

**PRELIMINARY FORECASTS AND PROJECTIONS FOR 1988 ALASKA
SALMON FISHERIES**

Edited by:

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and

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ABSTRACT

More than 95 million salmon were taken by commercial fishermen in Alaska in 1987. This is the first year since 1979 that Alaskan salmon harvests have been below 100 million fish. The ex-vessel value of the 1987 salmon harvest was approximately \$458 million dollars. This represents a record for ex-vessel value reflecting higher prices compensating for the reduced harvest level.

The 1987 salmon harvest was virtually identical to the pre-season forecasted catch of 94 million. Although the total 1987 statewide commercial salmon harvest was very close to the 1987 catch projection, there were some differences in actual harvest and forecasted harvest for some fisheries. The pink salmon returns to southern Southeastern were very much weaker than anticipated, whereas pink salmon returns to Prince William Sound were very much stronger than anticipated. Sockeye salmon returns, both Bristol Bay and Upper Cook Inlet, were much higher than forecasted. Salmon returns in other fisheries were, generally, very close to preseason expectations.

The projected 1988 salmon harvest is 135 million. This is substantially greater than the 1987 salmon harvests but very similar to the salmon harvests observed for recent years. The 1988 pink salmon returns are expected to be much stronger than 1987 in Southeast Alaska and very similar to the very strong return in 1987 in Prince William Sound. The 1988 sockeye salmon returns are expected to be stronger than the 1987 return in Bristol Bay.

There is much uncertainty associated with the 1988 salmon harvest projections, but the actual harvest is not expected to be below 103 million or above 178 million. Based on the statistical performance of the harvest projections, 1970-1987, only one of five realized harvests would be expected to fall outside this range.

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

INTRODUCTION

This report reviews Alaska's 1987 commercial salmon season and presents preliminary salmon return forecasts and projections for the 1988 commercial salmon fisheries. The report is released before final catch figures are available. This is to provide preliminary information to the Board of Fisheries, the fishing industry, and the public well before the season begins.

Forecasts of returns (catch + escapements) for major salmon fisheries as well as projections of the statewide commercial salmon harvest have been published yearly by the Alaska Department of Fish and Game since 1969 (ADF&G 1969-1984; Eggers 1985, 1986; Eggers and Dean 1987). The accuracy of those forecasts and harvest projections are summarized in Table 1. On the average, the return forecasts have been very close to the actual returns, with the forecast exceeding the return by less than 1% (Table 1). With regard to sign, the error has been 29%. The projected statewide harvest has, on the average, been lower than the actual harvest by 7% of the projected harvest (Table 1). The error without regard to sign has been 24%. The historical performance of the forecasted return to major salmon fisheries (Figure 1), as evidenced by the breadth of the 80% confidence interval on the relation between observed and actual return (1970-1987), has been somewhat poorer than the historical performance of the projected statewide commercial harvest projections (Figure 2). The errors have been due to inadequate knowledge of salmon escapement, the numbers of juvenile salmon produced from these escapements, and the natural variation in survival of salmon throughout various life history stages.

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.

Table 1. Forecasted return, harvest, escapement goal, preliminary return, escapement, harvest, management error (ie difference between realized escapement and escapement goal), and return forecast error for major salmon fisheries where formal forecasts were made, 1970-1987. Projected and realized Alaska commercial salmon harvests with absolute and relative error, 1970-1987. Figures are in thousands of salmon.

Year	Only Major Fisheries Where Formal Forecasts Are Made ^a										Projected Collective Harvest of all Alaska Salmon Fisheries				((1)-(2)) Forecasted Harvest Relative Projected Statewide Harvest
	Forecasted		(2) Escapement Goal	Actual (Note that Figures Based on Preliminary Returns)			(5) Management Error (thousands)	(5)/(2) %	(6) Forecast Error (thousands)	(6)/(1) %	(7) Projected Harvest	(8) Actual Harvest	(9) (7)-(8) Error	(9)/(7) Relative Error	
	(1) Return	Harvest		(3) Return	(4) Escapement	Harvest									
1970	114,347	77,080	37,267	64,653	17,271	47,382	19,996	54%	49,694	77%	95,500	68,500	27,000	39%	81%
1971	41,140	28,110	13,030	50,780	18,643	32,137	(5,613)	-43%	(9,640)	-19%	41,500	47,500	(6,000)	-13%	68%
1972	52,790	30,470	22,320	30,995	13,616	17,379	8,704	39%	21,795	70%	46,700	32,000	14,700	46%	65%
1973	38,650	18,820	19,830	21,650	10,636	11,014	9,194	46%	17,000	79%	30,000	22,300	7,700	35%	63%
1974	27,830	7,500	20,330	29,150	19,334	9,816	996	5%	(1,320)	-5%	15,600	21,900	(6,300)	-29%	48%
1975	28,740	8,435	20,305	45,937	28,496	17,441	(8,191)	-40%	(17,197)	-37%	19,900	26,200	(6,300)	-24%	42%
1976	45,202	25,702	19,500	48,940	18,860	30,080	640	3%	(3,738)	-8%	37,100	44,400	(7,300)	-16%	69%
1977	43,650	23,740	19,910	56,495	21,695	34,800	(1,785)	-9%	(12,845)	-23%	34,700	50,800	(16,100)	-32%	68%
1978	70,323	48,737	21,586	97,940	36,020	61,920	(14,434)	-67%	(27,617)	-28%	62,900	82,300	(19,400)	-24%	77%
1979	84,960	57,210	27,750	108,323	37,985	70,338	(10,235)	-37%	(23,363)	-22%	72,000	88,800	(16,800)	-19%	79%
1980	124,930	86,360	38,570	144,096	62,490	81,606	(23,920)	-62%	(19,166)	-13%	102,600	110,000	(7,400)	-7%	84%
1981	78,500	55,420	23,080	116,095	28,895	87,200	(5,815)	-25%	(37,595)	-32%	74,500	113,300	(38,800)	-34%	74%
1982	136,060	109,940	26,120	105,503	27,983	77,520	(1,863)	-7%	30,557	29%	135,000	109,100	25,900	24%	81%
1983	97,210	74,330	22,880	129,363	28,672	100,691	(5,792)	-25%	(32,153)	-25%	94,000	127,200	(33,200)	-26%	79%
1984	119,068	81,671	37,397	150,034	47,410	102,624	(10,013)	-27%	(30,966)	-21%	103,560	132,505	(28,945)	-22%	79%
1985	123,629	86,891	36,738	164,115	43,916	120,199	(7,178)	-20%	(40,486)	-25%	108,241	144,610	(36,369)	-25%	80%
1986	147,935	113,532	34,403	137,827	37,257	100,570 ^b	(2,854)	-8%	10,108	7%	138,015	127,864	10,151	8%	82%
1987	95,275	66,736	30,839	105,932	30,697	75,235 ^b	142	0%	(10,657)	-10%	94,132	95,525	(1,393)	-1%	71%
1970-86															
Averages	81,680	55,594	26,214	89,324	29,438	59,886	(3,223)	-12%	(7,644)	-0.28%	72,553	80,267	(7,714)	-6.67%	72%
Averages without regard to sign							7,631	29%	21,994	29%			17,209	24%	

^aPreliminary data published in ADF&G (1970-1984), Eggers (1985, 1986), Eggers and Dean (1987).

^bPreliminary harvest figures

Obs. Return versus Fcst. Return

Major Fisheries with Formal Forecasts

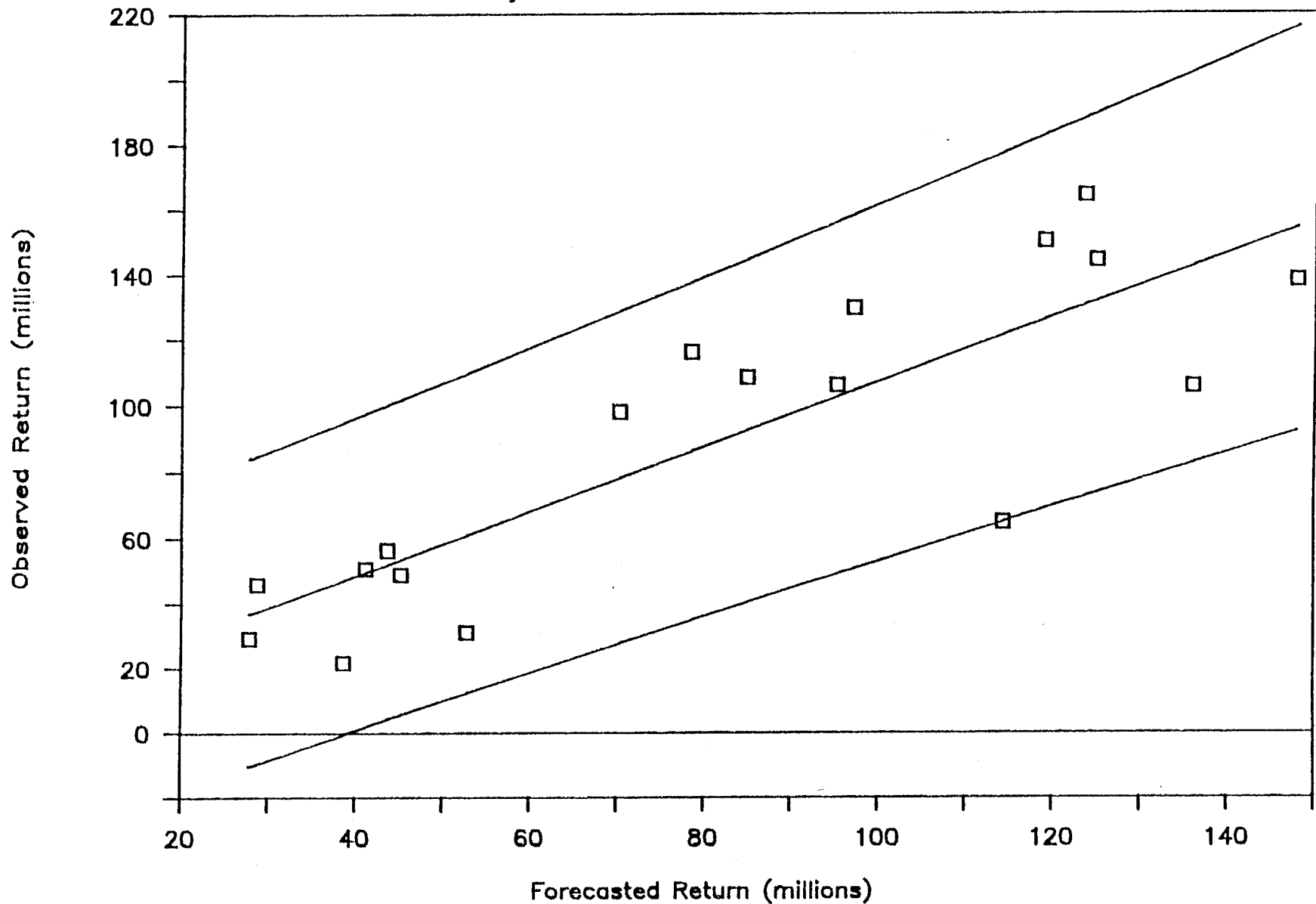


Figure 1. Relationship between observed return (millions) and forecasted return (millions) for major salmon fisheries with formal forecasts, 1970-1987. Also shown are the regression line, $Y = 9.53 + 0.977 X$, $R^2 = 0.707$, together with 80% confidence intervals; where, $Y =$ Observed Return and $X =$ Forecasted Return.

Obs. Harvest versus Fcst. Harvest

Projected Statewide Harvest

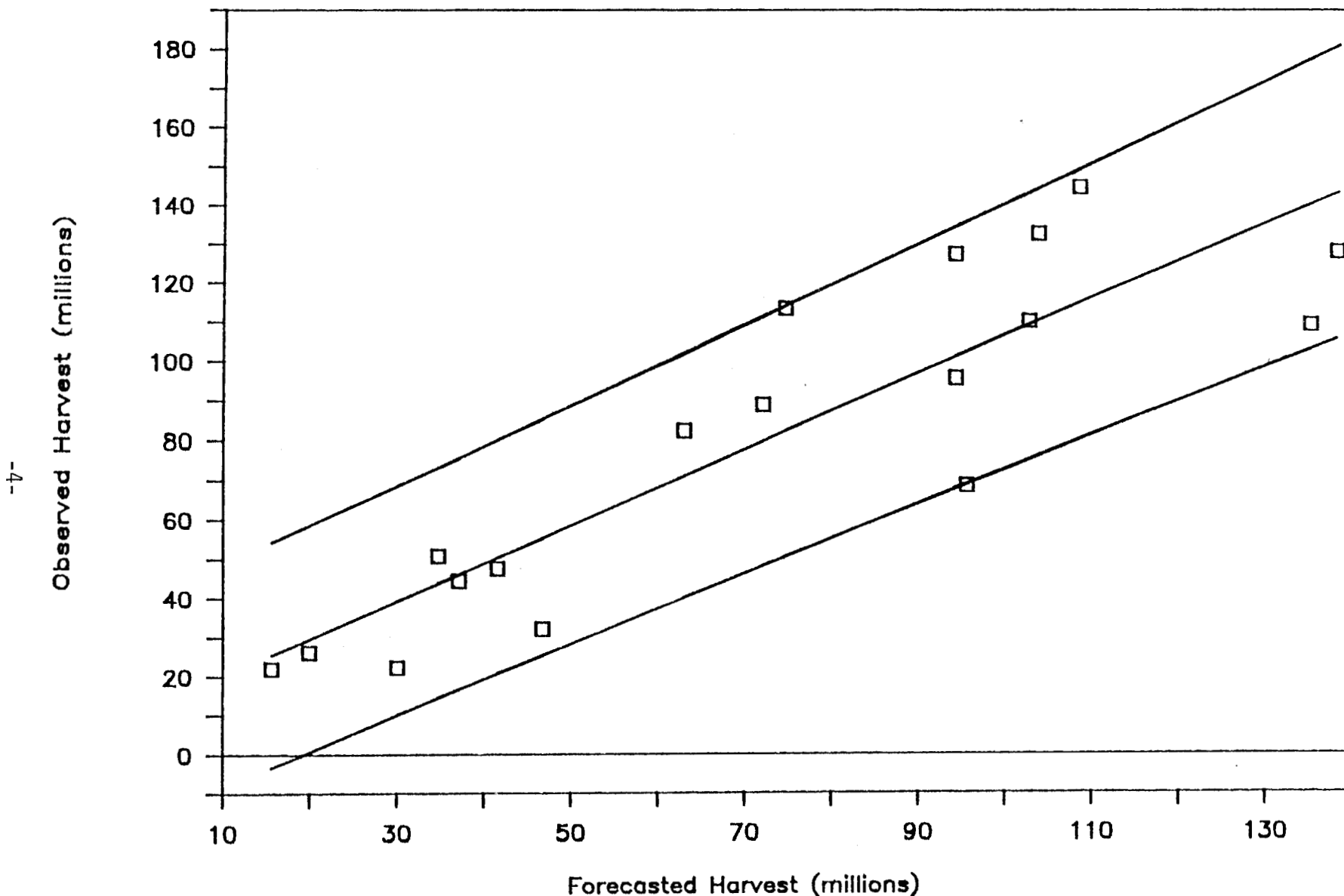


Figure 2. Relationship between observed harvest (millions) and projected harvest (millions) for Alaska commercial salmon fisheries, 1970-1987. Also shown are the fitted regression line, $Y = 10.32 + 0.964 X$, $R^2 = 0.779$, together with 80% confidence intervals; where Y = Observed Harvest and X = Forecasted Harvest.

Alaska Pacific Salmon Species

<u>Common and Vernacular Names</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 1988, by species and age¹

Species	Age of Returning Salmon in Years				
	2	3	4	5	6
Pink	1986				
Chum		1985	1984	1983	
Coho		1985	1984		
Sockeye			1984	1983	1982
Chinook			1984	1983	1982

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

Increasing salmon escapement levels through the period 1970-1987, as well as mild winters and generally warmer ocean water temperature contributing to higher juvenile survival, are thought to be the major factors responsible for the recent record-breaking commercial salmon harvest in Alaska. These favorable environmental conditions have worked in tandem with industry sacrifices and careful fisheries management that insured adequate well-distributed salmon escapements in the early 1970s when salmon returns were weak throughout the state. Sockeye and pink salmon returns in almost all areas of the state have now rebounded to robust levels. State and non-profit hatcheries have contributed several million salmon to the 1987 harvest of 95 million fish. These supplemental production sources are becoming increasingly significant in Cook Inlet and Prince William Sound areas.

The major fishing areas within the Southeastern, Central, and Western statistical regions are shown in Figure 3. These regions and areas are the ones used in the Department's statistical leaflet series and prior statistical reports.

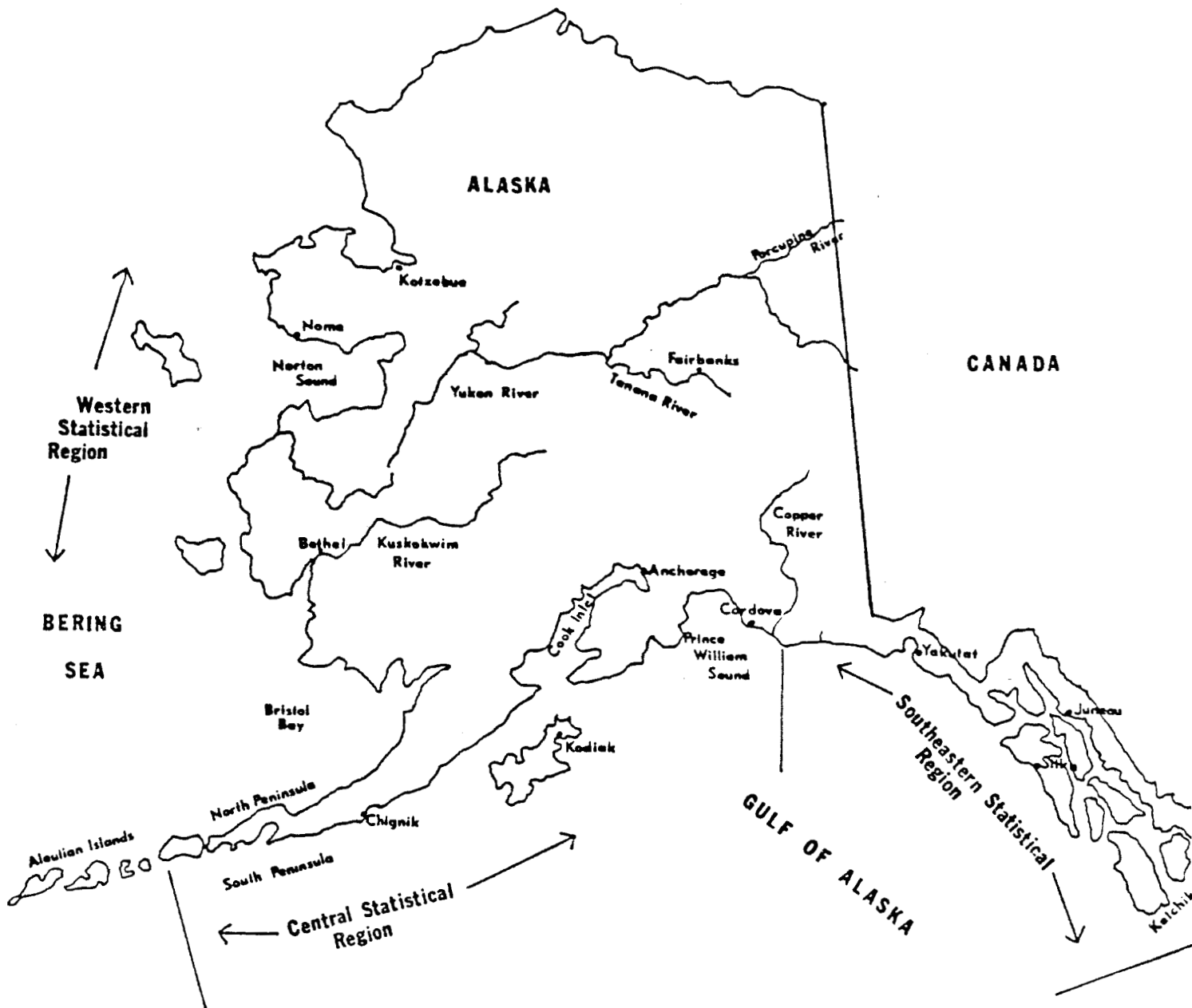


Figure 3. Alaska Department of Fish and Game Commercial Fisheries Statistical Regions.

REVIEW OF THE 1987 ALASKA COMMERCIAL SALMON FISHERY

The 1987 commercial salmon catch is estimated to have produced a harvest of 95 million fish weighing a total of 489.4 million pounds.

This is the first time in eight years that Alaska commercial salmon harvests have fallen below the 100 million fish level (Figure 4).

The ex-vessel value for this season is estimated to have set a record being worth an estimated 458 million dollars and may be even higher when more precise price information becomes available.

The 1987 salmon harvest was slightly more than the preseason catch projection of 94.7 million fish. Larger than expected sockeye salmon harvests especially in Bristol Bay (16.0 million) and Upper Cook Inlet (9.5 million) produced a total statewide catch of 35.4 million sockeye which greatly exceeded the 23.0 million projected sockeye harvest. However, the statewide harvest of 46.1 million pink salmon was substantially below the 53.9 million harvest projection. Failure of pink salmon returns occurred in Lower Cook Inlet and Southeast Alaska but were exceptionally higher than anticipated in Prince William Sound.

Comparisons of actual and forecasted 1987 salmon returns with errors and relative errors for salmon fisheries where formal forecasts were generated are presented in Table 2.

Preliminary 1987 catch estimates by fishing area and statistical region are summarized in Table 3. These estimates are presented in more detail by management region in Tables 4 through 7.

Southeast Region

The 1987 Southeast Alaska Region overall commercial salmon harvest is estimated to be approximately 15.8 million fish. The harvest is considerably below the expected preseason take of 34.6 million salmon, primarily due to a failure of the pink salmon runs.

The pink salmon harvest totaled approximately 10 million fish compared to a forecasted catch of 26.3 million fish. The catch included approximately 875,000 pink salmon taken for cost recovery at private hatcheries. Early run pink salmon returns in the northern and portions of the southern districts were good. Middle and late run pink salmon returns were generally poor in all areas, and particularly along the outer coastal portions of Prince of Wales Island in District 3. As most fishing opportunities for the purse seine gear are dependent on pink salmon run strength, the seasonal seine catch of all species was considerably lower than in recent years.

The overall sockeye salmon harvest totaled approximately 1.4 million fish which is considered good for recent years. However, the distribution of the return strength was mixed. It varied from poor in the Stikine River drainage to record level harvests in the Lynn Canal drift gill net and the East River set gill net fisheries. The Yakutat set gill net catch of sockeye salmon was

Alaska Commercial Salmon Harvest

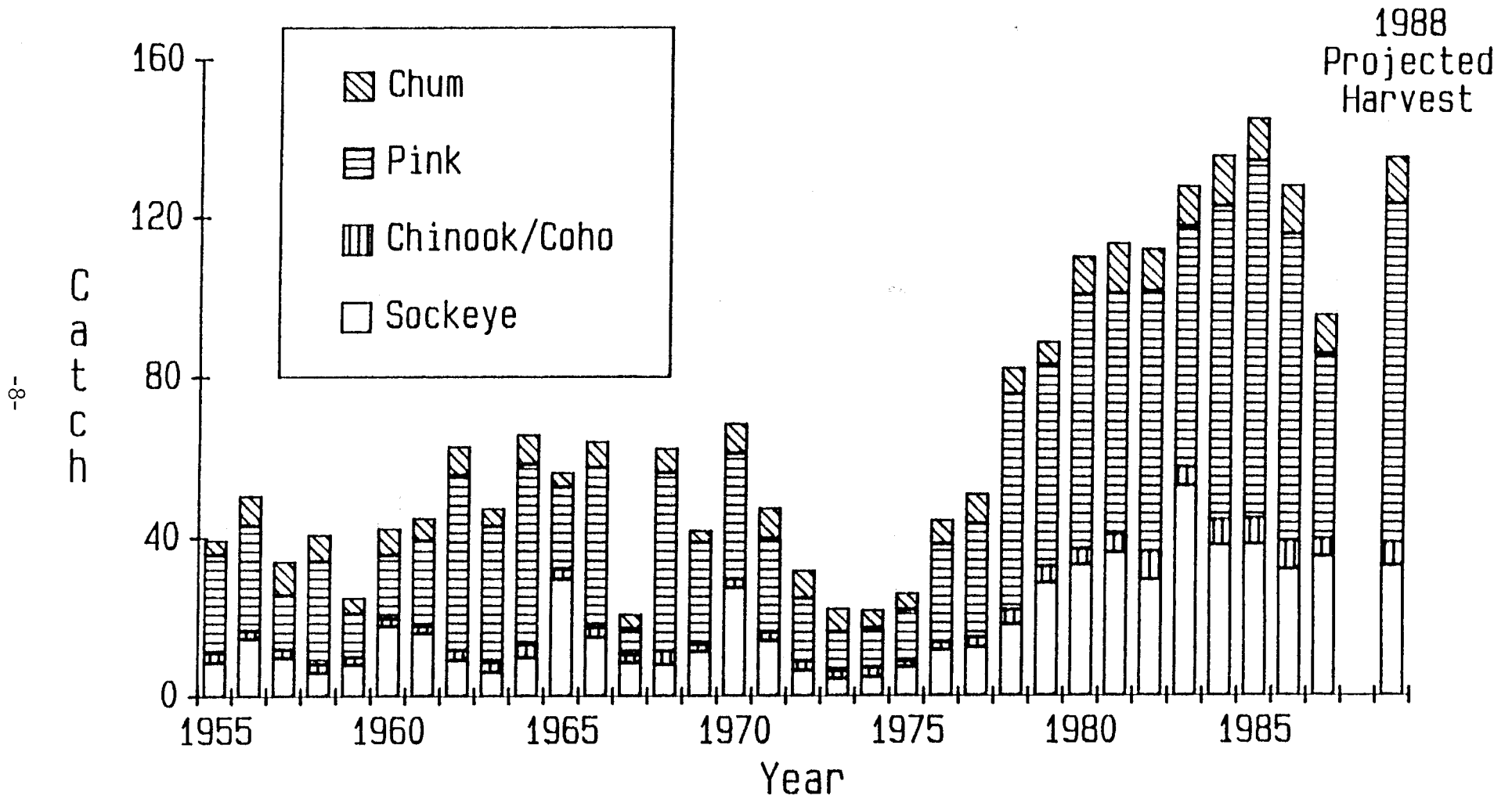


Figure 4. Alaska commercial salmon harvests by species, 1955-1987, and the 1988 projected harvest.

Table 2. Comparison of actual and forecast 1987 salmon returns, with errors and relative errors, for some major Alaska salmon fisheries.

		Thousands of Fish					
Area	Species	(1) Harvest	(2) Escapement ^a	(3) Return (1) + (2)	(4) Forecasted Return	(5) Error (4) - (3)	(6) Relative Error (5)/(3) x 100%
Southern Southeastern	pink	4,419	5,466	9,885	27,200	17,315	175%
Northern Southeastern	pink	5,145	4,224	9,369	9,700	332	4%
Southeastern total	pink	9,564	9,689	19,253	36,900	17,647	92%
Prince William Sound	pink	29,230	2,710	31,940	21,400	(10,540)	-33%
	chum	1,919	383	2,302	1,689	(613)	-27%
PWS Coghill District	sockeye	416	187	604	409	(195)	-32%
Copper River	sockeye	1,181	642	1,824	1,659	(165)	-9%
	chinook	41	11	52	47	(5)	-9%
Upper Cook Inlet	sockeye	9,500	2,124	11,624	5,800	(5,824)	-50%
Kodiak	pink	5,100	2,600	7,700	8,000	300	4%
Chignik ^b	sockeye	2,430	804	3,234	3,100	(134)	-4%
Bristol Bay ^c	sockeye	16,048	11,452	27,500	16,100	(11,400)	-41%
Bristol Bay, Nushagak District	chinook	48	84	132	133	1	1%
Bristol Bay, Togiak District	chinook	18	11	29	38	9	31%
TOTAL		75,496	30,697	106,193	95,275	(10,918)	-10%

^aPreliminary data compiled 15 December 1987.

^bThe harvest includes estimated interceptions of Chignik bound sockeye taken at Cape Igvak, Stepovak Bay, Aniakchak, and Hook Pass fisheries.

^cInshore harvest only.

Table 3. Preliminary 1987 Alaska commercial salmon harvest by species and fishing area¹.

Fishing Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
Southern Southeastern	10.1	534.0	246.0	4,418.8	1,091.2	6,300.1
Northern Southeastern	8.5	818.7	243.3	5,145.0	1,454.6	7,670.1
Southeast Troll	242.0	9.0	1,100.0	471.0	10.8	1,832.8
Southeastern Statistical Region Total	260.6	1,361.7	1,589.3	10,034.9	2,556.6	15,803.0
Cordova Area	41.9	1,737.8	175.2	29,230.2	1,919.3	33,104.4
Cook Inlet Area	40.8	9,748.5	466.3	310.6	506.1	11,072.3
Kodiak Area	4.6	1,789.8	194.7	5,100.0	678.5	7,767.6
Chignik	2.7	1,898.8	150.4	246.8	127.3	2,425.9
South Peninsula	9.0	1,450.0	225.0	1,200.0	930.0	3,814.0
Central Statistical Region Total	98.9	16,624.9	1,211.6	36,087.6	4,161.2	58,184.2
Aleutian Islands	0.0	0.1	0.0	0.0	0.0	0.1
North Peninsula	14.0	1,147.8	171.2	2.9	354.6	1,690.5
Bristol Bay Area	75.9	16,047.8	69.7	0.1	1,510.1	17,703.7
Kuskokwim Area	68.0	170.4	478.6	0.2	599.5	1,316.8
Yukon Area	132.0	0.0	0.0	0.0	442.2	574.2
Norton Sound	7.1	0.2	24.3	2.3	102.5	136.3
Kotzebue Area	0.0	0.0	0.0	0.0	109.5	109.5
Western Statistical Region Total	297.1	17,366.3	743.8	5.5	3,118.3	21,531.0
ALASKA TOTAL	656.6	35,352.9	3,544.6	46,128.0	9,836.1	95,518.2

¹Compiled 15 December 1987, catches in thousands of fish.

Table 4. Preliminary 1987 Southeast Alaska commercial salmon harvest by species and management area¹.

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southern Southeastern						
Portland Canal gill net	1.8	107.5	36.6	583.1	157.9	886.8
Annette Island gill net	0.5	47.4	23.9	223.2	86.3	381.3
Annette Island trap	0.0	6.1	0.7	83.1	0.9	90.8
Prince of Wales gill net	0.8	136.4	34.5	243.5	42.0	457.3
Stikine River gill net	0.2	1.6	3.6	3.6	2.0	11.0
Southern hatcheries	2.3	0.8	37.1	86.5	394.0	520.6
Southern districts seine	4.5	234.2	109.4	3,196.0	408.1	3,952.2
Southern Southeastern total	10.1	534.0	246.0	4,418.8	1,091.2	6,300.1
Northern Southeastern						
Taku-Snettisham gill net	2.0	74.4	34.3	357.6	119.7	588.0
Lynn Canal gill net	3.1	414.7	50.6	165.9	400.0	1,034.3
Yakutat gill net	1.8	253.9	121.8	12.8	14.4	404.5
Northern hatcheries	0.0	0.1	9.3	789.4	124.7	923.5
Northern districts seine	1.6	75.7	27.3	3,819.4	795.9	4,719.8
Northern Southeastern total	8.5	818.7	243.3	5,145.0	1,454.6	7,670.1
Southeast Troll	242.0	9.0	1,100.0	471.0	10.8	1,832.8
SOUTHEASTERN REGION TOTAL	260.6	1,361.7	1,590.7	10,034.9	2,556.6	15,804.5

¹Compiled 15 December 1987, catches in thousands of fish.

Table 5. Preliminary 1987 Central Region Alaska commercial salmon harvest by species and management area¹.

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Cordova Area						
Bering River	0.0	16.5	0.0	0.0	0.0	16.5
Copper River	41.0	1,181.2	127.5	31.7	14.8	1,396.2
Prince William Sound						
Hatcheries	0.0	0.0	7.0	2,986.1	2.5	2,995.6
Coghill District	0.4	416.4	15.4	1,578.6	378.1	2,388.8
Unakwik District	0.0	6.0	0.0	192.6	7.9	206.6
Eshamy District	0.0	6.0	0.3	89.9	52.2	148.5
General purse seine	0.4	111.7	25.0	24,351.4	1,463.8	25,952.3
Prince William Sound total	0.9	540.1	47.8	29,198.5	1,904.5	31,691.7
Cordova Area total	41.9	1,737.8	175.2	29,230.2	1,919.3	33,104.4
Cook Inlet Area						
Lower Cook Inlet						
Outer District	0.0	31.8	2.5	23.9	28.7	86.9
Southern District	1.1	89.1	1.7	89.9	5.0	186.8
Kamishak District	0.0	123.7	8.1	72.7	108.4	312.8
Eastern District	0.0	3.7	1.6	14.3	14.9	34.6
Lower Cook Inlet total	1.1	248.3	13.9	200.8	157.0	621.1
Upper Cook Inlet						
Central District	27.0	9,335.6	353.5	91.6	282.0	10,089.6
Northern District	12.7	164.6	98.9	18.2	67.2	361.6
Upper Cook Inlet total	39.7	9,500.2	452.4	109.8	349.1	10,451.2
Cook Inlet Area total	40.8	9,748.5	466.3	310.6	506.1	11,072.3
Bristol Bay						
Egegik District	2.0	5,386.8	29.6	0.0	148.2	5,566.6
Ugashik District	3.7	2,119.2	20.5	0.1	96.1	2,239.6
Naknek-Kvichak District	5.0	4,949.0	5.1	0.0	440.8	5,399.9
Nushagak District	47.6	3,252.9	13.1	0.0	403.4	3,717.0
Togiak District	17.6	339.9	1.4	0.0	421.7	780.6
Bristol Bay total	75.9	16,047.8	69.7	0.1	1,510.1	17,703.7
CENTRAL REGION TOTAL	158.6	27,534.1	711.2	29,540.9	3,935.5	61,880.4

¹Compiled 15 December 1987, catches in thousands of fish.

Table 6. Preliminary 1987 Westward Region Alaska commercial salmon harvest by species and management area¹.

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Kodiak Area	4.6	1,789.8	194.7	5,100.0	678.5	7,767.6
Chignik Area	2.7	1,898.8	150.4	246.8	127.3	2,425.9
Alaska Peninsula and Aleutians						
South Peninsula	9.0	1,450.0	225.0	1,200.0	930.0	3,814.0
North Peninsula	14.0	1,147.8	171.2	2.9	354.6	1,690.5
Aleutian Islands	0.0	0.1	0.0	0.0	0.0	0.1
Alaska Penin. Aleut. total	23.0	2,597.9	396.2	1,202.9	1,284.6	5,504.6
WESTWARD REGION TOTAL	30.3	6,286.5	741.3	6,549.7	2,090.4	5,504.7

¹Compiled 15 December 1987, catches in thousands of fish.

Table 7. Preliminary 1987 Arctic-Yukon-Kuskokwim Region Alaska commercial salmon harvest by species and management area¹.

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Kuskokwim Area						
Kuskokwim River	35.3	136.2	399.5	0.0	570.6	1,141.6
Kuskokwim Bay	32.7	34.2	79.1	0.2	28.9	175.2
Kuskokwim Area total	68.0	170.4	478.6	0.2	599.5	1,316.8
Yukon River						
Lower Yukon River	126.1	0.0	0.0	0.0	401.3	527.4
Upper Yukon River	5.8	0.0	0.0	0.0	41.0	46.8
Yukon River total	132.0	0.0	0.0	0.0	442.2	574.2
Norton Sound	7.1	0.2	24.3	2.3	102.5	136.3
Kotzebue Area	0.0	0.0	0.0	0.0	109.5	109.5
ARCTIC-YUKON-KUSKOKWIM REGION TOTAL	207.1	170.6	502.9	2.5	1,253.6	2,136.8

¹Compiled 15 December 1987, catches in thousands of fish.

the highest since statehood, the drift gill net catch was the second highest, however, the seine landings of sockeye salmon were the lowest in recent years.

The chum salmon catch of approximately 2.6 million fish was considerably down from the good landings experienced the previous three seasons. The return of summer chum salmon was below expected levels, while fair returns of fall chum salmon occurred. The commercial catch included approximately 750,000 chum salmon produced by state and private hatcheries.

The harvest of approximately 1.6 million coho salmon was the lowest reported in the region since 1980. This was below the preseason expected level as both natural and hatchery survivals appeared less than in recent years. The troll fishery catch of approximately 1.1 million fish accounted for approximately 70% of the total seasonal catch.

The commercial catch of all chinook salmon totaled approximately 261,000 fish. This includes a catch of 242,000 in the troll fisheries (including the winter troll catch from October 1, 1986, through April 14, 1987); 6,200 in the purse seine fisheries (including approximately 1,600 fish less than 21 inches not included in the tabulation of catch for purposes of the US/Canada Pacific Salmon Treaty); 8,800 in the drift gill net fisheries; and, 1,800 in the set gill net fisheries. The 1987 total all gear chinook salmon catch, tabulated as required for the US/Canada Pacific Salmon Treaty, was 279,000 fish (troll - 242,000; net 15,000; and sport 22,000) compared to the allowable target catch ceiling of 278,000 established by the Pacific Salmon Commission. The 1987 chinook salmon summer trolling season lasted for 23 days from June 20 to July 12. This was 18 days less than the 41-day season in 1986, and was the shortest season on record.

Central Region

Prince William Sound:

The Prince William Sound Area combined commercial salmon harvest for 1987 amounted to a new record catch of 33.1 million fish. This figure is nearly double the 1986 harvest figure and exceeds the previous record by of 7.8 million fish. New harvest records were set for Copper River sockeye (1.2 million), Prince William Sound pink salmon (29.2 million), and the area chum catch (1.9 million) is only slightly below the historic high. Coho salmon are the only species that failed to perform up to expectations. This year's harvest of 141,000 coho ranks as the lowest since 1975.

Hatchery production from the six hatcheries in the management area, contributed to a significant proportion of this year's catch. An accurate estimate of hatchery contributions will not be completed until coded wire tag recoveries are analyzed. The most significant contribution, however, came from the Solomon Gulch, Cannery Creek, Esther and Armin F. Koernig hatcheries, which collectively may have contributed more than 70% of the commercial harvest of pink salmon. In addition, nearly 3 million pink salmon were harvested by PNP (Private Nonprofit) facilities to offset operational costs.

With the exception of sockeye and coho systems on the Copper and Bering River delta, escapement objectives were met for all districts and all species. All hatcheries met or exceeded preseason sales harvest and egg take goals.

The value of the combined commercial salmon harvest is estimated at a record \$67.5 million exceeding the prior record by over \$20 million. Prices, overall, were exceptionally high, and average fish weights were above normal which contributed to outstanding seasons for all gear types.

Upper Cook Inlet:

The salmon harvest of approximately 10.5 million fish shattered the catch record of 8 million set last year. The approximate ex-vessel value of \$95 million was more than double the previous record. Prices paid for salmon were generally good with sockeye salmon bringing \$1.60 per pound for the initial half of the harvest and dropping to \$1.40 for the remainder of the season. Chinook, coho, chum, and pink salmon sold for \$1.30, \$.85, \$.40, and \$.25 per pound, respectively.

The sockeye salmon return to Upper Cook Inlet in 1987 was phenomenal totaling over 12 million and producing a catch of 9.5 million. The previous record catch was 5 million, and the average harvest for Upper Cook Inlet is 1.7 million.

The Kenai River escapement totaled 1.6 million or more than double the maximum goal (700,000). Escapement in the Susitna River was poor. Other notable escapements (in numbers of fish) include the Kasilof River at 249,000 (150,000-250,000 goal), Crescent River at 118,000 (50,000-100,000 goal) and Fish Creek at 90,000 (50,000 goal). The Fish Creek escapement triggered the Knik Arm terminal area fishery which harvested 25,000 sockeye.

The oil tanker, GLACIER BAY, hit a submerged object in Upper Cook Inlet during early July resulting in an oil spill. A fishing period for the lower east side set nets and drift gear had to be canceled when oil moved on-shore around Clam Gulch. The majority of the oil eventually weathered, came onshore or was cleaned up and the fishery was conducted without any major disruptions.

The overall damage from the oil spill was minor in comparison to the total value of the fishery.

Lower Cook Inlet:

The 1987 commercial salmon fishery in Lower Cook Inlet (LCI) had a few bright spots, but in general, was very poor due to the failure of pink salmon returns. The total salmon harvest of 621,000 fish was 38% below average and was due entirely to the failure of pink salmon returns (89% below preseason projections) to the Southern and Outer Districts and in particular to the Tutka Hatchery. The sockeye salmon harvest of over 248,000 was 34% above the preseason forecast, and the chum salmon harvest of 157,000 was 18% below forecast. The ex-vessel value was estimated at \$2.7 million and was similar to the previous three years due to the excellent sockeye price and an increasing price trend for pink and chum salmon.

Sockeye returns were strong throughout LCI, and 1987 was the fifth consecutive year where the harvest approached or exceeded 250,000 fish. Returns to Chenik, Mikfik and Leisure Lakes accounted for 60% of the sockeye harvest.

Pink salmon returns were generally poor in the Southern, Outer and Eastern Districts. Escapements to most streams ranged from 10-25% of the desired goals.

Only one-third of the Tutka Lagoon hatchery's egg take goal of 50 million eggs was achieved.

Chum salmon returns were generally as good as expected. The Eastern District harvest of 14,900 fish was a record and was produced entirely from Tonsina Creek in Resurrection Bay. Island Creek in Port Dick produced the entire Outer District harvest of 29,000 chum salmon.

The Kamishak District produced 70% of the total chum harvest. The 108,000 fish harvest was over 2-1/2 times the average and was the third highest on record.

Bristol Bay:

The commercial harvest of salmon from Bristol Bay in 1987 totaled 17.7 million fish valued at \$125 million for the fishermen. This represents the fifth consecutive year the ex-vessel value has exceeded \$100 million.

Sockeye salmon returns totaled 27.3 million fish, considerably over preseason projections of 16.8 million. The commercial harvest was 16.0 million fish, with all districts contributing to the catch. Escapements were met or slightly exceeded for most river systems. The Kvichak River, which was anticipated to experience a very poor return, showed remarkable strength, providing a good commercial harvest and achieving an escapement of 6 million fish.

Chinook salmon returns were weak with a commercial harvest totaling only 77,000, the lowest in the past 12 years. Escapements were adequate but were only achieved through greatly reduced fishing time and essentially a total closure of the Nushagak chinook season after the first 3 days of fishing.

Chum salmon returns were relatively strong providing a commercial harvest of over 1.5 million fish. This large catch was taken in connection with the sockeye fishery. Escapements to primary spawning systems were average except for the Nushagak River which was poor.

Pink salmon did not return to Bristol Bay in 1987, in keeping with the even-year run cycle.

Coho salmon returns were extremely weak. Extensive reductions in fishing time occurred in most districts. The commercial harvest totaled about 69,000 fish, the weakest seen in 10 years. Escapement levels in the Nushagak and Togiak Districts were poor to average despite almost complete closures.

Arctic-Yukon-Kuskokwim Region

Lower Yukon:

This season 126,140 chinook and 401,275 summer chum salmon were harvested in the lower Yukon Area. The chinook salmon catch was 3% above the recent 5-year average (1982-1986), while the summer chum salmon catch was 28% below the recent 5-year average. There was no commercial fishery for fall chum salmon this season.

A total of 10 processors operated in the lower Yukon Area. The majority of the catch was frozen on the grounds or flown out of the area.

A total of 659 Commercial Fisheries Entry Commission permit holders participated in the fishery during 1987. The catch was valued at \$6.7 million to fishermen which was 16% above the 1982-1986 average total value. Average earnings per fisherman was \$10,200. Fishermen received an average price of \$1.98 per pound for chinook and \$.49 per pound for summer chum salmon.

The 1987 fishing season was initially opened on a staggered basis: June 15 in District 1, June 17 in District 2, and June 21 in District 3.

The harvest of chinook salmon during the restricted mesh size fishing periods was twice the prior 5-year average (1982-1986) for the same time period. The average weight of chinook salmon in the commercial catch was 21.7 pounds.

Upper Yukon:

During the 1987 season, a total of 5,831 chinook, 40,963 summer run chums, and 122,259 pounds of salmon roe were commercially sold in the upper Yukon districts.

Upper Yukon commercial fishermen received an estimated per-pound average of \$.79 for chinooks, \$.19 for chums, and \$2.22 for salmon roe. The approximate ex-vessel value of the 1987 harvest was \$419,000, which was nearly 38% below the 1982-1986 average. Over the course of the season, deliveries were made by 141 commercial fishermen (an increase of approximately 10% over the recent 5-year period).

A total of 17 buyer-processors and registered catcher-sellers operated in the upper Yukon this season.

The commercial catch in District 4 of about 1,500 chinook salmon was the largest reported harvest since 1979. Although the commercial catch in District 5 of 3,100 chinooks was 17% below the 1982-1986 average, the run in that portion of the drainage was judged to have been stronger than in recent years.

In the Tanana River (District 6), the commercial fishing season was closed July 21 because of conservation concerns for chinook and chum salmon. The commercial guideline harvest range established by the Board of Fisheries for this district is 600-800 chinook salmon. Late catch reports and incidental catches of chinooks made when the chum salmon fishery was re-opened brought the season total catch to 1,200 chinook salmon.

summer chum run of below-average strength, and reduced fishing time was implemented in the districts.

The 1987 fall chum salmon run is judged to have been insufficient to allow commercial harvest but of sufficient size to allow escapement and subsistence fishery requirements to be met.

Kuskokwim:

The fishing season began in the Kuskokwim Area on June 18 in Districts 1, 4, and 5. The 1987 commercial catch for all four districts combined for the second highest catch on record of 1,313,400 salmon. The 170,400 sockeye salmon catch and the 599,500 chum salmon catch were the highest on record. The 478,600 coho salmon catch is the fourth largest on record.

In District W-1, the lower Kuskokwim River, 703 fishermen caught 33,000 chinook and 385,400 coho salmon. The record catch of 134,200 sockeye salmon surpasses the previous 1985 record of 104,100. The 1987 record chum salmon catch of 562,800 surpasses the previous catch record of 450,600 chum salmon set in 1980.

In District W-2, the middle Kuskokwim River, 29 permit holders caught 2,300 chinook, 1,970 sockeye, 14,100 coho, and 7,800 chum salmon. In District W-4, Quinhagak, 310 permit holders caught 26,000 chinook, 6,500 sockeye, 40,100 coho, and 8,600 chum salmon and was below the 5-year average harvest for all species. Commercial fishing in District W-4 was closed after the July 4 period because of poor chum and sockeye salmon escapements in the Kanektok River. Goodnews Bay, District W-5, had 116 fishermen participating this season. The commercial fishery harvested 3,360 chinook, 27,800 sockeye, 29,100 coho, and a record 20,400 chum salmon. The total salmon catch is above the previous 5-year average.

There were a total of seven registered buyers in the Kuskokwim Area in 1987. The average seasonal price paid per pound was \$1.10 for chinook, \$1.30 for sockeye, \$.73 for coho, \$.10 pink, and \$.27 for chum salmon. There was a record 798 permit holders participating in the Kuskokwim fishery this year. During 1987 the amount paid to permit holders during the season was \$6,398,000. The 1987 Kuskokwim permit holder earned an average of \$8,000. This is a 64% increase in earnings over the previous 5-year average and is the greatest amount ever paid to Kuskokwim area fishermen.

Norton Sound:

The 1987 Norton Sound commercial salmon harvest totaled 136,300 fish, which was comprised of 7,200 chinook, 200 sockeye, 24,300 coho, 2,300 pink, and 102,500 chum salmon.

The chinook harvest was 30% and 21% below the recent 5- and 10-year averages, respectively. The coho harvest was 45% and 65% below the recent 5- and 10-year averages, respectively. The low pink salmon harvest was again (as in 1985 and 1986) due to weak return rather than the lack of a market. The chum harvest was 45% and 43% below the recent 5- and 10-year averages, respectively.

A total of 198 Commercial Fisheries Entry Commission permits were renewed, with 164 actually fished during the 1987 season. Two domestic processors operated in Norton Sound during 1987. In addition, a foreign processing joint venture between KEG (Koyuk-Elim-Golovin), 3NC Corporation, and NPL Alaska, Inc., operated in Norton Sound during the 1987 season.

Commercial fishermen receive approximately \$504,600 for their catch. This is the lowest dollar value on record since 1976 and was 39% below the recent 5-year average of \$822,000. This low dollar value is attributed to below average catches of all salmon species. Prices paid per pound to the fishermen averaged \$1.11 for chinook, \$1.03 for sockeye, \$.57 for coho, \$.20 for pink, and \$.33 for chum salmon.

Kotzebue:

Kotzebue fishermen experienced one of the poorest salmon runs in the history of the commercial fishery. The catch of chum salmon this year was approximately 110,000 fish. This is the lowest total catch since 1969.

Many fishermen were discouraged from fishing because of the poor run. One hundred sixty permit holders, the lowest number of fishermen in almost 15 years, fished at least one fishing period during the season which extended from July 13 to August 21.

In order to allow more fish to reach their spawning areas, fishing time was limited to a total of only 11 days, the fewest number of fishing days ever.

The catch was worth \$515,000 to the fishermen. In the past 15 years, only the 1983 fishery had a lower value. Prices this year fluctuated between \$.36 and \$.64 per pound and averaged \$.57 per pound. One half of the fishermen earned less than \$2,800. Earnings ranged from \$25 to almost \$16,000, not including cash bonuses.

An estimated 3,500 Sikusuilaq hatchery fish were caught by commercial fishermen this year.

Westward Region

Kodiak:

A total of 7,767,600 salmon were harvested in the Kodiak Management Area. The catch was comprised of 4,600 chinook, 1,789,800 sockeye, 194,700 coho, 5,100,000 pink and 678,500 chum salmon.

This season's early (June 9 - July 15) sockeye production was below that of recent years. Early Upper Station sockeye and to a lesser degree early Karluk sockeye combined with sockeye from the Cape Igvak and the two day "Westside" fisheries accounted for the bulk of the salmon harvest during this period. The preseason projection harvest for this period was 640,000 sockeye salmon; the actual harvest was 750,000 fish.

Natural production of pink salmon was slightly less than expected (approximately 4.1 million actual harvest versus 4.8 million forecasted) while supplemental production from Kitoi hatchery was slightly more than

expected. Run timing of several major systems was late causing some concern in-season.

Chum salmon production (July 6 - September 5) was spotty and somewhat unpredictable. It was unexpectedly very strong in the Alinchak Section and unexpectedly weak in the Big River and Sitkalidak Sections. The Kukak Section chum fishery was very good with very high quality fish coming from this section. General overall quality of this season's chum harvest was above average.

Late sockeye salmon production (July 15 - September 15) essentially came from the Karluk and Upper Station systems. The preseason projected harvest for this period was 865,000 sockeye; the actual harvest was 1,040,000 sockeye salmon.

Coho salmon returns were late this season. Overall, the coho returns were above average. Returns to the West and North Afognak Sections and the Big River Section seemed generally below average while returns to the Chiniak Section were above average.

Escapement requirements were generally achieved for all species and for all major systems with the following exceptions: 1) the Fraser Lake sockeye return was less than the minimum escapement requirement; 2) the Uganik River early pink escapement was less than the goal even with an enlarged build-up sanctuary and reduced fishing time; and 3) the Buskin River pink salmon escapement was below minimum requirements. Also five minor sockeye systems on Afognak Island were below minimum escapement levels. Otherwise, the major sockeye systems of Karluk and Upper Station had excellent escapement levels for both early and late runs; Red River also had a very good sockeye escapement. Pink salmon escapement were exceptional in many major systems and very good in the remaining systems.

Because of record warm, drought-like conditions that prevailed from mid-July to early-September, there is some concern regarding spawning success for early pink and early chum runs and sockeye tributary-spawners.

Chignik:

The Chignik sockeye salmon fishery started on June 11 with an estimated harvest of 132,000 sockeye salmon for this 24-hour fishery. The fishery was extended until June 18. The commercial harvest for the period of June 11 through July 15 is estimated at about 1.7 million. Prior to July 15, as determined through in-season scale pattern analysis, the catch was composed predominantly of Black Lake stocks (early run). There after the run was composed primarily of Chignik Lake stocks (late run).

The Chignik Lake stock (late run) did not materialize as strongly as forecasted, and restricted salmon periods were enforced until the minimum escapement goal of 250,000 was achieved (after August 12). The total sockeye harvest for the Chignik Area is estimated at 1,897,800.

Pink and chum salmon returns for the area as a whole were very weak. The pink and chum salmon harvest for the Chignik Management Area was 247,000 and 127,000, respectively.

Again, the coho harvest was strong with processors quitting on September 25. The majority of the coho harvest (53%) came from the Chignik Bay area. The coho harvest is estimated at 150,300.

The total ex-vessel value of salmon caught within the Chignik Area is estimated at \$26,600,000.

Alaska Peninsula and Aleutians:

The South Unimak and Shumagin Islands (False Pass) June fishery produced a total harvest of 815,000 sockeye and 458,700 chum salmon. A total of 669,800 sockeye and 421,000 chums were caught in the South Unimak area where the sockeye guideline harvest level was 635,000 fish. Catch rates were low with weather being a significant factor. A total of 12 days of fishing were allowed.

In the Shumagins a total of 145,200 sockeye and 37,700 chum salmon were harvested. The sockeye guideline harvest level was 140,000. Catch rates were much higher in relation to the fishery size, and only one day per quota fishing period was needed to reach the quota. A total of 12 days of fishing were allowed.

Pink salmon harvest rates were very slow during June. The estimated pink salmon harvest for the Shumagin and South Unimak fisheries were 5,500 and 10,900 fish, respectively.

A total of 4,000 chinook, 470,000 sockeye, 219,200 coho, 1,110,400 pink, and 929,000 chum salmon were harvested in the South Peninsula Area during July through September.

The sockeye catch rate by the set gill net fishery in the Southeastern Mainland District was very high in the Beaver, Balboa, and Stepovak Bay Areas. Only four days were allowed in June to target on Chignik bound sockeye salmon. The total estimated Chignik interception through July 25 was 141,900 fish. This was 6.7% of the Chignik destined catch (the target was 6.2%).

The South Peninsula pink salmon run was down from the level of recent years while the chum salmon run was very strong.

The total 1987 Aleutian Islands salmon catch was only 100 sockeye salmon. Based on a very poor parent escapement and severe flooding during November 1985, a very weak pink salmon run was anticipated and did occur in 1987. Peak pink salmon escapements in traditional fishing areas totaled less than 60,000 fish.

The North Peninsula chinook salmon return of 24,700 fish was well below the previous 10-year average of 33,500. The catch was 14,000 and the escapement was only 10,700 chinook salmon.

The sockeye salmon catch of 1,147,000 was within the projection range of 1.0-1.5 million salmon and was the lowest catch since 1978. The estimated total escapement was approximately 506,000 fish.

The coho salmon catch of 171,200 fish was well above the previous 10-year average of 130,200. Escapement data is incomplete for the entire area. However, escapements were generally good at Swanson Lagoon, Nelson Lagoon, and Port Heiden, but were mediocre at Ilnik and poor at Cinder River.

Pink salmon are of minor importance along the North Peninsula, the catch was less than 3,000 fish.

The 1987 North Peninsula chum salmon run was 865,500 fish, slightly over the previous 10-year average of 828,300. The catch was 354,600, and the escapement was estimated at 510,900 chum salmon.

PRELIMINARY FORECASTS OF 1988 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, chum, and Coghill District sockeye
Prince William Sound/ Copper River	-	sockeye and chinook salmon
Upper Cook Inlet	-	sockeye salmon
Kodiak	-	pink and sockeye salmon
Chignik	-	sockeye salmon
Bristol Bay	-	sockeye and chinook salmon
Kotzebue Sound	-	chum salmon

In 1987, 79% of the total statewide harvest was taken in these fisheries (Table 1).

A variety of information was 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 confidence limits, are 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 1987, five of thirteen return forecasts were outside their respective ranges. The 1988 forecasts and ranges are summarized in Table 8.

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

Southeast Alaska Pink Salmon

The total Southeast pink salmon harvest is expected to be 42.1 million fish, a substantial increase from the 1987 harvest of 10.0 million. A return of 44.1 million pink salmon is expected to southern Southeast districts in 1988, with an expected harvest of 38.1 million. The escapement of pinks in 1986, the parent year for the 1988 return, was the largest on record, with relatively mild winter temperatures accounting for the relatively good survival and large forecasted return in 1988. A return of 7.7 million pink

Table 8. Preliminary forecasts of salmon returns and commercial harvests of some major Alaska fisheries in 1988.

Thousands of Fish							
Area	Species	Forecast Return	Escapement Goal	Estimated Harvest	Forecasted Return ^a Range	Estimated Harvest Range	
Southern Southeastern	pink	44,100	6,000	38,100	31,900 - 63,900	21,300 -	53,300
Northern Southeastern	pink	7,900	4,600	3,300	5,200 - 10,600	(5,400) -	0
Southeastern total	pink	52,700	10,600	42,100	40,200 - 72,700	29,600 -	62,100
Prince William Sound ^b	pink	22,370	5,950	16,420	18,000 - 29,007	12,050 -	23,057
	chum	1,430	357	1,073	1,155 - 1,777	798 -	1,420
PWS Coghill District	sockeye	117	55	62	104 - 133	49 -	78
Copper River	sockeye	1,379	678	701	1,198 - 1,561	520 -	883
	chinook	50	15	35	38 - 61	23 -	46
Upper Cook Inlet	sockeye	6,800	1,500	5,300	2,800 - 10,000	1,300 -	8,500
Kodiak ^c	pink	19,600	4,350	15,250	17,740 - 21,860	13,390 -	17,510
Kodiak, Fraser Lake	sockeye	344	238	106	100 - 690	0 -	453
Kodiak, Upper Station	sockeye	152	63	90	45 - 255	0 -	193
Chignik ^d	sockeye	2,220	650	1,570	2,030 - 2,420	1,380 -	1,770
Bristol Bay ^e	sockeye	28,302	9,735	18,567	19,400 - 37,200	9,665 -	27,465
Bristol Bay, Nushagak District	chinook	139	75	64	100 - 180	25 -	105
Kotzebue Sound	chum	---	---	275	---	178	372
TOTAL		135,602	34,264	101,613	119,041 - 158,816	84,777 -	124,552

^a Compiled 15 December, 1987. The forecast return and harvest ranges were estimated by several techniques. Based on past experience, somewhat less than half of the salmon returns and harvests can be expected to fall within their respective ranges.

^b Includes supplemental production, PWS pink escapement goal includes 3.7 million hatchery harvest, PWS chum escapement includes no anticipated hatchery harvests.

^c Includes supplemental production, Kodiak pink escapement goal includes 0.3 million hatchery harvest.

^d Includes estimated interceptions of Chignik bound sockeye at Cape Igvak and Stepovak Bay.

^e Inshore harvests only.

salmon is expected to occur in northern Southeast districts in 1987, with the harvest expected to be 3.3 million fish.

Prince William Sound Pink, Chum, and Coghill River Sockeye Salmon

The 1988 Prince William Sound common property harvest of pink salmon is expected to be 16.4 million fish. Of this 16.4 million common property harvest, 64% is expected to be hatchery fish. In addition, 3.7 million pink salmon are expected to be harvested at hatcheries. The expected 1988 chum harvest is 1.08 million. The anticipated pink harvest and anticipated chum salmon harvest are down from 1987 levels. The expected 1988 harvest of Coghill sockeye salmon is 62,000 and is substantially down from the 1987 level.

Prince William Sound/Copper River Sockeye and Chinook Salmon

A harvest of 678,000 sockeye and 39,000 chinook salmon is expected in 1988 for the Copper and Bering Rivers. The anticipated sockeye salmon harvest and anticipated chinook salmon harvest is lower than that achieved in 1987.

Upper Cook Inlet Sockeye Salmon

A harvest of 5.3 million sockeye salmon is expected in 1988. The return is expected to be less than the record 1987 level. There is potential for a large return of sockeye to Upper Cook Inlet in 1988 if survivals approach that realized for the 1987 return.

Kodiak Pink and Sockeye Salmon

The 1988 Kodiak pink salmon return forecast is 17.9 million with an expected catch of 14.0 million fish. This is approximately a three-fold increase over the 1987 level. The 1988 return of sockeye salmon to Upper Station Lakes is expected to be 152,000 fish with a anticipated harvest of 89,500 fish. The 1988 return of sockeye to Frazer Lake is expected to be 343,000 with a anticipated harvest of 105,500 fish.

Chignik Sockeye Salmon

The 1988 return of sockeye salmon is expected to be 2.22 million fish with a catch of 1.57 million, down from 1987 levels.

Bristol Bay Sockeye and Chinook Salmon

The 1988 return of sockeye salmon to Bristol Bay is expected to be 28.3 million fish with a harvest of 18.6 million expected. The forecast methods were changed in 1988 to attempt to correct the recent tendency for the Bristol Bay forecast to be lower than the actual returns. The return of Bristol Bay sockeye anticipated in 1988 is higher than the 1987 return. The 1988 return of Nushagak chinook salmon is expected to be 139,000 fish with a catch of 64,000.

Kotzebue Sound Chum Salmon

The 1988 harvest of chum salmon in Kotzebue Sound is expected to be 275,000 fish up substantially from the 1987 level.

PROJECTED 1988 ALASKA COMMERCIAL SALMON HARVESTS

The projections of the 1988 Alaska commercial salmon harvest by management region and species, as well as by statistical region and species are presented in Table 9 and Table 10, respectively. These projections are composed of forecast harvests, and harvest projections (recent harvest averages, sometimes modified if additional information is available) for fisheries without formal forecasts. Coho salmon returns are not forecast in any region. Forecasts of chum salmon returns are available only for Prince William Sound. Several smaller pink salmon returns are not forecast. Major sockeye salmon runs in the Central and Western statistical regions are forecast. Despite these gaps, 79% of the 1987 salmon harvest of 95 million came from fisheries where formal forecasts are made.

The 1988 total commercial harvest projection is 135 million salmon.

Species Outlook

Pink Salmon

The 1988 harvest projection of pink salmon is 84.4 million. This projection is 57% of the 1988 statewide total salmon harvest projection and 182% of the 1987 statewide pink salmon harvest of 46.2 million fish.

A substantial increase is expected from the 46.2 million pink salmon harvested in 1987 to a 84.4 million pink salmon harvest anticipated in 1988. The pink salmon harvest is expected to decrease slightly in Prince William Sound and to increase substantially in Southeast Alaska and Kodiak. Returns of pink salmon in Bristol Bay are expected to be below escapement requirements.

Sockeye Salmon

The 1988 harvest projection of sockeye salmon is 33.0 million fish. This projection is 24.5% of the 1988 statewide total salmon harvest projection and 94.2% of the 1987 statewide sockeye harvest of 35.4 million fish.

The 1988 catch of sockeye salmon is expected to be slightly lower than the 1987 harvest level.

Chum Salmon

The 1988 harvest projection of chum salmon is 11.9 million fish. This projection is 8.8% of the 1988 statewide total salmon harvest projection and 120.9% of the 1987 statewide chum harvest of 9.8 million fish.

Coho Salmon

The 1988 harvest projection of coho salmon is 4.9 million fish. This projection is 3.7% of the 1988 statewide total salmon harvest projection and 140.0% of the 1987 statewide coho harvest of 3.5 million fish.

Table 9. Preliminary projections of 1988 Alaska commercial harvests in thousands of fish by statistical region and species¹.

STATISTICAL REGION ²	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southeastern	305	1,500	2,500	42,100	3,900	50,305
Central	79	11,614	1,445	42,102	4,158	59,398
Western	272	19,939	1,007	198	3,877	25,293
TOTAL ALASKA	656	33,053	4,952	84,400	11,935	134,996

¹Compiled 15 December 1987. The projected 1988 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections for remaining fisheries. The latter based on recent catches.

²See Figure 3 for definition of statistical areas.

Table 10. Preliminary projections of 1988 Alaska commercial salmon harvests in thousands of fish by management region and species¹.

Management Region ²	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southeastern	305	1,500	2,500	42,100	3,900	50,305
Central	159	25,070	1,272	19,052	2,958	48,511
Arctic-Yukon-Kuskokwim	163	121	530	48	1,677	2,539
Westward	29	6,362	650	23,200	3,400	33,641
TOTAL ALASKA	656	33,053	4,952	84,400	11,935	134,996

¹Compiled 15 December 1987. The projected 1988 harvests were obtained by summing harvest forecast (Table 8) and harvest projections for remaining fisheries. The latter based on recent catches.

²Southeast, Central, A-Y-K, and Westward management regions are those fisheries reported in Tables 4, 5, 6, and 7, respectively.

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APPENDICES A THROUGH K
FORECAST METHODS AND DISCUSSIONS

FORECAST AREA: Southeast Alaska

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1988 RETURN:

NATURAL PRODUCTION:

	<u>Point</u>	<u>Range</u>
Southern Southeast:		
Return Estimate:	44.1 million	31.9 million - 63.9 million
Escapement Goal:	6.0 million	
Harvest Estimate: 1/	38.1 million	25.9 million - 57.9 million
Northern Southeast:		
Return Estimate:	7.9 million	5.2 million - 10.6 million
Escapement Goal:	4.6 million	
Harvest Estimate:	3.3 million	0.6 million - 6.0 million

SUPPLEMENTAL PRODUCTION:

Southern Southeast Return Estimate:	0.153 million
Northern Southeast Return Estimate:	0.515 million

TOTAL SOUTHEAST PRODUCTION:

Return Estimate:	52.7 million	40.2 million - 72.7 million
Escapement Goal:	10.6 million	
Harvest Estimate:	42.1 million	29.6 million - 62.1 million

1/ In order to achieve a good escapement distribution to all systems in southern Southeast, it is anticipated that we will need to put an additional 3 to 4 million pink salmon into the escapement which will reduce the harvest estimate by the same amount.

FORECAST METHODS

Returns to the southern and northern areas of Southeast Alaska are forecast separately because of differences in migration routes and run timing. The southern Southeast forecast is based on a multiple linear

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regression analysis of 26 years of data to forecast harvest. Variables utilized in the regression analysis include: average minimum winter air temperatures in southern Southeast, date of the coldest 15-day moving average over the same period, and the brood year escapement index.

In northern Southeast Alaska, this was the first year that the forecast was prepared without a pre-emergent fry index. As a check on the multiple regression model identified above, a Box-Jenkins time series model was fitted to the even-year pink salmon catch for the years 1916-1986. The time series model gave an estimate of 7.4 million fish and was consistent with that made with the multiple regression model. The estimate made with the multiple regression model was used as the forecast of pink salmon returns to northern Southeast Alaska.

FORECAST DISCUSSION:

Southern Southeast: The 1988 pink salmon prediction must be viewed with some caution because the most important variable (escapement) was outside the range of anything experienced since statehood. The escapement index for the 1986 brood year was 1 million higher than the previous record set in 1985 and produced a disappointingly low harvest of 10 million. This low return was presumably due to extremely harsh winter conditions during 1985 - 1986. In contrast, the 1986 brood year experienced relatively mild winter conditions.

The large forecasted return in 1988 is supported by the observation of exceptionally large numbers of fry during the early marine period.

There is no reason to expect any change in the recent years trend of harvesting the majority of returning salmon off the West Coast of Prince of Wales Island in Districts 103 and 104. It is also anticipated that it will be difficult to achieve escapement needs in Districts 105 through 108 because of interceptions in Districts 102 and 104.

The 1988 forecast differs from earlier forecasts in that harvest rather than return was predicted. The total return was estimated by summing the predicted harvest, based on methods described above, and the predicted escapement index based on a simple linear regression (R^2 , $n = 26$) of escapement index and harvest.

It has become apparent in recent years that the official escapement index goal of 6.0 million pink salmon is too low to achieve maximum sustained yield. The escapement index has exceeded the six million goal in every year where the catch has exceeded 19 million. This has resulted from the desire to achieve an even distribution of spawners. Consequently, the harvest projection is likely to be high because the historical escapement achieved in years of large returns of pink salmon have tended to be higher than the goal.

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Northern Southeast Alaska. Returns to the northern districts are expected to be good in Districts 109 and 112 but poor in other districts with little available harvestable surplus. The overall northern Southeast parent year escapement was only 2.9 million fish with over 51% of that occurring in Districts 109 and 112. The other districts had generally poor escapements.

While the overall District 109 escapement was excellent (739.8 thousand), it occurred primarily in streams of the Petersburg Management Area, with only 13.6 % occurring in streams of the Sitka Management Area. Thus any harvestable surplus is expected to be in the Petersburg Management Area.

District 110 had the poorest escapements since 1977, District 111 the worst since 1978, and District 14 the lowest since 1976. Little harvest is expected to occur in these areas.

District 113 had an escapement of 737 thousand pink salmon which was well below the district goal of 1.6 million. Within the district just over 502 thousand pink salmon were in the outer coastal area of Baranof and Chichagof Islands and the remainder was in the Peril Straits area. The Peril Straits area escapement was the lowest since 1976.

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Fishery Biologist
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Ketchikan

**APPENDIX B. PRINCE WILLIAM SOUND PINK AND CHUM SALMON AND
COGHILL RIVER SOCKEYE SALMON**

FORECAST AREA: Prince William Sound

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1988 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	7.21 million	3.91 million - 13.12 million
Escapement Goal:	1.35 million	
Harvest Estimate:	5.86 million	2.56 million - 11.85 million

SUPPLEMENTAL PRODUCTION

Cannery Creek Hatchery

Return Estimate: 2.12 million 1.72 million - 2.52 million

Brood Stock and
Stream Escapement: 0.17 million

Common Property
Harvest Estimate: 1.95 million 1.55 million - 2.35 million

Prince William Sound Aquaculture Corporation, A.F.K. Hatchery

Return Estimate: 6.15 million 4.99 million - 7.31 million

Brood Stock: 0.19 million

Hatchery Harvest: 0.93 million

Common Property
Harvest Estimate: 5.03 million 3.87 million - 6.19 million

Esther Island Hatchery

Return Estimate: 3.71 million 3.01 million - 4.41 million

Brood Stock: 0.33 million

Hatchery Harvest: 1.57 million

Common Property
Harvest Estimate: 1.81 million 1.11 million - 2.51 million

Appendix B (p 2 of 7)

Valdez Fisheries Development Association, Solomon Gulch Hatchery

Return Estimate: 3.18 million 2.58 million - 3.78 million
Brood Stock: 0.21 million
Hatchery Harvest: 1.2 million
Common Property
Harvest Estimate: 1.77 million 1.17 million - 2.37 million

TOTAL SUPPLEMENTAL PRODUCTION

	<u>Point</u>	<u>Range</u>
Return Estimate:	15.16 million	12.3 million - 18.02 million
Brood Stock and Stream Escapement:	0.9 million	
Hatchery Harvest:	3.7 million	
Common Property Harvest Estimate:	10.56 million	7.7 million - 13.42 million

TOTAL AREA PRODUCTION

Return Estimate: 22.37 million 18.0 million - 29.01 million
Stream Escapement,
Brood Stock and
Hatchery Harvest: 5.95 million
Harvest Estimate: 16.42 million 12.05 million - 23.06 million

FORECAST METHODS

Natural Production. The forecast for natural returns and 80% confidence interval was based on a multiple regression of log transformed total returns versus log transformed pre-emergent fry indices and mean April air temperatures.

Supplemental Production. Prior to the 1986/1987 coded wire tag (CWT) program there was no means for making a quantitative estimate of hatchery returns to Prince William Sound. Although fry releases were enumerated, the returns from hatcheries could not be distinguished from natural stock returns. Thus the actual marine survival of hatchery releases and associated variance were unknown. The forecast of hatchery

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returns in 1988 was based on a 5.3% marine survival for approximately 286 million pink salmon fry released from four area hatcheries in 1987. This survival rate is the best educated guess of area hatchery and ADF&G personnel based on approximations of past hatchery returns, and is consistent with the average marine survival estimated in the 1986/1987 CWT study. The lower and upper bounds of the forecast of hatchery returns was arbitrarily based on likely low and high marine survival rates of 4.3% and 6.3%, respectively. The projected broodstock needs for each facility are accurate. The hatchery harvest numbers may vary from projections depending on the final value for the 1987 hatchery harvests, the revenue generated for PNP's from the 2% assessment on area salmon harvests for 1987, and projected prices for 1988.

FORECAST DISCUSSION:

Extremely heavy rainfall in October of 1986 resulted in very severe scouring of pink salmon spawning streams particularly in the western half of the Sound and the pink salmon fry index for the 1986 brood year was lower than any since the poor pink salmon production years in the early 1970's. The spring of 1987 was very mild, and may have promoted better than average survival in the early marine life of the fry. The forecast based strictly on the fry index was below the long term 1960 to 1987 average return of 6.5 million fish. When April air temperature data were included in the regression, the forecast increased to 7.21 million fish. The 1988 forecast for natural production is slightly above the long term average but below the 12 million average for the last ten years.

The point estimate of 15.16 million fish returning to hatcheries in 1988 is based on an average marine survival of 5.3%. The fry from the 1985 brood year experienced much higher marine survival than this. It is possible that the mild spring in 1987 promoted similar above average marine survival for the fry released from the 1986 brood year. The fry releases in 1987 were larger than in any prior year. If marine survival for the 1986 brood approaches that observed for the 1985 brood, the 1988 return may approach or exceed the upper end of the forecast range and set a new record for hatchery return to the area.

Sam Sharr
Research Project Leader
Cordova

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FORECAST AREA; Prince William Sound

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF 1988 RETURN;

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	767,000	500,000 - 1,108,000
Escapement Goal:	225,000	
Harvest Estimate:	542,000	275,000 - 882,000

SUPPLEMENTAL PRODUCTION

Main Bay Hatchery

Return Estimate:	194,000	175,000 - 214,000
Brood Stock:	0	
Common Property Harvest Estimate:	194,000	175,000 - 214,000

Prince William Sound Aquaculture Corporation, A.F.K. Hatchery

Return Estimate:	187,000	169,000 - 206,000
Brood Stock:	0	
Common Property Harvest Estimate:	187,000	169,000 - 206,000

Esther Island Hatchery

Return Estimate:	229,000	206,000 - 252,000
Brood Stock:	125,000	
Common Property Harvest Estimate:	105,000	82,000 - 128,000

Valdez Fisheries Development Association, Solomon Gulch Hatchery

Return Estimate:	52,100	46,900 - 57,400
Brood Stock:	6,700	

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Common Property Harvest Estimate:	45,400	40,200 - 50,700
TOTAL SUPPLEMENTAL PRODUCTION		
Return Estimate:	663,000	597,000 - 729,000
Brood Stock:	131,000	
Common Property Harvest Estimate:	532,000	465,000 - 598,000
TOTAL AREA PRODUCTION		
Return Estimate:	1,430,000	1,155,000 - 1,777,000
Stream Escapement and Brood Stock:	357,000	
Common Property Harvest Estimate:	1,077,000	798,000 - 1,420,000

FORECAST METHODS:

Natural Production: The natural stock forecast was the pooled result of three separate regressions. The first model predicts returns of 3-year-old chums based on the prior year return of pink salmon. Pink salmon that returned in 1987 and 3-year-old chum salmon returning in 1988 are from the same brood year and entered the marine zone at the same time. This model reflects the fact that returns of these two groups is correlated and presumably reflects the concurrent effect of early marine environmental conditions on the two groups. The returns of 4- and 5-year-old chum salmon were predicted from the returns of sibling age classes of chum salmon, (i.e., 3- and 4-year-old chums in 1987, respectively). The variances of the three forecasts were summed to construct the 80% confidence intervals.

Hatchery Production. The hatchery returns for 1988 were projected from fry releases in 1983, 1984 and 1985, based on an estimated marine survival of 2%, and average age composition data for natural chum returns from brood years 1978 through 1982. The marine survival rate is a best guess and the range for the forecasted hatchery returns was based on likely low and high marine survival rates of 1.8% and 2.2%, respectively.

FORECAST DISCUSSION:

The forecast of natural chum returns in 1988 is 85% of the long term average, 1960 - 1987, and only 57% of the average return for the last

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ten years. The average returns by age for brood years extensively sampled is approximately 8.8% age 0.2, 65.2% age 0.3, and 24% age 0.4. The proportion of age 0.2 in the 1987 return was lower than the historical average of 8.8%, consequently the forecasted returns for sibling age class (i.e., age 0.3 in 1988) is low. Since this age group comprised the major portion of chum returns, the overall forecast is low.

Despite the lower than average forecast for natural stocks, the overall harvest of chums in 1988 should approach the recent ten-year average catch of 1.1 million fish as a result of rapidly increasing hatchery production in the area. The Armin F. Koernig and Main Bay hatcheries, which previously produced chum salmon, are no longer doing so, but large fry releases at those facilities in 1984 and 1985 will produce 1988 returns of approximately 380,000 fish. In the absence of brood stock requirements, these returns can be fully exploited. The Esther Island facility will also be experiencing its first large returns of chum salmon, of which over 100,000 will be available for harvest in the common property fisheries.

Sam Sharr
Research Project Leader
Cordova

Appendix B (p 7 of 7)

FORECAST AREA: Prince William Sound

SPECIES: Sockeye Salmon, Coghill River

PRELIMINARY FORECAST OF 1988 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	117,000	104,000 - 133,000
Escapement Goal:	50,000	
Brood Stock:	5,000	
Harvest Estimate:	62,000	54,000 - 83,000

FORECAST METHODS:

The forecast was the pooled results of four separate regressions. The returns of 4-year-old (age 1.2) and 5-year-old fish (age 2.2) were predicted based on a standard Ricker relationship between return of the respective age class and parent escapement. The return of 5-year-old fish (age 1.3) was estimated from a sibling age class model based on returns of age 1.2 in 1987. The returns of 6-year-old fish (age 2.3) were estimated from a regression of returns and parent year escapement. The 80% confidence interval was calculated based on the variance of the total 1988 return as the sum of the variances calculated for the respective component age classes.

FORECAST DISCUSSION:

The forecasted returns of Coghill Lake sockeye salmon in 1988 are only 37% of the average return since the installation of the weir at that site in 1974. The low forecast was based on an apparently poor production of the 1983 brood year as indicated by the very low, relative to historical averages, return of 4-year-old fish in 1987. The sibling component of that brood year production should comprise the majority of the 1988 return and is projected to be poor. The reasons for the poor production are unknown. The 1983 escapement of approximately 39,000 fish was below average for the system, but an escapement of similar magnitude in 1977 produced a record return of 5-year-old fish in 1982.

The brood stock needs shown in the forecast summary are for conversion of the Main Bay Hatchery from a chum salmon hatchery to a sockeye salmon hatchery.

Sam Sharr
Research Project Leader
Cordova

APPENDIX C. PRINCE WILLIAM SOUND/COPPER RIVER SOCKEYE AND CHINOOK SALMON

FORECAST AREA: Prince William Sound/Copper River

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1988 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	1,261,000	1,081,000 - 1,442,000
Escapement Goal:	631,000	
Harvest Estimate:	630,000	542,000 - 719,000

SUPPLEMENTAL PRODUCTION

Gulkana Hatchery

Return Estimate	118,000	94,000 - 142,000
Brood Stock and Stream Escapement:	47,000	
Harvest Estimate:	51,000	57,000 - 85,000

TOTAL PRODUCTION

Return Estimate:	1,379,000	1,198,000 - 1,561,000
Escapement and Brood Stock:	701,000	
Harvest Estimate:	678,000	520,000 - 823,000

FORECAST METHODS:

Natural Production: The 1988 sockeye salmon forecast utilized historical return per spawner data from the six most similar spawning populations and parent year escapement weighted age class (4-, 5-, and 6-year-olds) for the Copper River Delta and Upper Copper River independently. The 1988 predicted return is influenced heavily by the 1983 brood year for the Copper River Delta and the Upper Copper River.

Supplemental Production: The 1988 supplemental return will be the result of production from Gulkana Hatchery. Brood years 1983 and 1984 using F.R.E.D. Division standard survival assumptions should produce an adult return of 118,000. A harvest level of 60% would contribute 71,000 salmon to the catch.

FORECAST DISCUSSION:

Natural Production: Continued mild winter conditions, particularly on the Copper River Delta during the freshwater life history stages of the age groups represented in the 1988 return, should produce a near-average return per spawner contribution from the above average parent year escapements of 1983 and 1984. Upper Copper River escapements were above average in all three years, thus generally mild conditions and good spawner distribution should yield near average returns. The parent year escapement was one of the highest on record. The forecast will error on the conservative side if environmental conditions continue to produce above average survival rates.

Supplemental Production: Facility production data and conditions suggest that even a wide variation in survival from the expected would not significantly alter the overall 1988 return of sockeye salmon; however, in future years with the significant increases in fry production that have occurred since the 1983 and 1984 brood years, supplemental production and variation in marine survival will have an increasingly important affect on overall variability of the forecast.

Kenneth Roberson
Research Biologist
Glennallen

Appendix C (p 3 of 3)

FORECAST AREA: Prince William Sound/Copper River

SPECIES: Chinook Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN;

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	49,500	38,400 - 60,600
Escapement Goal:	15,000	
Harvest Estimate:	34,500	25,400 - 43,600

FORECAST METHODS

The 1987 chinook salmon forecast utilized historical aerial survey indices and age composition data. The projected return was based on average return per spawner, where numbers of spawners were estimated from weighted aerial survey indices.

Kenneth Roberson
Research Biologist
Glennallen

APPENDIX D. UPPER COOK INLET SOCKEYE SALMON

FORECAST AREA: Upper Cook Inlet

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1988 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	6.8 million	2.8 million - 10.0 million
Escapement Goal:	1.5 million	
Harvest Estimate:	5.3 million	1.3 million - 8.5 million

FORECAST METHODS

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

The basis of the forecast is historical data on total sockeye salmon return which are available for the first four systems noted above and for Fish Creek. Escapement-return relationships by river system provide estimates of total production from each brood year escapement. Analysis of these relationships by linear regression (log transformation of the data) and the application of average marine maturity schedules to the estimate of total return by brood year (Ricker curve) formed the basis of the forecast. Either the Ricker curve or the linear regression analysis results were selected based on the best statistical fit of the data set.

FORECAST DISCUSSION:

The total return of sockeye salmon to Upper Cook Inlet was estimated to be 6.8 million fish in 1988. Desired escapement levels to Upper Cook Inlet river systems total 1.5 million and provide an anticipated harvestable surplus of 5.3 million fish. Estimated returns to the Kenai River are 5.0 million fish, to the Kasilof River are 1.1 million fish, to the Susitna River are 0.4 million fish, to the Crescent River are 0.2 million fish, and to Fish Creek are 0.124 million fish.

Prior to 1987, the forecast methods had proved to be fairly accurate with the actual return averaging within eight percent of the forecasted return. However, in 1987 the actual return was over 12 million fish, more than double the forecast. Preliminary analysis of sockeye salmon commercial harvest and escapement age composition data indicated that the 1987 forecasted return to the Kasilof and Susitna Rivers was reasonable. The major difference between the 1987 forecast and the actual return was due to the 1987 Kenai River return being much greater

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than forecast. Because of the 1987 forecast error, there is potential for a larger 1988 return than forecast. The parent year escapements into the Kenai River for the 1988 return were similar in magnitude and distribution as those for the 1987 return. Lake rearing conditions were also similar. However, a note of caution is warranted. The data upon which the total forecast was based is limited to just a few years, and therefore, the potential for significant error in the forecast is high.

Kenneth E. Tarbox
Research Project Leader
Upper Cook Inlet

APPENDIX E. KODIAK PINK SALMON

FORECAST AREA: Kodiak

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN¹:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Total Return:	17.9 million	16.2 million - 19.5 million
Escapement Goal:	3.9 million	
Harvest Estimate:	14.0 million	12.6 million - 19.5 million

SUPPLEMENTAL PRODUCTION

Total Return:	1.7 million	.93 million - 3.3 million
Brood Stock:	.45 million	
Harvest Estimate:	1.25 million	.48 million - 2.85 million

TOTAL AREA PRODUCTION

Return Estimate:	19.6 million	17.74 million - 21.86 million
Brood Stock and Escapement:	4.35 million	
Harvest Estimate:	15.25 million	3.39 million - 17.51 million

¹ Hatchery production forecast is for Kitoi Bay Hatchery and was prepared by Tim Joyce. See Afognak District for additional discussion. All numerical values represent numbers of pink salmon.

FORECAST METHODS

The 1988 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 least squares regression analysis of the past 22 years pre-emergent data. Variables used in the analysis were the indexed live fry densities and the average April ambient air temperatures taken in Kodiak. The upper and lower range estimates were the 80% confidence intervals.

FORECAST DISCUSSION:

Pre-emergent fry sampling this spring (1987) indicated good to excellent overwinter survival from the brood year escapement of 4.2 million pink

Appendix E (p 2 of 3)

salmon. Sampling resulted in an unweighted live fry index of 237.6 live fry/m², which was one of the highest on record for an even-year return.

Distribution of the brood year escapement resulted in 84% of the fish entering the pre-emergent index streams. Sampling conditions during March 1987 were generally very good on Kodiak and Afognak Islands. Sampling on the mainland was limited by high winds and the end of the helicopter contract period. The warmer, milder spring conditions in 1987 combined with the excellent fry densities are the main reasons for an above average forecast for the 1988 return. A breakdown of the expected returns by major geographical districts is summarized below. All district harvest projections assume desired escapement goals will be met.

Afognak District: The pre-emergent fry index for this district was one of the highest on record. Considering the warmer April temperatures in 1987, a total of 895,000 pink salmon are expected to return. The desired escapement level is 250,000 pink salmon leaving 645,000 pink salmon available for harvesting.

Afognak District Supplemental Production: Kitoi Bay Hatchery total return point estimate is 1.7 million pink salmon from a release of 89.9 million fry. Approximately 150,000 pink salmon are required for escapement and brood stock, with an additional 300,000 pink salmon potentially being required for Kodiak Regional Aquaculture Association cost recovery to assist in funding the hatchery operations. This would leave approximately 1.15 million pinks available for harvesting.

Westside District: The overall live fry densities for the district are about average. This was due to less than desired brood year escapement into Karluk River and lower than expected fry densities in Uganik and Uyak Rivers because of scouring. The expected return to this district is 11.45 million pink salmon. The desired escapement goal is 2.5 million pinks, leaving 9.2 million pinks available for harvesting.

Alitak District: The live fry index for this district is above average. However, this may not necessarily reflect an above average return. Humpy Creek had excellent over winter fry survival, while the live fry densities for Deadman and Dog Salmon Rivers were poor, because of scouring. In 1988, 1.25 million pinks are expected to return to this district. The desired escapement goal is 0.5 million pinks, leaving 0.75 million pinks available for harvesting.

General District: The overall live fry index for the district is one of the highest on record. Combined with the mild spring temperature (1987), a total of 3.58 million pink salmon are expected to return to this district. The desired escapement goal is 500,000 pink salmon, leaving approximately 3.0 million pink salmon available for harvesting.

Mainland District: Fry sampling was limited to only six streams in 1987 due to high winds and the end of the helicopter contract. All streams sampled showed signs of scouring. Based on the success of the pink fry

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over winter survival on Kodiak and Afognak Islands and the favorable early marine conditions, approximately 716,000 pink salmon are expected to return to this district. The desired escapement goal is 400,000 pink salmon leaving approximately 316,000 pink salmon available for harvesting.

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APPENDIX F. KODIAK UPPER STATION LAKE SOCKEYE SALMON

FORECAST AREA: Kodiak, Upper Station Lake

SPECIES: Sockeye Salmon, Early Run

PRELIMINARY FORECAST OF THE 1988 RETURN:

	<u>Point</u>	<u>Range</u>
Total Return:	152,000	45,000 - 255,000
Escapement Goal:	62,500	
Projected Harvest:	89,500	0 - 192,500

FORECAST METHODS:

The 1988 forecast was calculated through a series of multiple linear regression equations using 1969 through 1984 parent year age composition data. Each major age class in the return was estimated by a regression equation chosen to maximize the coefficient of determination, verified to produce a non-negative estimate, and interpreted for reasonableness. After the first regression equation was accepted, the second equation was developed with the previous estimated number in the data base. The process was repeated until all major age classes were estimated.

FORECAST DISCUSSION:

The 1988 estimate for Upper Station early run return of 152,000 fish is composed of 46% 5-year-old fish from the 1983 parent year escapement of 115,900, 33% 4-year-old fish from the 1984 parent year escapement of 96,800 fish, and 21% 6-year-old fish from the 1982 parent year escapement of 170,600. The formulas used provided R-squared values ranging from 0.62 to 0.85.

If the 1988 Upper Station early run materializes as predicted, there will be a harvestable surplus of 89,500 sockeye salmon for the seine and gill net fisheries within the Alitak Bay District.

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APPENDIX G. FRASER LAKE SOCKEYE SALMON

FORECAST AREA: Kodiak, Frazer Lake

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN:

	<u>Point</u>	<u>Range</u>
Total Return:	343,000	100,000 - 690,000
Escapement Goal:	237,500	
Projected Harvest:	105,500	0 - 452,500

FORECAST METHODS:

The 1988 forecast was calculated through a series of multiple linear regression equations using 1968 through 1984 parent year age class return data, smolt meristic information and smolt age class composition data. Each major age class in the return was estimated by a regression equation chosen to maximize the coefficient of determination, verified to produce a non-negative estimate, and interpreted for reasonableness. After the first regression equation was accepted, the second equation was developed with the previous estimated number in the data base. The process was repeated until all major age classes were estimated.

FORECAST DISCUSSION:

The 1988 estimated Frazer Lake return of 343,900 fish is composed of 85% 5-year-old fish from the 1983 parent year escapement of 158,000 fish, 13% 4-year-old fish from the 1984 parent year escapement of 54,000 fish and 2% 6-year-old fish from the 1982 parent year escapement of 430,000 fish. The forecast lacks stability because most of the estimated return is progeny from a single brood year (1983). However, there are strong indications from the smolt sampling conducted in 1986 and the return of 4-year-old fish in 1987 that the 1983 parent year will produce a much higher return than either of the two preceding parent escapements which averaged more than 400,000 fish each.

If the 1988 Frazer Lake return occurs as predicted there will be a harvestable surplus of 105,500 fish for the seine and gill net fisheries of the Alitak Bay District.

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APPENDIX H. CHIGNIK SOCKEYE SALMON

FORECAST AREA: Chignik

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN:

<u>EARLY RUN</u> (Black Lake Stock)	<u>Point</u>	<u>80% Prediction Range</u>
Return Estimate:	1.43 million	1.27 - 1.59 million
Escapement Goal:	400,000	
Harvest Estimate:	1.03 million	.87 - 1.19 million
<u>LATE RUN</u> (Chignik Lake Stock)		
Return Estimate:	0.792 million	.70 - .90 million
Escapement Goal:	250,000	
Harvest Estimate:	.52 million	.45 - .65 million
<u>TOTAL CHIGNIK</u>		
Return Estimate:	2.22 million	2.03 - 2.49 million
Escapement Goal:	650,000	
Harvest Estimate:	1.57 million	1.38 - 1.77 million

FORECAST METHODS

Point estimates given above are sums of the predicted returns of 3-ocean and 2-ocean age sockeye salmon in the respective runs.

A multiple linear regression equation predicts the return of 1.3 and 2.3 age fish in the early run from data on the return of 1.2 age fish in the previous year, mean length of 1.2 males in the previous year, and size of the early run escapement 5 years earlier. The late run forecast was derived by using the average return per spawner based on the past 27 years of observed late run returns.

FORECAST DISCUSSION:

Early Run. The point estimate of 1.43 million sockeye for the early run is approximately equal to the average early run return for the past 7 years. One area of concern with this forecast is the classification accuracy of 1987 catch and escapement to respective stocks. The classification accuracy of the 1987 model is at the lower end of the range of acceptable accuracy. This was due to the similarity of the

scale patterns observed for two stocks during 1987. Further analysis is ongoing to reduce this possible sources of error.

Late Run. The 1988 preliminary forecast was developed by using the average return per spawner based on the last 27 years of observed returns. The 1988 forecast of 0.79 million fish and is below the average (1.2 million) of the observed returns for the period 1977-1987. It is anticipated that the 1988 return will fall within the prediction range of 0.7 - 0.9 million fish.

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APPENDIX I. BRISTOL BAY SOCKEYE SALMON

FORECAST AREA: Bristol Bay

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN:

	<u>Point</u>	<u>Range</u>
Total Return:	28.3 million	19.4 million - 37.2 million
Escapement Goal:	9.7 million	
Projected Harvest:	18.6 million	9.7 million - 27.5 million

Forecasted returns to individual river systems are as follows: 9.3 million for Kvichak, 0.4 million for Branch, 2.5 million for Naknek, 5.9 million for Egegik, 3.4 million for Ugashik, 3.0 million for Wood, 1.2 million for Igushik, 1.8 million for Nuyakuk, and 0.7 million for Togiak.

FORECAST METHODS:

Several modifications to improve forecast performance were made in calculating predictions for 1988. Since we were particularly interested in correcting the trend in under-forecasting actual returns (forecasts for 12 of the last 14 years have been less than actual returns), all data prior to the 1978 return year were omitted from calculations. We felt that this would provide a more accurate estimate of future sockeye salmon returns as the number of returning adults produced from each spawner has shown a dramatic increase for most systems since 1978. This increased production has been coincident with decreased interception of maturing sockeye salmon on the high seas, onset of more favorable climatic conditions, and improvements in the Department's ability to determine and attain spawning escapement goals for most major Bristol Bay systems.

For the past three years results from two independent forecasting techniques, the Standard ADF&G (ADF&G) and the Japanese Research Vessel Catch (JRVC) methods, have been combined to produce the preseason forecast. The ADF&G method, calculated by averaging results of simple linear regression models which used either spawner-recruit, sibling, or smolt data, produced forecasts by major age class for individual river systems. The JRVC method, calculated from multiple linear regression models which used catch per unit of effort and length data for immature sockeye collected by Japanese research vessels and mean Cold Bay air temperatures, produced forecasts by ocean age groups for all of Bristol Bay. Unfortunately, when data prior to 1978 were omitted from calculations, the JRVC three-ocean return model was not statistically significant at the 75% significance level. In addition, one of the input variables for the JRVC two-ocean return model (catch per unit of fishing

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effort) was outside the range of data used to build that model (range for 1978-1987, 0.18 to 1.33; value for 1988, 0.11). Therefore the 1988 forecast was based solely on results of the AFD&G method.

Results of the various models used within the ADF&G method were excluded from final forecast calculations if the fit of the model to historical data was not statistically significant at the 75% significance level and if the value of the input variable was outside the range of data used to build the model. If none of the model results could be used to forecast the return of an age class to a river system, the mean return of that age class to that river system for the past 10 years was used as the prediction.

FORECAST DISCUSSION:

Based on these calculations, 28.3 million sockeye salmon are expected to return to Bristol Bay in 1988 (80% confidence interval, 19.4 to 37.2 million). This return would be about 16% (3.8 million sockeye salmon) greater than the 20-year, 1968-1987, mean (24.5 million; range 3.5 to 66.3 million), but about 19% (6.5 million) less than the most recent 10-year, 1978-1987, mean (34.8 million, range 10.7 to 66.3 million).

Returns are expected to exceed spawning escapement goals for all systems. Total projected sockeye salmon harvest is expected to be 18.6 million (80% confidence interval, 9.6 to 27.5 million). This harvest would be 37% more than the 1968-1987 average of 13.6 million fish, but 13% less than the recent 1978-1987 average of 21.3 million fish.

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APPENDIX J. BRISTOL BAY, NUSHAGAK DISTRICT CHINOOK SALMON

FORECAST AREA: Bristol Bay, Nushagak District

SPECIES: Chinook Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	139,000	100,000 - 180,000
Escapement Goal:	75,000	
Projected Harvest:	64,000	25,000 - 105,000

FORECAST METHOD:

The 1988 Nushagak District chinook salmon forecast was based upon the relationship between returns of sibling age classes (i.e., age classes produced from the same spawning escapement). Standard linear regression techniques were used to estimate returns with 80% confidence intervals (ranges) for each major age class. These results were summed to provide the total return estimate.

FORECAST DISCUSSION:

The 1988 Nushagak District chinook salmon forecasted return of 139,000 fish is below the long term (1960-1987) average return of 177,000. Age 4₂, 5₂ and 6₂ returns are expected to contribute 13%, 37% and 45%, respectively. The projected harvest of 64,000 chinook salmon is also down from recent years.

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APPENDIX K. KOTZEBUE SOUND CHUM SALMON

FORECAST AREA: Kotzebue Sound

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF THE 1988 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	----	----
Escapement Goal:	----	
Projected Harvest:	275,000	178,000 - 372,000

FORECAST METHODS:

The model used predicts catch rather than total return. No escapement projects presently exist to estimate total escapement in the Kotzebue area. The model assumes that the total fishing time is constant from year to year.

Linear regression of sibling relationships were used to predict the number of 4- and 5-year-old fish in the 1988 commercial catch and involve the same methods used to predict the 1987 catch. However, an exceptionally poor run in 1987 required that fishing time be severely restricted to conserve the stocks. Fishermen were only allowed to fish 9 of the 15 normally scheduled periods. Therefore additional methods were employed to estimate the number of fish of each age group that would have been caught had the fishery been opened for the entire 15 periods. The catch was adjusted to that expected under an unrestricted fishery. The adjusted catches by age class were used to estimate 1988 catches.

FORECAST DISCUSSION:

Chum salmon will be returning to Kotzebue Sound in 1988 from the 1982-1985 brood years. Four-year-old fish have historically comprised 66% of the commercial catch, therefore if this trend continues in 1988, the 1984 brood year would dominate.

Historically, 6-year-olds have contributed less than 1% to the catch (5.5% maximum) and therefore are not considered in the projected catch estimate. The age composition of the 1987 catch was extremely unusual in that 6-year-olds comprised a record 11.6% of the harvest. However, since the 1987 catch of 5-year-olds was below the 10-year average (1977-1986), the return of age 6 chum salmon in 1988 is expected to be insignificant.

The return of 5-year-olds in 1988 is expected to be below the 10-year average based on the poor return of 4-year-olds in 1987. In the Kotzebue fishery, a strong relationship exists between the number 4-year-old fish

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caught in one year and the number of 5-year-old fish caught the next year. Based on this relationship, approximately 37,600 age 5 fish are expected in the 1988 commercial catch. This compares with an average (1977-1987) catch of 90,300 fish.

Four-year-olds are anticipated to be near average since the return of 3-year-olds in 1987 was average. Age 4 chum salmon are expected to total 211,800, compared to an average (1877-1987) catch of 201,800 fish.

Three year olds will be returning from the strong 1985 brood year. Although the 1985 return was near record levels, fall environmental conditions, which effect egg survival, were exceptionally poor. Since it is impossible to quantitatively assess the survival of this brood year without additional information, a catch of 25,500 3-year-olds in 1988 was estimated based on the historical average (1972-1986).

Combining results from sibling regressions for 4- and 5-year-olds and a historic average catch of 3-year-olds, the 1988 commercial catch is expected to total 274,900 chum salmon with 80% confidence bounds of 178,200 to 371,600. This compares with the recent 10-year average catch of 319 thousand chum salmon.

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