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PRELIMINARY FORECASTS AND PROJECTIONS FOR 1984 ALASKA SALMON FISHERIES

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ABSTRACT

More than 127 million salmon were taken by commercial fishermen in Alaska in 1983, the largest Alaska salmon harvest in history. Pink salmon returns to Southeastern Alaska and Bristol Bay sockeye runs were much stronger than expected. On the down side, salmon prices to fishermen were again sharply lower, and pink salmon catches in many central Alaska areas were smaller than had been anticipated.

To follow the record 1983 salmon harvest, a moderate decline to 104 million fish is expected in 1984. The decline is due almost entirely to an anticipated drop in the Bristol Bay sockeye harvest from 37 million in 1983 to 15 million in 1984. There is much uncertainty associated with the 1984 harvest projection, but the actual harvest is not expected to be below 75 million fish or above 150 million. Based on projection experience since 1970, only one of four realized harvests would fall outside this range.

KEY WORDS: salmon, *Oncorhynchus spp.*, salmon return forecast, salmon harvest projection

INTRODUCTION

This report reviews Alaska's 1983 commercial salmon season and presents preliminary salmon return forecasts and harvest projections for 1984 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; 1969-1983). Table 1 summarizes the accuracy of these projections. On the average, the projections have been too low by 6 million fish, or 9% of the average harvest of 67 million fish. Without regard to sign, the mean error is 16 million fish, 24% of the average harvest. Projection errors stem primarily from inadequate knowledge of salmon escapements, numbers of juveniles produced, and early marine survival.

Mild winters and generally warmer sea water temperatures are thought to be the major factor behind the higher juvenile salmon survival which has resulted in recent record-breaking commercial harvests. These very favorable environmental conditions have worked in tandem with the painstaking fisheries management which insured well-distributed salmon escapements in the early 1970s when salmon returns were weak throughout the state. Sockeye and pink salmon runs in almost all areas of the state have now rebounded to robust levels. State and private non-profit hatcheries contributed several million salmon to the 127-million-fish 1983 harvest, and these supplemental production sources are becoming increasingly significant, particularly in the Cook Inlet and Prince William Sound areas.

Table 1. Projected and realized Alaska commercial salmon harvests with absolute and relative errors, 1970-1983.

Year	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	82.3	-19.4	-24%
1979	72.0	88.8	-16.8	-19%
1980	102.6	110.0	-7.4	-7%
1981	74.5	113.3 ¹	-38.8	-34%
1982	135.0	109.1 ¹	25.9	24%
1983	<u>94.9</u>	<u>127.2¹</u>	<u>-32.3</u>	-25%
TOTAL	858.9	944.3	-85.4 (228.0) ²	
<hr/>				
1970-1983 average	61.4	67.4	-6.1 (16.3) ²	-9% (24%) ²

¹ Preliminary data. Compiled 6 December 1983.

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

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 or hatchery.
- Forecast: Forecast harvests and returns are estimated 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.

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 1984, by species and age¹

Species	Age of Returning Salmon in Years				
	2	3	4	5	6
Pink	1982				
Chum		1981	1980	1979	
Coho		1981	1980		
Sockeye			1980	1979	1978
Chinook			1980	1979	1978

¹ 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 1983 fishing season. Individual credit for forecast material is given with the area forecast discussions in the Appendix.

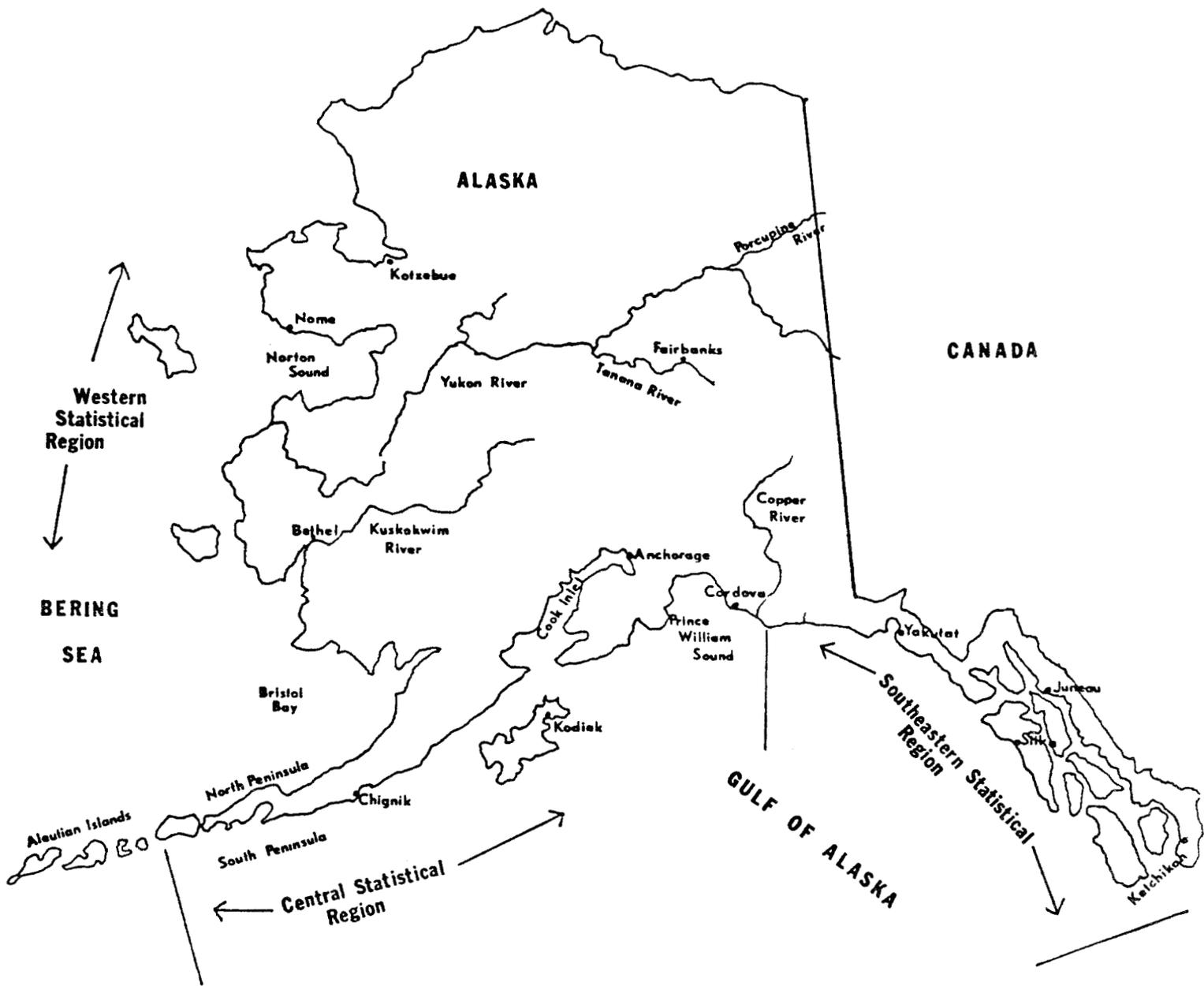


Figure 1. Alaska Department of Fish and Game Commercial Fisheries Statistical Regions.

REVIEW OF THE 1983 ALASKA COMMERCIAL SALMON FISHERY

Commercial salmon catches in Alaska in 1983 are believed to have totaled more than 127 million fish, the largest Alaska salmon harvest in history. Most price negotiations between fishermen and processors concluded before the season, but prices were generally 25% or more below those in 1982. Catches of sockeye salmon in Bristol Bay, and pink salmon in Southeastern Alaska, were much larger than had been expected. Pink salmon returns to Lower Cook Inlet, Kodiak, and the south side of the Alaska Peninsula, however, were disappointingly weak. The coupling of a poor pink salmon harvest with low prices was particularly painful to fishermen in the Kodiak area, where shrimp and king crab harvests have also fallen precipitously.

The statewide catch of 127 million fish exceeded the Department's projection by about 32 million, 33% of the projection. Table 2 compares actual and forecast 1983 salmon returns for selected fisheries; despite the record statewide harvest, six of the eleven forecasts were too optimistic in 1983. Preliminary catch estimates by fishing area and statistical region (Figure 1) are summarized in Table 3, and these estimates are presented in more detail by management region in Tables 4 through 7.

Southeastern Alaska

As in 1982, pink salmon returns to northern Southeastern Alaska were very much stronger than expected, and the northern harvest approached 6 million, more than five times that forecast. Southern Southeastern pink runs were also very strong, yielding a harvest of more than 31 million fish. Escapements were good to excellent in most areas.

Southeastern sockeye catches were the highest since 1945; two-thirds of the catch came in the Noyes Island purse seine fishery on the southern outside coast. Gill net sockeye harvests in Lynn Canal and the East River in the Yakutat area were good, but elsewhere sockeye catches were average or below average. Except for the very good fall chum salmon fishery in Lynn Canal, most chum harvests continued to decline in 1983. Hatcheries at Nakat Inlet and Hidden Falls contributed to improved production of chum salmon in those areas.

The Southeastern chinook catch of 290,000 fish was nearly identical to the 1982 catch, although the 1983 chinook troll season was the shortest on record. Coho salmon harvests were excellent, with nearly 70% of the 1.3 million-fish catch going to the troll fishery, mostly in outer coastal fishing areas. Coho returns to the Yakutat area, however, were weak.

Cordova Area

Most Cordova area salmon harvests were above average in 1983, with an all-species total of more than 16 million fish. Price were so low that the ex-vessel value of the area catch declined to less than half of that in 1982, about \$22 million. Catches of chinook in the Copper River District and sockeye in the Bering River District were historical records. Pink salmon returns to Prince William Sound were close to forecast levels; chum salmon runs, however, were much

Table 2. Comparison of actual¹ and forecast 1983 salmon returns, with errors and relative errors, for some major Alaska salmon fisheries.

Area	Species	Thousands of Fish					
		(1) Harvest ¹	(2) Escapement ¹	(3) Return: ¹ (1) + (2)	(4) Forecast return	(5) Error: (4) - (3)	(6) Relative error: (5)/(3) X 100%
Southern Southeastern	Pink	31,500	8,140	39,640	18,400	-21,240	-54%
Northern Southeastern	Pink	5,890	4,340	10,230	4,500	-5,730	-56%
Southeastern Total	Pink	37,390	12,480	49,870	22,900	-26,970	-54%
Prince William Sound	Pink	14,000	2,600	16,600	18,600	2,000	12%
	Chum	1,040	360	1,400	680	-720	-51%
Cook Inlet-Southern and Outer Districts	Pink	844	291	1,135	2,700	1,565	138%
Kodiak	Pink	4,600	2,100	6,700	14,800	8,100	121%
Chignik	Sockeye ²	2,320	780	3,100	1,600	-1,500	-48%
	Pink	321	500	821	1,800	979	119%
South Peninsula ³	Pink	2,700	850	3,550	6,500	2,950	82%
Bristol Bay ⁴	Sockeye	37,300	8,540	45,840	27,100	-18,740	-41%
Kotzebue Sound	Chum	176	171 ⁵	347	530	183	68%
TOTAL		100,691	28,672	129,363	97,210	-32,153	-25%

¹ Preliminary data, compiled 5 December 1983.

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

³ The harvest does not include June catches of migrating pink salmon bound for other areas.

⁴ Inshore harvest only.

⁵ Includes a subsistence harvest of 17,000 fish.

Table 3. Preliminary 1983 Alaska commercial salmon harvest by species and fishing area¹.

(Thousands of fish)

Fishing Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	All
Southern Southeastern	105.1	949.1	575.0	31,446.0	532.1	33,607.3
Northern Southeastern	182.4	599.4	1,291.1	5,942.2	580.3	8,595.4
Southeastern Statistical Region Total	287.5	1,548.5	1,866.1	37,388.2	1,112.4	42,202.7
Cordova Area	51.6	904.3	361.2	14,049.4	1,048.1	16,414.6
Cook Inlet Area	19.8	5,009.0	510.6	958.0	1,279.9	7,777.3
Kodiak Area	3.8	1,232.0	157.0	4,603.0	1,085.0	7,080.8
Chignik	5.4	1,807.0	56.2	321.1	160.1	2,349.8
South Peninsula	20.0	2,481.0	128.0	2,731.0	1,710.0	7,070.0
Central Statistical Region Total	100.6	11,433.3	1,213.0	22,662.5	5,283.1	40,692.5
Aleutian Islands		3.0		1.0	10.0	14.0
North Peninsula	28.0	2,009.0	74.0	4.0	337.0	2,452.0
Bristol Bay	201.0	37,276.0	117.0		1,467.0	39,061.0
Kuskokwim Area	93.7	90.9	249.0	0.4	306.6	740.6
Yukon Area	147.9		13.4		1,202.5	1,363.8
Norton Sound	10.3		49.7	76.9	319.4	456.3
Kotzebue Area	0.1			0.1	175.8	176.0
Western Statistical Region Total	481.0	39,378.9	503.1	82.4	3,818.3	44,263.7
ALASKA TOTAL	869.1	52,360.7	3,582.2	60,133.1	10,213.8	127,158.9

¹ Compiled 5 December 1983.

Table 4. Preliminary 1983 Southeastern Alaska commercial salmon harvest by species and management area¹.
(Thousands of fish)

Management Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	ATI
Southern Southeastern						
Portland Canal gill net	1.5	133.4	42.7	771.9	133.1	1,082.6
Annette Island gill net	0.1	21.8	7.8	209.9	17.5	257.1
Annette Island trap	0.2	4.9	6.3	802.7	1.8	815.9
Prince of Wales Is. gill net	0.5	48.6	60.9	203.3	19.7	333.0
Stikine River gill net	0.0	0.2	14.8	4.2	0.7	19.9
Southern districts seine	11.1	735.9	284.4	29,200.0	348.8	30,580.2
Southern districts troll	91.7	4.3	158.1	254.0	10.5	518.6
Southern Southeastern total	105.1	949.1	575.0	31,446.0	532.1	33,607.3
Northern Southeastern						
Taku-Snettisham gill net	0.9	30.9	23.8	63.7	15.3	134.6
Lynn Canal gill net	1.7	370.6	68.2	159.2	340.8	940.5
Yakutat gill net	0.8	155.5	73.6	50.6	11.0	291.5
Northern hatcheries				114.1		114.1
Northern districts seine	0.7	38.0	25.1	5,300.0	202.7	5,566.5
Northern districts troll	178.3	4.4	1,100.4	254.6	10.5	1,548.2
Northern Southeastern total	182.4	599.4	1,291.1	5,942.2	580.3	8,595.4
SOUTHEASTERN REGION TOTAL	287.5	1,548.5	1,866.1	37,388.2	1,112.4	42,202.7

¹ Compiled 10 November 1983

Table 5. Preliminary 1983 Central Region Alaska commercial salmon harvest by species and management area¹.

(Thousands of fish)

Management Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	All
Cordova Area						
Bering River	0.6	179.3	117.7	0.9	4.6	303.1
Copper River	50.0	633.0	233.0	7.3	2.2	925.5
Prince William Sd. Hatcheries				687.0		687.0
Coghill District	0.6	38.2	0.8	283.7	243.2	566.5
Unakwik District	0.0	13.3		4.0	2.1	19.4
Eshamy District	0.0	2.0	0.0	355.0	6.2	363.2
General purse seine	0.4	38.5	9.7	12,711.5	789.8	13,549.9
Prince William Sound total	1.0	92.0	10.5	14,041.2	1,041.3	15,186.0
Cordova Area total	51.6	904.3	361.2	14,049.4	1,048.1	16,414.6
Cook Inlet Area						
Lower Cook Inlet						
Outer District	0.0	15.2	0.0	190.1	26.4	231.7
Southern District	0.7	114.8	1.3	653.7	13.4	783.9
Kamishak District	0.0	11.3	7.0	0.8	137.5	156.6
Eastern District	0.0	24.0	0.0	34.7	7.5	66.2
Lower Cook Inlet total	0.7	165.3	8.3	879.3	184.8	1,238.4
Upper Cook Inlet						
Central District	18.2	4,682.2	451.4	58.8	1,063.8	6,274.4
Northern District	0.9	161.5	50.9	19.9	31.3	264.5
Upper Cook Inlet total	19.1	4,843.7	502.3	78.7	1,095.1	6,538.9
Cook Inlet Area total	19.8	5,009.0	510.6	958.0	1,279.9	7,777.3
Bristol Bay						
Egegik District	5.0	6,740.0	22.0		124.0	6,891.0
Ugashik District	9.0	3,342.0	8.0		108.0	3,467.0
Naknek-Kvichak District	10.0	21,314.0	0.0		326.0	21,650.0
Nushagak District	139.0	5,296.0	81.0		586.0	6,102.0
Togiak District	38.0	584.0	6.0		323.0	951.0
Bristol Bay total	201.0	37,276.0	117.0		1,467.0	39,061.0
CENTRAL REGION TOTAL	272.4	43,189.3	988.8	15,007.4	3,795.0	63,252.9

¹ Compiled 5 December 1983.

Table 6. Preliminary 1983 Arctic-Yukon-Kuskokwim Region Alaska commercial salmon harvest by species and management area¹.

(Thousands of fish)

Management Area	SPECIES					All
	Chinook	Sockeye	Coho	Pink	Chum	
Kuskokwim Area						
Kuskokwim River	33.2	68.9	196.9	0	276.7	575.7
Kuskokwim Bay	60.5	22.0	52.1	0.4	29.9	164.9
Kuskokwim Area total	93.7	90.9	249.0	0.4	306.6	740.6
Yukon River						
Lower Yukon River	142.8	0	7.2	0	933.8	1,083.8
Upper Yukon River	5.1	0	6.2	0	268.7	280.0
Yukon River total	147.9	0	13.4	0	1,202.5	1,363.8
Norton Sound	10.3	0	49.7	76.9	319.4	456.3
Kotzebue Area	0.1	0	0	0.1	175.8	176.0
ARCTIC-YUKON-KUSKOKWIM REGION TOTAL	252.0	90.9	312.1	77.4	2,004.3	2,736.7

¹ Compiled 24 October 1983

Table 7. Preliminary 1983 Westward Region Alaska commercial salmon harvest by species and management area¹.

(Thousands of fish)

Management Area	SPECIES					All
	Chinook	Sockeye	Coho	Pink	Chum	
Kodiak Area	3.8	1,232.0	157.0	4,603.0	1,085.0	7,080.8
Chignik	5.4	1,807.0	56.2	321.1	160.1	2,349.8
Alaska Peninsula and Aleutians						
South Peninsula	20.0	2,481.0	128.0	2,731.0	1,710.0	7,070.0
North Peninsula	28.0	2,009.0	74.0	4.0	337.0	2,452.0
Aleutian Islands		3.0		1.0	10.0	14.0
Alaska Peninsula and Aleutians total	48.0	4,493.0	202.0	2,736.0	2,057.0	9,536.0
WESTWARD REGION TOTAL	57.2	7,532.0	415.2	7,660.1	3,302.1	18,966.6

¹ Compiled 5 December 1983.

stronger than expected. The Coghill River sockeye run was weak.

Nearly one-third of the 1983 Prince William Sound pink salmon harvest (more than 3 million fish) is believed to have come from the four major State and private non-profit hatcheries located in the Prince William Sound area.

Lower Cook Inlet Area

Harvests in Lower Cook Inlet fisheries were generally above average, with hatchery and enhancement project returns accounting for about half of the harvest of 1.2 million salmon, about one-third of the ex-vessel value. Natural pink salmon returns to the Southern and Outer Districts were only 25% of the forecast 1.8 million fish. The Tutka Hatchery pink return was also weaker than expected. Pink salmon runs in other districts were mixed.

Sockeye returns were strong except in the Nuka Bay area. Chum returns were poor in the Outer District and the northern portion of the Kamishak District, but excellent in southern Kamishak systems.

Escapements of all species were mostly good to excellent. Low water delayed spawning in some areas, however, and may have caused some mortality.

Upper Cook Inlet Area

The Upper Cook Inlet area harvest of 6.5 million salmon was a record, ascribed to a phenomenal sockeye return combined with strong chum and coho runs. The record sockeye catch was four times average. The Kenai River was the largest contributor, augmented by strong Kasilof River, Crescent River, and Fish Creek runs. Escapement goals were met or exceeded in these systems; Susitna River sockeye escapement, however, was slightly below the desired level.

Chum and coho harvests were excellent. Most chum runs were strong, but only the Susitna River coho return appeared above average. The chinook harvest of 19,000 was again somewhat larger than average because returns were strong and interceptions increased when sockeye fisheries were extended.

As in other areas, despite the record harvest the ex-vessel value of the salmon harvest declined sharply in 1983. Sockeye brought only \$.70 per pound in 1983 compared to \$1.05 in 1982.

Kodiak Area

The harvest of 4.6 million pink salmon in the Kodiak area, only 40% of the forecast 12.6 million, was accompanied by near-record catches of other species. Declining fish prices drove fishermen's seasonal gross incomes to alarmingly low levels. Pink salmon escapements were well-distributed but low water flows and high water temperatures may have caused egg mortality in eastern and northern Kodiak systems, and in the Afognak District.

About 320,000 sockeye of the 1.2 million catch were taken in the Cape Igvak fishery on Chignik-bound fish. Local stocks formed the remainder of the harvest, and escapements were good, except in the Uganik, Red, Karluk, and Frazer Rivers.

The chum harvest of 1 million fish was, as expected, above average, and escapements appeared good. The coho catch was again much larger than average, at least partly because of increased fishing effort. Escapements were stronger than usual overall, but several streams on the road system received poor escapements despite restrictions on commercial fishing periods.

Chignik

Both early and late Chignik sockeye runs were very strong, and the return of 3.1 million was a record. Escapement goals for both runs were achieved. Chignik pink runs did not materialize at forecast levels, and the harvest was the smallest in seven years. Massive area closures were implemented and finally resulted in at least minimal pink escapements to most systems.

Chum salmon catches were moderate, but the chinook salmon harvest of 5,500 was a record. Chinook escapements were also exceptional. The coho catch of 60,000 fish, mostly from Chignik Lagoon, was considerably above average.

Alaska Peninsula and Aleutians

There was good weather for the June South Unimak and Shumagin Islands fisheries, and fishing effort was high. The guideline harvest levels of sockeye were taken quickly. Large sockeye catches were common in South Peninsula set net fisheries, and chum runs were very strong. Local sockeye and chum escapements were generally good.

South Peninsula pink runs, like those returning to Kodiak and Chignik, were considerably weaker than forecast, and the catch was less than half that expected. Coho catches were mediocre.

Aleutian pink salmon returns were extremely weak, and only 1,000 fish were harvested. The Unalaska Island escapement of 50,000 may not be sufficient to support a fishery in 1985.

The North Peninsula sockeye catch was the largest ever recorded, and the chinook harvest was also considerably above average. North Peninsula coho runs were weak, however.

Bristol Bay

An early price settlement and extremely strong sockeye returns resulted in a record Bristol Bay sockeye harvest of 37 million. Although prices were lower the total all-species ex-vessel value of the fishery was a record, at \$145 million.

Chinook and chum salmon runs were also exceptionally healthy. The Nushagak River chinook escapement was the largest on record, and the Nushagak and Togiak District catches were far above average. Chum salmon catch records were set in the Egegik, Ugashik, and Togiak Districts. Escapements appeared strong to adequate.

Bristol Bay coho returns were mixed. The Nushagak coho catch of 80,000 and an estimated escapement of about the same amount were strong. Togiak returns, however, were poor and the fishery was closed early in September.

Arctic-Yukon-Kuskokwim Region

The commercial harvest of chum salmon in the Yukon River was close to the recent 5-year average, but below average in the Kuskokwim and Kotzebue areas. A record chum salmon harvest was achieved in the Norton Sound area, 320,000 fish, nearly 50% over the previous high.

The commercial harvest of chinook salmon was above average in the Yukon River and in Norton Sound, and a record 94,000 fish in the Kuskokwim area. Returns of chinook salmon to the Kuskokwim River were weak but exceptionally strong to the districts surrounding Kuskokwim Bay.

The coho salmon commercial catch in the Kuskokwim area was well below the record catch of 1982 but near average for other recent years. The Norton Sound harvest of coho was well above recent year averages excluding 1982 in which a record catch was achieved. Pink salmon returns to Norton Sound were weaker than in recent years and only a minimal harvest was taken.

Prices ranged from a discouraging \$.25 per pound for chum salmon in the Kotzebue area to a respectable \$1.40 per pound for chinook on the lower Yukon.

PRELIMINARY FORECASTS OF 1984 SALMON RETURNS TO
SELECTED ALASKA 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
Lower Cook Inlet: Southern and Outer Districts	- pink salmon
Upper Cook Inlet	- sockeye salmon
Kodiak	- pink salmon
Chignik	- pink and sockeye salmon
South Peninsula	- pink salmon
Bristol Bay	- pink and sockeye salmon
Kotzebue Sound	- chum salmon

In 1983 about 80% 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, egg deposition, survival to intermediate life stages, high seas abundance, 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) somewhat less than half the time. In 1983, certainly not a typical salmon season, ten of the eleven return forecasts were outside their respective ranges. Five forecasts were too low; six too high. The 1984 forecasts and ranges are summarized in Table 8.

Forecast abstracts are given below; the reader is referred to the Appendix for further details.

Southeastern Alaska Pink Salmon

A return of 26 million pink salmon is expected in southern Southeastern districts in 1984, which should allow a harvest of 20 million fish. Pink salmon fisheries in central districts may have to be curtailed because of interceptions in the southern-most districts, where the strongest returns are foreseen. A very strong pink return is anticipated in northern Southeastern Alaska, with a forecast harvest more than 50% over the unexpectedly large 1983 catch.

Table 8. Preliminary forecasts of salmon returns and commercial harvests for some major Alaska fisheries in 1984.
(Thousands of Fish)

Area	Species	Forecast return	Escapement goal	Estimated harvest	Forecast return range ¹	Estimated harvest range ¹
Southern Southeastern ²	Pink	26,000	6,000	20,000	20,500 - 33,100	14,500 - 27,100
Northern Southeastern ²	Pink	14,200	4,600	9,600	9,200 - 19,200	4,600 - 14,600
Southeastern Total ²	Pink	40,200	10,600	29,600	29,700 - 52,300	19,100 - 41,700
Prince William Sound Total ²	Pink	18,800	1,800	17,000	13,100 - 26,800	11,400 - 25,100
	Chum	870	256	613	650 - 1,100	400 - 830
Cook Inlet-Southern and Outer Districts Total ²	Pink	1,100	220	880	0 - 1,250	0 ⁷ - 1,030
Upper Cook Inlet	Sockeye	3,200	1,000	2,200	2,200 - 4,200	1,200 - 3,200
Kodiak ²	Pink	11,600	4,000	7,600	9,900 - 14,000	5,900 - 10,000
Chignik	Sockeye ³	4,400	650	3,750	3,400 - 5,300	2,700 - 4,700
	Pink	350	700	0 ⁷	100 - 700	0 ⁷
South Peninsula ⁴	Pink	5,500	1,500	4,000	4,000 - 7,000	2,500 - 5,500
Bristol Bay ⁵	Sockeye	31,100	15,800	15,300	17,600 - 44,600	3,800 - 26,800
Bristol Bay, Nushagak District	Pink	1,700	1,000	700	850 - 2,600	0 ⁷ - 1,600
Kotzebue Sound	Chum	248	220 ⁶	28	138 - 376	0 ⁷ - 156
TOTAL		119,068	37,746	81,671		

¹ Compiled 5 December 1983. The forecast return and harvest ranges are estimated by several techniques. Based on past experience, somewhat less than half of the realized returns and harvests can be expected to fall within their respective ranges.

² Includes supplemental hatchery production.

³ Including estimated interceptions in Cape Igvak, Aniakchak, Hook Bay, and Stepovak Bay fisheries.

⁴ Not including pink salmon taken in June near False Pass, South Unimak, and the Shumagin Islands, which are returning to other areas.

⁵ Inshore harvest only.

⁶ Includes a 30,000-fish allowance for subsistence harvest.

⁷ Zero indicates incidental catches only.

Prince William Sound Pink and Chum Salmon

The 1984 Prince William Sound forecast total harvest of 17 million pink salmon, a moderate increase over the 1983 catch, is expected to consist of about two-thirds natural and one-third hatchery fish. Escapements and weather were good; the return may be stronger than expected. The forecast chum salmon harvest of 600,000 fish, while below the exceptionally high catches of recent years, is still very good when viewed in a historical context.

Lower Cook Inlet (Southern and Outer Districts) Pink Salmon

More than 80% of the forecast 800,000-fish pink salmon harvest in the Southern and Outer Districts of Cook Inlet are returns to the Tutka Lagoon hatchery. Extensive flooding in the fall and winter of 1982 is believed to have resulted in very poor egg survival.

Upper Cook Inlet Sockeye Salmon

A harvest of slightly over 2 million sockeye is expected in Upper Cook Inlet in 1984, less than half the record 1983 catch but still much better than average. This is the first formal Upper Cook Inlet sockeye forecast.

Kodiak Pink Salmon

The 1984 Kodiak pink salmon return forecast is about 12 million fish, with 7.6 million available for harvest. Pre-emergent fry indices were relatively low, but the extremely poor marine survival which yielded the dismal 1983 return is not expected to persist. The forecast 1984 pink salmon harvest is 3 million fish over the 1983 catch, but less than the average even-numbered year return.

Chignik Pink and Sockeye Salmon

No directed fishery on returning Chignik pink salmon is expected in 1984. Very severe stream scouring by ice and high water appears to have been responsible for extremely poor fry survival. Less than 700,000 pinks are expected to return; the escapement goal is 700,000.

On the other hand, a record Chignik sockeye harvest of 3.8 million is expected, which, if realized, will eclipse the previous 2.1-million-fish high set in 1947. Although accuracy of the Chignik sockeye forecast has been comparatively high, the very large 1984 prediction is speculative. An average late run is expected; the early run should provide the bulk of the catch.

South Peninsula Pink Salmon

A harvest of 4 million South Peninsula pinks is anticipated in 1984, a big improvement over the catch of less than 3 million in 1983, but below other recent catches.

Bristol Bay Sockeye and Pink Salmon

The forecast harvest of sockeye in Bristol Bay in 1984 is 15 million; however it might be as low as 4 million, or as high as 27 million. This uncertainty is heightened by relatively extreme disagreement between the forecast methods used--

forecast returns ranged from 11 to 53 million sockeye. A return of 1.7 million pink salmon to the Nushagak District is expected. The forecast harvest range is from insignificant to 1.6 million fish.

Kotzebue Sound Chum Salmon

Kotzebue area chum returns are expected to be dismal in 1984, permitting a commercial catch of only 28,000 fish. The 1983 3-year-old return, used to forecast the dominant 4-year-old age class returning in 1984, was very weak.

PROJECTED 1984 ALASKA COMMERCIAL SALMON HARVESTS

Projections of the 1984 Alaska commercial salmon harvest by statistical region and species are presented in Table 9. Table 10 gives the projections by management region and species. These 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 Sound have chum salmon forecasts. Several smaller pink salmon runs are not forecast. Major sockeye runs in the Central and Western Statistical Regions are forecast; important exceptions are the Copper River and Kodiak. Despite these gaps, 79% of the 1983 salmon harvest of 127 million fish was taken in forecast fisheries.

The 1984 statewide total commercial harvest projection is 103.6 million salmon.

Species Outlook

Pink Salmon

61% of the 1984 statewide total harvest projection, or 63 million fish

47% of the 1983 statewide total harvest, or 60 million fish

A moderate increase, from the 60 million pink salmon harvested in 1983 to 64 million in 1984, is expected. Proportionately, the increase is more significant because far fewer sockeye are anticipated in 1984. The 1984 pink catch increase is expected in Central and Western Alaska; a decrease is forecast in Southeastern.

Sockeye Salmon

27% of the 1984 statewide total harvest projection, or 28 million fish

41% of the 1983 statewide total harvest, or 52 million fish

About half the 1983 record sockeye catch of 52 million is looked for in 1984. Before 1983, the statewide sockeye harvest had never exceeded 38 million.

Chum Salmon

8% of the 1984 statewide total harvest projection, or 8.6 million fish

8% of the 1983 statewide total harvest, or 10.2 million fish

Fewer chum salmon are expected to return to Central Alaskan areas; slightly more to Southeastern and Western Alaska.

Coho Salmon

3% of the 1984 statewide total harvest projection, or 3.3 million fish

3% of the 1983 statewide total harvest, or 3.6 million fish

Table 9. Preliminary projections of 1984 Alaska commercial salmon harvests by statistical region and species¹.

Thousands of Fish

STATISTICAL REGION ²	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	All
Southeastern	256	1,200	1,500	29,600	1,300	33,856
Central	56	9,915	910	31,438	3,463	45,782
Western	451	16,858	857	1,929	3,827	23,922
TOTAL ALASKA	763	27,973	3,267	62,967	8,590	103,560

¹ Compiled 25 October 1983. The projected 1984 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections in the remaining fisheries.

² See Figure 1 for the definition of statistical regions.

Table 10. Preliminary projections of 1984 Alaska commercial salmon harvests by management region and species¹.

Thousands of Fish

MANAGEMENT REGION ²	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	All
Southeastern	256	1,200	1,500	29,600	1,300	33,856
Central	244	18,623	910	20,538	2,313	42,628
Arctic-Yukon-Kuskokwim	221	95	407	219	1,872	2,814
Westward	42	8,055	450	12,610	3,105	24,262
TOTAL ALASKA	763	27,973	3,267	62,967	8,590	103,560

¹ Compiled 5 December 1983. The projected 1984 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections in the remaining fisheries.

² See Tables 4, 5, 6, and 7 for the definition of management regions.

Chinook Salmon

1% of the 1984 statewide total harvest projection, or 770,000 fish

1% of the 1983 statewide total harvest, or 870,000 fish

Moderately lower chinook and coho catches are anticipated in all regions.

Regional Outlook

Statewide

1984 statewide total harvest projection: 103.6 million fish

1983 statewide total harvest: 127.2 million fish

A decline of nearly 20% in the statewide salmon harvest is expected in 1984. Much lower sockeye catches are anticipated in Bristol Bay.

Southeastern Statistical Region

33% of the 1984 statewide total harvest projection, or 34 million fish

33% of the 1983 statewide harvest, or 42 million fish

Moderately lower pink salmon catches are forecast for Southeastern Alaska in 1984.

Central Statistical Region

44% of the 1984 statewide total harvest projection, or 46 million fish

32% of the 1983 statewide total harvest, or 41 million fish

A considerable improvement in pink salmon catches in most central areas is expected.

Western Statistical Region

23% of the 1984 statewide total harvest projection, or 24 million fish

35% of the 1983 statewide total harvest, or 44 million fish

The expected decline in 1984 is due almost entirely to smaller anticipated Bristol Bay sockeye returns.

DISCUSSION

Over the ten-year period beginning in 1974, Alaska commercial salmon harvests have climbed from 22 million fish -- the smallest catch since 1967 -- to a historical high of 127 million in 1983 (see Figure 2). The only hesitation in this dramatic, sustained recovery, in 1982, was due to delays in fishing caused by price disagreements between fishermen and processors. The expected decline to about 100 million fish in the 1984 harvest, if it occurs, will have serious economic impacts on fishermen, fishing communities, and the fishing industry. The large inventory of canned and frozen salmon can hardly serve to bolster prices, and because proportionately more of the catch is expected to be pink salmon, the reduction in poundage from 1983 will be more severe than the reduction in numbers of fish.

Since 1970, salmon harvest projection errors, expressed as a percent of the projection, have ranged from 52% low in 1981 to 31% high in 1972. An approximate 75% confidence interval for the 1984 projection of 104 million salmon can be obtained by taking a weighted average of the two lowest percentage errors, and the two highest errors, and applying these two percentages (-27% and +48%) to the projection. The interval extends from 75 to 150 million fish. When applied to projected and realized Alaska salmon harvests since 1970, 12 of the 14 intervals about the projections do include the realized harvests, close to the expected 10 or 11 correct intervals.

A 50% confidence interval, constructed similarly, results in low and high percentages of -20% and +32%, giving an interval extending from 80 million to 135 million fish. Seven of the 14 intervals surrounding projected harvests since 1970 include realized harvests, exactly what would be expected.

Both these intervals are asymmetrical primarily because Department projections have been about 10% below realized harvests, on the average, since 1970. Realized harvests below the lower limit, or above the upper limit, are approximately equally likely. Because the upper limits for both 50% and 75% confidence intervals are larger than any harvests realized to date, however, caution is advised in their interpretation.

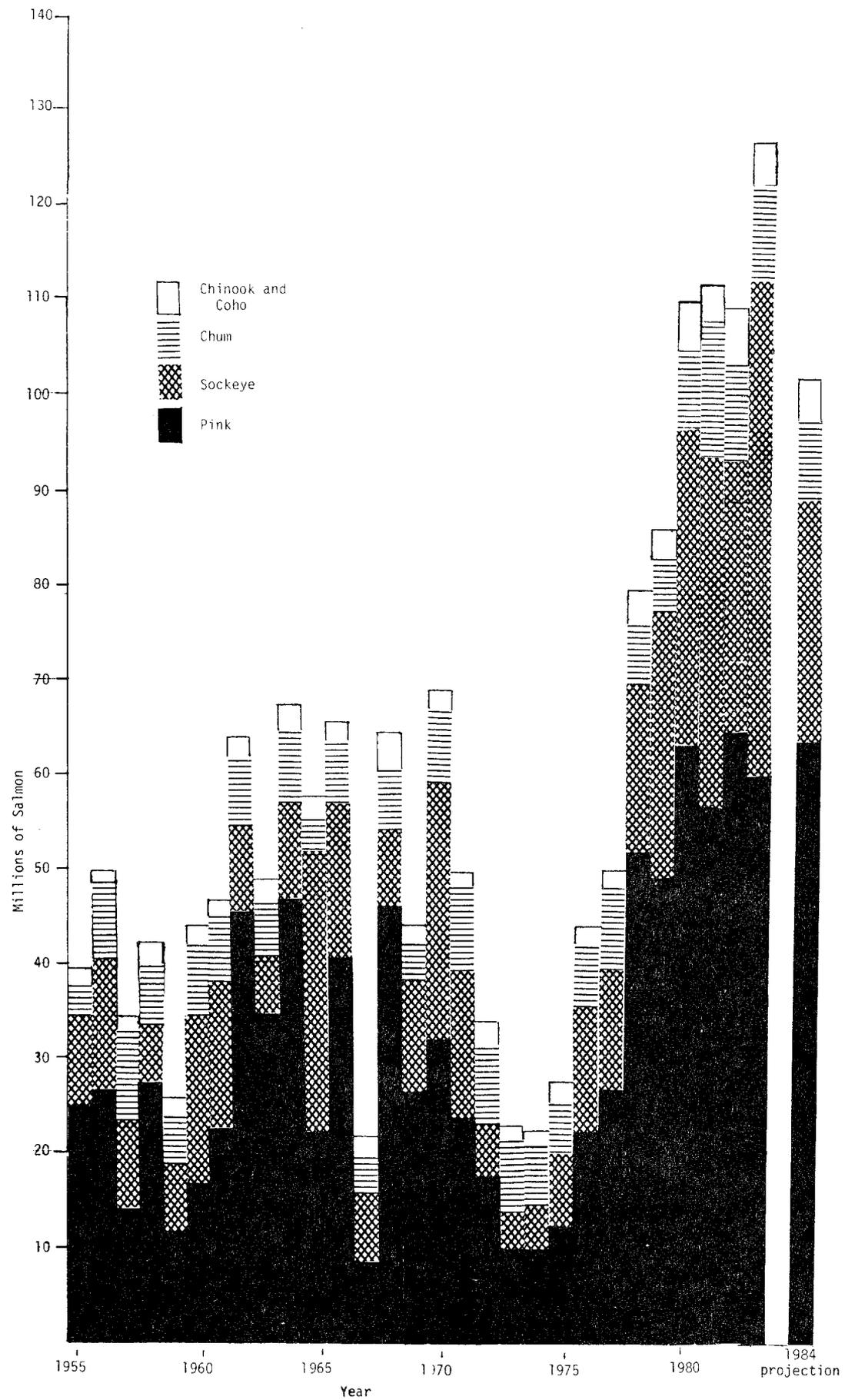


Figure 2. Alaska commercial salmon harvests by species, 1955-1983, and the 1984 projected harvest.

APPENDIX. FORECAST METHODS AND DISCUSSIONS

FORECAST AREA: Southeastern Alaska

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

Southern Southeastern:	<u>Point</u>	<u>Range</u>
Return Estimate:	26.0 million	20.5 million to 33.1 million
Escapement Goal:	6.0 million	
Harvest Estimate:	20.0 million	14.5 million to 27.1 million
Northern Southeastern:		
Return Estimate:	14.2 million	9.2 million to 19.2 million
Escapement Goal:	4.6 million	
Harvest Estimate:	9.6 million	4.6 million to 14.6 million
Total Southeastern:		
Return Estimate:	40.2 million	29.7 million to 52.3 million
Escapement Goal:	10.6 million	
Harvest Estimate:	29.6 million	19.1 million to 41.7 million

FORECAST METHODS

Separate forecasts are prepared for the pink salmon returns to northern and southern Southeastern Alaska because of significant differences in the migration routes and other population characteristics of the pink salmon stocks in the two areas. The 1984 forecast for southern Southeastern was prepared using a multiple regression analysis which incorporated parent year escapements, parent year weight, and an adjustment for the increasing numbers of females in the escapements in recent years. The northern Southeastern forecast was based primarily on a multiple regression analysis which included pre-emergent fry and spring air temperatures at five stations in the northern area.

DISCUSSION OF THE 1984 FORECAST

Southern Southeastern: A total of 26.0 million pink salmon are expected to return to southern Southeastern (Districts 101 through 108) in 1984. Although winter temperatures were not included in the prediction equation, their inclu-

sion would have accounted for 2 of the 3 largest forecast errors. An overestimate of 8.5 million which occurred in 1973 corresponded to the lowest winter temperatures of the study period. The largest underestimate was 6.1 million which occurred in a year when winter temperatures were the third highest of the study period and almost identical to those which have affected the 1984 return. Consequently it is quite possible the return will come in near the upper end of the range.

The distribution of the return is expected to be similar to that in 1983 with the majority of the harvest occurring off the west coast of Prince of Wales Island. The return to District 101 should be a somewhat larger proportion of the overall catch than it was in 1983, as this district had the largest escapement index of the study period.

Caution will again have to be exercised in Districts 105 through 108 as the extended fishing times which will be required to harvest the excess fish returning to the southern portions of southern Southeastern will intercept many of the fish returning to central Southeastern districts.

Northern Southeastern: The return to northern Southeastern is expected to be very strong in 1984 as a result of excellent parent-year escapements in 1982. Escapements were particularly good in Districts 109, 111, 112, and District 113 (for even-numbered years) but were somewhat below desired levels in Districts 110 and 114. The overall escapement of 3.8 million in northern Southeastern was the second largest since 1960 and this, combined with the very mild winter and favorable spring conditions, should produce very strong returns to the inside areas.

Overall escapements to District 109 were the second best since 1960 at 667,000 but the overall district fry index of 117.9 fry per meter was somewhat disappointing. Escapements in lower Baranof Island streams were very good with a total escapement for the area that was the best since 1963. The pre-emergent fry index was better than any since 1977 so some harvestable surplus is expected from the streams in this area. Escapements in the other areas of District 109 were also fairly strong and harvest is likely.

District 110 had an overall escapement below desired levels but the resulting fry index was one of the best ever. Escapements to the mainland streams were the second best, overall, in the past 20 years and harvestable surpluses are expected from these stocks. Escapements to the District 110 streams on Admiralty Island were somewhat below the recent 22-year average but the fry indices were fairly high indicating good overwinter survival. Chances are fair for harvestable surpluses from these stocks in 1984.

In District 111, escapements were very strong, overall, and the pre-emergent fry index was over double any since the program was initiated in 1966. The Seymour Canal area had average escapements but pre-emergent fry values were excellent in all the study systems so that the possibility of harvestable returns is good. The Taku River systems had very good escapements in the parent year and are also expected to produce good returns.

Escapements and pre-emergent fry values were generally good in District 112. The west Admiralty streams in particular had strong escapements and very good

pre-emergent values. Tenakee Inlet had good escapements and the overall fry index for the Inlet was the best since 1971.

District 113 had the best even-year escapement ever recorded with a total escapement of over a million pink salmon in the parent year. Escapements to the outside areas were strong but the fry index was disappointing. The Peril Straits streams had very strong escapements, a good fry index, and should produce some harvest.

In District 114, escapements were poor and the overall fry index was correspondingly low. Any harvest from this district should be minimal.

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Juneau

Karl T. Hofmeister
Fishery Biologist
Ketchikan

FORECAST AREA: Prince William Sound

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	11.8 million	8.8 million to 14.8 million
Harvest Estimate:	10.3 million	7.3 million to 13.3 million
Escapement Goal:	1.5 million	

SUPPLEMENTAL PRODUCTION

Cannery Creek Hatchery

Return Estimate:	900,000	635,000 to 1,165,000
Common Property Harvest Estimate:	831,000	566,000 to 1,096,000
Brood Stock and Stream Escapement:	69,000	

Main Bay Hatchery

Return Estimate:	1,000,000	750,000 to 1,360,000
Common Property Harvest Estimate:	910,000	660,000 to 1,270,000
Brood Stock:	90,000	

Valdez Fisheries Development Association

Return Estimate:	160,000	110,000 to 210,000
Common Property Harvest Estimate:	35,000	0 to 75,000
Brood Stock:	60,000	
Hatchery Harvest:	65,000	

Prince William Sound Aquaculture Corporation

Return Estimate:	4.9 million	2.8 million to 9.2 million
Common Property Harvest Estimate:	3.3 million	1.2 million to 7.6 million
Brood Stock:	100,000	
Hatchery Harvest:	1.5 million	

TOTAL SUPPLEMENTAL PRODUCTION

Return Estimate:	7.0 million	4.3 million to 11.9 million
Common Property Harvest Estimate:	5.1 million	2.4 million to 10.0 million

	<u>Point</u>	<u>Range</u>
Brood Stock and Stream Escapement:	320,000	
Hatchery Harvest:	1.6 million	
Total Harvest:	6.7 million	4.0 million to 11.6 million
 TOTAL PRODUCTION		
Return Estimate:	18.8 million	13.1 million to 26.7 million
Harvest Estimate:	17.0 million	11.3 million to 24.9 million
Escapement and Brood Stock:	1.8 million	

FORECAST METHODS

Natural Production: The 1984 forecast is the result of a multiple linear regression analysis of even-numbered year pre-emergent fry indices, March-April air temperatures of the following year, and subsequent adult returns.

The estimated wild stock return is the product of a 1982 estimated escapement of 2.3 million fish. This escapement produced a pre-emergent fry index of 362 fry per square meter. If the wild stock returns at the point estimate, the return/spawner ratio will be 5; however, in considering return/spawner ratio performances of brood years 1978 and 1980, both of which exceeded 10, the 1984 return may exceed the forecast. The excellent distribution of escapement in 1982 for all districts lends additional credibility to this possibility.

Supplemental Production: The 1984 supplemental return will be the result of production from two Fisheries Rehabilitation, Enhancement, and Development (FRED) Division hatcheries (Cannery Creek and Main Bay) and two private non-profit (PNP) hatcheries (Port San Juan and Solomon Gulch). The Port San Juan hatchery is operated by Prince William Sound Aquaculture Corporation while the Solomon Gulch hatchery is operated by the Valdez Fisheries Development Association (VFDA). The FRED Division hatcheries released a total of 47,875,000 unfed fry while the PNP hatcheries released a total of 92,884,000 fed and unfed fry. Adult returns were calculated by hatchery personnel using estimated average, low, and high fry-to-adult survival rates.

DISCUSSION OF THE 1984 FORECAST

Natural Production: The estimated 1982 escapement of 2.3 million fish is the highest recorded even-year escapement since statehood. Desired escapement levels were exceeded in all management districts and were well distributed.

The forecast return from the 1982 brood year is unexpectedly small when considering (1) the good escapement, (2) the good pre-emergent fry index, and (3) the warm spring of 1983. The only reason that lower than expected production could be realized is some unexplained high seas food competition incurred by exceptional oceanographic and climatological conditions prevailing

in the eastern North Pacific Ocean. At this time, however, it is believed that the 1984 return will come in at the high end of the forecast range with harvestable surplus fish available in all districts.

Supplemental Production: Hatchery production for 1984 is expected to contribute 5.2 million fish to the common property fishery; depending on the various fry-to-adult survival rates, the contribution could range anywhere from 2.5 million to 10.2 million. These catches will be the result of a record release of 140.8 million pink fry.

Most of these fish will be present in the fishery from mid-July to late August.

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	863,000	647,000 to 1,079,000
Harvest Estimate:	613,000	397,000 to 829,000
Escapement Goal:	250,000	

SUPPLEMENTAL PRODUCTION

Valdez Fisheries Development Association

Return Estimate:	6,400	4,800 to 8,000
Common Property Harvest:	0	0 to 1,600
Brood Stock:	6,400	
Hatchery Harvest:	0	

TOTAL PRODUCTION

Return Estimate:	869,400	651,800 to 1,087,700
Harvest Estimate:	613,000	397,000 to 830,600
Escapement Goal:	256,400	

FORECAST METHODS

Natural Production: The 1984 Prince William Sound chum salmon forecast is the result of linear regression analysis between brood year returns of 3-year-old and 4-year-old fish; and 4-year-old and 5-year-old fish. This method resulted in the projection of 602,000 4-year-olds and 157,000 5-year-olds. On the average these two groups of fish make up 88% of annual returns. Consequently, the total including 3-year-old and 6-year-old contributions, was estimated by dividing 0.88 into the estimated sum of 4- and 5-year-old fish.

Brood year escapements, beginning with 1977, have been replacing themselves at a phenomenal rate. To date the 1977 brood year estimated escapement has

replaced itself at a rate of 15.9 returns/spawner. The 1978 and 1979 brood year escapements now have replacement ratios of 13.0 and 9.3, respectively, and still have more fish yet to return. The 1980 brood year has already replaced itself with 3-year-old production alone.

The return range for this forecast is based on past forecast versus actual returns. The average error for this relationship is 25%.

DISCUSSION OF THE 1984 FORECAST

As in the recent past the vast majority of the 1984 returns will be headed for the northern half of the Sound; some minor returns are expected on Hinchinbrook Island. Return timing is expected to be fairly well spread out over the entire commercial season.

Supplemental Production: With the exception of the VFDA, no formal chum salmon forecasts were made for supplemental production. As shown in the accompanying table, VFDA plans to use the entire return as brood stock. This stock will certainly contribute to the common property fishery as it will probably be entering the fishery at least one month prior to arriving in the Port Valdez area.

Michael L. McCurdy
Fisheries Research Biologist
Cordova

FORECAST AREA: Lower Cook Inlet, Southern and Outer Districts

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	336,000	0 to 1,250,000
Escapement Goal:	191,000	
Harvest Estimate:	145,000	0 to 1,059,000
SUPPLEMENTAL PRODUCTION		
Return Estimate:	685,000	260,000 to 1,100,000
Required Brood Stock:	28,000	
Harvest Estimate:	657,000	232,000 to 1,072,000
TOTAL PRODUCTION		
Return Estimate:	1,021,000	260,000 to 2,350,000
Escapement and Brood Stock:	219,000	
Harvest Estimate:	802,000	232,000 to 2,131,000

FORECAST METHODS

The 1984 pink salmon forecast for the Southern and Outer Districts of Lower Cook Inlet is derived from a linear regression between indices of pre-emergent fry density in nine major spawning streams and the subsequent adult returns. Pre-emergent fry densities are determined from these streams each spring and are 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 Tutka Lagoon pink salmon hatchery has made major contributions to the Southern District pink salmon return, providing, since 1978, from 35 to 88% of the entire Southern District pink salmon catch. The hatchery released 11.1 million short-term-reared (STR) fry and 3.75 million directly-released (DR) fry into Tutka Bay in 1983. Survival rates have ranged between 4.5 and 16% for STR fry and between 1 and 4% for DR fry. For forecast purposes, survivals of 1 and 3% were used for DR fry, and 2 and 9% for STR fry.

DISCUSSION OF THE 1984 FORECAST

Severe flooding in the fall and winter of 1982 resulted in very low pre-emergent fry densities in several spawning streams. The formal forecast method yields a return of 335,800 pink salmon, while a return of 718,600 can be derived using average return per spawner data. If ocean conditions, which are believed to have caused the poor 1983 returns, have moderated, then the 1984 return could very easily fall between the average return per spawner forecast of 719,000 and the upper end of the forecast range of 1.2 million due to the excellent spring and summer weather conditions experienced this year.

Natural returns are expected to be poor to Southern District streams based on pre-emergent fry densities. Returns to Port Dick could be good based on pre-emergent fry densities and if survivals were equally good in the Nuka Bay area, fair returns could occur to James Lagoon and Desire Lake.

Thomas R. Schroeder
Area Biologist
Homer

FORECAST AREA: Upper Cook Inlet

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	3.2 million	2.2 million to 4.2 million
Escapement Goal:	1.0 million	
Harvest Estimate:	2.2 million	1.2 million to 3.2 million

FORECAST METHODS

The major sockeye salmon systems in Upper Cook Inlet are the Kenai, Kasilof, Susitna, Crescent, Chakachatna/McArthur, and Big Rivers. Fish Creek is also significant in some years.

Historical data on total sockeye salmon return are available for the first four systems noted and these data form the basis of the forecast. Escapement-return relationships by system provided estimates of total production from each brood year escapement. Average marine maturity schedules were then applied to estimate the numbers of adult salmon returning each year.

DISCUSSION OF THE 1984 FORECAST

The total return of sockeye salmon to Upper Cook Inlet is estimated to be 3.2 million in 1984. Desired escapement levels to the four major river systems and various minor systems total 1 million, providing an anticipated harvestable surplus of 2.2 million. Estimated returns to the Kenai River are 2.0 million, to the Kasilof River are 627,000, to the Susitna River are 488,000, and to the Crescent River are 150,000. Based on these forecasts and required escapement objectives, exploitation rates for the major contributing systems are calculated to be 80% for the Kenai, 81% for the Kasilof, 59% for the Susitna, and 67% for the Crescent Rivers.

In recent years more than 70% of the Kenai River sockeye return has been aged 5 years, with 2 years spent in freshwater. In 1979 (the brood year for 5-year-old fish in 1984), the number of spawners in the Kenai system was estimated at 246,000 fish which is significantly below the optimum goal of 390,000 fish. This factor was taken into account in the forecast. The Crescent River, by way of contrast, experienced a relatively large escapement of 86,000 fish in 1979. Returns from such large escapements have not been observed in the past, but there is concern that this level of escapement may well result in reduced production and a return of less than 150,000 fish in 1984.

Since the 1984 forecast is the first such attempt at forecasting sockeye salmon returns to Upper Cook Inlet, caution is advised in interpreting these results.

Kenneth Tarbox
Research Project Leader
Upper Cook Inlet

FORECAST AREA: Kodiak

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	10.5 million	9.5 million to 11.5 million
Escapement Goal:	3.9 million	
Harvest Estimate:	6.6 million	5.6 million to 7.6 million
SUPPLEMENTAL PRODUCTION		
Return Estimate:	1.1 million	380,000 to 2.4 million
Required Brood Stock:	150,000	
Harvest Estimate:	950,000	230,000 to 2.3 million
TOTAL PRODUCTION		
Return Estimate:	11.6 million	9.9 million to 14.0 million
Escapement and Brood Stock:	4.0 million	
Harvest Estimate:	7.6 million	5.9 million to 10.0 million

FORECAST METHODS

The 1984 pink salmon forecast return to the Kodiak Management Area was determined as follows: A point estimate for the total management area return was calculated from a multiple linear regression analysis of the past 18 years' pre-emergent data. Variables used in the analysis were the adjusted live fry density indexes and the average April ambient air temperatures taken in Kodiak. The upper and lower range estimates are the 80% confidence intervals.

DISCUSSION OF THE 1984 FORECAST

Pre-emergent fry sampling this spring (1983) indicated poor to good overwinter survival from the brood year escapement of 5.3 million pinks. Sampling resulted in an unweighted index of 145.9 live fry/m². This fry index is one of the lower indices on record for an even-numbered year return.

Distribution of the brood year escapement resulted in 89% of the fish entering the pre-emergent index streams. Low water conditions and good weather encountered during the month of March contributed to timely sampling of all major

spawning systems. Fall and winter rains resulted in scouring in some river systems. Heavy scouring was evident in streams in the Mainland District.

Marine survival of the 1983 pink salmon return was poor. Explanations range from increased predation, lower estuarine and bay temperatures during the peak of fry outmigration, to high seas interception of returning adults; or a combination of the above.

In 1984, 9.5 to 11.5 million naturally-produced pink salmon are expected to return to the Kodiak Management Area. An escapement of 3.9 million pinks is desired, leaving 5.6 to 7.6 million pinks available for harvesting.

The expected return is partitioned by major geographical district below. All district harvest projections assume desired escapement goals will be met.

Afognak District: The pre-emergent fry index was good. Taking into consideration the lower marine survival experienced in the past two years, 814,000 pinks are expected to return. The desired escapement level is 250,000 pinks, leaving 564,000 fish available for harvesting.

Afognak District Supplemental Production: The Kitoi Bay Hatchery total return point estimate is 1.1 million pinks, assuming average survival. Hatchery brood stock requirements are 150,000 fish, leaving an estimated 962,000 pinks available for harvest. Considering the worst and the best survival estimates, pinks available for harvest could range from 216,000 to 2.3 million.

Westside District: The overall fry index for this area was better than the brood year's. Scouring appeared to have affected survival in Uyak, Zachar, and Uganik Rivers; Karluk and Red River will once again be the major producers. Total pink salmon return is expected to be 7.25 million fish. The desired escapement goal is 2.25 million pinks, leaving approximately 5 million pinks available for harvesting.

Alitak District: Scouring appeared to have affected fry survival in Deadman and Humpy Rivers considering their excellent parent year escapements. Freezing temperatures were also a minor factor in overwinter survival in this District. 1.08 million pinks are expected to return to the Alitak District. Escapement requirements are 500,000 pinks, leaving 582,000 fish available for harvesting.

General District: The overall live fry index was lower than the last two even-year returns. Several river systems had been scoured or changes in stream channels occurred due to heavy fall and winter rains. Taking into consideration the poor marine survival of the 1983 return only 914,000 pinks are expected to return in 1984. The escapement goal is 500,000, leaving 414,000 pinks available for harvest.

Mainland District: Overall live fry was poor in this District. Most streams from Kinak south to Wide Bay appeared to have been severely scoured by high water levels. An estimated 450,000 pinks are expected to return. Escapement requirements are 400,000, leaving 50,000 pinks available for harvest.

David Prokopowich
Ass't. Area Management Biologist
Kodiak Management Area

FORECAST AREA: Chignik

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF THE 1984 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	350,000	100,000 to 700,000
Escapement Goal:	700,000	
Harvest Estimate:	0	Incidental catch only

FORECAST METHODS

The Chignik forecast was determined by considering pre-emergent fry densities, stream conditions, return per spawner rates in recent years, coupled with brood year escapements. Historical catch and escapement information was used also to arrive at a probable return range.

DISCUSSION OF THE 1984 FORECAST

Spring pre-emergent sampling in the Chignik area revealed very poor fry survival. A total of eleven pink salmon index streams were sampled and only 8 individual pink salmon fry were found. Very severe stream scouring was indicated throughout the Chignik area and probably is responsible for the poor fry survival.

The parent-year escapement for the 1984 return was also weak at 427,000. Return-per-spawner during the last four years has ranged from 1.0 to 2.0 which when coupled with the weak brood year would result in a maximum possible return of 427,000 to 854,000.

Very poor fry survival, weak brood year escapements and a downward trend in pink returns in other western Alaska areas all point to a low return for the Chignik area in 1984.

No pink salmon fishery is anticipated and no harvest is forecast. However, undoubtedly some pinks will be caught incidentally when the fishery is targeted on other species. The 1984 forecast range is from 100,000 to 700,000 pinks. The escapement goal is 700,000.

Tyler Gilmer
Ass't. Area Management Biologist
Peninsula/Aleutians Area

FORECAST AREA: Chignik

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

EARLY RUN	<u>Point</u>	<u>Range</u>
Return Estimate:	3.2 million	2.6 million to 3.7 million
Escapement Goal:	400,000	
Harvest Estimate:	2.8 million	2.2 million to 3.3 million
LATE RUN		
Return Estimate:	1.2 million	760,000 to 1.6 million
Escapement Goal:	250,000	
Harvest Estimate:	950,000	510,000 to 1.4 million
TOTAL		
Return Estimate:	4.4 million	3.4 million to 5.3 million
Escapement Goal:	650,000	
Harvest Estimate:	3.75 million	2.7 million to 4.7 million

FORECAST METHODS

The total point and range estimates given above are sums of predictions for early and late runs. To obtain the prediction for each run, the return of sockeye which have spent 3 years in the ocean (3-ocean sockeye) or 2 years in the ocean (2-ocean sockeye) are individually estimated and totaled. The range is an approximate 80% confidence interval.

A multiple linear regression was used to predict the early-run return of 3-ocean sockeye from the number of returning 2-ocean sockeye the previous year, the mean length of male 2-ocean sockeye which had spent one year in fresh water (again obtained the previous year), and the magnitude of early-run escapement 5 years previous. The early-run estimate of 2-ocean sockeye is the geometric mean of early-run 2-ocean returns since 1965, excluding 1969 and 1975.

A single linear regression forecasts the return of late-run 3-ocean sockeye from the number of late-run 2-ocean sockeye the previous year. The late-run estimate of 2-ocean sockeye is the geometric mean of late-run 2-ocean returns since 1962.

DISCUSSION OF THE 1984 FORECAST

Early run: The early-run forecast is for a much larger sockeye return than any on record. The prediction is based mainly on an abnormally large early-run

return in 1983 of 2-ocean sockeye which had spent one year in freshwater. Values of the other two predictor variables were near or slightly above average. The early-run return forecast of 3.2 million fish, with an escapement goal of 400,000, is expected to permit a harvest of from 2.2 to 3.3 million sockeye.

A substantial degree of uncertainty is associated with the 1984 early-run forecast for two reasons. First, Pacific Ocean warming during the winter of 1982-83 may have disrupted the normal brood maturity schedule causing a larger-than-normal fraction of the 1979 brood to return as 2-ocean rather than 3-ocean fish. However, there is no evidence that this occurred in other sockeye runs. Second, the relationship between 2-ocean returns in one year and 3-ocean returns in the next is assumed to be linear. While the relationship does appear linear over the range of data available, the 1983 return of 2-ocean sockeye was far outside that range.

Late run: The predicted return of late-run sockeye falls well within the range of past runs and is somewhat smaller than the average for years since 1975. While the relationship between 2-ocean and 3-ocean returns is quite variable in late run data, observed runs were within the prediction range in 18 of 20 forecasts using the 1984 prediction equations for years since 1961. As no irregularities were noted in the return of 2-ocean age fish in 1983, it is anticipated that the 1984 late run will be reasonably close to the forecast return of 1.2 million fish. An escapement goal of 250,000 should permit a harvest of from 510,000 to 1.4 million sockeye.

Prepared by:

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Peter J. Probasco
Area Management Biologist
Chignik Area

FORECAST AREA: South Peninsula

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	5.5 million	4.0 million to 7.0 million
Escapement Goal:	1.5 million	
Harvest Estimate:	4.0 million	2.5 million to 5.5 million

FORECAST METHODS

The forecast was developed from a combination of a linear regression using average pre-emergent fry/m² and average return per spawner trends in recent years. Climatic conditions and pink salmon return strength in other western Alaska areas were considered in adjusting the forecast.

DISCUSSION OF THE 1984 FORECAST

The forecast is based on the pre-emergent pink salmon fry sampling program conducted each March in key index streams. This program appears accurate in determining fry survival and yields a value which relates yearly returns to fry density. Linear regression analysis using 10 years of pre-emergent fry density data points was used to develop the present forecast.

Because the 1983 pink return was significantly below the forecasted range, however, more importance has been placed on recent average returns per spawner. The 1983 total return resulted in a return per spawner of 1.5 which is a ten-year low. This may indicate poor ocean survival due to changing climatic conditions such as above-normal water temperatures.

In 1982 (the brood year for the 1984 return) the return per spawner was 2.8, which if repeated in 1984 would result in a total return of over 6.0 million. If return per spawner trends remain low then a decreased return would result.

The forecast return is surrounded by a range of 4.0 to 7.0 million. The point estimate is a total return of 5.5 million with an expected harvest of 4.0 million.

The forecast does not include the incidental pink harvest during the June fishery on salmon migrating to other areas.

Tyler R. Gilmer
Ass't. Area Management Biologist
Peninsula/Aleutians Area

FORECAST AREA: Bristol Bay

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	31.1 million	17.6 million to 44.6 million
Escapement Goal:	15.8 million	13.8 million to 17.8 million
Harvest Estimate:	15.3 million	3.8 million to 26.8 million

FORECAST METHODS

The Bristol Bay sockeye forecast is a weighted average of several independently-prepared 1984 forecasts:

- 1) [Standard ADF&G] -- A forecast based on a compendium of methods including predicted return per spawner by age class and river system; prediction using the previous-year returns of younger sibling age classes; and several techniques employing estimates of the number of juvenile sockeye migrating to the ocean;
- 2) [Japanese high-seas gill net sampling] -- Either the arithmetic or the geometric mean of catch per unit effort data collected by Japanese research vessels south of the Aleutian Islands during the summer months is used;
- 3) [Escapement-temperature model] -- Sockeye return is estimated by a multiplicative model incorporating escapement 4, 5, and 6 years previous, and mean June air temperature at Cold Bay on the south side of the Alaska Peninsula one and two years previous;
- 4) [Temperature-length model] -- Sockeye return is estimated by a multiplicative model incorporating the mean June air temperature at Cold Bay 1, 2, and 3 years previous, and the mean length of sockeye which had spent 2 years in the ocean, obtained in the Japanese high seas samples; and
- 5) [Previous-year sibling age class return] -- Linear regressions relating the previous-year returns of 3, 4, and 5-year-old sockeye to the forecast year's return of 4, 5, and 6-year-old fish are employed, with pooled Bristol Bay return data.

Standard deviations and confidence limits for each of these methods were estimated by standard methods from a simple linear regression relating forecast returns to those observed. Weights in the weighted average were inverses of the squared standard deviations. Individual forecasts for 1984 Bristol Bay inshore returns, with standard deviations, are (millions of fish):

Standard ADF&G	41.5 ± 11.8
Japanese high seas gill net, arithmetic mean	11.2 ± 9.0
Japanese high seas gill net, geometric mean	14.4 ± 8.9
Escapement-temperature model	53.4 ± 9.1
Temperature-length model	24.9 ± 7.4
Previous-year sibling age class return	31.0 ± 11.1

DISCUSSION OF THE 1984 FORECAST

The individual 1984 forecasts are unusually discordant, ranging from 11 to 53 million fish. The weighted average is 31.1 million.

Offshore surface seawater temperatures south of the Aleutians in the summer of 1983 were about 5°C lower than normal. Weak returns in the past have been associated with low temperatures; however, immature sockeye distribution might have been affected by the colder temperatures, and the Japanese forecast may be too low.

Bristol Bay escapement goals are currently being revised and will probably be increased in several systems. The corresponding harvest estimates will decline accordingly.

Douglas M. Eggers

and

Henry J. Yuen
 Fishery Research Biologists
 Anchorage

FORECAST AREA: Bristol Bay, Nushagak District

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	1.7 million	850,000 to 2.6 million
Escapement Goal:	1.0 million	
Harvest Estimate:	700,000	0 to 1.6 million

FORECAST METHOD

Recent forecasts of Nushagak River pink salmon runs, which are of commercial significance only in even-numbered years, have been very inaccurate. In 1982, over 9 million pinks were expected; the actual return was less than 3 million. The 1984 forecast, in contrast to the more elegant but patently less successful methods employed in 1982, is a simple average of returns resulting from parent years having large escapements, and an estimate based on pink fry out-migration observations in the spring of 1983.

DISCUSSION OF THE 1984 FORECAST

The 1984 parent year escapement of pink salmon in the Nushagak River in 1982 was quite large (1.7 million fish). Returns per spawner from years of similarly large escapements (1958, 1966, 1978, and 1980) have averaged less than 0.5, however. The average return in the 5 years listed above was 1.3 million pinks. If 1958 and 1978 are eliminated, the average is 1.9 million; leaving out only 1958 yields 1.6 million. Using a preliminary rough estimate of the number of pink salmon fry migrating to the ocean in the spring of 1983 provides a 1984 return forecast of about 2 million fish. The unweighted average of these estimates gives a forecast return of 1.7 million pink salmon. With escapement requirements of 1 million fish, the harvest might range from insignificant to 1.6 million.

Prepared by:

Michael L. Nelson
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Dillingham

FORECAST AREA: Kotzebue Sound

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF 1984 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	248,000	138,000 to 376,000
Escapement Goal:	190,000	
Subsistence Harvest:	30,000	
Commercial Harvest:	28,000	0 to 156,000

FORECAST METHODS

Three-year-old returns are predicted using the relation between total escapement in the brood year (1981 for 3-year-olds in 1984) and the return per spawner (R/S) for 3-year-old Kotzebue chum salmon. Four- and five-year-old returns are predicted on the basis of similarities in survivorship (expressed as R/S) between sibling year classes from the same brood year. Thus, the low R/S ratio of 3-year-old fish in the 1983 return indicates a low R/S ratio of 4-year-olds in 1984 since both age classes are the result of the 1980 brood year escapement.

DISCUSSION OF THE 1984 FORECAST

Poor returns are expected from the 1980 brood year, based on the weak return of 3-year-olds in 1983. Since the majority of the return in a given year is comprised of 4-year-olds, poor survival of the 1980 brood will be manifested primarily in 1984.

Survivorship curves used to predict year class returns are the result of 17 years of accumulated Kotzebue Sound chum salmon data. Since more and better data have been collected in the past five years than in preceding years, it is expected that the accuracy of the forecast will improve in the future.

The return in 1984 is expected to consist of 21,000 3-year-old, 162,000 4-year-old, and 65,000 5-year-old chum salmon.

The forecast return for 1983 was 530,000 chum salmon and the actual return was estimated to be 347,000. The discrepancy is due to fewer 3- and 4-year-old returns than forecast.

Brian Bigler
Fisheries Biologist
Kotzebue

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