Special Publication 17-08

Run Forecasts and Harvest Projections for 2017 Alaska Salmon Fisheries and Review of the 2016 Season

Edited by

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and

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March 2017

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

SPECIAL PUBLICATION 17-08

RUN FORECASTS AND HARVEST PROJECTIONS FOR 2017 ALASKA SALMON FISHERIES AND REVIEW OF THE 2016 SEASON

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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 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. A sustainable escapement goal is used in situations where a biological escapement goal 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 2016 commercial salmon season and forecasts for 2017. The Alaska all-species salmon harvest for 2016 totaled 112.5 million, which was about 49 million less than the preseason forecast of 161 million. This combined harvest was composed of 434,000 Chinook salmon *Oncorhynchus tshawytscha*, 52.9 million sockeye salmon *O. nerka*, 3.9 million coho salmon *O. kisutch*, 39 million pink salmon *O. gorbuscha*, and 16 million chum salmon *O. keta*. The Alaska Department of Fish and Game is expecting an increase in commercial salmon harvests in 2017, mostly due to an increase in pink salmon harvests compared to 2016. The 2017 total commercial salmon catch (all species) projection of 204 million is expected to include 80,000 Chinook salmon in areas outside Southeast Alaska, 40.8 million sockeye salmon, 4.7 million coho salmon, 141.9 million pink salmon, and 16.7 million chum salmon. Thus, compared to 2016 commercial harvests, the projected 2017 commercial harvests are expected to be as follows: pink salmon, 102.7 million more; sockeye salmon, 12 million less; coho salmon, 778,000 more; and chum salmon, 1.2 million more.

When the appropriate data were available, harvest forecasts were arrived at through quantitative projections based on information of 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 2017 as well as a detailed review of Alaska's 2016 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 an increase in commercial salmon harvest in 2017. The 2017 total commercial salmon harvest (all species) projection of 204 million is expected to include 80,000 Chinook salmon in areas outside Southeast Alaska, 40.8 million sockeye salmon, 4.7 million coho salmon, 141.9 million pink salmon, and 16.7 million chum salmon. The projected pink salmon harvest is about 102.7 million more than harvested in 2016 (39.2 million); the sockeye salmon harvest is expected to be about 12 million fewer than were harvested in 2016; the coho salmon harvest is expected to be about 778,000 more than were harvested in 2016; and the chum salmon harvest is expected to be about 1.2 million more than were harvested in 2016.

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 2017 Alaska commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species				
Region & Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Alaska						
Natural Production		1,325	2,843	43,000	1,283	48,451
Hatchery Production[a]					7,269	7,269
Southeast Region Total	[b]	1,325 [c]	2,843 [c]	43,000	8,552	55,721
Prince William Sound						
Natural Production	4	891 [d]	296 [e]	19,647	171	21,009
Hatchery Production[f]		1,324	350	36,278	2,646	40,597
Lower Cook Inlet						
Natural Production	1 [c]	91 [c]	2	615	74 [c]	783
Hatchery Production		242 [g]		163		405
Upper Cook Inlet	6 [c]	1,700	167 [c]	98 [c]	184 [c]	2,155
Bristol Bay	27 [c]	27,470	133 [c]	1 [h]	830 [c]	28,461
Central Region Total	37	31,718	949	56,802	3,905	93,410
Kodiak						
Natural Production	15 [c]	2,027 [i]	137 [c]	18,400 [j]	587 [c]	21,166
Hatchery Production		408 [k]	174	9,700 [g]	47	10,329
Chignik	9 [c]	1,190 [l]	75 [c]	1,437 [c]	120 [c]	2,831
South Peninsula & Aleutians	17 [c]	2,269 [c]	226 [c]	12,419 [m]	631 [c]	15,562
North Alaska Peninsula	1 [c]	1,936 [n]	61 [c]	108 [h]	165 [c]	2,272
Westward Region Total	42	7,831	673	42,063	1,550	52,160
Arctic-Yukon-Kuskokwim Total	1	4	235	63	2,740	3,043
Statewide Total	80	40,878	4,700	141,928	16,747	204,333

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 Fisheries Corporation, and Metlakatla Indian Community less broodstock (650,000). Wild chum catch estimated as 15% of total harvest.

[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 2017. Release of the 2017 Chinook salmon quota for Southeast Alaska is expected in late March or early April.

[c] Average harvest of the previous 5 years (2012–2016).

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

[e] Five-year average harvest (2012–2016) 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 odd-year harvests (2007–2015).

[i] Total Kodiak harvest of 2.03 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 953,000 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 (408,000 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 odd-year harvests for the Aleutian Islands.

[n] Five-year average harvest (2012–2016); includes formal forecasts for Bear late run (450,000) and Nelson River (585,000) sockeye salmon stocks.

The Alaska all-species salmon harvest for 2016 totaled 112 million, which was about 49 million fewer salmon than the preseason forecast of 161 million. This combined harvest was composed of 434,000 Chinook, 52.9 million sockeye, 3.9 million coho, 39 million pink, and 16 million chum salmon. Table 2 shows 2016 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 2016 harvest by species and area.

Table 2.–Preliminary 2016 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]	337	1,506	2,331	18,400	9,118	31,692
Prince William Sound	13	1,989	484	13,051	3,172	18,710
Lower Cook Inlet[b]	1	258	2	100	74	434
Upper Cook Inlet	10	2,397	147	382	124	3,060
Bristol Bay	30	37,330	91	752	1,042	39,245
Central Region Total	54	41,974	724	14,285	4,412	61,450
Kodiak Area	7	2,064	207	3,200	404	5,881
Chignik	21	1,386	94	141	118	1,760
South Peninsula and Aleutians	13	2,478	185	2,871	424	5,972
North Peninsula	2	3,503	76	12	89	3,682
Westward Region Total	44	9,430	562	6,224	1,036	17,296
Arctic-Yukon-Kuskokwim Region Total	0	3	304	336	1,443	2,086
Total Alaska	434	52,914	3,922	39,246	16,008	112,524

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, 2015–September 30, 2016 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 2016 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]	3,668	8,501	16,121	72,828	72,958	174,075
Prince William Sound	230	10,414	4,346	51,637	21,977	88,604
Lower Cook Inlet[b]	9	1,221	10	446	507	2,193
Upper Cook Inlet	186	13,841	925	1,657	878	17,487
Bristol Bay	372	201,584	530	3,007	6,254	211,748
Central Region Total	797	227,061	5,811	56,747	29,617	320,032
Kodiak Area	63	10,649	1,520	14,898	2,766	29,896
Chignik	155	8,208	658	563	805	10,390
South Peninsula and Aleutians	115	14,199	1,087	8,607	2,668	26,676
North Peninsula	35	19,622	554	44	660	20,914
Westward Region Total	368	52,678	3,819	24,112	6,899	87,877
Arctic-Yukon-Kuskokwim Region Total	2	16	1,969	1,193	10,165	13,346
Total Alaska	4,834	288,256	27,719	154,880	119,639	595,329

Note: Columns may not total exactly due to rounding.

[a] Total commercial harvest of Chinook salmon for the October 1, 2015–September 30, 2016, 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 online on 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 2016 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 2016 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 31.7 million fish in 2016 (Table 4). Total common property commercial harvest was 26.3 million fish, 90% of total harvest after excluding private hatchery cost recovery, Annette Island Reservation harvests, and miscellaneous harvests. Overall harvest in numbers of salmon in 2016 was 63% that of 2015. The 2016 harvests by species compared with 2015 were as follows: Chinook 96%, sockeye 98%, coho 109%, pink 52%, and chum salmon 79%. The Region I total commercial salmon harvest proportions by species were: 1% Chinook, 5% sockeye, 7% coho, 58% pink, and 29% chum salmon. The 2016 combined-gear, Chinook salmon harvest of 337,000 fish was 107% of the most recent 10-year average and 111% of the long-term average. The sockeye salmon harvest of 1.5 million was 129% of the recent 10-year average and 112% of the long-term average. The coho salmon harvest of 2.3 million fish was 90% of the 10-year average and 108% of the long-term average. The pink salmon harvest of 18.4 million was 48% of the 10-year average and 59% of the long-term average. The chum salmon harvest of 9.1 million was 87% of the 10-year average and 155% of the long-term average. The all species total harvest was 60% of the recent 10-year average harvest and 77% of the long-term average harvest.

CHINOOK SALMON

The Chinook salmon harvest of 337,000 in 2016 was above both the recent 10-year and long-term averages and ranks 16th over the previous 55 years. The average total Chinook salmon harvest since 1962 is around 300,000 fish. Preliminary harvests of coastwide Chinook salmon accountable under the Pacific Salmon Treaty included 265,666 by troll gear, 20,323 by seine gear, and 5,544 by gillnet gear. Total commercial harvests of Alaska hatchery-origin Chinook salmon were 32,000, 9% of total Chinook salmon harvests; 9,000 Chinook salmon were harvested in private hatchery cost-recovery fisheries.

SOCKEYE SALMON

The harvest of sockeye salmon was 1.5 million in 2016. This harvest was above both the recent 10-year average of 1.2 million and the long-term average of 1.3 million. The 2016 sockeye salmon harvest ranks 19th over the previous 55 years since 1962. The majority of sockeye salmon were harvested in the Southeast Alaska Area drift gillnet fishery. The drift gillnet fishery harvest of 622,000 was above the recent 10-year average of 455,000 and accounted for 41% of the regional total harvest. The set gillnet fishery harvest of 93,000 was below the recent 10-year average harvest of 130,000. The purse seine harvest of 611,000 sockeye salmon was above average levels.

COHO SALMON

The 2016 coho salmon harvest was 2.3 million. This harvest was greater than the long-term average harvest since 1962 and less than the recent 10-year average harvest. The 2016 coho salmon harvest ranks 22nd of the 55 years since 1962. The coho salmon harvest in the troll fishery was 1.4 million, more than the long-term and less than the recent 10-year average harvests, and accounted for 59% 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 more than the long-term and recent 10-year averages.

PINK SALMON

The 2016 pink salmon harvest was 18.4 million, 58% of the total region salmon harvest. The purse seine harvest was 15.4 million, 84% of the total pink salmon harvest. The 2016 pink salmon harvest was below the recent 10-year and long-term average harvests, ranking as the 37th largest harvest since 1962. The 2016 pink salmon return is the lowest even-year return since 2008.

CHUM SALMON

The 2016 chum salmon harvest of 9.1 million fish ranks 18th since statehood and was less than 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 2016 Southeast Region commercial salmon harvests, by fishing area and species in thousands of fish.

	Species					
Fishery	Chinook[a]	Sockeye	Coho	Pink	Chum	Total
Purse Seine						
Southern Purse Seine Traditional	20	594	241	13,722	1,698	16,276
Northern Purse Seine Traditional	0	9	7	1,499	149	1,664
Hatchery Terminal	8	7	9	172	1,262	1,457
Total Purse Seine	28	611	257	15,393	3,109	19,398
Drift Gillnet						
Tree Point	1	40	46	561	274	922
Prince of Wales	2	107	122	358	130	719
Stikine	10	70	22	35	201	338
Taku-Snettisham	1	148	34	45	448	676
Lynn Canal	0	177	30	66	693	967
Drift Gillnet Hatchery Terminal	6	81	8	87	934	1,117
Total Drift Gillnet	21	622	264	1,153	2,679	4,739
Set Gillnet (Yakutat)	0	93	144	22	1	260
Troll						
Hand Troll						
Traditional	7	0	54	7	1	69
Hatchery Terminal	0	0	0	0	1	1
Spring Areas	3	0	0	0	0	4
Total Hand Troll	10	0	54	7	2	73
Power Troll						
Traditional	227	6	1,327	38	61	1,659
Hatchery Terminal	0	0	1	8	95	105
Spring Areas	39	0	4	0	7	51
Total Power Troll	266	6	1,332	47	163	1,814
Total Troll	276	7	1,386	53	165	1,888
Annette Island Reservation						
Seine	1	18	10	1,145	152	1,327
Drift Gillnet	1	4	36	273	243	557
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	22	46	1,418	396	1,884
Hatchery Cost Recovery	9	148	231	331	2,731	3,451
Miscellaneous[b]	1	3	3	30	36	73
Southeast Region Total	337	1,506	2,331	18,400	9,118	31,692

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. Catch accounting period for the 2016 Chinook salmon season goes from October 1, 2015, to September 30, 2016.

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

CENTRAL REGION

PRELIMINARY 2016 PRINCE WILLIAM SOUND SALMON SEASON SUMMARY

The 2016 Prince William Sound (PWS) area commercial salmon harvest was 18.71 million fish (Table 5). Harvest was composed of 13.05 million pink, 1.99 million sockeye, 3.17 million chum, 484,000 coho, and 13,100 Chinook salmon. The 2016 harvest included 13.34 million (71.3%) commercial common property fishery (CCPF), and 5.37 million (28.7%) hatchery cost-recovery and broodstock fish.

Gillnet Fisheries

Copper River District

The 2016 preseason commercial harvest forecast for the Copper River District was 21,000 Chinook, 1.62 million sockeye, and 201,000 coho salmon. Gulkana Hatchery was projected to contribute 169,000 sockeye salmon to the CCPF harvest. The commercial salmon fishing season in the Copper River District began on Monday, May 16. Through the end of July, the commercial fishery was open 756 hours, 96 hours more than the recent 10-year average. The sockeye salmon harvest of 1.18 million fish was 21% less than the previous 10-year (2006–2015) harvest average of 1.46 million sockeye salmon. Based on department sampling, the unweighted average sockeye salmon weight was 5.04 lb, the smallest on record. The number of wild sockeye salmon in the Copper River District CCPF harvest was 1.0 million or 85% of the harvest. Gulkana Hatchery contribution to the sockeye salmon CCPF was 158,000 fish or 13% of the harvest. Main Bay Hatchery contributed 17,500 fish, or 1% of the Copper River District harvest. The CCPF harvest of 13,100 Chinook salmon was below the previous 10-year (2006–2015) average harvest of 18,000. The season total coho salmon commercial harvest of 369,000 fish was nearly double the previous 10-year (2006–2015) average harvest of 202,000 coho salmon. The 2016 preliminary sonar inriver estimate was 802,000 salmon and was within the 712,000–1,100,000 range of the inriver goal. Spawning escapement in Copper River Delta systems based on aerial survey indices was 51,600 sockeye salmon, and was below the SEG range of 55,000–130,000 fish. However, pilot availability and poor survey conditions likely contributed to the lower counts and it is likely that the goal was achieved. Coho salmon spawning escapement in the Copper River Delta based on aerial survey indices was 65,700 and was within the SEG range of 32,000–67,000 fish. The 2016 Chinook salmon inriver abundance point estimate from the mark–recapture program run by the Native Village of Eyak was 16,009 fish. After upriver fisheries harvests are subtracted, the total spawning escapement estimate will likely be close to half of the lower bound SEG of 24,000 fish.

Bering River District

The 2016 preseason commercial harvest forecast for the Bering River District was 14,000 sockeye and 46,000 coho salmon. The sockeye salmon commercial harvest of 9,840 fish was 53% above the previous 10-year (2006–2015) harvest average of 6,420 fish. The coho salmon commercial harvest of 80,400 was 77% above the previous 10-year (2006–2015) harvest average of 45,500 fish. Commercial fishing effort in both sockeye and coho salmon fisheries was high due to proximity to productive fishing in the eastern portion of the Copper River District. The aerial escapement index of 21,700 sockeye salmon was within the SEG range of 15,000–33,000 fish. Aerial surveys of coho salmon produced an escapement index of 25,800 fish that was within the SEG range of 13,000–33,000 fish.

Coghill District (Drift Gillnet)

Prince William Sound Aquaculture Corporation (PWSAC) forecast a 2016 Wally Noerenberg Hatchery run of 2.15 million chum and 20,700 coho salmon and anticipated 1.17 million (55%) chum and 2,700 (13%) coho salmon for cost recovery and broodstock. The Coghill District CCPF drift gillnet harvest of chum salmon was 1.53 million fish. PWSAC harvested 959,000 chum salmon for cost recovery and broodstock. The Coghill District CCPF drift gillnet harvest of sockeye salmon was 63,700 fish. The proportion of wild sockeye salmon in the Coghill District CCPF harvest was 8,430 fish (13%). Coghill District CCPF drift gillnet pink salmon harvest was 8,970 fish. The proportion of wild pink salmon in the Coghill District CCPF harvest was 26%. The Coghill District CCPF drift gillnet harvest of coho salmon was 5 fish.

The Coghill River sockeye salmon run forecast was 110,000 fish. The Coghill River weir passed 8,708 sockeye salmon, coming in below the SEG range of 20,000–60,000 fish and was the second lowest escapement on record since 1974.

Eshamy District

PWSAC forecast a Main Bay Hatchery enhanced sockeye salmon run of 1.60 million. The Eshamy District CCPF harvest of sockeye salmon was 663,000 fish, 59% below the forecast. The proportion of wild sockeye salmon in the Eshamy District CCPF harvest was 3% (21,500 fish).

Unakwik District

Unakwik District CCPF harvest was 359 sockeye salmon, which was well below the 10-year average of 3,000 sockeye salmon.

Montague District, Port Chalmers Subdistrict

PWSAC forecast a 2016 Port Chalmers remote release site run of 330,000 chum salmon. The drift gillnet gear group had access to the Port Chalmers Subdistrict in 2016 under the Prince William Sound Management and Salmon Enhancement Allocation Plan. The Montague District CCPF drift gillnet chum salmon harvest was 197,000, 40% below forecast. The proportion of wild chum salmon in the Port Chalmers Subdistrict CCPF harvest was 11% (22,000 fish).

Purse Seine Fisheries

Chum Salmon

The PWS 2016 chum salmon total run forecast was 3.3 million fish, with 2.87 million fish (87%) projected to be of PWSAC origin. Of these, 394,000 chum salmon were expected to be harvested by the purse seine fleet at the Armin F. Koernig Hatchery.

Based on the department's wild chum salmon forecast of 426,000 fish, there was a preseason expectation for the potential CCPF harvest of 242,000 wild chum salmon in PWS, leaving 200,000 fish for escapement.

Purse seine chum salmon harvest in PWS was predominantly from the Southwestern, Eastern, and Coghill districts. Chum salmon commercial harvest in Armin F. Koernig Hatchery Hatchery special harvest area (SHA) was 205,000 hatchery fish, or 48% below PWSAC's 394,000 preseason forecast. Despite a restrictive fishing schedule, the purse seine harvest of sockeye salmon during the Armin F. Koernig Hatchery Hatchery chum salmon fishery was 52,100 fish, 4% of which were wild stock origin (2,300 fish). Eastern District harvest total was 56,600 chum salmon. The purse seine fleet was allowed into the Coghill District on July 7 and 11—to harvest

a buildup of poor quality fish in the Wally Noerenberg Hatchery terminal harvest area—and harvested 101,000 chum salmon.

Pink Salmon

The PWS 2016 pink salmon total run forecast was 40.9 million fish. This estimate included 19.6 million PWSAC enhanced fish, 3.8 million wild fish, and 17.4 million Valdez Fisheries Development Association (VFDA) enhanced fish. Approximately 4.7 million (24%) of PWSAC's pink salmon forecast was projected for cost recovery and broodstock, with the remaining 14.9 million PWSAC fish expected to be available for CCPF harvest. Approximately 3.4 million (20%) of VFDA's pink salmon forecast were projected for cost recovery and broodstock. The remaining 14.0 million VFDA fish were expected to be available for common property harvest. A total harvest of 2.7 million wild stock pink salmon was forecasted for PWS CCPF harvest, leaving 1.2 million fish for escapement.

The CCPF harvest of 8.65 million pink salmon is the lowest harvest since 2002 and the second lowest in the last 20 years, or 73% below the 31.6 million CCPF preseason forecast. Total pink salmon harvest was 13.05 million fish, including 4.40 million fish for hatchery cost recovery (2.37 million for PWSAC and 2.03 million for VFDA). Pink salmon otolith contributions for CCPF harvest were 25% wild stock fish, 69% Solomon Gulch Hatchery fish, and 6% PWSAC fish.

During the 2016 season, weather and pilot availability resulted in limited aerial survey escapement data. When surveys were completed, escapement indices were above anticipated escapements in most districts for most of the season. This allowed for some opportunity to target surplus wild and enhanced pink salmon. Escapements were below anticipated within the Northern District for most of the season, and a conservative management approach was taken in Northern District migration corridors to ensure escapement goals were met. Preliminary area-under-the-curve estimates of pink salmon escapement indices were within or above SEG's for all districts except Eshamy.

Coho Salmon

VFDA projected their coho salmon run at 101,000 fish. Total PWS CCPF coho salmon harvest (excluding Copper River and Bering River districts) was 29,700 fish. Otolith contributions indicate that 76% of PWS CCPF coho salmon harvested (excluding Copper River and Bering River districts) were of wild origin.

COOK INLET

Lower Cook Inlet

The preliminary estimate of the 2016 Lower Cook Inlet Area commercial salmon harvest, based on current fish ticket data, was 434,401 salmon. The harvest was composed of 919 Chinook, 258,004 sockeye, 1,632 coho, 99,633 pink, and 74,213 chum salmon (Table 5). The harvest was composed of 234,453 (54.0%) CCPF fish, and 199,948 (46.0%) hatchery cost-recovery fish.

In January 2017, the Secretary of Commerce issued a disaster declaration for 2016 Gulf of Alaska pink salmon fisheries in Southeast Alaska, Prince William Sound, Kodiak, Chignik, and Lower Cook Inlet management areas. In Lower Cook Inlet, the 2016 pink salmon commercial harvest of approximately 100,000 fish was about 13.3% of the 753,000 pink salmon forecast and about 17% of the five-year average harvest of even-year pink salmon.

Southern District

The 2016 preseason CCPF forecast for natural production in the Southern District was 52,600 sockeye and 47,000 pink salmon. Hatchery salmon runs were anticipated to contribute to Southern District CCPF in 2016 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 Thursday, June 2. The preliminary purse seine harvest estimate for the 2016 season was 112 Chinook, 47,235 sockeye, 169 coho, 44,637 pink, and 165 chum salmon. This compares to a previous 10-year average harvest of 49 Chinook, 37,279 sockeye, 785 coho, 53,606 pink, and 736 chum salmon. The preliminary set gillnet harvest estimate was 731 Chinook, 19,427 sockeye, 687 coho, 21,872 pink, and 2,124 chum salmon. The previous 10-year average harvest for this gear type was 277 Chinook, 26,314 sockeye, 1,288 coho, 6,512 pink, and 3,108 chum salmon. In addition, 23,708 sockeye and 23,783 pink salmon were harvested by Cook Inlet Aquaculture Association (CIAA) from the Tutka Lagoon SHA for cost-recovery purposes. Preliminary passage estimate at the English Bay River weir was 7,673 sockeye salmon, which was within the SEG of 6,000–13,500 for this system. There are 7 streams in the Southern District that have a total of 8 SEGs. Of those goals, 6 are for pink, 1 is for chum, and 1 is for sockeye salmon. Escapement for both the chum and sockeye salmon goals was within the SEG range for those systems. However, 2 streams, Seldovia River and China Poot Creek, did not achieve their pink salmon SEG, and 2 streams, Tutka Creek and Humpy Creek, exceeded the upper end of their pink salmon SEG.

Kamishak Bay District

The 2016 preseason wild stock commercial harvest forecast for the Kamishak Bay District was 36,800 sockeye and 2,700 chum salmon. CIAA forecasted a run of 18,158 sockeye salmon to the Kirschner Lake remote release site. Total preliminary estimated common property harvest was 18,218 sockeye, 578 coho, 350 pink, and 10,984 chum salmon. This compares to a previous 10-year average of 65,091 sockeye, 2,487 coho, 32,342 pink, and 25,080 chum salmon harvested in the common property fishery. In addition, 44,765 sockeye salmon were harvested by CIAA from the Kirschner Lake SHA for cost-recovery purposes. There are 12 systems in the Kamishak District that have a total of 13 SEGs. Of those goals, 7 are for chum, 3 are for sockeye, and 3 are for pink salmon. Escapement for sockeye salmon was within SEGs at 2 systems, Mikfik Lake and Amakdedori Creek, and exceeded the SEG at Chenik Lake. Chum salmon escapement was below the SEG at 3 systems: Big Kamishak River, Cottonwood Creek, and Iniskin River. The chum salmon SEG was exceeded at the Bruin River. Pink salmon escapement was below the SEG range at Sunday Creek and Brown's Peak Creek. Escapement levels for salmon in the Kamishak District may have been underestimated due to poor weather conditions that prevented regular aerial surveys of that area.

Outer District

The 2016 preseason commercial harvest forecast for the Outer District was 14,300 sockeye, 194,000 pink, and 56,800 chum salmon. The commercial salmon fishing season began in this district on Monday, July 11. Overall preliminary harvest from 13 permit holders that participated was 1 Chinook, 7 sockeye, 2 coho, 5,369 pink, and 60,800 chum salmon. This harvest compares to previous 10-year averages of 11,180 sockeye, 956,481 pink, and 45,515 chum salmon. There are 11 streams in the Outer District that have a total of 15 SEGs. Of those goals, 9 are for pink salmon, 4 are for chum, and 2 are for sockeye salmon. Pink salmon escapement to all but 1 of the

systems (Dogfish Lagoon) was below the SEG ranges. Chum salmon escapement exceeded SEGs at 2 systems, Dogfish Lagoon and Port Dick Creek, and sockeye salmon escapement was below the SEG at both Delight and Desire lakes. Escapement levels for salmon in the Outer District may have been underestimated due to poor weather conditions that prevented regular aerial and ground surveys of that area.

Eastern District

Due to small runs in the last 10 years, no wild stock sockeye or pink salmon were forecast to be available for CCPF from the Eastern District in 2016. CIAA forecasted a total run of 171,081 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 102,776 sockeye salmon with 1,484 donated at the weir to members of the public. Commercial common property harvests occurred July 5–15. Commercial common property harvest is confidential due to fewer than 3 permit holders delivering fish to processors. Total sockeye salmon passage through the Bear Creek weir was 12,775 fish. From those, 3,764 fish were harvested by CIAA for use as hatchery broodstock. This is fewer than the broodstock goal of 4,452 from this system. The remaining 9,011 fish were allowed to spawn naturally in Bear Lake. This was above the SEG range of 700–8,300 sockeye salmon for this system. The only other SEG in the Eastern District is for sockeye salmon at Aialik Lake, which did not return in sufficient abundance to meet the SEG.

Upper Cook Inlet

The 2016 Upper Cook Inlet (UCI) commercial harvest of approximately 3.0 million salmon was 12% less than the recent 10-year average annual harvest of 3.5 million fish (Table 5). Although all 5 species of Pacific salmon are present in UCI, sockeye salmon are the most valuable, accounting for nearly 93% of the total value during the past 20 years.

Currently, there are 6 sockeye salmon systems with escapement/inriver goals that are monitored in UCI. Sonar was used to estimate sockeye salmon passage in the Kenai and Kasilof rivers, while weirs were operated at Larson, Chelatna, and Big (Fish Creek) lakes. Remote video technology was utilized to evaluate the SEG at Packers Lake. For the 2016 season, escapement objectives were exceeded at 2 systems (Kenai River and Chelatna Lake), met at 2 systems (Kasilof River and Fish Creek), and not met at 1 system (Larson Lake), and the final escapement will not be known for Packers Creek until all of the video is processed.

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. Although moderate improvements had been seen in Chinook salmon numbers for the past 2 years, runs were again expected to be below average in watersheds throughout Southcentral Alaska during the 2016 season. Therefore, it was uncertain if restrictions to sport and commercial fisheries beyond those identified in the management plan would be required to ensure escapement objectives were achieved. In the Northern District, 7 Chinook salmon stocks have been classified as *stocks of concern* by the BOF since 2011. This led to the development of an action plan that identified reductions to Chinook salmon harvests 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 1.5 miles south of Tyonek north to the Susitna River was closed to fishing during the directed Chinook salmon fishery. From 2012 to

2014, ADF&G 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 reduced time during the remaining fishing periods from 12 hours to 6 hours. This same strategy was followed in 2015. In 2016, there were only 4 scheduled periods during the directed Chinook salmon commercial fishery; there had been 5 scheduled Monday periods during the previous 3 years. As a precautionary measure, the first fishing period in 2016, which occurred on Monday, May 30, was reduced in duration from 12 hours to 6 hours. The remaining 3 Monday fishing periods were all open for 12 hours each.

The estimated Chinook salmon harvest in the Northern District directed Chinook salmon fishery in 2016 was 2,030 fish, or about 3% less than the previous 10-year average annual harvest of 2,110 fish. The total Chinook salmon harvest in the Northern District set gillnet fishery in 2016 was 2,202 fish.

The Deshka River is the primary system in northern Cook Inlet where Chinook salmon escapement has been monitored inseason with a weir. Based on weir counts of more than 11,000 fish through June 9, the Division of Sport Fish restored the Chinook salmon annual limit in the Deshka River from 2 to 5. The final 2016 Deshka River Chinook salmon escapement estimate of 22,774 fish was within the SEG range of 13,000–28,000 fish and represented the second highest escapement since 2006.

In response to below average Kenai River Chinook salmon runs, the BOF substantially modified the *Kenai River Late-Run King Salmon Management Plan* (5 AAC 21.359) 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 estimated harvest of all Chinook salmon stocks in the 2016 Upper Subdistrict set gillnet fishery was 6,759 fish. The stock composition of the 2016 harvest will not be known until genetic samples collected during the fishery are processed by the ADF&G Gene Conservation Laboratory. The preliminary estimate of late-run Chinook salmon passage at the river mile 14 sonar site was 22,535 fish. The total estimated inriver mortality (harvest and catch and release mortality) above the sonar was 4,497 fish, with an estimated 761 Chinook salmon spawning downstream from the sonar. This resulted in a preliminary escapement estimate of 18,790 Chinook salmon, which was within the SEG of 15,000–30,000 fish.

For the first time since 2012, the Kenai River early-run Chinook salmon sport fishery was opened to harvest. An emergency order opened the lower 18 miles of the Kenai River under a no-bait provision from June 18 to June 30. The estimated passage of early-run Chinook salmon was 9,851 fish; the optimal escapement goal for Kenai River early-run Chinook salmon is 5,300–9,000 fish. Therefore, after harvest above the river mile 14 sonar is subtracted from the passage estimate, it is likely the upper end of the optimal escapement goal was exceeded.

In all of UCI, approximately 10,027 Chinook salmon were harvested in 2016, which was slightly less than the previous 10-year (2006–2015) average annual harvest of 10,227 fish.

Sockeye Salmon

The total 2016 UCI sockeye salmon run was estimated to be approximately 5.2 million fish, which was 27% less than forecast. All UCI salmon runs in 2016 came in less than forecast; the Kasilof River total run estimate of 559,000 sockeye salmon was the smallest run to this system since 1995. The UCI commercial harvest of 2.4 million sockeye salmon was approximately 17% less than the 2006–2015 average annual harvest of 2.9 million fish, with higher harvests in 6 of the previous 10 years.

Upper Subdistrict Set Gillnet and Central District Drift Gillnet

The 2016 UCI preseason forecast was for a total run of approximately 7.1 million sockeye salmon, with a harvest estimate (sport, personal use, and commercial) of 5.3 million fish. Approximately 4.1 million sockeye salmon were expected to be harvested commercially. The Kenai River is generally the largest producer in UCI and the 2016 total run was forecasted to be nearly 4.7 million sockeye salmon. For Kenai River runs greater than 4.6 million fish, the inriver goal range is 1.10–1.35 million sockeye salmon.

The Kasilof Section set gillnet fishery opens by regulation on or after June 25, unless 50,000 sockeye salmon are projected to enter the Kasilof River prior to June 25. By late afternoon on June 22, more than 37,000 sockeye salmon had passed the Kasilof River sonar counter with passage estimates for June 22 at nearly 10,000 fish. Thus, the Kasilof Section was opened to set gillnetting beginning on Thursday, June 23. Sockeye salmon passage in the Kasilof River through midnight on June 24 was 51,000 fish.

At the 2014 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 fish, 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 2016 Kenai River late-run Chinook salmon was for a total run of approximately 30,000 fish. Based on this projection, the sport fishery in the Kenai River began the season on July 1 under a no-bait restriction due to concerns about achieving the SEG of 15,000–30,000 fish. Based on this action, the Upper Subdistrict set gillnet fishery was managed conservatively, but was not held to the mandatory 36-hour weekly restriction because the inriver run of late-run Chinook salmon was expected to exceed 22,500 fish. By July 8, the passage estimate of late-run Chinook salmon in the Kenai River had exceeded 3,600 fish, which prompted a return of bait to the sport fishery beginning on July 9.

During the month of July, the Kasilof Section set gillnet fishery was open on 17 different days, whereas the Kenai and East Foreland sections were open on 12 different days, because this area did not begin fishing by regulation until Monday, July 11. The Kasilof River SHA was not opened in 2016.

The *Kenai River Late-Run King Salmon Management Plan* states that from August 1 through August 15, if the projected escapement of Chinook salmon into the Kenai River is at least 16,500 fish but less than 22,500 fish, the set gillnet fishery in the Upper Subdistrict is to be limited to no more than 36 hours of fishing time. On August 2, the Division of Sport Fish projected the final escapement of late-run Chinook salmon would be less than 22,500 fish, which limited the Upper Subdistrict set gillnet fishery to no more than 36 hours of fishing time for the remainder of the month. This change also eliminated the regular Monday and Thursday fishing periods. Three 12-hour fishing periods were provided to the Upper Subdistrict set gillnet fishery on August 3, 5, and 7. However, due to concerns over exceeding the upper end of the Kenai River sockeye salmon inriver goal, 1 additional 12-hour fishing period beyond the 36-hour limitation was provided on August 9.

The final sockeye salmon passage estimate in the Kasilof River, where the sonar was in operation through August 14, was approximately 240,000 fish[1]. In the Kenai River, the final estimate of sockeye salmon passage, based on enumeration through August 19, was nearly 1,389,000 fish.[1]

From June 20 through August 9, the drift fleet fished a total of 32 days as follows: 4 days in the regular Kasilof Section; 2 days in the Expanded Kenai/Kasilof sections; 12 days in the Expanded Kenai/Kasilof and Anchor Point sections; 3 days in Drift Area 1; and 11 days in all of the Central District. The regular Monday/Thursday districtwide periods scheduled for August 11 and 15 were restricted to Drift Gillnet Areas 3 and 4 per the drift gillnet 1% rule. The regular fishing periods on August 4 and August 8 both resulted in sockeye salmon harvests less than 1% of the season total, which triggered the 1% rule to go into effect.

The 2016 UCI sockeye salmon run was similar to the 2015 run in that the peak daily harvest rate (CPUE) of 355 sockeye salmon per boat in the Central District drift fishery on noncorridor days was the third lowest since 1985. This follows the 2015 peak CPUE of 278 sockeye salmon per boat, which was the lowest CPUE since 1985. Similarly, in the Upper Subdistrict set gillnet fishery the peak daily harvest in 2016 of 99,000 sockeye salmon represented the second lowest peak daily harvest since 1981 (2012 was excluded due to significant restrictions to the Upper Subdistrict set gillnet fishery), trailing only behind the 2015 peak daily harvest of 95,000 fish. This same pattern was observed in sockeye salmon daily passage in the Kenai River. The 2016 peak daily passage was 53,000 fish on August 1. This was the lowest peak daily passage ever measured in the Kenai River since sonar enumeration began in the late 1970s. The peak daily passage in 2015 of 75,000 fish was the fourth lowest ever measured. The highest single day of sockeye salmon passage in the Kenai River occurred in 2013, the second highest occurred in 2011, and the fifth highest occurred in 2012. The very low daily passage resulted in reduced catch rates by all user groups (sport, commercial, and personal use) who harvest Kenai River sockeye salmon.

The 2016 total sockeye salmon harvest breakdown between set and drift gillnet gear was very close to the previous 10-year average. Drifters harvested 1.27 million sockeye salmon or 53% of the total harvest, compared to the previous 10-year average of 51% (2012 was excluded due to significant restrictions to the Upper Subdistrict set gillnet fishery), whereas setnetters harvested

[1] Sonar estimate at river mile 8 on the Kasilof River and river mile 19 on the Kenai River; not escapement. Harvest upstream of sonar must be subtracted to estimate escapement. Sport harvest estimated from Statewide Harvest Survey; results for 2016 available fall of 2017 at the earliest.

1.13 million or 47% of the total sockeye salmon harvest compared to their previous 10-year average of 49%. In the Upper Subdistrict set gillnet fishery, the harvest was larger in those statistical areas north of the Kenai River with the Salamatof and East Foreland areas taking 54% of the harvest compared to the previous 10-year average (excluding 2012) of 31%.

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 2016, 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 3 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 July 4 through August 8. In total, approximately 37,000 sockeye salmon were harvested by setnetters in the Western Subdistrict in 2016, which was 14% less than the average annual harvest of approximately 43,000 fish during the previous 10-year period.

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 2015, 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 from June 1 through June 24. Approximately 4,100 sockeye salmon were harvested in the Kustatan Subdistrict in 2016, with nearly 3,500 of these caught during the Big River fishery. The 2016 sockeye salmon harvest was approximately 34% greater than the average annual harvest of 3,075 fish during the previous 10 years.

Kalgin Island Subdistrict

The Kalgin Island Subdistrict opened for regular fishing periods beginning June 27; however, the west side of Kalgin Island was open for commercial fishing on Mondays, Wednesdays, and Fridays from June 1 to June 24 as part of the Big River sockeye salmon fishery. In 2016, approximately 41,000 sockeye salmon were harvested from the Kalgin Island Subdistrict, with nearly 6,300 (15%) of those fish taken during the Big River sockeye salmon fishery. The average annual sockeye salmon harvest on Kalgin Island during the previous 10 years was approximately 58,000 fish, with roughly 13,000 of those fish harvested during the early season Big River fishery. A remote video system is deployed at Packers Creek to monitor sockeye salmon escapement into Packers Lake. Due to issues with beaver dams blocking salmon migration into the lake for several days in July, a review of the video data did not support any additional fishing periods beyond Monday and Thursday regular periods in the Kalgin Island Subdistrict in 2016.

Northern District

Commercial fishing in the Northern District opened on June 1 for the directed Chinook salmon fishery (see Chinook salmon section above) and for regular periods beginning on June 27. In 2016, approximately 47,000 sockeye salmon were harvested in the Northern District, with about 2,200 of

these fish harvested during the 4 directed Chinook salmon fishing periods. The 2016 sockeye salmon harvest was 55% greater than the 2006–2015 average annual harvest of 31,220 sockeye salmon, and approximately 43% less than the 1966–2015 average of nearly 85,000 fish.

Coho Salmon

The 2016 UCI harvest estimate of about 147,000 coho salmon in all commercial fisheries was approximately 14% less than the recent 10-year (2006–2015) average annual harvest of approximately 170,000 fish. The 2016 drift gillnet harvest of 90,000 coho salmon was 10% less than the recent 10-year average of approximately 100,000 fish.

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 fish. Coho salmon escapement was enumerated at the Fish Creek weir from July 12 through August 15 and produced a final count of 2,483 fish. During the 2016 season, the sport fishing bag and possession limit for coho salmon was increased to 3 fish beginning at 6 a.m. on August 13 in waters open to salmon fishing on Fish, Cottonwood, and Wasilla creeks. In addition, fishing was allowed at Fish Creek 7 days per week, and anglers were allowed to fish on Saturdays, Sundays, and Mondays at Cottonwood and Wasilla creeks.

In the Little Susitna River, there is a coho salmon SEG of 10,100–17,700 fish. Coho salmon escapement was enumerated at the Little Susitna weir from July 6 through September 7, producing a passage estimate of 9,998 fish. In an effort to ensure that better numbers of coho salmon passed through the weir on the Little Susitna River, the use of bait was prohibited in the sport fishery from the mouth of the river up to the Parks Highway from August 6 through September 30. In the commercial fishery, that portion of the General Subdistrict of the Northern District east of the Susitna River, including Fire Island, was closed for the remainder of the 2016 season, beginning on Thursday, August 18, in an effort to reduce the harvest of Little Susitna River coho salmon.

Finally, there is a coho salmon foot survey SEG of 450–1,400 fish at Jim Creek located in the Knik River drainage. At the time this document was prepared, the 2016 foot survey had not been conducted at McRobert's Creek.

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 2016 UCI commercial harvest of pink salmon was estimated to be approximately 382,000 fish which was slightly higher than the average annual harvest of 373,000 fish from the previous 10-years of even-year harvests. During the season many fishermen and processors reported that pink salmon were larger than normal, especially during the latter part of July and into August. At this time of year, the Upper Subdistrict set gillnet fishery is the primary harvester of pink salmon. A review of the fish tickets that have been entered to date show that the average weight of pink salmon harvested in the Upper Subdistrict set gillnet fishery in 2016 was approximately 5.0 lb. The previous 10-year average weight for pink salmon in the Upper Subdistrict fishery was 3.6 lb, and the largest average weight for pink salmon from 1966–2015 was 4.5 lb, occurring during the 2006 season. Thus, the preliminary data from the 2016 Upper Subdistrict set gillnet fishery harvest indicated this year's pink salmon were the largest on record.

Chum Salmon

The 2016 harvest of about 124,000 chum salmon was approximately 10% less than the previous 10-year average annual harvest of 136,000 fish. There is only 1 chum salmon escapement goal in UCI, which is an aerial survey SEG of 3,800–8,400 fish in Clearwater Creek, the major tributary that drains into Chinitna Bay. Nearly 5,100 chum salmon were observed in this watershed during an August 26 survey flight. Chinitna Bay was opened to set and drift gillnetting for 12-hour fishing periods on Tuesdays and Fridays, beginning on Friday, August 26.

BRISTOL BAY

The 2016 inshore Bristol Bay sockeye salmon run of 51.4 million fish ranks secondnd out of the last 20 years (1996–2015) and was 46% above the 35.1 million average run for the same period. This year's Bristol Bay sockeye salmon run was 10% above the preseason inshore forecast of 46.6 million fish. The Egegik, Nushagak, Togiak, and Ugashik districts were higher than the preseason forecast while Naknek-Kvichak district was less than predicted. The 37.3 million sockeye salmon commercial harvest (Table 5) was 26% above the 29.5 million preseason forecast. All escapement goals were met or exceeded, with a total sockeye salmon escapement of 14.1 million fish. A total of 29,545 Chinook salmon were harvested in Bristol Bay in 2016. The harvests for other species are 1,042,345 chum, 91,387 coho, and 751,756 pink salmon. The 2016 sockeye salmon run timing was similar to 2015 as it was one of the latest on record, approximately 7 days late. Fish weights and lengths were smaller than the historical average, with an average sockeye salmon weight of 5.4 pounds, but overall fish were slightly larger than 2015.

Chinook Salmon

Chinook salmon harvests in Bristol Bay were below average in the Nushagak, Togiak, and Egegik districts. No directed Chinook salmon fishing periods occurred in the Nushagak District in 2016. Chinook salmon were caught during directed sockeye periods in all commercial districts and approximately 29,570 fish were harvested, 60% of the 20-year average of 49,368 fish. Chinook salmon escapement into the Nushagak River was 125,368 fish and above the escapement goal range of 55,000–120,000 fish. The Chinook salmon escapement into the Alagnak River was 1,283 fish based on aerial surveys and was below the lower bound escapement goal of 2,700.

Sockeye Salmon

This year's Bristol Bay sockeye salmon run of 51.4 million fish was 10% above the preseason inshore forecast of 46.6 million fish. The 2016 harvest was 64% higher than the recent 20-year average for all districts. Sockeye salmon escapement goals were met in all systems except Ugashik and Igushik, where the escapement goal ranges were exceeded.

Coho Salmon

The preliminary total coho salmon harvest in 2016 was 91,387 fish. Typically the Nushagak District is the largest coho salmon producer. The 80,144 harvested in the Nushagak District was above the 20–year average.

Pink Salmon

The dominant pink salmon run in Bristol Bay occurs in even years. The preliminary harvest in 2016 was 751,756 fish. The majority of pink salmon are harvested in the Togiak and Nushagak districts.

Chum Salmon

The 2016 preliminary Bristol Bay chum salmon harvest was 1,042,345 fish. Harvest in all districts was slightly above the 20-year average harvest. Nushagak District was the largest producer of chum salmon, where 527,753 fish were harvested.

Table 5.–Preliminary 2016 Central Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species				
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum
Purse Seine					
Eastern District	0	6	27	7,537	57
Northern District	0	2	1	417	7
Coghill District	0	0	0	5	101
Northwestern District	0	3	0	172	4
Southwestern District	0	53	1	356	211
Montague District	0	0	0	0	0
Southeastern District	0	0	0	38	0
Unakwik District	0	0	0	0	0
Drift Gillnet					
Bering River District	0	10	80	0	0
Copper River District	13	1,185	369	35	6
Coghill District	0	64	0	9	1,531
Eshamy District	0	444	0	52	78
Montague District	0	3	0	19	197
Unakwik District	0	0	0	0	0
Set Gillnet					
Eshamy District	0	219	0	8	21
Hatchery[a]	0	0	5	4,403	959
Prince William Sound Total	13	1,989	484	13,051	3,172
Southern District	1	67	1	67	2
Kamishak District	0	18	1	0	11
Outer District	0	0	0	5	61
Eastern District[b]					
Hatchery[c]	0	173	0	27	0
Lower Cook Inlet Total[d]	1	258	2	100	74
Central District	8	2,350	117	374	121
Northern District	2	47	30	8	3
Upper Cook Inlet Total	10	2,397	147	382	124
Naknek-Kvichak District	1	13,460	1	10	190
Nushagak District	23	8,013	80	531	528
Egegik District	0	8,480	0	0	76
Ugashik District	1	6,766		0	69
Togiak District	4	611	10	211	179
Bristol Bay Total	30	37,330	91	752	1,042
Central Region Total	54	41,974	724	14,285	4,412

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] Confidential information.

[c] Lower Cook Inlet hatchery harvest includes cost recovery only, not broodstock or donated fish.

[d] Confidential information not included in District totals.

ARCTIC-YUKON-KUSKOKWIM REGION

Arctic-Yukon-Kuskokwim (AYK) Region commercial salmon harvests totaled 2,086,000 salmon and 13,346,000 lb in 2016 (Tables 2, 3, and 6). Cumulative all-gear commercial harvest included fewer than 200 Chinook, 2,652 sockeye, 304,000 coho, 1,443,000 chum, and 336,000 pink salmon.

KUSKOKWIM AREA

The 2016 season marked the first time since statehood that there were no large scale commercial salmon buyer/processors in the Kuskokwim Area. This resulted in very little opportunity for fishermen in District 1 and no opportunity for fishermen in District 4 (Quinhagak) and District 5 (Goodnews Bay).

Kuskokwim River

The 2016 Kuskokwim River Chinook salmon forecast was for a return of 125,000–219,000. The drainagewide Chinook salmon SEG is 65,000–120,000. Average subsistence Chinook salmon harvest is 84,000.

The BOF met in January to consider proposals concerning the Arctic-Yukon-Kuskokwim areas. The most significant regulatory change for the Kuskokwim Management Area was the establishment of an early season subsistence fishing closure. The regulation annually suspends directed subsistence fishing for Chinook salmon in the Kuskokwim River until after June 11.

Preseason management actions including early season subsistence fishing closures, tributary closures, time and area restrictions, gillnet mesh size and length restrictions, and live release requirements were jointly recommended by ADF&G and the U.S. Fish and Wildlife Service in an effort to achieve escapement goals. The Kuskokwim River Salmon Management Working Group voted to support the management actions.

The early season subsistence fishing closure was initiated on May 20 from the mouth of the Kuskokwim River to the Holitna River and upstream of the Holitna River beginning June 1. With the closure came additional restrictions including tributary closures and live release of Chinook salmon requirements.

Beginning June 1, the Federal Subsistence Board adopted a Special Action to close the Kuskokwim Chinook and chum salmon fishery to non-Federally qualified users within the boundary of the Yukon Delta National Wildlife Refuge. The U.S. Fish and Wildlife Service managed the subsistence fishery within the Yukon Delta National Wildlife Refuge through 6:00 p.m. July 7 at which time ADF&G resumed management of the entirety of the Kuskokwim River.

Subsistence management under ADF&G consisted of a June 12, 48-hour 6-inch or less mesh, 25-fathom gillnet opportunity from the refuge boundary at Aniak to the Holitna River, and removal of subsistence restrictions in waters upstream of the Holitna River. Beginning June 16, ADF&G removed all subsistence fishing restrictions upstream of the refuge boundary at Aniak except for the Aniak River gillnet closure which remained in effect. Final removal of all subsistence restrictions for the entire Kuskokwim River drainage occurred on July 27.

Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2016 will not be available until after postseason harvest surveys have been completed, data have been analyzed, and preliminary harvest estimates are produced.

Short commercial fishing opportunities directed at coho salmon were provided in the Kuskokwim River on July 29 and August 12, resulting in well below average harvests. Participants included those commercial fishermen who had registered with ADF&G as catcher/sellers and had secured their own markets. Due to the small number of participants during these commercial fishing periods, State of Alaska confidentially requirements prohibit release of the harvest.

The preliminary Kuskokwim River total run estimate is approximately 186,400 Chinook salmon (95% CI: 141,300–245,800). The Kuskokwim River drainagewide escapement goal was likely achieved but will not be fully assessed until after all data has been analyzed this winter.

Due to the early season subsistence fishery closures, Bethel Test Fish (BTF) was limited as an indicator of Chinook salmon run timing. Subsistence harvest is historically weighted towards the beginning of the run, and the lack of this early season fishery resulted in the evaluation of a larger proportion of the early run than other years on record. Run timing was average based on BTF.

Chinook salmon escapement at Kogrukluk River weir achieved the SEG, although escapement at George River weir was below the SEG. The Kwethluk River experienced operational difficulties throughout the season. Subsequently Chinook salmon passage did not meet the established SEG. Seven tributaries have aerial survey SEGs; 3 tributaries were within the respective SEG ranges and 4 tributaries were either below the SEG or stream conditions prevented an accurate survey.

Based on BTF sockeye salmon run timing was late. Overall, sockeye salmon escapement was well above average across the drainage. The Kogrukluk River weir has the only established sockeye salmon escapement goal which was exceeded. The Telaquana weir observed the second highest escapement of sockeye salmon since 2010.

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

High water conditions hampered efforts to assess the coho salmon run at escapement projects drainagewide. Coho salmon passage at the Kwethluk River weir met the SEG for that system. Counts at Kogrukluk River weir are considered incomplete due to high water.

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

There were no commercial salmon fishing periods in District 4 (Quinhagak) during the 2016 season due to a lack of processing capacity.

The Kanektok River weir was not operated in 2016 due to a lack of funding. Subsequently, aerial surveys were conducted in order to assess escapements throughout the drainage. The Kanektok River Chinook salmon aerial survey SEG (range 3,500–8,000) was achieved with 5,631 fish observed, while the sockeye salmon aerial survey SEG (range 14,000–34,000) was exceeded with 80,160 fish observed.

There were no commercial salmon fishing periods in District 5 (Goodnews Bay) during the 2016 season due to a lack of processing capacity.

YUKON AREA

The 2016 Yukon River total commercial harvest was 0 Chinook, 525,809 summer chum, 465,396 fall chum, 201,482 coho, and 127,338 pink salmon for the Alaska portion of the drainage. A total of 521,789 summer chum, 439,801 fall chum, 180,877 coho, and 127,338 pink salmon were harvested in the lower Yukon River (Districts 1–3) and 4,020 summer chum, 25,595 fall chum, and 20,605 coho salmon were harvested in the upper Yukon River (Districts 4–6). A total of 492 permit holders sold fish in the Yukon Management Area in 2016.

Summer Season

The 2016 preseason Chinook salmon outlook was a range of 130,000–175,000 fish and the 2016 preseason summer chum salmon outlook was a range of 1.3–1.8 million fish. As with previous years, restrictions to Chinook salmon directed subsistence fishing were taken in response to poor Chinook salmon runs in recent years. For the ninth consecutive year, Chinook salmon directed commercial fishing was not allowed in the mainstem Yukon River or in the Tanana River. However, commercial fishing opportunity was provided to target summer chum salmon in Districts 1, 2, and 6. 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.

Since Chinook salmon are encountered incidentally in the commercial summer chum salmon fishery, a suite of strategies were used to manage these fisheries to minimize the impact to the 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 7 in District 1. The department allowed thirteen 12-hour periods in District 1 and nine 12-hour periods in District 2 using dip nets and beach seines only. In 2016 the use of gillnet gear was delayed in an effort to reduce the incidental harvest of Chinook salmon until inseason assessment indicated the majority of the Chinook salmon run had migrated upriver. Commercial opportunity with 5.5-inch or smaller mesh size gillnets not exceeding 30 meshes in depth was provided in District 1 only, for 8 periods beginning June 25, 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. District 1 began using 6-inch mesh gillnets on July 5. The 5.5-inch gear restriction was not applied in District 2 since most fishermen do not have gillnets with that mesh size. Therefore, commercial fishing with 6-inch mesh or smaller gillnets in District 2 began on June 27. Finally, the first commercial fishing period to target summer chum salmon in District 6 was on July 11. There were 9 commercial fishing periods with a total harvest of 4,020 summer chum salmon.

The preliminary total summer chum salmon commercial harvest was 525,809 fish and above the 2011–2015 average harvest of 393,965 fish. The summer chum salmon commercial harvest in the Lower Yukon Area (Districts 1–3) was 521,789 fish and above the 2011–2015 average harvest of 326,987 fish. The 4,020 summer chum salmon harvested in the Upper Yukon Area (Districts 4-6) was below the 2011-2015 average harvest of 5,955 fish. A total of 437 permit holders participated in the summer chum salmon commercial fishery, above the 2011–2015 average of 417 permit holders. The Lower Yukon Area and Upper Yukon Area are separate Commercial Fisheries Entry Commission permit areas. A total of 435 permit holders fished in

the Lower Yukon Area in 2016, which is above the 2011–2015 average of 408. In the Upper Yukon Area, 2 permit holders fished, which was below the 2011–2015 average of 9.

In 2016, escapement assessment for Chinook salmon was hampered by high water conditions for all aerial and tower counting projects. Sonar estimates of passage were collected at Chena and Salcha rivers but the estimates will not be available until later this winter. The SEG at the East Fork Andreafsky River Weir was met with a passage of 2,676 Chinook salmon. Preliminary Chinook salmon passage at the border sonar project near Eagle was approximately 72,329 fish. This passage exceeded the Interim Management Escapement Goal of 42,500–55,000 Chinook salmon.

The summer chum salmon drainagewide escapement goal was exceeded and the East Fork Andreafsky River summer chum salmon goal was met. Escapement on the Anvik River was 337,821 chum salmon which was just below the SEG of 350,000 (a substantial number of summer chum likely migrated past the weir site prior to operation of the weir). The summer chum salmon tower counts were not made on the Chena and Salcha rivers for most of the 2016 season because of unfavorable water conditions. Postseason estimates derived from sonar counts may be provided at a later date.

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 800,000–900,000 fall chum salmon. All districts and subdistricts were placed on their full regulatory subsistence fishing schedules commensurate with switching over to fall management (some subsistence restrictions were taken in the U.S. portion of the mainstem Porcupine River). By August 2, subsistence fishing in all mainstem Yukon River districts was open 7 days per week, 24 hours per day, except for closures before, during, and after commercial periods in Districts 1 and 2.

Districts 1 and 2 were placed on a 2-period-per-week commercial fishing schedule at the beginning of the season, and then periods were adjusted to be on pulses of fish as the run projection increased and each pulse continued for 3 to 13 days. 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 Districts 1 and 2 from September 1 to September 10.

In 2016 there were a total of 65 commercial periods during the fall season in the Yukon Area. 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 Area fall season was 465,396 fall chum and 201,482 coho salmon. The fall chum salmon commercial harvest was the second largest on record and doubled the 2011–2015 average harvest of 214,758 fish. The coho salmon harvest was a record harvest for the third consecutive year, eclipsing the previous high of 129,700 fish in 2015. A total of 467 individual permit holders participated in the fall chum and coho salmon fishery: 459 in Districts 1 and 2 combined, and 8 in Districts 5 and 6 combined.

The preliminary 2016 fall chum salmon run size is estimated to be 1.4 million, which exceeded the preseason forecast range of 550,000–780,000 and the preseason projection of 800,000-900,000. The forecasted fall chum salmon run size uses a brood year analysis, whereas the preseason projection is developed from a historical relationship between summer and fall chum salmon run sizes. The preliminary drainagewide escapement estimate for fall chum salmon is 828,000 which exceeded the upper end of the SEG range of 300,000–600,000. All other fall chum salmon escapement goals were met or exceeded—drainagewide. The large run size observed this year was due to the exceptionally high return of age-4 fish. The estimated passage of 168,300 coho salmon at the mainstem Yukon River sonar operated near Pilot Station was above the historical median of 133,000 fish. Preliminary run reconstruction indicates a run size of 398,000 which is above historical median of 198,000. 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 fish. A boat survey conducted in the Delta Clearwater River in late October observed 6,767 coho salmon which was within the goal range.

NORTON SOUND AREA

Highlights of the 2016 Norton Sound District salmon fishery included near record runs of pink salmon and the seventh highest commercial coho salmon harvest. The chum salmon harvest was less than half the forecast with a smaller than expected run. Restrictions were taken in the subsistence fishery in southern Norton Sound to protect Chinook salmon, but escapements were poorer than recent years. Another big run of sockeye salmon to the Pilgrim River on the Nome road system resulted in a record 509 subsistence salmon permits issued, and smashed the record of 377 permits issued the previous year.

Large coho and pink salmon harvests accounted for the majority of the commercial salmon harvest, with coho salmon accounting for 28% of the harvest and pink salmon accounting for 57% of the harvest. Permit holder participation was the highest in over 20 years with 141 commercial permit holders that fished. Commercial salmon harvests were 183 Chinook, 2,635 sockeye, 102,722 coho, 208,745 pink, and 51,167 chum salmon (Table 6).

The 2016 forecasted commercial chum salmon harvest range was 130,000–170,000 fish. However, the chum salmon run was nowhere near as strong as expected. However, the pink salmon run was at least the third greatest run since statehood, but the harvest range of 250,000–750,000 fish was not reached because of the buyer's limited capacity. There were no directed pink salmon commercial fishing periods and the pink salmon harvest was an incidental catch during chum and coho salmon directed fishing periods.

The 2016 coho salmon harvest fell short of the forecast range of 120,000–160,000 fish. Southern Norton Sound Subdistricts 4–6 combined represented the majority (85%) of the harvest. However, a record harvest of 14,441 coho salmon occurred in Subdistrict 3, Elim, in northern Norton Sound.

Chinook salmon escapement goals were not met and the North River and Kwiniuk River counting towers failed to reach the goal for the first time in the past 3 years. The Pilgrim River sockeye salmon run was again well above average and catch limits were waived early in the season and the escapement goal range of 4,000–8,000 fish at Salmon Lake was slightly exceeded with 8,558 sockeye salmon counted by aerial survey. Based upon available escapement monitoring information, all pink salmon escapement goals were achieved and coho salmon

escapement goals were likely achieved. Chum salmon escapement goals were achieved in all areas except for Subdistrict 3, Elim.

KOTZEBUE SOUND AREA

The Kotzebue Sound chum salmon harvest in 2016 was the second highest in over 30 years and was only the seventh time the harvest exceeded 400,000 fish, and the commercial harvest of 400,417 fish (Table 6) was the seventh highest in history. There were 86 permit holders that sold chum salmon in 2016. This year's participation by permit holders was 82% of last year's participation when 105 permit holders sold fish, but was the fourth highest permit holder participation in 20 years. The highest fishing effort occurred on August 9 when 55 permit holders fished. Buyers only purchased chum salmon, but harvest retained for personal use included 75 Chinook, 8 sockeye, 1,460 pink, and 5 coho salmon, 710 Dolly Varden, 51 sheefish, 1 whitefish, and 18 chum salmon that were included in the commercial harvest total.

Table 6.–Preliminary 2016 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	0	0	0	0
Kuskokwim Bay	0	0	0	0	0	0
Kuskokwim Area Total	0	0	0	0	0	0
Lower Yukon River	0	0	181	127	962	1,270
Upper Yukon River	0	0	21	0	30	50
Yukon River Total	0	0	201	127	991	1320
Norton Sound	0	3	103	209	51	365
Kotzebue Sound	0	0	0	0	400	400
AYK Region Total	0	3	304	336	1,443	2,086

Note: Zeros indicates no harvest or fewer than 500 fish harvested.

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

[a] Confidential information not included.

WESTWARD REGION

KODIAK MANAGEMENT AREA

The commercial fishing effort in 2016 decreased compared to recent years. Of the 592 eligible commercial salmon permits, 305 (52%) made commercial landings. By gear type, a total of 165 purse seine, 3 beach seine, and 137 set gillnet permit holders made deliveries in 2016. Participation by purse seine permit holders was above average while set gillnet permit holder participation was below the previous 10-year average.

The 2016 commercial harvest (not including personal use or ADF&G Test Fishery) in the Kodiak Management Area (KMA) was 7,478 Chinook, 2,063,472 sockeye, 206,540 coho, 3,245,549 pink, and 403,879 chum salmon. The total Kodiak areawide harvest (including Kodiak Regional Aquaculture Association cost recovery) of 5,926,918 salmon was well below the 2016 forecast and the previous 10-year average of approximately 24,068,105 salmon.

The estimated exvessel value of the 2016 fishery was approximately $14.5 million. This was the fourth lowest value since 1975 and well below the previous 10-year average exvessel value of $36.2 million.

Purse seine fishermen accounted for the majority of the total harvest (in number of fish) and their earnings averaged $66,243 per fished permit. Set gillnet earnings averaged $25,972 per permit fished. Beach seine earnings averaged $7,111 per permit fished.

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 extended for the seine fleet from July 6 until July 30 along the Westside of Kodiak from the latitude of Cape Kuliuk to the latitude of Low Cape. Both Karluk and Ayakulik Chinook salmon achieved their escapement goals. The 2016 commercial harvest of Chinook salmon in the KMA totaled 7,478 fish which was below the previous 10-year average (16,019 fish) and below the 2016 forecast (15,000 fish; Table 2).

Sockeye Salmon

The 2016 commercial harvest of sockeye salmon totaled 2,063,472 fish. The harvest was slightly below the recent 10-year average (2,200,839 fish) but well below the forecast (3,408,000 fish; Table 2).

Early season management for much of the Westside of Kodiak Island is driven by Karluk early-run sockeye salmon (through July 5). Extended fishing time 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 339,940 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 159,000 fish.

Late-season management for much of the Westside of Kodiak Island is driven by the Kodiak Island pink salmon fishery (beginning July 6) and Karluk late-run sockeye salmon (beginning August 16). A total of 670,592 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, which was similar to the forecasted Karluk late-run harvest of 675,000 fish.

Westside sockeye salmon numbers include an estimated contribution of approximately 174,666 sockeye salmon from the enhanced Spiridon Lake sockeye salmon run, of which 82,649 were harvested in Spiridon Bay SHA.

The Ayakulik sockeye salmon run was weak and there was only 1 fishing period during early-run sockeye salmon management (through July15). A total of 48,619 sockeye salmon were harvested in areas managed based on Ayakulik early-run sockeye salmon. Three short openings were allowed during Ayakulik late-run sockeye salmon management, and the fishery was then closed due to extremely weak Ayakulik pink salmon escapement. A total of 93,128 sockeye salmon were harvested in areas managed based on Ayakulik late-run sockeye salmon. A total 141,747 of sockeye salmon were harvested from Westside sections opened based on Ayakulik returns, which was well below the 2016 forecast of 266,000 fish.

Frazer Lake and Upper Station sockeye salmon runs came in weaker than forecasted. However, both runs were strong enough to allow for limited commercial salmon openings in the traditional fishing areas (i.e., seine and gillnet sections of the Alitak District). To facilitate for longer closures, the nontraditional Dog Salmon Flats Section also opened simultaneously with the traditional areas. This strategy effectively harvested more Frazer sockeye salmon per commercial salmon opening, allowing less Frazer sockeye salmon escapement, permitting the longer Alitak District closures. These longer closures allowed for more early-run sockeye salmon Upper Station escapement. The Alitak District early-run (through July 15) sockeye salmon harvest was 86,867 fish, below the projected harvest of 182,000 fish.

Upper Station late-run sockeye salmon run came in as weak as expected and very few fishing periods were permitted after August 9. The total harvest of the Alitak District late-run sockeye salmon was 96,428 fish, which was above the forecasted harvest of 80,000.

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 weaker than forecast but the allocative and biological criteria were met throughout the year. Fishing time was allowed in the Cape Igvak Section during both June and July with 326,740 sockeye salmon harvested through July 25. This was above the preseason forecast of approximately 284,000 fish.

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 managed based on local pink salmon runs. 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 were met. A Seaward Zone closure was implemented in the North Shelikof Unit at noon, July 10, when it was estimated that the cumulative sockeye salmon harvest had approached the 15,000 fish limit. The total July 6 to July 25 harvest in the North Shelikof Unit was 101,856 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 19,239 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 below average effort and harvest in the Foul Bay SHA with a total of 8,794 sockeye salmon harvested.

In the Spiridon Bay SHA (Telrod Cove), 82,649 sockeye salmon were harvested. This includes cost-recovery fish 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 92,017 Spiridon enhancement fish were harvested outside of Telrod Cove, bringing the total Spiridon enhancement sockeye salmon harvest to 174,666 fish.

The Kitoi Bay Hatchery harvest was an estimated 46,872 sockeye salmon, which was below the forecast of 100,000 fish. 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. 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 206,540 fish was below the forecast (330,000 fish) and the previous 10-year average (329,952 fish; Table 2). The majority of the coho salmon were caught in the Westside Kodiak fishery.

Pink Salmon

The 2016 KMA pink salmon harvest of 3,245,549 fish was well below the forecast (16,193,000 fish) and the previous 10-year average harvest of 20,721,265 fish, and the smallest harvest since 1975 (Table 2).

The wild stock pink salmon harvest was one of the lowest in the past 50 years with 2,100,315 pink salmon harvested in the KMA. The majority of the pink salmon were harvested on the Westside but both Afognak and the Eastside/Northend of Kodiak had significant harvests. Westside pink salmon fisheries (Raspberry Cape to Ayakulik) accounted for 1,090,581 fish, the Afognak District had a harvest of 532,588 fish, the Eastside/Northend Kodiak fisheries had a combined harvest of 204,434 fish, the Alitak District had a harvest of 182,615 fish, and the Mainland District had a harvest of only 90,097 fish.

The Kitoi Bay Hatchery pink salmon run was weaker than expected with 1,145,234 pink salmon harvested in sections near the hatchery (4,293,000 forecast). Kitoi-bound pink salmon were likely 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 403,879 fish was below the forecast (643,000 fish). Additionally, the Kitoi Bay Hatchery chum salmon production was relatively weak but came in as forecast with a harvest of 72,554 chum salmon (72,000 fish forecast).

Escapement Summary

Fish counting weirs were operated on 9 systems in 2016, including the Karluk, Ayakulik, Upper Station, Dog Salmon, Litnik, Buskin, Saltery, Pauls Bay, and Pasagshak systems. Three observers also flew a near record low number of 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 KMA.

Chinook Salmon

The total Chinook salmon escapement (8,126) was above 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 River weir (3,434 fish) was within the biological escapement goal range of 3,000–6,000 fish. Chinook salmon escapement through the Ayakulik River weir (4,594 fish) was within the biological escapement goal range of 4,000–8,000 fish.

Sockeye Salmon

Sockeye salmon runs in many systems in the KMA were average to below average. All of the major systems met or exceeded their established escapement goals. The entire KMA estimated sockeye salmon escapement of (1,285,363 fish) was slightly above the previous 10-year average of 1,220,000 fish.

Coho Salmon

The only established coho salmon escapement goals occur in the Northeast Kodiak and Eastside Kodiak districts for the following systems: American (400 fish), Olds (1,000 fish), Buskin (3,200–7,200 fish), and the Pasagshak rivers (1,200 fish). 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 KMA coho salmon escapement.

Pink Salmon

The KMA pink salmon escapement of 1,764,586 fish was well below the previous 10-year average of (4,070,000 fish). 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 (1,699,281 fish) was well below the escapement goal range of 3.0– 6.0 million fish. The Mainland District pink salmon escapement of 65,305 fish was well below the established escapement goal range (250,000–750,000 fish). However, due to limited funding the department no longer conducts all peak aerial surveys and both the Kodiak Archipelago and Mainland numbers should be considered minimum estimates.

Chum Salmon

The overall chum salmon escapement of 197,285 fish was below the previous 10-year average (375,738 fish). Escapement goals have been established for the Kodiak Archipelago and the Mainland District. The escapement of 128,585 fish in the Kodiak Archipelago was below the escapement goal of 151,000 fish, and the Mainland District escapement of 68,700 fish was well below the escapement goal of 104,000 fish. However, due to limited funding, the department no longer conducts all peak aerial surveys, so 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 2016, the combined early- and late-run Chignik River sockeye salmon escapement and harvest in the CMA was similar to the recent 10-year averages. The first commercial fishing period in the CMA began on June 4 and the final fishing period closed on August 31. A total of 70 permits made deliveries in 2016 (including the department's test fishery permit).

Escapement Summary

Escapement through the Chignik River weir was monitored using underwater digital video equipment from May 23 through September 12. 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 2016 season.

On August 20, 2 DIDSON (Dual Identification Sonar) acoustic units were installed in the Chignik River to monitor escapement. The numbers of fish passing upstream of the DIDSONs were counted for the first 10 minutes of each hour. The counts were then expanded to obtain hourly escapement estimates. Species apportionment was determined by fishing with a gillnet at least every other day. The results of the fishing samples were then applied to the escapement numbers. Daily postweir escapement estimates were produced from the DIDSONs beginning September 13 (when the weir was removed) through September 23.

Aerial surveys were flown throughout the season to monitor escapement into other CMA streams. Peak aerial survey counts, by index stream and species, were summed and compared to

available escapement goals established by Schaberg et al. (2015). Pink and chum salmon escapements were measured against established areawide SEGs.

Chinook Salmon

The Chignik River is the only major Chinook salmon-producing stream within the CMA and one of the largest Chinook salmon streams on the South Alaska Peninsula. The biological escapement goal for Chinook salmon into the Chignik River watershed is 1,300–2,700 fish (Schaberg et. al. 2015). The 2016 Chignik River Chinook salmon escapement, above the weir, of 1,843 fish was below the most recent 5-year and 10-year averages. Subsistence and sport fishery harvest of Chinook salmon will not be known until permits and questionnaires are returned and tabulated by the spring of 2017.

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 fish was met with an estimated escapement of 418,290 fish. The early-run sockeye salmon escapement was similar to both the 5-year and 10-year average escapements.

The Chignik River also has an inriver run goal (IRRG) of 75,000 sockeye salmon (25,000 in August and 50,000 in September) to provide for additional freshwater subsistence fishing opportunity. The IRRG is incorporated into the late-run SEG of 275,000–400,000 sockeye salmon. In 2016, the late-run SEG was met with an estimated total escapement of 354,884 fish. Of these fish, an estimated 3,464 late-run sockeye salmon were estimated post-DIDSON for the time period of September 24–30. Sockeye salmon escapement in August was estimated at 103,886 fish, meeting the minimum escapement requirements for the month (50,000 fish), as well as the August IRRG component of 25,000 fish. Approximately 48,921 sockeye salmon escaped during September 1–23 and were included in the total late-run escapement estimate. September escapement was slightly less than the September IRRG component of 50,000 fish. The total late-run estimated escapement was similar to the 10-year average escapement and below the 5-year average escapement.

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 2016 Chignik River coho salmon escapement through the weir plus postweir DIDSON estimates through September 23 was 30,291 fish, which was below the most recent 5- and 10-year average escapement estimates.

Pink Salmon

An estimated 486 pink salmon passed the Chignik River weir in 2016, which was well below the previous 5- and 10-year average pink salmon escapements. Pink salmon escapements into other CMA streams were estimated via aerial surveys. A new even-year pink salmon SEG (170,000–280,000) was adopted at the 2016 BOF meeting for all districts combined, and is based on 8 index streams within the districts. In 2016, pink salmon peak estimated escapement was very poor in the CMA and the minimum goal was not met. Pink salmon estimated total peak escapement was 68,100 fish for all index streams and made up approximately 40% of the minimum escapement goal.

Chum Salmon

The 2016 Chignik River chum salmon escapement was 114 fish, which was above average for the Chignik River. Chum salmon escapements to other CMA streams were estimated via aerial surveys. A new chum salmon SEG (45,000–180,000) was adopted at the 2016 BOF meeting based on escapement into 6 index streams within the districts (Schaberg et al. 2015). The 2016 estimated total peak chum salmon escapement for all index streams of 69,900 fish was within the escapement goal range.

Commercial Fishery Summary

The first commercial fishing period occurred in the CMA on June 4. Throughout the months of June and July fishing periods were interspersed by short closures, typically 1–3 days in length. After a weeklong closure in late July, commercial fishing reopened in the Chignik Bay and Central districts on August 3 and remained open until the end of the month except for 1 short closure. The Eastern District closed to commercial salmon fishing on July 5 and remained closed due to poor pink salmon escapement. The Western and Perryville districts were closed throughout August due to poor pink salmon escapement. In September, sockeye salmon escapement lagged behind the necessary number of fish required to meet the month's IRRG component for the Chignik River, so the fishery remained closed. In 2016, 70 permit holders (including the department's test fishery permit) made a total of 2,554 landings (Table 2).

Harvest Summary

Chinook Salmon

A total of 20,719 Chinook salmon were commercially harvested in 2016, which was well above recent average harvests. The majority of the 2016 CMA Chinook salmon harvest occurred in the Central District.

Sockeye Salmon

A total of 1,385,673 sockeye salmon were commercially harvested in the CMA during 2016, which was below the most recent 5-year and 10-year average harvest. The majority of the 2016 CMA sockeye salmon harvest came from the Chignik Bay and Central districts.

In 2016, the Cape Igvak Section in the Kodiak Management Area (Area K) opened to commercial salmon fishing on June 8 and the Southeastern District Mainland (SEDM) in the Alaska Peninsula Management Area (Area M) opened on June 7. Cape Igvak fisherman harvested 331,633 sockeye salmon (298,469 considered Chignik-bound) during the allocation period through July 25. A total of 118,488 sockeye salmon (94,790 considered Chignik-bound) were harvested in SEDM during the allocation period.

Coho Salmon

A total of 94,397 coho salmon were commercially harvested in 2016, which was similar to the recent 10-year average harvests. The majority of the coho salmon harvest in 2016 took place in the Central, Western, and Perryville districts.

Pink Salmon

A total of 140,913 pink salmon were commercially harvested in the CMA in 2016, which was well below recent even-year average harvests. The majority of the pink salmon harvest occurred in the Central District during late June and July. Commercial salmon fishing was closed in the

Eastern District throughout July and August while the Western and Perryville districts were closed throughout August due to poor pink salmon returns.

Chum Salmon

A total of 118,435 chum salmon were commercially harvested in 2016, which was below the 5-year and 10-year average chum salmon harvests. The majority of the chum salmon harvest in 2016 took place in the Eastern, Central, and Western districts in late June and July.

ADF&G Test Fishery Summary

The department conducted 1 cost-recovery test fishery and 2 run assessment test fisheries in Chignik Lagoon in 2016. An estimated 7,087 sockeye salmon were harvested, which provided approximately $44,000 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 2016 commercial salmon harvest in the Alaska Peninsula, Aleutian Islands, and Atka-Amlia Islands Management Areas totaled 15,345 Chinook, 5,981,217 sockeye, 260,922 coho, 2,883,577 pink, and 513,338 chum salmon (Table 7). Subsistence salmon harvest will be reported in the 2016 annual management report. Data detailed in this report are considered preliminary.

South Unimak and Shumagin Islands June Fisheries

The South Unimak and Shumagin Islands commercial salmon fishery 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 6,055 Chinook, 1,260,883 sockeye, 1,716 coho, 2,499,140 pink, and 261,318 chum salmon.

Consistent with the BOF regulatory changes during the February 2016 meeting, commercial salmon fishing was closed in both the West Pavlof Bay Section south of Black Point and the Volcano Bay Section on June 21 when the sockeye salmon harvest exceeded 191,000 fish as shown by fish ticket information. The Dolgoi Island Area remained closed through July 25; however, the portion of the West Pavlof Bay Section south of Black Point reopened to commercial salmon fishing on July 17 concurrent with scheduled fishing periods during the post-June fishery. Beginning July 26, the Dolgoi Island Area was managed consistent with the scheduled fishing periods during the post-June fishery.

Southeastern District Mainland

From June 1 to July 25, the SEDM (excluding the Northwest Stepovak Section beginning July 1) is managed based on the strength of the Chignik sockeye salmon run. Due to the early run timing of sockeye salmon returns to Chignik River in 2016, the CMA opened to commercial salmon fishing on June 4. During years in which it appears that the sockeye salmon harvest will be greater than 600,000 fish in the CMA, and the first run begins to develop as anticipated followed by a commercial salmon opening in the CMA, commercial salmon fishing can be allowed in the East Stepovak, Stepovak Flats, Southwest Stepovak, Balboa Bay, and Beaver Bay sections of SEDM. The first commercial salmon opening in the SEDM was for 48 hours beginning on June 7, the second 48-hour opening occurred on June 24, and the final 24-hour opening occurred

on July 22. A total of 339 Chinook, 118,148 sockeye, 3,777 coho, 9,190 pink, and 4,656 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. The first commercial fishing period in the Northwest Stepovak Section began on July 1. The cumulative sockeye salmon escapement in Orzinski Lake of 21,019 fish was above the SEG of 15,000–20,000 sockeye salmon. The total harvest in the Northwest Stepovak Section from July 1 through July 25 was 193 Chinook, 257,279 sockeye, 2,773 coho, 12,201 pink, and 9,655 chum salmon.

From July 26 through August 31, SEDM is managed based on the abundance of local salmon stocks. Due to weak returns of pink salmon into SEDM streams, there were no fishing periods during the month of August, and there were 2 coho salmon directed fishing periods during September. The total harvest in SEDM from July 26 through September 30 for the 2016 season was 12 Chinook, 49,813 sockeye, 3,276 coho, 6,330 pink, and 3,561 chum salmon.

The total percent of sockeye salmon harvested in the Southeastern District Mainland considered to be Chignik-bound for the 2016 allocation period was 8.12%.

South Peninsula Post-June Fishery

Prior to the South Peninsula post-June fishery, ADF&G conducts a test fishery to determine immature salmon abundance in the Shumagin Islands. Test fishing occurred on July 2, 3, 5, 8, and 9. Test fisheries resulted in an average of 89 immature salmon per set on July 2, and an average of 51 immature salmon per set on July 3. The third and fourth test fisheries, which occurred on July 5 and 8, resulted in an average of 130 (July 5) and 151 (July 8) 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 33-hour fishing period that was scheduled to occur on July 6. The final test fishery, which occurred on July 9, resulted in an average of 31 immature salmon per set. Reduced harvest of immature salmon on July 9 allowed the July 10 commercial fishing period in the Shumagin Islands Section to open to the seine fleet.

From July 6 through July 31, there was one 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 pink and chum salmon stocks. In September and October, management focuses on coho salmon returns, though the status of late pink and chum salmon returns may also be taken into consideration. The low number of pink salmon returning to local streams resulted in no commercial fishing in the South Peninsula in August. Below average coho salmon harvest in September also limited commercial fishery openings until processor interest was withdrawn.

The total commercial harvest for the South Peninsula post-June fishery (including the SEDM from July 26 to October 31) was 6,804 Chinook, 807,336 sockeye, 176,799 coho, 339,864 pink, and 139,519 chum salmon.

South Peninsula Escapement

The South Peninsula sockeye salmon escapement of 120,170 fish was above the management objective range of 48,200–86,400 fish. Escapement into Mortensen Lagoon (13,000 fish) exceeded its SEG range of 3,200–6,400 fish. Escapement into Thin Point Lagoon (18,000 fish) was within the SEG range of 14,000–28,000 fish. Pink salmon total indexed escapement of

1,038,160 fish was below the SEG range of 1,750,000–4,000,000 fish. Chum salmon indexed total escapement of 626,776 fish was within the cumulative district escapement goal range of 330,400–660,800 fish. There were no coho salmon observed 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, which prevented 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 of the Aleutian Islands in early August, an inadequate amount of pink salmon (approximately 42,000 fish) 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 2016. McLees Lake had a sockeye salmon escapement of 39,892 fish and was within the SEG range of 10,000–60,000 fish.

South Peninsula Test Fisheries

The department generated revenue from the Shumagin Island Immature Test Fishery and from 2 additional cost-recovery test fisheries in 2016. The total amount generated for the department was $65,817.

North Alaska Peninsula

In 2016, 157 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 2016 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 2016, the harvest of sockeye and coho salmon on the North Peninsula exceeded projected harvest levels, while the harvest of Chinook, pink, and chum salmon were below projected harvest levels. The North Alaska Peninsula harvest of sockeye and coho salmon were above the previous 10-year (2006–2015) averages for each species, while the harvest of Chinook, pink, and chum salmon were below the 10-year averages.

Northwestern District

In the 2016 Northwestern District commercial salmon fishery, a total of 39,598 sockeye, 2,379 coho, 1,812 pink, and 69,903 chum salmon were harvested. A total of 21 permit holders participated in the fishery, consisting of 5 purse seiners and 16 drift gillnetters.

In the Northwestern District, the chum salmon escapement of 113,250 fish was within the chum salmon SEG of 100,000–215,000 fish. This escapement estimate represents a minimum; the actual escapement likely being greater due to very poor survey conditions in one of the major chum salmon producing streams in the Northwestern District. The sockeye salmon escapement

for 2016 in the Northwestern District was above the escapement goal range of 52,600–106,000 with a total escapement of 143,200 fish.

Black Hills Section

Due to the lack of extensive closures during 2016 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 47,096 sockeye salmon and 2,484 chum salmon were harvested in the Black Hills Section in 2016. Weekly fishing periods occurred throughout the season in the Black Hills Section. North Creek is the only system in the Black Hills Section with a sockeye salmon escapement goal. The 2016 North Creek salmon escapement of 21,000 sockeye salmon (determined by aerial surveys) exceeded the escapement goal of 4,400–8,800 fish.

Nelson Lagoon Section

The Nelson (Sapsuk) River total run of 601,786 sockeye salmon (includes harvest and escapement) was below the estimated forecast of 692,000 sockeye salmon. From the total run, 301,786 sockeye salmon were harvested in Nelson Lagoon and 300,000 fish escaped in the Nelson River. The 2016 sockeye salmon escapement into Nelson River exceeded the BEG of 97,000–219,000 fish.

The Nelson Lagoon Section was opened for all weekly fishing periods along with many extensions in fishing time in 2016. Beginning August 15, the Nelson Lagoon Section is managed on local coho salmon runs. In 2016, 45,000 coho salmon were observed in Nelson River escapement, exceeding the Nelson River SEG threshold of 18,000 fish. A directed coho salmon fishery occurred inside Nelson Lagoon with a harvest of 27,312 coho salmon in 2016.

Bear River and Three Hills Sections

By regulation, the Bear River Section opens to commercial salmon fishing on May 1 while the Three Hills Section opens June 25. Both areas are managed based on the sockeye salmon run strength into Bear and Sandy rivers. The early sockeye salmon run at Bear River was above average, while the late-run of sockeye salmon was below average; the combined totals of early and late sockeye salmon runs at Bear River were above average and extensive closures were not necessary. During the fishing season large closed water buffers were utilized around streams when needed in order to ensure adequate escapement. A total of 256,226 sockeye salmon were harvested in the Bear River Section during 2016, and 57,919 sockeye salmon were harvested in the Three Hills Section.

The Bear River early-run (through July 31) sockeye salmon escapement of 293,280 fish exceeded the escapement goal of 176,000–293,000 fish. The Bear River late-run (after July 31) sockeye salmon escapement of 139,720 fish met the late-run escapement goal of 117,000–195,000 fish. The Bear River season sockeye salmon escapement was 433,000 fish, which met the season escapement goal of 293,000–488,000 fish.

The 2016 Sandy River sockeye salmon escapement of 170,000 fish exceeded the season ending escapement goal range of 34,000–74,000 fish, and was the largest escapement on record.

Ilnik Section

In 2016, the Ocean River, a spawning tributary of the Ilnik River system, emptied directly into the Bering Sea and therefore sockeye salmon escaped into the Ocean River without being

counted at the Ilnik River weir. As a result Ocean River was monitored by aerial survey in 2016, and observed escapement was added to the Ilnik River escapement. In 2016, the Ilnik River system sockeye salmon escapement through the weir was 92,000 fish, exceeding the Ilnik River escapement goal of 32,000–48,000 fish. The observed escapement into the Ocean River was 32,000 fish, which exceeded the escapement goal of 8,000–12,000 fish. The total Ilnik River system sockeye salmon escapement (including Ocean River) was 124,000 sockeye salmon, exceeding the total Ilnik River system goal of 40,000–60,000 fish. By regulation, the Ilnik Section can open to commercial salmon fishing on June 20. Sockeye salmon escapement into Ilnik River exceeded interim escapement objectives throughout the season. A total of 2.2 million sockeye salmon were harvested in the Ilnik section, well above average, and the highest on record. No commercial fishing effort occurred in Ilnik Lagoon in 2016 despite weekly fishing periods.

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. Despite allowed opportunity to fish the Ilnik Section in August, the majority of permit holders made an effort to fish Bear River, which was more productive in August than the Ilnik Section, and also more convenient when seeking shelter from weather events.

Inner and Outer Port Heiden Sections

Aerial escapement surveys began on the Meshik River on June 17. Subsequent surveys occurred throughout the season and the final sockeye salmon escapement into the Meshik River system was 116,800 fish, exceeding the escapement goal of 48,000–86,000 fish. 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 25 and had openings of 2½ days per week until the section closed on July 31. In 2016, a total of 632,474 sockeye salmon were harvested from the Outer Port Heiden Section.

Cinder River Section

In 2016 the commercial fishing effort in the Cinder River Section was minimal, despite weekly fishing periods of 2½ days per week for the entire season. Effort in 2016 in the Cinder River Section targeted coho salmon, and the fishery was open continuously due to low effort. Confidentiality rules prohibit the reporting of the Cinder River Section harvest because of the low effort. The total Cinder River (including Mud Creek) sockeye salmon escapement estimate of 205,700 fish exceeded the escapement goal of 36,000–94,000 fish.

ADF&G Test Fishery

The department conducted a cost-recovery test fishery and run assessment test fishery in the Port Moller and Bear River areas in 2016. An estimated 5,830 sockeye salmon were harvested and provided, after paying for the vessels, approximately $25,000 to the department that will be used to help fund the Port Moller ADF&G office and 4 North Peninsula weir sites.

North Peninsula Escapement

Chinook Salmon

Nelson River is the only river in Area M with a Chinook salmon escapement goal. At the Nelson River weir a total of 4,618 Chinook salmon escaped, and exceeded the goal of 2,400–4,400 fish. The total Northern District Chinook salmon escapement of 16,514 fish was comparable to the most recent 10-year average of 15,443 fish.

Chum Salmon

The Northern District has a districtwide chum salmon escapement goal of 119,600–239,200 fish. This goal was exceeded with an escapement of 277,674 fish, well above the most recent 10-year average of 190,930 fish. The bulk of the chum salmon escapement occurred in the Herendeen-Moller Bay Section (98,300 fish) and the Cinder River (94,900 fish).

Coho Salmon

Coho salmon surveys were done on all Northern District streams in early September. Coho salmon runs continue through September, so escapements tabulated from aerial surveys are considered minimum estimates. Both the Nelson and Ilnik rivers have coho salmon lower-bound escapement goals in the Northern District. The Nelson River escapement of 45,000 fish met the lower bound escapement goal of 18,000 fish. A total of 4,500 fish escaped into the Ilnik River and 5,000 fish escaped into the Ocean River in 2016. During years in which the Ocean River drains into the Bering Sea, instead of draining into the Ilnik River, the Ocean River escapement is added to the Ilnik River escapement for management purposes. The combined escapement of the Ocean and Ilnik rivers was 9,500 fish, meeting the lower bound escapement goal of 9,000 fish. Like Nelson River, it is expected that more coho salmon entered the system after early September when the last aerial survey occurred. The coho salmon escapement into the Cinder River was 56,000 fish, and 80,000 coho salmon escaped into the Meshik River system (Meshik River and Landlocked Creek) as observed by aerial survey during early September.

Table 7.–Preliminary 2016 Westward Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kodiak	7	2,064	207	3,200	404	5,881
Chignik	21	1,386	94	141	118	1,760
South Peninsula and Aleutians Islands [a]	13	2,478	185	2,871	424	5,972
North Peninsula [a]	2	3,503	76	12	89	3,682
Alaska Peninsula Total	15	5,981	261	2,884	513	9,654
Westward Region Total	44	9,430	562	6,224	1,036	17,296

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

[a] Catches include test fishery catch.

PRELIMINARY FORECASTS OF 2017 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 2017 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, 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.

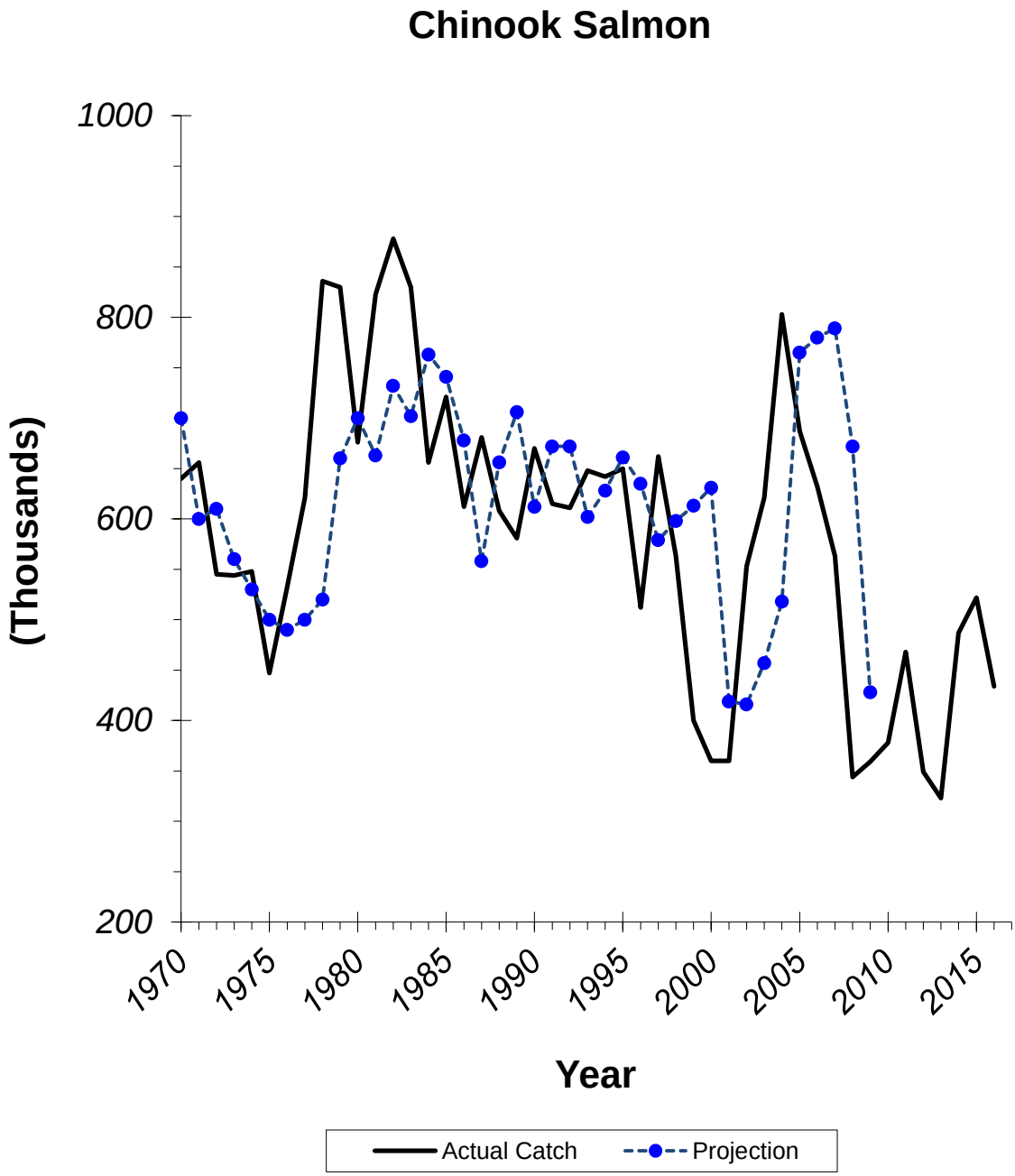

Figure 2.–Relationship between actual catch and projected catch in thousands, for Alaska Chinook salmon fisheries from 1970 to 2016, 2010–2017 projections are not available.

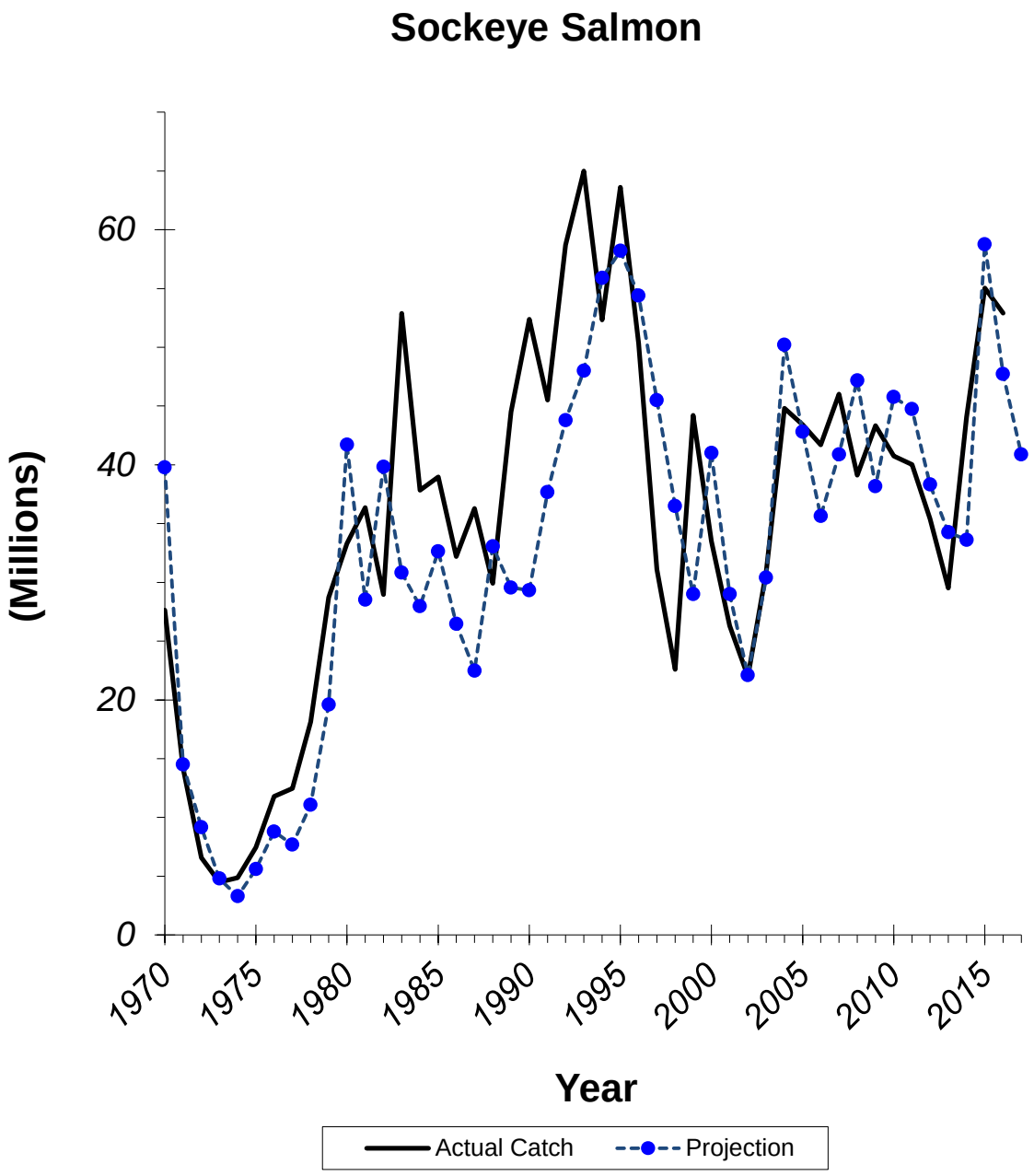

Figure 3.–Relationship between actual catch and projected catch in millions, for Alaska sockeye salmon fisheries from 1970 to 2016, with the 2017 projection.

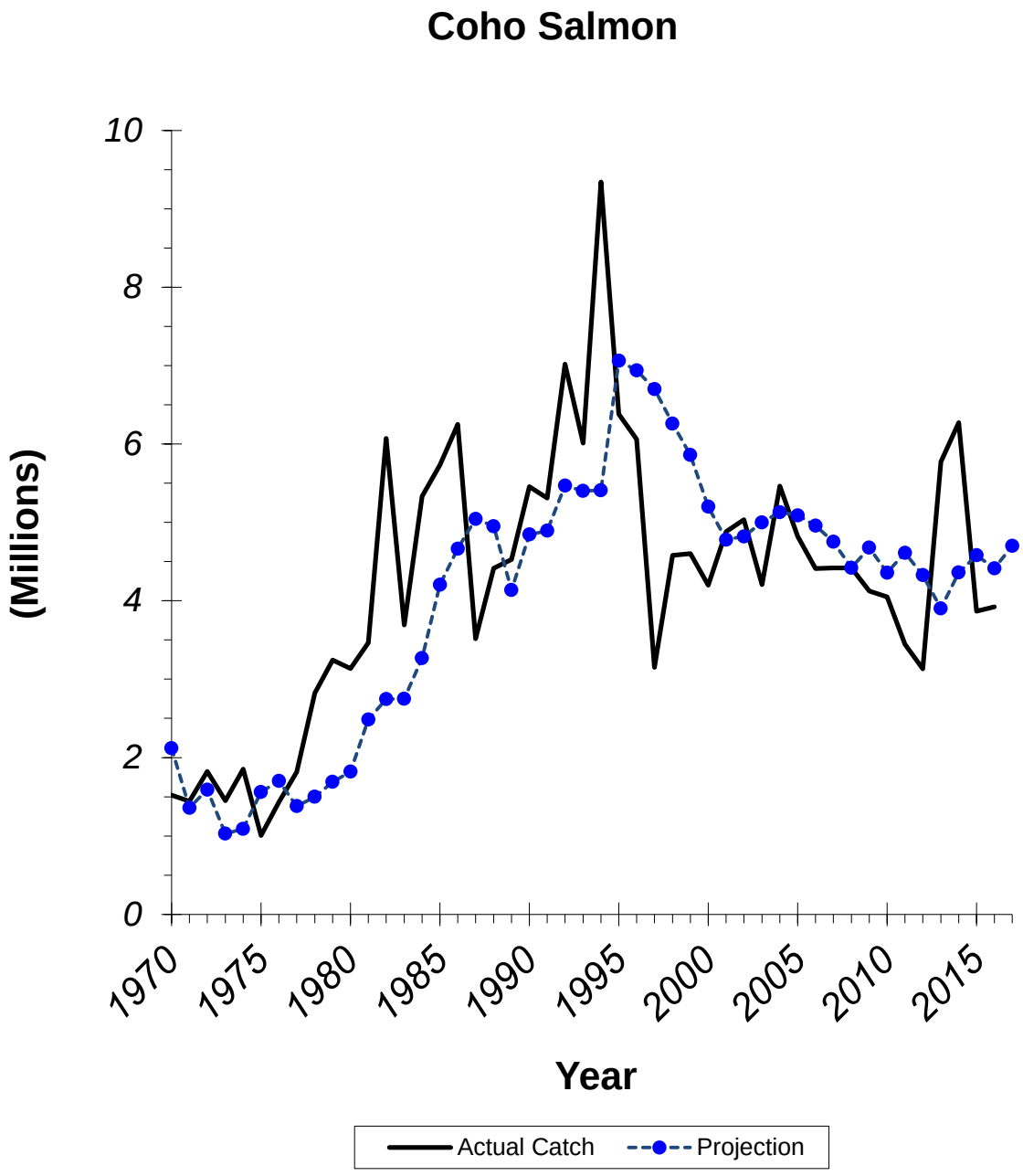

Figure 4.–Relationship between actual catch and projected catch in millions, for Alaska coho salmon fisheries from 1970 to 2016, with the 2017 projection.

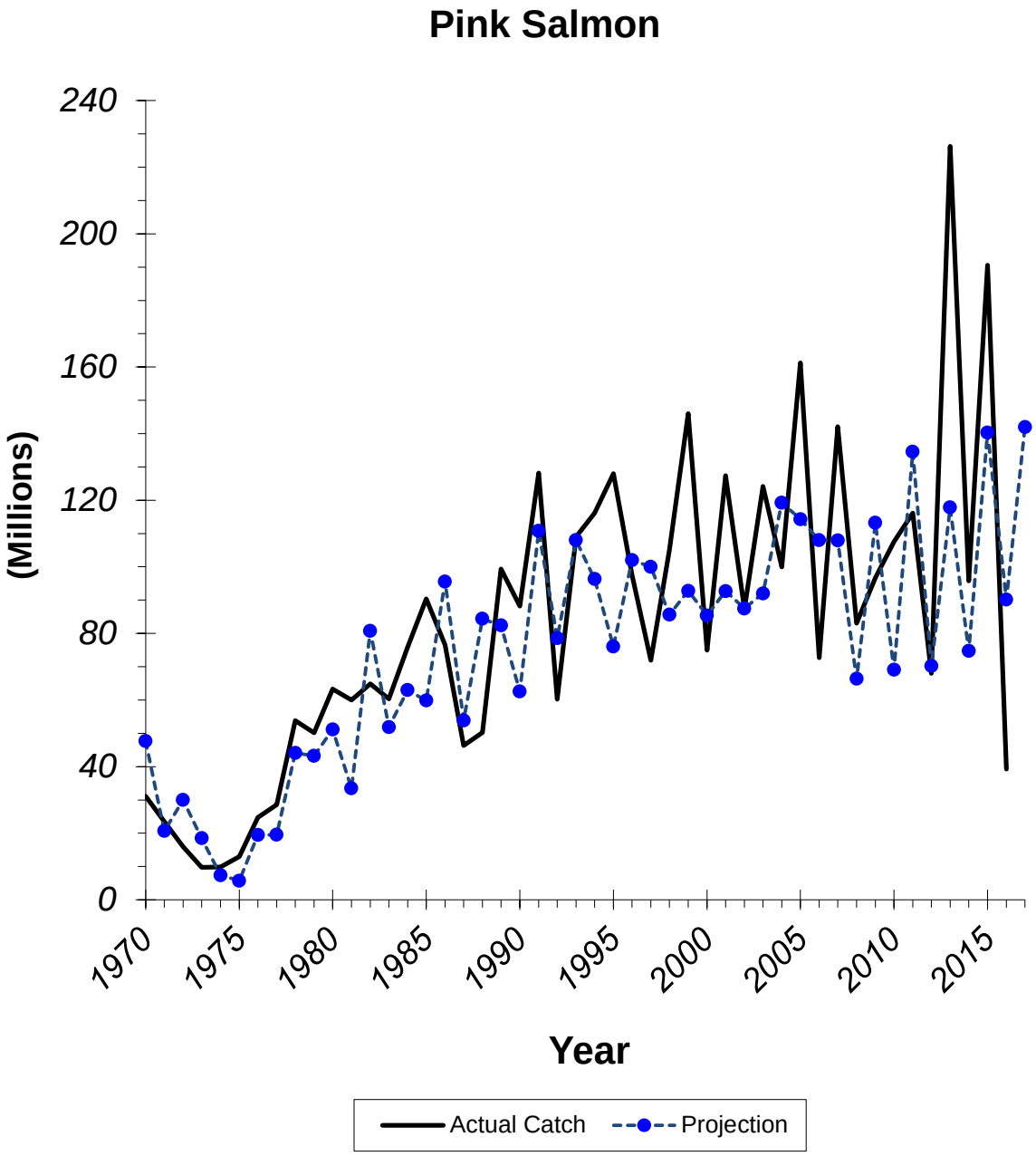

Figure 5.–Relationship between actual catch and projected catch in millions, for Alaska pink salmon fisheries from 1970 to 2016, with the 2017 projection.

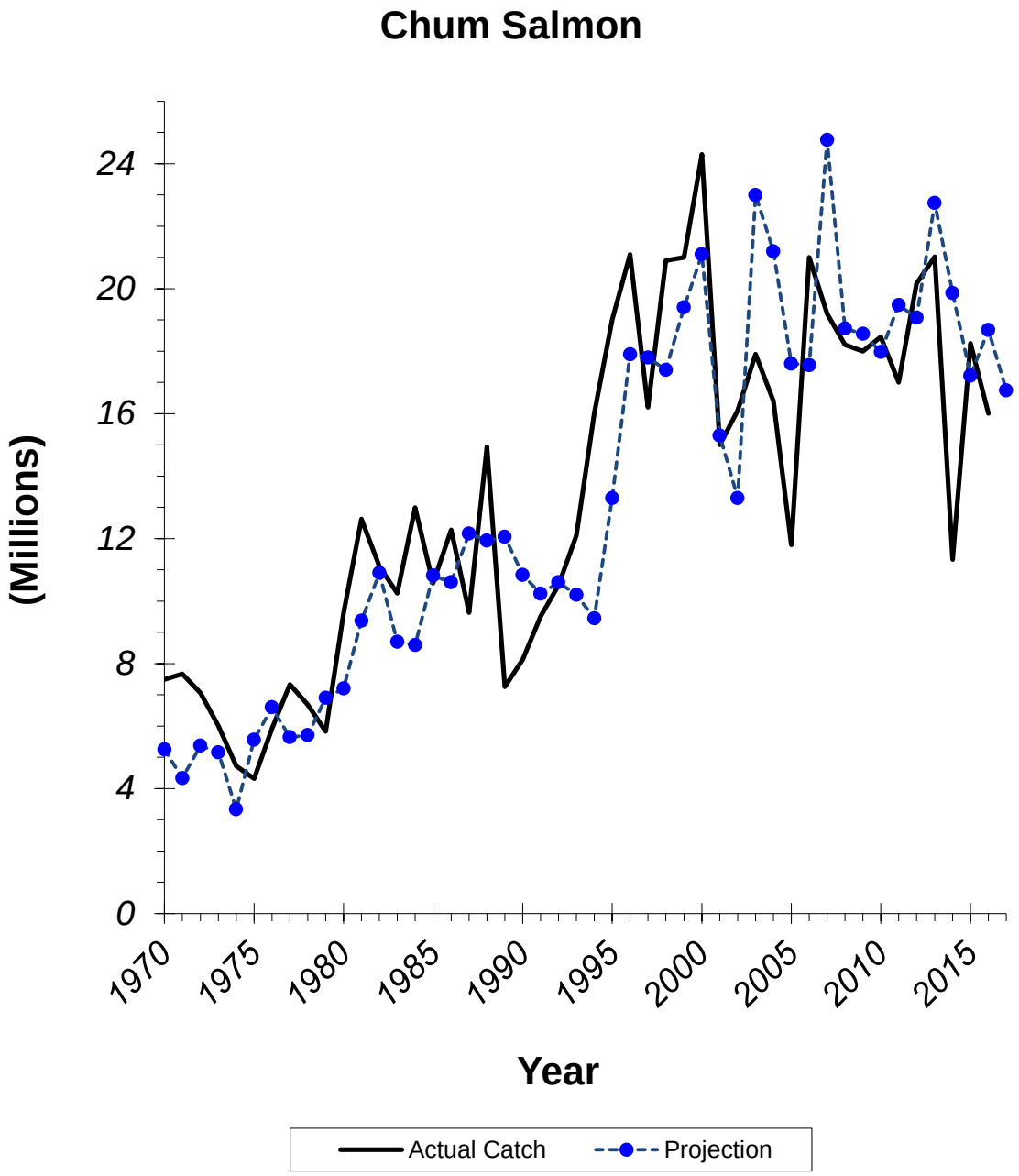

Figure 6.–Relationship between actual catch and projected catch in millions, for Alaska chum salmon fisheries from 1970 to 2016, with the 2017 projection.

ACKNOWLEDGMENTS

This report is based on information contributed by Division of Commercial Fisheries biologists located in field offices throughout the state. Contributing regional and area biologists, statistical technicians, research analysts, and analyst programmers include Todd Anderson, Bonnie Borba, Jeremy Botz, Charles Brazil, Greg Buck, Jan Conitz, Jack Erickson, Jeff Estensen, Heather Finkle, Ethan Ford, Birch Foster, Lisa Fox, Dan Gray, Stormy Haught, Steve Heinl, Glenn Hollowell, Kathrine Howard, Sabrina Garcia, Christine Gleason, James Jackson, Deena Jallen, Reid Johnson, Brad Kalb, Holly Krenz, Mary Beth Loewen, Randy Mason, James Menard, Steve Moffitt, Bob Murphy, Ted Otis, Andrew Piston, Aaron Poetter, Charles Russell, Paul Salomone, Tim Sands, Kevin Schaberg, Jennifer Shriver, Pat Shields, Lucas Stempf, Aaron Tiernan, Jeff Wadle, Michelle Wattum, Fred West, Dawn Wilburn, and Mark Willette. Individual credit for forecast material is contained in area forecast discussions in the Appendix. Area biologists throughout the state supplied reviews of the 2016 fishing season. We thank Sabrina Larsen for GIS support.

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Schaberg, K. L., D. A. Tracy, M. B. Foster, and M. Loewen. 2015. Review of salmon escapement goals in the Chignik Management Area, 2015. Alaska Department of Fish and Game, Fishery Manuscript Series No. 15-02, Anchorage.

APPENDIX A: SOUTHEAST ALASKA

Forecast Area: Southeast Alaska

Species: Pink Salmon

The Southeast Alaska pink salmon harvest in 2017 is predicted to be in the *strong* range with a point estimate of 43 million fish (80% confidence interval: 27–59 million fish). 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 57-year period 1960 to 2016.

Category	Range (millions)	Percentile
Poor	Less than 11	Less than 20th
Weak	11 to 19	20th to 40th
Average	19 to 34	40th to 60th
Strong	34 to 51	60th to 80th
Excellent	Greater than 51	Greater than 80th

Forecast Methods

The 2017 forecast was produced in 2 steps: (1) a forecast of the trend in harvest, and (2) the forecast trend adjusted using 2016 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 38 million pink salmon (Figure 1).

We adjusted the forecast using peak June–July juvenile pink salmon catch-per-distance-trawled (CPDT) statistics provided by the National Oceanic and Atmospheric Administration (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.[a]

[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 Fisheries Science Center, National Marine Fisheries Service, NOAA, 17109 Point Lena Loop Road, Juneau, AK 99801-8626, USA. Available from http://www.npafc.org/new/pub_documents.html (accessed February 27, 2017).

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We developed a simple equation to predict the forecast error in the exponential smooth by regressing the forecast error residuals from 1998 to 2016 on the corresponding NOAA CPDT data from 1997 to 2015 (Figure 2). The forecast error residuals were simply the exponential smooth forecast subtracted from the actual harvest. The predicted forecast error for 2017 was +5 million, which, when added to the exponential-smooth forecast, increased the forecast to 43 million pink salmon (Figure 3). The forecast range (27–59 million) is based on an 80% confidence interval calculated from the mean squared error of the adjusted hind-cast predictions.

Forecast Discussion

The 2017 harvest forecast of 43 million pink salmon is just above the recent 10-year average harvest of 39 million pink salmon. The NOAA Auke Bay Lab's 2016 peak June–July juvenile pink salmon CPDT statistic (3.10) from upper Chatham and Icy straits in northern Southeast Alaska ranked sixth out of the 20 years that they have collected juvenile salmon abundance information. Pink salmon harvests associated with juvenile indices similar to the 2016 index (±20%) ranged from 24 to 67 million fish. Perhaps the largest potential source of uncertainty regarding the 2017 pink salmon return is 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 and 2015 returned in numbers well below expectation and pink salmon that went to sea in 2016 (and set to return in 2017) may have experienced similar conditions.

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 2017 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 relatively poor in the past 3 seasons (Figure 4), overall performance since 2007 is much improved (mean absolute percent error = 31%) 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). Hindcasts of past harvests (1998–2016) using our current forecast method exhibited good performance in predicting the direction of forecast error (Figure 3). Even though hindcasts were not always accurate (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 an 11th consecutive year.

The department will manage the 2017 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.

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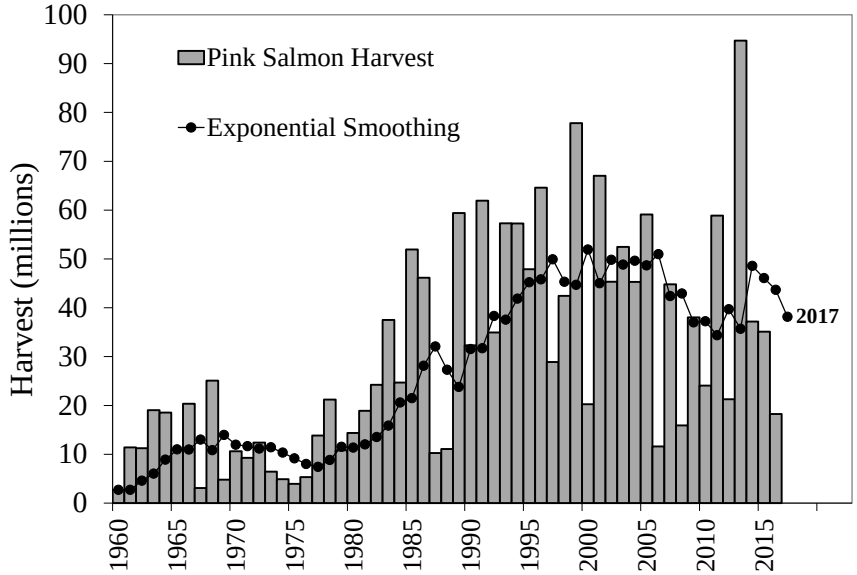

Figure 1.–Comparison of the annual harvest of pink salmon in Southeast Alaska, and exponential smoothed hindcast values of the harvest used in the 2017 forecast model. This method produced a 2017 harvest forecast of 38 million pink salmon.

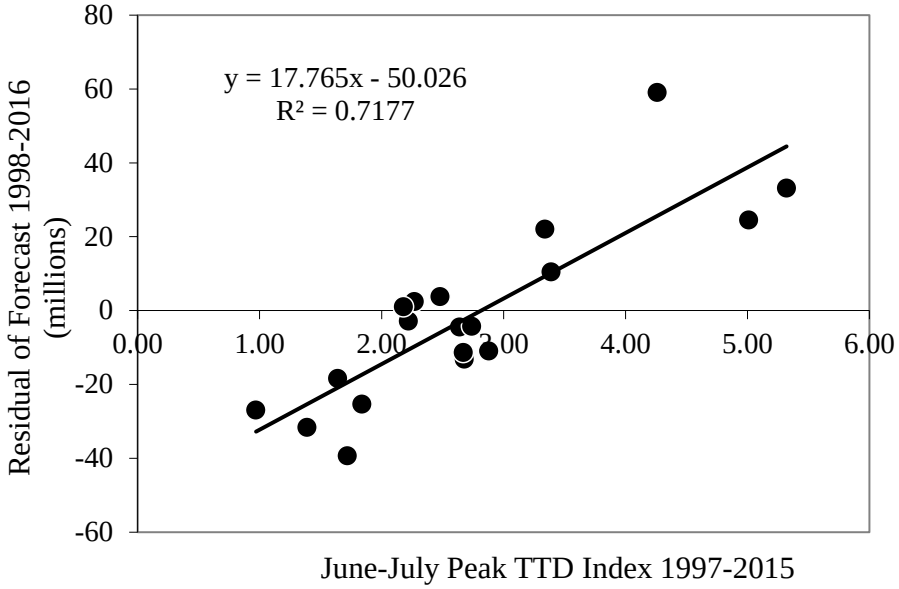

Figure 2.–Regression of ADF&G forecast error on the peak June–July juvenile pink salmon CPDT index from Icy Strait 1 year prior.

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

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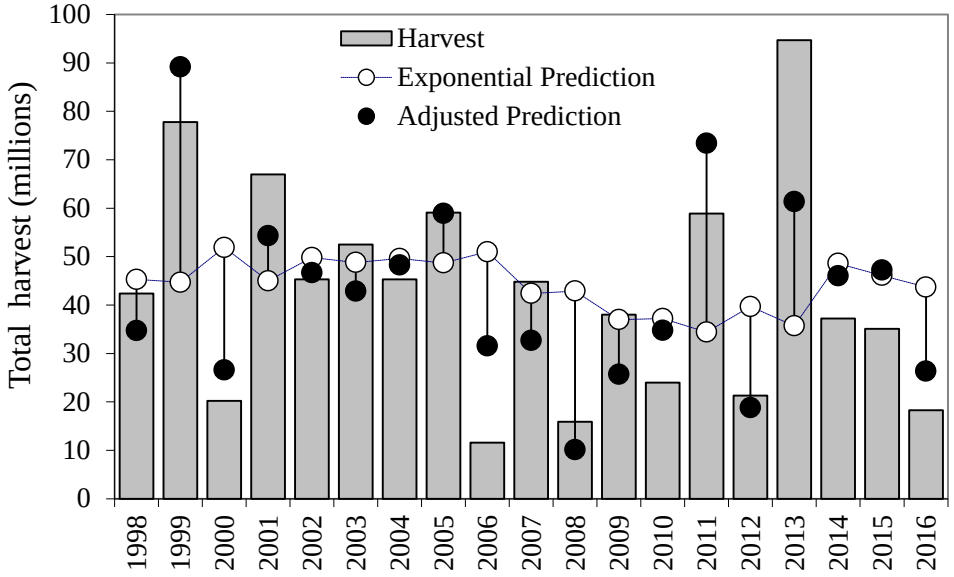

Figure 3.–Annual harvest of pink salmon in Southeast Alaska, 1998–2016, compared to the exponential smoothed hindcast predictions of the harvest adjusted using NOAA Auke Bay Laboratories juvenile pink salmon data.

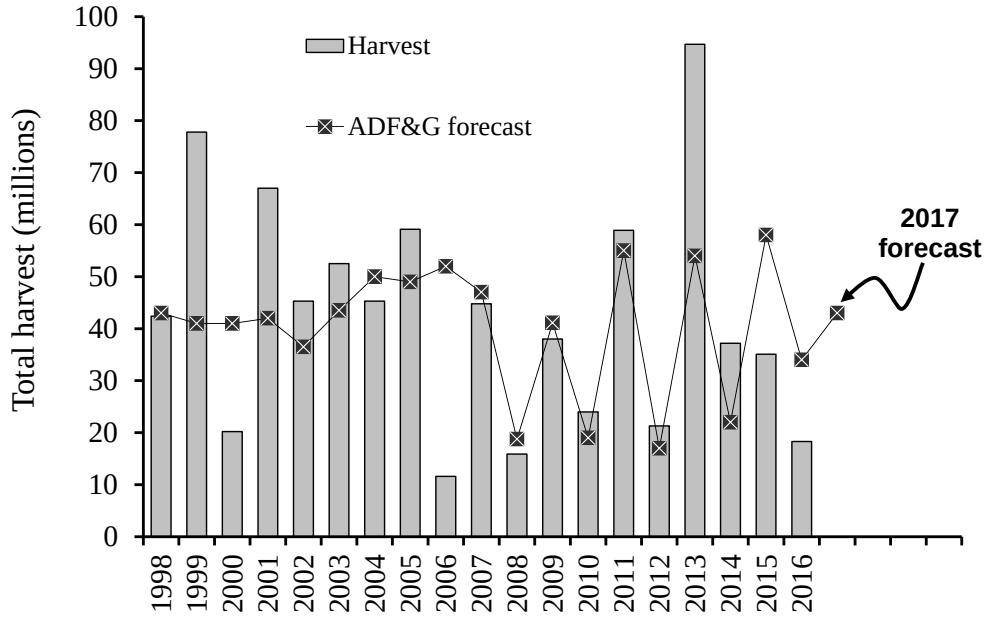

Figure 4.–Annual harvest of pink salmon in Southeast Alaska compared to the ADF&G preseason harvest forecast, 1998–2016. The 2007–2017 ADF&G harvest forecasts were adjusted using NOAA's juvenile pink salmon data.

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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 2017 run.

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound General Districts		
Total Run	21,097	11,770–30,424
Escapement Target [a]	1,450	
Common Property Harvest[b]	19,647	12,764–26,530

[a] Prince William Sound pink salmon escapement target is the sum of the median historical odd-years (1965–2009) escapement for each district in Prince William Sound with a sustainable escapement goal. Escapement goals were changed in 2011 from a single soundwide SEG to district and brood line specific sustainable escapement goals (first implementation in 2012). The sum of district specific SEG ranges is 0.99–2.28 million pink salmon (median of 1.45 million) for the odd-year brood line and 0.79–1.70 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. Beginning in 2015, the number of index streams surveyed was reduced from 214 to 134 streams. Because escapement goals established in 2011 were based on the 214 index streams, the 2015 escapement index from the reduced subset of index streams was expanded using average escapement index proportion (1995–2013 odd years) represented by the 134 streams. 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 (CCPF) were estimated by subtracting hatchery contributions from the CCPF total. Hatchery contributions were determined from thermal marked otolith recoveries (1997–2016), 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 2017 forecast is based on the average of 3 recent odd-year returns (2011, 2013, and 2015). Prior to 1997, forecast methods employed surveys of pre-emergent fry; however, these surveys ended in 1995. The 2017 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 odd-years, 1961–2015. Approximate 80% prediction interval for the total run forecast was calculated using the squared deviations between the 1995–2015 odd-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 odd-year returns, t is the critical value, n is the sample size, and MSE is the mean squared error.

-continued-

Forecast Discussion

The predicted natural total run of pink salmon in 2017 uses the recent 3 odd-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 2017 natural run included (1) previous odd-year total run (most naïve forecast method), (2) total run averages with 2–10 years of data (odd years), and (3) linear regression of log-transformed total Prince William Sound (PWS) escapement index versus log-transformed total PWS return by brood line. The 2017 forecast (average of 3 recent odd-years total runs) had the lowest MAPE (52%) and standard deviation of the MAPE (70%) for models examined with 1995–2015 odd-years data.

The brood year 2015 escapement index (6.14 million) was the largest on record, followed by 4.74 million in 2005, and 4.68 million in 2013. This was well above the sum of the current district-specific SEG ranges (0.99–2.28 million) for the odd-years broodline and greater than the 1.70 million average of observed odd-year escapement indices since 1961 (median = 1.39 million). If the 2017 total run forecast (harvest + escapement index = 21.09 million) is realized, it will almost triple the 7.48 million average odd-year return since 1961 (median = 4.94 million) and will rank as the second largest natural run on record.

Environmental factors, which probably play a significant role in determining pink salmon run size in PWS, have been variable in recent years. Pacific Decadal Oscillation values were positive throughout 2015 and 2016, corresponding with above average sea surface temperatures throughout the Gulf of Alaska (http://research.jisao.washington.edu/pdo/PDO.latest). Weak La Niña conditions beginning in early summer 2016 followed strong El Niño conditions from late winter of 2015 through spring 2016. A transition to neutral conditions during January-March 2017 is anticipated (http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml).

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

-continued-

Forecast Area: Prince William Sound

Species: Chum Salmon (natural run only)

Preliminary Forecast of the 2017 run.

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound General Districts		
Total Run	371	241–501
Escapement Target[a]	200	
Common Property Harvest[b]	171	41–301

[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 sustainable escapement goals 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 2017 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 2017. 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. The number of index streams surveyed in 2015 was reduced from 214 to 134 and the chum index was expanded as described earlier in the pink salmon methods. 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. CCPF harvest contributions of natural stock chum salmon were estimated using prehatchery average natural runs (2002 and 2003) or thermally marked otolith estimates (2004–2016) for each district in PWS. An approximate 80% prediction interval for the total run forecast was calculated using the squared deviations between the 2007–2016 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 CCPF were not consistently available prior to otolith thermal marking. 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 CCPF harvests are unavailable for most PWS districts. If the 2017 natural chum salmon forecast of 371,000 is realized, it would be third smallest in the last 20 years. For comparison, the estimated total run size of natural chum salmon was greater than 1.3 million from 1981–1988, but has not exceeded 1 million since 1988.

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Environmental factors that may influence chum salmon abundance include warm North Pacific waters from 2014 through early 2016 followed by moderately cooler or average temperatures in the latter part of 2016. Average weight and length at age of PWS chum salmon harvested in 2016 showed a substantial increase following 2 years of steep decline. However, an overall trend in declining weight and length at age in chum salmon harvested in PWS is evident across the historical time series.

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

-continued-

Forecast Area: Prince William Sound

Species: Sockeye Salmon (natural run only)

Preliminary Forecast of the 2017 run.

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound, Coghill Lake		
Total Run	74	50–130
Escapement Target[a]	30	
Harvest Estimate[b]	44	20–100

[a] The escapement target of 30,000 for Coghill Lake is the median of historical escapement estimates and is within the sustainable escapement goal (SEG) range of 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 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 fish 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 2017 used the return of age-1.2 fish in 2016 as the input parameter. Predicted returns of age-1.1, -1.2, -2.2, and -2.3 sockeye salmon were calculated as the 2007–2016 mean return of that age class.

Harvest, escapement, and age composition data are available for Coghill Lake sockeye salmon runs since 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%). The Coghill Lake total run 80% prediction intervals were calculated as the sum of the individual age class forecast point estimates plus/minus the square root of the sum of the squared differences between the age class forecast point estimates and age class forecast 80% prediction intervals. Prediction intervals were calculated using data from 2007 to 2016 for mean run forecasts and data from 1974 to 2016 for the sibling model forecast. The harvest forecast is the total run forecast minus escapement target. No formal forecast was generated for the 2017 run of Eshamy Lake sockeye salmon due to incomplete escapement information since 2012.

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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 biological escapement goal (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 fish). In 2012, the department began managing for the long-term median escapement of 30,000 fish. The Coghill Lake natural run escapement was within or above the escapement goal range every year since 1995 before failing to meet escapement in 2013, 2015 and 2016. If achieved, the 2017 total run forecast midpoint (74,000 fish) would be the 15th largest run in the last 20 years and less than the median run size of 110,000 fish in the last 20 years. The largest proportion (35,423 fish; ~47%) of the overall Coghill Lake sockeye salmon forecast is predicted to come from age-1.3 fish (5 years old) from the 2012 brood year. The number of age-1.1 fish (jacks) observed in 2016 was higher than the recent 10-year average and could indicate a strong run of age-1.2 (4 year old) sockeye salmon in 2017. However, there is considerable uncertainty in models used to estimate this component of the run. This forecast uses the average total return of age-1.2 sockeye salmon (34,000 fish) rather than sibling model estimates (40,000). 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 CCPF 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. Eshamy Lake escapement has been enumerated at a weir since 1950, except 1987, 1998 and 2012–present because of budget constraints. Weir operations at Eshamy are not anticipated to resume in the near future. The BEG range for Eshamy Lake is 13,000–28,000 fish (midpoint 20,500 fish).

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APPENDIX C: COPPER RIVER

Appendix C.–Copper River.

Forecast Area: Copper River

Species: Chinook Salmon

Preliminary Forecast of the 2017 run.

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	29	3–55
Escapement Goal[a]	24	
Harvest Estimate[b]	5	0–31

[a] The Chinook salmon spawning escapement goal of 24,000 is a lower bound sustainable escapement goal.

[b] Maximum harvest by all fisheries (subsistence, personal use, sport, and commercial) that allows achieving the lower bound sustainable escapement goal of 24,000. The maximum projected commercial common property harvest for 2017 is 3,500.

Forecast Methods

The total run forecast of Copper River Chinook salmon for 2017 was estimated using the previous year's (2016) 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 the following: (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 mean absolute percentage error (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 (29%) and a smaller standard deviation of the MAPE (21%) than other forecast models examined and was used as the forecast for 2017. The total run forecast range was calculated using the methods described earlier for Coghill Lake sockeye salmon forecast, except 1999–2016 Chinook salmon retrospective forecasts, and actual data were used in the calculation. The harvest forecast is the Copper River Chinook salmon total run forecast minus the lower-bound sustainable escapement goal of 24,000 Chinook salmon.

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 collaborator on the project and eventually took the lead role. There are currently 18 years (1999–2016) of inriver abundance estimates. Thus, while estimates of commercial harvest of Chinook

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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 2016, Chinook salmon in the commercial harvest were examined for clipped adipose fins and coded wire tags. Approximately 5% of the fish scanned in 2016 were clipped, down from 15% in 2015. All decoded tags originated from hatchery stocks outside of the Copper River.

The 2017 Chinook salmon total run forecast point estimate of 29,000 fish is ~34,000 less than the 18-year average total run size (1999–2016 average = 63,000 fish). If realized, the 2017 forecast total run would tie with 2016 as the smallest run since 1980.

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Forecast Area: Copper River

Species: Sockeye Salmon

Preliminary Forecast of the 2017 run.

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	1,510	1,070–1,960
Escapement Target[a]		
Upper Copper River	450	
Copper River Delta	169	
Common Property Harvest[b]	890	490–1,300
Hatchery and Supplemental Production		
PWSAC - Gulkana Hatchery		
Hatchery Run	300	210–380
Broodstock Needs	20	
Supplemental Escapement[c]	70	
Common Property Harvest[b]	210	110–300
Total Production		
Run Estimate	1,810	1,280–2,340
Natural Escapement Goal	619	
Broodstock Needs	20	
Supplemental Escapement [c]	70	
Upper Copper River Inriver Goal [d]	700	
Common Property Harvest [e]	1,100	700–1,510

[a] The upper Copper River escapement target of 450,000 sockeye salmon is the historical average spawning escapement (1979–2010). The sustainable escapement goal 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 2016 are available.

[e] Commercial common property harvest midpoint estimate is 890,000 sockeye salmon and the 80% prediction interval is 480,000–1,290,000. 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

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harvests of sockeye salmon, and the Gulkana Hatchery sockeye salmon broodstock and hatchery-excess 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 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 fishery, 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; 2004–2016), coded wire tags (1995–2003), and 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 at 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 an estimate of Chinook salmon inriver abundance and an estimate of 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 2017 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, -1.3 and -2.2 sockeye salmon. 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 (2012–2016) 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 1983–2016 data were used for sibling model forecasts and 2011–2016 data were used for mean run forecasts.

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The 2017 run to Gulkana Hatchery was estimated as the recent 3-year average fry-to-adult survival estimate (1.35%) 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 17% (age 4) and 83% (age 5). An estimated exploitation rate of 70% was used to project the total harvest of Gulkana Hatchery stocks in 2017. The 80% prediction intervals for the forecast of Gulkana Hatchery sockeye salmon production and harvest were calculated as described above for Coghill Lake sockeye salmon, except data from the years 2007–2016 were used.

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 fish to 360,000–750,000 fish. 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 fish.

The Gulkana Hatchery run of sockeye salmon will include fish from Crosswind Lake smolt migrations of 120,000 in 2014 (second smallest in previous 20 years) and 1.09 million in 2015. For brood years 1994–2013, the average migration from Crosswind Lake was 1.16 million smolt. Summit Lake outmigration counts of 180,000 in 2014 and 120,000 in 2015 were below the average of 370,000 from the most recent 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.

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The 2017 total run forecast of natural and enhanced sockeye salmon (1.81 million) is below the recent 10-year average total run (2.55 million). If realized, the 2017 forecast total run would be the 24th largest in the last 38 years (since 1980). The 1.51 million natural run would be below the recent 10-year average (2.24 million), and a 290,000 Gulkana Hatchery enhanced run would be similar to the recent 10-year average (300,000). Copper River total run forecast errors have averaged 26.6% over the last 10 years (Range = 0.5–38.1%). The 2017 run of natural sockeye salmon to the Copper River will be composed primarily of returns from brood years 2012 and 2013. Five-year-old fish (brood year 2012) are expected to predominate Copper River Delta and upper Copper River runs and compose approximately 63% of the total natural run forecast in 2017.

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 warm North Pacific waters through 2015 and into early 2016, with a return to more normal temperatures in the second half of 2016 will increase the uncertainty in the 2017 run projection. Copper River sockeye salmon in 2016 were the smallest in the 1966–2016 time series. It is unknown if the short period of moderate cooling in 2016 will result in increased growth and survival for the 2017 run.

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APPENDIX D: UPPER AND LOWER COOK INLET

Forecast Area: Upper Cook Inlet

Species: Sockeye Salmon

The forecast of the 2017 Upper Cook Inlet sockeye salmon run.

TOTAL PRODUCTION	Forecast Estimate (millions)	Forecast Range (millions)
Total Run	4.0	3.2–4.8
Escapement	1.4	
Commercial Harvest	1.7	
Other Harvests	0.9	

Forecast Methods

The major sockeye salmon systems in Upper Cook Inlet (UCI) are the Kenai, Kasilof, and Susitna rivers, and Fish Creek. Available escapement (spawner abundance), return, sibling, fry, and smolt data were examined for each system. Four models were evaluated to forecast the total run of sockeye salmon to UCI in 2017: (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 2017 was forecasted using a sibling model. The sibling model prediction of returning age-1.3 salmon is based on the abundance of age-1.2 salmon that returned in 2016. A spawner-recruit model predicts the age-1.2 salmon return based upon the spawning escapement in 2013. The Kenai River returns of age-2.2 and -2.3 salmon were forecasted using sibling models based upon the abundances of age-2.1 and -2.2 salmon that returned in 2016. The returns of age-1.3, -2.2, and -2.3 Kasilof River sockeye salmon in 2017 were forecasted using sibling models based upon returns of age-1.2, -2.1, and -2.2 salmon in 2016. A smolt model based upon age-1 smolt abundances in 2015 was used to forecast the return of age-1.2 Kasilof River sockeye salmon in 2017.

The returns of age-0.3, -1.2, -2.2, and -2.3 Susitna River sockeye salmon were forecasted using mean return per spawner by age class for brood years 2006–2012. Mark–recapture estimates of inriver run and genetic estimates of commercial harvest were available for these brood years. A sibling model based upon the abundance of age-1.2 salmon returning in 2016 was used to forecast the return on age-1.3 Susitna River sockeye salmon.

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.

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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 midpoints of the escapement goal ranges for each of the monitored sockeye salmon-producing systems and the escapement into unmonitored systems (estimated as 17% of the escapement into monitored systems). The harvest by all other user groups (sport, personal use, and subsistence) was estimated using a relationship between *other harvests* and total run. Commercial harvest was estimated by subtracting *other harvests* from total harvest.

The total UCI run forecast range was calculated by multiplying the forecast by the MAPE of the actual UCI runs from published UCI run forecasts from 2007 through 2016.

2016 Run and Forecast

In 2016, the harvest of sockeye salmon by all user groups in UCI (3.3 million) was 2.0 million less than the preseason forecast of 5.3 million. In 2016, the total run was 3.7 million to the Kenai River, 607,000 to the Kasilof River, 390,000 to the Susitna River, and 64,000 to Fish Creek. The 2016 run forecast was 4.7 million to the Kenai River, 861,000 to the Kasilof River, 372,000 to the Susitna River, and 110,000 to Fish Creek. Overall, the 2016 sockeye salmon run was 26% below forecast, largely due to the below-forecast Kenai sockeye salmon run.

Forecast Discussion

In 2017, a run of approximately 4.0 million sockeye salmon is forecasted to return to UCI with a commercial harvest of 1.7 million. The forecasted commercial harvest in 2017 is 1.2 million less than the 20-year average harvest.

The run forecast for the Kenai River is approximately 2.2 million, which is 1.4 million less than the 20-year average run of 3.6 million. A sibling model based upon the return of age-1.2 salmon in 2016 (239,000; 399,000 20-year average) predicted a return of 1.3 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 2013 (9.5 million; 17.7 million 20-year average) and the average weight of fall fry rearing in Skilak Lake predicted a return of 1.6 million age-1.3 salmon. The sibling model was used for this forecast, because the 10-year MAPE was lower for the sibling (26%) than the fry model (27%). A sibling model based upon the return of age-2.2 salmon in 2016 (128,000; 249,000 20-year average) predicted a return of 322,000 age-2.3 salmon in 2016. A fry model based upon the abundance of age-1 fry rearing in Skilak Lake in fall 2013 (2.9 million) predicted a return of 625,000 age-2.3 salmon. The sibling model was used for this forecast, because the 10-year MAPE was lower for the sibling (44%) than the fry model (52%). The predominant age classes in the 2017 run forecast are age 1.3 (60%), age 1.2 (16%), and age 2.3 (15%). The 10-year MAPE for the set of models used for the 2017 Kenai sockeye salmon run forecast is 20%.

The Kasilof River sockeye salmon run forecast is 825,000, which is 16% less than the 20-year average of 987,000. A sibling model based upon the abundance of age-1.2 salmon in 2016 (167,000; 306,000 20-year average) was used to forecast a return of 231,000 age-1.3 salmon in 2017. A spawner-recruit model predicted a return of 292,000 age-1.3 salmon; no smolt data was available for this forecast. The sibling model was used for this forecast because the 10-year MAPE was lower for the sibling (37%) than the spawner-recruit model (79%). A smolt model based upon the abundance of age-1 smolts emigrating from the Kasilof River in 2015 (5.3 million;

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4.1 million 20-year average) was used to forecast a return of 282,000 age-1.2 salmon in 2017. A sibling model based upon the abundance of age-1.1 salmon in 2016 forecasted a return of 239,000 age-1.2 salmon. The smolt model was used for this forecast because the 10-year MAPE was lower for the smolt (54%) than the sibling model (56%). A sibling model based upon the abundance of age-2.1 salmon in 2016 was used to forecast a return of 203,000 age-2.2 salmon in 2017. A smolt model forecast for age-2.2 salmon was 357,000. The sibling model was used for this forecast because the 10-year MAPE was lower for the sibling (16%) than the smolt model (35%). The predominant age classes in the 2017 run forecast are age 1.2 (34%), age 1.3 (28%), and age 2.2 (25%). The 10-year MAPE for the set of models used for the 2017 Kasilof sockeye salmon run forecast is 12%.

The Susitna River sockeye salmon run forecast is 366,000, which is 5% less than the 10-year average of 387,000. This forecast was derived using mean return per spawner by age class and mark–recapture estimates of spawner abundance for brood years 2006–2012. 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 4-year MAPE for this forecast method is 17%. The predominant age classes in the 2017 Susitna sockeye salmon run forecast are age 1.2 (20%), age 1.3 (53%) and age 2.3 (12%).

The Fish Creek sockeye salmon run forecast is 75,000, which is 11% less than the 20-year average of 84,000. A sibling model was used to forecast the return of age-1.3 salmon, and smolt models were used to forecast returns age-1.2, -2.2, and -2.3 salmon in 2017. The predominant age classes in the 2017 Fish Creek run forecast are age 1.2 (64%) and age 1.3 (23%). The 10-year MAPE for the Fish Creek sockeye salmon run forecast is 70%.

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	345	1,299	161	322	2,164	900 – 1,100[b]
	20-yr average	399	2,185	249	737	3,634	
Kasilof River	Forecast	282	231	203	81	825	160 – 340
	20-yr average	306	325	240	83	987	
Susitna River	Forecast	75	194	12	44	366	See Below[c]
	20-yr average	79	221	26	42	387	
Fish Creek	Forecast	48	17	1	1	75	See Below[d]
	20-yr average	44	22	6	3	84	
Unmonitored	Forecast	128	298	65	76	586	No Goal
	20-yr average	141	471	89	148	871	
Total Run	Forecast	877	2,039	411	523	4,016	
	20-yr average	968	3,223	610	1,013	5,961	

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 for runs less than 2.3 million measured using sonar at river mile 19 on the Kenai River.

[c] Susitna sockeye salmon are managed to achieve escapement goals at Larson, Chelatna, and Judd lakes. Current escapement goals for these lakes are (in thousands of fish): Larson (15–50), Chelatna (20–65), and Judd (25–55), and recommended escapement goal ranges are: Larson (15–35), Chelatna (20–45), and Judd (15–40).

[d] The current escapement goal for Fish Creek sockeye salmon is (in thousands of fish): 20–70 and the recommended escapement goal range is 15–45.

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Upper Cook Inlet Other Salmon Species

The forecast of the 2017 commercial harvest of other salmon species is as follows.

Species	Commercial Harvest Forecasts
Pink Salmon	98,000
Chum Salmon	184,000
Coho Salmon	167,000
Chinook Salmon	6,300

Forecast Methods

The recent 5-year average commercial harvest was used to forecast the harvest of chum, coho, and Chinook salmon in 2017. The forecast for pink salmon is based upon the average harvest during the past 5 odd-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.

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Mark Willette, Research Project Leader, Upper Cook Inlet

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Forecast Area: Lower Cook Inlet

Species: Pink Salmon

Preliminary forecast of the 2017 run.

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION		
Total Run	909	455–1,710
Escapement	295	120–459
Commercial Harvest	615	335–1,251
HATCHERY AND SUPPLEMENTAL PRODUCTION		
Total Run	382	255–510
Broodstock	219	219–219
Commercial Harvest	163	36–291
TOTAL AREA PRODUCTION		
Total Run	1,291	710–2,220
Broodstock and Escapement	514	339–678
Commercial Harvest	777	371–1,542

Note: Columns may not total exactly due to rounding to the nearest thousand fish. Commercial harvest = total run minus escapement and/or broodstock. Commercial harvest refers to fish available for harvest; no prediction of fishing effort is made. Additional harvests may be expected from systems not included in the forecast.

Forecast Methods

The 2017 forecast of wild pink salmon runs to 10 harvest areas in the Lower Cook Inlet (LCI) Management area was based on a logarithmic regression of total run and escapement from 41 to 51 years of observations. The total run forecast for LCI natural production was the sum of the 10 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 Port Graham and Tutka Bay Lagoon hatcheries 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.

Forecast Discussion

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 1 line over the other. In LCI, dominance of 1 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 2015, the last odd-numbered year, LCI experienced record high pink salmon runs. Two of 9 forecasted systems had runs within the forecast range (the remaining 7 were above the forecast range). The 2017 forecast for natural production of 909,000 pink salmon has a forecast range of 455,000–1,710,000 fish. Exceptional parent-year runs in 2015 led to several index streams exceeding their respective escapement goals by considerable amounts, which is likely to negatively affect brood year returns in 2017. In addition, marine survival of pink salmon adults that returned in 2016 was exceptionally low for many index streams, which indicated ocean conditions were not favorable for high survival rates. These 2 factors suggest the 2017 pink salmon run is more likely to be closer to the low end of the forecast range than the midpoint. If realized, a natural run of 909,000 pink salmon would be approximately 84% of the mean run size of 1,077,000 fish for odd-year returns between 1963 and 2015. If the midpoint of the forecast range is achieved, all 10 index areas will likely 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 Southern District is projected to be 117,400 fish, with 56,600 pink salmon coming from Seldovia Bay, 42,000 from Port Graham, and 18,800 from Humpy Creek. Hatchery production of pink salmon in LCI recently resumed after several years of inactivity and significant adult returns are expected to Southern District in 2017. Tutka Bay Lagoon Hatchery is expecting 343,000 pink salmon to return to Tutka Lagoon in 2017. An additional 39,300 enhanced pink salmon are forecasted to return to Port Graham Bay. The 2017 broodstock and cost-recovery goals for the Tutka Bay Lagoon and Port Graham hatcheries have not been finalized so the proportion of their forecasted returns available for common property harvest cannot be estimated at this time.

In Outer District, the number of naturally produced pink salmon available for harvest is projected to be 436,500 fish, with over half of it (249,200 fish) expected to occur in Port Dick Subdistrict. If realized, the Port Dick harvest would be approximately 98% of the mean odd-year catch since 1963. Harvests ranging from 52,100 to 73,800 pink salmon are expected from Port Chatham, Windy, and Rocky bays in 2017.

No pink salmon harvest is expected from Eastern District in 2017. 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 Resurrection Bay Salmon Management Plan, which limits commercial interference with the sport coho and Chinook salmon fisheries.

Relatively small runs are forecasted for major pink salmon producers in Kamishak Bay District. Approximately 14,100 pink salmon are expected to be available for harvest in Bruin Bay and 47,100 in the Ursus and Rocky Cove Subdistricts. Cook Inlet Aquaculture Association recently repaired and reopened the fish ladder on the Paint River where they intend to establish a productive, naturally-spawning population of pink salmon.

Edward O. Otis, Area Finfish Research Biologist, Homer
Glenn J. Hollowell, Area Finfish Management Biologist, Homer

APPENDIX E: KODIAK

Forecast Area: Kodiak

Species: Pink Salmon

Preliminary forecast of the 2017 run.

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
KMA Wild Stock Total Run	23.4	13.3–33.6
KMA Escapement Goal [a]	5.0	
KMA Wild Stock Harvest	18.4	8.3–28.6
Kitoi Bay Hatchery Harvest [b]	9.7	7.2–12.2
Total KMA Pink Salmon Harvest	28.1	15.4–40.8

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

[a] The 2017 estimated escapement is within the range of the odd-year aggregate escapement goals for the Kodiak Archipelago (2.0–5.0 million) and the Mainland District (0.25–1.0 million).

[b] This figure is the total expected return (10.1 million) minus the broodstock collection goal of 430,000 fish; the Kitoi Bay Hatchery cost-recovery harvest is expected to be roughly 2.0 to 3.0 million fish.

The 2017 Kodiak Management Area (KMA) predicted pink salmon harvest is expected to be in the *Excellent* category with a point estimate of 28.1 million fish 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 2016.

KMA Harvest Category	Range (millions)	Percentile
Poor	Less than 7.3	Less than 20th
Weak	7.3 to 10.9	21st to 40th
Average	10.9 to 16.7	41st to 60th
Strong	16.7 to 23.7	61st to 80th
Excellent	Greater than 23.7	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 count, aerial survey index, and harvest estimates.

For the 2017 KMA wild stock pink salmon forecast, a generalized Ricker spawner-recruit model was fitted to the odd-year KMA returns from 1981 to 2015 utilizing KMA pink salmon indexed escapement for the spawner index.

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 (Kodiak airport) of average air temperature, total precipitation, and peak precipitation from August to June were considered.

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Chosen for inclusion in the regression model were 10 parameters: district brood year escapement for Westside; previous year even-year total return; air temperature for October, November, March, and May; precipitation for August and May; and peak precipitation for August and March. The linear regression model was chosen over the spawner-recruit model because of its significant edge in hindcasting (Figure 1). Forecast range was estimated as the 80% prediction intervals from the regression model.

The 2017 Kitoi Bay Hatchery pink salmon forecast was prepared by evaluating pink salmon survivals from odd brood years 1995 through 2013 when releases from the facility were in excess of 100 million fry. Brood years 1995 through 2013 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 return to Kitoi Bay Hatchery is an odd-year dominant return which experiences exceptional marine survival every fourth year dating back to the first releases in 1977 (with the exception of 1997). The primary forecasting consideration for 2017 relates to this 4-year cyclical return which the stronger of the 2 odd-year cycles. The midpoint estimate of 10.1 million reflects a marine survival of 7.33% for the 138.1 million fry released (0.99 g), above the traditional target size (0.8 g).

Forecast Discussion

The 2017 KMA wild stock pink salmon total run (23.4 million) is predicted to be an excellent odd-year return (Figure 1). Brood year escapement in 2015 was the highest odd-year since 1995, and climate variables correlated with odd-year returns suggest higher than average freshwater survival. Confidence in the 2017 forecast estimate is only fair considering the unpredictable nature of the KMA wild stock and hatchery 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 2017 Kitoi Bay Hatchery pink salmon production is expected to be 10.1 million fish. The brood stock collection goal is 425,000 fish, resulting in a total hatchery harvest projection of about 9.7 million fish.

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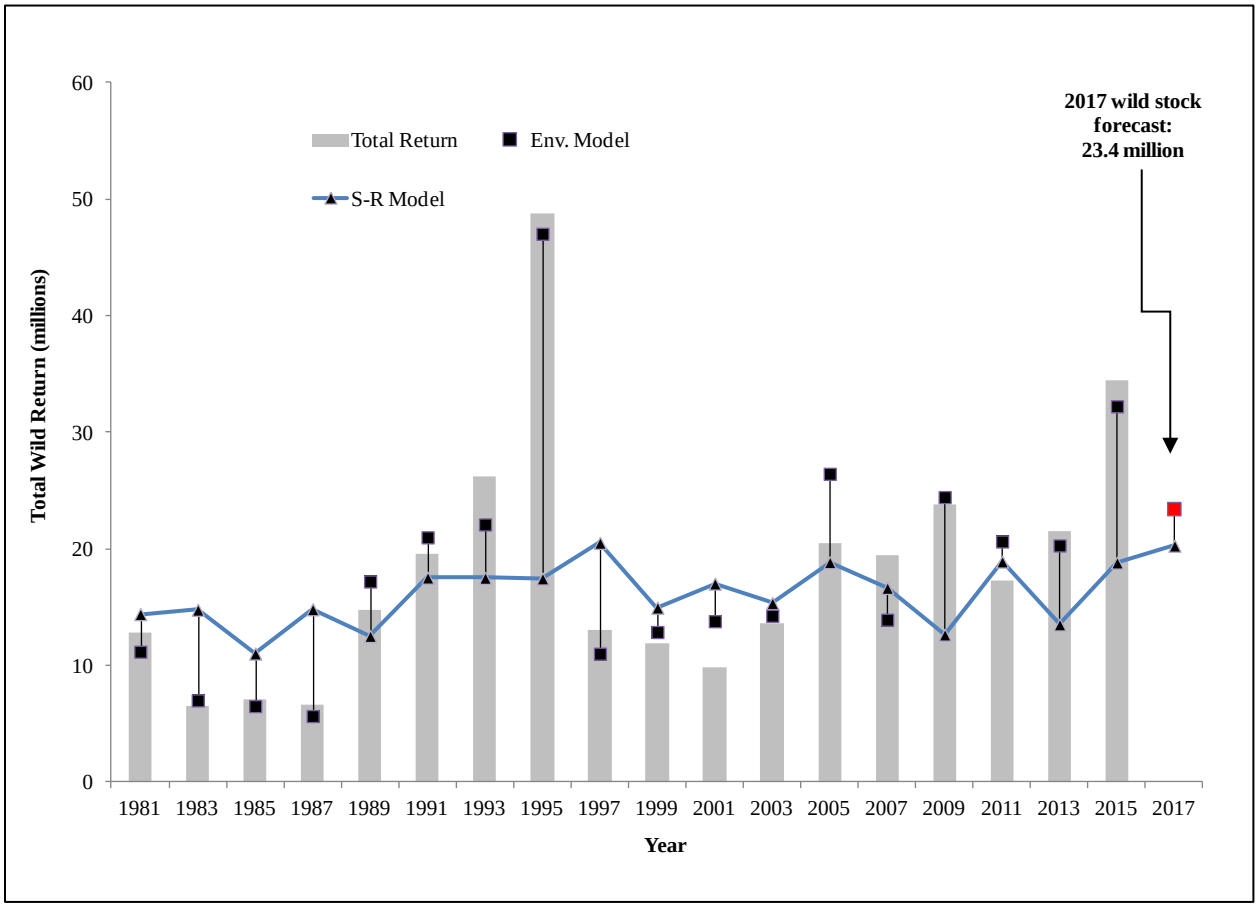

Figure 1.–Kodiak odd-year pink salmon wild stock total return compared to S-R estimates and environmental model estimates, 1981 to 2015, and 2017 forecast.

M. Birch Foster, Finfish Research Biologist, Westward Region
Randy Mason, Kitoi Bay Hatchery Manager, Kodiak Regional Aquaculture Association

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Forecast Area: Kodiak, Ayakulik River

Species: Sockeye Salmon

Preliminary Forecast of the 2017 run.

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	451	193–709
Escapement Goal [a]	300	200–400
Harvest Estimate	151	

[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 2017 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.

The age-.3 sockeye salmon were predicted from prior year age-.2 returns using outmigration years (1989–2013). The age-.2 sockeye salmon were predicted from prior year age-.1 returns (ln transformed) using outmigration years (1989–2014). 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 2017. 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 2017 Ayakulik forecast of 451,000 sockeye salmon is about 88,000 more fish than the 2016 run estimate of 363,000 and 25,000 fish less than the most recent 10-year average. The 2017 run is estimated to be composed of approximately 52% age-.2 fish and 43% age-.3 fish. The confidence in the 2017 Ayakulik forecast is fair, due to the regression relationship. The projected harvest of 151,000 fish is based on the achievement of the midpoint of the combined escapement goal ranges (300,000 fish). 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 (2011–2013), approximately 70% of the total run will occur in the early portion of the run.

Michelle Wattum, Finfish Research Biologist, Westward Region

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Forecast Area: Kodiak, Karluk River

Species: Sockeye Salmon

Preliminary Forecast of the 2017 run.

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run	Total Run Estimate	294	200–387
	Escapement Goal [a]	180	110–250
	Harvest Estimate	114	
Late Run	Total Run Estimate	814	618–1,011
	Escapement Goal [a]	275	170–380
	Harvest Estimate	539	
Total Karluk River	Total Run Estimate	1,108	818–1,399
System	Escapement Goal [a]	455	280–630
	Harvest Estimate	653	

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

[a] The escapement estimates are based on midpoints for the early run and late run escapement goals and summed for the total run.

Forecast Methods

The 2017 Karluk River sockeye salmon forecast was prepared primarily by investigating simple linear regression models utilizing recent age class relationships and median returns.

Karluk River sockeye salmon production demonstrates strong positive autocorrelation (i.e., good years followed by good years, and bad years followed by bad years). As a result, recent-year trends have normally been a better prognosticator of the near future at Karluk River than utilizing age class relationships and regression models that have considerable uncertainty. For both the early and late runs, the age-.1, -.2, -.3, and -.4 return predictions were calculated using their pooled 5-year median contribution.

Median estimates were summed to estimate the total Karluk sockeye salmon run for 2017. 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 total 2017 sockeye salmon run to the Karluk River is expected to be approximately 1,108,000 fish. The early run is expected to be approximately 294,000 fish, which is about 34,000 above the recent 10-year average (260,000 fish) and 78,000 above the 2016 run (216,000 fish). The late run is expected to be approximately 814,000 fish which is 197,000 above the recent 10-year average (618,000 fish) and 38,000 more than the 2016 run (777,000 fish).

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The projected harvest estimate for the early run (114,000) is based on achievement of the midpoint of the early-run escapement goal. The projected harvest estimate for the late run (539,000) is based on achievement of the midpoint of the late-run escapement goal. The vast majority of both runs are expected to be age-.2 fish. The large abundance of smolt observed outmigrating in 2015 and the age-.1 age class predictors in 2016 suggest the 2017 return will be robust, corroborating the prediction. The overall confidence in the Karluk sockeye salmon forecast is good.

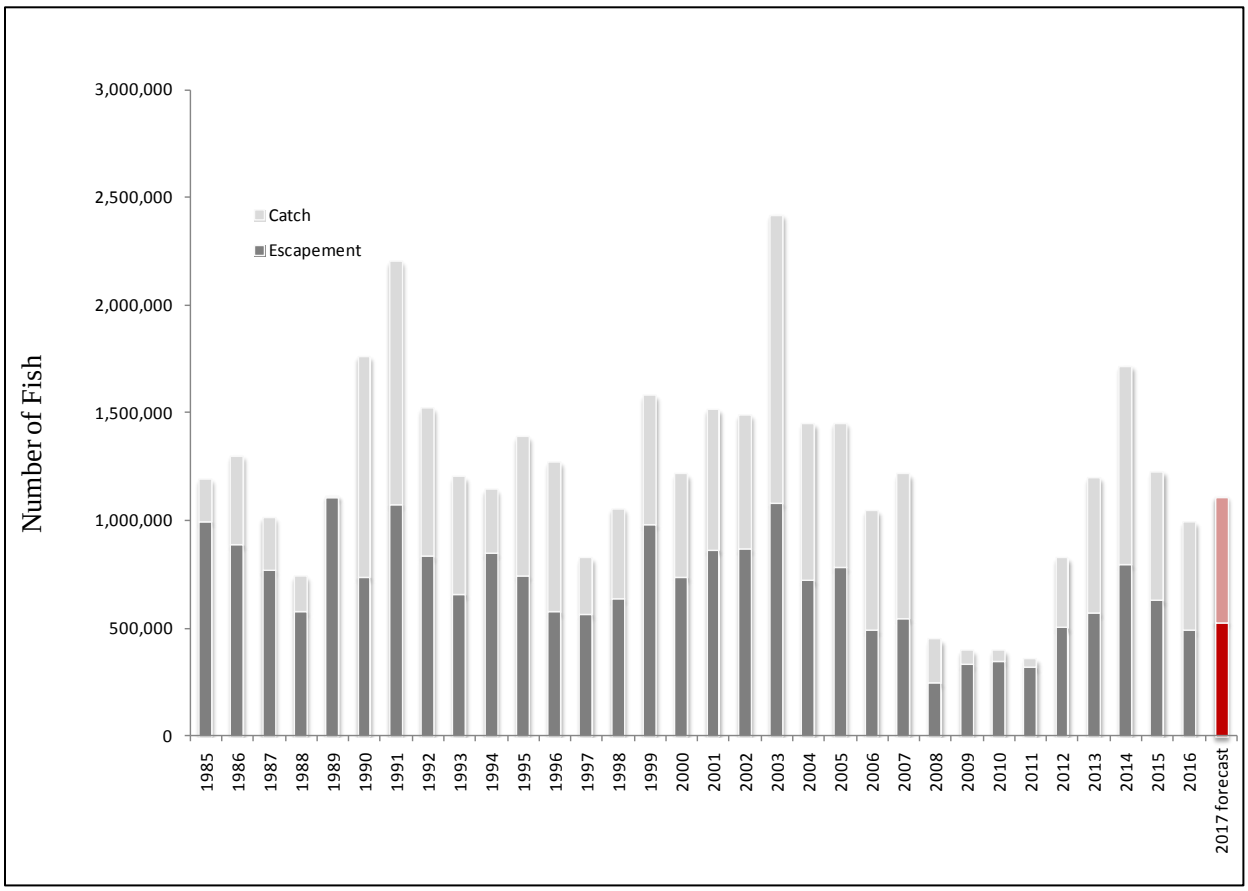

Figure 1.–Karluk River sockeye salmon annual run (combined early and late) estimates showing catch and escapement by year 1985–2016, and the 2017 forecast

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 2017 run.

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Upper Station	Total Run Estimate	125	69–182
	Escapement Goal [a]	65	43–93
	Harvest Estimate [b]	60	
Late Upper Station	Total Run Estimate	215	101–328
	Escapement Goal	186	120–265
	Harvest Estimate [b]	29	
Frazer Lake	Total Run Estimate	237	113–361
	Escapement Goal [c]	137	95–190
	Harvest Estimate [b]	100	
Total Alitak District	Total Run Estimate	577	283–870
	Escapement Goal	388	258–548
	Harvest Estimate [b]	189	

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

[a] Upper Station early run has a biological escapement goal of 43,000–93,000 fish. BOF instituted an optimal escapement goal of 25,000 fish in 1999, which was amended from 2014–2016 to 30,000 fish. This is in effect only if ADF&G determines that the upper end of the Frazer system sockeye salmon escapement goal will be exceeded.

[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.

[c] The Frazer Lake escapement goal (75,000–170,000) is increased by an additional 20,000 fish, which is the 20-year median of the number of fish that pass through Dog Salmon weir but do not ascend the Frazer Lake fish pass. This value is also applied to the estimate of S_{MSY}.

Forecast Methods

The 2017 sockeye salmon run to the Alitak District was forecasted with 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 (early-run outmigration years, 1988–2014 and 1988–2013; late-run outmigration years, 1999–2014 and 1999–2013). 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-.2 salmon were predicted using prior year age-.1 returns (outmigration years, 2001–2015), seasonal average 3-meter lake temperature, Kodiak airport March precipitation, and July zooplankton biomass in a multiple regression model. Environmental variables were lagged to correspond to the rearing period in Frazer Lake as an age-2 fish. Frazer age-.3 salmon were predicted using prior year age-.2 returns (outmigration years, 2003–2013). Frazer age-.1 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 2017.

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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.

Forecast Discussion

The 2017 sockeye salmon run to the Alitak District is expected to be approximately 577,000 fish, approximately 58,000 less fish than the recent 10-year average run (634,000) and 80,000 more than the 2016 run (497,000). The Upper Station early run is expected to be approximately 125,000 fish, which exceeds the recent 10-year average run (61,000). The Upper Station late run is expected to be approximately 215,000 fish, which is below the recent 10-year average run (228,000). The Frazer Lake run is expected to be approximately 237,000 fish, which is below the recent 10-year average (345,000). The 2017 Alitak District sockeye salmon run should be composed of approximately 67% age-.2 fish, 25% age-.3 fish, and 7% 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 189,000 fish 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 fish (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.

Michelle Wattum and Heather Finkle, Finfish Research Biologists, Kodiak

APPENDIX F: CHIGNIK

Forecast Area: Chignik

Species: Sockeye Salmon

Preliminary Forecast of the 2017 run.

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run (Black Lake)	Total Run Estimate	1,266	319–2,213
	Escapement Goal [a]	400	350–450
	Harvest Estimate [b]	866	
Late Run (Chignik Lake)	Total Run Estimate	938	456–1,420
	Escapement Goal [a]	338	275–400
	Harvest Estimate [b]	600	
Total Chignik System	Total Run Estimate	2,204	775–3,634
	Harvest Estimate [b]	1,466	
	Chignik Area	1,190	
	SEDM Area	90	
	Cape Igvak Section	186	

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

[a] Represents the midpoint of the escapement goal range.

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

Forecast Methods

Simple linear regression models using age class relationships were used to forecast the 2017 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 class returns that could not be estimated with statistical models were estimated using pooled medians; median prediction intervals were calculated from the 10th and 90th percentiles of the data.

For the early run, prior year age-.2 returns predicted age-.3 returns using data from the 1988 outmigration year to the present. Prior year early-run age-.1 returns predicted age-.2 returns (outmigration years 1998 to present). For the late run, prior year age-.2 sockeye salmon returns predicted age-.3 returns using data from the 1999 outmigration year to the present. Prior year age-.1 early- and late-run returns were combined to predict late-run age-.2 returns (outmigration years 1988 to present).

The early- and late-run regression and median estimates were summed to estimate the total Chignik River sockeye salmon run for 2017. The prediction interval range was 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 and upper prediction bounds of the 2 runs.

Forecast Discussion

The 2017 Chignik sockeye salmon early run is forecasted to be 1.27 million fish, which is 53,000 less than the 10-year average run of 1.32 million and 120,000 less than the 2016 early run of 1.39 million fish. The early run is predicted to be approximately 85% age-.3 and 15% age-.2 fish. The late run is forecasted to be 938,000 fish, which is approximately 200,000 fish less than the 10-year average run of 1.14 million fish and 236,000 less than the 2016 late run of 1.17 million fish.

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The 2017 late run is predicted to be composed of approximately 81% age-.3, 18% age-.2, and 1% age-.1 and -.4 fish. The 2017 total Chignik sockeye salmon run is expected to be 2.20 million fish, which is approximately 253,000 less than the 10-year average of 2.46 million fish and 356,000 less than the 2016 total run of 2.56 million fish.

Inseason genetic estimates of each run were used to manage the fishery in 2016 and will continue to be used in 2017. The projected 2017 early-run total harvest estimate of 866,000 fish is based on achievement of the midpoint of the early-run escapement goal range. The projected late-run harvest estimate of 600,000 fish is based on achieving the midpoint (338,000 fish) of the late-run goal, which includes the inriver run goal of 75,000 fish added to the lower bound (200,000 fish) of the escapement goal. Sockeye salmon harvest estimates for both runs include fish harvested in the Chignik Management Area, Chignik-bound fish harvested in the Cape Igvak Section of the Kodiak Management Area, and fish harvested in the Southeastern District Mainland of the Alaska Peninsula Management Area.

The wide confidence intervals around the point estimate of the 2017 forecasts reflect the uncertainty inherent in the forecast models. 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 corroborated 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 fair.

Heather Finkle, Finfish Research Biologist, Westward Region

APPENDIX G: BRISTOL BAY

Forecast Area: Bristol Bay

Species: Sockeye Salmon

Forecast of the 2017 run.

Total Production	Forecast (millions)	Forecast Range (millions)
Total Run	41.47	31.20–51.73
Escapement	12.46	
Commercial Common Property Harvest	29.01	
Bristol Bay Harvest	27.47	
South Peninsula Harvest	1.53	
Inshore Run	39.93	

Forecast Methods

The 2017 Bristol Bay sockeye salmon forecast is the sum of individual predictions of 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 1972–2013 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 the most recent 3-year (2014–2016) and 5-year (2012–2016) windows.

The forecast range is the upper and lower values of the 80% confidence interval for the total run forecast. The confidence bounds were calculated from the deviation of actual runs and run forecasts from 2001 through 2016.

Forecast Results

A total of 41.47 million sockeye salmon (range 31.20–51.73 million) are expected to return to Bristol Bay in 2017. This is virtually identical to the most recent 10-year average of Bristol Bay total runs (41.39) and 27% greater than the long-term mean of 32.76 million fish. All systems are expected to meet their spawning escapement goals.

Where practical, the department will manage escapements proportional to the run size and relative to the historical record (5AAC 06.355(d)(1)). Escapement is projected to be the midpoint of the upper half of the escapement goal range if the forecast is above the historical trend line (Ugashik, Egegik, and Wood Rivers in 2017) or to the midpoint of the lower half of the escapement goal range if the forecast is below the historical trend line (Igushik, Nushagak, Naknek, Kvichak, and Togiak Rivers in 2017; Table G1). Because it is passively managed, the Alagnak River exploitation rate is assumed to be the same as the Kvichak River exploitation rate; therefore, the escapement is projected to be the total run forecast minus expected harvest. Preseason projections are provided to aid industry in planning. Once the run begins to develop, the department relies on catch and escapement data for management decisions.

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A run of 41.47 million sockeye salmon would allow for a potential total harvest of 29.01 million fish: 27.47 million fish in Bristol Bay and 1.53 million fish in the South Peninsula fisheries. A Bristol Bay harvest of this size is 2% lower than the most recent 10-year harvest which has ranged from 15.43 million to 37.53 million, and 34% greater than the long-term harvest average of 20.52 million fish (1963 to present).

The run forecast to each district and river system is as follows: 16.07 million to Naknek-Kvichak District (7.76 million to the Kvichak River, 4.04 million to the Alagnak River, and 4.27 million to the Naknek River); 10.65 million to the Egegik District; 5.46 million to the Ugashik District; 8.62 million to the Nushagak District (5.50 million to the Wood River, 1.87 million to the Nushagak River, and 1.25 million to the Igushik River); and 0.66 million to the Togiak District (Table G1).

We forecast the 2017 run will consist of 12.05 million age-1.2 fish (29% of the total run), 9.35 million age-2.2 fish (23% of the total run), 16.50 million age-1.3 fish (40% of the total run) and 3.50 million age-2.3 fish (8% of the total run; Table G1).

Forecast Discussion

Historically, sockeye salmon runs to Bristol Bay have been highly variable. The Bristol Bay total run has averaged 32.76 million from 1963 through 2016 and has averaged 41.39 million fish during the most recent 10-year period. 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. Since 2001, our forecasts have, on average, underforecasted the run by 10% and have ranged from 44% below actual run in 2014 to 19% above actual run in 2011. Forecasted harvests have had a mean absolute percent error of 15% since 2011.

Individual river forecasts have greater uncertainty compared to Bay-wide forecasts. Since 2001, on average, we have underforecasted the returns to the Alagnak (–48%), Togiak (–20%), Kvichak (–22%), Wood (–9%), Nushagak (–10%), and Naknek (–5%) rivers, and overforecasted returns to Igushik (+15%), Egegik (+18%), and Ugashik rivers (+2%). Overforecasting returns to some rivers while underforecasting returns to other rivers means that the overall Bristol Bay forecast is generally more accurate than the forecast to any individual river.

ADF&G would like to thank the following organizations for funding assistance and operating fishery monitoring programs: Bristol Bay Regional Seafood Development Association, Bristol Bay Economic Development Corporation, Bristol Bay Regional Science and Research Institute , Trident, Choggiung Limited, Peter Pan, Manokotak Village Council, Bristol Bay Native Association, Dylan Braund, Togiak Traditional Council, Twin Hills Village Council, North Pacific Seafoods, American President Line, and Copper River Seafoods. Bristol Bay Regional Seafood Development Association contributed $225,000 towards management of 2016 Bristol Bay commercial fisheries. Without this contribution operational funds to manage the fishery would have been obtained through cost-recovery test fishing. The Bristol Bay management program budget has been reduced 17% over the last 2 years and ADF&G anticipates additional cuts in 2017. A Memorandum of Agreement has been signed by ADF&G and Bristol Bay Regional Seafood Development Association to explore alternative future funding strategies.

Greg Buck, Bristol Bay Area Research Biologist

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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 2017.

	Millions of Sockeye Salmon								
DISTRICT	Forecast Production by Age Class					Forecast			
River	1.2	2.2	1.3	2.3	Total	Escapement	Harvest	South Peninsula [a]	BB Inshore
NAKNEK-KVICHAK									
Kvichak	2.42	2.92	2.00	0.42	7.76	4.00	3.47	0.29	7.47
Alagnak	1.43	0.81	1.61	0.20	4.04	2.09	1.81	0.15	3.89
Naknek	2.08	0.60	1.16	0.44	4.27	1.10	3.01	0.16	4.11
Total	5.92	4.33	4.77	1.05	16.07	7.19	8.29	0.59	15.48
EGEGIK	0.77	4.38	3.63	1.87	10.65	1.70	8.56	0.39	10.26
UGASHIK	1.69	0.45	2.86	0.47	5.46	1.18	4.09	0.20	5.26
NUSHAGAK									
Wood	2.97	0.15	2.33	0.05	5.50	1.53	3.77	0.20	5.29
Igushik	0.34	0.01	0.89	0.02	1.25	0.21	0.99	0.05	1.21
Nushagak	0.25	0.00	1.52	0.02	1.87 [b]	0.50	1.30	0.07	1.80
Total	3.55	0.16	4.74	0.09	8.62	2.24	6.06	0.32	8.30
TOGIAK	0.12	0.02	0.49	0.02	0.66	0.16	0.48 [c]	0.02	0.63
BRISTOL BAY	12.05	9.35	16.50	3.50	41.47	12.46	27.47	1.53	39.93
	29%	23%	40%	8%	100%				

Note: This table summarizes the forecast of sockeye salmon in millions of fish. Small differences may be observed 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] Nushagak River forecast includes age-0.3 (119) and age-1.4 (78,346) fish.

[c] 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, Bear Lake (Late Run)

Species: Sockeye Salmon

Preliminary forecast of the 2017 run.

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	450	233–667
Escapement Goal [a]	156	117–195
Harvest Estimate	294	

[a] The escapement estimate is the midpoint of the escapement goal range (117,000–195,000) in 2017.

Forecast Methods

The 2017 forecast of the Bear Lake sockeye salmon late run was prepared using simple linear regressions of sibling age classes and environmental data. 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 since the 1991 brood year to the present. Age-.2 sockeye salmon returns were predicted by linear regression, comparing returns with the winter air temperatures in Cold Bay during the year of outmigration of the predominant 2.2 age class from 1993 until present. Yearly winter air temperature was calculated as the November through March average. 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 2017. 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 2017 Bear Lake late-run forecast of 450,000 sockeye salmon is 19,000 fewer than the 10-year average of approximately 469,000 fish and 117,000 more than the 2016 run of 333,000 fish. The 2016 late run is expected to be composed of 4% age-.1, 75% age-.2, 21% age-.3, and 0.1% age-.4 fish. The projected harvest of 294,000 fish is based on achieving the midpoint of the late-run escapement goal range (156,000 fish) 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. Bear River late-run sockeye salmon returns have shown a general decline in total run since 1990. The wide range around the point forecast is a result of large fluctuations in age-2.2 salmon returns in the last 2 years. Over the last 10 years, age-2.2 fish have averaged of 54% of the annual run, but that number 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.

Reid Johnson, Fishery Biologist, Alaska Peninsula

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Forecast Area: Alaska Peninsula/Aleutian Islands Management Area, Nelson River

Species: Sockeye Salmon

Preliminary forecast of the 2017 run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	585	303–868
Escapement goal [a]	158	97–219
Harvest estimate	427	

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 2017.

Forecast Methods

The 2017 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 28 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 predominant age-2.2 fish from 1984 to 2011, and averaged the November temperature of year prior to and temperature of year of outmigration as juveniles. Age-.3 sockeye salmon returns were predicted by simple linear regression from prior year age-.2 returns from 1992 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 2017. 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 2017 Nelson River forecast of 585,000 fish is about 196,000 more than the most recent 10-year average (2006–2015) of 389,000 fish and is approximately 16,000 less than the 2016 run of about 602,000 fish. The 2017 run should be composed mainly of age-.2 (67%) and -.3 (32%) 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 427,000 fish is based on achieving the midpoint (158,000 fish) of the escapement goal range.

Reid Johnson, Fishery Biologist, Alaska Peninsula

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Forecast Area: Alaska Peninsula, South Alaska Peninsula Aggregate

Species: Pink Salmon

Preliminary forecast of the 2017 run.

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
Total Run Estimate	15.6	11.4–19.8
Escapement Goal [a]	4.0	1.8–4.0
Harvest Estimate	11.6	9.7–15.8

[a] The escapement estimate is the upper end of the aggregate goal range (1.8–4.0 million) in 2017.

The 2017 South Alaska Peninsula predicted pink salmon harvest is expected to be in the *excellent* category with a point estimate of 11.6 (9.7–15.8) million fish. Harvest categories were calculated from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest on the South Alaska Peninsula from 1984 to 2016.

S. Pen Harvest Category	Range (millions)	Percentile
Poor	Less than 2.4	Less than 20th
Weak	2.5 to 4.3	21st to 40th
Average	4.4 to 7.4	41st to 60th
Strong	7.5 to 9.6	61st to 80th
Excellent	Greater than 9.6	81st to 100th

Forecast Methods

The 2017 South Alaska Peninsula pink salmon harvest forecast is derived from a total run forecast minus the upper end (4.0 million fish) of the combined even- and odd-year South Alaska Peninsula escapement goal range. The total run was forecasted with a simple linear regression model using the average air temperature in Cold Bay between emergence (April) and early ocean survival (November). The regression model was fit to odd-year South Peninsula pink salmon returns from 1997 through 2013. The range was estimated as the 80% prediction intervals based on the error structure of the regression.

Forecast Discussion

The 2017 South Alaska Peninsula pink salmon total harvest (11.6 million fish) is predicted to be excellent. Although forecasts of pink salmon returns to the South Alaska Peninsula have only been published since 2011, odd-year forecasts of pink salmon on the South Alaska Peninsula have generally been more accurate than even years. However, changing ocean conditions and average temperatures outside the ranges used in the historical dataset mean that the model's predictive power may be diminished. The largest potential source of uncertainty in anticipated returns of pink salmon may be warm sea surface temperatures that have persisted in the Gulf of Alaska over the past several winters. Pink salmon that migrated to sea in 2015 returned in numbers well below forecasted returns, and it is likely that pink salmon that went to sea in 2016 experienced similar conditions.

The wide confidence intervals around the point estimate of the 2017 forecasts reflect the uncertainty inherent in the forecast models. Due to the relative strength in the regression model, but accounting for uncertainty in changing ocean changes, confidence in the forecast is good.

Mary Loewen, Alaska Peninsula–Aleutian Islands Asst. Area Management Biologist

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. While 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 US/Canada Yukon River Panel in the spring of 2017.

In the AYK Region, salmon production notably decreased for many stocks from 199 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 the Sustainable Salmon Fisheries Policy.

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 using surface trawls to capture juvenile salmon 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. It is expected that the age-5 and age-6 components of the 2017 Chinook salmon run will be strong, based on robust juvenile abundance in 2014 and strong age-4 and age-5 returns in 2016. Current projections of Canadian-origin Yukon River Chinook salmon indicate increasing abundance should be expected over the next 3 years. The 2017 projection is for a run size similar to, or better, than 2016, which should meet escapement objectives and provide for subsistence harvest opportunity, but would still be below average.

In general, management for anticipated low Chinook salmon abundance in 2017, 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 2017 commercial harvest outlook by management area, in thousands of fish.

	Salmon Species					
Management Area	Chinook	Sockeye	Coho	Pink	Chum	Fall Chum
Kuskokwim River						
Kuskokwim Bay						
Kuskokwim Area Total[a]						
Yukon	0	0	60-200	0	1,200–1,500	850–1,100
Norton Sound	0–2	3–5	90–120	50–75	50–80	
Kotzebue Sound					250–450	

[a] There is not anticipated to be a commercial buyer in the Kuskokwim area in 2017.

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Forecast Area: Yukon Area

Species: Fall Chum Salmon

Preliminary Forecast of the 2017 run.

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	1,560	1,400–1,700
Escapement Goal	450	300–600
Harvest Estimate[a]	1,110	950–1,250

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

Forecast Methods

The forecast for the 2017 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 was used from the complete brood years 1974 to 2010, production from incomplete brood years 2011 and 2012 was estimated based on return per spawner from brood year returns, and an auto-regressive Ricker model was used to predict returns from the 2013 and 2014 parent years.

Predicted returns were multiplied by corresponding average maturity schedules for odd and even-numbered parent years to estimate 2017 run size, and rounded to the nearest thousand fish. The odd/even maturity schedule from 1974 to 2010 was used to estimate the 2017 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 2016.

The 2017 projected run size of fall chum salmon for the Yukon Area is approximately 1.56 million fish. This forecast is above average for odd-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 2017 forecast range from 1.4 million to 1.7 million 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), provide an average subsistence harvest, and a surplus for commercial harvest.

Drainagewide escapements between 300,000 and 600,000 provide a mean yield of 446,000 fall chum salmon. The mean subsistence harvest from 2005 to 2015 for Alaskan subsistence and Canadian aboriginal harvests is 92,000 fall chum salmon. Commercial harvests may be allowed on the amount above 550,000 fish 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 fish and an available commercial harvest between 850,000 and 1.15 million fish. 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 1.56 million fall chum salmon is expected to be composed of 63% age-4 and 35% 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 even-odd abundance cycle (averaging >1.1 million in odd-numbered years and 829,000 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 thought to be primarily due to conditions in the marine environment, although density dependence may also be a cause in some years. The effect of the even-odd 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 2017, 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 37 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, 50% of the observed runs were within the range, 22% were below, and 28% were above. Returns of age-4 fish in odd-numbered years are typically 15% higher than even-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. Productivity was at its lowest in 2005 with the most recent peak in the 2009 brood year (2.39 R/S). However the R/S for the 2012 brood year appears to be exceptional (R/S of 2.64, ranking the fourth highest on record) and production is estimated to be well above replacement. The forecasted run in 2017 is predicting an average R/S of 1.7 for the age-4 component from brood year 2013; however, there is concern that there could be decreased productivity, as escapements over 800,000 rarely produce any yield. If density dependence is a factor, the run size would be expected to be slightly below the forecast range. The 2017 point estimate of 1.56 million fall chum salmon should be dominated by the age-4 component; however, the age-5 return is forecasted to contribute a higher than average proportion of the run. The forecasted run size of 1.56 million fall chum salmon would provide for a commercial harvest of nearly 1.0 million fish based on the current management plan.

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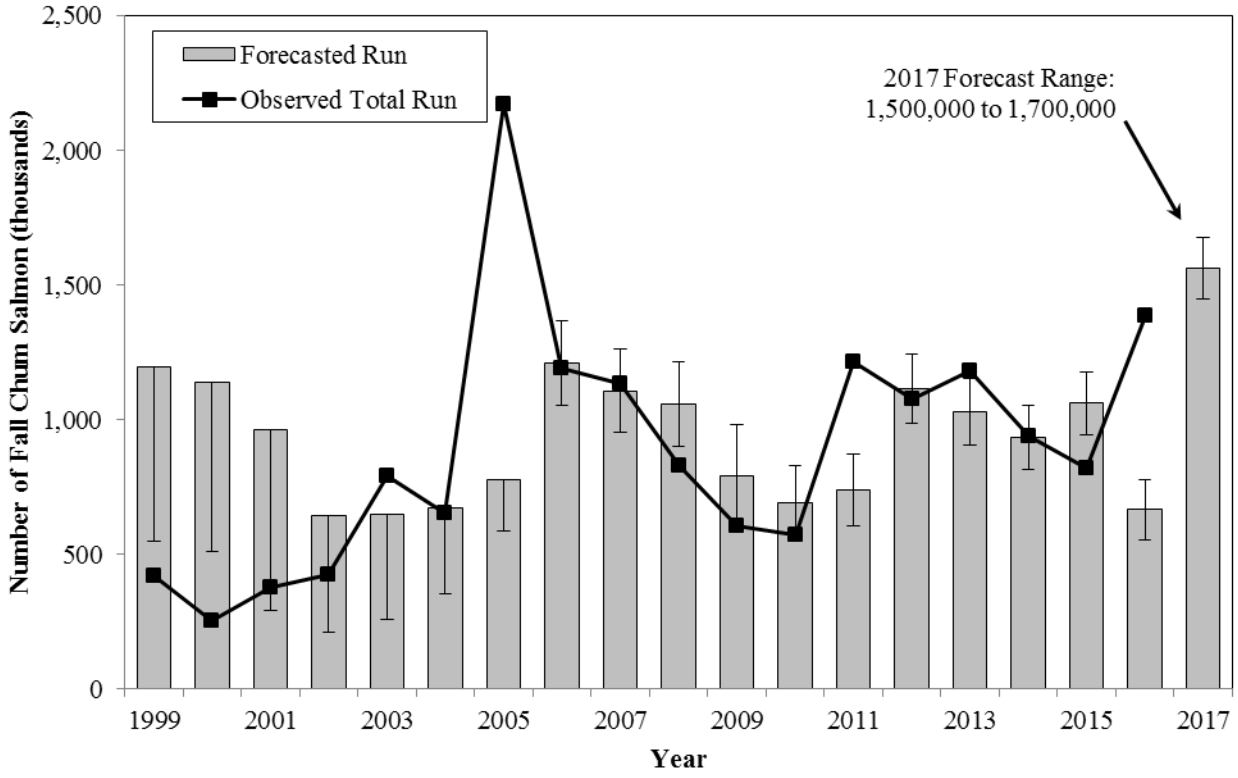

Figure I1.–Observed total run of fall chum salmon compared to the spawner-recruit estimates used in the annual forecast, Yukon River, 1999–2017.

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

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