



REGIONAL INFORMATION REPORT NO. 5J89-01

Preliminary Forecasts and Projections for 1989 Alaska Salmon Fisheries

Edited by:

Harold J. Geiger

and

Herman Savikko

February 1989

PRELIMINARY FORECASTS AND PROJECTIONS FOR 1989

ALASKA SALMON FISHERIES

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REGIONAL INFORMATION REPORT¹ NO. 5J89-01

**Alaska Department of Fish and Game
Division of Commercial Fisheries
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ABSTRACT

Salmon harvests were down slightly in 1988 from recent levels, and in 1988 harvests were slightly less than forecast. Yet revenues to fishermen were up sharply due to record prices. In 1988, 529 million pounds of salmon were harvested in Alaskan waters, and \$742 million were paid to fishermen for these fish. This years record stands in contrast to the 1987 record ex-vessel value of \$478 million.

The 1989 harvest outlook is for 127.0 million salmon distributed as 701 thousand chinook salmon, 29.0 million sockeye salmon, 3.97 million coho salmon, 81.9 million pink salmon, and 11.4 million chum salmon. Chinook salmon harvests are expected to rise, partially due to hatchery cost recovery harvests in the Southeastern Region, and a return to more normal production in Bristol Bay. Total sockeye salmon harvest is expected to be similar to 1988 levels. Sockeye salmon harvests in Bristol Bay are expected to be down slightly from the higher levels of the mid 1980's. Pink salmon production is expected to sharply increase. Much of the increase is expected to occur in Prince William Sound. In 1989 the Prince William Sound hatchery harvest alone (27 million fish forecasted) is expected to be over 90% of the 1987 harvest (29 million fish; cost recovery harvest included) which is the largest pink salmon harvest that ever occurred in Prince William Sound. The pink salmon forecasts in southern Southeast has been an over-estimate of the actual catch for two years, with no obvious explanation. If the same, as yet unknown, mechanisms are operating in 1989, the forecast will again over state the actual harvest.

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

INTRODUCTION

This report reviews Alaska's 1988 commercial salmon season and presents preliminary salmon forecasts and projections for the 1989 commercial 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.

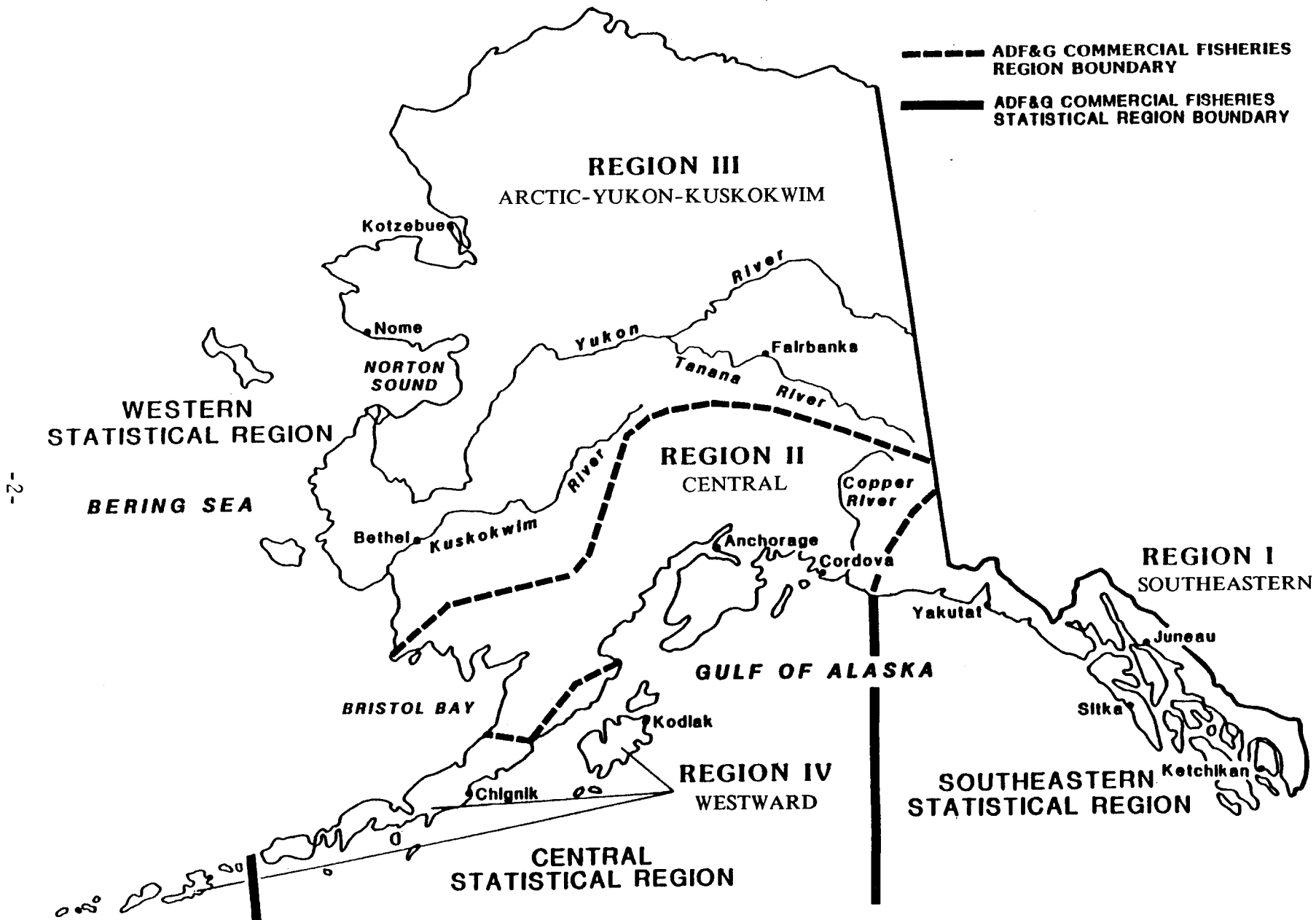
Forecasts of returns (catch + escapements) for major salmon fisheries as well as projections of the statewide commercial salmon harvest have been published yearly by the Alaska Department of Fish and Game since 1969 (ADF&G 1969-1984; Eggers 1985, 1986; Eggers and Dean 1987, 1988). This is the first year that formal herring forecasts will be released. It will be available as a separate report. Other fisheries, such as the shellfish fisheries, will be included in the forecasts as reliable methods are developed for these species.

The distinguishing feature of the 1988 season were the extremely high prices that were paid to fishermen. Ex-vessel values were up partly as a result of the exchange rate between the dollar and the yen. The late 1980's have been a time of historically high salmon harvests. In 1988 the harvest was 99.4 million salmon, up very slightly from the 1987 figure, yet less than the predicted 135 million salmon. While 1988 saw some large harvests, such as the Cook Inlet sockeye salmon, pink salmon production was severely depressed in many areas, such as Cook Inlet, Prince William Sound, and Southern Southeast Alaska. Hatcheries, especially in Cook Inlet, Prince William Sound, and to a lesser extent in Southeast Alaska, have greatly altered the traditional fisheries in the late 1980's. State and non-profit hatcheries contributed several million salmon to the 1988 harvest, and were especially important to the Prince William Sound and Cook Inlet areas.

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.

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

The accuracy of the salmon forecasts and harvest projections for salmon are summarized in Table 1. On the average, the return forecasts for the total number of salmon have been close to the actual returns, with the forecast exceeding the return in 13 of the last 19 years (Table 1). The projected statewide harvest has also exceeded the actual harvest 13 out of 19 years, with an average error of 24%, without regard to the sign of the error (Table 1). The historical performance of the forecasted return to major salmon fisheries during the period 1970-1988 is shown in Figure 2. The historical



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Figure 1. The 3 statistical regions (Western, Central, Southeastern) and the 4 fisheries regions (Westward, A-Y-K, Central, Southeastern) of the Alaska Department of Fish and Game, Division of Commercial Fisheries.

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, 1970-1988. Projected and realized Alaska commercial salmon harvests with absolute and relative error, 1970-1988. Figures are in thousands of salmon.

Year	Only Major Fisheries Where Formal Forecasts Are Made										Projected Collective Harvest of all Alaska Salmon Fisheries				
	Forecasted		(2) Escapement Goal	Actual (Note that Figures Based on Preliminary Returns)			(5) Management Error (thousands)	(5)/(2) %	(6) Forecast Error (thousands)	(6)/(3) %	(7) Projected Harvest	(8) Actual Harvest	(9) Error (7)-(8)	(9)/(8) Relative Error	(1-2)/(7) Forecasted Harvest Relative Projected Statewide Harvest
	(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	(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	142	0%	(10,657)	-10%	94,132	95,525	(1,393)	-1%	71%
1988	135,602	101,613	34,264	87,585	24,924	62,661	9,340	27%	48,017	55%	134,996	99,204	35,793	36%	75%
1970-88															
Averages	84,518	58,016	26,638	89,232	29,200	60,032	(2,562)	-10%	(4,714)	2.62%	75,839	81,264	(5,424)	-4.42%	72%
Averages without regard to sign							7,631	29%	21,994	29%			17,209	24%	

Preliminary data published in ADF&G (1970-1988)

Preliminary harvest figures.

performance of the projected statewide commercial harvest projections is shown in (Figure 3).

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 outlook or projections:	Harvest outlooks are generated by local fisheries managers for all areas of the state. Harvests are based on the formal forecasts where available. For fisheries where no formal forecast was generated the harvest outlook is based on historical averages subjectively adjusted based on recent trends, and local knowledge of the fisheries situation. In general harvest outlooks are less reliable than formal forecasts.
Commercial Harvest:	Those fish harvested in fisheries other than sport and personal use, and intended to be used for sales. This category includes fish caught by the commercial fleet in the common property fishery, and fish harvested by hatchery operators for cost recovery.
Common Property Harvest:	Fish harvested by fishers holding limited entry permits, issued by the State of Alaska to harvest fish for commercial purposes.
Cost Recovery Harvest:	Fish harvested by hatchery operators, separately from the common property fishery, to fund the operation of the hatchery.

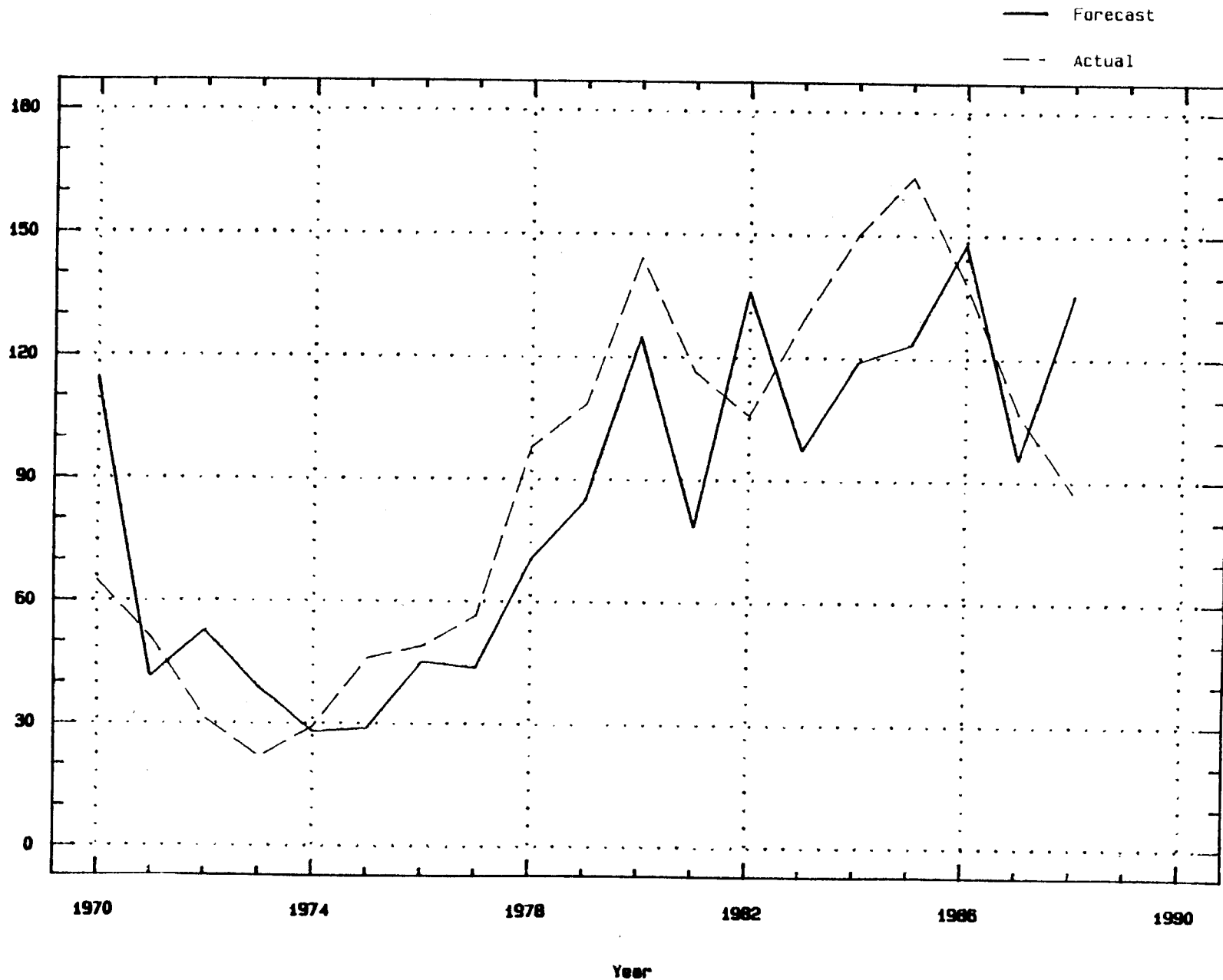


Figure 2. Relationship between observed return (millions) and forecasted return (millions) for major salmon fisheries with formal forecasts, 1970-1988.

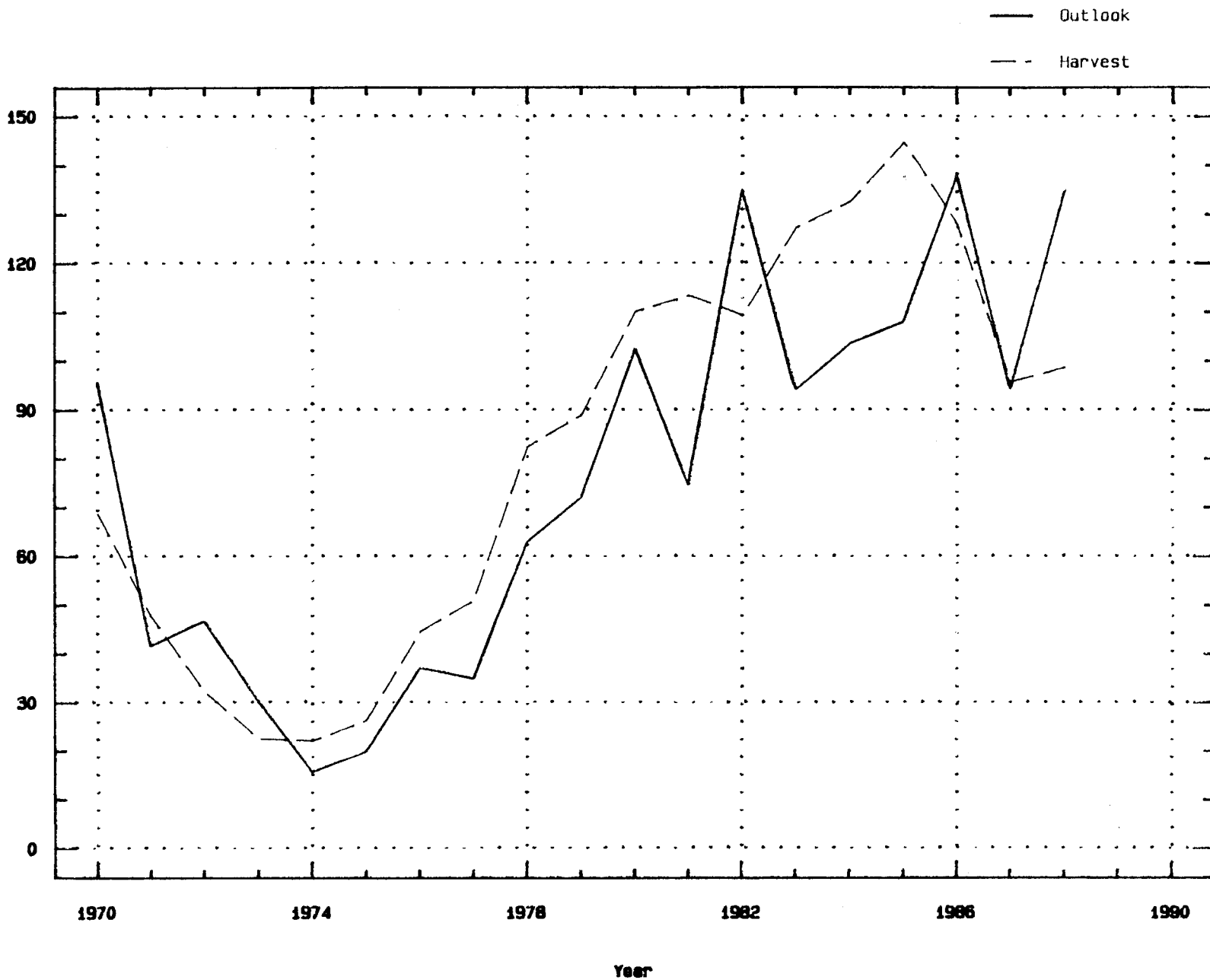


Figure 3. Relationship between observed harvest (millions) and projected harvest (millions) for Alaska commercial salmon fisheries, 1970-1988.

Alaska Pacific Salmon Species

Common and Vernacular Names

Scientific Name

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 1989

Species	Age of Returning Salmon in Years				
	2	3	4	5	6
Pink	1987				
Chum		1986	1985	1984	
Coho		1986	1985		
Sockeye			1985	1984	1983
Chinook			1985	1984	1983

PRELIMINARY REVIEW OF THE 1988 ALASKA COMMERCIAL SALMON FISHERY

The 1988 commercial salmon catch is estimated to have produced a harvest of 99.4 million fish weighing a total of over 529 million pounds.

This is only the second time in nine years that the Alaska commercial harvest has fallen below the 100 million fish (Figure 4). The 1987 catch was the only other year that this occurred, with an estimated catch of 96.4 million.

The ex-vessel value for this season is estimated to have set a new record, surpassing last year's old record of \$478 million, with a total ex-vessel value of \$742 million. As more precise catch and price information becomes available, this figure may be even higher.

The 1988 salmon harvest was considerably less than the preseason catch projection of 135 million fish. Sockeye inshore forecasts in Bristol Bay of 26.5 million did not materialize, as the entire inshore return reached 23.1 million. This was the smallest sockeye run since 1982 and was far below the 1978-87 average sockeye run of 35.4 million fish. Coho and pink salmon returns to both Southeast Alaska and the Prince William Sound area were also far below the preseason forecasts. Total catch for Southeast pinks was approximately 11.2 million, while projections were for 42.1 million fish. In Prince William Sound the catch of pink salmon (including hatchery cost recovery and brood stock needs) was approximately 11.7 million fish, while the preseason projection was for 16.4 million.

Comparisons of actual and forecasted 1988 salmon returns with errors and relative errors for salmon fisheries where formal forecasts were generated are presented in Table 2. Preliminary 1988 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 1988 Southeast Alaska commercial harvest by all gear types including hatchery cost recovery totaled approximately 17.5 million fish. The ex-vessel value for this salmon catch is estimated to exceed \$129 million.

It represented the second consecutive season of reduced salmon production following several years of very high output. The harvest was considerably below the expected pre-season take of 50.3 million fish, primarily due to a failure of the pink salmon run. A majority of the harvest was a result of natural salmon returns. Preliminary estimates indicate that salmon returns from Southeast Alaska hatcheries contributed approximately 1.6 million fish to the harvest, predominantly chum salmon.

The harvest of approximately 11.2 million pink salmon accounted for 64% of the 1988 salmon catch. Region-wide sockeye salmon landings of about 1.5 million fish were above the average reported since 1960. The commercial

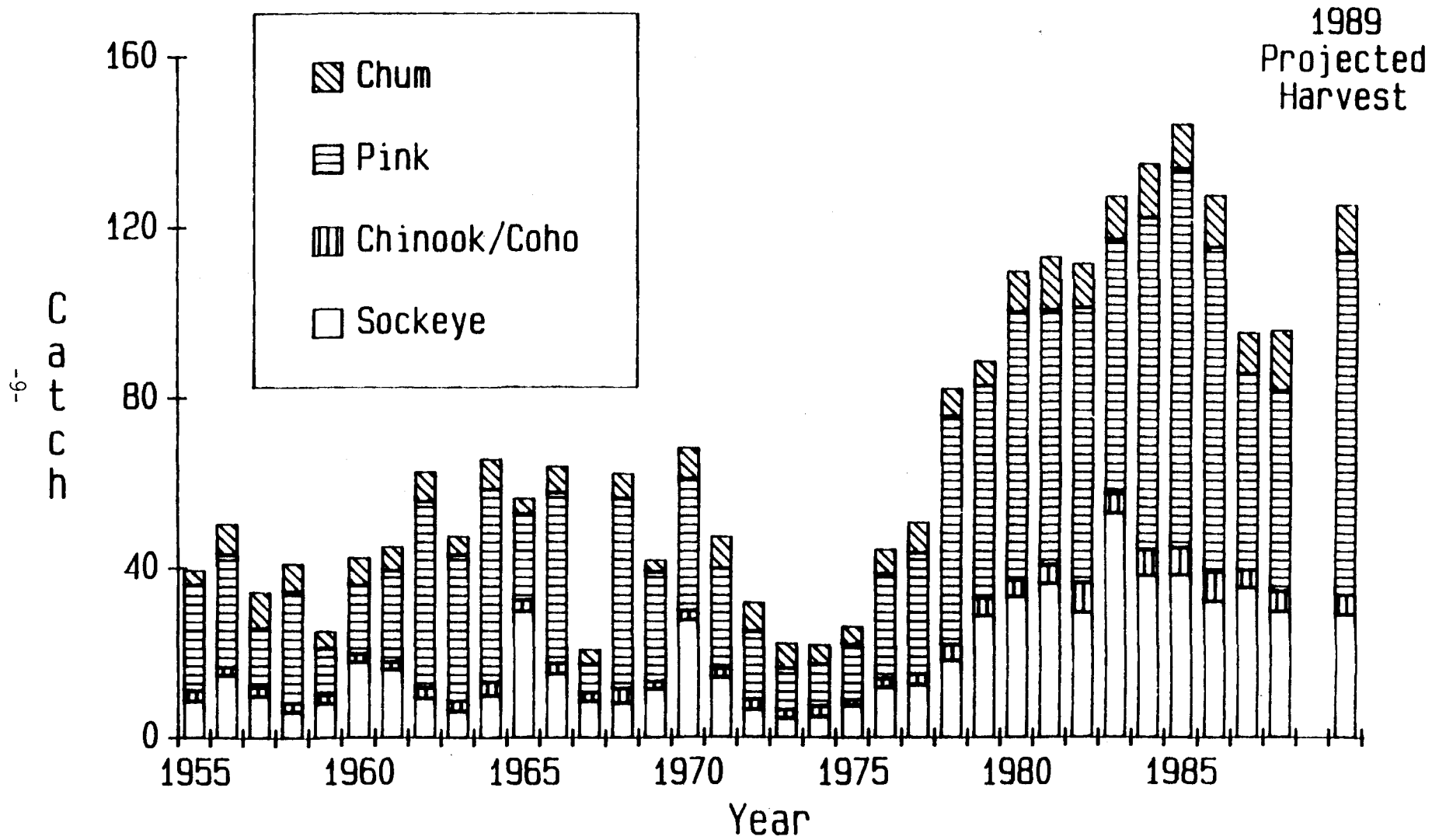


Figure 4. Alaska commercial salmon harvests by species, 1955-1988, and the 1989 projected harvest.

Table 2. Comparison of actual and forecast 1988 salmon returns, with errors and relative errors, for some major Alaska salmon fisheries.¹

		Thousands of Fish					
Area	Species	(1)	(2)	(3)	(4)	(5)	(6)
		Harvest	Escapement	Return (1) + (2)	Forecasted Return	Error (4) - (3)	Relative Error (5)/(3) x 100%
Southern Southeastern	pink	9,054	4,066	13,120	44,100	30,980	236%
Northern Southeastern	pink	2,146	2,679	4,825	7,900	3,075	64%
Southeastern total	pink	11,200	6,745	17,945	52,000	34,055	190%
Prince William Sound	pink	12,530	970	13,500	22,370	8,870	66%
	chum	1,840	484	2,324	1,430	(894)	-38%
PWS Coghill District	sockeye	87	68	154	117	(37)	-24%
Copper River	sockeye	579	594	1,173	1,379	206	18%
	chinook	37	9	46	50	4	8%
Upper Cook Inlet	sockeye	6,700	1,400	8,100	6,800	(1,300)	-16%
Kodiak	pink	14,600	4,400	19,000	19,600	600	3%
Chignik ²	sockeye	796	676	1,472	2,200	728	49%
Bristol Bay ³	sockeye	14,623	9,381	24,004	28,302	4,298	18%
Bristol Bay, Nushagak District	chinook	26	57	83	139	56	67%
TOTAL		74,219	31,529	105,747	186,387	80,640	76%

¹ Preliminary data compiled 25 November 1988.

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

³ Inshore harvest only.

Table 3. Preliminary 1988 Alaska commercial salmon harvest by species and fishing area.¹

Fishing Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southern Southeastern	28	885	182	8,846	2,050	11,990
Northern Southeastern	6	566	361	1,835	1,397	4,165
Southeast Troll	231	9	500	520	88	1,349
Southeastern Statistical Region Total	265	1,460	1,043	11,201	3,535	17,505
Cordova Area	32	768	478	11,736	1,841	14,855
Cook Inlet Area	31	7,124	567	1,391	1,029	10,141
Kodiak Area	22	2,700	303	14,600	1,400	19,025
Chignik	7	796	370	3,000	267	4,441
South Peninsula	11	1,465	480	6,310	1,889	10,156
Central Statistical Region Total	103	12,852	2,198	37,038	6,426	58,618
Aleutian Islands	0	5	0	188	1	194
North Peninsula	17	1,443	221	63	384	2,128
Bristol Bay Area	45	14,010	187	922	1,475	16,639
Kuskokwim Area	75	150	624	38	1,444	2,330
Yukon Area	100	0	67	1	1,212	1,380
Norton Sound	4	1	37	75	108	225
Kotzebue Area	0	0	0	0	353	353
Western Statistical Region Total	240	15,610	1,136	1,287	4,976	23,249
ALASKA TOTAL	609	29,922	4,377	49,526	14,937	99,371

¹ Compiled 13 January 1989, catches in thousands of fish.

Table 4. Preliminary 1988 Southeastern Alaska commercial salmon harvest by species and management area.¹

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southern Southeastern						
Portland Canal gill net	2	116	17	230	500	864
Annette Island gill net	1	27	7	364	115	514
Annette Island trap	0	2	0	34	0	37
Neets Bay	0	0	0	0	9	10
Lower Clarence	0	0	0	21	2	23
Prince of Wales gill net	1	93	13	69	70	246
Stikine River gill net	0	1	0	0	3	5
Wrangell Narrows	2	0	1	0	0	3
Blind Slough	1	0	0	0	0	1
Southern hatcheries	10	2	12	118	528	670
Southern districts seine	11	642	131	7,974	817	9,575
Southern Southeastern total	27	883	181	8,811	2,045	11,947
Northern Southeastern						
Taku-Snettisham gill net	2	39	45	157	140	383
Lynn Canal gill net	1	352	81	208	378	1,020
Yakutat gill net	1	162	206	120	29	518
Northern hatcheries	0	0	1	41	194	237
Northern districts seine	1	13	25	1,296	654	1,990
Northern Southeastern total	5	566	358	1,824	1,395	4,148
Southeast Troll ²	231	9	500	520	88	1,349
Miscellaneous ³	1	2	3	47	7	60
SOUTHEASTERN REGION TOTAL	265	1,460	1,043	11,202	3,535	17,505

¹ Compiled 13 January 1989, catches in thousands of fish.

² Includes catch from winter troll fishery (1 October 1987 - 14 April 1988).

³ Test fishery, Salmon Derby, Public Safety, etc.

Table 5. Preliminary 1988 Central Region Alaska commercial salmon harvest by species and management area.¹

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Cordova Area						
Bering River	0	7	87	0	0	94
Copper River	31	577	316	3	11	937
Prince William Sound						
Hatcheries	0	0	6	2,104	39	2,150
Coghill District	1	82	41	1,314	346	1,785
Unakwik District	0	9	0	0	2	10
Eshamy District	0	69	1	529	300	899
General purse seine	0	23	27	7,785	1,143	8,979
Prince William Sound total	1	184	76	11,734	1,830	13,824
Cordova Area total	32	768	478	11,736	1,841	14,855
Cook Inlet Area						
Lower Cook Inlet						
Outer District	0	10	0	6	71	87
Southern District	2	105	3	852	8	970
Kamishak District	0	184	4	61	218	468
Eastern District	0	20	0	2	25	47
Lower Cook Inlet total	2	319	8	921	322	1,572
Upper Cook Inlet						
Central District	16	6,675	409	416	631	8,147
Northern District	13	130	150	54	76	422
Upper Cook Inlet total	29	6,805	559	470	707	8,570
Cook Inlet Area total	31	7,124	567	1,391	1,028	10,141
Bristol Bay						
Egegik District	3	6,400	46	4	245	6,698
Ugashik District	3	1,532	40	0	92	1,667
Naknek-Kvichak District	7	3,549	28	612	299	4,495
Nushagak District	16	1,713	54	249	368	2,400
Togiak District	16	817	19	57	471	1,379
Bristol Bay total	45	14,010	187	922	1,475	16,639
CENTRAL REGION TOTAL	108	21,902	1,232	14,050	4,344	41,635

¹ Compiled 13 January 1989, catches in thousands of fish.

Table 6. Preliminary 1988 Westward Region Alaska commercial salmon harvest by species and management area.¹

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Kodiak Area	22	2,700	303	14,600	1,400	19,025
Chignik Area	7	796	370	3,000	267	4,441
Alaska Peninsula and Aleutians						
South Peninsula	11	1,465	480	6,310	1,889	10,156
North Peninsula	17	1,443	221	63	384	2,128
Aleutian Islands	0	5	0	188	1	194
Alaska Penin. Aleut. total	28	2,913	701	6,562	2,274	12,478
WESTWARD REGION TOTAL	58	6,409	1,374	24,162	3,941	35,944

¹ Compiled 13 January 1989, catches in thousands of fish.

Table 7. Preliminary 1988 Arctic-Yukon-Kuskokwim Region Alaska commercial salmon harvest by species and management area.¹

Management Area	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	

Kuskokwim Area						
Kuskokwim River	56	92	524	11	1,382	2,065
Kuskokwim Bay	19	58	99	27	62	265

Kuskokwim Area total	75	150	624	38	1,444	2,330
Yukon River						
Lower Yukon River	94	0	65	1	1,116	1,276
Upper Yukon River	6	0	2	0	96	104

Yukon River total	100	0	67	1	1,212	1,380
Norton Sound	4	1	37	75	108	225
Kotzebue Area	0	0	0	0	353	353
=====						
ARCTIC-YUKON-KUSKOKWIM REGION TOTAL	178	151	728	113	3,117	4,288

¹ Compiled 13 January 1989, catches in thousands of fish.

harvest of approximately 3.5 million chum salmon was the second highest since 1960. Coho landings at about 1.0 million fish were below pre-season expected levels and the lowest since the 1977 season. The 1988 commercial catch of chinook salmon was approximately 265,000 fish including those fish caught in the winter troll fishery from October 1, 1987 through April 14, 1988. The private cost recovery salmon harvest totaled approximately 907,000 fish.

Troll gear accounted for 87% of the region's landings of chinook salmon and 48% of the coho salmon harvest. Purse seine fisheries took 83% of the pink, 45% of the sockeye, and 42% of the region's chum salmon harvest. Drift gill net landings accounted for 43% of sockeye, 34% of the chum, 16% of the coho, and 9% of the pink salmon harvest. The set gill net landings of coho and sockeye salmon represented 20% and 11% of the regional harvest of these species, respectively. The trap catch of pink salmon was less than 1% of the Region 1 pink salmon landings.

Central Region

Prince William Sound

The Prince William Sound Area (PWS) combined commercial salmon harvest for 1988 was 14.9 million fish. This is far below last season's record catch of 33.1 million. However, the value to the fishermen and hatchery cost recovery efforts was about \$76.0 million, due to record prices. Wild production was only about 10% of that seen in the past seven, even year averages, the lowest return on record. This season's common property pink salmon harvest of 9.63 million fish came almost entirely from near terminal hatchery areas, catching those pinks that were excess to hatchery needs. While even the hatcheries had returns at only 25% of anticipated levels, record prices up to \$1.28 per pound allowed cost recovery needs to be easily met. The catch is still well below the 1976-85 average of 14.3 million pinks.

Sockeye harvest amounted to about 768,000 fish. This is below the 1976-85 average of 985,000, and well below the past 4 year average of 1.3 million sockeye.

Coho catches were slightly under the 1978-87 average, and also slightly under preseason projections. Total catch was approximately 478,000 fish.

Upper Cook Inlet

The 1988 commercial salmon fishery harvested nearly 8.6 million fish, due in large part to the sockeye catch of 6.8 million. The sockeye catch is the second largest on record, exceeded only by last years catch of 9.5 million fish. The ex-vessel value was \$119 million, shattering last year's record of \$95 million. Sockeye accounted for nearly 91% of the value to the fishery. The return to the Kenai River dominated the fishery. The Susitna River return, as expected, was relatively poor and the Kasilof River return was at or slightly below expectations. The intense East side fishery kept the

Kasilof River escapement count close to the minimum of 150,000 but subsequent weir counts and stream surveys of tributaries indicate that a substantial number of fish entered the system prior to sonar counter installation and the actual escapement was probably in excess of 200,000.

The harvest of 707,000 chum salmon was slightly above the long term average and accounted for 3.2% of the ex-vessel value to the fishery.

The harvest of 470,000 pink salmon represents the smallest even year harvest ever recorded for Upper Cook Inlet and accounted for less than 0.5% of the overall ex-vessel value. The autumn floods of 1986 appear to be the primary factor for the dismal return with the Susitna River return being nearly nonexistent and the Kenai River return being well below average. Escapement of pink salmon is not directly measured, but is considered to be exceptionally poor in the Susitna and fair in the Kenai.

Substantial reductions in the catch due to the drift restrictions this season still allowed a harvest of 559,000 coho salmon. This was well above the 1954-86 average of 289,000 fish and accounted for 3.2% of the overall ex-vessel value. The drift restrictions appeared to be very effective in moving large numbers of coho salmon through into the Northern District and into northern streams.

The catch of 29,000 chinook salmon was well above average but substantially below the 1987 catch due to a major reduction in the reported catch from the Upper subdistrict set net fishery (12,000, down from 21,000) and the drift fishery (2,200, down from 4,600). The reduction in the set net catch can be partially attributed to increased efforts to release live chinook, but some under-reporting also appeared to have occurred. A reduction in the closed waters at the mouth of the Kenai River to control Kenai River sockeye salmon escapement led to a substantial increase in the daily chinook salmon catch in the drift fishery, although a significant portion of the catch is presumed to have remained unreported.

Lower Cook Inlet

The 1988 commercial salmon harvest in Lower Cook Inlet (LCI) totaled 1.57 million fish. The present catch ranks sixth highest in LCI history and is expected to rank fourth by the time all fish tickets have been tabulated. The sockeye harvest of 319,000 is a record, exceeding the 1987 harvest by 15 percent and the chum salmon harvest of 322,000 ranks second to the 1981 record of 336,000.

F.R.E.D. hatchery and lake stocking returns accounted for a major portion of the LCI production this year. The commercial harvest of approximately 830,000 pink salmon from Tutka Hatchery releases was the second highest on record and accounted for 90% of the LCI pink salmon harvest of 921,000 fish. The pink salmon harvest was 15% above average for the past 30 years. The ex-vessel value is presently estimated at \$7.7 million, which is a new record, and should easily exceed \$8.0 million by the time retroactive settlements are

made on pink and chum salmon prices. F.R.E.D. salmon production accounted for \$4.2 million, or 54% of the total ex-vessel value in 1988.

The set gillnet catch presently stands at 43,100 fish, which is 13% below average, but the sockeye harvest of 14,500 fish is the lowest on record since 1970. Upper Cook Inlet sockeye did not appear to swing into Kachemak Bay and contributed to the low set gillnet harvest. Weather patterns and late snow melt-off causing colder water temperatures were most probably the reason UCI fish moved up the middle of the inlet.

Sockeye returns to LCI were generally strong as evidenced by the record harvest of 320,000 fish. The Mikfik Lake return at McNeil River was not as strong as hoped for and the 14,800 fish harvest was below the previous three year's harvests which ranged from 21,400-67,000. The two primary sockeye returns were to F.R.E.D. division lake enhancement projects at Chenik and Leisure Lakes.

Strong chum salmon returns occurred to virtually all streams in LCI. Two thirds of the 322,000 fish harvest came from the Kamishak District, which represented a new record harvest exceeding the 1983 harvest by 44%. The majority of all chum harvests were comprised of five year old fish and the four year old return appears weak. Several chum salmon areas were fished for the first time since the late 1970's and the harvest of 24,700 fish in Resurrection Bay was a record and was 78% above the 1987 harvest. McNeil River produced the most significant return.

Bristol Bay

The 1988 Bristol Bay salmon runs were strong in some districts and noticeably weak in others. The inshore sockeye run totaled 23.1 million fish compared to the preseason forecast of 26.5 million. The inshore sockeye salmon harvest was 14.0 million fish. This was the smallest sockeye run since 1982 and was far below the 1978-87 average sockeye run of 35.4 million fish. The commercial chinook salmon harvest totaled approximately 45,000 fish, the smallest catch recorded since 1975 and way below the 1978-87 average of 158,000 chinook. The chum salmon harvest to date stands at 1.47 million fish, stronger than the 1978-87 average catch of 1.28 million chum salmon. The coho salmon harvest totaled 187,000. This is greater than the last two years, but still below average, largely due to poor returns to the Nushagak and Togiak Districts. The Nushagak normally produces over 51% of the Bay's coho. The Naknek-Kvichak coho harvest of 28,000 is the second highest on record.

The total salmon harvest this season stands at 16.6 million fish. The total value is estimated at \$178.8 million to fishermen, exceeding the previous record ex-vessel value of \$141.9 million set in 1986.

The pink salmon harvest was over 922,000 fish, with catches greater than normal in the Naknek-Kvichak and Togiak Districts, and weaker than normal in the Nushagak District.

Arctic-Yukon-Kuskokwim Region

Lower Yukon

Total chum catch for the area was over 1.1 million salmon. This season a record 1.1 million summer chum were harvested, along with over 94,000 chinook. Fall chum catch was low at 79,500 fish, and coho harvest reached 72,600 fish, the second highest on record. The chinook catch exceeded preseason projections, but fell under the 1978-87 average of 126,000. The total area catch was valued at a record \$11.7 million to the fishermen. The commercial season closed on August 31.

Upper Yukon

During the 1988 season over 96,000 chum salmon were harvested along with chinook harvests totaling 5,600 fish. Total value was estimated at nearly \$800,000.

Kuskokwim

The fishing season produced an accumulated catch of 2.3 million fish. This is the first time in recorded history that the catch has exceeded 2.0 million fish. The record chum run of over 1.44 million fish contributed to about 63% of the total harvest. This accounted for about \$3.98 million to fishermen in the area, almost all local residents. The projected chum salmon harvest was only expected to be 391,000 fish. Chinook salmon catches reached 74,400 fish, with 150,000 sockeye, 612,000 coho, and 36,000 pink salmon bringing the total ex-vessel value to \$12.36 million. Chinook, sockeye and coho fell under preseason projections, while pink salmon exceeded projections by over four times.

Norton Sound

The 1988 Norton Sound commercial fishery produced a total catch of 225,000 fish. Chum salmon are the primary commercial species throughout the Sound with a catch of 108,000 fish. The 1988 chum catch was valued at \$301,000. Total value of the commercial fishery is estimated at \$755,000, below the 1981-87 average of \$786,000. This is partially because the chinook catch of 4,100 fish was the lowest on record since 1976, and well below the five year average of 10 thousand fish. It also fell below the preseason outlook of 8,000 fish. Chinook prices averaged about \$1.26 per pound, and the average chinook weighed 16.4 pounds. While the coho catch of 37,000 was slightly lower than the past ten year average of 39,000, it was well below the past five year average of 40,000 fish. Coho prices averaged \$1.15 per pound. Pink salmon exceeded the preseason outlook of 40,000 fish with a catch of 74,600.

Kotzebue

The chum salmon catch of 353,000 far surpassed last year's poor catch of only 110,000 fish, and was just below the 1981-87 average of 355,000. Chum salmon averaged \$0.85 per pound. With an ex-vessel value of \$2.58 million, it was the second highest ex-vessel value on record, surpassed only by the 1981 value of \$3.25 million. That year 678,000 fish were harvested, compared to this season's total of 353,000.

Westward Region

Kodiak

The 1988 total harvest was 19.0 million fish. The catch was comprised of about 22,000 chinook, 2.7 million sockeye, 303,000 coho, 14.6 million pinks, and 1.4 million chum salmon. Escapement goals were achieved for all major sockeye systems for both early and late runs. Overall, pink and chum escapements were good to excellent. Chinook salmon escapements into Karluk and Red Rivers were some of the highest on record. Coho escapements are fair to good with at least minimum escapement goals met in major systems. Preliminary harvest estimates indicate all pre-season harvest estimates were met or exceeded resulting in a near record harvest for all species combined. Because of the excellent prices fishermen received for all species, the estimated ex-vessel value of \$94.4 million is twice the previous record for dollar value to the fishermen. Approximately 330 purse seiners, 175 set net and 20 beach seine permit holders participated in this year's fishery. Sixteen different processors/buyers were active in the Kodiak management area this year.

Chignik

The 1988 commercial salmon harvest for the Chignik area was 4.4 million fish. Pink salmon comprised about 67% of this total, with a record catch of 3.0 million fish. This was an unusual year for the Chignik Management Area. Total economic value of the fisheries may be record setting at \$30.04 million, however the fisheries were focused on outside districts rather than the traditional Chignik Lagoon waters. The fishery opened on June 30, later than normal for this area. Escapement goals for the month of June were finally met for Black Lake, justifying this opening for surplus early run sockeye. The second run was late, and resulted in Lagoon closures. The pre-season projected harvest was for about 1.57 million sockeye. The total sockeye harvest was estimated at 796,000 fish, less than half that seen in 1987, and the lowest seen since 1975.

Coho salmon harvest was record setting at 370,400 fish, surpassing the old record set in 1982 by nearly 50,000 fish. With ex-vessel prices at \$1.45, the value of this fishery was also a record at \$4.1 million.

Alaska Peninsula and Aleutians

The South Unimak and Shumagin Islands (False Pass) June fishery produced a total harvest of 760,000 sockeye and 513,000 chum salmon. High chum to sockeye ratios plagued the fisheries' ability to harvest its sockeye allocation, and the South Unimak fishery fell almost 800,000 fish short. The fishery terminated on June 27 when the 500,000 chum cap was reached. The chum percentage at South Unimak approximated that of sockeye for the entire month. Total sockeye catch reached 2.9 million fish. Had the chum cap not been in place during the June fishery, the additional catch of sockeye would have placed it at the previous 10 year average of 3.75 million. The total chum salmon catch of 2.27 million exceeded the 1978-87 average of 1.89 million fish.

The 1988 Alaska Peninsula-Aleutian Island chinook salmon catch was 28,000 fish.

The pink salmon catch was 6.56 million as compared to the previous 10 year average of 6.4 million.

Escapements of all species was good to excellent in the majority indexed total pink salmon escapement of 2.9 million is the second best since 1962.

**PRELIMINARY FORECASTS OF 1989 SALMON RETURNS TO
SELECTED ALASKA FISHERIES**

The Alaska Department of Fish and Game's 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. For the 1989 fishing year, 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

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. A range of return possibilities 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.

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

Southeast Alaska Pink Salmon

The total Southeast pink salmon return is expected to be 31.4 million fish, with a harvest forecast to be 19.5 million salmon (Table 8). A return of 19.8 million pink salmon is expected in the southern areas of Southeast Alaska. The harvest in the southern areas is expected to be 13.8 million pink salmon, yet 3 million salmon over the escapement goal of 6.0 million are expected to be needed to assure a good distribution of spawners in all systems. The northern areas of Southeast Alaska are forecast to produce a run of 11.6 million pink salmon with a harvest of 7.0 million salmon. Hatchery

Table 8. Preliminary forecasts of salmon returns and commercial and hatchery cost recovery harvests of some Alaskan fisheries in 1989.¹

Area	Species	----- (millions of fish) -----			
		Forecast Return	Escapement Goal	Forecast Harvest	Forecast Return Range
Southern Southeast	pinks	19.8	6.0	13.8	11.8 - 32.9
Northern Southeast	pinks	11.6	4.6	7.0	7.3 - 13.7
Southeast Total		31.4	10.6	20.8	22.7 - 39.8
Prince William Sound	pinks	48.2	2.24	46.0	34.98 - 66.79
	chums	1.49	0.35	1.14	0.81 - 2.169
PWS Coghill District	sockeye	0.398	0.054	0.344	0.173 - 0.623
Copper River	sockeye	1.730	0.762	0.968	1.512 - 1.956
	chinook	0.057	0.015	0.042	0.047 - 0.067
Upper Cook Inlet	sockeye	4.0	1.5	2.5	3.0 - 5.0
Kodiak	pinks	12.75	2.15	10.60	10.80 - 17.10
Upper Station, Early	sockeye	0.134	0.062	0.072	0.080 - 0.189
Upper Station, Late	sockeye	0.929	0.150	0.779	0.366 - 1.492
Kodiak, Frazer	sockeye	0.537	0.170	0.367	0.302 - 0.910
Chignik ²	sockeye	2.10	0.65	1.45	1.68 - 2.52
Bristol Bay ³	sockeye	30.3	12.7	16.1	20.7 - 40.1
Bristol Bay, Nushagak District	chinook	0.1286	0.075	0.0536	0.058 - 0.199
TOTAL		134	31	101	

¹ Compiled January 1989. Based on past experience, less than half of the salmon returns and harvests will fall within their production and harvest ranges.

² Includes estimated interception of Chignik bound sockeye salmon.

³ Bristol Bay harvest forecast is for inshore harvest only. An additional 1.5 million sockeye salmon are forecast to be harvested in the South Peninsula.

production is expected to be less than 2 million in all of the Southeast area.

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

The 1989 pink salmon run in the Sound is forecast to be 48.2 million fish, with a projected common property harvest of 41.1 million salmon. This is approximately 1.6 times the largest harvest in the historical record. That historical high was in 1987 when the hatchery cost recovery, and common property harvest was slightly over 29 million pink salmon. The 1989 projection is held up by the projection of a combined hatchery return of 28.1 million pink salmon, and a forecast of a near record wild stock harvest. The chum salmon run is forecast to be 1.49 million fish, with an expected harvest of 1.15 million. The Coghill District sockeye salmon run is expected to be 154 thousand fish, with an expected common property harvest of 82 thousand fish.

Upper Cook Inlet Sockeye Salmon

A harvest of 2.5 million sockeye salmon is forecast from fish of Upper Cook Inlet origin. The total run is forecast to be 4.0 million. This forecast is down considerably from the high catches of the previous two years.

Kodiak Pink and Sockeye Salmon

The forecast for Kodiak pink salmon is a return of 12.75 million fish in 1989, with a projected harvest of 10.60 million fish. This is down slightly from the 1988 catch of 14.6 million pink salmon. The Upper Station lakes are forecast to produce an early run of 134 thousand sockeye salmon, with an expected harvest of 71.5 thousand fish, and a late run of 929 thousand sockeye salmon with a harvest of 779 thousand fish. Frazer Lake is forecast to produce a run of 537 thousand sockeye salmon, with an expected harvest of 367 thousand fish.

Chignik Sockeye Salmon

The return of sockeye salmon to the Chignik system is forecast to be 2.10 million sockeye salmon, with a harvest forecast to be 1.45 million. This figure represents sockeye near Chignik as well as interceptions elsewhere.

Bristol Bay Sockeye and Chinook Salmon

The return of sockeye salmon in Bristol Bay is expected to be 30.3 million fish, with an expected total harvest of 17.6 million fish, and an inshore harvest of 16.1 million fish. This forecast, if realized would mean 1989 would see a decline in harvest from recent average levels, but up slightly from the 1988 harvest. The return of Nushagak chinook salmon is forecast to

be 128.6 thousand fish, with an expected harvest of 53.6 thousand fish. This is below historical levels.

OUTLOOK FOR THE 1989 ALASKA COMMERCIAL SALMON HARVESTS

The Alaska Department of Fish and Game does not produce formal forecasts for all salmon runs in the state, although local managers do prepare harvest outlooks, or catch projections for all areas. The catch projections are based on formal forecasts, when available; otherwise historical catches and local knowledge of recent events are used to develop the harvest outlooks. Below are outlook projections for the 1989 Alaska commercial salmon harvest by species, and by statistical region, as well as by management region and in some cases by finer divisions. These are presented in Tables 9 and 10, respectively. The harvest outlooks for AYK Region are developed as ranges. A table of these ranges are found in Appendix B.1. 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, 75% of the 1988 salmon harvest came from fisheries where formal forecasts have been developed for the 1989 fishery.

The 1989 total commercial harvest projection is for 127.0 million salmon: 701 thousand chinook salmon, 29.0 million sockeye salmon, 3.97 million coho salmon, 81.9 million pink salmon, and 11.4 million chum salmon.

Species Outlook

Chinook Salmon. Production of chinook salmon is expected to increase in 1989. The expected harvest is 701 thousand chinooks, which would be the largest harvest since 805 thousand chinook salmon were harvested in 1983-- prior to the U.S./Canadian treaty. Bristol Bay and Southeast Alaska are two areas expecting increases over the 1988 harvest; although the Bristol Bay harvest is expected to be lower than chinook salmon harvests in this area in the early and mid 1980's. Much of the projected increase in Southeast Alaska is from increased hatchery cost recovery harvest -- not chinook available to the commercial fleet.

Sockeye Salmon. The 1989 harvest of sockeye salmon is expected to total 29.0 million fish. The harvest in Bristol Bay makes up nearly 60% of this projection. Bristol Bay is projected to total 16.1 million sockeye in the inshore fisheries. This is up from the 1988 harvest in Bristol Bay of 14.0 million, and down slightly from the 1984-1988 average harvest of 19.0 million sockeye salmon in Bristol Bay.

Coho Salmon. The 1989 harvest projection for coho salmon is 3.97 million fish. This number represents 3% of the projected statewide salmon harvest of all species. If realized, this will be a 6% decline from 1988 levels.

Pink Salmon. The 1989 harvest projection for pink salmon is 81.9 million fish. This number represents 65% of the total number of all salmon projected to be harvested in 1989. If realized, this will be a 65% increase over the number of pink salmon harvested in 1988. This projection reflects an enormous

Table 9. Preliminary projections of 1989 Alaska commercial salmon harvests by statistical region and species in thousands of fish.

Statistical Region	SPECIES					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southeastern	319 ¹	1,500	1,700	20,800	3,500	26,519
Central	91	9,389	1,350	61,049	3,799	75,577
Western	291	18,134	924	58	4,061	23,468
TOTAL ALASKA	701	29,023	3,974	81,906	11,360	126,964

¹ Includes 175 thousand in general common property harvest, plus 44 thousand in cost recovery and terminal area harvest.

Compiled 17 January 1989, catches in thousands of fish. The projected 1989 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections for remaining fisheries. The latter based on recent catches.

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

Table 10. Preliminary projections of 1989 Alaska commercial salmon harvests by fishing area and species in thousands of fish.

Fishing Area	SPECIES					
	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeastern	319 ¹	1,500	1,700	20,800	3,500	27,819
Cordova Area	42	1,314	440	46,000	1,149	48,945
Upper Cook Inlet	30	2,500	400	100	800	3,830
Lower Cook Inlet	1	425	10	900	130	1,466
Bristol Bay Area	90	16,100	237	0	1,440	17,867
Central Region	163	20,339	1,087	47,000	3,519	72,108
Kodiak Area	5	2,500	200	10,600	800	14,105
Chignik	3	1,150	100	448	120	1,821
South Peninsula	10	1,500	200	3,000	800	5,510
North Peninsula	20	1,900	200	5	500	2,625
Aleutian Islands	0	5	0	50	0	55
Westward Region	38	7,055	700	14,103	2,220	24,116
A.Y.K. Region	181	129	487	3	2,121	2,921
TOTAL ALASKA	701	29,023	3,974	81,906	11,360	126,964

¹ Includes 275 thousand in general common property harvest, and 44 thousand in cost recovery and special terminal area harvest.

Compiled 17 January 1989, catches in thousands of fish. The projected 1989 harvests were obtained by summing harvest forecasts (Table 8) and harvest projections for remaining fisheries. The latter based on recent catches.

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

increase in pink salmon expected to come from hatchery production in Prince William Sound. In southern Southeast Alaska the pink salmon harvest is projected to be 13.8 million pink salmon. The southern Southeast pink salmon forecast failed to predict a tremendous downturn in pink salmon production in this area for the last two years, and no reasonable explanation for the error has been discovered. Perhaps the same phenomena will occur in 1989, causing the forecast to be substantially higher than the actual catch in southern Southeast areas.

Chum Salmon. The 1989 harvest projection for chum salmon is 11.4 million fish. This number represents 9% of the projected statewide harvest of all species. If realized, this will be a 20% decline in harvest from the 1988 level.

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APPENDICES A THROUGH B
FORECAST METHODS AND DISCUSSIONS

APPENDIX A.1 SOUTHEAST ALASKA PINK SALMON

FORECAST AREA: Southeast Alaska

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF 1989 RETURN:

NATURAL PRODUCTION:

Southern Southeast:	<u>Point</u>	<u>Range</u>
Return Estimate:	19.6 million	11.8 - 32.9 million
Escapement Goal:	6.0 million ¹	
Harvest Estimate:	13.6 million	5.8 - 26.9 million

Northern Southeast:

Return Estimate:	10.5 million	7.3 - 13.7 million
Escapement Goal:	4.6 million	
Harvest Estimate:	5.9 million	2.7 - 9.1 million

SUPPLEMENTAL PRODUCTION:

Southern Southeast Return Estimate:	.17 million
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Northern Southeast Return Estimate:	1.1 million
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TOTAL SOUTHEAST PRODUCTION:

Return Estimate:	31.4 million	22.7 - 39.8 million
Escapement Goal:	10.6 million ¹	
Harvest Estimate:	19.5 million	8.1 - 26.2 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 and 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 regression analysis of 20 years of data (1967 through 1986). Variables utilized in the regression analysis include: brood year escapement index, average minimum winter air temperatures (November 1 through February 28), and the lowest average 50 day precipitation over the spawning period (July 15 through September 30).

In northern Southeast Alaska, this is the second year the forecast was prepared without the benefit of the pre-emergent fry index and again a number of approaches were tried but none were considered particularly reliable. The escapement index in northern Southeast is poorly correlated with return and therefore is probably not a good predictor variable so other models were explored. The model finally selected used escapement indices weighted by the size of the parent year adults and environmental conditions during the year of outmigration.

FORECAST DISCUSSION

Southern Southeast: The 1989 pink salmon prediction should be viewed with more than the normal degree of skepticism. The last two predictions were both extreme overestimates of the actual return (Appendix A.1, Figure 1); and a search for variable(s) to account for the overestimates was unsuccessful. Consequently, if the conditions responsible for the poor survival over the previous two years are still occurring, the 1989 prediction will again be an overestimation of the actual return. If 1987 and 1988 data are included into the regression analysis the prediction midpoint drops to 11.3 million.

The 1987 escapement index of 5.6 million was the lowest achieved in the last 7 years and less than half of that which was achieved over the previous two years. Winter temperatures were well above average; but a drought probably resulted in some increased mortality. The drought severity as measured by a 50 day moving average precipitation over the spawning period was equal to the most severe of the 20 year study period. However, the drought started later in the season than normal; with the lowest water levels occurring during the third week of September. This later timing may have reduced the droughts negative impacts because of shorter days and a lower sun angle during the latter part of September. Pre-spawn dieoffs were noted in a few streams, especially those in which a large portion of the watershed had been

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logged. The number of streams affected and severity of the dieoffs in the affected streams did not however appear as severe as that which occurred in 1977 and 1979.

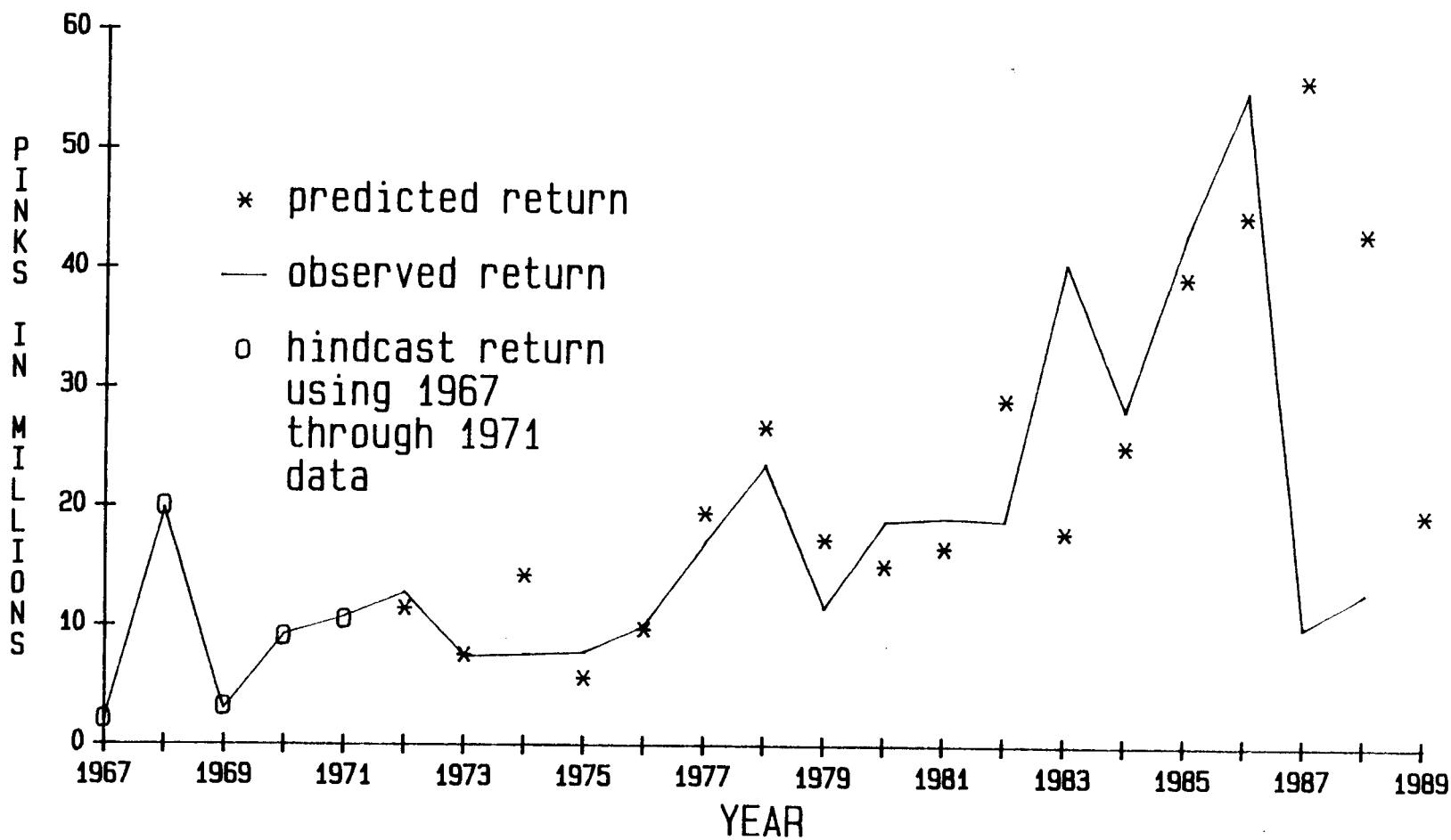
It may be prudent to conclude that the chance of the actual run being smaller than forecast is much greater than the chance of the run being larger than forecast. The reason is that no parameter was found to account for the extremely poor survival over the last two years. Consequently, if the conditions which were responsible for that poor survival are still occurring the 1989 prediction will again be an extreme overestimate of the actual return.

Northern Southeast Alaska: Returns to the northern districts are expected to be good in all districts except District 114 which had relatively poor parent year escapements. Overall parent year escapements in the rest of the northern areas were very good with an overall total of 4.2 million pink salmon.

Escapements in the parent year were very well distributed through most of the northern areas. Escapements to Districts 110 and 111 were at all time high levels and both districts met the established escapement goals in the parent year. Harvestable surpluses are expected from both districts. District 109 and 112 parent year escapements were right at or just below desired levels and both should produce harvestable surpluses. District 113 parent year escapements while below the established goal should produce some harvest with the very good overwinter and spring environmental conditions.

Karl T. Hofmeister
Fishery Biologist
Ketchikan

Doug Jones
Fishery Biologist
Juneau



Appendix A.1 Figure 1. Southern Southeast pink salmon returns and predictions using escapement index, winter temperatures, and precipitation during spawning season.

**APPENDIX A.2 PRINCE WILLIAM SOUND PINK AND CHUM SALMON
AND COGHILL RIVER SOCKEYE SALMON**

FORECAST AREA: Prince William Sound

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Total Return:	20.10 million	12.10 - 33.40 million
Escapement Goal:	1.35 million	
Harvest Estimate:	18.75 million	10.75 - 32.05 million

SUPPLEMENTAL PRODUCTION

Valdez Fisheries Development Association - Solomon Gulch Hatchery

Total Return:	6.94 million	5.63 - 8.25 million
Brood Stock:	0.20 million	
Sales Harvest:	1.16 million	
Common Property Harvest:	5.58 million	4.27 - 6.89 million

Prince William Sound Aquaculture Corporation - Armin F. Koernig Hatchery

Total Return:	5.91 million	4.79 - 7.02 million
Brood Stock:	0.19 million	
Sales Harvest:	1.48 million	
Common Property Harvest:	4.24 million	3.12 - 5.35 million

Prince William Sound Aquaculture Corporation - Esther Island Hatchery

Total Return:	10.22 million	8.38 - 12.15 million
Brood Stock:	0.29 million	
Sales Harvest:	1.48 million	
Common Property Harvest:	8.45 million	6.61 - 10.38 million

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Prince William Sound Aquaculture Corporation - Cannery Creek Hatchery

Total Return:	5.03 million	4.08 - 5.97 million
Brood Stock:	0.21 million	
Sales Harvest:	0.74 million	
Common Property Harvest:	4.08 million	3.13 - 5.02 million

TOTAL SUPPLEMENTAL PRODUCTION Point Range

Total Return:	28.20 million	22.88 - 33.39 million
Brood Stock:	0.89 million	
Sales Harvest:	4.86 million	
Common Property Harvest:	22.35 million	17.13 - 27.64 million

COMBINED NATURAL AND SUPPLEMENTAL PRODUCTION

Total Return:	48.20 million	34.98 - 66.79 million
Natural Escapement Goal:	1.35 million	
Brood Stock:	0.89 million	
Sales Harvest:	4.86 million	
Common Property Harvest:	41.10 million	27.88 - 59.69 million

FORECAST METHODS:

The forecast for natural returns is based on a multiple regression of log transformed pre-emergent fry indices and mean March/April air temperatures versus log transformed total returns. The harvest range is the 80% confidence interval around the regression.

Prior to the 1986/87 coded wire tag program there was no means for making a formal quantitative estimate of hatchery returns to Prince William Sound. Consequently, though fry releases are enumerated, the actual mean marine survival and an associated variance are unknown. The forecast for hatchery returns for 1988 is based on an assumed average

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marine survival of 5.3% for approximately 530 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. The lower and upper bounds of the forecast for hatchery returns are arbitrarily based on likely low and high marine survival rates of 4.3% and 6.3%, respectively. The projected brood stock needs for each facility are fairly accurate. The sales harvest numbers may vary depending on the final value for the 1988 sales harvests, the revenues generated for PNP's from the 2% assessment on area salmon harvests for 1988, and the projected prices for 1989. The escapement, brood stock, and sales harvest requirements are treated as constants and the confidence interval for the common property harvest is the same as for the total return.

FORECAST DISCUSSION:

The forecasted returns of 20.1 million of wild stock pink salmon in 1989 is the largest forecast on record and if it materializes will rival the previous high wild stock return of 20.4 million in 1984. The large forecast is driven in large part by the 1988 pre-emergent fry index which was the largest ever recorded in Prince William Sound. Because the index exceeded the bounds of available data the projection based on a regression violates some basic assumptions. Nevertheless, the climatic conditions prior to the emergence of fry in 1988 were mild and there is no question that huge numbers of fry outmigrated. Not a single fry dig transect was frozen over or snow covered and indices were uniformly high throughout the Sound. Because the late winter and spring conditions were so mild fry may have emerged earlier than normal. Conversely, the spring plankton bloom appears to have been delayed. Area aquaculture associations held and fed fry for 10 to 14 days longer than anticipated because of this delay in zooplankton production. It is possible that early emergence coupled with the delayed zooplankton production may have resulted in poor early marine survival of outmigrating wild stock fry. Because of concerns about the validity of using out of range data in the forecast regression and concerns about their early marine survival, the lower end of the forecast for wild stocks may be the most reasonable projection.

The point estimate of 28.1 million fish returning to hatcheries in 1989 exceeds any previous estimate for hatchery returns by almost 10 million fish. The forecast is based on the largest fry release to date and an average marine survival of 5.3% which may be a conservative figure. Hatchery fry are fed and held until natural zooplankton food resources are plentiful and the hatchery stocks appear to have good early marine survival even in years when wild stocks do not.

Sam Sharr
Research Project Leader
Cordova

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FORECAST AREA: Prince William Sound

SPECIES: Chum Salmon

PRELIMINARY FORECAST OF 1989 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Total Return:	792,000	182,000 - 1,402,000
Escapement Goal:	225,500	
Harvest Estimate:	541,600	0 - 1,176,500

SUPPLEMENTAL PRODUCTION

Valdez Fisheries Development Association - Solomon Gulch Hatchery

Total Return:	46,500	41,800 - 51,100
Brood Stock:	15,000	
Common Property Harvest:	31,500	26,800 - 36,100

Prince William Sound Aquaculture Corporation - Armin F. Koernig Hatchery

Total Return:	80,300	72,200 - 88,300
Brood Stock:	none	
Common Property Harvest:	80,300	72,200 - 88,300

Prince William Sound Aquaculture Corporation - Esther Island Hatchery

Total Return:	326,500	295,800 - 359,100
Brood Stock:	100,000	
Common Property Harvest:	226,500	193,800 - 259,100

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Alaska Department of Fish and Game F.R.E.D. Division - Main Bay Hatchery

Total Return:	224,800	220,300 - 269,300
Brood Stock:	none	
Common Property Harvest:	224,800	220,300 - 269,300

TOTAL SUPPLEMENTAL PRODUCTION

	<u>Point</u>	<u>Range</u>
Total Return:	698,100	628,100 - 767,800
Brood Stock:	115,000	
Common Property Harvest:	583,100	513,100 - 652,800

COMBINED NATURAL AND SUPPLEMENTAL PRODUCTION

Total Return:	1,490,100	810,100 - 2,169,800
Natural Escapement Goal:	225,500	
Brood Stock:	115,000	
Common Property Harvest:	1,149,600	513,100 - 1,829,300

FORECAST METHODS:

The natural stock forecast is the pooled results of three separate regressions in which the returns of 3, 4, and 5 year old fish are predicted from pink returns from the same brood year. To calculate an 80% confidence interval the returns for years 1974 through 1988 were predicted by hindcasting with these same models.

The hatchery returns for 1988 are projected from fry releases in 1984, 1985, and 1986, an assumed marine survival of 2%, and average age composition data for natural chum returns from brood years 1978 through 1982. The marine survival rate is, once again, simply a best guess and the range for the forecasted returns is based upon likely low and high marine survival rates of 1.8% and 2.2%, respectively.

FORECAST DISCUSSION:

The forecast for natural chum returns in 1989 is 86% of the 1970 to 1988 average. The regression between sibling age groups which have been used in some prior years to forecast explain less of the variability in returns than the models used in the 1989 forecast but they corroborate the lower than average prediction for 1989.

Despite the lower than average forecast for natural stocks, the overall harvest of chums in 1989 should exceed the 1970 - 1988 average by 330,000 fish because of close to full production levels from the area hatcheries. The Main Bay hatchery which previously produced chum salmon is no longer doing so but large fry releases at that facility in 1985 and 1986 will produce 1989 returns of approximately 245,000 fish. In the absence of brood stock requirements, these returns can be fully exploited. The Esther Island facility will also have large returns of which 226,000 fish will be available for harvest in the common property fisheries.

Sam Sharr
Research Project Leader
Cordova

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FORECAST AREA: Prince William Sound/Coghill District

SPECIES: Sockeye Salmon

PRELIMINARY HARVEST OF THE 1989 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Total Return:	398,000	173,000 - 623,000
Escapement Goal:	50,000	
Brood Stock:	4,500	
Harvest Estimate:	343,500	123,000 - 573,000

FORECAST METHODS:

The forecast is the pooled results of 4 separate regressions. The returns of four 4 year old fish aged 1.2 are predicted from a regression of the brood year escapement versus the log of the return per spawner. The returns of 5 year old fish aged 1.3 are predicted from a sibling model using returns of fish aged 1.2 from the prior year. The mean return at age is used to predict 5 year old fish aged 2.2. The returns of 6 year old fish aged 2.3 are predicted from a regression of the siblings age 2.2 returning in the previous year. Although catch and escapement at age data exist for the Coghill sockeye returns from as far back as 1962, escapement data prior to the installation of the full weir in 1974 are unreliable. Escapement and catch at age data in the regressions are from 1974 to the present. To calculate an 80% confidence interval the returns for years 1979 through 1988 were predicted by hindcasting with these same models. Because the number of years of data were limited a jackknife procedure was used in preference to the 1989 standard hindcasting procedure in which data in years subsequent to the one being forecast are omitted.

FORECAST DISCUSSION:

The forecasted returns of Coghill Lake sockeye salmon in 1989 are almost 100,000 fish greater than the recent 15-year average. If this above average return materializes, the commercial harvest will be the fifth largest in the history of the fishery. The favorable forecast is based on the above average returns of 4 year old fish from the 1984 brood year in the otherwise poor returns in 1988. This evidence of good production from the 1984 brood year is indicative of a strong return of 5 year old fish in 1989. Five year old fish are historically more than 70% of the returns to the Coghill system.

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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 A.3 PRINCE WILLIAM SOUND/COPPER RIVER SOCKEYE AND CHINOOK SALMON

FORECAST AREA: Prince William Sound/Copper River

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF 1989 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	1.52 million	1.34 - 1.70 million
Escapement Goal:	.68 million	
Harvest Estimate:	.84 million	.75 - .94 million

SUPPLEMENTAL PRODUCTION

Gulkana Hatchery

Return Estimate:	.21 million	.17 - .25 million
Brood Stock and Stream Escapement:	84.6 thousand	
Harvest Estimate:	.13 million	.10 - .15 million

TOTAL PRODUCTION

Return Estimate:	1.73 million	1.51 - 1.96 million
Escapement and Brood Stock:	.76 million	
Harvest Estimate:	.97 million	.85 - 1.09 million

FORECAST METHODS:

Natural Production: The 1989 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 1989 predicted return is influenced heavily by the 1984 brood year for the Copper River Delta and the Upper Copper River.

Supplemental Production: The 1989 supplemental return will be the result of production from Gulkana hatchery. Brood years 1984 and 1985 using F.R.E.D. Division standard survival assumptions should produce an

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adult return of 211,500. A harvest level of 60% would contribute 126,900 salmon to the commercial catch.

FORECAST DISCUSSION:

Natural Production: There were mild winter conditions on the Copper River Delta during the freshwater life history stages of the age groups represented in the 1989 return. Upper Copper River escapements were above average in all three years parent years, thus generally mild conditions and good distribution should yield near average returns. The parent year escapement is one of the highest in the available data base thus few similar prediction points are available. The forecast will error on the high side if environmental conditions continue to produce above average survival rates; however, high fry densities may significantly reduce the return per spawner.

Supplemental Production: Facility production data and conditions suggest that a wide variation in survival from the expected could significantly alter the 1989 total sockeye return; however, as future years data is collected, predictions will become more reliable.

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FORECAST AREA: Prince William Sound/Copper River

SPECIES: Chinook Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Return Estimate:	57.1 thousand	47.4 - 66.8 thousand
Escapement Goal:	15.0 thousand	
Harvest Estimate:	42.1 thousand	34.1 - 50.1 thousand

FORECAST METHODS:

The 1989 chinook salmon forecast utilized historical aerial index and age composition data from the 4-, 5-, 6- and 7-year-old age classes. Weighted index figures are combined to create a single index of abundance figure which for lack of a better data base is compared to the historical average escapement index. The expected return is then a return per spawner calculation which does not consider relative density, climate conditions or distribution of spawners.

FORECAST METHODS:

During the past six years, chinook salmon returns to the Copper River have been consistently above average and have established several of the top catches on record while escapements have also been maintained at high levels. Only a failure of the 1983 or 1984 brood year could seriously affect the forecasted return. No climate condition or other event is believed to have impacted any of the brood years involved. A chinook salmon harvest of the 42,100 fish magnitude appears to be a solid estimate.

Kenneth Roberson
Research Biologist
Glennallen

APPENDIX A.4 UPPER COOK INLET SOCKEYE SALMON

FORECAST AREA: Upper Cook Inlet

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST FOR 1989 RETURN:

	<u>Point</u>	<u>Range</u>
Return Estimate:	4.0 Million	3.0 - 5.0 Million
Escapement Goal:	1.5 Million	
Harvest Estimate:	2.5 Million	1.5 - 3.5 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. In addition, sockeye salmon smolt data for the Kasilof River and Fish Creek were factored into the forecast.

FORECAST DISCUSSION:

The total return of sockeye salmon to Upper Cook Inlet is estimated to be 4.0 million fish in 1989. Desired escapement levels to Upper Cook Inlet river systems total 1.5 million fish and provide an anticipated harvestable surplus of 2.5 million fish. Estimated returns to the Kenai River are 2.0 million fish, to the Kasilof River are 0.75 million fish, to the Susitna River are 0.7 million fish, and to Fish Creek are 0.25 million fish.

In 1988, the total return of sockeye salmon to Upper Cook Inlet was forecasted at 6.8 million fish with a projected harvest of 5.3 million fish. The actual return was approximately 8.3 million fish with a harvest of 6.7 million sockeye salmon. As noted in the 1988 forecast, the potential for a larger harvest and return than forecasted for Kenai

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River sockeye salmon existed and this proved true in 1988. Preliminary data indicated that the Kenai River return was 5.9 million sockeye salmon which was 0.9 million fish above forecast. Unfortunately, the trend of greater Kenai River sockeye salmon returns than forecasted is unlikely to continue in 1989. A lower number of spawners in the system combined with a relatively poor distribution of those spawners form the basis for this conclusion.

The return to the Kasilof River in both 1987 and 1988 has been close to the forecasted return (using adult spawner/return ratios) but below expectations based on the number of smolt leaving the system. The forecasted return for 1989 has combined both smolt data and spawner information to make the forecast. Approximately 4.0 million smolt were produced from the 1985 brood year of these only slightly more than 1.0 million fish were age 1. Therefore, using standard marine survival data and age composition information for the Kasilof River, the return of four year-old fish in 1989 to the Kasilof River is expected to be very poor (less than 50 thousand fish). The lower sockeye salmon smolt production from both the 1985 and 1986 brood years (approximately 2.0 million age 1 smolt) for the Kasilof River would indicate a strong potential for smaller returns in both 1990 and 1991.

Ken Tarbox
Research Project Leader
Upper Cook Inlet

APPENDIX A.5 KODIAK PINK SALMON

FORECAST AREA: Kodiak

SPECIES: Pink Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN¹:

NATURAL PRODUCTION	<u>Point</u>	<u>Range</u>
Total Return:	10.4 million	9.6 - 11.2 million
Escapement Goal:	2.0 million	
Harvest Estimate:	8.4 million	7.6 - 9.2 million
SUPPLEMENTAL PRODUCTION		
Total Return:	2.35 million	
Brood Stock Needs:	.15 million	
Sales Harvest:	.10 million	
Common Property Harvest:	2.10 million	.95 - 5.65 million
TOTAL AREA PRODUCTION		
Total Return:	12.75 million	10.80 - 17.10 million
Escapement Goal:	2.15 million	
Harvest Estimate:	10.60 million	8.65 - 14.95 million

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

FORECAST METHODS:

The 1989 pink salmon forecast return to the Kodiak Management Area was determined as follows: A point estimate for the total management area natural return was calculated from a linear least squares regression analysis of the past 23 years pre-emergent fry data. Variables used in the analysis were the indexed live fry densities and the average combined departure from the norm of the March-April ambient air temperatures taken in Kodiak. The upper and lower ranges are the 80% confidence intervals.

FORECAST DISCUSSION:

Pre-emergent fry sampling this spring (1988) indicated poor to excellent overwinter survival from the excellent brood year escapements of 2.7 million pink salmon. Sampling resulted in an unweighted live fry index of 204.3 live fry/m². This fry index is one of the highest on record for an odd year return.

Sixty percent of the spawners entered the pre-emergent index streams. Sampling conditions during March and April (1988) were generally very good on Kodiak and Afognak Islands. Sampling on the Mainland was limited once again by severe weather conditions and length of helicopter contract. The close to normal spring conditions in 1988 combined with the overall excellent live fry densities are the main reasons for the above average forecast for the 1989 return.

A breakdown of the expected return 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 is below average. A total of 500,000 pink salmon are expected to return. The desired escapement level is 150,000 pink leaving 350,000 pink available for harvesting.

Afognak District Supplemental Production: The Kitoi Bay Hatchery total return point estimate is 2.35 million pink salmon from a release of 11 million emergent fry and 83 million reared pink fry. Approximately 150,000 pink salmon are required for escapement and brood stock and an estimated 100,000 are necessary for cost recovery needs leaving 2.1 million pinks available for harvesting.

Westside District: Overall, live fry densities for this district are some of the best on record. Some scouring was evident on all streams sampled, however, Uganik River suffered the worst. Approximately 3.5 million pink salmon are expected to return to this district. The desired

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escapement goal is 400,000 pinks leaving 3.1 million pink salmon available for harvesting.

Alitak District: Live fry densities for this district were excellent. Scouring was evident at lower Dog Salmon and portions of Deadman River. As a result of the excellent live fry densities 2.5 million pink salmon are expected to return to this district. The desired escapement goal is 400,000 pinks leaving 2.1 million pink salmon available for harvesting.

General District: The overall live fry densities for this district are average. Warm low water conditions at Seven Rivers during the early spawning period appeared to be the main reason for the lower than expected fry densities. The remaining streams sampled had good to excellent fry densities. Approximately 2.5 million pink salmon are expected to return to this district. The desired escapement goal is 650,000 pinks leaving 1.85 million pink salmon available for harvesting.

Mainland District: Seven streams were sampled between Wide Bay and Kinak. Additional sampling was not completed due to weather conditions. Based on the streams sampled, brood year escapements, and the overwinter success of the fry on Kodiak Island approximately 1.4 million pinks are expected to return to this district. The desired escapement goal is 400,000 pinks leaving 1.0 million pink salmon available for harvesting.

David Prokopowich
Assistant Area Management Biologist
Kodiak Management Area

APPENDIX A.6 KODIAK UPPER STATION LAKE SOCKEYE SALMON

FORECAST AREA: Kodiak, Upper Station Lake

SPECIES: Sockeye Salmon, Early Run

PRELIMINARY FORECAST OF THE 1989 RETURN:

	<u>Point</u>	<u>Range</u>
Total Return:	134,000	79,500 - 189,200
Escapement Goal:	62,500	
Projected Harvest:	71,500	17,500 - 126,700

FORECAST METHODS:

The 1989 forecast was calculated from a series of multiple regression equations using age specific returns from the 1969 through 1985 parent-year escapements. Each major age class in the forecast was estimated by a regression equation chosen to maximize the coefficient of determination and interpreted for reasonableness.

FORECAST DISCUSSION:

The forecast of 134,000 sockeye salmon for the Upper Station early run is 51% 5-year-old fish produced from the 1984 parent escapement of 97,000 fish, 34% 4-year-old fish produced from the 1985 parent escapement of 27,000 fish, and 15% 6-year-old fish from the 1983 parent escapement of 116,000 fish. The formulas used in developing the forecast provide R-squared values ranging from 0.65 to 0.85.

This marks the second year that a formal forecast has been prepared on the early sockeye run to Upper Station. The 1988 run was approximately 124,600 which was 18% lower than the forecasted 152,000 fish. The 1989 forecast of 134,000 fish is based on an additional year of spawner-return data which should improve the reliability of the forecast model.

If the 1989 run materializes as predicted, purse seine and gill net fishermen can expect to harvest about 71,500 Upper Station early run fish in the Alitak Bay District.

Bruce M. Barrett
Research Biologist
Kodiak

Appendix A.6 (p 2 of 2)

FORECAST AREA: Kodiak, Upper Station Lake

SPECIES: Sockeye Salmon, Late Run

PRELIMINARY FORECAST OF THE 1989 RETURN:

	<u>Point</u>	<u>Range</u>
Total Run:	929,000	366,000 - 1,492,000
Escapement Goal:	150,000	
Projected Harvest:	779,000	216,000 - 1,342,000

FORECAST METHODS:

The forecast was calculated from a series of multiple regression equations using age-specific returns from the 1966 through 1986 parent-year escapements and average lengths of age 1.2 female fish in the 1973 through 1988 escapements. Each major age class in the forecast was estimated by a regression equation chosen to maximize the coefficient of determination and interpreted for reasonableness. Individual age classes were estimated using existing count data except for one case in which a forecasted value was used to forecast another age class.

FORECAST DISCUSSION:

This is the first time that a formal forecast has been prepared on the late sockeye run to the Upper Station Lakes. The forecast of 929,000 late run sockeye salmon is 8% 3-year-old fish produced from the 1986 parent escapement of 368,000 fish, 46% 4-year-old fish produced from the 1985 parent escapement of 408,000 fish, and 46% 5-year-old fish from the 1984 parent escapement of 240,000 fish.

The late sockeye run to Upper Station Lakes in 1988 was approximately 1,002,000 fish which is within 30% of the record high 1986 run of 1,393,000 fish. The 1988 escapement was about 248,000 fish. The forecast indicates that there will be about 5% less fish in 1989 than occurred in 1988 and about 35% less fish in 1989 than the record high 1986 run.

If the 1989 run forecast is correct, purse seine and gill net fishermen should harvest about 779,000 Upper Station late run fish in the Alitak Bay District.

Bruce M. Barrett
Research Biologist
Kodiak

B. Alan Johnson
Biometrician
Kodiak

APPENDIX A.7 FRAZER LAKE SOCKEYE SALMON

FORECAST AREA: Kodiak, Frazer Lake

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN:

	<u>Point</u>	<u>Range</u>
Total Run:	537,000	302,000 - 910,000
Escapement Goal:	170,000	
Projected Harvest:	367,000	132,000 - 740,000

FORECAST METHODS:

The 1989 forecast was calculated from a series of multiple regression equations using historic escapement-return relationships, smolt meristic information, and smolt age composition data. Each major age class in the forecast was estimated by a regression equation chosen to maximize the coefficient of determination. Each estimate was interpreted for reasonableness. After the first estimate was accepted, a second equation was developed with that estimate in the data base. This process was repeated until all major age classes were estimated.

FORECAST DISCUSSION:

The forecast of 537,000 sockeye salmon for the Frazer run is 80% 5-year-old fish produced from the 1984 parent escapement of 54,000 fish, 15% 6-year-old fish produced from the 1983 parent escapement of 158,000 fish, 4% 4-year-old fish produced from the 1985 parent escapement of 486,000 fish, and 1% 3-year-old fish from the 1986 parent escapement of 127,000 fish.

This is the third year that a formal forecast has been prepared on the Frazer Lake sockeye run. The 1987 run was approximately 58,000 fish which was 54% lower than the forecasted 127,000 fish. The 1988 run was approximately 456,000 fish which was 33% higher than the forecasted 343,000 fish. The 1989 forecast of 537,000 fish is based on an additional year of data which should improve the reliability of the forecast model. However, the 1989 run forecast is predominated by a single age class (80% 5-year-old fish) produced from a relatively low, 54,000 fish escapement. This tends to accentuate the likelihood that the actual 1989 run may be significantly different than the forecasted number. The forecast indicates that there will be about 21,000 4-year-old fish in the 1989 Frazer Lake run. To date all available smolt and escapement-return data indicates that the 1985 parent escapement of

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486,000 fish will produce an insignificant number of 4-year-olds in 1989, 5-year-olds in 1990, and 6-year-olds in 1991.

If the 1989 run materializes as predicted purse seine and gill net fishermen can expect to harvest about 367,000 Frazer Lake sockeye salmon in the Alitak Bay District.

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APPENDIX A.8 CHIGNIK SOCKEYE SALMON

FORECAST AREA: Chignik Management Area

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN:

<u>Early Run</u> (Black Lake Stocks)	<u>Point</u>	<u>Range</u>
Total Run:	1,150,000	0.85 - 1.45 million
Escapement Goal:	400,000	
Harvest Estimate:	750,000	

Late Run (Chignik Lake Stocks)

Total Run:	954,000	0.763 - 1.15 million
Escapement Goal:	250,000	
Harvest Estimate:	704,000	

Total Chignik

Total Run:	2,100,000	1.68 - 2.52 million
Escapement Goal:	650,000	
Harvest Estimate:	1,450,000	

FORECAST METHODS

The estimated returns to Black Lake provided above are the summation of the predicted returns of two and three ocean sockeye salmon while the Chignik Lake returns are calculated using all contributing age classes.

The Black Lake forecast is based on the historical relationship between the prior year total return of age 1.2 fish, the average length of prior year age 1.2 male fish and the parent year escapement of age 1.3 and 2.3 fish. These variables provided the framework for the multiple linear regression model used to predict the 1989 return. The Chignik Lake forecast has historically been quite variable in its accuracy and developing a model such as the one used for the first run has been unsuccessful. The forecast for 1989 was derived using an average return per spawner for each age class represented in the return.

FORECAST DISCUSSION:

Early Run. The estimated return of Black Lake sockeye salmon in 1989 is 1.15 million fish. This is approximately 320,000 fish less than the previous ten-year average return of 1.47 million. The parent year escapement in 1984 was almost 600,000 fish, 200,000 above the 400,000 first run escapement goal. Although the parent year escapement exceeded established escapement goals the total number of age 1.2 fish returning in 1988 represents only 41% of the past ten-year average. As a result the 1989 forecast is lower than the previous ten-year average.

Late Run: The estimated return of second run sockeye salmon in 1989 is 954 thousand fish, 120 thousand above the 834 thousand average from 1954 to 1988. The second run forecast has historically been quite variable when compared to actual returns. The 1983 parent year escapement of 441,000 was the second highest escapement since 1954. The average return per spawner for each contributing age class was used to forecast the return and it is anticipated that the actual return will fall within the prediction bounds.

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Chignik Area

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Chignik Area

APPENDIX A.9 BRISTOL BAY SOCKEYE SALMON

FORECAST AREA: Bristol Bay

SPECIES: Sockeye Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN:

	<u>Point</u>	<u>Range</u>
Total Return:	30.3 million	20.7 - 40.1 Million
Escapement Goal:	12.7 million	10.7 - 14.7 Million
S. Peninsula Quota:	1.5 million	
Inshore Harvest:	16.1 million	8.5 - 23.9 million

Forecasted harvests for inshore Bristol Bay fishing districts are as follows: Naknek-Kvichak, 6.8 million; Egegik, 4.6 million; Ugashik, 2.9 million; Nushagak, 1.4 million; Togiak, 0.5 million.

FORECAST METHODS:

The 1989 Bristol Bay forecast is the sum of individual predications for nine river systems (Kvichak, Branch, Naknek, Egegik, Ugashik, Wood, Igushik, Nuyakuk, and Togiak) and four age classes (age 1.2, 1.3, 2.2, and 2.3 sockeye salmon). Predictions for each age class returning to a river system were calculated by averaging results from three simple linear regression models based on the relationship between returns and either spawners, siblings, or smolt. Results from each regression model were excluded from final forecast calculations if the fit of the model was not significant at the 75% level or if the independent variable was outside the range of past data. The mean return of an age class to a specific river system was used to predict returns when none of the models could be used.

Initial calculations were made using data collected only since 1978. Justification for this was based on the observation that the number of returning adults produced from each spawner has shown a dramatic increase since 1978. It was hoped that use of only recent data would provide a more accurate estimate of total sockeye salmon returns and would help correct the past bias towards under-forecasting returns. Performance of this method in 1988 seemed to confirm this since use of recent data resulted in an 18% over-forecasting error of the total return while use of all data would have resulted in a 24% under-forecasting error. To examine this hypothesis more closely, hindcasted predictions were also made for 1984-1987. For total Bristol Bay return predictions, results indicated that use of recent data would increase

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accuracy (mean absolute percent error, 1984-1988: 14.0% using recent data, 34.1% using all data) and decrease bias (mean percent error, 1984-1988: 2.0% using recent data, -34.1% using all data). Unfortunately, for individual system return forecasts, results strongly suggested that use of recent data would decrease accuracy and increase bias. This problem was most severe when using recent data for Nushagak District system forecasts for which accuracy decreased about five-fold (e.g., Wood River, mean absolute percent error, 1984-1988: 72.2 using recent data, 15.0 using all data) and a large bias toward over-forecasting was observed (e.g., Wood River, mean percent error, 1984-1988: 184.6% using recent data, -13.5% using all data). For the 1989 forecast we have tried to balance gains and losses in total Bristol Bay and individual system forecast accuracy and bias by using all data for Nushagak District system predications and only recent data for all other system predications.

FORECAST DISCUSSION:

Based on the methods described above, 30.3 million sockeye salmon are expected to return to Bristol Bay in 1989. This return would be 10% greater than the previous 20 year mean (27.6 million; range, 3.5 - 66.3 million), but 19% less than previous 10 year mean (37.5 million; range 24.0 - 66.3 million) return.

Returns are expected to exceed spawning escapement goals for all systems. The inshore harvest is expected to be 16.1 million. This harvest would be 13% more than the previous 20 year mean (14.2 million; range, 0.7 - 37.7 million), but 26% less than the previous 10 year mean (21.7 million; range 13.9 - 37.3 million) harvest. An additional 1.5 million Bristol Bay sockeye salmon will be harvested during June in the Shumagin Islands and South Unimak fisheries under guidelines of the current Alaska Board of Fisheries management plan (8.3% of the total projected 17.6 million harvest).

Although out-of-range data were not used in calculations, they suggest how actual returns may deviate from the pre-season forecast. An extremely large number of age-II smolt migrated to sea from the Kvichak River during 1987 (about 330 million), and a large number of age-2.1 jacks returned to the Egegik River in 1988 (about 0.1 million). These data indicate that large deviations from predicted returns could occur for both the Kvichak and Egegik River systems. This could place the actual total return closer to the 40.1 million upper limit of the forecast range.

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Beverly A. Cross

Research Biologists

APPENDIX A.10 BRISTOL BAY, NUSHAGAK DISTRICT CHINOOK SALMON

FORECAST AREA: Bristol Bay, Nushagak District

SPECIES: Chinook Salmon

PRELIMINARY FORECAST OF THE 1989 RETURN:

	<u>Point</u>	<u>Range</u>
Total Run:	128,600	58 - 199 thousand
Escapement Goal:	75,000	
Projected Harvest:	53,600	0 - 124 thousand

FORECAST METHOD:

Linear regression techniques were used to estimate sibling relationships for the four major chinook salmon age groups (age-1.2 on age-1.1, age-1.3 on age-1.2, age-1.4 on age-1.3, and age-1.5 on age-1.4). Meaningful regressions were obtained for estimating ages-1.3 and -1.4, while the relationships for ages-1.2 and -1.5 were less than desired. Ages-1.2 and -1.5 were estimated using the mean return. The four age group estimates were summed to provide the total run estimate and the calculated forecast errors were jackknifed to obtain 80% confidence bounds.

FORECAST DISCUSSION:

The 1989 Nushagak District chinook salmon forecasted return of 128,600 fish is below the long term (1960-1988) and ten year (1979-1988) averages of 167,000 and 218,000, respectively. The projected harvest of 53,600 is also considerably less than the long term average of 80,000 and ten year average of 100,000 fish.

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Biometrician

APPENDIX B.1 A-Y-K HARVEST OUTLOOK BY AREA

Kuskokwim Area

With a few exceptions, projected 1989 Kuskokwim Area salmon harvests are largely based on the previous five year (1983-88) range of catches in all districts. The chinook salmon harvests in Kuskokwim Bay districts have declined in recent years. The 1989 harvest projection range of 45,000-98,000 chinook salmon for the combined Kuskokwim Bay and River fisheries is based on recent five year catches (1984-88) with the record catches made in 1983 excluded. Kuskokwim River coho salmon have displayed a strong odd-even year cycle in recent years. The 1989 projection range for the Kuskokwim Area of 240,000 to 606,000 coho salmon is based on the odd year harvests for the last ten years. The 1984 Kuskokwim Bay coho salmon harvest which was the largest on record and exceeded the recent average harvest by 40% has been excluded from the recent five year average which serves as the basis of the 1989 harvest projection. The all-time record 1988 chum salmon harvest also was not included in the development of the 1989 projection range of 212,000 to 657,000 chum salmon. The projected 1989 sockeye salmon harvest range is from 62,000-195,000.

Yukon Area

Salmon return projections for the Yukon River during the 1989 season are based on an evaluation of brood year run size and survival. Overall, the 1989 chinook salmon return is anticipated to be average in strength. The projected harvest for the 1989 season is expected to be average ranging from 90,000-110,000. Assuming average survival, it is expected that the Yukon River summer chum run for 1989 will be above average in magnitude. The commercial harvest should be similar to the 1987 harvest, ranging from 900,000 to 1,000,000. An average return of fall chum salmon is anticipated in 1989 which should allow an average (pre-1986) harvest of 145,000-320,000. The 1989 season represents the first year of returns produced under the Alaska Board of Fisheries conservation, stock rebuilding plan initiated in the 1986 season. Comprehensive escapement information for coho salmon is generally lacking for the Yukon area. During 1985, escapement surveys in the Tanana River, a major spawning tributary, indicated average run strength; therefore, an average harvest of 50,000-90,000 is expected.

Norton Sound

Return and harvest projections for the 1989 Norton Sound commercial fisheries are based largely on qualitative assessments of brood year return strength and subjective determinations of survival of eggs and juvenile fish. The chinook salmon escapements for primary parent years were average and assuming relatively normal survival should produce an average return and

harvest ranging from 8,000-10,000. Pink salmon have developed a cycle of weak returns during odd years due to a series of poor escapement during parent years. Consequently, pink salmon returns and harvests are projected to be below average (0-5,000) for 1989. Brood years for the 1989 chum salmon return were below average runs, but during 1985 minimal escapement goals were met. Therefore, the 1989 return and harvest is projected to be slightly below average ranging from 120,000-180,000. The 1989 coho return will be produced by the 1985 brood year which produced below average catch and escapement. Below average return and escapement are projected for 1989. A catch of 15,000-30,000 coho salmon is projected.

Kotzebue Sound Area

The outlook for the 1989 Kotzebue chum salmon return and harvest has a broad range due to conflicting run strength indicators. The cycle that has developed over several generations would suggest a strong return. However, a projection for the 1989 commercial season based on an assessment of relationships among year classes in the 1988 return suggests a below average return and harvest; therefore, a very broad range of harvests has been projected (200,000-500,000).

Appendix Table B.1. Preliminary projections of the 1989 A-Y-K commercial salmon harvest in thousands of fish by management area and species.

Management Area	Species					
	Chinook	Sockeye	Coho	Pink	Chum	Fall Chum
Kuskokwim Area						
Kuskokwim River	19-56	49-137	196-399	0	199-574	
Kuskokwim Bay	26-42	13- 58	46-207	0	13- 83	
Total	45-98	62-195	240-606	0	212-657	
Yukon Area	90-110	0	50- 90	0	900-1,000 ¹	145-320
Norton Sound Area	8- 10	0	15- 30	0-5	120-180	
Kotzebue Area		0	0	0	200-500	
A-Y-K Total	143-218	62-195	305-726	0-5	1,432-2,337	138-330

¹ In addition, a projected harvest of 250,000 pounds of chum salmon roe is anticipated.

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