecasts, but several smaller pink runs are not forecast. Major sockeye runs in the Central and Western Regions are forecast; important exceptions are Copper River, Cook Inlet, and Kodiak. Despite these gaps, 74% of the 1980 salmon harvest of 110 million fish was taken in forecast fisheries.

Table 5. Preliminary projections of 1981 Alaskan commercial salmon harvests by statistical region and species, and projected statewide salmon production by species<sup>1</sup>.

Thousands of Fish

Statistical Region	Chinook	Sockeye	Coho	Pink	Chum	All
Southeastern	290	800	1,000	10,600	900	13,590
Central	38	5,475	805	22,160	4,140	32,618
Western	335	22,240	680	706	4,331	28,292
TOTAL ALASKA	663	28,515	2,485	33,466	9,371	74,500
Total production, thousands of pounds <sup>2</sup>	7,600	120,000	19,000	79,000	61,000	286,600

<sup>1</sup> Compiled November 24, 1980. The projected 1981 harvests were obtained by summing harvest forecasts (Table 4) and harvest projections in the remaining fisheries.

<sup>2</sup> Including canned, cured, fresh, and frozen salmon and roe.

The 1981 statewide total commercial harvest projection is 74.5 million salmon.

## Species Outlook

### Pink Salmon

45% of the 1981 statewide total harvest projection, or 33 million fish

57% of the 1980 statewide total harvest, or 63 million fish

Declines in pink salmon returns are expected in all three statistical regions; particularly in Central and Western Alaska. Increased pink harvests are anticipated only in lower Cook Inlet and Chignik fisheries.

### Sockeye Salmon

38% of the 1981 statewide total harvest projection, or 29 million fish

30% of the 1980 statewide total harvest, or 33 million fish

Sockeye are expected to increase in relative importance in 1981, but catches will probably decline slightly in Central and Western Alaska.

### Chum Salmon

13% of the 1981 statewide total harvest projection, or 9.4 million fish

9% of the 1980 statewide total harvest, or 9.9 million fish

Little change is anticipated in the statewide chum catch, which is expected to increase slightly or remain near recent levels in central and western areas, while declining in Southeastern Alaska.

### Coho Salmon

3% of the 1981 statewide total harvest projection, or 2.5 million fish

3% of the 1980 statewide total harvest, or 3.1 million fish

### Chinook Salmon

1% of the 1981 statewide total harvest projection, or 670,000 fish

1% of the 1980 statewide total harvest, or 670,000 fish

Catches of coho and chinook salmon in 1981 are not expected to differ much from those in 1980, but a somewhat smaller coho harvest is projected.

## Regional Outlook

### Statewide

1981 statewide total harvest projection: 74.5 million fish

1980 statewide total harvest: 110.3 million fish

A 32% decline in the statewide salmon catch is projected, mostly due to markedly lower pink salmon catches. Smaller salmon harvests are expected in all statistical regions.

#### Southeastern Region

18% of the 1981 statewide total harvest projection, or 14 million fish

17% of the 1980 statewide total harvest, or 19 million fish

Moderately smaller harvests of all species are anticipated in Southeastern Alaska in 1981.

#### Central Region

44% of the 1981 statewide total harvest projection, or 33 million fish

50% of the 1980 statewide total harvest, or 55 million fish

Pink salmon harvests in the Central Region are not expected to be much more than half of the 1980 pink catch. No radical changes are projected for other species.

#### Western Region

38% of the 1981 statewide total harvest projection, or 28 million fish

33% of the 1980 statewide total harvest, or 37 million fish

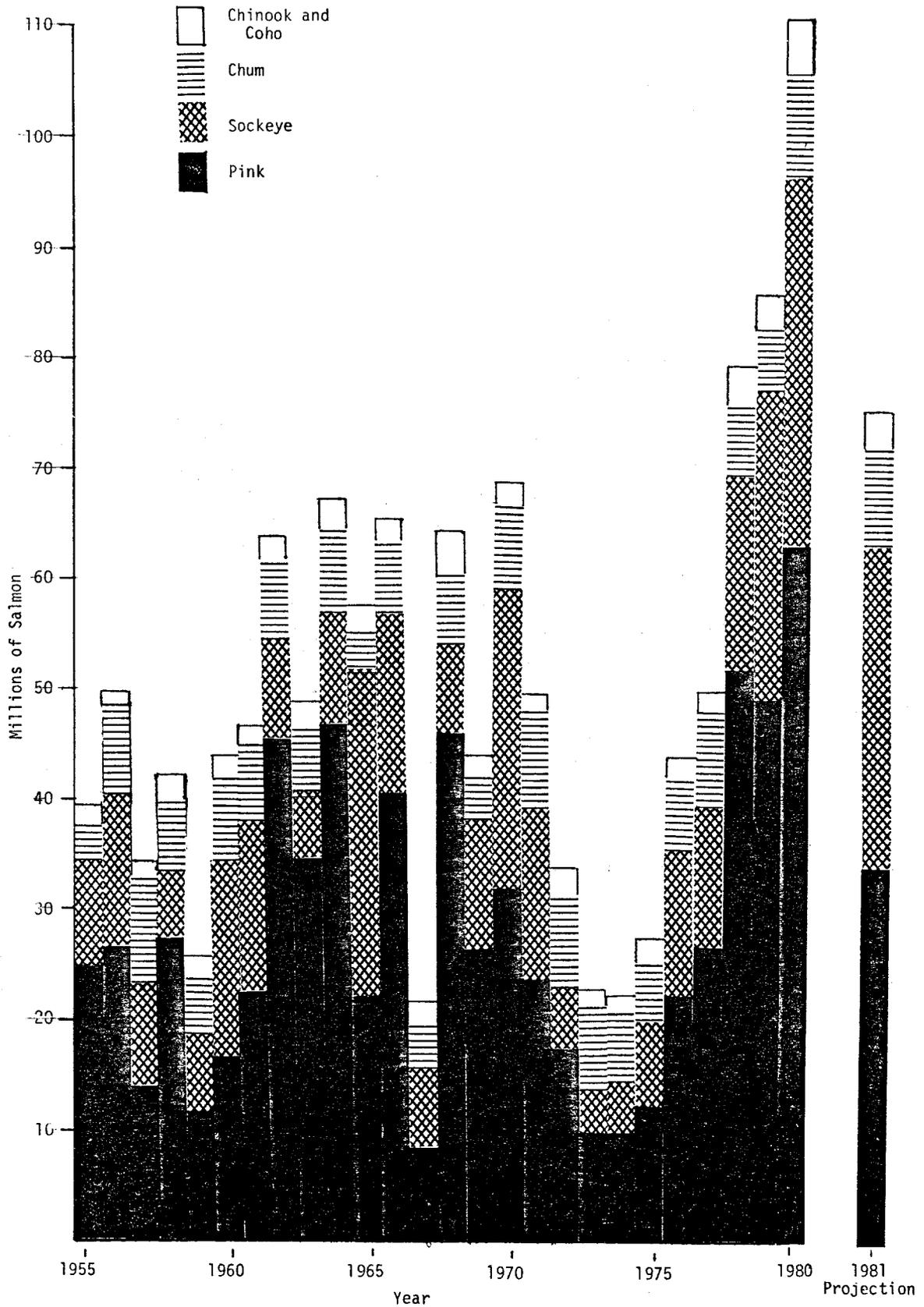
The numerical decrease in 1981 is due almost entirely to smaller pink and sockeye salmon harvests. Bristol Bay pink salmon returns are negligible in odd-numbered years, and erratic Aleutian Island pink runs, very strong in 1980, can not be counted on to repeat that performance in 1981.

### DISCUSSION

Commercial salmon harvests in Alaska, displayed in Figure 2, have consistently increased since the 1974 statewide total catch of 22 million fish. During this period, Department projections have just as consistently fallen below realized catches. During the eleven years harvest projections have been published, relative error, as a percent of the actual harvest, has ranged from 32% low in 1977 to 46% high in 1972 (see Table 1). When applied to the 1981 projection of 74.6 million, a range of from 51 to 110 million fish results. While it appears improbable that the 1981 salmon harvest will exceed the 110 million total reached in 1980, a catch below 50 million would be equally unlikely.

The steady improvement in Alaska's commercial salmon fisheries from the distressed levels of the mid-1970's, while aided by milder weather, could not have occurred without the escapements obtained from 1971 through 1976,

Figure 2: Alaskan commercial salmon harvests by species, 1955 - 1980, and the 1981 projected harvest.



when statewide harvests never rose above 48 million fish, and fell as low as 22 million. Higher harvests during that period would almost certainly have resulted in a slower and more erratic recovery.

## APPENDIX. FORECAST METHODS AND DISCUSSIONS

FORECAST AREA: Southeastern Alaska

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

Southern Southeastern:	<u>Point</u>	<u>Range</u>
Return Estimate:	14.6 million	11.3 million to 18.6 million
Escapement Goal:	6.0 million	
Harvest Estimate:	8.6 million	5.3 million to 12.6 million
Northern Southeastern:		
Return Estimate:	6.8 million	3.8 million to 11.9 million
Escapement Goal:	4.8 million	
Harvest Estimate:	2.0 million	500,000 to 7.1 million
Total Southeastern:		
Return Estimate:	21.4 million	15.1 million to 30.5 million
Escapement Goal:	10.8 million	
Harvest Estimate:	10.6 million	5.8 million to 19.7 million

### FORECAST METHODS

Separate forecasts are prepared for the pink salmon returns to northern and southern Southeastern Alaska due to the differences in migration routes and other population characteristics of the pink salmon returning to the two areas. The 1981 forecast to southern Southeastern was based primarily on a multiple regression analysis incorporating escapement and August, November-February, and spring air temperatures for several stations located in southern Southeastern. The northern Southeastern forecast was based on a regression analysis with the pre-emergent fry index and an index of spring environmental conditions in northern Southeastern. A number of forecast formulas were examined but none appeared as accurate as the ones used.

### DISCUSSION OF THE 1981 FORECAST

Southern Southeastern: The 1981 pink salmon return to southern Southeastern Alaska (Districts 1 through 8) is expected to be strong enough to allow moderate fishing pressure. Fish returning in the 1979 parent

year did, however, encounter drought conditions which reduced survival in temperature-sensitive streams. Staney, Naha, and Steelhead Creeks had the most severe adult mortality before spawning, losing 24, 21, and 16 percent respectively of their peak escapements. Reduced fishing pressure, as the severity of the drought became apparent, partially offset these losses by allowing late-arriving fish to enter the streams after it rained in early September. A relatively mild winter probably improved average survival of those eggs which survived the drought.

The 1979 pink salmon escapements in southern Southeastern were generally good with the exception of the eastern portion of District 1 which experienced disastrously low escapement levels. However, this area was not affected by the drought, and density-dependent mortality factors may have come into play which could result in a relatively high return per spawner. These factors, combined with a pattern of fishing similar to that which occurred in 1979, could result in adequate escapement levels again in 1981.

Almost 50% of the southern Southeastern pink salmon escapement was in Districts 2 and 3 alone and the bulk of the return can be expected in these areas. District 6 had fair escapements and in only two years (1967 and 1972) was the pre-emergent fry value higher than the 140.0 fry per square meter observed there this spring. There is good potential for a harvestable return in some areas of District 6.

Northern Southeastern: Pink salmon returns to some areas of northern Southeastern Alaska are expected in sufficient strength to support harvests in 1981. The 1979 parent-year escapements totaled 4.4 million pink salmon, the best since statehood, with approximately 43% or 1.9 million in District 13 alone. Escapements in District 9, 10, and 12 were also at or near established guideline levels.

The potential for harvest appears good in District 9 where pink escapements were above any in the past 20 years and the overall pre-emergent fry index was the second largest since the program was initiated. The portion of District 9 surrounding Kuiu Island looks particularly promising with very strong overall escapements and a good pre-emergent fry index. In addition, the lower portion of Admiralty Island shows a good potential for a harvestable return in 1981. The pre-emergent fry values there were by far the best since the 1972 brood year.

The District 12 total pink salmon escapement was just below the goal of 600,000 and some harvest is likely, particularly in lower Chatham Straits. The Tenakee Inlet area had fair escapements, but the pre-emergent fry index for that area was one of the poorest in recent years, so little harvest can be expected.

District 13 had a low fry index relative to the parent year escapement but chances for some harvestable surplus still appear good. The outside area of Chichagof Island and upper Baranof Island had some of the best overall escapements in the past twenty years and although the overall fry index was relatively low, some pre-emergent study areas were quite good indicating overwinter survival was probably fairly good in some areas.

The overall fry index for northern Southeastern was just above the previous 14-year average. Relatively cold weather followed by a rapid warming trend and rain during the fall of 1979 caused ice scouring problems, particularly in some of the larger watersheds, and numbers of dead fry and eggs were very high in some systems. In addition, fry captured in the spring in inshore waters were smaller both in length and weight than fry sampled the previous year, indicating that survival for this brood year was probably poorer in estuarine areas than it was for the 1978 brood year.

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FORECAST AREA: Prince William Sound

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate	12.1 million	5.4 million to 18.8 million
Escapement Goal:	1.5 million	
Harvest Estimate:	10.6 million	3.9 million to 17.3 million
SUPPLEMENTAL PRODUCTION		
Return Estimate:	930,000	300,000 to 1.4 million
Required Brood Stock:	80,000	
Harvest Estimate:	850,000	220,000 to 1.3 million
TOTAL PRODUCTION		
Return Estimate:	13.0 million	5.7 million to 20.2 million
Escapement and Brood Stock:	1.6 million	
Harvest Estimate:	11.4 million	4.1 million to 18.6 million

FORECAST METHODS

Natural Production: As in past years, the annual forecast is based on a linear regression analysis with brood-year pre-emergent fry indices and the resulting adult return. The 1981 forecast pre-emergent fry index was obtained from a standard odd-numbered-year stream list; these streams were sampled in the same manner as in the past. Only post-earthquake odd-year relationships were used in calculating this forecast.

The 1979 brood year's record estimated escapement of 2.9 million fish produced a pre-emergent fry index of 336 fry per square meter. This is the second largest index in the program's history; it is second only to the 1969 brood-year index of 339 fry per square meter, which resulted in a return of 9.5 million adults.

The forecast return range is an 80 percent confidence interval.

Supplemental Production: The 1981 return will follow a release of 21.5 million fry. All fry were held and fed for periods ranging from 8 to 25 days. Release dates ranged from 9 April to 31 May.

The forecast point and range estimates were obtained using the average, low, and high fry-to-adult survival rates experienced by the Prince William Sound Aquaculture Corporation's fry releases. The average percent return is 4.33, and high and low percentages are 6.56 and 1.40, respectively. The low return occurred in 1978, and the high return in 1980.

The Nerka Corporation's Perry Island hatchery and the State's Fisheries Rehabilitation, Enhancement, and Development Division hatchery at Cannery Creek are expected to make negligible contributions to the return due to small fry releases.

DISCUSSION OF THE 1981 FORECAST

Natural Production: This is the largest forecast in the history of Prince William Sound pink salmon forecasting.

Based on a desired escapement level of 1.5 million fish, the commercial catch is expected to be 10.6 million fish. However, the harvest could be as low as 3.9 million or as high as 17.3 million fish.

The 1981 return is expected to be strong throughout the season. Geographically, the only possible weak areas, regarding harvestable surpluses, are located in the northwest section of the Sound, i.e., from Eaglek Bay to Eshamy. However, Coghill River could produce a large return as the 1979 pre-emergent fry index is larger than the two previous odd-year pre-emergent indices despite the small escapement. The areas in question produce a largely middle-run return.

Supplemental Production: With a Prince William Sound Aquaculture Corporation brood stock requirement of 80,000 fish and a minimum hatchery fish sale of 240,000 fish, the hatchery's contribution to the common property fishery should range from 20,000 to 1.1 million fish.

Peak catches resulting from the hatchery return should occur from late July to early August.

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	640,000	220,000 to 1.1 million
Escapement Goal:	250,000	
Harvest Estimate:	390,000	100,000 to 850,000
 SUPPLEMENTAL PRODUCTION		
Return Estimate:	24,000	16,000 to 31,000

Required Brood Stock:	Entire return	
Harvest Estimate:	None	
TOTAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	660,000	240,000 to 1.1 million
Escapement and Brood Stock:	270,000	
Harvest Estimate:	390,000	100,000 to 850,000

#### FORECAST METHODS

Natural Production: Linear regression analysis, with pre-emergent fry indices and subsequent 4-year-old fish returns, is used to forecast annual adult returns. After the 4-year-old return is calculated, it is divided by the average 4-year-old fish contribution to annual returns, yielding a total return figure for all age classes. Chum salmon returns to Prince William Sound are composed of 3, 4, 5, and to a very small extent 6-year-old fish. Four-year-old fish contribute an average of 75 percent to total annual returns.

The 1981 forecast return to Prince William Sound is based on a pre-emergent fry index of 79 fry per square meter. The 1977 brood-year estimated escapement was 144,610 fish.

The forecast return range is an 80 percent confidence interval.

Supplemental Production: The point estimate is based on an average of 3 percent fry-to-adult survival and includes 3, 4, and 5-year-olds. The upper and lower limits are based on 4 percent and 2 percent survival, respectively. All of the fry releases involved were fed fry.

Specifically, the 1981 return is made up of the following fry releases, average age class contribution, and fry-to-adult survival rates:

I. The 3-year-old fish return was calculated as follows:

$$1979 \text{ release of } 247,500 \text{ fry} \times 3\% \text{ survival} \times 10\%^1 = 742$$

II. The 4-year-old fish return was calculated as follows:

$$1978 \text{ release of } 1,014,000 \text{ fry} \times 3\% \text{ survival} \times 75\%^1 = 22,815$$

III. The 5-year-old fish return was calculated as follows:

$$1977 \text{ release of } 5,000 \text{ fry} \times 3\% \text{ survival} \times 15\%^1 = 22$$

<sup>1</sup> These percentages are the average age-class contributions to annual returns.

## DISCUSSION OF THE 1981 FORECAST

Natural Production: Harvestable surpluses from the 1977 brood-year return are expected in the Eastern, Northern, and Coghill Districts. Middle-run streams are expected to be the major contributors of this surplus.

The 1980 return had an extremely high percentage of 3-year-old fish. It is believed that this advance in the maturity schedule was prompted by the same environmental conditions that preceded the excellent 1979 pink salmon return to the Sound. In view of the excellent 1980 return, it is expected that 3-year-old chums from the 1978 brood year will again be significant contributors to the return in 1981.

Supplemental Production: Due to fishing effort timing patterns in the Southwestern District and the expected timing of the hatchery's chum salmon return, it is expected that the hatchery will utilize the entire escapement to its special harvest area as brood stock.

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Cordova

FORECAST AREA: Cook Inlet, Southern and Outer Districts

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	2.7 million	2.2 million to 3.1 million
Escapement Goal:	320,000	
Harvest Estimate:	2.3 million	1.9 million to 2.8 million
SUPPLEMENTAL PRODUCTION		
Return Estimate:	330,000	220,000 to 450,000
Required Brood Stock:	33,000	
Harvest Estimate:	300,000	190,000 to 420,000
TOTAL PRODUCTION		
Return Estimate:	3.0 million	2.4 million to 3.6 million
Escapement and Brood Stock:	350,000	
Harvest Estimate:	2.6 million	2.0 million to 3.2 million

FORECAST METHODS

The 1981 pink salmon forecast for the Southern and Outer Districts of Cook Inlet is derived from a linear regression between indices of pre-emergent fry densities in nine major spawning streams and the subsequent adult returns. Pre-emergent fry abundance is determined from these streams each spring, and the index for each stream is weighted by the average escapement for that stream. The resultant individual stream indices are combined to yield a single, weighted pre-emergent fry index for all nine streams.

The Fisheries Rehabilitation, Enhancement, and Development Division Tutka Lagoon pink salmon hatchery has added a new dimension to the Southern District pink salmon return. The hatchery released 5.4 million short-term reared fry and 880,000 unfed fry into Tutka Bay in 1980. Based on recent returns from similar releases, 2 percent and from 4 to 8 percent survival rates are used in predicting returns from unfed and short-term reared fry, respectively. The projected 1981 adult pink salmon return to the Tutka Hatchery is from 220,000 to 450,000. A similar fry release in 1978 produced an adult return of approximately 370,000 in 1979.

## DISCUSSION OF THE 1981 FORECAST

The 1979 pink salmon escapement of 575,000 was the largest on record, with excessive escapements in Humpy Creek and Windy Left. Three separate forecasts were calculated. A regression with all available pre-emergent index data since 1964 yielded a predicted return of 2.1 million. When only odd-numbered-year indices were used, the estimate increased to 2.7 million. A third prediction using return-per-spawner data also projected a return of 2.7 million.

The selected forecast return of 3.0 million, including Tutka Lagoon hatchery fish, is the highest ever forecast for the lower Cook Inlet area. A majority of the return should be to the Outer District where record fry levels were observed in Port Dick and Rocky Rivers. Windy Bay streams were sampled late and, thus, only slightly above average fry levels were seen.

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Homer

FORECAST AREA: Kodiak

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	5.9 million	4.5 million to 7.5 million
Escapement Goal:	1.5 million	
Harvest Estimate:	4.4 million	3.0 million to 6.0 million

SUPPLEMENTAL PRODUCTION

Return Estimate:	320,000	170,000 to 460,000
Required Brood Stock:	60,000	
Harvest Estimate:	260,000	110,000 to 400,000

TOTAL PRODUCTION

Return Estimate:	6.2 million	4.7 million to 8.0 million
Escapement and Brood Stock:	1.6 million	
Harvest Estimate:	4.6 million	3.1 million to 6.4 million

FORECAST METHODS

The 1981 pink salmon return forecast for the Kodiak management area was determined as follows: For the Kodiak-Afognak Island complex a total return figure representing the midpoint was established using the 1979 brood-year pre-emergent fry index/subsequent return ratio and relating it to the fry index for the 1981 return. For the Mainland District's midpoint, a return-per-spawner relationship was chosen which best reflected that District's reduced fry index. Combining these two midpoints resulted in the Kodiak area point estimate return of 5.9 million pink salmon.

The estimated range is a fairly realistic spread intended to encompass a return of the magnitude suggested by the relatively low pre-emergent fry densities observed throughout the Kodiak area.

DISCUSSION OF THE 1981 FORECAST

Pre-emergent fry sampling indicated only poor to fair survival from a record brood-year escapement. Scouring of the spawning beds as a result of heavy rainfall during September and October appeared to be the major

cause of the reduction in fry survival. The lack of not only live fry but dead fry and eggs as well, from a very heavy escapement, plus physical evidence of stream channel erosion in many streams lends credibility to this speculation.

Sampling of 35 index streams and 5 other streams occurred during March and early April. No evidence of fry outmigration prior to sampling was detected. The sampling process yielded an unweighted fry index of 86.9 fry per square meter, a 37% decrease from the average odd-numbered year index of 137.9, the third lowest of eight odd-year runs. The two lower indices (59.5 and 65.8) led to returns of 900,000 and 4.1 million fish in 1967 and 1975, respectively.

Because the low fry production is attributed to scouring and because almost 30% of the brood-year escapement occurred in the generally smaller and less stable non-index streams, their contribution to the 1981 production should be below average.

As a result, in 1981 4.5 to 7.5 million pink salmon are expected to return to the entire management area. Taking into consideration a minimum escapement level of 1.5 million pinks, the harvest should be between 3.0 million and 6.0 million pink salmon. This does not compare favorably with the 23-year average odd-year cycle harvest of 6.8 million pinks, and is much less than the brood-year harvest of 11.3 million pink salmon. The forecast return of 5.9 million would represent a fairly poor 2:1 return-per-spawner. The most recent ten-year average is 4:1.

A breakdown of the expected return by major geographical district is given below. District catch projections assume that adequate escapement levels are achieved.

Afognak District: Total district natural production should be weak, accounting for only 2% of the total area return. Pre-emergent fry survival was spotty, being poor to fair from an excellent brood-year escapement; the district fry index was 31% below average. Since a relatively large proportion (59%) of the escapement occurred in non-index streams, scouring mortality probably greatly diminished the District's local salmon production. However, interception of salmon bound for Kodiak Island will continue to provide a significant part of this District's harvest. With minimum escapement requirements of 130,000 pinks, this District's harvest of natural stocks should range from 70,000 to 220,000 pinks.

Supplemental production from the Kitoi Bay Fisheries Rehabilitation, Enhancement, and Development Division hatchery is expected to result in a total return of 170,000 to 460,000 pinks from the 22.5 million fry released in the spring of 1980. Hatchery brood-stock requirements are approximately 60,000 fish, leaving from 110,000 to 400,000 pinks available for harvesting.

Westside District: Total district production should be approximately 41% of the total area return. Pre-emergent fry survival was again spotty, being fair to good from an excellent brood-year escapement of

which index streams received almost 60%. The district fry index was only 3% below average with the weaker systems being Zachar River and the smaller Uyak Bay streams. Relatively good production should come from the remainder of the district with a projected harvest of from 1.3 million to 2.5 million, assuming that minimum escapement requirements of 370,000 are met.

Alitak District: Total district production should be weak, accounting for only 9% of the total area return. Pre-emergent fry survival was poor to fair from an excellent brood-year escapement of which index streams received almost 90%. However the district fry index was almost 65% below average with a record low fry density for Humpy River, the District's major producer. Additional weak production from this District's other two important systems should result in a district harvest of from 210,000 to 600,000 pinks, again assuming that minimum escapement requirements of 300,000 are achieved.

General District: Total district production should be approximately 38% of the total area return. Pre-emergent fry survival was only fair from an excellent brood-year escapement of which index streams received their normal 65%. The district fry index was over 50% below the average index with almost all systems indicating production levels similar to those of the 1975 return. The weakest systems appear to be in Kaiugnak and Middle Bays, with the remainder of the area generally equal in diminished production. With a minimum escapement level of 450,000 pinks, this District's harvest should fall between 1.1 million and 2.3 million pinks.

Mainland District: Total district production should be roughly 10% of the total area return. Pre-emergent fry survival was very spotty, being poor to good from a fairly good brood-year escapement of which index streams received over 90%. The Kukak and Alinchak sections appeared to have the weakest overall fry production with the remaining sections being slightly stronger yet still only fair in productivity. Considering minimum escapement requirements of 250,000 pinks, this District's harvest should approach 450,000 pinks.

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Kodiak

FORECAST AREA: Chignik

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

	<u>Point</u>	
Return Estimate:	1.7 million	1.4 million to 1.8 million
Escapement Goal:	650,000	
Harvest Estimate:	1.0 million	800,000 to 1.2 million

FORECAST METHODS

For the early run a linear regression relating the number of sockeye returning after spending 2 years in the ocean (2-ocean fish) to the number of 3-ocean fish the following year was employed. Data from 1950 through 1980 were used.

The average number of 2-ocean sockeye returning during the years 1970 through 1980, excluding the highest and lowest year, is added to the predicted number of 3-ocean fish. The reason for utilizing only recent data is that the runs appear more productive now than in previous years.

For the late run the average return per spawner data and pre-emergent densities were used since no correlation between 2 and 3-ocean fish exists.

DISCUSSION OF THE 1981 FORECAST

Early run: A standard linear regression was utilized to estimate the number of 3-ocean fish from 2-ocean returns in 1980. A return of 450,000 is expected, which is only slightly above the minimum escapement goal of 400,000 by June 30. No commercial harvest is anticipated on the early run.

Late run: Because there appears to be no correlation between 2-ocean and 3-ocean fish for either the late run or the total run, average return-per-spawner and pre-emergent density data were used. Only data from 1974-1979 was utilized due to similarities in run strength, environmental conditions, and uniform pre-emergent data. The predicted late run return for 1981 is 1.3 million with a normal escapement goal of 250,000. The late run harvest should approximate 1.0 million.

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Kodiak

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	1.9 million	1.8 million to 2.1 million
Escapement Goal:	700,000	
Harvest Estimate:	1.2 million	1.1 million to 1.4 million

FORECAST METHODS

The 1981 Chignik area pink salmon return forecast was determined using 1971 through 1980 pre-emergent fry densities and resulting returns. Average returns and fry densities were calculated for the Eastern, Western, and Perryville Districts. Pre-emergent fry densities sampled in 1980 were higher than the average by 2%, 7%, and 2% for these Districts, respectively. The return range was determined subjectively, after examining return-per-spawner and district pre-emergent fry data accumulated since 1971.

DISCUSSION OF THE 1981 FORECAST

Ten pink salmon index streams were included in the 1980 pre-emergent schedule. Five of the ten streams showed an increase in density over the 1979 sampling. The Eastern, Western, and Perryville Districts produced combined densities slightly above the ten-year average.

The pink return for the combined Central and Eastern Districts is expected to be about 570,000 fish in 1981. Forecast returns to the Western and Perryville Districts are 1.0 million and 300,000 fish, respectively. The area return is expected to be between 1.8 million and 2.1 million pink salmon.

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Kodiak

FORECAST AREA: South Peninsula

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	3.6 million	2.5 million to 4.8 million
Escapement Goal:	1.5 million	
Harvest Estimate:	2.1 million	1.0 million to 3.3 million

#### FORECAST METHODS

The 1981 South Peninsula pink salmon forecast return was determined by total catch, escapements, and fry densities from 1969 through 1980. That portion of the south side of the Alaska Peninsula from eastern Stepovak to Cold Bay was divided into five sections: Stepovak Bay, Shumagin Islands, San Diego Bay to Cape Tolstoi, Pavlof Bay, and Volcano Bay to Deer Island. The area from Cold Bay to South Unimak Island has not been included in the pre-emergent program and only catch and escapement figures are available.

In each section the 1969-1980 average pre-emergent fry density and subsequent total return were calculated to develop an average return-to-density ratio that was multiplied by the brood-year sectional density.

The forecast range was estimated using 1974-1980 data for the high limit and 1969-1980 information for the low limit.

The escapement goals are based on expected returns; however, actual goals will depend on run distribution within the various sections. Optimum escapement goals of 2 million pinks have been justified in previous years of record runs. Actual returns may lower the 1981 goals to 1.5 million fish.

#### DISCUSSION OF THE 1981 FORECAST

The 1981 pre-emergent sampling program included 16 pink salmon index streams in the South Peninsula area. The 1979-1980 winter was severe in this area, with repeated freezing and thawing. Overall fry survival was below average. Slightly increased densities were recorded in the Volcano Bay to Deer Island area and in the Stepovak Bay region. Marked decreases were noted in the Shumagin Islands, San Diego Bay to Cape Tolstoi, and in Pavlof Bay.

Stepovak Bay and Volcano Bay to Deer Island exhibited density increases of 1% and 4% respectively, while the Shumagin Islands, San Diego Bay to Cape Tolstoi and Pavlof Bay showed decreases of 18%, 1%, and 1% respectively, from the 1969-1979 average densities.

The expected South Peninsula total run is expected to fall near 3.6 million with a range of 2.5 to 4.8 million pink salmon.

Tyler R. Gilmer  
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Kodiak

FORECAST AREA: Bristol Bay

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	26.7 million	15.0 million to 38.4 million
Escapement Goal:	5.5 million	
Harvest Estimate:	21.2 million	9.5 million to 32.9 million

#### FORECAST METHODS

Most Bristol Bay sockeye salmon mature 4 to 6 years from the time of parental spawning. The run in 1981 will, therefore, be the progeny of the escapements of 1975, 1976, and 1977. The total Bristol Bay forecast is the sum of the forecasts of individual river systems, each based on one or more of the following methods:

- (1) Escapement-return relationships, based on historical data, provide estimates of total production from each brood-year escapement. Average marine maturity schedules are then applied to estimate the numbers of adult salmon returning each year.
- (2) On the Kvichak and Wood Rivers, numbers of smolt migrating to the ocean are enumerated annually. The return of adult salmon each year is estimated using these smolt counts, past survival data and average maturity schedules.
- (3) For each river system, relationships between the number of adult fish returning a year earlier and the number of adult fish from the same parent escapement and freshwater age group that will return the following year are utilized.

To aid in the selection of forecast techniques a measure of forecast error is calculated for each method and age class. Individual forecasts are then weighted by their relative historic performance.

#### DISCUSSION OF THE 1981 FORECAST

The pre-season forecast of the 1981 Bristol Bay sockeye salmon return is 26.7 million. Escapement requirements for Bristol Bay in 1981 total 5.5 million sockeye salmon, consistent with the Kvichak River post-peak cycle escapement strategy of 2 million spawners. Analysis of the projected inshore run by system suggests a potential harvestable surplus of 21.2 million. A harvest of this size would be considerably above both the comparable cycle average harvest of 9 million and the peak year average harvest of 17.5 million sockeye. Point estimates of allow-

able harvest by district in descending order of magnitude are: Naknek-Kvichak 11.1 million, Nushagak 4.5 million, Egegik 2.5 million, Ugashik 2.5 million, and Togiak 547,000.

Inshore returns are expected to be composed of 50% two-ocean and 50% three-ocean sockeye.

SPECIES:       Pink Salmon

Pink salmon returns to the Nushagak District of Bristol Bay are negligible in odd-numbered years.

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FORECAST AREA: Kotzebue

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF 1981 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	340,000	220,000 to 750,000
Escapement Goal:	85,000	
Harvest Estimate:	230,000	150,000 to 300,000

#### FORECAST METHODS

The forecast utilizes measurements of environmental parameters pertinent to chum salmon survival in the Kotzebue area combined intuitively to produce an environmental index, given by  $E = C/BD$  where  $C$  is mean daily Kobuk River flow (cubic feet per second) during the chum salmon fry emigration period of May and June for contributing brood years;  $B$  is mean September-through-April (incubation period) air temperature at Kotzebue for contributing brood years; and  $D$  is mean daily Kobuk River flow (cubic feet per second) during chum salmon spawning in August and September for contributing brood years. Chum salmon returns are positively correlated with  $E$  ( $r = 0.83$ ), implying that adequate Kobuk River flow during fry emigration ( $C$ ) is important to good survival; and that flooding during spawning ( $D$ ), or warmer weather during fry incubation ( $B$ ) tend to be associated with lower survival. Brood years contributing to the 1981 return are 1976, 1977, and 1978.

The resultant environmental index  $E$  is used with a simple linear regression model to predict Kotzebue chum salmon returns.

For forecast purposes the Kotzebue chum salmon total return is divided into component brood-year contributions of commercial catch, subsistence catch, and escapement. Commercial catch data is obtained from fish tickets and is the most reliable and most easily obtained component. The subsistence catch is more difficult to estimate because of sampling problems. What is actually obtained is an incomplete sample of fish on drying racks and interviews with some of the fishermen. However, the data available is probably consistent in its lack of completeness from year to year, and does indicate trends and general utilization patterns. The escapement data base is probably the least reliable and consistent segment of the total return because it is based on aerial surveys which are subject to weather, water conditions, and observer variability.

#### DISCUSSION OF THE 1981 FORECAST

Within the framework of the forecast data base (1971-1980), the chum

salmon return for 1981 is expected to be the fifth largest, producing an expected return of 340,000 chum salmon with a subsequent predicted harvest of 230,000 fish. This marks a reduction of 50% from the large 1980 return of 685,000, but still is an increase over the prior four year's returns (1976-1979).

In estimating survival, all environmental parameters used were given equal weight. The combined effect of these parameters, expressed by  $E$ , was considered the prime survival determinant. At this time too few years of data are available to allow formal estimation of a level of confidence or reliability. Work will continue in the future on the development and refinement of the environmental index as a forecast tool. This is the first Kotzebue chum salmon forecast published.

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