Special Publication 16-07

Run Forecasts and Harvest Projections for 2016 Alaska Salmon Fisheries and Review of the 2015 Season

Edited by

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and

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March 2016

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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RUN FORECASTS AND HARVEST PROJECTIONS FOR 2016 ALASKA SALMON FISHERIES AND REVIEW OF THE 2015 SEASON

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The Special Publication series was established by the Division of Sport Fish in 1991 for the publication of techniques and procedures manuals, informational pamphlets, special subject reports to decision-making bodies, symposia and workshop proceedings, application software documentation, in-house lectures, and became a joint divisional series in 2004 with the Division of Commercial Fisheries. Special Publications are intended for fishery and other technical professionals. Special Publications are available through the Alaska State Library, Alaska Resources Library and Information Services (ARLIS) and on the Internet: http://www.adfg.alaska.gov/sf/publications/. This publication has undergone editorial and peer review.

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DEFINITION OF TERMS

Biological escapement goal	The number of salmon in a particular stock that the Alaska Department of Fish and Game has determined should be allowed to escape the fishery to spawn to achieve the maximum yield (human use). This determination is based on biological information about the fish stock in question. (Also see: optimum escapement goal.)
Commercial harvest	Harvests of fish that are used for commercial purposes. This includes fish caught by the commercial common property fishery (see below) and by hatchery operators for cost recovery; it excludes sport, subsistence, and personal use harvests.
Commercial common property harvest	Harvests taken by traditional, competitive commercial fisheries (gillnet, purse seine, and troll), as opposed to commercial harvests resulting from hatchery cost recovery, fishing derbies, and sale of confiscated fish.
Common property harvest	Harvests taken by the commercial common property fisheries (see above), as well as the sport, subsistence, and personal use fisheries. This category excludes hatchery cost-recovery harvests.
Cost-recovery harvest	Harvests of salmon by hatchery operators in specially designated areas to fund the operation of hatcheries and other enhancement activities.
Enhancement of runs	Hatcheries and other means of artificial propagation to create salmon runs or make existing salmon runs larger. Enhancement includes remote fish stocking, fertilization of lakes, and other techniques.
Escapement, spawning population, or broodstock	The portion of a salmon run that is not harvested and survives to reach the spawning grounds or hatchery.
Harvest projections or harvest outlooks	Harvest outlooks are the best available estimates of upcoming harvest levels. Prepared by local biologists, outlooks are based on formal run forecasts, when available. At other times outlooks are based on historical average catches, subjectively adjusted based on recent trends and local knowledge.
Optimum escapement goal	The number of salmon in a particular stock that should be allowed to spawn to achieve sustainable runs based on biological needs of the stock, as well as consideration of social and allocative needs.
Run forecast	Forecasts of a run (harvest + escapement) are estimates of the fish that will return in a given year based on such information as parent-year escapements, subsequent fry abundance, and spring seawater temperatures. Run forecasts are generally thought to be more reliable than harvest outlooks, but run forecasts are provided only for selected areas.
Salmon run	Run refers to the total number of mature fish returning in a given year from ocean-rearing areas to spawn.
Sustainable escapement goal	Sustainable escapement goal (SEG) is defined as a level of escapement, indicated by an index or a range of escapement estimates that is known to have provided for sustained yield over a 5- to 10-year period. An SEG is used in situations where a BEG cannot be estimated due to the absence of a stock-specific catch estimate.
Return	Return refers to an aggregation of salmon over several or more years that represent the surviving adult offspring from a single brood year.

NAMES FOR ALASKA'S PACIFIC SALMON SPECIES

Common Name	Vernacular Name	Scientific Name
Chinook	king	*Oncorhynchus tshawytscha*
sockeye	red	*Oncorhynchus nerka*
coho	silver	*Oncorhynchus kisutch*
pink	humpy, humpback	*Oncorhynchus gorbuscha*
chum	dog	*Oncorhynchus keta*

ABSTRACT

This report contains a detailed review of Alaska's 2015 commercial salmon season and forecasts for 2016. The Alaska all-species salmon harvest for 2015 totaled 268.3 million, which was about 47.5 million more than the preseason forecast of 220.8 million. This combined harvest was composed of 521,612 Chinook salmon *Oncorhynchus tshawytscha*, 55 million sockeye salmon *O. nerka*, 3.8 million coho salmon *O. kisutch*, 190.5 million pink salmon *O. gorbuscha*, and 18.2 million chum salmon *O. keta*. The Alaska Department of Fish and Game is expecting a decrease in commercial salmon harvests in 2016, mostly due to a drop in pink salmon harvests compared to 2015. The 2016 total commercial salmon catch (all species) projection of 161 million is expected to include 99,000 Chinook salmon in areas outside Southeast Alaska, 47.7 million sockeye salmon, 4.4 million coho salmon, 90.1 million pink salmon, and 18.7 million chum salmon. Thus, compared to 2015 commercial harvests, the projected 2016 commercial harvests are expected to be as follows: pink salmon, 100 million less; sockeye salmon, 7.3 million less; coho salmon, 556,000 more; and chum salmon, 475,000 more.

When the appropriate data were available, harvest forecasts were arrived at through quantitative projections based on information on previous spawning levels, smolt outmigrations, returns of sibling age classes, and recent survival rates observed for hatchery releases. Other projections were based on averages of recent catch levels. Fishing effort influences average catch levels, and effort is partly determined by market conditions in addition to the size of salmon runs. Therefore these projections may not be indicative of actual harvest levels.

Key words: pink salmon, *Oncorhynchus gorbuscha*, sockeye salmon, *O. nerka*, chum salmon, *O. keta*, Chinook salmon, *O. tshawytscha*, coho salmon, *O. kisutch*, catch projection, run forecast, harvest projection, smolt outmigrations, sibling age classes, hatchery releases, fishing effort, salmon management

INTRODUCTION

This report contains salmon run forecasts and harvest projections for 2016 as well as a detailed review of Alaska's 2015 commercial salmon season. Salmon escapement and harvest estimates reported in this document were summarized from the Alaska Department of Fish and Game (ADF&G) escapement and fish ticket databases. Data provided in this report are preliminary and supersede any data previously published.

ADF&G is expecting a decrease in commercial salmon harvests in 2016, mostly due to the projected decrease in pink salmon harvests compared to 2015. The 2016 total commercial salmon catch (all species) projection of 161 million is expected to include 99,000 Chinook salmon in areas outside Southeast Alaska, 47.7 million sockeye salmon, 4.4 million coho salmon, 90.1 million pink salmon, and 18.7 million chum salmon. The projected pink salmon harvest is about 100 million fewer than harvested in 2015 (190.5 million); the sockeye salmon harvest is expected to be about 7.3 million fewer than were harvested in 2015; the coho salmon harvest is expected to be about 556,000 more than were harvested in 2015; and the chum salmon harvest is expected to be about 475,000 more than were harvested in 2015.

Table 1 shows specific harvest projection numbers by species and fishing area. These projections reflect potential harvests for most of the major sockeye salmon fisheries as well as for large hatchery runs, including pink, sockeye, and chum salmon to the Southeast Alaska, Kodiak, and Prince William Sound areas. Fishing effort influences average catch levels, and effort is partly determined by market conditions and the size of salmon runs. Therefore these projections may not be indicative of potential harvest levels. With the exception of the Southeast Alaska Chinook salmon fisheries and the South Peninsula June fisheries, Alaska salmon management will be based on inseason estimates of salmon run strength. Alaska managers have the primary goal of maintaining spawning population sizes—not of reaching preseason catch projections.

Table 1.–Projections of 2016 Alaska commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Alaska						
Natural Production		1,273	2,831	34,000	2,270	40,373
Hatchery Production[a]					9,079	9,079
Southeast Region Total	[b]	1,273[c]	2,831[c]	34,000	11,349	49,452
Prince William Sound						
Natural Production	21	1,636[d]	236[e]	3,840	226	5,959
Hatchery Production[f]		1,761	30	19,599	2,874	24,263
Upper Cook Inlet	7[c]	4,100	160[c]	393[c]	184[c]	4,844
Lower Cook Inlet						
Natural Production	0[c]	56[c]	2	324	66[c]	448
Hatchery Production		256[g]		149		405
Bristol Bay	29[c]	29,520	118 [c]	796[h]	762[c]	31,224
Central Region Total	57	37,329	546	25,101	4,111	67,143
Kodiak						
Natural Production	17[c]	3,296[i]	217[c]	11,900[j]	571[c]	16,001
Hatchery Production		396[k]	116	4,300[g]	74	4,886
Chignik	6[c]	1,767[l]	71[c]	849[c]	150[c]	2,844
South Peninsula & Aleutians	16[c]	2,158[c]	219[c]	13,394[m]	742[c]	16,529
North Alaska Peninsula	1[c]	1,421[n]	50[c]	28[h]	206[c]	1,706
Westward Region Total	41	9,038	673	30,471	1,743	41,966
Arctic-Yukon-Kuskokwim Region Total	2	94	365	575	1,480	2,516
Statewide Total	99	47,733	4,415	90,146	18,683	161,077

Note: Columns and rows may not total exactly due to rounding.

[a] Hatchery projections made by Southern Southeast Regional Aquaculture Association, Northern Southeast Regional Aquaculture Association, Douglas Island Pink and Chum, Armstrong-Keta, Inc., Kake Nonprofit Fishereis Corporation, and Metlakatla Indian Community less broodstock (500,000). Wild chum salmon catch estimated as 20% of total catch.

[b] Southeast Chinook treaty forecast not available. The allowable catch of Chinook salmon in Southeast Alaska is determined by the Pacific Salmon Commission, which has not published the quota for 2016. Release of the 2016 Chinook salmon quota for Southeast Alaska is expected in late March or early April.

[c] Average harvest of the previous 5 years (2011–2015).

[d] Includes harvest estimates for Coghill and Eshamy lakes, Unakwik District, and Copper River sockeye salmon.

[e] Five-year average harvest (2011–2015) in the Copper River and Bering River districts.

[f] Hatchery projections made by Prince William Sound Aquaculture Corporation and Valdez Fisheries Development Association. Gulkana Hatchery projection made by ADF&G.

[g] Includes common property plus cost-recovery harvests.

[h] Average of previous 5 even-year harvests (2006–2014).

[i] Total Kodiak harvest of 3.29 million natural run sockeye includes projected harvests from formally forecasted systems, projected Chignik harvest at Cape Igvak, and projected harvest from additional minor systems totaling 1.36 million fish.

[j] See formal pink salmon forecast.

[k] Hatchery projections made by Kodiak Regional Aquaculture Association. Sockeye salmon hatchery projections include enhanced Spiridon Lake sockeye salmon run harvest forecast and other Kodiak Regional Aquaculture Association projections (396,000 total).

[l] Chignik sockeye salmon harvest estimate based on a formal forecast with projected harvest at Igvak and Southeastern District Mainland excluded.

[m] Based on South Peninsula formal forecast and the average of previous 4 even-year harvests (2006–2012) for the Aleutian Islands.

[n] Five-year average harvest (2011–2015); includes formal forecasts for Bear late run (268,000) and Nelson River (534,000) sockeye salmon stocks.

The Alaska all-species salmon harvest for 2015 totaled 268.3 million, which was about 47.5 million salmon more than the preseason forecast of 220.8 million. This combined harvest was composed of 522,000 Chinook, 55 million sockeye, 3.9 million coho, 190.6 million pink, and 18.2 million chum salmon. Table 2 shows 2015 harvest numbers by salmon species and fishing area, in units of fish harvested, and Table 3 provides this information in units of pounds harvested. Tables 4–7 provide detailed information on the 2015 harvest by species and area.

Table 2.–Preliminary 2015 Alaska commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region Total[a]	351	1,528	2,146	35,064	11,523	50,612
Prince William Sound	23	3,388	227	97,316	2,512	103,466
Upper Cook Inlet	11	2,648	216	48	276	3,199
Lower Cook Inlet[b]	1	245	4	6,388	113	6,752
Bristol Bay	55	36,574	35	2	1,054	37,719
Central Region Total	90	42,854	481	103,754	3,955	151,135
Kodiak Area	8	3,104	400	33,027	771	37,310
Chignik	9	1,552	82	1,978	101	3,723
South Peninsula and Aleutians	51	3,207	266	16,684	676	20,883
North Peninsula	3	2,728	57	12	192	2,992
Westward Region Total	71	10,592	805	51,701	1,739	64,909
Arctic-Yukon-Kuskokwim Region Total	9	61	433	72	1,031	1,605
Total Alaska	522	55,035	3,865	190,590	18,248	268,261

Note: Missing data indicates no harvest, and zeros indicate harvest activity but <500 fish.

Note: Columns may not total exactly due to rounding.

[a] Total commercial harvest of Chinook salmon for the October 1, 2014–September 30, 2015 catch accounting period.

[b] Commercial harvest in Lower Cook Inlet includes commercial common property and hatchery cost-recovery harvest, but not homepack, broodstock, or hatchery donated fish.

Table 3.–Preliminary 2015 Alaska commercial salmon harvests, by fishing area and species, in thousands of pounds.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region Total[a]	4,184	8,381	13,735	127,538	94,489	248,327
Prince William Sound	399	17,326	1,564	326,874	15,415	361,579
Upper Cook Inlet	180	13,928	1,255	157	1,815	17,335
Lower Cook Inlet[b]	8	1,109	27	20,098	732	21,974
Bristol Bay	573	192,865	232	7	6,308	199,985
Central Region Total	1,160	225,227	3,078	347,136	24,271	600,873
Kodiak Area	74	15,030	2,462	109,501	5,435	132,503
Chignik	73	8,470	524	5,844	646	15,556
South Peninsula and Aleutians	325	18,039	1,556	52,449	4,230	76,599
North Peninsula	42	15,325	462	40	1,273	17,142
Westward Region Total	514	56,864	5,004	167,834	11,584	241,800
AYK Region Total	95	371	3,353	195	7,296	11,309
Total Alaska	5,953	290,844	25,170	642,703	137,639	1,102,310

Note: Columns may not total exactly due to rounding.

[a] Total commercial harvest of Chinook salmon for the October 1, 2014–September 30, 2015, catch accounting period.

[b] Commercial harvest in Lower Cook Inlet includes commercial common property and hatchery cost-recovery harvest, but not homepack, broodstock, or hatchery donated fish.

Inseason harvest information, postseason statistics, and other information about salmon in Alaska can be found at http://www.fishing.adfg.alaska.gov.

ADF&G's 4 major fishery management regions (Southeast, Central, Arctic-Yukon-Kuskokwim, and Westward) are shown in Figure 1. These regions supersede any references to ADF&G's former statistical regions.

Though ADF&G does not produce formal run size forecasts for all salmon runs in the state, local salmon biologists prepare harvest projections or harvest outlooks for all areas. Projections are based on formal forecasts when available. When the formal forecasts are not available, local biologists use average historical catches and local knowledge of recent events to develop these outlooks.

This report contains a detailed review of Alaska's 2015 commercial salmon season. We normally release it before final catch figures are available to provide preliminary information to the Alaska Board of Fisheries (BOF), the fishing industry, and the public.

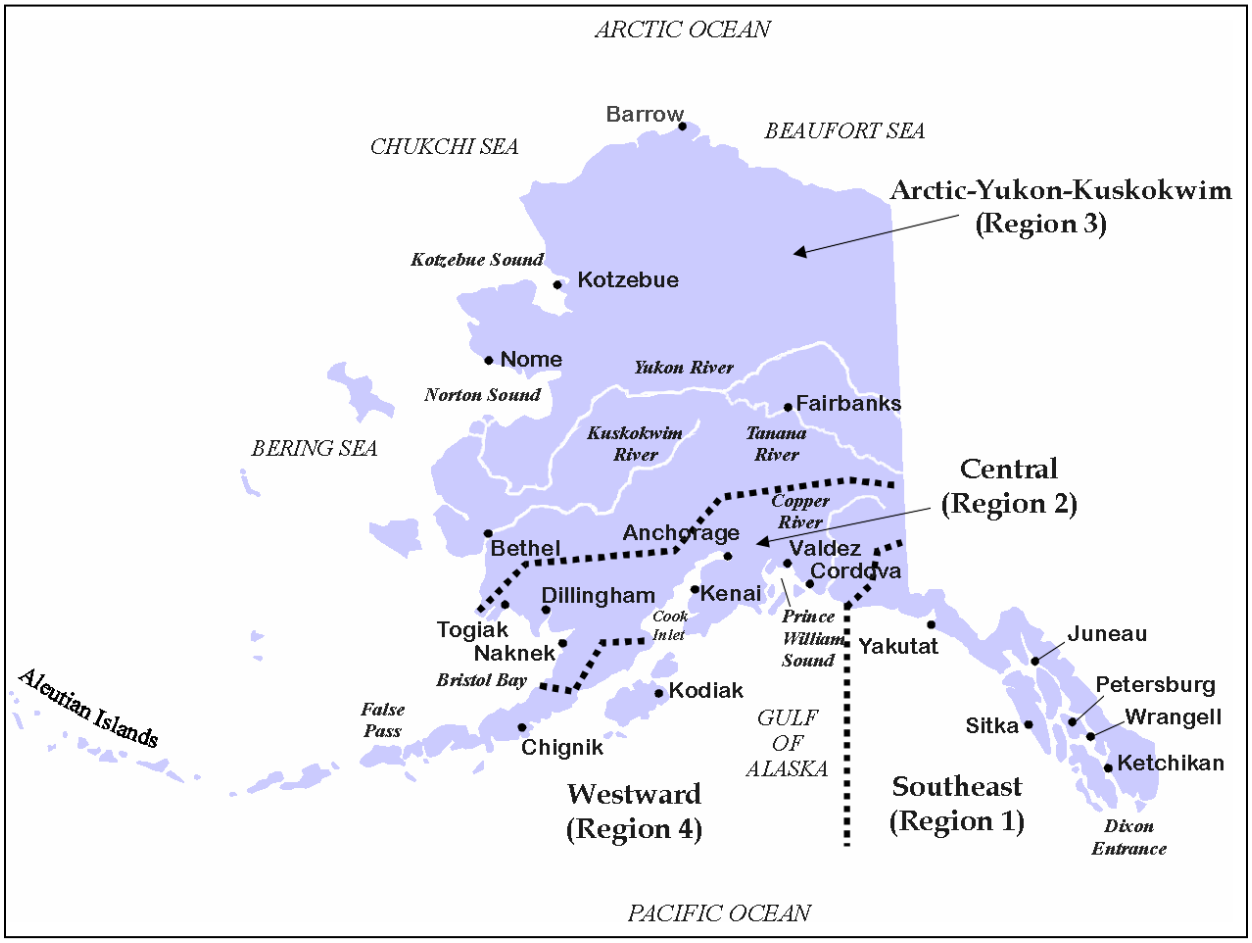

Figure 1.–The 4 ADF&G fishery management regions (Southeast, Central, Arctic-Yukon-Kuskokwim, and Westward) of the Division of Commercial Fisheries.

PRELIMINARY REVIEW OF THE 2015 ALASKA COMMERCIAL SALMON FISHERIES

SOUTHEAST ALASKA AND YAKUTAT REGION

The Region I cumulative commercial salmon harvest by all harvest categories, including hatchery cost recovery, was 50.6 million in 2015 (Table 4). Total common property commercial harvest was 46.0 million, which was 91% of the total harvest after excluding private hatchery cost recovery, Annette Island Reservation harvests, and miscellaneous harvests. Overall harvest in numbers of salmon in 2015 was 102% of that in 2014. The 2015 harvests by species compared with 2014 were as follows: Chinook 82%, sockeye 92%, coho 57%, pink 94%, and chum salmon 173%. The Region I total commercial salmon harvest proportions by species were as follows: 1% Chinook, 3% sockeye, 4% coho, 69% pink, and 23% chum salmon. The 2015 combined-gear, Chinook salmon harvest of 351,000 was 108% of the most recent 10-year average and 116% of the long-term average. The sockeye salmon harvest of 1.5 million was 130% of the recent 10-year average and 114% of the long-term average. The coho salmon harvest of 2.1 million was 80% of the 10-year average and 99% of the long-term average. The pink salmon harvest of 35.1 million was 86% of the 10-year average and 112% of the long-term average. The chum salmon harvest of 11.5 million was 115% of the 10-year average and 199% of the long-term average. The all species total harvest was 92% of the recent 10-year average harvest and 124% of the long-term average harvest.

CHINOOK SALMON

The Chinook salmon harvest of 351,000 in 2015 was above both the recent 10-year and long-term averages, and was the 11th highest of the previous 54 years. The average total Chinook salmon harvest since 1962 has been around 300,000. Preliminary harvests of coastwide Chinook salmon accountable under the Pacific Salmon Treaty included 251,172 by troll gear, 11,763 by seine gear, and 7,050 by gillnet gear. Total commercial harvests of Alaska hatchery origin Chinook salmon were 59,000 (17% of total Chinook salmon harvests), and 17,000 were harvested in private hatchery cost-recovery fisheries. For transboundary river stocks regulated under the Pacific Salmon Treaty, preseason forecasts in 2015 provided no allowable catch for directed fisheries on returns of large Chinook (28 inches in length or greater) to the Stikine and Taku Rivers.

SOCKEYE SALMON

The harvest of sockeye salmon was 1.5 million in 2015. This harvest was above both the recent 10-year average of 1.2 million and the long-term average of 1.3 million. The 2015 sockeye salmon harvest was the 17th highest of the previous 54 years since 1962. The majority of sockeye salmon were harvested in the Southeast Alaska Area purse seine fishery. The drift gillnet fishery harvest of 390,000 was below the recent 10-year average of 462,000 and accounted for 26% of the regional total harvest. The set gillnet fishery harvest of 83,000 was below the recent 10-year average harvest of 129,000. The purse seine harvest of 908,000 sockeye salmon was well above average levels.

COHO SALMON

The 2015 coho salmon harvest was 2.1 million. This harvest was less than the long-term average harvest since 1962 and the recent 10-year average harvest. The 2015 coho salmon harvest ranks 24th of the 54 years since 1962. The coho salmon harvest in the troll fishery was 1.2 million, less than the long-term and recent 10-year average harvests, and accounted for 58% of the harvest. Seine and drift gillnet harvests of coho salmon were below long-term and recent 10-year average harvests. The set gillnet harvest of coho salmon was below the long term average but above the recent 10-year average.

PINK SALMON

The 2015 pink salmon harvest was 35.1 million, 69% of the total region salmon harvest. The purse seine harvest was 32.2 million, 92% of the total pink salmon harvest. The 2015 pink salmon harvest was below the recent 10-year average and above the long-term average harvests, ranking as the 22nd largest harvest since 1962. Following a sharp decline in harvest in the 2006 season, a strong odd-year, weak even-year return pattern was established and that pattern continued until this year. The 2015 pink salmon return is the lowest odd-year return since 1997.

CHUM SALMON

The 2015 chum salmon harvest of 11.5 million ranks 9th since statehood and was above the recent 10-year average of 10.0 million. Most chum salmon production in the region is attributable to hatchery production. Before hatchery chum salmon production became significant in 1984, the 1962–1983 regional average chum salmon harvest was 1.6 million.

Table 4.–Preliminary 2015 Southeast Region commercial salmon harvests, by fishing area and species in thousands of fish.

	Species					
Fishery	Chinook[a,b]	Sockeye	Coho	Pink	Chum	Total
Purse Seine						
Southern Purse Seine Traditional	10	723	165	11,183	1,588	13,669
Northern Purse Seine Traditional	1	176	86	20,258	632	21,153
Hatchery Terminal	19	10	33	716	2,596	3,374
Total Purse Seine	30	908	284	32,157	4,817	38,197
Drift Gillnet						
Tree Point	1	28	40	148	453	670
Prince of Wales	3	122	113	225	232	694
Stikine	14	23	30	36	166	269
Taku-Snettisham	1	55	23	289	475	843
Lynn Canal	0	124	23	463	710	1,321
Drift Gillnet Hatchery Terminal	10	37	22	212	1,251	1,532
Total Drift Gillnet	29	390	251	1,373	3,287	5,330
Set Gillnet (Yakutat)	1	83	129	69	1	282
Troll						
Hand Troll						
Traditional	8	0	61	16	6	91
Hatchery Terminal	0	0	1	0	1	2
Spring Areas	4	0	0	2	1	7
Total Hand Troll	13	0	62	17	8	100
Power Troll						
Traditional	207	6	1,165	203	274	1,855
Hatchery Terminal	0	0	7	2	118	127
Spring Areas	49	0	7	37	25	118
Total Power Troll	257	7	1,178	242	416	2,100
Total Troll	270	7	1,240	259	424	2,201
Annette Island Reservation						
Seine	1	21	10	632	260	923
Drift Gillnet	1	6	24	145	445	621
Troll	0	0	0	0	0	0
Hand Troll	0	0	0	0	0	0
Power Troll	0	0	0	0	0	0
Trap						
Total Annette Island Reservation	2	27	34	777	704	1,544
Hatchery Cost Recovery	17	111	204	305	2,277	2,915
Miscellaneous[c]	1	2	4	124	12	144
Southeast Region Total	351	1,528	2,146	35,064	11,523	50,612

Note: Missing data indicates no harvest, and zeros indicate harvest activity but <500 fish.

Note: Columns may not total exactly due to rounding.

[a] Chinook salmon adults and jacks are totaled.

[b] Catch accounting period for the 2015 Chinook salmon season goes from October 1, 2014, to September 30, 2015.

[c] Includes salmon that were confiscated or caught in sport fish derbies or commercial test fisheries and sold.

CENTRAL REGION

PRELIMINARY 2015 PRINCE WILLIAM SOUND SALMON SEASON SUMMARY

The 2015 Prince William Sound (PWS) Area commercial salmon harvest was 103.47 million (Table 5). Harvest was composed of 97.32 million pink, 3.39 million sockeye, 2.51 million chum, 227,000 coho, and 23,400 Chinook salmon. The 2015 harvest was composed of 95.07 million (92%) commercial common property fishery (CPF), and 8.44 million (8%) hatchery cost recovery and broodstock fish.

Gillnet Fisheries

Copper River District

The 2015 preseason commercial harvest forecast for the Copper River District was 5,500 Chinook, 2.24 million sockeye, and 214,000 coho salmon. Gulkana Hatchery was expected to contribute 250,000 sockeye salmon to the CPF harvest. The commercial salmon fishing season in the Copper River District began on Thursday, May 14. Through the end of July, the commercial fishery was open 840 hours, the highest number of hours fished since 1982 and 184 hours more than the recent 10-year average. The sockeye salmon harvest of 1.75 million was 23% more than the previous 10-year (2005–2014) harvest average of 1.42 million. The average sockeye salmon weight of 5.1 lb was the smallest on record. The number of wild sockeye salmon in the Copper River District CPF harvest was 1.58 million (90%). Gulkana Hatchery contribution to the sockeye salmon commercial harvest was 137,000 (8%) and was 51% below forecast. Main Bay Hatchery contributed 29,700 (2%) of the Copper River harvest. The CPF harvest of 22,500 Chinook salmon was above the previous 10-year (2005–2014) average harvest of 18,400. The coho salmon commercial harvest of 137,000 was 36% below the previous 10-year (2005–2014) average harvest of 214,000. The inriver goal for salmon passing the Miles Lake sonar site was 759,000–1,150,000. The 2015 preliminary sonar escapement estimate was 1.35 million and exceeded the upper end of the inriver goal. Spawning escapement to Copper River delta systems based on aerial survey indices was 66,200 sockeye salmon, and was within the sustainable escapement goal (SEG) range of 55,000–130,000. Coho salmon spawning escapement to the Copper River Delta based on aerial survey indices was 41,700 and was within the SEG range of 32,000–67,000. Preliminary estimates of inriver Chinook salmon abundance indicate that spawning escapement was above the lower bound SEG of 24,000.

Bering River District

The 2015 preseason commercial harvest forecast for the Bering River District was 15,000 sockeye and 49,000 coho salmon. The sockeye salmon commercial harvest of 2,140 was 85% below the previous 10-year (2005–2014) harvest average of 14,000. The coho salmon commercial harvest of 12,100 was 75% below the previous 10-year (2005–2014) harvest average of 48,600. Commercial fishing effort in both the sockeye and coho salmon fisheries was low due to smaller run size than anticipated for both species. The aerial escapement index of 21,700 sockeye salmon was within the SEG range of 15,000–33,000. Aerial surveys of coho salmon produced an escapement index of 15,600 that was within the SEG range of 13,000–33,000.

Coghill District (Drift Gillnet)

Prince William Sound Aquaculture Corporation (PWSAC) forecast a 2015 run of 1.30 million chum and 56,700 coho salmon to Wally Noerenberg Hatchery and required 812,000 (61%) chum

and 2,700 (5%) coho salmon for corporate cost recovery and broodstock. The CPF drift gillnet harvest of chum salmon in the Coghill District was 778,000. PWSAC harvested 979,000 chum salmon for corporate cost recovery and broodstock. The CPF drift gillnet harvest of sockeye salmon in the Coghill District was 74,400. The proportion of wild sockeye salmon in the Coghill District CPF harvest was 29%. Pink salmon CPF drift gillnet harvest in the Coghill District was 655,000. The proportion of wild pink salmon in the Coghill District CPF harvest was 12%. The CPF drift gillnet harvest of coho salmon in the Coghill District was 6,090, the majority of which were assumed to be hatchery origin.

The sockeye salmon run forecast for Coghill River was 123,000. The Coghill River weir passed 13,600 sockeye salmon, coming in below the SEG range of 20,000–60,000. Additionally, 377,000 pink salmon were passed at the weir.

Eshamy District

The department's preseason forecast for Eshamy Lake was 53,000 wild sockeye salmon and PWSAC forecast a run of 1.60 million Main Bay Hatchery enhanced sockeye salmon. The CPF harvest of sockeye salmon in the Eshamy District was 1.13 million, 39% above the 10-year average of 812,000. The proportion of wild sockeye salmon in the Eshamy District CPF harvest was 4%. PWSAC harvested 181,000 sockeye salmon for corporate cost recovery and broodstock. No sockeye salmon escapement estimate is available for Eshamy Lake at this time.

Unakwik District

The department's preseason harvest forecast for the Unakwik District was 5,700 sockeye salmon. Unakwik District CPF drift gillnet harvest of sockeye salmon was 2,960, which was below the 10-year average of 4,520.

Montague District, Port Chalmers Subdistrict

PWSAC forecast a run of 258,000 chum salmon to the Port Chalmers remote release site in 2015. The drift gillnet gear group had access to the Port Chalmers Subdistrict in 2015 under the Prince William Sound Management and Salmon Enhancement Allocation Plan. The CPF drift gillnet harvest of chum salmon in the Montague District was 168,000, 35% below the forecast. The proportion of wild chum salmon in the Port Chalmers Subdistrict CPF harvest 11%.

Purse Seine Fisheries

Chum Salmon

The 2015 chum salmon total run forecast was 2.35 million, with 1.87 million (80%) projected to be of PWSAC origin. Of these, 280,000 were expected to be harvested by the purse seine fleet at Armin F. Koernig Hatchery.

Based on the department's wild chum salmon forecast of 484,000, there was a preseason expectation for the potential CPF harvest of 284,000 wild chum salmon in PWS, leaving 200,000 for escapement. The preseason forecast for total chum salmon CPF harvest in PWS was 1.34 million.

Total commercial chum salmon harvest in PWS was 2.51 million, including 979,000 for Wally Noerenberg Hatchery broodstock and cost recovery. Chum salmon CPF harvest was 1.53 million, which was 14% above the CPF preseason forecast. Purse seine chum salmon harvest in PWS was predominantly from the Southwestern, Eastern, and Coghill districts. Chum salmon

commercial harvest in the Southwestern District was 177,000, or 37% below the 280,000 forecast. Purse seine harvest of sockeye salmon during the Armin F. Koernig chum salmon fishery was 103,000, 5% of which were wild stock origin. The Eastern District harvest total was 143,000 chum salmon. From July 11 to July 15, purse seine CPFs in the Coghill District harvested 115,000 chum salmon.

Pink Salmon

The 2015 pink salmon total run forecast for PWS was 54.19 million. This estimate included 21.60 million PWSAC enhanced fish, 16.87 million wild fish, and 15.72 million Valdez Fisheries Development Association (VFDA) enhanced fish. Approximately 3.13 million (15%) of PWSAC's pink salmon forecast was projected for cost recovery and broodstock with the remaining 18.47 million PWSAC fish expected to be available for CPF harvest. Approximately 3.10 million (20%) of VFDA's pink salmon forecast were projected for cost recovery and broodstock. The remaining 12.62 million VFDA fish were expected to be available for CPF harvest. A total harvest of 15.42 million wild stock pink salmon was forecasted for CPF harvest in PWS, leaving 1.45 million fish for escapement.

The CPF harvest of 90.10 million pink salmon was the largest PWS pink salmon harvest on record and nearly double the preseason forecast. Total pink salmon harvest was 97.32 million, including 7.21 million for hatchery cost recovery (4.59 million for PWSAC and 2.63 million for VFDA). Pink salmon otolith contribution estimates result in commercial harvest contributions of 25.54 million wild stock fish, and 31.39 million Solomon Gulch Hatchery fish, both of which are records; pink salmon otolith contribution estimates result in a commercial harvest contribution of 33.14 million PWSAC fish.

For the 2015 season, inseason pink salmon aerial survey escapement estimates were above anticipated escapement thresholds in most districts for most of the season. This allowed for expanded time and area for fishing effort targeting surplus wild and enhanced pink salmon. The area-under-the-curve estimate of pink salmon escapement is not yet available, but considering that inseason escapement indices were above anticipated counts, overall escapement was probably within or above the odd-year SEG range for all districts.

Coho Salmon

The VFDA coho salmon run was anticipated to be 105,000. Total CPF harvest of coho salmon in PWS (excluding Copper River and Bering River districts) was 57,200. The majority of CPF coho salmon harvested in PWS are assumed to be of enhanced stock origin.

COOK INLET

Lower Cook Inlet

The preliminary estimate of the 2015 Lower Cook Inlet Area commercial salmon harvest, based on current fish ticket data, was 6,934,564 salmon. The harvest was composed of 6,553,791 pink, 261,622 sockeye, 113,469 chum, 4,811 coho, and 871 Chinook salmon (Table 5, which excludes hatchery broodstock). The harvest was composed of 4.5 million (65.1%) commercial common property fishery (CPF) fish, and 2.4 million (34.9%) hatchery cost recovery and broodstock fish.

Southern District

The 2015 preseason commercial common property harvest forecast for natural production in the Southern District was 40,700 sockeye and 26,000 pink salmon. Hatchery salmon runs were anticipated to contribute to Southern District commercial common property harvest in 2015 only if hatchery salmon runs to Resurrection Bay were sufficient to fully meet cost-recovery needs. The commercial salmon fishing season in the Southern District began on Monday, June 1. The preliminary purse seine harvest estimate for the 2015 season was 52 Chinook, 54,783 sockeye, 997 coho, 141,604 pink, and 1,450 chum salmon. This compares to a previous 10-year average harvest of 42 Chinook, 30,878 sockeye, 610 coho, 31,944 pink, and 486 chum salmon. The preliminary set gillnet harvest estimate was 752 Chinook, 36,061 sockeye, 3,102 coho, 27,726 pink, and 11,539 chum salmon. The previous 10-year average harvest for this gear type was 254 Chinook, 24,275 sockeye, 1,168 coho, 3,774 pink, and 2,087 chum salmon. In addition, 32,455 sockeye, and 2.1 million pink salmon were harvested by Cook Inlet Aquaculture Association (CIAA) from the Tutka Lagoon special harvest area (SHA) for cost-recovery purposes. The estimated spawning escapement at the English Bay River weir was 6,290 sockeye salmon, which is within the SEG of 6,000–13,500 for this system.

Kamishak Bay District

The 2015 preseason wild stock commercial harvest forecast for the Kamishak Bay District was 37,900 sockeye and 16,800 chum salmon. CIAA forecasted a run of 39,500 sockeye salmon to the Kirschner Lake remote release site. Total preliminary estimated common property harvest was 33,735 pink and 626 chum salmon. In addition, 23,581 sockeye salmon and 1,560 pink salmon were harvested by CIAA from the Kirschner Lake SHA for cost-recovery and broodstock purposes. This compares to a previous 10-year average of 70,093 sockeye, 29,547 pink, and 33,412 chum salmon harvested in the common property fishery. Video enumeration at Chenik Lake documented 19,073 sockeye salmon, which was above the SEG range of 3,500–14,000. Video documentation of salmon returning to Mikfik Lake resulted in a final escapement estimate of 3,502 sockeye salmon, which is within the SEG range of 3,400–13,000 for this species.

Outer District

The 2015 preseason commercial harvest forecast for the Outer District was 14,800 sockeye, 370,000 pink, and 41,700 chum salmon. The commercial salmon fishing season began in this district on Monday, July 13. Overall preliminary estimated harvest from 19 permit holders that participated was 613 sockeye, 4,096,578 pink, and 97,974 chum salmon. This harvest compares to previous 10-year averages of 11,119 sockeye, 557,843 pink, and 36,970 chum salmon.

Eastern District

Due to small runs in the last 10 years, no wild stock sockeye or pink salmon were forecast to be available for commercial common property harvest from the Eastern District in 2015. CIAA forecasted a total run of 322,737 sockeye salmon to Resurrection Bay facilities with all of these fish intended for broodstock or cost-recovery purposes. Total cost-recovery harvest from this district was 92,776 sockeye salmon with 2,062 donated at the weir to members of the public. Commercial common property harvests occurred July 2–17 with a preliminary estimate of 4,633 sockeye salmon harvested by 3 permit holders. Escapement of 13,505 sockeye salmon through the weir at Bear Creek surpassed the desired inriver passage goal of 12,750. This goal is the

combination of the SEG (700–8,300) as well as the estimated 4,450 sockeye salmon required for broodstock for the CIAA Resurrection Bay sockeye salmon program at the Trail Lakes Hatchery.

Upper Cook Inlet

The 2015 Upper Cook Inlet (UCI) commercial harvest of approximately 3.2 million salmon was 15% less than the recent 10-year average annual harvest of 3.7 million (Table 5). Although all 5 species of Pacific salmon are present in UCI, sockeye salmon are the most valuable, accounting for nearly 78% of the exvessel value in the commercial fishery since 1960, and more than 93% of the total value during the past 20 years.

Currently, there are 7 sockeye salmon systems with escapement/inriver goals that are monitored in UCI. Sonar is used to estimate sockeye salmon passage in the Kenai and Kasilof rivers, while weirs are operated at Larson, Chelatna, Judd, and Big (Fish Creek) lakes. Remote video technology was utilized to evaluate the SEG at Packers Lake. For the 2015 season, 3 of 7 sockeye salmon enumeration estimates fell within the established goal ranges, while estimates in the other 4 systems exceeded their goal objectives.

Chinook Salmon

In UCI, there are 2 commercial fisheries where the majority of Chinook salmon are harvested: the set gillnet fisheries in the Northern District, and in the Upper Subdistrict of the Central District. Chinook salmon runs were again expected to be below average in watersheds throughout Southcentral Alaska during the 2015 season. Therefore, similar to recent years, it was anticipated that restrictions to both sport and commercial fisheries would be required to ensure that escapement objectives were achieved. In the Northern District, many Chinook salmon stocks were classified as *stocks of management concern* by the BOF in 2011. An action plan was developed that aimed to reduce Chinook salmon harvest in both sport and commercial fisheries. In the commercial fishery, beginning in 2011, that portion of the General Subdistrict of the Northern District, from approximately 1½ miles south of Tyonek north to the Susitna River, was closed to fishing during the directed Chinook salmon fishery. From 2012 to 2014, the department determined that additional restrictions were necessary to further reduce Chinook salmon commercial harvest. These additional restrictions included closing the first Monday fishing period of the season and reducing time in the remaining fishing periods from 12 hours to 6 hours. This same strategy was followed in 2015. The first fishing period of the year, which was scheduled for Monday, May 25, was closed and the remaining 4 fishing periods were reduced to 6 hours by emergency order. However, the department determined during the season that the Deshka River Chinook salmon escapement goal would be achieved, and as a result, the use of bait and multiple hooks was allowed back into the sport fishery beginning Saturday, June 13. In response to this, the last 2 set gillnet fishing periods, those on June 15 and June 22, were returned to 12 hours in duration. The estimated Chinook salmon harvest in the Northern District directed fishery was approximately 1,560, or about 35% less than the previous 10-year average annual harvest of 2,269.

The Deshka River is the primary system in northern Cook Inlet where Chinook salmon escapement has been monitored inseason with a weir. The 2015 Deshka River Chinook salmon escapement estimate of 24,316 was within the escapement goal range of 13,000–28,000 and represented the highest escapement since 2006.

In response to below-average Kenai River Chinook salmon runs in recent years, the BOF substantially modified the 5AAC 21.359 *Kenai River Late-Run Chinook Salmon Management Plan* at the 2014 UCI finfish meeting. The newly modified plan significantly changed management of the Upper Subdistrict set gillnet fishery in years of low Chinook salmon abundance (please see the sockeye salmon section of this document for a description of restrictive actions taken in the Upper Subdistrict set gillnet fishery to conserve Kenai River Chinook salmon).

The 2015 Upper Subdistrict set gillnet fishery Chinook salmon harvest was estimated to be 6,666. This does not include Chinook salmon harvested in the Kasilof River SHA, where approximately 371 Chinook salmon were harvested by the set gillnet fishery and an additional 81 Chinook were taken by the drift fishery. Thus, the 2015 total Chinook salmon harvest by setnetters in the Upper Subdistrict was 7,037. The stock composition of the 2015 harvest will not be known until genetic samples collected during the fishery are processed by the department's Gene Conservation Laboratory (http://www.adfg.alaska.gov/index.cfm?adfg=fishinggeneconservationlab.main). As noted in the sockeye salmon section of this document, the 2015 Kenai River late-run Chinook salmon escapement estimate was approximately 22,600, which is within the SEG of 15,000–30,000.

In all of UCI, approximately 10,798 Chinook salmon were harvested in 2015, which was approximately 17% less than the previous 10-year (2005–2014) average annual harvest of 11,914.

Sockeye Salmon

The total sockeye salmon run to UCI in 2015 was estimated to be approximately 6.3 million, which was 7% more than forecast. Based on Anchor Point offshore test fishery data, the midpoint of 2015 sockeye salmon run occurred on July 25, which is the latest midpoint of the run ever estimated using offshore test fishery data. The latest run on record had previously occurred in 2006, when the midpoint of the run occurred on July 24. The Kenai and Kasilof rivers sockeye salmon runs were moderately higher than forecast, while the Susitna River and Fish Creek runs were well above forecast. The number of sockeye salmon returning to all other systems (minor systems) was approximately 150,000 less than forecast. The UCI commercial harvest of 2.6 million sockeye salmon was approximately 17% less than the 2005–2014 average annual harvest of 3.1 million and ranks as the 6th lowest harvest in the past 10 years.

Upper Subdistrict Set Gillnet and Central District Drift Gillnet

The 2015 UCI preseason forecast was for a total run of approximately 5.8 million sockeye salmon, with a harvest estimate (sport, personal use, and commercial) of 3.7 million. Approximately 2.9 million sockeye salmon were predicted to be harvested commercially. The total run to the Kenai River, generally the largest producer in UCI, was forecasted to be nearly 3.6 million. For Kenai River runs of 2.3–4.6 million, the inriver sonar goal range is 1.0–1.2 million.

The Kasilof Section set gillnet fishery opens by regulation on or after June 25; however, the section may open anytime between June 20 and June 24 if the department projects that 50,000 sockeye salmon have entered the Kasilof River by that date. More than 50,000 sockeye salmon had passed the Kasilof River sonar site by midnight of June 20, but due to concerns over Kenai River early-run Chinook salmon escapement levels, the fishery was not opened until June 22 to allow for additional Chinook salmon escapement into the Kenai River. The Kenai River early-

run Chinook salmon sport fishery was closed for the entire season. The final escapement of Kenai River early-run Chinook salmon (June 30 is the final day of enumeration for the early run) was estimated at 6,190, which meant the optimum escapement goal (OEG) of 5,300–9,000 was achieved.

At the 2014 Alaska Board of Fisheries (BOF) meeting, the *Kenai River Late-Run King Salmon Management Plan* was modified to include specific "paired" restrictions to sport and commercial fisheries during periods of low Chinook salmon abundance. The modified plan stated that from July 1 through July 31, if the projected inriver run of Kenai River late-run Chinook salmon is less than 22,500, the Kenai River Chinook salmon sport fishery may be restricted to no bait, retention of Chinook salmon may be restricted in the Kenai River personal use fishery, and the set gillnet fishery may be restricted to no more than 36 hours of fishing time per week with regular Monday/Thursday 12-hour fishing periods no longer in effect. If retention of Chinook salmon is prohibited in the sport fishery, the set gillnet fishery is restricted to no more than 12 hours of fishing time per week.

The preseason forecast for 2015 Kenai River late-run Chinook salmon was for a total run of approximately 22,000. Based on this projection, the sport fishery in the Kenai River began the season on July 1 under a no-bait restriction, and the Upper Subdistrict set gillnet fishery was restricted to fishing no more than 36 hours per week without regular Monday/Thursday fishing periods. Both fisheries remained in this restricted mode through July 24. Based on a Chinook salmon passage estimate of more than 13,000 through July 24, the no-bait restriction in the sport fishery was removed beginning on Saturday, July 25. In turn, this meant that the 36-hour weekly restriction in the Upper Subdistrict set gillnet fishery was also removed beginning on July 25.

Beginning August 1, a different provision within the *Kenai River Late-Run King Salmon Management Plan* went into effect. It stated that from August 1 through August 15, if the projected escapement of Chinook salmon into the Kenai River was at least 16,500 but less than 22,500, the set gillnet fishery in the Upper Subdistrict was to be limited to no more than 36 hours of fishing time. So, beginning on August 1, daily passage estimates of Chinook salmon into the Kenai River were assessed so that projections of the final escapement could be made. From July 26 through August 4, Kenai River Chinook salmon escapement projections declined each day. Based on a cumulative passage estimate of 18,136 Chinook salmon through August 4, it was no longer certain that the final escapement would make or exceed 22,500. Thus, beginning on Thursday, August 6, the Upper Subdistrict set gillnet fishery was to be limited to fishing no more than 36 hours for the remainder of the month. This change also eliminated the regular Monday/Thursday fishing schedule. At the same time, Chinook salmon escapement data was also viewed in relationship to strong sockeye salmon passage in both the Kenai and Kasilof rivers.

During the 2015 season, the Kasilof River SHA was fished on part or all of 21 different days. In addition, for the first time ever, the Kasilof Section opened in those waters only within 600 feet of the mean high tide mark; this occurred during a portion of 6 days during the season. Fishing in this area was employed in an attempt to harvest Kasilof-bound sockeye salmon, while attempting to reduce the harvest of Kenai River Chinook salmon. Between June 22 and August 10, the Kasilof Section was open to set gillnetting 1 day within ½ mile of the mean high tide mark and during a portion of 27 different days in the full section. From July 9 through August 13, the Kenai and East Foreland sections were open for a portion of 20 different days. For the 2015 season, the Upper Subdistrict set gillnet fishery (excluding the Kasilof River SHA) harvested

6,666 Chinook and 1,357,136 sockeye salmon. An additional 452 Chinook and 124,354 sockeye salmon were harvested by set and drift gillnetters in the Kasilof River SHA.

The final Kenai River Chinook salmon passage estimate for the 2015 season was approximately 23,705, and after inriver mortality above the sonar was subtracted, the final estimate of escapement was approximately 22,600. The cumulative sockeye salmon passage estimate in the Kasilof River, which was enumerated through August 14, was approximately 470,000. In the Kenai River, the final estimate of sockeye salmon passage, based on enumeration through August 26, was more than 1.7 million.[a]

In 2014, the BOF made substantive changes to the 5 AAC 21.353 *Central District Drift Gillnet Fishery Management Plan*, confining the drift fleet primarily to the east side of the Central District during the latter half of July. In this region, the BOF created a new drift gillnet fishing area, the Anchor Point Section, which included those waters from the Ninilchik River south to the Anchor River. During the month of July, the drift fleet fished a total of 26 days as follows: 1 day in the regular Kasilof Section, 2 days in the Expanded Kenai/Kasilof sections, 7 days in the Expanded Kenai/Kasilof and Anchor Point sections, 10 days in the Kasilof River SHA, 4 days in Drift Area 1, and 2 days in all of the Central District (July 2 and July 6). Due to the lateness of this year's sockeye salmon run, the drift fleet also fished 6 districtwide periods in the first 13 days of August. For the 2015 season, approximately 992,000 sockeye salmon were harvested by the drift fleet, which represented 38% of the total UCI sockeye salmon harvest.

In summary, the 2015 UCI sockeye salmon run was the latest run on record. The 2015 season was also unusual in that peak daily harvest rates in both the Central District drift fishery and Upper Subdistrict set gillnet fishery were the lowest on record (since 1985). For example, the 2015 peak daily harvest (catch per boat) in the drift fishery during noncorridor openings of 283 sockeye salmon per boat was the lowest CPUE ever measured in the drift fleet. Similarly, in the Upper Subdistrict set gillnet fishery, the peak daily harvest in 2015 of 95,000 sockeye salmon represented the lowest peak daily harvest ever measured (2012 was not considered because the entire Upper Subdistrict only fished 1 day in July that year). In other words, the 2015 sockeye salmon run can be characterized as very protracted, and it never experienced a significant buildup of fish in either the Central District drift or in the Upper Subdistrict set gillnet fisheries. Finally, the average weight of sockeye salmon captured in the 2015 UCI commercial fishery was the second smallest on record at 5.3 lb, with the 2006 average size of 5.1 lb as the smallest.

Western Subdistrict

By regulation, the Western Subdistrict set gillnet fishery opened for regular periods on Thursday, June 18. This fishery primarily harvests sockeye salmon returning to the Crescent River. The Crescent River sonar program was discontinued in 2014. In 2015, sockeye salmon harvest rates in the set gillnet fishery from the beaches near the Crescent River area were consistent with historic harvest rates when this fishery had been provided additional fishing time due to increased sockeye salmon passage into Crescent River. Therefore, an emergency order was issued on July 11 opening that portion of the Western Subdistrict south of the latitude of Redoubt Point from 6:00 a.m. until 10:00 p.m. on Mondays, Thursdays, and Saturdays each week from

[a] Sonar estimate at river mile 19 on Kenai River and river mile 8 on Kasilof River; not escapement. Harvest upstream of sonar must be subtracted to estimate escapement. Sport harvest estimated from Statewide Harvest Survey; results for 2015 available fall of 2016 at the earliest.

July 13 through August 10. Approximately 34,500 sockeye salmon were harvested by setnetters in the Western Subdistrict in 2015.

Kustatan Subdistrict

The Kustatan Subdistrict includes those waters from the Drift River terminal to the Northern District boundary near the West Forelands. From 1993 to 2014, approximately 9 permit holders per year have reported harvest from this area. The majority of participation and harvest (more than 92% of the harvest) typically comes from the Big River sockeye salmon fishery, which is an early season fishery limited to 1 net per permit holder and occurs June 1–24. Approximately 2,200 sockeye salmon were harvested in the Kustatan Subdistrict in 2015, with nearly 1,500 of these caught during the Big River fishery.

Kalgin Island Subdistrict

The Kalgin Island Subdistrict opened for regular fishing periods beginning June 25; however, the west side of Kalgin Island was open for commercial fishing on Mondays, Wednesdays, and Fridays June 1–24 as part of the Big River sockeye salmon fishery. In 2015, approximately 60,000 sockeye salmon were harvested from the Kalgin Island Subdistrict, with nearly 5,600 of those taken during the Big River sockeye salmon fishery. The average annual sockeye salmon harvest on Kalgin Island during the previous 10 years was approximately 62,000, with approximately 14,000 of those harvested during the early season Big River fishery. Based upon a video weir assessment of sockeye salmon escapement into Packers Lake, which projected a final escapement within the SEG range of 15,000–30,000, 3 additional 12-hour fishing periods were provided in the Kalgin Island Subdistrict on the first 3 Saturdays in August (August 1, 8, and 15). According to 5 AAC 21.370 *Packers Creek Sockeye Salmon Management Plan*, for the purpose of harvesting Packers Creek sockeye salmon, extra fishing time in the Kalgin Island Subdistrict shall be limited to no more than 1 additional fishing period per week.

Northern District

Commercial fishing in the Northern District opened on June 1 for the directed Chinook salmon fishery and for regular periods beginning on June 25. In 2015, approximately 56,000 sockeye salmon were harvested in the Northern District, with about 1,900 of these harvested during the 4 directed Chinook salmon fishing periods. The 2015 sockeye salmon harvest was 97% greater than the 2005–2014 average of 28,274, yet approximately 35% less than the 1966–2014 average of more than 85,000.

Coho Salmon

The 2015 UCI harvest estimate of 216,000 coho salmon in all commercial fisheries was approximately 24% greater than the recent 10-year (2005–2014) average annual harvest of approximately 171,000. The 2015 drift gillnet harvest of 127,000 coho salmon was 25% greater than the recent 10-year average of approximately 101,000.

In UCI, there are 2 coho salmon systems with escapement goals that are monitored inseason with weirs: Fish Creek and the Little Susitna River. The goal at Fish Creek is an SEG of 1,200–4,400. Coho salmon escapement was enumerated at the Fish Creek weir from July 13 through September 27 and produced a final count of 7,370. In the Little Susitna River, the goal is an SEG of 10,100–17,700. Coho salmon escapement was enumerated at the Little Susitna weir from July 6 through August 27, producing an escapement estimate of 12,421. Finally, there is a coho salmon foot survey SEG of 450–700 at McRobert's Creek, which drains into Jim Creek, both

located in the Knik River drainage. A foot survey conducted late in September found 571 coho salmon in the stream, which was within the SEG range for this system. Therefore, all coho salmon escapement goals in Northern Cook Inlet were met or exceeded in 2015.

Pink Salmon

Pink salmon runs in UCI are even-year dominant, with odd-year average annual harvests typically less than one-sixth of even-year harvests. The 2015 UCI commercial harvest of pink salmon was estimated to be approximately 48,000, which was 43% less than the average annual harvest of nearly 83,000 from the previous 10 years of odd-year harvests.

Chum Salmon

The 2015 harvest of approximately 276,000 chum salmon was more than double the previous 10-year average annual harvest of nearly 123,000 and represents the highest chum salmon harvest since 1995. There is only 1 chum salmon escapement goal in UCI, which is an aerial survey SEG of 3,800–8,400 in Clearwater Creek, the major tributary that drains into Chinitna Bay. Nearly 11,000 chum salmon were observed during an August 14 survey flight. Based on this escapement estimate, Chinitna Bay was opened to set and drift gillnetting for 12-hour fishing periods on Tuesdays and Fridays beginning on Tuesday, August 18.

BRISTOL BAY

The 2015 inshore Bristol Bay sockeye salmon run of 58 million ranks 2nd out of the last 20 years (1995–2014) and was 70% above the 34.2 million average run for the same period. This year's Bristol Bay sockeye salmon run was 12% above the preseason inshore forecast of 52 million. The Naknek-Kvichak, Nushagak, and Ugashik districts were higher than the preseason forecast while Egegik and Togiak districts were less than predicted. The 36.6 million sockeye salmon commercial harvest was below the 37.6 million preseason forecast. All escapement goals were met or exceeded, with a total sockeye salmon escapement of 22.4 million. A total of 55,356 Chinook salmon were harvested in Bristol Bay in 2015. The harvests for other species are 1,053,594 chum, 34,530 coho, and 2,021 pink salmon. The 2015 sockeye run timing was one of the latest on record, approximately 7 days late. Overall fish weights and lengths were smaller than average, especially in Egegik. The baywide average sockeye salmon weight of 5.2 lb is the smallest average weight in the last 20 years.

Chinook Salmon

Chinook salmon harvests in Bristol Bay were below average in every district except the Nushagak in 2015. No directed Chinook salmon fishing periods occurred in the Nushagak District in 2015. Chinook salmon were caught during directed sockeye periods in all commercial districts and approximately 55,356 fish were harvested, 4% below the 20-year average of 54,507. Chinook salmon escapement into the Nushagak River was 98,019 and within the escapement goal range of 55,000–120,000.

Sockeye Salmon

The 2015 Bristol Bay sockeye salmon total run was above the preseason inshore forecast of 52 million. The 2015 harvest was approximately 53% higher than the recent 20-year average for all districts. Sockeye salmon escapements were met or exceeded in all systems. The Egegik, Ugashik, Wood, and Igushik rivers were above the established escapement goal ranges while all other systems were within ranges. Limitations in processing capacity also affected the

department's ability to control sockeye salmon escapements into several river systems in Bristol Bay.

Coho Salmon

The total coho salmon harvest was 34,530. Typically the Nushagak District is the largest coho salmon producer. In 2015, there was no commercial interest in coho salmon and the 5,635 harvest was incidental to the sockeye fishery. Togiak District led the bay in coho salmon harvest in 2015 with 21,999 fish.

Pink Salmon

Pink salmon return to Bristol Bay in even years. The harvest in 2015 was 2,179.

Chum Salmon

The 2015 preliminary Bristol Bay chum salmon harvest was 1,053,594. Togiak, Egegik, and Ugashik districts were below their 20-year average harvest. Nushagak District was the largest producer of chum salmon, where 542,422 were harvested.

Table 5.–Preliminary 2015 Central Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Purse Seine						
Eastern District	0	67	27	42,422	143	42,660
Northern District	0	12	2	13,559	8	13,580
Coghill District	0	2	1	5,602	121	5,726
Northwestern District	0	0	0	0	0	0
Southwestern District	0	114	10	23,746	177	24,046
Montague District	0	1	1	1,531	1	1,534
Southeastern District	0	43	4	2,235	14	2,296
Unakwik District	0	2	0	0	0	3
Drift Gillnet						
Bering River District	0	2	12	0	0	14
Copper River District	23	1,751	137	85	16	2,011
Coghill District	0	74	6	655	778	1,514
Eshamy District	0	861	5	178	86	1,130
Montague District	0	10	1	59	168	237
Unakwik District	0	3	0	0	0	3
Set Gillnet						
Eshamy District	0	265	1	29	22	317
Hatchery[a]	0	181	20	7,215	979	8,395
Prince William Sound Total	23	3,388	227	97,316	2,512	103,466
Southern District	1	91	4	169	13	278
Kamishak District	0	0	0	34	1	34
Outer District	0	1	0	4,097	98	4,195
Eastern District	0	5	0	0	0	5
Hatchery[b]	0	149	0	2,089	2	2,239
Lower Cook Inlet Total	1	245	4	6,388	113	6,752
Central District	9	2,592	169	46	270	3,086
Northern District	2	56	47	2	6	113
Upper Cook Inlet Total	11	2,648	216	48	276	3,199
Naknek-Kvichak District	3	16,526	1	0	350	16,880
Nushagak District	50	5,529	7	1	492	6,078
Egegik District	1	8,737	1	0	69	8,807
Ugashik District	0	5,479	0	0	70	5,549
Togiak District	2	304	26	1	73	405
Bristol Bay Total	55	36,574	35	2	1,054	37,719
Central Region Total	90	42,854	481	103,754	3,955	151,135

Note: Missing data indicates no harvest and zeros indicate harvest activity but <500.
Note: Columns may not total exactly due to rounding.

[a] Hatchery sales for operating expenses and broodstock harvests.
[b] Lower Cook Inlet hatchery harvest includes cost recovery only, not broodstock or donated fish.

ARCTIC-YUKON-KUSKOKWIM REGION

Arctic-Yukon-Kuskokwim (AYK) Region salmon harvests totaled 1,605,000 salmon and 11,310,000 lb in 2015 (Tables 2, 3, and 6). Cumulative all-gear commercial harvest included 9,000 Chinook, 61,000 sockeye, 433,000 coho, 1,031,000 chum, and 72,000 pink salmon. Commercial salmon harvests for sockeye, chum, and pink salmon, which comigrate with Chinook salmon, were limited by conservation measures to protect Chinook salmon. Chum salmon abundance was variable throughout the region, with large abundance occurring in Kotzebue and low abundance in Kuskokwim Area. Sockeye and coho salmon abundance was generally strong throughout the region in locations where they occur. Landings were made by 1,122 limited entry permit holders in 2015.

KUSKOKWIM AREA

The Kuskokwim Area commercial salmon harvest in 2015 was 8,254 Chinook, 56,260 sockeye, 148,349 coho, and 21,068 chum for a total of 233,931 fish. A total of 396 permit holders participated.

Overall sockeye and chum salmon harvests were similar to what was expected. Chinook salmon harvest was above the expected harvest range in 2015, while coho salmon harvest was below the expected range. Escapement goals were achieved for sockeye and coho salmon. However, only 9 of 13 escapement goals were met for Chinook salmon. Chum salmon abundance was one of the lowest in the last 10 years. In general, run timing throughout Kuskokwim area for Chinook salmon was characterized as average, while sockeye, coho, and chum salmon were considered to be late.

Kuskokwim River

In 2015 the following preseason and inseason management actions were taken in an attempt to conserve Chinook salmon and achieve escapement goals.

On May 18, the Federal Subsistence Board adopted a Special Action to close the Kuskokwim Chinook salmon fishery to non-Federally qualified users within the boundary of the Yukon Delta National Wildlife Refuge (NWR). Subsistence fishing in the Kuskokwim River was restricted to the use of gillnets with 4-inch or less mesh size not to exceed 60 feet in length 3 days per week within the Yukon Delta NWR boundaries from May 21 to July 1. This restriction was also implemented by ADF&G upstream of Aniak beginning June 4. Fishing for Chinook salmon with hook and line gear was closed drainagewide beginning June 4. An area at the mouth of the Kuskokwim River (east of the Ishkowik River to the northern boundary of District W-4) was closed to subsistence fishing on May 28, in order to provide additional protection to Chinook salmon entering the Kuskokwim River. The U.S. Fish and Wildlife Service instituted a community harvest permit program from June 7 to June 30 that allowed the harvest of up to 7,000 Chinook salmon within the Yukon Delta NWR boundaries.

Subsistence fishing with dip nets and fish wheels was allowed upstream of the Yukon Delta NWR at Aniak beginning June 4. All Chinook salmon caught in a dip net were required to be immediately released unharmed. Fish wheels where required to be monitored closely or be equipped with a chute to facilitate the live release of Chinook salmon.

Beginning June 1, ADF&G implemented a test fishery near the village of Aniak on the mainstem Kuskokwim River to provide an assessment of species ratios and run timing of salmon leaving

waters within the Yukon Delta NWR. As chum and sockeye salmon abundance started to exceed Chinook salmon abundance, as indicated by the Bethel Test Fish and Aniak Test Fish, limited subsistence fishing opportunity with 6-inch mesh gillnet gear was provided upstream of Aniak. The first 6-inch mesh fishing period on June 20 was restricted to Alaska residents 60 years of age or older and gillnets no longer than 10 fathoms in length. On July 2, ADF&G resumed management of the entirety of the Kuskokwim River and implemented restrictions in conjunction with those in place upstream of the Yukon Delta NWR boundary to conserve Chinook salmon. Additional limited fishing opportunities on chum and sockeye salmon were allowed as those runs progressed. However, the chum salmon run was assessed to be poor based on low Bethel Test Fish CPUEs. Restrictions continued until August 4 when all restrictions were rescinded.

The first District 1 commercial fishing period was on August 10 and the last on August 21 with a total of 3 commercial fishing periods directed at harvesting coho salmon. The initiation of the commercial fishery was delayed until the majority of the Chinook and chum salmon runs had passed through the district as a conservative measure, because both species showed below average abundance at assessment projects. As a result, commercial fishing was directed primarily at coho salmon. The Bethel Test Fish cumulative CPUE index indicated that coho salmon escapement goals would be met. However, escapements at weir projects were delayed and were below average at the time, prompting limited commercial opportunity. End-of-season-escapement counts indicated an above-average total run and additional coho salmon could have been commercially harvested. A total of 2 Chinook, 130 sockeye, 65,034 coho, and 507 chum salmon were commercially harvested. During commercial periods 6 Chinook salmon were kept as personal use. Harvests of sockeye, coho, and chum salmon were well below their respective recent 10-year averages. Landings were attributed to 283 individual permits.

Chinook salmon escapements at Kogrukluk and George River weirs achieved their SEGs. The Kwethluk River exceeded the upper bound of the established SEG. Seven tributaries have aerial survey SEGs: 2 tributaries were within the respective SEG ranges, 1 tributary exceeded the upper bound, and 4 tributaries were either below the SEG or stream conditions prevented an accurate survey. The Kuskokwim River drainagewide SEG was likely achieved, but it will not be fully assessed until after estimates are made this winter.

Overall, sockeye salmon escapement was well above average across the drainage. The Kogrukluk River weir has the only established sockeye salmon escapement goal and the escapement was within the SEG. The Telaquana weir observed the highest escapement of sockeye salmon on record since 2010.

Chum salmon run timing was late and all escapement projects showed a below-average run. Escapement at the Kogrukluk River weir achieved the SEG.

Coho salmon escapements were above average with returns into the Kwethluk and Kogrukluk rivers achieving their established escapement goals. Low, warm water in the spawning tributaries for this time of year is theorized to have further delayed coho salmon movement past the escapement monitoring sites.

Kuskokwim Bay District 4 (Quinhagak) and District 5 (Goodnews Bay)

The District 4 commercial fishing season began on July 3 and ended on August 24. In an effort to conserve Chinook salmon, the commercial fishing season was delayed from the normal start of June 15 and subsistence salmon fishing with gillnets was restricted to three 72-hour scheduled

opportunities with 6-inch or less mesh gear for the month of June. To reduce harvest of Chinook salmon during commercial periods, a closed waters box around the mouth of the Kanektok River was implemented during the July 3 and July 10 fishing periods. The department determined through communication with local fisherman that Chinook salmon mill near the mouth of the Kanektok River, moving in and out with the tides. The closure box was intended to provide a sanctuary for Chinook salmon while still providing opportunity for fishermen to harvest abundant sockeye salmon. The effectiveness of this management action is unclear due to a larger-than-anticipated return of Chinook salmon. There were a total of 17 commercial fishing periods. Due to chum salmon escapement concerns commercial fishing was suspended July 28 and resumed on August 5 for the coho salmon fishery.

The District 5 commercial fishing season began on July 3 and ended on August 14. There were 13 commercial fishing periods. Over the last 3 years the Goodnews River has seen some of the lowest Chinook salmon escapements on record with the 2015 return expected to be similar to 2014. The subsistence salmon fishery was restricted to three 72-hour gillnet opportunities with a mesh size of 6 inches or less for the month of June due to the concern for low Chinook salmon abundance. The commercial fishery was delayed until July 3 and the fishing district was reduced by half during periods between July 3 and July 18 to minimize potential Chinook salmon harvest. Fishing periods were suspended after August 14 due to poor escapement of coho salmon at the Middle Fork Goodnews River weir.

In 2015, 189 individual permit holders recorded landings during 17 commercial periods in District 4. A total of 7,547 Chinook, 30,269 sockeye, 76,285 coho, and 16,051 chum salmon were commercially harvested. Catch rates for chum salmon were below average, whereas catch rates for Chinook, sockeye, and coho salmon were above average. Coho salmon harvest was above the most recent 10-year average. Chinook, sockeye, and chum salmon harvests were below the most recent 10-year averages. Chum salmon harvest was the 3rd lowest since 2005.

A total of 61 individual permit holders recorded landings in District 5 during 13 commercial periods. The District 5 total commercial harvest of 38,106 was composed of 705 Chinook, 25,861 sockeye, 7,030 coho, and 4,510 chum salmon. Chinook and coho salmon catch rates were below average. Catch rates for chum salmon were average and sockeye salmon catch rates were above average. Chinook, sockeye, coho, and chum salmon harvests were below the most recent 10-year averages. The Chinook and chum salmon harvest were the 3rd lowest in the most recent 10 years, while coho salmon harvest was the 4th lowest on record.

Based on escapement at the Kanektok River weir, the Chinook run timing was average while sockeye and chum salmon run timing was late. Chinook salmon escapement was above average while the sockeye and chum salmon escapements were below average. The Kanektok River Chinook salmon aerial survey SEG (range 3,500–8,000) was achieved with 4,919 fish observed, while the sockeye salmon aerial survey SEG (range 14,000–34,000) was exceeded with 39,970 fish observed. The Chinook salmon run was anticipated to be similar in size to the 2014 run. However, both aerial surveys and weir assessment indicate that the 2015 run was over double that of 2014. Coho salmon were not completely enumerated at the Kanektok River weir.

Based on escapement counts at the Goodnews River weir, Chinook, sockeye, and chum salmon run timing was 1–3 days earlier than average. The Chinook salmon biological escapement goal (BEG) of 1,500–2,900 was not met with an estimated escapement of 1,398. The sockeye salmon BEG (range 18,000–40,000) was exceeded with an estimated escapement of 54,383. The chum

salmon lower bound SEG of 12,000 was not achieved with an estimated escapement of 10,885. The Middle Fork Goodnews River weir was removed on September 1; by that date 15,084 coho salmon had been observed, which exceeded the lower bound SEG of 12,000. An aerial survey was flown at the North Fork Goodnews River on July 27. The Chinook salmon aerial SEG of 640–3,300 was achieved with a count of 991, whereas the sockeye salmon SEG of 5,500–19,500 was exceeded with 38,390 counted.

YUKON AREA

The 2015 Yukon River total commercial harvest was 0 Chinook, 358,856 summer chum, 191,470 fall chum, 129,700 coho, and 7,378 pink salmon for the Alaska portion of the drainage. A total of 354,086 summer chum, 174,776 fall chum, 120,889 coho, and 7,378 pink salmon were harvested in the lower Yukon River (Districts 1–3) and 4,770 summer chum, 16,694 fall chum, and 8,811 coho salmon were harvested in the upper Yukon River (Districts 4–6). A total of 486 permit holders sold fish in 2015.

Summer Season

The 2015 preseason outlook, which attempts to account for low productivity observed since 2007, was 118,000–140,000 Chinook salmon. Thus, the 2015 Yukon River Chinook salmon run was expected to range from poor to below average. The upper end of this range is close to the run size observed in 2014 and, similar to 2014, subsistence fishing restrictions would be necessary to meet escapement goals.

Consistent with the preseason management plan, conservative actions were broadly implemented early in the Chinook salmon run. Subsistence salmon fishing was closed in the northern portion of the Coastal District and Districts 1 and 2 on May 30. Subsistence salmon fishing closures were similarly implemented in upriver districts chronologically as Chinook salmon migrated through these areas. Based on the expectation that the 2015 Chinook salmon run would be weak, these closures were expected to be in place for nearly the entire duration of the Chinook salmon run unless inseason assessment projects indicated that escapement goals were likely to be met.

Subsistence fishing opportunity was provided during subsistence salmon closures for the harvest of nonsalmon species, such as sheefish, whitefish species, and Northern pike, with 4-inch or smaller mesh size gillnets not exceeding 60 feet in length. This opportunity to harvest nonsalmon species was allowed at all times during subsistence salmon fishing closures. The department encouraged subsistence fishermen to avoid fishing in areas where Chinook salmon were known to migrate.

Once summer chum salmon became abundant, liberal subsistence fishing opportunity was provided with selective fishing gear (i.e., beach seines and dip nets in the lower river and dip nets and fish wheels in District 4) with the requirement that Chinook salmon be released alive. District 5 experienced the most restrictive management measures because very few summer chum salmon migrate through this district and any subsistence opportunity would likely target Canadian-bound Chinook salmon.

Conservative management actions were also taken in Yukon River tributaries in an effort to provide protection for Alaska Chinook salmon stocks. Gillnets were restricted to 6-inch or smaller mesh size in the Innoko and Koyukuk rivers for a significant portion of the Chinook salmon run. In the Tanana River (Subdistricts 6-A and 6-B), subsistence salmon fishing remained on its regulatory schedule of two 42-hour periods per week for the entirety of the

Chinook salmon season. However, gear was restricted to 6-inch or smaller mesh size gillnets and manned fish wheels until mid-July.

In 2015, for the 8th consecutive year, no commercial periods targeting Chinook salmon were allowed in the mainstem Yukon River or in the Tanana River. However, commercial fishing opportunity was provided to target the available surplus of summer chum salmon in Districts 1, 2, and 6. No commercial fishing occurred in District 4 in 2015. The sale of incidentally caught Chinook salmon was prohibited by emergency order during the entire commercial fishing season (both summer and fall seasons) to dissuade fishermen from targeting Chinook salmon during commercial fishing periods.

Because Chinook salmon are encountered incidentally in the commercial summer chum salmon fishery, a suite of strategies were used to conservatively manage these fisheries to minimize the impact to the poor Chinook salmon run. An early breakup and the use of selective gear types allowed the department to open commercial fishing of summer chum salmon using dip nets and beach seines beginning June 11 in District 1 and June 15 in District 2. The impact to Chinook salmon was expected to be minimal because fishermen were required to immediately release all incidentally caught Chinook salmon back to the water alive from dip net and beach seine gear. The department allowed two 10-hour and seventeen 12-hour periods in District 1 and twenty 10-hour periods in District 2 using dip nets and beach seines only. Although commercial and subsistence fishing occurred concurrently during the week, mornings during the week and Saturdays were reserved for subsistence fishing.

In 2015, in an effort to reduce the incidental harvest of Chinook salmon, the use of gillnet gear was delayed until inseason assessment indicated the majority of the Chinook salmon run had migrated upriver. In District 1 only, commercial opportunity with 5.5-inch or smaller mesh size gillnets not exceeding 30 meshes in depth was provided for 3 periods in a further attempt to reduce the incidental harvest of Chinook salmon. Once managers were confident that the majority of the run had migrated out of each district, gillnet opportunity with 6-inch gillnet gear was provided for the remainder of the summer season beginning on July 7 in District 1 and July 6 in District 2.

The preliminary summer chum salmon commercial harvest for Districts 1 and 2 combined was 354,086 fish for all gear types combined. The summer chum salmon harvest was 21% above the 2010–2014 average harvest of 238,929. The dip net harvest (217,654) was a significant contributor in making the 2015 summer chum salmon commercial harvest in the lower Yukon River the 3rd largest since 2004. A total of 9,507 Chinook salmon were reported as caught and released alive back to the water (dip nets and beach seines combined), and 3,289 Chinook salmon were recorded on fish tickets as caught but not sold for Districts 1 and 2 combined. A total of 98 Chinook salmon were caught but not sold in the fall season.

The first commercial fishing period to target summer chum salmon in District 6 was on July 13. Commercial fishing gear was restricted to fish-friendly (as defined in regulation) fish wheels that had to be attended at all times, and all Chinook salmon caught in the fish wheels had to be immediately released to the water alive. These gear restrictions were relaxed on July 24 after both Chinook salmon escapement goals on the Chena and Salcha Rivers were met. There were 8 commercial fishing periods with a total harvest of 4,770 summer chum salmon. A total of 347 Chinook salmon were reported as caught and released back to the water alive, and 83 Chinook

salmon were recorded on fish tickets as caught but not sold. One Chinook salmon was recorded as caught but not sold in the fall season.

A total of 437 permit holders participated in the summer chum salmon commercial fishery, approximately 7% below the 2005–2014 average of 472 permit holders. The Lower Yukon Area (Districts 1–3) and Upper Yukon Area (Districts 4–6) are separate Commercial Fisheries Entry Commission permit areas. A total of 435 permit holders fished in the Lower Yukon Area in 2015, which was approximately 5% below the 2005–2014 average of 458. In the Upper Yukon Area, 2 permit holders fished, which was approximately 86% below the 2005–2014 average of 14. The dramatic decrease in permit holders that fished in the Upper Yukon Area is mostly due to the lack of a commercial fishery in District 4 in 2015.

Four SEGs, 2 BEGs, and an international interim management escapement goal exist for Chinook salmon. In 2015, all escapement goals for Chinook salmon were met or surpassed. Preliminary Chinook salmon passage at the Eagle sonar was approximately 84,100, which was adequate to exceed both the Canadian Yukon River mainstem escapement and harvest sharing objectives.

Two escapement goals exist for summer chum salmon on the East Fork Andreafsky and Anvik rivers. Both escapement goals for summer chum salmon were met; however, all summer chum salmon tributaries (except for Henshaw Creek) experienced below average escapement in 2015. The 2015 summer chum salmon counts on the Chena and Salcha rivers were inhibited by unfavorable water conditions.

Fall Season

The Yukon Area fall season began by regulation on July 16 in District 1. The subsequent transition of upriver districts and subdistricts to the fall season was based on the migration timing of fall chum salmon. Management was based on a preseason run projection range of 700,000–800,000 fall chum salmon. All districts and subdistricts were placed on their full regulatory subsistence fishing schedules commensurate with switching over to fall management. By August 8, subsistence fishing in all mainstem districts was open 7 days per week, 24 hours per day. Subsistence fishing for salmon in the mainstem Porcupine River closed on August 22. This closure was because fall chum salmon escapements into the Canadian Fishing Branch River, a tributary of the Porcupine River, have fallen short of meeting the escapement objective agreed upon by U.S. and Canadian representatives in 3 of the last 5 years. The closure was an attempt to improve fall chum escapement into the Canadian portion of the drainage.

Districts 1 and 2 were placed on a 2-period-per-week commercial fishing schedule at the beginning of the season. The schedule was mostly adhered to with the exception of several skipped periods because of low numbers of fall chum present in the lower Yukon River, poor weather conditions, or because attempts were made to get fall chum salmon upriver for subsistence needs. The fall chum salmon directed commercial fishery ended by regulation after August 31. The department identified a surplus of coho salmon in addition to what was harvested in the fall chum salmon commercial fishery and allowed a coho salmon directed fishery in District 1 from September 1 to September 4.

There were a total of 44 commercial periods during the fall season in 2015. The majority of fall season commercial harvest occurred in the lower river districts. Commercial fishing periods were established in Districts 5 and 6, but limited markets resulted in low fishing effort and relatively

small harvests. The total commercial harvest for the Yukon River fall season in the Alaska portion of the drainage was 191,470 fall chum and 129,700 coho salmon. Fall chum salmon commercial harvest was above the most recent 5-year (2010–2014) and 10-year (2005–2014) averages. The coho salmon harvest was the highest on record, eclipsing the previous high of 106,696 in 1991. The average weight of both fall chum and coho salmon caught commercially in Districts 1 and 2 was 7.3 lb. All salmon were sold in the round and no salmon roe was sold separately. The average price per pound paid for fall chum salmon Districts 1 and 2 was $0.60; the average price paid for coho salmon was $0.70. Both were well below their most recent 5-year (2010–2015) averages of $0.85 (fall chum salmon) and $1.17 (coho salmon). A total of 446 individual permit holders participated in the fall chum and coho salmon fishery: 440 in Districts 1 and 2 combined, and 6 in Districts 5 and 6 combined.

The preliminary 2015 fall chum salmon run size is estimated to be 800,000, which was below the lower end of the preseason forecast range of 944,000–1.2 million. The preliminary drainagewide escapement estimate for fall chum salmon is 453,000, the midpoint of the SEG range (300,000–600,000). Most fall chum salmon escapement goals were exceeded (drainagewide, Mainstem Yukon, Chandalar, Tanana, and Delta rivers). The exception was the Fishing Branch River (Porcupine River drainage including the Sheenjek River) which has failed to achieve the lower end of its interim management escapement goal range (22,000–49,000) for 3 of the last 5 years despite other Yukon River stocks meeting or exceeding their escapement goals or objectives.

The estimated passage of 97,600 coho salmon past Pilot Station sonar was below the historical median of 121,000. However, preliminary run reconstruction indicates a run size of 229,000 which is above historical median of 176,000. The Delta Clearwater River has the only established escapement goal for coho salmon in the Yukon Area, an SEG range of 5,200–17,000. A boat survey conducted in the Delta Clearwater River in late October observed 14,130 coho salmon.

NORTON SOUND AREA

Highlights of the 2015 Norton Sound District salmon fishery included the highest exvessel value on record, record harvests of coho and sockeye salmon, and the highest chum salmon harvest in over 30 years. For odd-numbered years, pink salmon run strength throughout Norton Sound was the strongest since the record odd-year run of 2005. Restrictions were taken in the subsistence fishery in southern Norton Sound to protect Chinook salmon and escapements were much improved.

Large chum and coho salmon harvests accounted for the majority of the $1,915,749 paid to 137 permit holders despite significant reductions in dock prices paid for salmon. Permit holder participation, although the highest in over 20 years, was similar to last year when 128 permit holders fished. Commercial salmon harvests were 1,059 Chinook, 4,322 sockeye, 154,487 coho, 64,497 pink, and 153,039 chum salmon.

The 2015 forecasted commercial chum salmon harvest range was 70,000–100,000. However, the chum salmon run was much stronger than expected. Commercial chum salmon fishing was delayed until July in Subdistricts 5 (Shaktoolik) and 6 (Unalakleet) to protect Chinook salmon, but the chum salmon harvest was still the 5th year out of the last 6 years that harvest exceeded 100,000, and it was the largest harvest since 1983. Before 2010 the commercial harvest had not exceeded 100,000 in over 20 years.

The 2015 pink salmon commercial harvest ranked 7th out of 26 odd-numbered year harvests and was 60% above the odd-year average harvest (1965–2013) of 40,287 and within the forecast range of 25,000–75,000.

The 2015 record coho salmon harvest greatly exceeded the forecast range of 60,000–90,000 and was nearly 20% above the previous record harvest in 2006. Southern Norton Sound Subdistricts 4–6 combined represented the majority (89%) of the harvest. Record harvests occurred in Norton Bay (9,709) and Unalakleet (101,783) Subdistricts.

The average price paid per pound was $2.28 for Chinook, $0.69 for sockeye, $0.50 for chum, $0.21 for pink, and $1.10 for coho salmon. Prices were down for all species except Chinook and sockeye salmon this season.

Chinook salmon escapement goals were met throughout Norton Sound, including the North River and Kwiniuk River counting towers which made the goal for the 2nd season in row after failing to reach the goal for 3 consecutive (North River) and 4 consecutive seasons (Kwiniuk River). The Pilgrim River sockeye salmon run was the greatest since the record runs in middle of the last decade. Based upon available escapement monitoring information, chum, coho, and pink salmon escapement goals were likely achieved throughout Norton Sound.

KOTZEBUE SOUND AREA

The Kotzebue Sound chum salmon harvest in 2015 was the 12th highest in the 54-year history of the fishery. The harvest fell short of a top-10 finish because of buyer capacity issues that resulted in some fishing periods being cancelled. In 2015 there was only 1 major buyer compared to 3 buyers last year. The Kobuk River test fish index was the 4th highest on record for the 23-year project history. The commercial harvest of 306,174 chum salmon, although less than half of last year's harvest, was still the 3rd highest in over 25 years. Buyers only purchased chum salmon, but harvest retained for personal use included 5 Chinook, 6 sockeye, 27 pink, and 6 coho salmon; 62 Dolly Varden; 22 sheefish; and 100 chum salmon that were included in the commercial harvest total.

There were 103 permit holders that sold chum salmon in 2015. This year's participation by permit holders was the highest number since 1994 when 109 permit holders sold fish. The highest fishing effort occurred on August 11 when 72 permit holders fished a 6-hour period. This was the greatest number of permit holders to participate during 1 fishing period since 1994. One difference was that period length in 1994 was 36 hours.

A total of 2,589,104 lb of chum salmon (average weight 8.6 lb) were sold at an average price of $0.33 per pound. This year's price was a drop of nearly 40% from last year's price of $0.54 per pound.

Table 6.–Preliminary 2015 Arctic-Yukon-Kuskokwim Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total [a]
Kuskokwim River	0	0	65	0	1	66
Kuskokwim Bay	8	56	83	0	21	168
Kuskokwim Area Total	8	56	148	0	21	234
Lower Yukon River			121	7	529	657
Upper Yukon River			9		21	30
Yukon River Total			130	7	550	687
Norton Sound	1	4	154	64	153	377
Kotzebue Sound					306	306
AYK Region Total	9	61	433	72	1,031	1,605

Note: Missing data indicates no harvest, and zeros indicate harvest activity but <500.

Note: Columns and rows may not total exactly due to rounding error.

[a] Confidential information not included.

WESTWARD REGION

KODIAK MANAGEMENT AREA

Commercial fishing effort increased slightly during 2015. Of the 591 eligible commercial salmon permits, 335 (57%) made commercial landings. By gear type, a total of 180 purse seine, 1 beach seine, and 154 set gillnet permit holders made deliveries in 2015. Participation by purse seine and set gillnet permit holders was above the previous 10-year average.

The 2015 commercial harvest (not including personal use or ADF&G test fishery) in the Kodiak Management Area (KMA) was 8,380 Chinook, 3,103,703 sockeye, 400,385 coho, 33,026,567 pink, and 771,127 chum salmon (Table 7). The total Kodiak areawide harvest (including Kodiak Regional Aquaculture Association cost recovery) of 37,310,162 salmon was well above the 2015 forecast and the previous 10-year average of approximately 23,745,906 salmon.

Purse seine fishermen accounted for the majority of the total harvest (in number of fish) and their earnings averaged $158,714 per fished permit. Set gillnet earnings averaged $30,228 per permit fished. Beach seine fishermen harvested a negligible amount of fish.

Commercial Harvest Summary

Chinook Salmon

There are no directed Chinook salmon commercial fisheries in the KMA, but incidental commercial harvest occurs during targeted sockeye salmon fisheries. The Ayakulik and Karluk river systems support the largest Chinook salmon populations in the KMA. Nonretention of Chinook salmon was implemented for the seine fleet areawide from June 3 through July 5. Nonretention of Chinook salmon was implemented for the seine fleet from July 6 until the end of the season along the Westside of Kodiak from the latitude of Cape Kuliuk to the latitude of Low Cape. Neither Karluk nor Ayakulik Chinook salmon achieved their escapement goals. The 2015 commercial harvest of Chinook salmon in the KMA totaled 8,087 which was below the previous 10-year average (16,651) and below the 2015 forecast (15,000).

Sockeye Salmon

The 2015 commercial harvest of sockeye salmon totaled 3,103,703. The harvest was well above the recent 10-year average (2,195,831) but slightly below the forecast (3,494,116).

Early season management for much of the Westside and north end of Kodiak Island is driven by Karluk early-run sockeye salmon (through July 5). Extended fishing was allowed along the Westside of Kodiak in the Central, North Cape, Southwest Afognak, and Outer Karluk sections until the management focus turned to pink salmon beginning July 6. A total of 304,821 sockeye salmon were harvested in early season (through July 15) Westside areas opened based on Karluk early-run sockeye salmon, which was above the forecasted Karluk early-run harvest of 176,867.

Late-season management for much of the Westside and north end of Kodiak Island is driven by the Kodiak Island pink salmon fishery (beginning July 6) and Karluk late-run sockeye salmon (after August 16). A total of 1,205,542 sockeye salmon were commercially harvested in late season (after July 15). Westside areas opened based on Karluk late-run sockeye salmon and during the Kodiak Island pink salmon fishery. This was above the forecasted Karluk late-run harvest of 824,440.

Westside sockeye salmon numbers include an estimated contribution of approximately 237,994 sockeye salmon from the enhanced Spiridon Lake sockeye salmon run—of which 92,222 were harvested in Spiridon Bay SHA.

The Ayakulik sockeye salmon run was strong and there were several openings throughout the season. The first commercial opening occurred in both the Inner and Outer Ayakulik sections on June 15. A total 568,932 of sockeye salmon were harvested from Westside sections attributed to Ayakulik, which was well above the 2015 forecast of 101,273.

The Frazer Lake sockeye salmon run came in as forecasted and the Upper Station early run was strong enough to allow for openings in the traditional fishing areas. The Alitak District early-run (through July 15) sockeye salmon harvest was 151,632, which was below the projected harvest of 257,657. However, a large amount of the Frazer sockeye salmon run showed up late and extended fishing time was allowed until early August. The Upper Station late-run sockeye salmon run came in as weak as expected and no fishing periods were permitted after August 9 in areas in which Upper Station-bound sockeye salmon would be harvested in high numbers. The total harvest of the Alitak District late-run sockeye salmon was 213,652, which was above the forecasted harvest of 106,673.

Cape Igvak Salmon Management Plan

This regulatory management plan (5 AAC 18.360) allocates up to 15% of the total Chignik-bound sockeye salmon harvest to KMA fishermen in the Cape Igvak Section. Based on regulations, 90% of all sockeye salmon caught prior to July 25 in the Cape Igvak Section are considered to be Chignik-bound.

Both Chignik sockeye salmon runs were extremely late and the allocative and biological criteria were not met until mid-July. Although extended fishing time was allowed after July 16, only 6,595 sockeye salmon were harvested in the Cape Igvak Section by July 25 which was below the preseason forecast of approximately 235,353.

North Shelikof Sockeye Salmon Management Plan

From July 6 to July 25, this regulatory management plan (5 AAC 18.363) places harvest limits on areas along the northern Shelikof Strait to limit interception of sockeye salmon that are considered Cook Inlet-bound. During the period that this management plan is in effect, KMA fisheries are targeting local pink salmon runs and fishing periods are based on projected pink salmon run strength. If it appears that the sockeye salmon harvest will meet or exceed limits set by the management plan, then fisheries are to be restricted to inshore *Shoreward Zones* only, and offshore *Seaward Zones* are closed.

A department biologist was present on the grounds to determine the sockeye salmon catch and to facilitate orderly and short-notice closures if the harvest limits are met. A *Seaward Zone* closure was implemented in the North Shelikof Unit at 3:00 p.m., July 15, when it was estimated that the cumulative sockeye salmon harvest had approached the 15,000 limit. The total July 6–25 harvest in the North Shelikof Unit was 82,225 sockeye salmon, which included both the *Shoreward* and *Seaward Zone* harvests. A *Seaward Zone* closure did not take place in the Southwest Afognak Section and the harvest cap of 50,000 was never exceeded. Approximately 38,294 sockeye salmon were harvested in the Southwest Afognak Section between July 6 and July 25.

Terminal and Special Harvest Areas

Some fisheries occur in areas where salmon enhancement projects create surplus production.

There was no effort or harvest in the Waterfall Bay SHA. There was below-average effort and harvest in the Foul Bay SHA with a total of 8,327 sockeye salmon harvested.

In the Spiridon Bay SHA (Telrod Cove), 92,222 sockeye salmon were harvested. This includes a cost-recovery fishery harvested by Kodiak Regional Aquaculture Association. The harvest in the Spiridon Bay SHA represents only a portion of the total harvest of Spiridon enhancement fish; the remainder is harvested in traditional fisheries along the Westside of Kodiak. It is estimated that 145,772 Spiridon enhancement fish were harvested outside of Telrod Cove, bringing the total Spiridon enhancement sockeye salmon harvest to 237,994.

The Kitoi Bay Hatchery harvest was an estimated 62,627 sockeye salmon, which was below the forecast of 87,516. This includes the commercial harvest of both enhanced and wild salmon from the Inner Kitoi Bay, Outer Kitoi Bay, Duck Bay, and Izhut Bay sections and includes fish retained for personal use (294). Additional enhanced sockeye salmon may have been harvested in adjacent sections, but stock separation data are not available.

Coho Salmon

The commercial coho salmon harvest of 400,385 was above the forecast (330,889) and above the previous 10 year average (329,946). The majority of the coho salmon were caught in the Westside Kodiak, Eastside/Northend and the Afognak fisheries.

Pink Salmon

The 2015 pink salmon harvest of 33,026,567 was above forecast (14,298,094), above the previous 10-year average harvest of 20,432,760, and the 3rd largest ever in the KMA.

The wild stock pink salmon harvest was the second largest ever with 28,057,301 harvested in the KMA. The majority of the pink salmon were harvested on the Westside but both Alitak and the Eastside/Northend of Kodiak had significant harvests. Westside pink salmon fisheries (Raspberry Cape to Ayakulik) accounted for 10,449,128, the Alitak District had a harvest of 5,813,080, and the Eastside/Northend Kodiak fisheries had a combined harvest of 8,057,474.

The Kitoi Bay Hatchery pink salmon run was weaker than expected with 4,957,598 harvested in sections near the hatchery (7,365,000 forecast). Kitoi-bound pink salmon were probably harvested along the west and east sides of Kodiak and Afognak islands. Likewise, additional wild stock salmon were likely harvested in areas associated with Kitoi Bay Hatchery. However, the department does not have a stock separation program for pink salmon and is unable to differentiate stocks. There was a cost-recovery fishery near the hatchery with sockeye, pink, and chum salmon harvested and sold by the Kodiak Regional Aquaculture Association.

Chum Salmon

The chum salmon harvest of 771,127 was above the forecast (707,416). However, the Kitoi Bay Hatchery chum salmon production was again very weak with only 55,256 chum salmon harvested, which is below the preseason forecast of 171,000.

Escapement Summary

Fish counting weirs were operated on 9 systems in 2015, including the Karluk, Ayakulik, Upper Station, Dog Salmon, Litnik, Buskin, Saltery, Pauls Bay, and Pasagshak systems. Three observers also flew a record low 18 aerial surveys, and several observers conducted foot and skiff survey escapement estimates. Due to the lack of sufficient funding, peak aerial surveys were not conducted in much of the Kodiak Area.

Chinook Salmon

The total Chinook salmon escapement (5,250) was below the previous 10-year average. Escapement goals for Chinook salmon have been developed for the Karluk and Ayakulik rivers, and escapements are estimated using fish counting weirs.

The Chinook salmon escapement through the Karluk weir (2,777) was below the escapement goal range of 3,000–6,000. Chinook salmon escapement through the Ayakulik weir (2,392) was below the escapement goal range of 4,000–8,000.

Sockeye Salmon

Sockeye salmon runs in many systems in the KMA were strong (particularly Karluk and Ayakulik). Most of the major systems either met or exceeded their established escapement goals. However, the sockeye salmon runs to Uganik River and Pasagshak River did not achieve the minimum escapement goal values. The entire KMA estimated sockeye salmon escapement of (1,498,756) was well above the previous 10-year average of 1,219,116.

Coho Salmon

The only established coho salmon escapement goals occur in the Northeast Kodiak and Eastside Kodiak districts for the following systems: American (400), Olds (1,000), Buskin (3,200–7,200) and the Pasagshak rivers (1,200). At the time of this report the final estimated escapement numbers have not been calculated.

It is expected that coho salmon enter systems in the fall after weirs have been removed and aerial and foot surveys have concluded. However, due to limited funding, the department no longer flies peak- or late-season salmon surveys, and the areawide coho salmon escapement numbers do not reflect the actual the KMA coho salmon escapement.

Pink Salmon

The KMA pink salmon escapement of 5,906,331 was above the previous 10-year average of (4,075,413). Pink salmon escapement goals have been established as aggregate goals for the entire Kodiak Archipelago and the Mainland District. The escapement for the Kodiak Archipelago (5,151,731) was within the escapement goal range of 3.0–6.0 million. The Mainland District pink salmon escapement of 754,600 was above the established escapement goal range (250,000–750,000). However, due to limited funding, the department no longer conducts peak aerial surveys, and both the Kodiak Archipelago and Mainland numbers should be considered minimum estimates.

Chum Salmon

The overall chum salmon escapement of 437,544 was above the previous 10-year average (355,031). Escapement goals have been established for the Kodiak Archipelago and the Mainland District. The escapement in the Kodiak Archipelago was above the escapement goal of

151,000 with an estimated 304,344, and the Mainland District escapement of 133,200 was above the escapement goal of 104,000. However, due to limited funding, the department no longer conducts peak aerial surveys, and both the Kodiak Archipelago and Mainland numbers should be considered minimum estimates.

CHIGNIK MANAGEMENT AREA SEASON SUMMARY

The Chignik River watershed supports 2 genetically distinct sockeye salmon runs which traditionally provide the majority of directed harvest opportunities within the Chignik Management Area (CMA). In 2015, the combined early- and late-run Chignik River sockeye salmon escapement was above recent averages, whereas Chignik-bound harvest was similar to recent averages. The CMA was open to commercial salmon fishing for 64 days (June 24–September 14) and a total of 72 permits were fished (including the department's test fishery permit).

Escapement Summary

Escapement through the Chignik River weir was monitored using underwater digital video equipment from May 19 to August 20. Two underwater gates in the weir were open to provide uninterrupted escapement. Fish passing the weir were counted by species for the first 10 minutes of each hour. The counts were expanded to obtain hourly escapement estimates, and then summed to provide an estimate of daily fish passage. A digital video archive was kept of each 10-minute counting period in the 2015 season.

Beginning August 21, escapement was estimated using 2 DIDSON acoustic units. The numbers of fish passing by the DIDSONs were counted for the first 10 minutes of each hour and then the counts were expanded to obtain hourly escapement estimates. Species apportionment was determined by fishing with a seine net at least every other day. The results of the fishing samples were then applied to the escapement numbers. The last day of DIDSON escapement estimates was September 23.

Aerial surveys were flown throughout the season to monitor escapement into CMA streams. Peak aerial survey counts, by index stream and species, were summed and compared to available escapement goals. Pink and chum salmon escapements were measured against established areawide SEGs.

Chinook Salmon

The Chignik River is the only Chinook salmon-producing stream within the CMA and one of the largest Chinook salmon streams on the South Alaska Peninsula. The BEG for Chinook salmon in the Chignik River watershed is 1,300 to 2,700. The 2015 Chignik River Chinook salmon escapement, above the weir (2,054), was below the most recent 5-year and 10-year averages. Subsistence and sport fishery harvest of Chinook salmon above the weir will not be known until permits and questionnaires are returned and tabulated by the spring of 2016.

Sockeye Salmon

Sockeye salmon escapement to the Chignik River is managed based on separate escapement objectives for both early- and late-run sockeye salmon. The early-run SEG of 350,000–450,000 was exceeded with an estimated escapement of 534,088.

The late-run objectives include an additional 50,000 sockeye salmon, which are incorporated into the late-run SEG to provide for additional freshwater subsistence fishing opportunity. The late-run SEG of 250,000–400,000 sockeye salmon was exceeded with an estimated escapement of 589,810. Of these fish, an estimated 286,553 passed through the weir and 303,257 were estimated by postweir DIDSON counts. Approximately 131,985 sockeye salmon escaped from September 1 to September 15 and were included in the total late-run escapement estimate.

Both the early- and late-run escapements were above the most recent 5- and 10-year average escapements. Sockeye salmon escapements into other CMA streams were relatively minor. The 2015 sockeye salmon run timing for both Chignik River runs was at least a week later than the previous 10-year average. Fish weight and lengths were also smaller than average in the CMA. The 2015 average sockeye salmon weight of 5.5 lb is the smallest average weight in the last 20 years.

Coho Salmon

Coho salmon begin to enter CMA drainages in mid-August and continue through November. The coho salmon run is generally building when the weir is removed. The 2015 Chignik River coho salmon weir escapement estimate through September 23 was 60,209, which was well above the most recent 5- and 10-year average escapement estimates.

Pink Salmon

An estimated 4,269 pink salmon passed the Chignik River weir in 2015, which was below the previous 5- and 10-year average pink salmon escapements. Pink salmon escapements into other CMA streams were estimated via aerial survey and summarized by district. The odd-year pink salmon SEG for all districts combined (500,000–800,000) was exceeded with an estimated total peak escapement of 1,132,529.

Chum Salmon

The 2015 Chignik River chum salmon escapement was 54, which was below average for the Chignik River. Chum salmon escapements to other CMA streams were estimated via aerial survey and summarized by district. The SEG lower bound for all districts combined (57,400) was exceeded with an estimated total peak escapement of 238,214.

Commercial Fishery Summary

The CMA was open to commercial salmon fishing for 68 days during the 2015 commercial salmon season. The first fishing period occurred on June 24 and the CMA closed to commercial salmon fishing on September 14. Salmon processors ceased operations in the CMA on August 20, the last day the area was actively fished in the 2015 season. In 2015, 72 permit holders (including the department's test fishery permit) made a total of 2,276 landings.

Harvest Summary

Chinook Salmon

A total of 9,105 Chinook salmon were commercially harvested (excluding home pack and the department's test fishery) in 2015, which was well above recent average harvests. The majority of the 2015 CMA Chinook salmon harvest occurred in the Central and Western districts.

Sockeye Salmon

A total of 1,540,310 sockeye salmon were commercially harvested (excluding home pack and the department's test fishery) in the CMA during 2015, which was below the prior 5-year average harvest and above the most recent 10-year average harvest. The majority of the 2015 CMA sockeye salmon harvest came from the Chignik Bay and Western districts.

In 2015, Cape Igvak and Southeastern District Mainland (SEDM) opened to commercial salmon fishing on July 16. Cape Igvak fisherman harvested 6,595 sockeye salmon (5,936 considered Chignik-bound) during the allocation period through July 25. A total of 123,091 sockeye salmon (98,473 considered Chignik-bound) were harvested in SEDM through July 18 when the fishery closed.

Coho Salmon

A total of 82,049 coho salmon were commercially harvested in 2015, which was similar to the 5- and 10-year average harvests. The majority of the coho salmon harvest in 2015 took place during July and August in the Western District.

Pink Salmon

A total of 1,978,134 pink salmon were commercially harvested (excluding the department's test fishery and home pack) in the CMA in 2015, which was well above the 5-year and 10-year average harvests. The majority of the pink salmon harvest occurred in the Western and Central districts during late-July and August.

Chum Salmon

A total of 101,001 chum salmon were commercially harvested in 2015, which was well below the 5-year and 10-year average chum salmon harvests. The majority of the chum salmon harvest in 2015 took place in the Central and Western districts in late-July.

ADF&G Test Fishery Summary

The department conducted 6 test fisheries in Chignik Lagoon for run assessment and cost-recovery purposes in 2015. An estimated 12,107 sockeye salmon were harvested, which provided approximately $49,000 that was used to offset the cost of vessel charters and operations at the Chignik River weir.

ALASKA PENINSULA, ALEUTIAN ISLANDS, AND ATKA-AMLIA ISLANDS MANAGEMENT AREAS SALMON SEASON SUMMARY

The 2015 commercial salmon harvest in the Alaska Peninsula, Aleutian Islands, and Atka-Amlia Islands Management Areas totaled 53,876 Chinook, 5,933,433 sockeye, 322,181 coho, 16,695,994 pink, and 867,279 chum salmon (Table 7). Subsistence salmon harvest will be reported in the 2015 annual management report. Data detailed in this report are considered preliminary.

South Unimak and Shumagin Islands June Fisheries

The South Unimak and Shumagin Islands fishing season began on June 7 for set gillnet gear and on June 10 for seine and drift gillnet gear. There were four 88-hour and one 64-hour fishing periods for set gillnet gear and four 88-hour fishing periods for seine and drift gillnet gear. The

commercial salmon harvest for the June fishery consisted of 44,389 Chinook, 1,115,504 sockeye, 20,193 coho, 573,104 pink, and 178,715 chum salmon.

Southeastern District Mainland

From June 1 to July 25, the Southeastern District Mainland (excluding the Northwest Stepovak Section beginning July 1) is managed based on the strength of the Chignik sockeye salmon run. Due to later run timing of sockeye salmon returns to Chignik River in 2015, the CMA remained closed to commercial salmon fishing until June 24. During years in which it appears that the sockeye salmon harvest will be greater than 600,000 fish in the CMA but the first run fails to develop, commercial salmon fishing will be curtailed in the East Stepovak, Stepovak Flats, SW Stepovak, Balboa Bay and Beaver Bay sections of SEDM until the department projects that 600,000 fish will be harvested in the CMA. The harvest exceeded 600,000 sockeye salmon on July 15, and one 48-hour commercial fishing period was permitted on July 16. A total of 187 Chinook, 123,091 sockeye, 6,507 coho, 59,989 pink, and 7,796 chum salmon were harvested during the allocation period from June 1 through July 25.

Beginning July 1, the Northwest Stepovak Section of SEDM is managed on the strength of the Orzinski Lake sockeye salmon run. Due to the later run timing of sockeye salmon returning to Orzinski Lake, the first commercial fishing period in the Northwest Stepovak Section began on July 10. The cumulative sockeye salmon escapement in Orzinski Lake of 26,600 was above the SEG of 15,000–20,000. The total harvest in the Northwest Stepovak Section from July 1 through July 25 was 44 Chinook, 110,527 sockeye, 1,306 coho, 18,223 pink, and 4,448 chum salmon.

From July 26 through August 31, SEDM is managed based on the abundance of local salmon stocks. Due to strong returns of pink and chum salmon into SEDM streams, weekly fishing periods were established throughout the month of August and September that were interspersed by 36-hour closures. The total harvest in SEDM for the 2015 season was 261 Chinook, 624,096 sockeye, 22,646 coho, 1,595,876 pink, and 56,299 chum salmon.

South Peninsula Post-June Fishery

Prior to the South Peninsula post-June fishery, the department conducts a test fishery to determine immature salmon abundance in the Shumagin Islands. Test fishing occurred on July 2, 8, and 9. The first test fishery, which occurred on July 2, resulted in 985 Chinook, 54 sockeye, 19 coho, and 194 chum immature salmon per set, for an average greater than 100 immature salmon per set. As a result, the seine fleet was closed to commercial salmon fishing in the Shumagin Islands of the Southeastern District during the first 33-hour fishing period that occurred on July 6. The final test fishery resulted in approximately 191 Chinook, 95 sockeye, 9 coho, and 168 chum immature salmon per set respectively, for an average of less than 100 immature salmon per set. A reduction in the amount of immature salmon harvested during the test fishery on July 8 and July 9 permitted the seine fleet to harvest salmon in the Shumagin Islands section during the second commercial fishing period that occurred on July 10.

From July 6 to July 31, there was a 33-hour fishing period followed by a 63-hour closure, followed by six 36-hour fishing periods separated by 60-hour closures. During August, the post-June fishery is managed based on the abundance of local stocks. In September and October, management focuses on coho salmon returns, although the status of late pink and chum salmon returns may also be taken into consideration.

The total commercial harvest for the South Peninsula post-June fishery (including the SEDM from July 26 to October 31) was 6,457 Chinook, 1,858,238 sockeye, 237,646 coho, 16,032,286 pink, and 484,644 chum salmon.

South Peninsula Escapement

The South Peninsula indexed sockeye salmon escapement of 88,010 was above the management objective range of 48,200–86,400. Mortensen Lagoon and Thin Point did not meet their respective SEGs from aerial surveys due to poor surveying conditions. However, reports from sport and subsistence groups suggest that sockeye salmon returns were considerably stronger than what could be estimated from aerial surveys. Pink salmon total escapement of 7,820,800 was above the SEG range of 1,637,800–3,275,700. Chum salmon indexed total escapement of 906,420 was above the cumulative district escapement goal range of 330,400–660,800. A total of 2,320 coho salmon were documented in South Peninsula streams. Some of the major coho salmon systems are typically not surveyed or surveyed during off-peak times. A lack of escapement information for coho salmon is due to the departure of management staff from the South Peninsula region prior to peak coho salmon runs, and poor weather conditions during the peak coho salmon runs preventing aerial surveys from being conducted.

Aleutian Islands Fishery and Escapement

The Aleutian Islands Area may open to commercial salmon fishing by emergency order if adequate escapement is observed and there is interest from the fishing industry. During an aerial survey in July of the Aleutian Islands, an inadequate amount of pink salmon (approximately 37,000) were observed in streams. The low abundance of pink salmon in the Unalaska Area did not allow for a commercial salmon fishery to occur in 2015. McLees Lake had a sockeye salmon escapement of 12,424, which met the SEG of 10,000–60,000.

North Alaska Peninsula

In 2015, 164 Area M permit holders participated in commercial salmon fisheries along the North Alaska Peninsula. There was no effort by Area T permit holders. The number of Area M permit holders participating in 2015 was far below the historic numbers observed during the 1990s.

The North Alaska Peninsula fishery is predominantly a sockeye salmon fishery, although depending on market conditions, directed Chinook, coho, and chum salmon fisheries occur in some locations. During even-numbered years, depending on market conditions, pink salmon runs are frequently targeted in the Northwestern District.

In 2015, the harvest of Chinook, sockeye, and chum salmon on the North Peninsula exceeded projected harvest levels, whereas the harvest of pink and coho salmon were below projected harvest levels. The North Alaska Peninsula harvest of sockeye, pink, and chum salmon were above the previous 10-year (2005–2014) averages for each species, whereas the harvest of Chinook and coho salmon were below the 10-year averages.

Northwestern District

In the 2015 Northwestern District commercial salmon fishery a total of 50 Chinook, 31,705 sockeye, 599 coho, 6,087 pink, and 155,102 chum salmon were harvested. A total of 8 permit holders participated in the fishery, consisting of 5 purse seiners and 3 drift gillnetters.

In the Northwestern District, the chum salmon escapement of 89,800 was below the SEG of 100,000–215,000. This escapement estimate represents a minimum, with the actual escapement probably being greater due to very poor survey conditions in 1 of the major chum salmon producing streams in the Northwestern District streams. The sockeye salmon escapement for 2015 in the Northwestern District was within the escapement goal range of 52,600–106,000 with a total escapement of 69,690.

Black Hills Section

Due to the lack of extensive closures during 2015 in the Bear, Three Hills, and Ilnik sections in the Northern District, effort by the drift gillnet fleet in the Black Hills Section was limited. A total of 34,342 sockeye and 16,577 chum salmon were harvested in the Black Hills Section in 2015. Weekly fishing periods occurred throughout the season in the Black Hills Section. North Creek is the only river in the Black Hills Section with a sockeye salmon escapement goal. The 2015 North Creek escapement of 18,000 sockeye salmon (determined by aerial surveys) exceeded the escapement goal of 4,400–8,800.

Nelson Lagoon Section

The Nelson (Sapsuk) River total run of 569,894 sockeye salmon (includes harvest and escapement) exceeded the estimated forecast of 419,000. From the total run, 312,894 sockeye salmon were harvested in Nelson Lagoon and 257,000 escaped in the Nelson River. The 2015 sockeye salmon escapement into Nelson River exceeded the BEG of 97,000–219,000.

The Nelson Lagoon Section was opened for all regularly scheduled fishing periods along with many extensions in fishing time in 2015. Beginning August 15, the Nelson Lagoon Section may be managed on local coho salmon runs. In 2015, 45,000 coho salmon were observed in Nelson River escapement exceeding the Nelson River SEG threshold of 18,000.

Bear River and Three Hills Sections

By regulation, the Bear River Section opens to commercial salmon fishing on May 1 and the Three Hills Section opens June 25. Both areas are managed based on the sockeye salmon run strength into Bear and Sandy rivers. In 2015, Bear and Sandy rivers experienced strong salmon runs; extensive closures that occurred in recent years were not necessary. During 2015, a total of 495,409 sockeye salmon were harvested in the Bear River Section, and 519,880 sockeye salmon were harvested in the Three Hills Section.

The Bear River early-run (through July 31) sockeye salmon escapement of 304,356 exceeded the escapement goal of 176,000–293,000. The Bear River late-run (after July 31) sockeye salmon escapement of 210,644 exceeded the late-run escapement goal of 117,000–195,000. The Bear River season sockeye salmon escapement was 515,000, which exceeded the season escapement goal of 293,000–488,000.

The 2015 Sandy River sockeye salmon escapement of 116,000 exceeded the season ending escapement goal range of 34,000–74,000.

Ilnik Section

In 2015 the Ilnik River sockeye salmon escapement through the weir was 26,000 and did not meet the Ilnik River escapement goal of 40,000–60,000. By regulation, the Ilnik Section can open to commercial salmon fishing on June 20. Sockeye salmon escapement into Ilnik River

exceeded interim escapement objectives early in the season and met the 5-day escapement objectives between June 20 and July 5. The Ilnik Section was open to commercial salmon fishing for 3½ days from June 24 to June 27 and then remained closed to commercial salmon fishing until the Ilnik river run was complete on July 20. No commercial fishing effort occurred in Ilnik Lagoon in 2015 despite weekly fishing periods.

In 2015, 464,156 sockeye salmon were harvested in the Ilnik Section. Beginning August 15, the Ilnik Section is managed for coho salmon runs into Ilnik Lagoon. Effort occurred in the Ilnik Section after August 15 targeting sockeye and coho salmon during weekly fishing periods; however, the effort was limited due to weather.

Inner and Outer Port Heiden Sections

Aerial escapement surveys began on the Meshik River on June 18. Subsequent surveys occurred throughout the season and the final sockeye salmon escapement into the Meshik River system was 154,500, exceeding the escapement goal of 25,000–100,000. This includes escapement into the Meshik River and tributaries, as well as Red Bluff and Yellow Bluff creeks.

Fishing time in the Outer Port Heiden Section is based on Meshik River sockeye salmon abundance unless management actions are taken for the conservation of Ugashik River sockeye salmon in the Egegik District. By regulation, the Outer Port Heiden Section can open to commercial salmon fishing from June 20 to July 31. The weekly fishing periods in the Outer Port Heiden Section are scheduled from 6:00 a.m. Monday to 6:00 p.m. Wednesday. The Outer Port Heiden Section opened on June 24 and had openings of 2½ days per week until the section closed on July 31. In 2015, a total of 867,674 sockeye salmon were harvested from the Outer Port Heiden Section.

Cinder River Section

No commercial salmon fishing effort occurred in the Cinder River Section (Figure 3) in 2015 despite weekly fishing periods of 2½ days per week for the entire season. The total Cinder River (including Mud Creeks) sockeye salmon escapement estimate of 132,600 exceeded the escapement goal of 12,000–48,000.

North Peninsula Escapement

Chinook Salmon

Nelson River is the only river in Area M with a Chinook salmon escapement goal. The 2015 Nelson River Chinook salmon escapement totaled 2,890 and met the escapement goal of 2,400–4,400. The total Northern District Chinook salmon escapement of 11,545 was below the most recent 10-year average of 17,261.

Chum Salmon

The Northern District has a districtwide chum salmon escapement goal of 119,600–239,200. This goal was met with an escapement of 182,994, close to the most recent 10-year average of 182,378. The bulk of the chum salmon escapement occurred in the Herendeen-Moller Bay Section (92,850) and the Meshik River in the Inner Port Heiden Section (32,100).

Coho Salmon

Coho salmon surveys were done on all Northern District streams; however, the surveys were done in early September and the runs were not complete at that time so the escapement numbers

are considered minimum estimates. Nelson and Ilnik rivers each have coho salmon threshold escapement goals in the Northern District. The Nelson River escapement of 45,000 coho salmon met the threshold goal of 18,000. The coho salmon run continues through September and the last aerial survey was on September 8. The Ilnik River escapement of 14,000 coho salmon met the threshold of 9,000. Like Nelson River, it is expected that more coho salmon entered the system after early September when the last aerial survey occurred. There was no directed coho salmon fishery in the Ilnik Section in 2015. The coho salmon escapement into the Cinder River was 28,000, and 112,000 escaped into the Meshik River system (Meshik River and Landlocked Creek) as observed by aerial survey during early September.

Table 7.–Preliminary 2015 Westward Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kodiak	8	3,104	400	33,027	771	37,310
Chignik	9	1,552	82	1,978	101	3,723
South Peninsula and Aleutians Islands [a]	51	3,207	266	16,684	676	20,883
North Peninsula [a]	3	2,728	57	12	192	2,992
Alaska Peninsula Total	54	5,936	323	16,696	867	23,876
Westward Region Total	71	10,592	805	51,701	1,739	64,909

Note: Columns and rows may not total exactly due to rounding error.

[a] Catches include test fishery catch.

PRELIMINARY FORECASTS OF 2016 SALMON RUNS TO SELECTED ALASKA FISHERIES

ADF&G prepares forecasts for salmon runs that affect major fisheries around the state. Salmon runs to be forecasted are selected using several criteria, including economic importance, feasibility, compatibility with existing programs, and management needs. For the 2016 fishing year, forecast fisheries are as follows:

Southeast	pink salmon
Prince William Sound	wild chum, sockeye, and pink salmon
Copper River/Copper River Delta	Chinook and sockeye salmon
Upper Cook Inlet	sockeye salmon
Lower Cook Inlet	pink salmon
Kodiak	
Kodiak Management Area	pink salmon
Spiridon Lake	sockeye salmon
Ayakulik River	sockeye salmon
Karluk River	sockeye salmon (early and late runs)
Alitak District (Frazer Lake and Upper Station)	sockeye salmon
Chignik	
Chignik River	sockeye salmon (early and late runs)
Bristol Bay	sockeye salmon
Alaska Peninsula	
South Alaska Peninsula	pink salmon
Bear River	sockeye salmon (late run)
Nelson River	sockeye salmon
Arctic-Yukon-Kuskokwim	
Yukon Area	fall chum salmon

A variety of information is used to forecast salmon runs. In most cases the principal indicator of future abundance is the escapement magnitudes of parental stocks. Other information that might have been considered includes spawning stock distribution, outmigrating smolt numbers, returns to date from sibling age classes of the projected return, and environmental conditions. A range of run possibilities are predicted for each forecasted fishery. In general, based on past experience, the actual run can be expected to fall within the range (between the lower and upper limits) less than half the time. Please see the appendices for further details.

Catch projections based on quantitative forecasts of salmon runs generally reflect potential harvests and are made for most of major sockeye salmon fisheries and pink salmon fisheries in Southeast Alaska, PWS, Cook Inlet, Kodiak, and the Alaska Peninsula. Forecasts for large hatchery runs including sockeye, pink, and chum salmon runs to the Southeast Alaska, PWS, and Kodiak areas are provided by private nonprofit operators. For other fisheries, the catch projections are made based on recent catch levels and are reflective of recent levels of fishing effort. Recent harvest levels have been constrained in many areas by historically low fishing effort, and thus recent catch levels are reflective of both market conditions and recent levels of salmon runs. Harvest projections for these fisheries may not be indicative of potential harvest levels.

SALMON SPECIES CATCH AND PROJECTIONS

Figures 2–6 show actual catch and projected catch for Chinook, sockeye, coho, pink, and chum salmon.

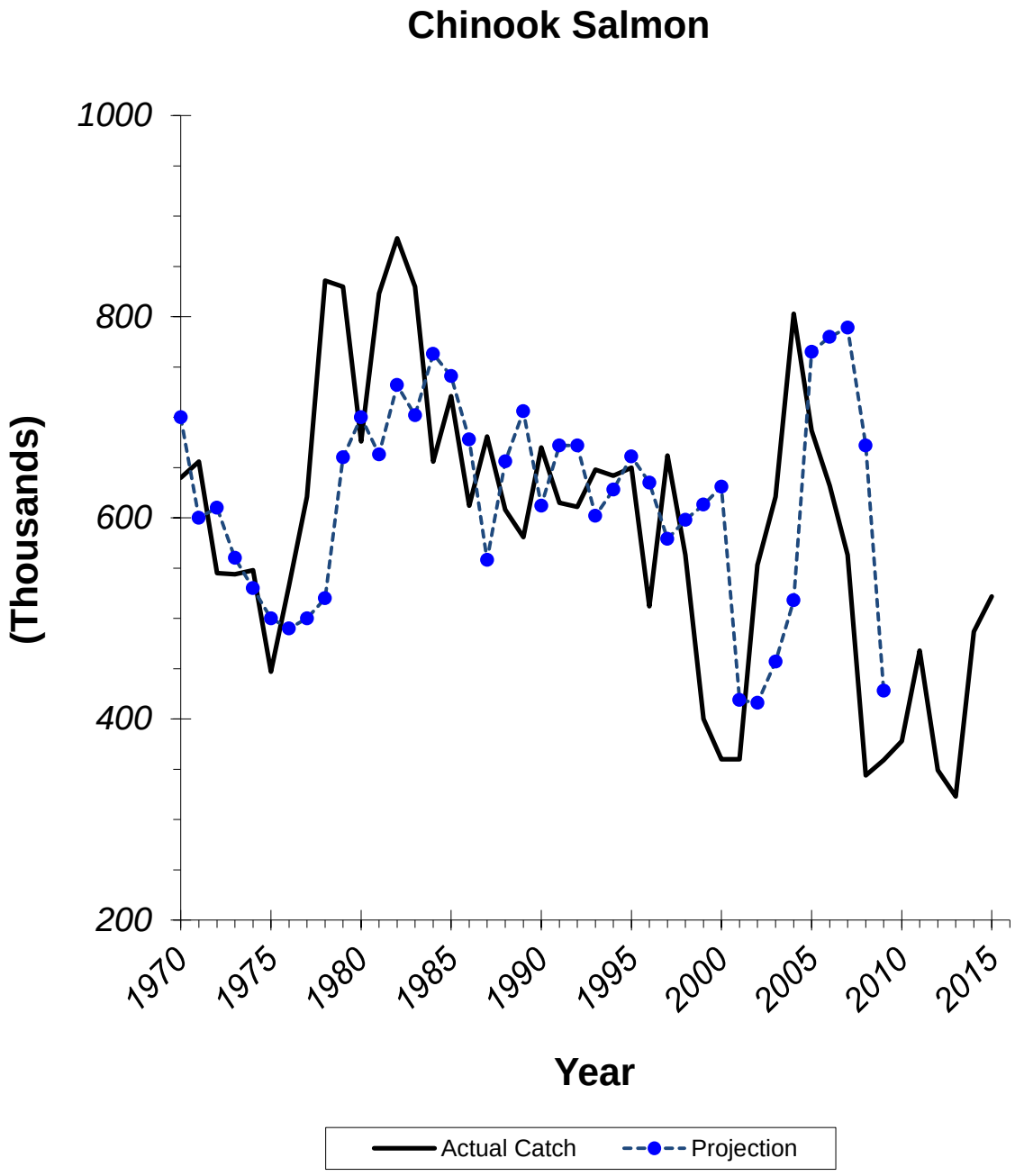

Figure 2.–Relationship between actual catch and projected catch in thousands, for Alaska Chinook salmon fisheries from 1970 to 2015; 2010–2016 projections are not available.

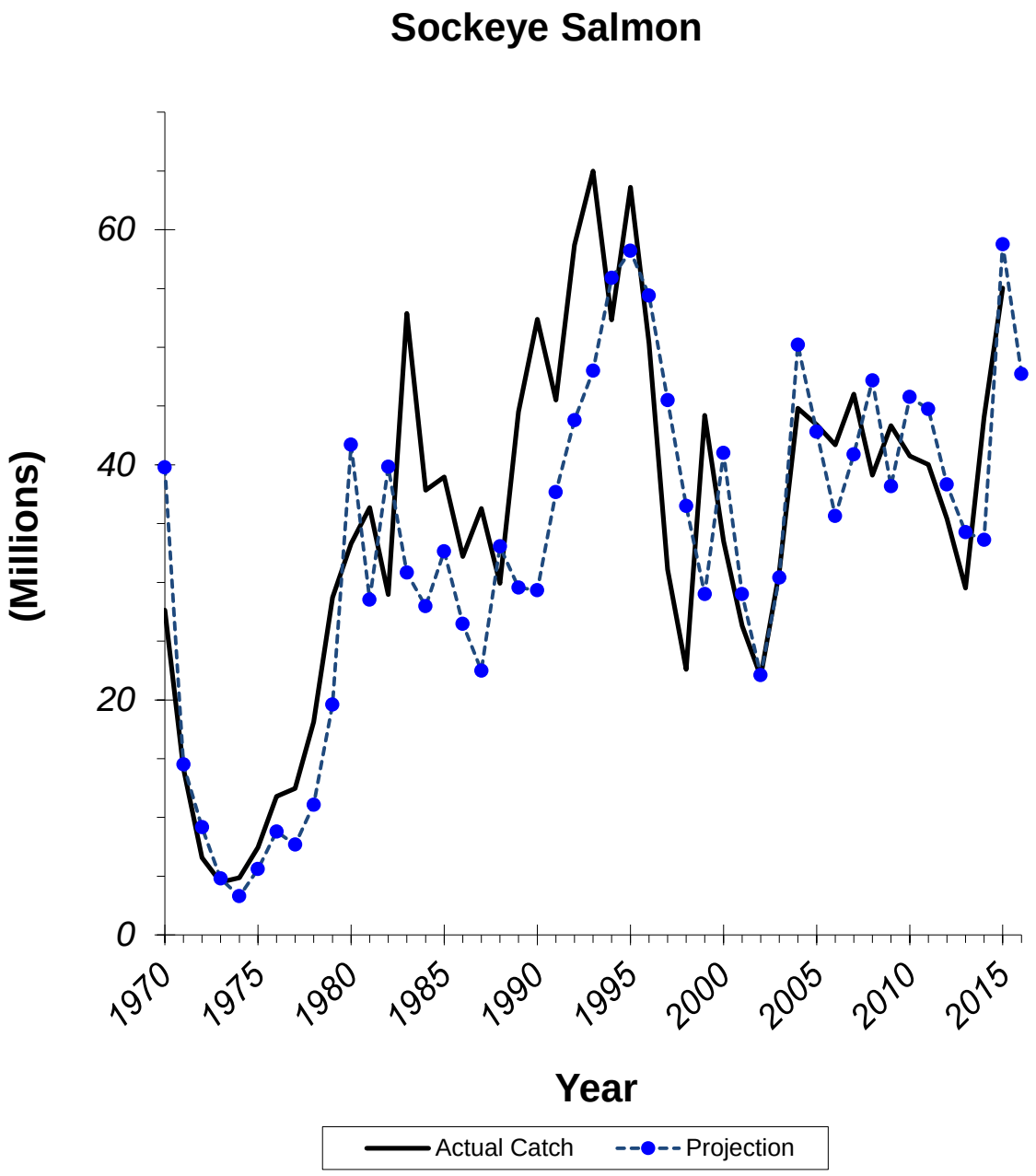

Figure 3.–Relationship between actual catch and projected catch in millions, for Alaska sockeye salmon fisheries from 1970 to 2015, with the 2016 projection.

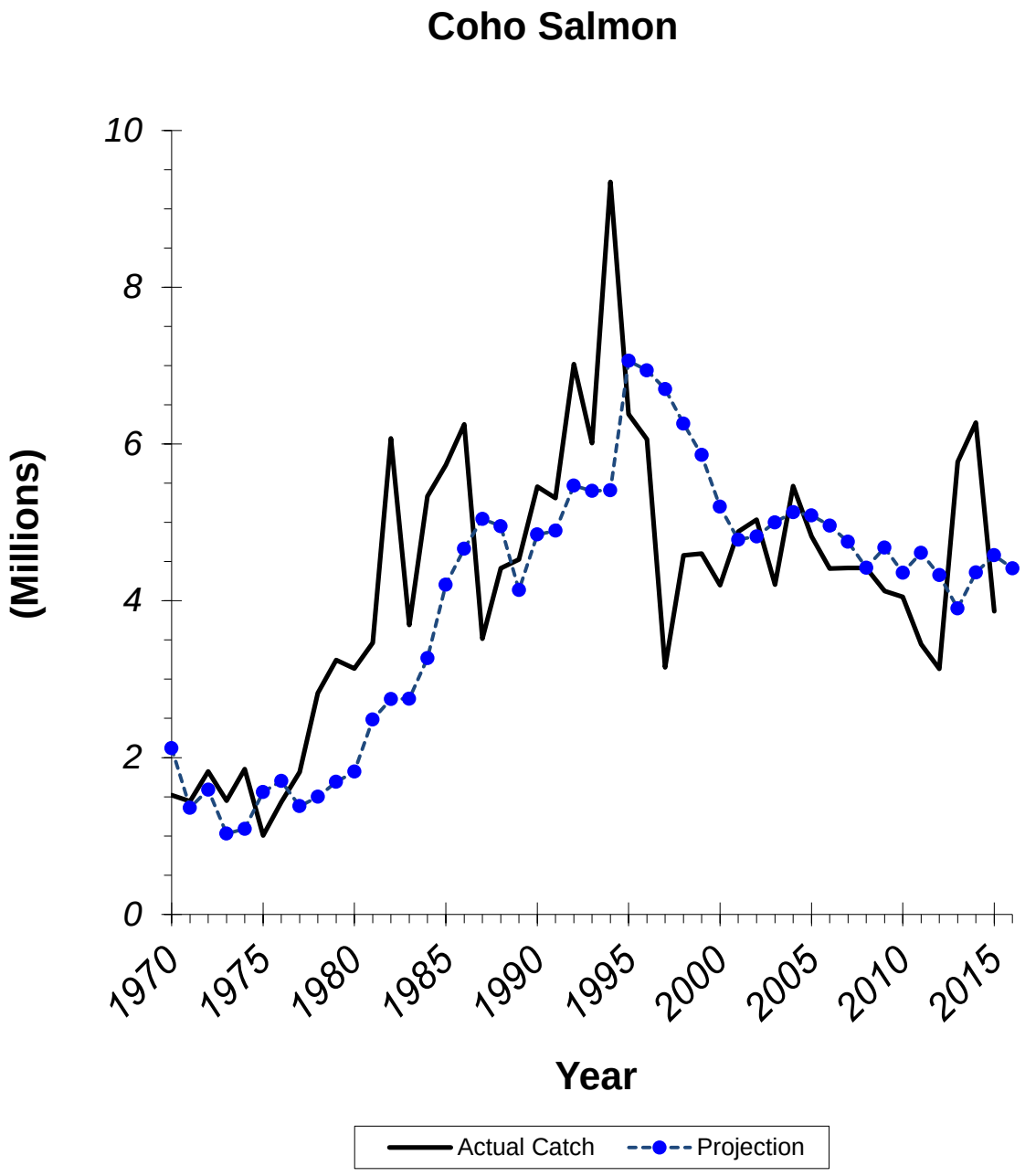

Figure 4.–Relationship between actual catch and projected catch in millions, for Alaska coho salmon fisheries from 1970 to 2015, with the 2016 projection.

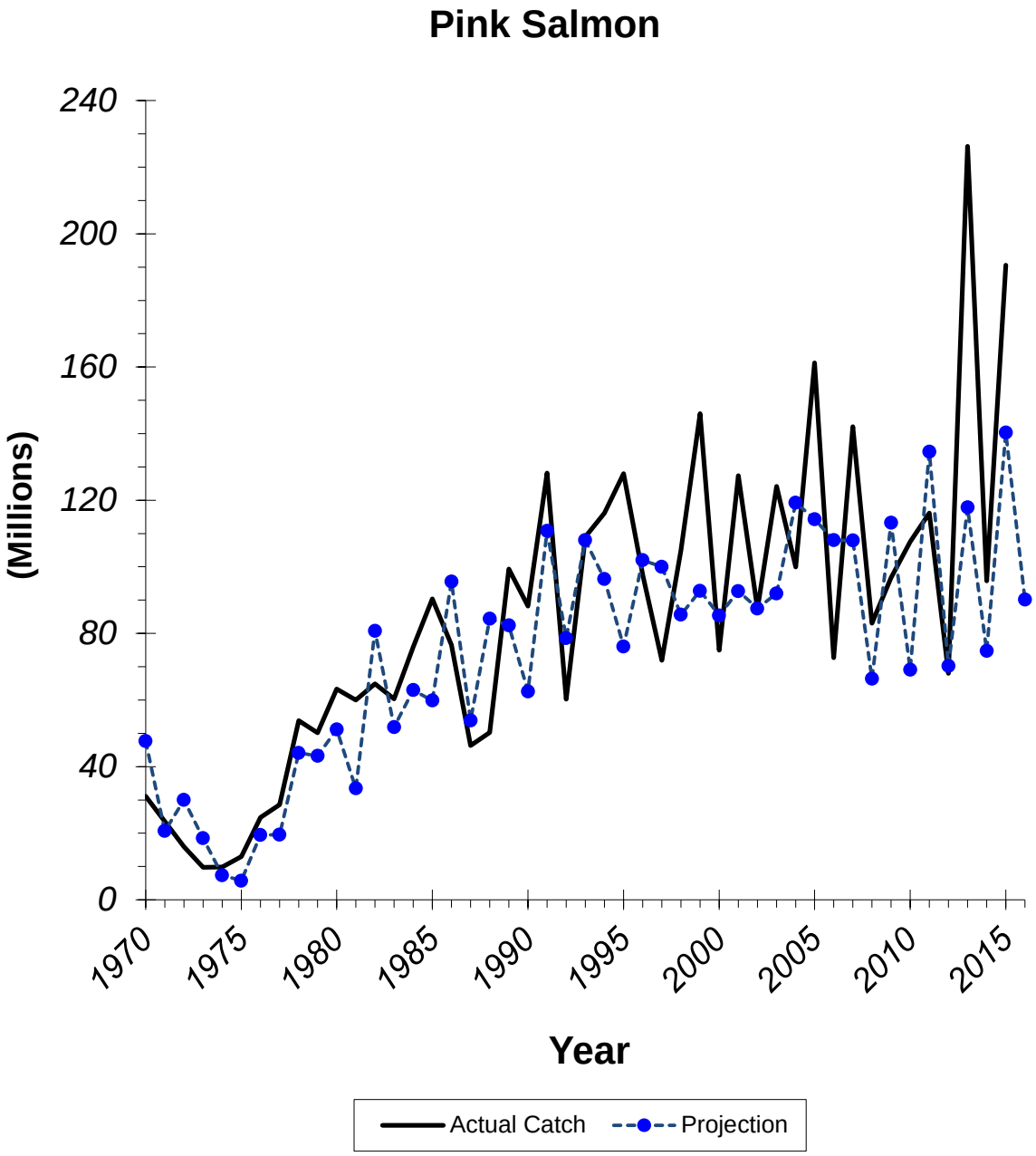

Figure 5.–Relationship between actual catch and projected catch in millions, for Alaska pink salmon fisheries from 1970 to 2015, with the 2016 projection.

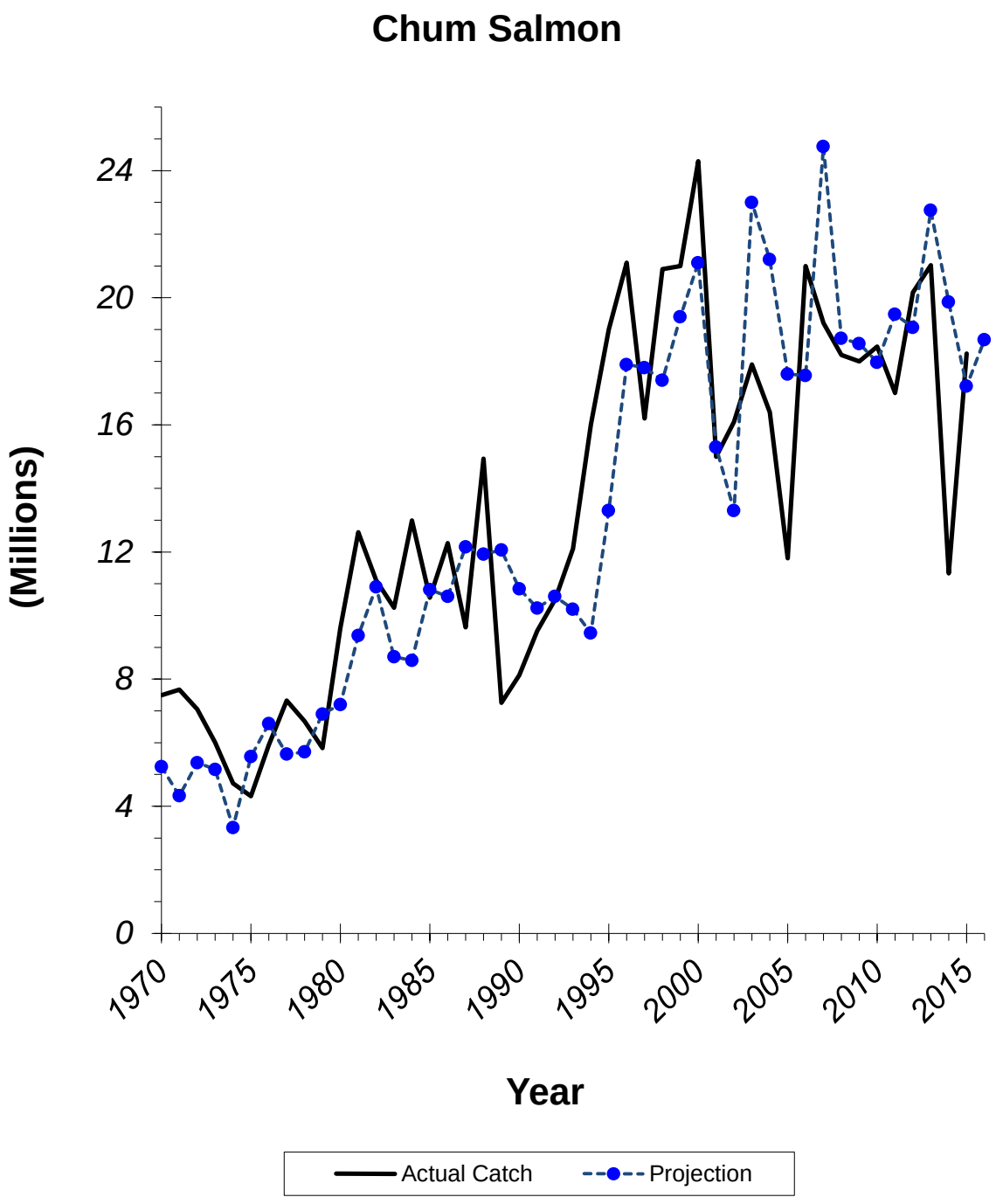

Figure 6.–Relationship between actual catch and projected catch in millions, for Alaska chum salmon fisheries from 1970 to 2015, with the 2016 projection.

ACKNOWLEDGMENTS

This report is based on information contributed by Division of Commercial Fisheries biologists located in field offices throughout the state. Regional and Area research biologists Charles Brazil, Heather Finkle, Birch Foster, Steve Heinl, Kathrine Howard, Mary Beth Loewen, Steve Moffitt, Ted Otis, Andrew Piston, Kevin Schaberg, Stephanie Schmidt, and Mark Willette; and Regional management biologists Todd Anderson, Dan Bergstrom, Travis Elison, Lisa Fox, Reid Johnson, Matt Jones, Dan Gray, Matthew Keyse, Bob Murphy, Bert Lewis, Charles Russell, Paul Salomone, Tim Sands, Pat Shields, Jeff Wadle, and Dawn Wilburn assembled the forecasts and salmon season summaries for their respective regions. Individual credit for forecast material is contained in area forecast discussions in the Appendix. Area biologists throughout the state supplied reviews of the 2015 fishing season.

APPENDIX A: SOUTHEAST ALASKA

Forecast Area: Southeast Alaska
Species: Pink Salmon

The Southeast Alaska pink salmon harvest in 2016 is predicted to be in the *Strong* range with a point estimate of 34 million (80% confidence interval: 13–55 million). The categorical ranges of pink salmon harvest in Southeast Alaska were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest over the 51-year period 1960 to 2010:

Category	Range (millions)	Percentile
Poor	Less than 11	Less than 20th
Weak	11 to 19	20th to 40th
Average	19 to 29	40th to 60th
Strong	29 to 48	60th to 80th
Excellent	Greater than 48	Greater than 80th

Forecast Methods

The 2016 forecast was produced in 2 steps: (1) a forecast of the trend in harvest, and (2) the forecast trend adjusted using 2015 juvenile pink salmon abundance data. The forecast of the trend in pink salmon harvests was based on a time-series technique called *exponential smoothing.* This technique is similar to a running average except that all harvests since 1960 were used in the forecast estimate. Recent harvest observations were given more weight in the analysis while past harvest observations were increasingly down-weighted with time; i.e., the older the datum, the less influence it has on the forecast. If x_t, x_{t-1}, ... denotes the observed harvests in year t, t–1, and so on, then the forecast in year t+1 is given by $\hat{x}_{t+1} = cx_t + (1-c)\hat{x}_t$.

We estimated a value of c to be approximately 0.22 based on minimizing the sum of past squared errors in the entire data set (odd and even years combined). The forecast for year t, that is $\hat{x}_t$, is also a weighted average of the forecast made for year t–1 and the actual harvest in year t–1. This is a kind of recursive equation that contains all of the data in the series. This analysis produced a forecast of 44 million pink salmon (Figure A1).

We adjusted the forecast using peak June–July juvenile pink salmon CPUE statistics provided by the NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratories (Joe Orsi, Auke Bay Laboratories, personal communication). These data were obtained from systematic surveys conducted annually in upper Chatham and Icy straits in conjunction with NOAA's Southeast Coastal Monitoring Project and are highly correlated with the harvest of adult pink salmon in the following year (see Wertheimer et al. 2011[a]).

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[a] We gratefully acknowledge the assistance and advice of Joe Orsi and Alex Wertheimer (retired) and their colleagues at the NOAA Auke Bay Laboratories. However, we accept responsibility for this forecast, and we accept sole responsibility for this use of their data. For a detailed description of these NOAA research activities see: Wertheimer, A. C., J. A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2011. Forecasting pink salmon harvest in Southeast Alaska from juvenile salmon abundance and associated environmental parameters: 2010 returns and 2011 forecast (NPAFC Doc. 1343) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 17109 Point Lena Loop Road, Juneau, AK 99801-8626, USA; http://www.npafc.org/new/pub_documents.html.

We developed a simple equation to predict the forecast error in the exponential smooth by regressing the forecast error residuals from 1998 to 2015 on the corresponding NOAA CPUE data from 1997 to 2014 (Figure A2). The forecast error residuals were simply the exponential smooth forecast subtracted from the actual harvest. The predicted forecast error for 2016 was –9.8 million, which, when added to the exponential smooth forecast, dropped the forecast to 34 million pink salmon (Figure A3). The forecast range (13–55 million) is based on an 80% confidence interval calculated from the mean squared error of the adjusted hind-cast predictions.

Forecast Discussion

The 2016 harvest forecast of 34 million pink salmon is below the recent 10-year average harvest of 38 million. The NOAA Auke Bay Lab's 2015 peak June–July juvenile pink salmon CPUE statistic from upper Chatham and Icy straits in northern Southeast Alaska ranked 13th out of the 19 years that they have collected juvenile salmon abundance information. Pink salmon harvests associated with juvenile indices similar to the 2015 index (±20%) ranged from 12 to 45 million.

Perhaps the largest potential source of uncertainty regarding the 2016 pink salmon return are the anomalously warm sea surface temperatures that have persisted throughout the Gulf of Alaska since fall 2013. Pink salmon that went to sea in 2014 returned in numbers well below expectation in 2015, particularly in the southern half of the region. Pink salmon that went to sea in 2015 (and set to return in 2016) experienced similar above-average sea surface temperatures. There were also widespread reports of more southern species in the eastern Gulf of Alaska in 2015 (e.g., albacore, American shad, market squid, ocean sunfish, Pacific bonito, Pacific pompano, skipjack tuna, et al.), suggesting pink salmon may experience more competition or predation than normal. Another reason to expect the harvest could be below average in 2016 is the recent poor performance of even-year returns to northern inside waters. The harvest averaged 3 million over the past 5 even years and was only 1 million in the 2 most recent even years. In addition, escapement indices were below management targets for 17 of 21 northern inside pink salmon stock groups in 2014, which may help perpetuate continued poor harvests in northern inside waters.

The NOAA Auke Bay Laboratories continues to conduct research that has improved our ability to forecast pink salmon harvests in Southeast Alaska. NOAA has been using juvenile pink salmon catch and associated biophysical data to forecast adult pink salmon harvest in SEAK since 2004. The 2016 NOAA forecast can be found at the following link: http://www.afsc.noaa.gov/ABL/EMA/EMA_PSF.htm. ADF&G forecasts have been adjusted using NOAA's juvenile pink salmon data since 2007. Although forecast performance was poor for the past 3 seasons (Figure A4), overall performance since 2007 is much improved (mean absolute percent error = 26%) over forecasts made prior to 2007 (mean absolute percent error = 58%), and recent forecasts have performed better than naïve forecasting models (e.g., 3-year running average, brood year average harvest, unadjusted exponential smooth, etc.). Hindcasts of past harvests (1998–2006) using our current forecast method exhibited good performance in predicting the direction of forecast error (Figure A3). Even though hindcasts were not always precise (e.g., in 2006), the ability to predict if the harvest will be greater than average or less than average is an immense improvement over past ADF&G forecasts. For these reasons, we are using this method to forecast the pink salmon harvest for a 10th consecutive year.

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The department will manage the 2016 commercial purse seine fisheries inseason based on the strength of salmon runs. Aerial escapement surveys and fishery performance data will continue, as always, to be essential in making inseason management decisions.

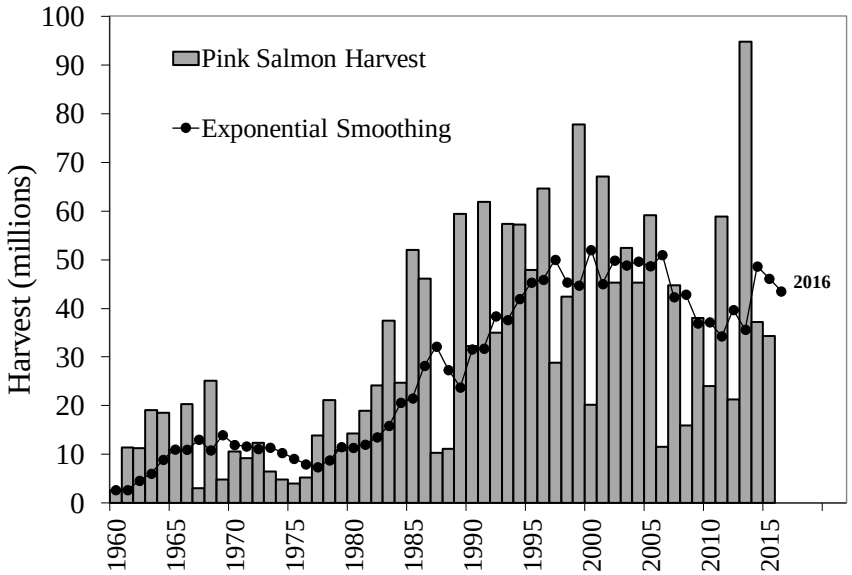

Figure A1.–Comparison of the annual harvest of pink salmon in Southeast Alaska, and exponential smoothed hindcast values of the harvest used in the 2016 forecast model. This method produced a 2016 harvest forecast of 44 million pink salmon.

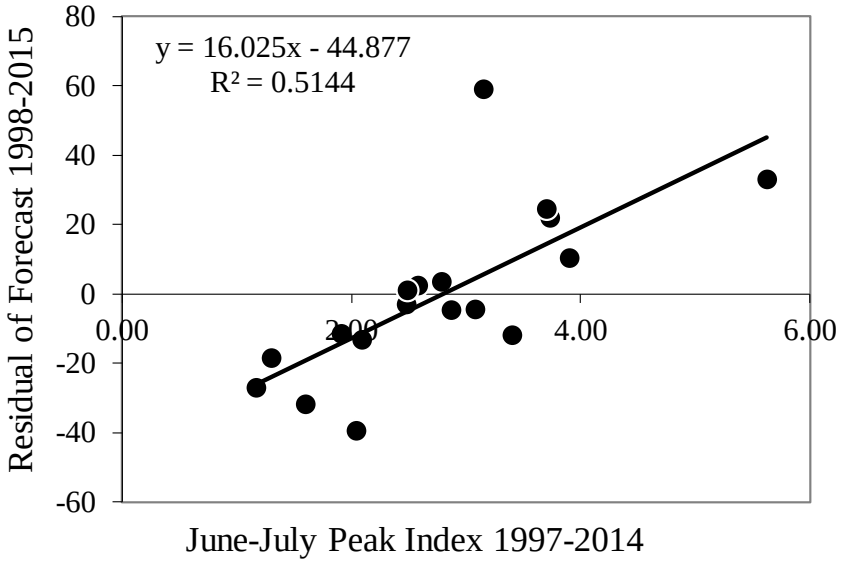

Figure A2.–Regression of ADF&G forecast error on the peak June–July juvenile pink salmon CPUE index from Icy Strait 1 year prior.

Source: Pink salmon fry index data provided by Joe Orsi, NOAA Auke Bay Laboratories, personal communication.

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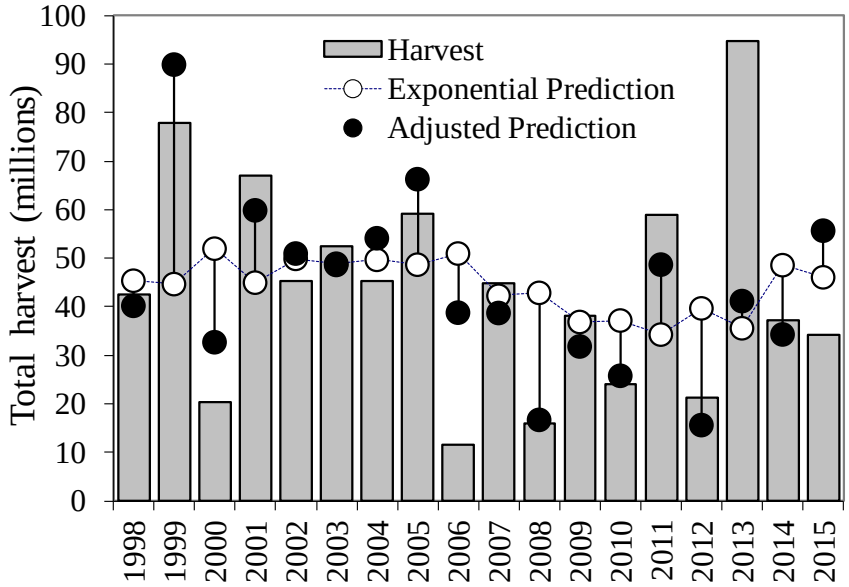

Figure A3.–Annual harvest of pink salmon in Southeast Alaska, 1998–2015, compared to the exponential smoothed hindcast predictions of the harvest adjusted using NOAA Auke Bay Laboratories juvenile pink salmon data.

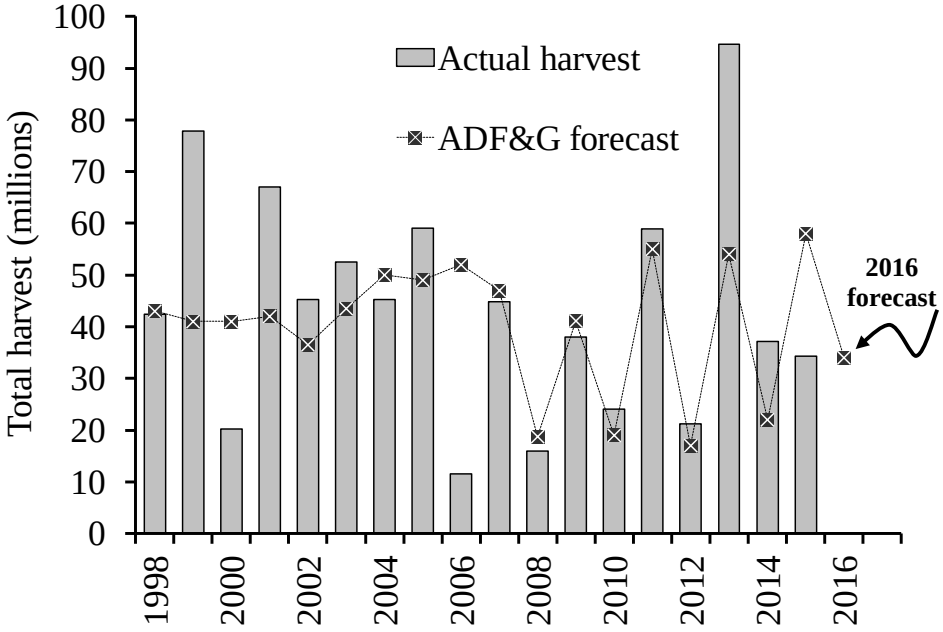

Figure A4.–Annual harvest of pink salmon in Southeast Alaska compared to the ADF&G pre-season harvest forecast, 1998–2015. The 2007–2016 ADF&G harvest forecasts were adjusted using NOAA's juvenile pink salmon data.

Andy Piston, Pink and Chum Salmon Project Leader, Ketchikan
Steve Heinl, Regional Research Biologist, Ketchikan

APPENDIX B: PRINCE WILLIAM SOUND

Forecast Area: Prince William Sound
Species: Pink Salmon (natural run only)

Preliminary Forecast of the 2016 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound General Districts		
Total Run	3,840	1,700–5,980
Escapement Target [a]	1,160	
Common Property Harvest[b]	2,680	540–4,820

[a] PWS pink salmon escapement target is the sum of the median historical even-years (1966–2010) escapement for each district in PWS with an SEG. Escapement goals were changed in 2011 from a single soundwide SEG to district- and brood line-specific SEGs (first implementation in 2012). The sum of district-specific SEG ranges is 990,000–2.28 million pink salmon (median of 1.45 million) for the odd-year brood line and 790,000–1.70 million pink salmon (median of 1.16 million) for the even-year brood line.

[b] Common property harvest includes harvests from commercial, subsistence, and sport fisheries.

Forecast Methods

Total natural run by year was estimated as the total natural (nonhatchery) contribution to commercial harvests combined with the stream escapement index. The stream escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. No adjustments to the escapement index were made for aerial observer efficiency, the proportion of the total escapement represented by the index streams, or the number of hatchery strays in streams. Natural pink salmon contributions to the commercial common property fishery (CCP) were estimated by subtracting hatchery contributions from the CCP total. Hatchery contributions were determined from thermal marked otolith recoveries (1997–2015), coded wire tag recoveries (1985–1996), or average fry-to-adult survival estimates multiplied by fry release numbers, and estimated exploitation rates (1977–1984).

The 2016 forecast is based on the average of 3 recent even-year returns (2010, 2012, and 2014). Prior to 1997, forecast methods employed surveys of pre-emergent fry; however, these surveys ended in 1995. The 2016 forecast model was selected by comparing the mean absolute percentage error (MAPE) and the standard deviation of the MAPE for retrospective forecasts of each model examined for even years 1962–2014. Approximate 80% prediction interval for the total run forecast was calculated using the squared deviations between the 1996–2014 even-broodline retrospective forecasts and actual runs as the forecast variance:

$$\hat{y} \pm t_{\alpha/2,n-1} \times MSE,$$

where $\hat{y}$ is the forecast prediction from the average of the recent 3 even-year returns, t is the critical value, n is the sample size, and MSE is the mean squared error.

Forecast Discussion

The predicted natural total run of pink salmon in 2016 uses the recent 3 even brood years total run average. Beginning in 2004, the department stopped producing hatchery pink salmon forecasts because the hatchery operators were already producing forecasts for their releases. Forecast methods examined for the 2016 natural run included (1) previous even-year total run (most naïve

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forecast method), (2) total run averages with 2–10 years of data (even years), (3) linear regression of log-transformed total PWS escapement versus log-transformed total PWS return by brood line, and (4) lag 1 exponential smoothing. The 2016 forecast (average of 3 recent even-years total runs) had the lowest MAPE (47%) and standard deviation of the MAPE (77%) for models examined with 1996–2014 even-years data.

The brood year 2014 escapement index (810,000) was within the sum of the current district-specific SEG ranges (790,000–1.70 million) for the even-years broodline, but was less than the median of observed even-year escapement indices since 1960 (1.17 million). If the 2016 total run forecast (harvest + escapement index = 3.84 million) is realized, it will be less than the median even-year return since 1960 (4.26 million).

Environmental factors, which probably play a significant role in determining pink salmon run size in PWS, have been quite variable in recent years. Pacific Decadal Oscillation values were positive throughout 2014 and 2015, corresponding with above average sea surface temperatures throughout the Gulf of Alaska (http://research.jisao.washington.edu/pdo/PDO.latest). A strong El Niño developed in late winter of 2015 and is expected to continue influencing Gulf of Alaska climate through late spring or early summer of 2016 (http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml).

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Forecast Area: Prince William Sound
Species: Chum Salmon (natural run only)

Preliminary Forecast of the 2016 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound General Districts		
Total Run	426	311–541
Escapement Target[a]	200	
Common Property Harvest[b]	226	111–341

[a] The department intends to manage for the long-term average escapement to districts with escapement goals: a total of 200,000 chum salmon for the Eastern, Northern, Coghill, Northwestern, and Southeastern districts combined. The sum of the lower bound SEGs for these districts is 91,000.

[b] Common property harvest includes harvests from commercial, subsistence, and sport fisheries.

Forecast Methods

We evaluated several naïve methods for the 2016 PWS natural chum salmon forecast, including average run size for the previous 2, 3, 4, 5, and 10 years and total run size from the previous year. From these models, the recent 2-year average run size had the smallest MAPE in retrospective forecasts and was chosen as the forecasting method for 2016. Total natural run by year was calculated as the natural chum salmon commercial harvest contribution from all PWS districts combined with the chum salmon escapement index. The escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. No adjustments to the escapement index were made for aerial observer efficiency, the proportion of the total escapement represented by the index streams, or the number of hatchery strays in streams. CCP harvest contributions of natural stock chum salmon were estimated using prehatchery average natural runs (2002 and 2003) or thermally marked otolith estimates (2004–2015) for each district in PWS. An approximate 80% prediction interval for the total run forecast was calculated using the squared deviations between the 2006–2015 retrospective forecasts and actual runs using the method described for pink salmon.

Forecast Discussion

Beginning in 2004, the department stopped producing hatchery chum salmon forecasts because the hatchery operators were already producing forecasts for their releases. Our ability to accurately forecast natural chum salmon stocks is limited because of the limited data available. Estimates of natural chum salmon contributions to CCP were unavailable prior to 2003. Natural chum salmon contribution estimates based on thermally marked otoliths are available for the Coghill and Montague districts since 2003 and from other PWS districts since 2004. Historical natural chum salmon age data from escapements and CCP harvests are unavailable for most PWS districts. If the 2016 natural chum salmon forecast of 426,000 is realized, it would be 17th smallest in the last 20 years. For comparison, the estimated total run size of natural chum salmon was greater than 1.3 million from 1981 to 1988 but has not exceeded 1 million since 1988.

Environmental factors that may influence chum salmon abundance include the cooler ocean waters in 2012 and 2013 that were followed by significantly warmer North Pacific waters throughout 2014 and 2015.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Stormy Haught, Finfish Management/Research Biologist, Cordova

Forecast Area: Prince William Sound
Species: Sockeye Salmon (natural run only)

Preliminary Forecast of the 2016 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound, Coghill Lake		
Total Run	110	70–210
Escapement Target[a]	30	
Harvest Estimate[b]	80	40–180

[a] The escapement target of 30,000 for Coghill Lake is the median of historical escapement estimates and is within the SEG range is 20,000–60,000. The upper end of the SEG was increased in 2011 from 40,000 to 60,000 (implemented in 2012).
[b] Includes the harvests from commercial, subsistence, and sport fisheries.

Forecast Methods

The natural sockeye salmon run forecast to Coghill Lake is the total of estimates for 5 age classes. Natural run by year was estimated as the total commercial harvest contribution combined with the Coghill River weir escapement count. A linear regression model with natural log-transformed data was used to predict returns of age-1.3 sockeye salmon. This linear regression model was parameterized using the historical relationship between returns of age-1.3 sockeye salmon and returns of the age-1.2 fish 1 year previous (sibling model), which are from the same brood year. For example, the model to predict the return of age-1.3 sockeye salmon in 2016 used the return of age-1.2 fish in 2015 as the input parameter. Predicted returns of age-1.1, -1.2, -2.2, and -2.3 sockeye salmon were calculated as the 1974–2015 mean return of that age class.

Harvest, escapement, and age composition data are available for Coghill Lake sockeye salmon runs going back to 1962; however, inclusion of escapements prior to the installation of a full weir in 1974 reduced forecast reliability. Therefore, only data collected since 1974 were used to estimate model parameters, calculate individual age class forecasts, and generate 80% prediction intervals. Historically, sibling model estimates of age-1.3 returns to Coghill Lake have a much smaller MAPE (~31.4%) than the sibling model used to predict returns of age-1.2 fish (~85%). An approximate 80% prediction interval for the total run forecast was calculated using the squared deviations between the 2007 and 2013 retrospective forecasts and actual runs using the method described earlier for pink salmon. The harvest forecast is the total run forecast minus escapement target.

No formal forecast was generated for the 2016 run of Eshamy Lake sockeye salmon. Eshamy Lake escapement has been enumerated at a weir since 1950, except in 1987, 1998, and 2012–present. Commercial harvest data are available for the same period, but age composition data are available for only some years after 1962. Beginning in 2012, a video monitoring system was developed to enumerate the sockeye salmon run to Eshamy Lake; however, no age, sex, and size data for the escapement has been collected. Since 2011, data available to calculate a formal forecast are limited due to the lack of escapement data comparable to historical weir counts, and no age, sex, or size collections.

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Forecast Discussion

Beginning in 2004, the department stopped forecasting hatchery runs of sockeye salmon to Main Bay Hatchery because hatchery operators were already producing forecasts. Coghill Lake has dynamic limnological characteristics that significantly impact the sockeye salmon population. Studies conducted in the mid-1980s and early 1990s indicated the lake may be zooplankton limited. As a result, the BEG midpoint was lowered in 1992 (from 40,000 to 25,000) to allow zooplankton populations to recover. Fertilizers were added to the lake (1993–1996) in a cooperative project with the U.S. Forest Service to improve the forage base for rearing sockeye salmon juveniles. In 2005, current data were reviewed and the midpoint escapement goal remained unchanged, but the goal type was changed from a BEG to an SEG. In 2002 the department began collecting limnological data to monitor basic lake characteristics. In 2011, the upper end of the Coghill Lake SEG was increased from 40,000 to 60,000 (new range = 20,000–60,000). In 2012 the department began managing for the long-term median escapement of 30,000. The Coghill Lake natural run escapement has been within or above the escapement goal range every year since 1995 except 2013 and 2015. If achieved, the 2016 total run forecast midpoint (110,000) would be the 12th largest run in the last 20 years and slightly less than the median run size of 113,000 in the last 20 years. The majority (65,200) of the overall Coghill Lake sockeye salmon forecast is predicted to come from age-1.3 fish (5 years old) from the 2011 brood year. Relatively few age-1.1 fish (jacks) were observed in 2015 compared to other years, which could indicate a small run of age-1.2 (4-year-old) sockeye salmon in 2016. However, there is considerable uncertainty in models used to estimate this component of the run, and this forecast uses the average total return of age-1.2 sockeye salmon (35,000) rather than sibling model estimates (7,300). Environmental factors that may influence the Coghill Lake sockeye salmon run in 2016 are as discussed for the pink and chum salmon forecasts.

Historically, Eshamy Lake was the largest natural stock contributor to CCP harvests of sockeye salmon in PWS outside of the Coghill District, and contributed to a substantial incidental harvest by the purse seine fishery in the Southwestern District. Although escapements into Eshamy River were counted at a weir for 50 years, only periodic collection of age, sex, and size data has occurred for the Eshamy and Southwestern districts' CCP harvests because of inconsistent harvest and delivery locations outside of Cordova. Contributions to CCP harvests in western PWS of sockeye salmon produced by the Main Bay Hatchery have been estimated by recovery of coded wire tags and thermally marked otoliths. However, not all harvests can be adequately sampled, which increases the uncertainty of total run estimates for all natural and enhanced sockeye salmon stocks in western PWS. Age composition data and complete weir counts were not collected in 1987, 1998 and 2012–present because of budget constraints and are not anticipated to resume in the near future.

The escapement goal for Eshamy Lake was reviewed in 2008 and the range was changed. The new BEG range is 13,000–28,000 (midpoint 20,500). The old range was 20,000–40,000. The goal was reviewed again in 2014 and retained for at least 1 more BOF cycle.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Stormy Haught, Finfish Management/Research Biologist, Cordova

APPENDIX C: COPPER RIVER

Forecast Area: Copper River
Species: Chinook Salmon

Preliminary Forecast of the 2016 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	64	38–90
Escapement Goal[a]	24	
Harvest Estimate[b]	40	14–66

[a] The Chinook salmon spawning escapement goal of 24,000 is a lower bound SEG. ADF&G intends to manage for a long-term estimated average escapement of 27,000 Chinook salmon.

[b] The maximum harvest by all fisheries (subsistence, personal use, sport, and commercial) that allows achieving the lower bound SEG of 24,000. The maximum projected commercial common property harvest is 27,000.

Forecast Methods

The total run forecast of Copper River Chinook salmon for 2016 was estimated using the previous year's (2015) total run size. Total run size was calculated as the sum of commercial and subsistence harvests of Chinook salmon below Miles Lake and the mark–recapture point estimate of Chinook salmon inriver abundance. Forecast methods examined for the Chinook salmon forecast included (1) the previous year's run size (most naïve method), (2) mean total run size estimates (2-, 3-, 4-, and 5-year averages), and (3) pseudo-sibling (no age data from escapements) models that examined linear relationships between log-transformed returns of younger fish to predict returns of fish from the same brood class the following year (e.g., returns of age-1.2 fish to predict returns of age-1.3 fish). Historically, sibling model estimates of age-1.3 returns to the Copper River have a much smaller MAPE (~38%) than the sibling model used to predict returns of age-1.4 fish (~68%); therefore, the only sibling model evaluated was to predict returns of age-1.3 fish. Retrospective forecasts of Chinook salmon total run using the previous year's run size had the second smallest MAPE (26%) and a smaller standard deviation of the MAPE (14%) than other forecast models examined, and was used as the forecast for 2016. The total run forecast range was calculated using the methods described earlier for Coghill Lake sockeye salmon forecast except only 1999–2015 Chinook salmon retrospective forecasts and actual data were used in the calculation of mean squared error.

The harvest forecast is the Copper River Chinook salmon total run forecast minus the lower bound SEG of 24,000 Chinook salmon. The maximum commercial harvest was calculated with the projected total harvest multiplied by the recent 5-year average proportion of harvest by the commercial fishery (~0.67).

Forecast Discussion

The department did not generate a formal Chinook salmon total run forecast between 1998 and 2007 because of inadequate estimates of inriver abundance or spawning escapement. Forecasts made prior to 1998 used aerial survey indices adjusted to approximate the total escapement. These forecasts performed poorly, especially after the number of aerial surveys was significantly reduced in 1994. In 1999, the ADF&G Division of Sport Fish began a mark–recapture program to estimate the inriver abundance of Chinook salmon. The Native Village of Eyak became a

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collaborator on the project and eventually took the lead role. There are currently 17 years (1999–2015) of inriver abundance estimates. Thus, although estimates of commercial harvest of Chinook salmon to the Copper River date to 1890, only data collected since 1999 were used to estimate model parameters, calculate individual age class forecasts, and calculate the ranges.

This forecast assumes that all historical commercial harvest in the Copper River District originates from the Copper River. In 2015, Chinook salmon in the commercial harvest were examined for clipped adipose fins and coded wire tags. Approximately 15% of the fish scanned in 2015 were clipped, and all decoded tags originated from hatchery stocks outside of the Copper River.

The 2016 Chinook salmon total run forecast point estimate of 64,000 is about 2,000 less than the 17-year average total run size (1999–2015 average = 66,000). If realized, the 2016 forecast total run would rank 12th of the 20 annual runs since 1997, and would be the largest run since 2007.

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Forecast Area: Copper River
Species: Sockeye Salmon

Preliminary Forecast of the 2016 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	2,280	1,480–3,070
Escapement Target[a]		
Upper Copper River	450	
Copper River Delta	169	
Common Property Harvest[b]	1,660	970–2,350
Hatchery and Supplemental Production		
PWSAC - Gulkana Hatchery		
Hatchery Run	290	190–390
Broodstock Needs	20	
Supplemental Escapement[c]	70	
Common Property Harvest[b]	200	120–290
Total Production		
Run Estimate	2,560	1,670–3,460
Natural Escapement Goal	620	
Broodstock Needs	20	
Supplemental Escapement [c]	70	
Upper Copper River Inriver Goal [d]	700	
Common Property Harvest [e]	1,860	1,180–2,530

[a] The upper Copper River escapement target of 450,000 sockeye salmon is the historical average spawning escapement (1979–2010). The SEG adopted in 2011 is 360,000–750,000. The adjusted Copper River Delta escapement target is the average peak count from aerial surveys (84,500) multiplied by 2 to adjust for proportion of the total number of fish estimated by aerial observers. The SEG (55,000–130,000) was calculated from the sum of unadjusted peak counts of index streams.

[b] Includes harvests from commercial, subsistence, personal use, and sport fisheries.

[c] Hatchery production that will not be harvested to ensure that natural escapement to the upper Copper River is achieved, because natural stocks cannot sustain the higher exploitation rates of hatchery stocks.

[d] Upper Copper River inriver goal categories include spawning escapement (sockeye and other salmon); sport, subsistence, and personal use fishery harvests; and hatchery broodstock and supplemental escapement (5 AAC 24.360(b)). The inriver goal estimate is preliminary until final upriver harvest estimates from 2015 are available.

[e] Commercial common property harvest midpoint estimate is 1,620,000 sockeye salmon and the 80% prediction interval is 940,000–2,300,000. The point estimate for the total common property harvest is calculated as the forecast total run estimate minus the sockeye salmon portion of the inriver goal and the Copper River Delta escapement goal.

Forecast Methods

Copper River sockeye salmon forecast models include data from harvests, escapements, age compositions, and natural and Gulkana Hatchery stock contributions to fishery harvests. Harvests are summarized from commercial fishery fish tickets, state and federal subsistence permits, state personal use permits, and a sport fishing mail survey. Since 1978, spawning escapements of sockeye salmon above the Miles Lake sonar site have been estimated as the sonar count minus an estimate of the Chinook salmon inriver abundance; all upper Copper River harvests of sockeye salmon; and the Gulkana Hatchery sockeye salmon broodstock and excess hatchery fish at Crosswind Lake, Summit Lake, and the Gulkana I and Gulkana II sites. Prior to 1978, sockeye salmon escapements above Miles Lake were estimated from either mark–recapture projects or

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expanded aerial surveys—after subtracting Chinook salmon, upper Copper River removals of sockeye salmon, and an estimate of sockeye salmon hatchery stocks. Escapements of sockeye salmon to the Copper River Delta below Miles Lake are estimated from the peak counts of approximately weekly aerial surveys of index streams adjusted for observer efficiency of 0.5 (from limited aerial survey and weir count comparisons in the 1970s). Sockeye salmon age compositions are estimated from scales or otoliths collected from the commercial fisher, upper Copper River subsistence and personal use fisheries, and Copper River Delta spawning escapements. Contributions of natural and Gulkana Hatchery sockeye salmon to commercial and upper Copper River personal use and subsistence fisheries are estimated from otoliths marked with strontium chloride (Sr; 2004–2015), coded wire tags (1995–2003), fry-to-adult survival, age composition at return, and estimated exploitation rates (1977–1994). Natural and hatchery contributions of sockeye salmon to sport fishery harvests are estimated using contribution proportions from the upper Copper River subsistence and personal use fisheries samples. Prior to 2003, contributions of unmarked sockeye salmon released from Gulkana Hatchery sites into Paxson Lake were calculated using assumptions of 1% fry-to-adult survival and adult returns of 17% age 4 and 83% age 5. Total natural runs of sockeye salmon (adult salmon returning in a given year) are estimated as the sum of all natural fishery harvests of sockeye salmon below Miles Lake and the Miles Lake sonar count, minus the estimates of Chinook salmon inriver abundance and the upper Copper River Gulkana Hatchery sockeye salmon run (broodstock and excess). Total natural brood year returns (an aggregation of adult salmon returning over several years from a single brood year) are estimated as the sum of all sockeye salmon returns by age minus the Gulkana Hatchery returns of sockeye salmon by age.

Forecast models examined for natural Copper River sockeye salmon for 2016 included (1) previous year's run size (most naïve method), (2) mean total run size estimates (2-, 3-, 4-, 5-, 10-, and all-year averages), (3) mean return of individual age classes, and (4) regression models of sibling relationships. The forecast of natural sockeye salmon to the Copper River is the total of estimates for 6 age classes. Linear regression models with log-transformed data were used to predict returns for age-1.2 and -2.2 sockeye salmon, while untransformed data were used to predict the return of age-1.3 fish. These 3 age classes were predicted from the relationship between returns of that age class and returns of the age class 1 year younger from the same brood year (sibling model). Predicted return of age-1.1, -0.3, and -2.3 sockeye salmon were calculated as the 5-year (2011–2015) mean return of those age classes. The total common property harvest forecast was calculated by subtracting the Gulkana Hatchery broodstock, hatchery surplus, and wild stock escapement goal needs (upriver and Copper River Delta) from the total run forecast. The commercial common property estimate was calculated by subtracting from the total run a preliminary estimate of the inriver goal categories (5 AAC 24.360(b)) and the Copper River Delta spawning escapement goal. The 80% prediction bounds for the Copper River natural sockeye salmon total run and harvest forecasts were calculated using the method described previously for Coghill Lake sockeye salmon, except only data from the years 1983–2015 were used in the calculation of mean squared error.

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The 2016 run to Gulkana Hatchery was estimated as the recent 10-year average fry-to-adult survival estimate (1.55%) from all Gulkana I and Gulkana II hatcheries releases combined (onsite and remote). The run was apportioned to brood year using a maturity schedule of 13% age 4 and 87% age 5. An estimated exploitation rate of 70% was used to project the total harvest of Gulkana Hatchery stocks in 2016. The 80% prediction intervals for the forecast of Gulkana Hatchery sockeye salmon production and harvest were calculated using the mean square error estimate of the total run as described above for Coghill Lake sockeye salmon, except only data from the years 1983–2015 were used in the calculation of mean squared error.

Forecast Discussion

Forecasts prior to 1998 relied on the relationship between numbers of spawners and subsequent returns, using return-per-spawner values for parent-year abundance similar to the predominant age class (age 5) of the forecast year. Because average return-per-spawner values do not reflect recent production trends, and because returns are still incomplete from the recent brood years, linear regressions of brood year sibling returns were used for forecasts beginning in 1998. Additionally, more precise estimates of survival and contributions from hatchery production for brood years and release locations were available from coded wire tag recoveries in harvests and escapements for brood years 1995–1998.

Historical estimates of Gulkana Hatchery production prior to 1995 are considered imprecise. Improved contribution estimates for brood years 1995–1998 indicated large contributions from supplemental production and smolt-to-adult survival estimates for Crosswind Lake releases that averaged about 20%. Fish with strontium chloride (Sr) marked otoliths began returning in 2003 (age-4 fish) and the majority of the adult run (age-4 and age-5 fish) was marked beginning in 2004. Fish from all release locations (Gulkana I and Gulkana II hatchery sites and Crosswind and Summit lakes) are now marked, but all fish have the same mark. We can estimate the total contribution of enhanced fish from all Gulkana Hatchery releases, but until different marks for individual releases locations can be developed, forecasts of enhanced sockeye salmon runs to Crosswind and Summit lakes using smolt-to-adult survival estimates are no longer possible.

Spawning escapement goals for the upper Copper River and Copper River Delta natural sockeye salmon were reviewed in 2014 and no changes were made to the existing goals. The upper Copper River spawning escapement goal was changed in 2011 from an SEG of 300,000–500,000 to 360,000–750,000. This change was because of the conversion of Bendix sonar counts to DIDSON sonar equivalent counts and an update in the years used in the goal calculation. There was no change to the Copper River Delta SEG of 55,000–130,000.

The 2016 run of natural sockeye salmon to the Copper River will be composed primarily of returns from brood years 2011 and 2012. Five-year-old fish (brood year 2011) are expected to predominate Copper River Delta and upper Copper River runs. The Copper River Delta escapement indices for 2011 (76,500) and 2012 (66,850) were within the SEG range of 55,000–130,000.

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The Gulkana Hatchery run of sockeye salmon will include fish from Crosswind Lake smolt migrations of 850,000 in 2013 (6th smallest in previous 20 years) and 160,000 in 2014 (2nd smallest in previous 20 years). For brood years 1993–2012 the average migration from Crosswind Lake was 1.2 million smolt. No smolt data are available for Summit Lake outmigration in 2013 because of flood conditions. The Summit Lake outmigration count in 2014 was 180,000 and ranks as the 15th smallest in the last 20 years with outmigration counts. No estimates are made for Paxson Lake smolt migrations because they are mixed with large numbers of wild sockeye salmon smolt.

The 2016 total run forecast of natural and enhanced sockeye salmon (2.56 million) is similar to the recent 10-year average total run (2.60 million). If realized, the 2016 forecast total run would be the 11th largest in the last 36 years (since 1980). The 2.28 million natural run would be similar to the recent 10-year average (2.27 million), and a 290,000 Gulkana Hatchery enhanced run would be below the recent 10-year average (340,000). Copper River total run forecast errors have averaged 26.6% over the last 10 years (Range = 0.2–37.8%). The natural run forecast is driven by the large 4-year-old (age-1.2) sockeye salmon estimate in 2015 (561,000; 3rd largest since 1965) and the subsequent prediction for 5-year-old (age-1.3) fish in 2016. The enhanced run forecast is influenced by small smolt outmigration numbers from both Crosswind and Summit lakes. Returns of Copper River sockeye salmon that entered the ocean beginning in 2008 have had excellent survival so far, but the significantly warmer North Pacific waters in 2015 will increase the uncertainty in the 2016 run projection. Copper River sockeye salmon in 2015 were the smallest in the 1966–2015 time series, and the continued warm ocean temperatures may affect growth and survival for the 2016 run.

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APPENDIX D: UPPER AND LOWER COOK INLET

Forecast Area: Upper Cook Inlet
Species: Sockeye Salmon

Preliminary Forecast of the 2015 Run

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
Total Run	7.1	5.6–8.6
Escapement	1.8	
Commercial Harvest	4.1	
Other Harvests	1.2	

Forecast Methods

The major sockeye salmon systems in Upper Cook Inlet (UCI) are the Kenai, Kasilof, Susitna, and Crescent rivers, and Fish Creek. Available escapement (spawner abundance), return, sibling, fry, and smolt data, if available, were examined for each system. Four models were evaluated to forecast the total run of sockeye salmon to UCI in 2016: (1) the relationship between adult returns and spawners, (2) the relationship between adult returns and fall fry, (3) the relationship between adult returns and smolts, and (4) the relationship between sibling adult returns. Several forecast models were evaluated for each stock and age class. Models providing the smallest mean absolute percent error (MAPE) between the forecast and actual runs over the past 10 years were typically selected. Forecast model predictions were compared to evaluate uncertainty.

The return of age-1.3 Kenai River sockeye salmon in 2016 was forecasted using a sibling model. The sibling model prediction of the return of age-1.3 salmon is based on the abundance of age-1.2 salmon that returned in 2015. A spawner-recruit model predicts the age-1.2 salmon return based upon the spawning escapement in 2012. The Kenai River return of age-2.3 salmon was forecasted using a smolt model based upon age-2 smolt abundances available after brood year 2002 and age-1 fall fry abundances available for brood years 1984–2002. The returns of age-1.2, -1.3, and -2.2 Kasilof River sockeye salmon in 2016 were forecasted using sibling models based upon returns of age-1.1, -1.2 and -2.1 salmon in 2015. A smolt model based upon age-2 smolt abundances in 2013 was used to forecast the return of age-2.3 Kasilof River sockeye salmon in 2016.

The total run of Susitna River sockeye salmon was forecasted using mean return per spawner by age class for brood years 2006–2011. Mark–recapture estimates of inriver run and genetic estimates of commercial harvest were available for these brood years.

The sockeye salmon forecast for unmonitored systems in UCI was estimated as 17% of the aggregate forecast for the 4 monitored stocks. Unmonitored stocks include Crescent River, Big River, McArthur River, Chilligan River, Coal Creek, Cottonwood Creek, Wasilla Creek, Eagle River, and many other smaller systems in the area. The fraction of the total run destined for unmonitored systems was estimated using genetic estimates of the stock composition of offshore test fishery harvests.

The total harvest by all user groups was estimated by subtracting the aggregate escapement from the total run forecast for all stocks. Aggregate escapement was estimated from the sum of the

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midpoints of the escapement goal ranges for each of the monitored sockeye salmon-producing systems and the escapement into unmonitored systems (estimated as 17%). The commercial harvest was estimated from the fraction of total harvest taken in the commercial fishery in relation to run sizes in 2010–2014. The harvest by all other user groups (sport, personal use, and subsistence) was estimated by subtracting commercial harvest from total harvest.

The total run forecast range was calculated by multiplying the forecast by the MAPE of the actual runs from published forecast runs from 2006 through 2015.

Forecast Discussion

In 2015, the harvest of sockeye salmon by all user groups in UCI (3.6 million) was 100,000 less than the preseason forecast of 3.7 million. In 2015, the total run was 3.9 million to the Kenai River, 1,168,000 to the Kasilof River, 435,000 to the Susitna River, and 120,000 to Fish Creek. The 2015 run forecast was 3.6 million to the Kenai River, 1,092,000 to the Kasilof River, 276,000 to the Susitna River, and 61,000 to Fish Creek.

A run of approximately 7.1 million sockeye salmon is forecasted to return to UCI in 2016, with a commercial harvest of 4.1 million. The forecasted commercial harvest in 2016 is 1.1 million greater than the 20-year average harvest.

The run forecast for the Kenai River is approximately 4.7 million, which is 1.0 million greater than the 20-year average run of 3.7 million. A sibling model based upon the return of age-1.2 salmon in 2015 (534,000; 404,000 20-year average) predicted a return of 3.1 million age-1.3 salmon. A fry model based upon the abundance of age-0 fry rearing in Skilak and Kenai lakes in the fall of 2012 (23.6 million; 17.3 million 20-year average) predicted a return of 2.6 million age-1.3 salmon. The sibling model was used for this forecast, because the 10-year MAPE was lower for the sibling (27%) than the fry model (55%). A sibling model based upon the return of age-2.2 salmon in 2015 predicted a return of 413,000 age-2.3 salmon in 2016. A smolt model based upon the abundance of age-2 smolt emigrating from the Kenai River in spring 2013 (5.6 million) predicted a return of 1.0 million age-2.3 salmon. The smolt model was used for this forecast, because the 10-year MAPE was lower for the smolt (38%) than the sibling model (46%). The predominant age classes in the 2016 run forecast are age 1.3 (65%), age 1.2 (8%), and age 2.3 (21%). The 10-year MAPE for the set of models used for the 2016 Kenai sockeye salmon run forecast is 20%.

The Kasilof River sockeye salmon run forecast is 861,000, which is 13% less than the 20-year average of 987,000. A sibling model based upon the abundance of age-1.2 salmon in 2015 was used to forecast a return of 215,000 age-1.3 salmon in 2016. The smolt model predicted a return of 288,000 age-1.3 salmon. The sibling model was used for this forecast, because the 10-year MAPE was lower for the sibling (33%) than the smolt model (55%). A sibling model based upon the abundance of age-1.1 salmon in 2015 was used to forecast a return of 262,000 age-1.2 salmon in 2016. A spawner-recruit model based upon the abundance of spawners in 2012 forecasted a return of 248,000 age-1.2 salmon. The sibling model was used for this forecast, because the 10-year MAPE was lower for the sibling (56%) than the spawner-recruit model (59%).

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A sibling model based upon the abundance of age-2.1 salmon in 2015 was used to forecast a return of 256,000 age-2.2 salmon in 2016. A spawner-recruit model forecast for age-2.2 salmon was 214,000. The sibling model was used for this forecast, because the 5-year MAPE was lower for the sibling (12%) than the spawner-recruit model (22%). The predominant age classes in the 2016 run forecast are age 1.2 (31%), age 1.3 (25%), and age 2.2 (30%). The 10-year MAPE for the set of models used for the 2016 Kasilof sockeye salmon run forecast is 17%.

Sockeye salmon run forecasts, 20-year average runs, and escapement goals (in thousands of fish) to individual freshwater systems are as follows:

		Major Age Classes				Total	Escapement
System		1.2	1.3	2.2	2.3	Run	Goals[a]
Kenai River	Forecast	370	3,061	225	992	4,731	1,100–1,350[b]
	20-yr average	404	2,217	255	701	3,652	
Kasilof River	Forecast	262	215	256	113	861	160–340
	20-yr average	307	339	239	84	987	
Susitna River	Forecast	42	249	28	23	372	No Goal[c]
	20-yr average	97	215	27	23	421	
Fish Creek	Forecast	63	32	9	2	110	20–70
	20-yr average	48	21	8	3	84	
Unmonitored	Forecast	126	608	88	193	1,039	No Goal
	20-yr average	146	477	91	139	880	
Total Run	Forecast	863	4,166	606	1,323	7,113	
	20-yr average	1,003	3,269	619	950	6,023	

Note: BEG = Biological Escapement Goal, SEG = Sustainable Escapement Goal.

[a] Goals listed here are as follows: Kenai River, Inriver; Kasilof River, BEG; Susitna River, SEG (weir goals); and Fish Creek, SEG.

[b] This is the inriver sockeye salmon goal measured using sonar at river mile 19 on the Kenai River.

[c] Susitna sockeye salmon are managed to achieve escapement goals (in thousands of fish) at Larson (15–50), Chelatna (20–65), and Judd (25–55) lakes.

The Susitna River sockeye salmon run forecast is 372,000, which is 12% less than the 10-year average of 421,000. This forecast was derived using mean return per spawner by age class for brood years 2006–2011 and mark–recapture estimates of spawner abundance in 2010–2012. Sonar estimates of spawner abundance were not used, because mark–recapture studies have shown that the Yentna sonar project underestimated sockeye salmon escapement, causing estimates of adult returns to also be underestimated. The 3-year MAPE for this forecast method is 21%. The predominant age classes in the 2016 Susitna sockeye salmon run forecast are age 1.2 (11%) and age 1.3 (67%).

The Fish Creek sockeye salmon run forecast is 110,000, which is 31% greater than the 20-year average of 84,000. Sibling models were used to forecast the returns the age-1.2, -1.3, -2.2 and -2.3 salmon in 2016. The predominant age classes in the 2016 Fish Creek run forecast are age 1.2 (57%) and age 1.3 (29%). The 10-year MAPE for the Fish Creek sockeye salmon run forecast is 62%.

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Forecast Area: Upper Cook Inlet
Species: Other Salmon Species

Preliminary Forecast of the 2016 Commercial Harvest

Natural Production	Forecast Estimate (thousands)
Pink Salmon	393,000
Chum Salmon	184,000
Coho Salmon	160,000
Chinook Salmon	6,700

Forecast Methods

The recent 5-year average commercial harvest was used to forecast the harvest of chum, coho, and Chinook salmon in 2016. The forecast for pink salmon is based upon the average harvest during the past 5 even-numbered years.

Forecast Discussion

The recent 5-year average commercial harvest was used in the forecast, because regulatory changes have substantially restricted harvests of these species in recent years.

Mark Willette, Research Project Leader, Upper Cook Inlet

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Forecast Area: Lower Cook Inlet
Species: Pink Salmon

Preliminary forecast of the 2016 run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	649	325–1,220
Escapement	325	115–551
Commercial Harvest	324	210–669
Supplemental Production		
Total Run	418	276–560
Broodstock	269	264–274
Commercial Harvest	149	13–286
Total Area Production		
Total Run	1,067	601–1,780
Broodstock and Escapement	594	379–825
Commercial Harvest	473	223–955

Note: Columns may not total exactly due to rounding to the nearest thousand fish.

Note: Commercial Harvest = Total Run – Escapement/Broodstock and refers to fish available for harvest; no prediction of fishing effort is made.

Note: Additional harvests may be expected from systems not included in the forecast.

Forecast Methods

The 2016 forecast of wild pink salmon runs to 9 harvest areas in the Lower Cook Inlet (LCI) Management area was based on a logarithmic regression of total run and escapement from 41 to 50 years of observations. The total run forecast for LCI natural production was the sum of the 9 individual harvest area forecasts. Upper and lower bounds around the total run forecast, however, were derived by multiplying the forecast times the upper and lower values of the percent error ([actual run–forecast run]/actual run) observed during the previous 10 years. Forecasted commercial harvest ranges from natural production were obtained by subtracting corresponding escapement goals from the upper and lower bounds of the forecast range. The forecasted escapement was the sum of midpoints from the individual escapement goals minus any expected escapement shortfall. The forecast for supplemental production by the Tutka Bay Lagoon Hatchery was based on a marine survival rate of 3.0% (range: 2.0–4.0%). Projected harvest from supplemental production was obtained by subtracting broodstock goals from the supplemental production forecast.

Because pink salmon exhibit a 2-year life cycle, comparisons of run size are stratified by odd and even years to account for dominance of one line over the other. In LCI, dominance of one line is typically short lived, lasting 2–6 generations before the opposing line becomes dominant. Despite the relative parity between odd and even year pink salmon runs in LCI over broad time scales, we continue to stratify run size comparisons by odd and even years to account for the short-term dominance cycles.

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In 2014, the last even-numbered year, 8 of 9 forecasted systems had runs within the forecast range (the remaining one was above the forecast range). The 2016 forecast for natural production of 649,000 pink salmon has a forecast range of 325,000–1,220,000. Strong parent-year escapements in 2014 and above-average marine survival in 2014–2015 suggest there is a strong likelihood of reaching at least the midpoint of this forecast range. If realized, a natural run of 649,000 pink salmon would be approximately 79% of the mean run size of 822,000 for even-year returns between 1962 and 2014. If the midpoint of the forecast range is achieved, all 9 index areas will meet the low end of their respective escapement goal ranges.

Commercial salmon fishing is allowed in 4 districts of the LCI management area. The harvestable surplus of naturally produced pink salmon in the Southern District is projected to be 47,000, with 21,000 pink salmon coming from Seldovia Bay, 20,000 from Port Graham, and the balance from Humpy Creek. Hatchery production of pink salmon in LCI recently resumed after several years of inactivity and significant adult returns are expected to the Southern District in 2016. Tutka Bay Lagoon Hatchery is expecting 337,500 pink salmon to return to Tutka Lagoon in 2016. An additional 66,000 enhanced pink salmon are forecasted to return to Port Graham Bay. The 2016 broodstock and cost-recovery goals for the Tutka Bay Lagoon Hatchery have not been finalized, so the proportion of the forecasted return available for common property harvest cannot be estimated at this time.

In the Outer District, the number of naturally produced pink salmon available for harvest is projected to be 194,000, with virtually all of it expected to occur in Port Dick Subdistrict. If realized, the Port Dick harvest would be approximately 87% of the mean even-year catch since 1962. Minimal harvest is expected from Port Chatham, Windy, and Rocky bays in 2016.

No pink salmon harvest is expected from Eastern District in 2016. Commercial fishing specifically directed at pink salmon has not been allowed in Eastern District in recent years due to a combination of low production and potential conflicts with the 5 AAC 21.376 *Resurrection Bay Salmon Management Plan*, which limits commercial interference with the sport coho salmon fishery.

Relatively poor runs are forecasted for 2 of the 3 major pink salmon producers in Kamishak Bay District. Approximately 83,000 pink salmon are expected to be available for harvest in Bruin Bay. However, depending on where the actual run falls within the forecast range, escapement shortfalls may occur in the Ursus and Rocky Cove Subdistricts. Cook Inlet Aquaculture Association (CIAA) recently repaired and reopened the Paint River fish ladder. In 2015, CIAA seeded the river with 1 million pink salmon fry and is expecting approximately 15,000 adults to return to Paint River in 2016. If initial stocking efforts are successful, CIAA intends to establish a productive, naturally spawning population of pink salmon in the Paint River that only requires minimal fish ladder maintenance without additional stocking or enhancement.

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APPENDIX E: KODIAK

Forecast Area: Kodiak
Species: Pink Salmon

Preliminary forecast of the 2016 run

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
KMA Wild Stock Total Run	16.9	13.1–20.6
KMA Escapement Goal [a]	5.0	
KMA Wild Stock Harvest	11.9	8.1–15.6
Kitoi Bay Hatchery Harvest [b]	4.3	3.1–5.5
Total KMA Pink Salmon Harvest	16.2	11.2–21.1

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.

[a] The 2016 estimated escapement is within the range of the even-year aggregate escapement goals for the Kodiak Archipelago (3.0–7.0 million) and the Mainland District (250,000–1.0 million).

[b] This figure is the total expected return (4.7 million) minus the broodstock collection goal of 430,000; the Kitoi Bay Hatchery cost-recovery harvest is expected to be roughly 2.0–3.0 million.

The 2016 Kodiak Management Area (KMA) predicted pink salmon harvest is expected to be in the *Average* category with a point estimate of 16.2 million combining the wild stock and Kitoi Bay Hatchery harvest estimates. Harvest categories were delimited from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest in the KMA from 1978 to 2015.

KMA Harvest Category	Range (millions)	Percentile
Poor	Less than 7.6	Less than 20th
Weak	7.6 to 11.0	21st to 40th
Average	11.0 to 16.7	41st to 60th
Strong	16.7 to 24.3	61st to 80th
Excellent	Greater than 24.3	81st to 100th

Forecast Methods

The KMA wild stock pink salmon harvest forecast is derived from a total run forecast minus the estimated KMA escapement (5.0 million). The total run estimates were derived from a combination of Karluk and Ayakulik weir counts, aerial survey index, and harvest estimates.

For the 2016 KMA wild stock pink salmon forecast, a generalized Ricker spawner-recruit model was fit to the even-year KMA returns from 1980 to 2014 utilizing KMA pink salmon indexed escapement for the spawner index, plus an additional term for Karluk and Ayakulik pink salmon weir counts.

In addition, a linear regression model using escapement estimates by district and climate variables during the freshwater phase was constructed. It is assumed that environmental conditions affect the survival at early life history stages of pink salmon and the year class strength is primarily determined prior to outmigration. Monthly values of average air temperature, total precipitation, and peak precipitation (Kodiak airport) from August to June were considered.

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Chosen for inclusion in the regression model were 16 parameters: district escapement for Afognak, Westside, and Alitak; air temperature for October, November, January, and March; precipitation for August, September, and November; and peak precipitation for September, November, December, January and February. The linear regression model was chosen over the spawner-recruit model because of its significant edge in hindcasting (Figure E1). Forecast range was estimated as the maximum deviation from true in the regression model hindcast.

The 2016 Kitoi Bay Hatchery pink salmon forecast was prepared by evaluating pink salmon survivals from odd brood years 1994 through 2012, when releases from the facility were in excess of 100 million fry. Brood years 1996 through 2012 are particularly important to the forecasting model because all pink fry were released on the same day in order to saturate the release area with fry (predator satiation). This release strategy has proven to significantly improve fry-to-adult survival.

The pink salmon return to Kitoi Bay Hatchery is odd-year dominant and exhibits higher than average strength returns every 4th year and average returns in between. The midpoint estimate reflects a marine survival of 2.67% for the 177.2 million fry released—which were above average size (0.96 g)—and is an average of the previous 5 cyclical returns (2012, 2008, 2004, 2000 and 1996).

Forecast Discussion

The 2016 KMA wild stock pink salmon total run (16.9 million) should be an average even-year return (Figure E1). While brood year escapement in 2014 was low, climate variables correlated with even-year returns suggest higher-than-average freshwater survival. Confidence in the 2016 forecast estimate is only fair considering the unpredictable nature of the KMA wild stock pink salmon returns. Despite the strength of the forecast model, the authors recognize that environmental corollaries are often fleeting due to the dynamic nature of the Gulf of Alaska.

The 2016 Kitoi Bay Hatchery pink salmon production is expected to be 4.7 million. The broodstock collection goal is 425,000, resulting in a total hatchery harvest projection of about 4.3 million.

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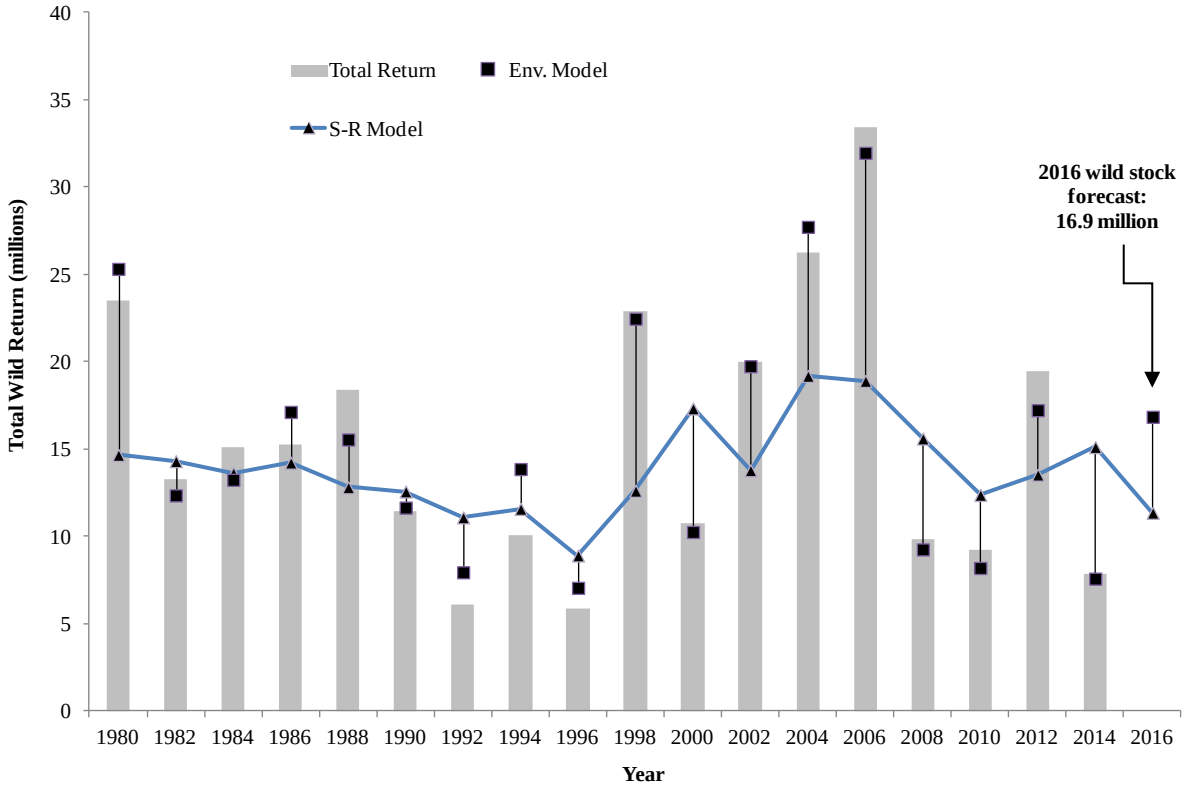

Figure E1.–Kodiak even-year pink salmon wild stock total return compared to spawner-recruit (S-R) estimates and environmental model estimates, 1980–2014, and 2016 forecast.

M. Birch Foster, Finfish Research Biologist, Westward Region
Drew Aro, Kitoi Bay Hatchery Manager, Afognak

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Forecast Area: Kodiak, Ayakulik River
Species: Sockeye Salmon

Preliminary Forecast of the 2016 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	567	308–827
Escapement Goal [a]	300	200–400
Harvest Estimate	267	

[a] The escapement estimate is the sum of the approximate midpoints of escapement goals for the early (140,000–280,000) and late run (60,000–120,000).

Forecast Methods

The 2016 Ayakulik River sockeye salmon forecast was prepared primarily by investigating simple linear regression models utilizing recent outmigration year ocean age class relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were used. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. The age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

Age-.3 sockeye salmon were predicted from prior year age-.2 returns using outmigration years (1989–2012). The age-.2 sockeye salmon were predicted from prior year age-.1 returns (ln transformed) using outmigration years (1989–2013). Age-.1 and -.4 sockeye salmon were predicted by the median return since 1989. Regression and median estimates were summed to estimate the total Ayakulik sockeye salmon run for 2016. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted.

Forecast Discussion

The 2016 Ayakulik forecast of 567,000 sockeye salmon is about 250,000 less than the actual 2015 run estimate of 818,000, which was the largest since 1999. The 2016 run will likely be composed of approximately 58% age-.2 and 39% age-.3 fish. If realized, this run will be 116,000 more than the recent 10-year average (2005–2014). The confidence in the 2016 Ayakulik forecast is good, due to the strong regression relationship. The projected harvest of 267,000 is based on the achievement of the midpoint of the combined escapement goal ranges (300,000). Ayakulik is managed based on both early- and late-run (post-July 15) components. Based on brood year escapement proportions from what will be the major contributing brood years (2010–2012), approximately 72% of the total run will occur in the early portion of the run.

M. Birch Foster, Finfish Research Biologist, Westward Region

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Forecast Area: Kodiak, Karluk River
Species: Sockeye Salmon

Preliminary Forecast of the 2016 Run

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run	Total Run Estimate	334	177–491
	Escapement Goal [a]	175	110–250
	Harvest Estimate	159	
Late Run	Total Run Estimate	1,055	590–1,520
	Escapement Goal [a]	380	170–380
	Harvest Estimate	675	
Total Karluk River System	Total Run Estimate	1,389	767–2,011
	Escapement Goal [a]	555	280–630
	Harvest Estimate	834	

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.

[a] The escapement estimates are based on the S_{msy} for the early-run (175,000) and upper end for late-run (170,000–380,000) escapement goals and summed for the total run.

Forecast Methods

The 2016 Karluk River sockeye salmon forecast was prepared primarily by investigating simple linear regression models utilizing recent age class relationships. Each model was assessed with standard diagnostic procedures. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. The age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

For the early run, age-.2 sockeye salmon returns were predicted based on the abundance of the prior-year return of age-.1 sockeye salmon using recent outmigration years (2004–2013). The age-.1, -.3, and -.4 return predictions were calculated using their pooled 10-year median contribution.

For the late run, age-.2 sockeye salmon returns were predicted based on the abundance of the prior-year return of age-.1 sockeye salmon using recent outmigration years (2000–2013). The age-.1, -.3, and -.4 return predictions were calculated using their pooled 15-year median contribution.

Regression and median estimates were summed to estimate the total Karluk sockeye salmon run for 2016. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted. The combined early- and late-run 80% prediction interval was calculated by summing the lower prediction bounds and upper prediction bounds of the 2 runs.

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Forecast Discussion

The total 2016 sockeye salmon run to the Karluk River is expected to be approximately 1,389,000. The early run is expected to be approximately 334,000, which is about 48,000 above the recent 10-year average (286,000) and 52,000 below the 2015 run (386,000). The late run is expected to be approximately 1,055,000, which is 458,000 above the recent 10-year average (597,000) and 214,000 more than the 2015 run (842,000).

The projected harvest estimate for the early run (159,000) is based on achievement of S_{msy} for the early run. The projected harvest estimate for the late run (675,000) is based on achievement of the upper end of the late-run escapement goal. The vast majority of both runs is expected to be age-.2 fish. The large smolt migrating out of the lake in 2014 and high abundance of age class predictors like age-.1 fish in 2014 suggest the 2016 return will again be robust. More uncertainty, in absolute terms, exists in the 2016 forecast due to the high anticipated return. Therefore, the overall confidence in the Karluk sockeye salmon forecast is only fair.

M. Birch Foster, Finfish Research Biologist, Westward Region

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Forecast Area: Kodiak, Alitak District (Frazer Lake and Upper Station)
Species: Sockeye Salmon

Preliminary Forecast of the 2016 Run

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Upper Station	Total Run Estimate	94	63–125
	Escapement Goal [a]	66	43–93
	Harvest Estimate [b]	28	
Late Upper Station	Total Run Estimate	215	101–329
	Escapement Goal	186	120–265
	Harvest Estimate [b]	29	
Frazer Lake	Total Run Estimate	342	183–501
	Escapement Goal	137	95–190
	Harvest Estimate [b]	205	
Total Alitak District	Total Run Estimate	650	347–955
	Escapement Goal	389	258–548
	Harvest Estimate [b]	262	

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.

[a] Alaska Board of Fisheries instituted an optimal escapement goal (OEG) of 30,000 in 2014 that is in effect only if the department determines that the upper end of the Frazer system sockeye salmon escapement goal will be exceeded. Upper Station early run has a BEG of 43,000–93,000.

[b] The harvest of Upper Station-bound sockeye salmon is concurrent with the harvest of Frazer Lake-bound sockeye salmon and predominantly occurs within the Alitak District.

Forecast Methods

The 2016 sockeye salmon run to the Alitak District was forecasted with simple linear regression models using ocean age class relationships by system from recent outmigration years. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were used. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. The age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimate.

Upper Station early- and late-run age-.2 and -.3 salmon returns were each predicted using their respective prior year age-.1 and -.2 returns (outmigration years 1999–2013 and 1999–2012). Upper Station early- and late-run age-.1 and -.4 sockeye salmon predictions were calculated using the pooled 10-year median contributions by stock and ocean age. Frazer age-.3 salmon were predicted using prior year age-.2 returns (outmigration years 2002–2012). Frazer age-.1, -.2, and -.4 returns were calculated using the pooled median contributions from the last 10 years.

Regression and median estimates were summed to estimate the total Alitak District sockeye salmon run for 2016. The prediction interval ranges for each stock were calculated as the square root of the sum of the squared prediction intervals for each age class forecasted. The combined Alitak District prediction interval was calculated by summing the lower and upper prediction bounds of the 3 runs.

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Forecast Discussion

The 2016 sockeye salmon run to the Alitak District is expected to be approximately 650,000, approximately 29,000 more than the recent 10-year average run (621,000) and 40,000 less than the 2015 run (658,000). The Upper Station early run is expected to be approximately 94,000, which exceeds the recent 10-year average run (58,000). The Upper Station late run is expected to be approximately 215,000, which is below the recent 10-year average run (231,000). The Frazer Lake run is expected to be approximately 342,000, which is above the recent 10-year average (332,000). The 2016 Alitak District sockeye salmon run should be composed of approximately 70% age-.2, 24% age-.3, and 6% age-.1 fish. Overall, our confidence in the forecast is only fair based on the strength of the regression models and the large prediction interval.

The projected harvest estimate of 262,000 is based on achieving the S_{MSY} estimates for both the Upper Station early and late runs and the S_{MSY} estimate plus an additional 20,000 (20-year median of the number of fish that pass through Dog Salmon but do not ascend the Frazer Lake fish pass) for the Frazer run. S_{MSY} is an estimate of the escapement that has the largest expectation of subsequent surplus production.

Heather Finkle, Finfish Research Biologist, Kodiak

APPENDIX F: CHIGNIK

Forecast Area: Chignik
Species: Sockeye Salmon

Preliminary Forecast of the 2016 Run

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run (Black Lake)	Total Run Estimate	1,801	737–2,877
	Escapement Goal [a]	400	350–450
	Harvest Estimate [b]	1,407	
Late Run (Chignik Lake)	Total Run Estimate	1,108	436–1,781
	Escapement Goal [a]	325	250–400
	Harvest Estimate [b]	783	
Total Chignik System	Total Run Estimate	2,909	1,173–4,658
	Harvest Estimate [b]	2,190	
	Chignik Area	1,767	
	SEDM Area	139	
	Cape Igvak Section	284	

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.

[a] Harvest represents the midpoint of the escapement goal. An inriver run goal of 50,000 sockeye salmon is added to the lower bound of the late-run escapement goal.

[b] Includes anticipated harvests of Chignik-bound fish in Southeastern District Mainland (SEDM) and Cape Igvak fisheries.

Forecast Methods

Simple and multiple linear regressions models using age class relationships and parent escapement data were used to forecast the 2016 early- and late- Chignik sockeye salmon runs. Each regression model was assessed with standard regression diagnostic procedures. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

For the early run, simple linear regression was used to predict age-.3 sockeye salmon from prior year age-.2 returns using data from the 1998 outmigration year to the present. Remaining age class components of the run were predicted by calculating median returns since the 1998 outmigration year (8% of the run).

The late run was predicted using ocean age class and sibling relationships. Age-1.3 sockeye salmon were predicted by simple linear regression from prior year age-1.2 returns from 1991 to the present. Age-2.3 sockeye salmon were predicted by simple linear regression from prior year age-2.2 returns from 1992 to the present. Remaining age class components of the run (age-.1, -.2, -0.3, -3.3 and -.4 sockeye salmon) were predicted by calculating median returns since the 1991 outmigration year (less than 15% of the run).

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The early- and late-run regression and median estimates were summed to estimate the total Chignik River sockeye salmon run for 2016. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted. The combined early- and late-run 80% prediction interval was calculated by summing the lower prediction bounds and upper prediction bounds of the 2 runs.

Forecast Discussion

The 2016 Chignik sockeye salmon early run is forecasted to be 1.80 million, which is 548,000 more than the 10-year average run of 1.26 million and 645,000 more than the 2015 early run of 1,161,915. The early run is predicted to comprise 92% age-.3 and 7.8% age-.2 fish, and less than 1% of remaining age class components. The late run is forecasted to be 1.11 million, which is 9,000 more than the 10-year average run of 1.12 million and 511,000 less than the 2015 late run of 1,618,886. The 2016 late run is predicted to comprise 86% age-.3 (31% age-1.3 and 54% age-2.3 fish), 13% age-.2, and less than 1% age-.1 and -.4 fish. The total Chignik sockeye salmon run is expected to be 2.91 million, which is approximately 539,000 more than the 10-year average of 2.38 million and 135,000 more than the 2015 total run of 2.78 million.

Inseason genetic estimates of each run were used to manage the fishery in 2015, and will continue to be used in 2016. Inseason genetics proved particularly important in 2015 because both runs came in strong but late. The projected 2016 early-run total harvest estimate of 1.41 million is based on achievement of the midpoint of the early-run escapement goal range of 350,000–450,000. The projected late-run harvest estimate of 783,000 is based on achieving the midpoint of the late-run goal of 200,000–400,000 plus the inriver run goal of 50,000, which is added to the lower bound of the escapement goal. Therefore, the midpoint is the escapement objectives, or 325,000. Sockeye salmon harvest estimates for both runs include fish harvested in the Chignik Management Area, and Chignik-bound fish harvested in the Cape Igvak Section of the Kodiak Management Area and in the Southeastern District Mainland of the Alaska Peninsula Management Area.

The 2016 forecast for the early run is larger the most recent 10-year average run size, while the late-run forecast approximates the most recent 10-year average run size. Predicting future runs of salmon is always difficult, and the wide confidence interval around the point estimate of the 2016 forecasts is due to the substantial uncertainty included within each of forecast models. The magnitude of the early run is typically more variable than the late run, resulting in wider confidence intervals for early run. Exploratory analysis using other sibling relationships, smolt outmigration data, and environmental variables yielded results similar to this formal forecast. Similar methods have been used for forecasting the early and late runs since 2004. Due to the range of variation in the relationships used in these forecasts and their historical accuracy, our confidence in them is good.

Mary Beth Loewen Finfish Research Biologist, Alaska Peninsula

APPENDIX G: BRISTOL BAY

Forecast Area: Bristol Bay
Species: Sockeye Salmon

Forecast of the 2016 Run

Total Production	Forecast (millions)	Forecast Range (millions)
Total Run	46.55	36.37–56.44
Escapement	15.31	
Commercial Common Property Harvest	31.24	
Bristol Bay Harvest	29.52	
South Peninsula Harvest	1.72	

Methods

The 2016 Bristol Bay sockeye salmon forecast is the sum of individual predictions for 9 river systems (Kvichak, Alagnak, Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak, and Togiak rivers) and 4 age classes (ages 1.2, 1.3, 2.2, and 2.3; plus ages 0.3 and 1.4 for the Nushagak River). Adult escapement and return data from brood years 1972–2011 were used in the analyses.

Predictions for each age class returning to a river system were calculated from models based on the relationship between adult returns and spawners or siblings from previous years. Tested models included simple linear regression and recent year averages. In general, models chosen were those with statistically significant parameters having the greatest past reliability (accuracy and precision) based on mean absolute deviation, mean absolute percent error, and mean percent error between forecasts and actual returns for 2 time periods, 2013–2015 and 2011–2015.

The forecast range is the upper and lower values of the 80% confidence interval for the total run forecast. The confidence bounds were calculated using deviations of actual runs from published predictions from 2001 through 2015.

Results

A total of 46.55 million sockeye salmon (range 36.67–56.44 million) are expected to return to Bristol Bay in 2016. This prediction is 15% greater than the previous 10-year mean of total runs and 41% greater than the long-term mean of 32.94 million. All systems are expected to meet their spawning escapement goals.

A run of 46.55 million sockeye salmon can produce a potential total harvest of 31.24 million. The projected harvest includes 29.52 million in Bristol Bay and 1.72 million in the South Peninsula fisheries. A Bristol Bay harvest of 29.52 million would be 8% greater than the previous 10-year mean harvest (27.32 million; range of 15.42 million to 36.45 million), and 46% greater than the long-term mean harvest of 20.20 million.

The run forecast to each district and river system is as follows: 23.17 million to Naknek-Kvichak District (12.69 million to Kvichak River, 5.72 million to Alagnak River, 4.76 million to Naknek River); 7.41 million to Egegik District; 4.95 million to Ugashik District; 10.36 million to Nushagak District (7.53 million to Wood River, 1.74 million to Nushagak River, 1.09 million to Igushik River); and 660,000 to Togiak District (Table G1).

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The total run forecast of 46.55 million sockeye salmon is expected to be comprised of 16.28 million age-1.2 fish (35%) followed by 12.70 million age-1.3 fish (27%), 11.40 million age-2.2 fish (24%), and 6.05 million age-2.3 fish (13%), with minor age classes contributing to the remainder of the return (Table G1).

Discussion

Forecasting future salmon returns is inherently difficult and uncertain. We have used similar methods since 2001 to produce the Bristol Bay sockeye salmon forecast. These methods have performed well when applied to Bristol Bay as a whole. Forecasts since 2001 have averaged 8.2% below the actual total run. Run forecast differences have ranged from 35.9% below actual run in 2014 to 20.6% above actual run in 2011. Forecasted harvests have averaged 1.8% below actual harvest since 2001 and harvest differences have ranged from 39% below actual harvest in 2014 to 35% above actual harvest in 2011.

Individual river forecasts have greater uncertainty compared to Baywide forecasts. Since 2001, on average, we have underforecasted the returns to the Alagnak (–34%), Togiak (–14%), Kvichak (–11%), Wood (–6%), and Nushagak (–1%) rivers and overforecasted returns to Igushik (48%), Egegik (31%), Ugashik (15%), and Naknek (8%) rivers.

The overall Bristol Bay forecasts have been fairly accurate since 2001 in spite of a large amount of individual river forecast variability. This is the result of overforecasting returns to some rivers and underforecasting returns to other rivers. The forecasts to individual rivers offset each other such that the overall Bristol Bay forecast has been more accurate than the individual forecasts.

Historically, total runs of sockeye salmon to Bristol Bay have been highly variable. The 2016 forecast of 46.55 million is above the long-term (1963–2015) average of 32.93 million, and above the most recent 10-year (2006–20015) average of 40.54 million.

Chuck Brazil, Fred West, and Greg Buck
Bristol Bay Research Staff

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Table G1.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay river systems in 2016.

District	Millions of Sockeye Salmon							
	Forecasted Production by Age Class					Forecasted		South
River	1.2	2.2	1.3	2.3	Total	Escapement	Harvest	Peninsula [a]
Naknek-Kvichak								
Kvichak	4.30	6.09	1.25	1.06	12.69	6.34	5.87	0.47
Alagnak	1.78	0.07	3.73	0.15	5.72	2.86 [b]	2.65	0.21
Naknek	0.94	1.44	1.41	0.98	4.76	1.40	3.18	0.18
Total	7.02	7.59	6.38	2.18	23.17	10.61	11.71	0.86
Egegik	0.30	3.12	0.50	3.49	7.41	1.40	5.74	0.27
Ugashik	3.67	0.48	0.54	0.26	4.95	0.95	3.82	0.18
Nushagak								
Wood	4.91	0.16	2.38	0.08	7.53	1.25	6.00	0.28
Igushik	0.13	0.02	0.93	0.01	1.09	0.28	0.77	0.04
Nushagak	0.14	0.00	1.48	0.00	1.74 [c]	0.64	1.04	0.06
Total	5.17	0.19	4.78	0.10	10.36	2.16	7.82	0.38
Togiak [d]	0.12	0.02	0.49	0.02	0.66	0.20	0.44	0.02
Bristol Bay	16.28	11.40	12.70	6.05	46.55	15.31	29.52	1.72
	35%	24%	27%	13%	100%			

Note: This table summarizes the forecast of sockeye salmon in millions of fish. Any differences in addition are due to rounding.

[a] The projected harvest accounts for the harvest of Bristol Bay sockeye salmon in the South Peninsula commercial salmon fisheries. The South Peninsula harvest has averaged 3.7% of the total Bristol Bay sockeye salmon production during the last 5 years.

[b] The projected escapement to the Alagnak River was estimated based on exploiting the Alagnak River at the same exploitation rate as the Kvichak River.

[c] Nushagak River forecast includes age-0.3 (18,914) and age-1.4 (101,994) fish.

[d] Forecasts for Kulukak, Kanik, Osviak, and Matogak river systems are not included. These systems contribute approximately 50,000 to Togiak District harvest each year.

APPENDIX H: ALASKA PENINSULA

Forecast Area: Alaska Peninsula, Nelson River
Species: Sockeye Salmon

Preliminary forecast of the 2016 run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	692	456–928
Escapement Goal [a]	158	97–219
Harvest Estimate	534	

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.
[a] The escapement estimate is the midpoint of the escapement goal range (97,000–219,000) in 2016.

Forecast Methods

The 2016 Nelson River sockeye salmon run was forecasted using simple linear regression and generalized Ricker models of ocean age class and air temperature from the past 27 years. Air temperature indices were constructed from Cold Bay Airport data. Standard regression diagnostics were used to evaluate each model. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

Age-.2 sockeye salmon returns were forecasted with a generalized Ricker model that used parental escapement of dominant age-2.2 fish from 1984 to 2010, and averaged November of year prior to and year of outmigration as juveniles. Age-.3 sockeye salmon returns were predicted by simple linear regression from prior year age-2.2 returns from 1995 to the present. The remaining age-.1 and -.4 returns were calculated from median estimates for each ocean age class using run data from 1995 to the present.

Regression and median estimates were summed to estimate the total Nelson River sockeye salmon run for 2016. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted.

Forecast Discussion

The 2016 Nelson River forecast of 692,000 is about 294,000 more than the most recent 10-year average of 399,000 and is approximately 126,000 more than the 2015 run of about 567,000. The 2016 run should be composed mainly of age-.2 (72%) and -.3 (27%) fish. Regression relationships predicting age-.2 and -.3 sockeye salmon are significant and represent the majority of the run. However, the Nelson River sockeye salmon run has been notoriously unpredictable. Therefore, confidence in this forecast is fair. The projected harvest of 534,000 is based on achieving the midpoint (158,000) of the escapement goal range.

Mary Beth Loewen, Finfish Research Biologist, Alaska Peninsula

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Forecast Area: Alaska Peninsula, Bear Lake (Late Run)
Species: Sockeye Salmon

Preliminary forecast of the 2016 run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	424	130–718
Escapement Goal [a]	156	117–195
Harvest Estimate	268	

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.
[a] The escapement estimate is the midpoint of the escapement goal range (117,000–195,000) in 2016.

Forecast Methods

The 2016 forecast of the Bear Lake sockeye salmon late run was prepared using simple linear regressions of sibling age classes and environmental data from 1991 to the present. Models were evaluated with standard regression diagnostics. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. The age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the 80% prediction interval of the medians.

Age-2.3 sockeye salmon were predicted from prior year age-2.2 returns from the 1991 brood year to the present. Remaining age class components of the run were predicted by calculating median returns from the most recent 10 years.

Regression and median estimates were summed to estimate the total Bear Lake late-run sockeye salmon for 2016. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted.

Forecast Discussion

The 2016 Bear Lake late-run forecast of 424,000 sockeye salmon is below (54,000) the 10-year average of approximately 478,000, and 149,000 less than the 2015 run of 573,000. The 2016 late run is expected to comprise 4% age-.1, 66% age-.2, 30% age-.3, and 0.1% age-.4 fish. The projected harvest of 268,000 is based on achieving the midpoint of the late-run escapement goal range (156,000) and adequate run strength as determined by the area management biologist. All major age classes directly affected by a severe storm in December 2007 that impacted lake rearing conditions have returned. However, winter temperatures have remained consistently low on the North Peninsula and Bering Sea since 2006, which has likely limited production, especially in spring 2012. Additionally, Bear River late-run sockeye salmon returns have shown a general decline in total run since 1989. Significant relationships using adult age class returns and environmental variables incorporating this cold spring were found, but other relationships and outmigrating smolt condition in 2014 did not corroborate the prediction point. The wide range around the point forecast is a result of large fluctuations in age-2.2 salmon returns in the last 2 years.

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Over the last 10 years, age-2.2 fish have comprised an average of 56% of the annual run, but has varied from as low as 16% (2011) to as much as 78% (2014). Based on uncertainty associated with the variable predictive capabilities of sibling age class, our confidence in this forecast is fair.

Mary Beth Loewen, Finfish Research Biologist, Alaska Peninsula

-continued-

Forecast Area: Alaska Peninsula, South Alaska Peninsula Aggregate
Species: Pink Salmon

Preliminary forecast of the 2016 run

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
Total Run Estimate	16.6	10.8–22.4
Escapement Goal [a]	3.7	1.9–3.7
Harvest Estimate	12.9	9.0–18.7

Note: Column numbers may not total or correspond exactly with numbers in text due to rounding.
[a] The escapement estimate is the upper end of the aggregate goal range (1.9–3.7 million) in 2016.

The 2016 South Alaska Peninsula predicted pink salmon harvest is expected to be in the *Excellent* category with a point estimate of 12.9 (9.0–18.7) million. Harvest categories were delimited from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest on the South Alaska Peninsula from 1984 to 2015.

S. Pen Harvest Category	Range (millions)	Percentile
Poor	Less than 2.4	Less than 20th
Weak	2.4 to 4.3	21st to 40th
Average	4.3 to 7.6	41st to 60th
Strong	7.6 to 9.7	61st to 80th
Excellent	Greater than 9.7	81st to 100th

Forecast Methods

The 2016 South Alaska Peninsula pink salmon harvest forecast is derived from a total run forecast minus the upper end (3.7 million) of the even-year South Alaska Peninsula escapement goal range. The total run was forecasted with a simple linear regression model using the average temperature in Cold Bay between emergence (April) and migration and juvenile ocean survival (November). The regression model was fit to the South Peninsula pink salmon returns from 1984 to 2014. The range was estimated as the 80% prediction intervals based on the error structure of the regression.

Forecast Discussion

The 2016 South Alaska Peninsula pink salmon total harvest (12.9 million) is predicted to be strong. The average temperature index correlated with South Alaska pink salmon returns suggest a robust return in 2016; however, the average temperature between April and November in the parent year (2014) is the highest in the dataset, and therefore outside the range of the model prediction. Therefore, the average temperature from April through November in 2002, which was the next highest temperature on record within the timeframe of the model, was used as the predictor. Due to a relative lack of strength in the regression model, confidence in the forecast is only fair.

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APPENDIX I: ARCTIC-YUKON-KUSKOKWIM

Forecast Area: Arctic-Yukon-Kuskokwim
Species: All Salmon

ADF&G does not produce formal run forecasts for most salmon runs in the AYK Region. The salmon run outlooks presented in this report are qualitative in nature because of a lack of information with which to develop more rigorous forecasts. Consequently, these commercial harvest outlooks are typically based upon available parent-year spawning escapement indicators, age composition information, recent year trends, and the likely level of commercial harvest that can be expected to be available from such indicators given the fishery management plans in place. Although commercial harvest outlooks provide for a general level of expectation, fisheries management is based on inseason run assessment. A formal forecast of Yukon River fall chum salmon is provided. A Canadian-origin Yukon River Chinook salmon forecast will be made prior to the meeting of U.S./Canada Yukon River Panel in the spring of 2015.

In the AYK Region, salmon production notably decreased for many stocks from 1998 to 2002, but increased rapidly beginning in 2003 to record and near-record runs from 2004 to 2006. Since 2007, Chinook salmon production has shown a sharp decline. Currently, Yukon River and southeastern Norton Sound Chinook salmon stocks and northern Norton Sound chum salmon stocks are classified as *stocks of yield concern* under 5 AAC 39.222 *Policy for the management of sustainable salmon fisheries*.

The northeastern Bering Sea is the primary rearing habitat for juvenile Yukon and Norton Sound salmon during their first summer at sea. Marine surveys in the northeastern Bering Sea were initiated in 2002 by the National Oceanic and Atmospheric Administration (NOAA) and have continued in recent years in partnership with ADF&G. These surveys occur primarily in September and capture juvenile salmon using surface trawls after they experience a critical transition from freshwater to marine environments. Surveys have been demonstrated to provide a leading indicator of Canadian-origin Yukon River Chinook salmon run abundance, but may provide some indication of marine production trends for other northeastern Bering Sea stocks as well. The age-5 component of the 2016 Chinook salmon run is expected to be strong, based on robust juvenile abundance in 2013 and strong age-4 returns in 2015. Current projections of Canadian-origin Yukon River Chinook salmon indicate increasing abundance should be expected over the next 3 years. The 2016 projection is for a run size similar to or better than 2015, which should meet escapement objectives and provide for subsistence harvest opportunity, but will still be below average.

In general, management for anticipated low Chinook salmon abundance in 2016, and small processing capacity in some areas, will likely result in chum and sockeye salmon harvests that are lower than the outlook projections in the AYK Region.

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Table I1.–The 2016 commercial harvest outlook by management area, in thousands of fish.

	Salmon Species					
Management Area	Chinook	Sockeye	Coho	Pink	Chum	Fall Chum
Kuskokwim River	0	5–15	50–100	0	20–80	
Kuskokwim Bay	0–2	60–100	50–100	0	20–80	
Kuskokwim Area Total	0–2	65–115	100–200	0	40–160	
Yukon	0	0	30-100	50-100	450–950	50–230
Norton Sound	0–2	3–5	130–170	250–750	120–160	
Kotzebue Sound					300–500	

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Forecast Area: Yukon Area
Species: Fall Chum Salmon

Preliminary Forecast of the 2016 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	670	550–780
Escapement Goal	450	300–600
Harvest Estimate[a]	220	120–330

[a] Includes harvests from subsistence (~100,000) and commercial fisheries.

Forecast Methods

The forecast for the 2016 Yukon Area fall chum salmon run is based on run reconstruction of 5 river systems (Tanana, Chandalar, Sheenjek, Fishing Branch, and the mainstem Yukon River in Canada) and 4 age classes: age-3 through age-6 (with age-4 fish dominating), followed by age-5 fish. Adult escapement and return data were used from the complete brood years 1974–2009, production from incomplete brood years 2010 and 2011 was estimated based on return per spawner from brood year returns, and an auto-regressive Ricker model was used to predict returns from the 2012 and 2013 parent years.

Predicted returns were multiplied by corresponding average maturity schedules for even- and odd-numbered parent years to estimate 2016 run size, and rounded to the nearest thousand fish. The even/odd maturity schedule from 1974 to 2009 was used to estimate the 2016 return. The forecast range is the upper and lower values of the 80% confidence bounds for the total run forecast. Confidence bounds are calculated using deviation of the run projection point estimates and the observed returns from 1987 to 2015.

The 2016 projected run size of fall chum salmon for the Yukon Area is approximately 670,000. This forecast is below average for even-numbered year runs; however, recent runs have fluctuated more widely and have produced runs as low as 252,000 in 2000 to as high as 2.2 million in 2005. The 80% confidence bounds for the 2016 forecast range from 550,000 to 780,000 fall chum salmon. If the run materializes as forecasted, abundance would be sufficient to meet escapement goals including Canadian border passage and harvest sharing objectives and provide an average subsistence harvest, possibly with a small surplus for commercial harvest.

Drainagewide escapements between 300,000 and 600,000 provide a mean yield of 477,000 fall chum salmon. The mean subsistence harvest from 2005 to 2014 for Alaskan subsistence and Canadian aboriginal harvests is 93,000 fall chum salmon. Commercial harvests may be allowed on the amount above 550,000 based on inseason assessments of run size. Targeting the midpoint of the escapement goal of 450,000 fall chum salmon, ADF&G anticipates a subsistence harvest of approximately 100,000 and a commercial harvest between 20,000 and 230,000. In mid-July, a projection based on the relationship of summer chum salmon to fall chum salmon returns to the Yukon River will be developed and used for initial management. The actual harvest will be dependent on inseason assessment of run size as applied to the guidelines of the 5 AAC 01.249 *Yukon River Drainage Fall Chum Salmon Management Plan* with further considerations of fishing effort and buying capacity.

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The forecasted total run of fall chum salmon is expected to be composed of 72% age-4 and 23% age-5 fish. The age-4 component of fall chum salmon runs has varied widely, ranging from 37% (1992) to 94% (2005). Fall chum salmon exhibit an odd-even abundance cycle (averaging more than 1.1 million in odd-numbered years and 800,000 in even-numbered years) that was consistent between 1974 and 1992. Since 1993 the cycle has deteriorated, and now wide swings in production are being observed. These swings are primarily thought to be due to conditions in the marine environment, although density dependence may also be a cause in some years. The effect of the odd-even cycle was restricted between 1993 and 2002 during which most years' (1993 and 1997–2002) stocks were severely depressed, with peaks of high production occurring in 1995 and 2005. Age-4 fish contributed greater than 90% (record levels) during the runs in 2003 and 2005. However, based on this analysis, the extremely large escapement observed in 2005 only produced an estimated 0.27 return per spawner (R/S).

Forecast Discussion

Point projections for expected returns have been developed since 1987 for fall chum salmon in the Yukon River drainage. Forecast methods were changed to provide ranges beginning in 1999. From 1999 to 2005 adjustments to the point estimates were made by reducing them by the average ratio of observed to predicted returns in attempts to reflect expected poor runs. From 2006 to 2016, the ranges were developed around the point estimate, based on the 80% confidence bounds, using the standard deviation between the annual point estimates and observed returns (Figure I1). High and low cycles in production have changed approximately 33-fold (based on 36 brood year returns) with the most drastic fluctuations occurring between brood years 2001 and 2005; therefore, forecasts of run size remain difficult to determine with accuracy.

Since forecasted ranges were established in 1999, 53% of the observed runs were within the range, 23% were below, and 24% were above. Returns of age-4 fish in even-numbered years are typically 16% lower than odd-numbered years. Sibling relationships for this stock are weak. Both the age-4 and age-5 components are returning from large escapements, each above the upper end of the drainagewide escapement goal. The R/S for the 2011 brood year appears to have once again dipped below replacement. Productivity was at its lowest in 2005 with the most recent peak in the 2009 brood year (2.48 R/S). The forecasted run in 2016 may be affected by an apparent decrease in productivity, estimated as 0.7 R/S (2011 brood year) and 1.06 R/S (2012 brood year) that will contribute as age-5 and age-4 components of the run. The 2016 point estimate of 670,000 fall chum salmon should be dominated by age-4 component; the age-5 return is forecasted to make up less than a quarter of the run.

Bonnie Borba, Yukon Area Fall Season Research Project Leader, Fairbanks

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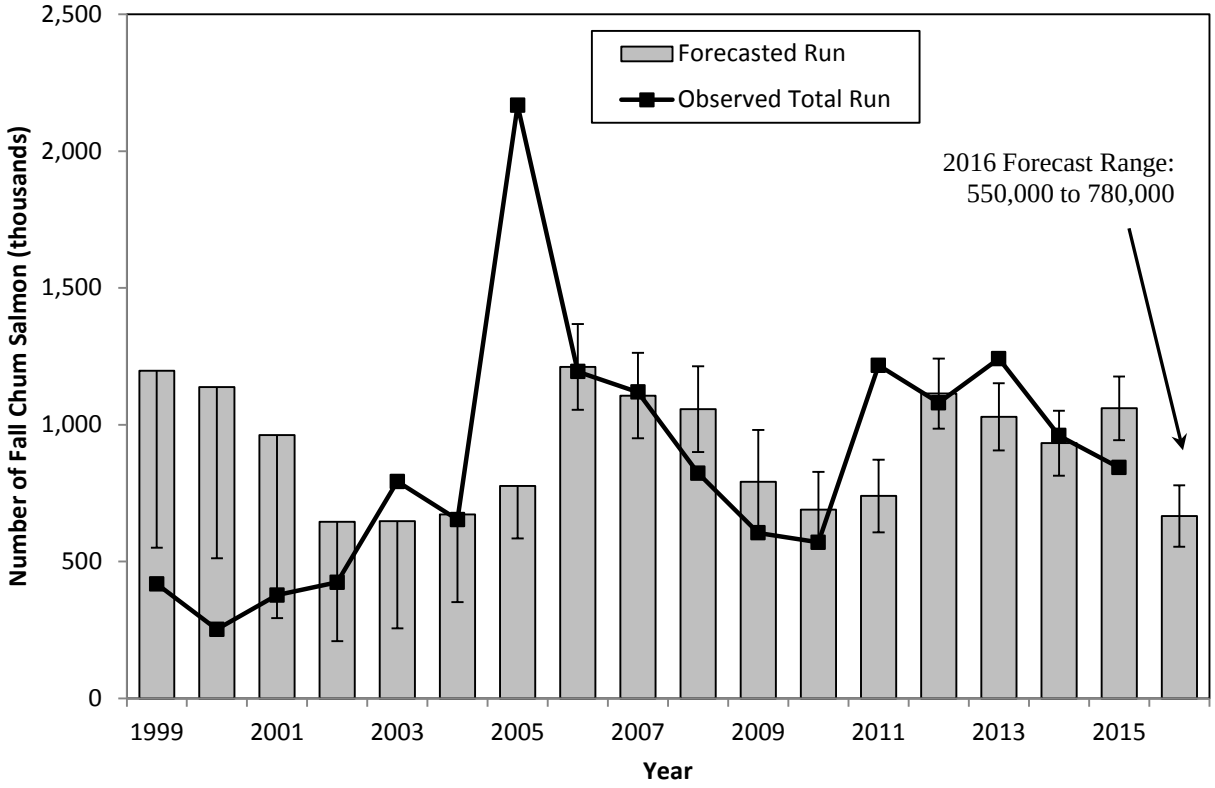

Figure I1. Observed total run of fall chum salmon compared to the spawner recruit (S-R) estimates used in the annual forecast, Yukon River, 1999–2016.

Note: Different methods were used for determining bounds and are documented in annual Yukon River U.S./Canada Joint Technical Committee reports.

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