Special Publication 21-07

Run Forecasts and Harvest Projections for 2021 Alaska Salmon Fisheries and Review of the 2020 Season

Edited by

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March 2021

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

Symbols and Abbreviations

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

Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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RUN FORECASTS AND HARVEST PROJECTIONS FOR 2021 ALASKA SALMON FISHERIES AND REVIEW OF THE 2020 SEASON

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

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DEFINITION OF TERMS

Biological escapement goal	The number of salmon in a particular stock that the Alaska Department of Fish and Game has determined should be allowed to escape the fishery to spawn to achieve the maximum yield (human use). This determination is based on biological information about the fish stock in question. See 5 AAC 39.222(f)(3). (Also see *optimum escapement goal*.)
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.
Commercial harvest	Harvests of fish that are used for commercial purposes. This includes fish caught by the commercial common property fishery and by hatchery operators for cost recovery; it excludes sport, subsistence, and personal use harvests.
Common property harvest	Harvests taken by the commercial common property fisheries, 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.
Enhanced salmon stock, 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. See 5 AAC 39.222(f)(9).
Escapement, spawning population, or broodstock	The portion of a salmon run that is not harvested and survives to reach the spawning grounds or hatchery. See 5 AAC 39.222(f)(10)).
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 both achieve sustainable runs based on biological needs of the stock and meet social and allocative needs. See 5 AAC 39.222(f)(25).
Return	Return refers to an aggregation of salmon over several or more years that represent the surviving adult offspring from a single brood year. See 5 AAC 39.222(f)(30).
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. See 5 AAC 39.222(f)(31).
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. See 5 AAC 39.222(f)(36).

ABSTRACT

This report contains a detailed review of Alaska's 2020 commercial salmon season and harvest forecasts for 2021. The Alaska all-species salmon harvest for 2020 totaled 118.3 million, about 14.4 million fewer fish than the preseason forecast of 132.7 million fish. This combined harvest was composed of 272,000 Chinook salmon *Oncorhynchus tshawytscha*, 46.4 million sockeye salmon *O. nerka*, 2.4 million coho salmon *O. kisutch*, 60.7 million pink salmon *O. gorbuscha*, and 8.6 million chum salmon *O. keta*. The Alaska Department of Fish and Game is expecting an increase in commercial salmon harvests in 2021. The 2021 total commercial salmon harvest (all species) projection of 190.1 million is expected to include 269,000 Chinook salmon, 46.6 million sockeye salmon, 3.8 million coho salmon, 124.2 million pink salmon, and 15.3 million chum salmon. Compared to 2020 commercial harvests, the projected 2021 commercial harvests are expected to be as follows: 63.5 million more pink salmon, 203,000 more sockeye salmon, 1.4 million more coho salmon, and 6.7 million more chum salmon.

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 2021 as well as a detailed review of Alaska's 2020 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 2021, mostly due to an increase in pink salmon *Oncorhynchus gorbuscha* harvests compared to 2020. The 2021 total commercial salmon harvest (all species) projection of 190.1 million is expected to include 269,000 Chinook salmon *O. tshawytscha*, 46.6 million sockeye salmon *O. nerka*, 3.8 million coho salmon *O. kisutch*, 124.2 million pink salmon, and 15.3 million chum salmon *O. keta*. Compared to 2020 commercial harvests, the projected 2021 commercial harvests are expected to be as follows: 63.5 million more pink salmon, 203,000 more sockeye salmon, 1.4 million more coho salmon, and 6.7 million more chum salmon. We note that—except for Southeast Alaska—pink salmon forecasts are generally based on average returns from previous brood years. The pink salmon harvest forecast for 2021 is partly an artifact of this method; there is a great deal of uncertainty in predicting pink salmon returns.

Table 1 shows specific harvest projection numbers by species and fishing area. 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 survival rates for hatchery releases. Other projections were based on averages of recent harvests. Fishing effort influences harvests, 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 harvests.

Except for 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 harvest projections.

Table 1.–Projections of 2021 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		784[a]	1,314[a]	28,000	1,078	31,177
Hatchery production[b]	[c]	99	626	288	7,907	8,920
Southeast Region Total	191[c]	883	1,940	28,288	8,985	40,288
Prince William Sound						
Natural production	8	842[d]	323[a]	17,349	308	18,831
Hatchery production[e]		1,218	193	37,508	1,954	40,873
Lower Cook Inlet						
Natural production	1[a]	133[a]	6	1,851	34[a]	2,024
Hatchery production		380[f]	29	846		1,256
Upper Cook Inlet	5[a]	1,640	191[a]	74[a]	127[a]	2,037
Bristol Bay	31[a]	34,560	137[a]	9[g]	1,169[a]	35,906
Central Region Total	46	38,773	879	57,637	3,592	100,927
Kodiak						
Natural production	7[a]	1,808[h]	301[a]	11,636	646[a]	14,398
Hatchery production[i]		215	118	10,868	88	11,289
Chignik	6[a]	165[j]	114[a]	2,657[g]	177[a]	3,119
South Peninsula & Aleutians	17[a]	1,943[a]	299[a]	12,930	1,090[a]	16,279
North Alaska Peninsula	2[a]	2,789[k]	55[a]	143[g]	124[a]	3,113
Westward Region Total	32	6,919	887	38,234	2,125	48,198
Arctic-Yukon-Kuskokwim Total	1	2	100	50	570	353
Statewide Total	269	46,577	3,807	124,210	15,272	190,135

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

[a] Average harvest of the previous five years (2016–2020).

[b] Hatchery salmon 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 (5-year average) and excess. Wild chum salmon catch estimated as 12% of total catch.

[c] The allowable catch of Chinook salmon in Southeast Alaska is determined by the Pacific Salmon Commission, which agreed to a Southeast Alaska all-gear commercial harvest quota of 163,980 Chinook salmon during 2021. Also includes an average of 27,430 "add on" harvest of fish from Alaska hatcheries. More information available here: https://www.adfg.alaska.gov/index.cfm?adfg=pressreleases.pr&release=2021_02_05.

[d] Includes natural harvest estimates for Prince William Sound and Copper/Bering River district sockeye salmon.

[e] Hatchery salmon projections made by Prince William Sound Aquaculture Corporation and Valdez Fisheries Development Association. Gulkana Hatchery projection made by ADF&G, less broodstock (5-year average).

[f] Hatchery salmon projections made by Cook Inlet Aquaculture Corporation minus broodstock (5-year average).

[g] Average of previous 5 odd-year harvests (2011–2019).

[h] Total Kodiak harvest of natural run sockeye includes projected harvests from formally forecasted systems, projected Chignik harvest at Cape Igvak, and projected harvest from additional minor systems.

[i] Hatchery projections made by Kodiak Regional Aquaculture Association (KRAA), minus estimates of broodstock. Sockeye salmon hatchery projections include enhanced Spiridon Lake sockeye salmon run harvest forecast and other KRAA projections.

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

[k] Five-year average harvest (2016–2020); includes formal forecasts for Bear late run and Nelson River sockeye salmon stocks.

The Alaska all-species salmon harvest for 2020 totaled 118.3 million fish, about 14.4 million fewer fish than the preseason forecast of 132.7 million fish. This combined harvest was composed of 272,000 Chinook, 46.4 million sockeye, 2.4 million coho, 60.7 million pink, and 8.6 million chum salmon. Table 2 shows 2020 harvest numbers by salmon species and fishing area in units of thousands of fish harvested, and Table 3 provides this information in units of thousands of pounds harvested. Tables 4–7 provide detailed information on the 2020 harvest by area and species.

Table 2.–2020 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,b]	215	458	1,163	8,083	4,696	14,615
Prince William Sound[a]	7	942	289	23,004	2,017	26,258
Lower Cook Inlet[c,d]	1	181	4	2,516	14	2,716
Upper Cook Inlet[d]	3	696	139	345	29	1,212
Bristol Bay	10	39,580	114	72	293	40,069
Central Region Total	20	41,399	547	25,937	2,353	70,255
Kodiak Area	8	1,524	441	21,551	368	23,892
Chignik						
South Peninsula and Aleutians	21	1,069	183	5,050	913	7,237
North Peninsula	1	1,780	48	30	56	1,916
Westward Region Total	31	4,373	672	26,632	1,138	33,045
Arctic-Yukon-Kuskokwim Region Total[d]	6	145	55	13	200	418
Total Alaska	272	46,375	2,437	60,665	8,587	118,333

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

Note: Columns may not total exactly due to rounding.

[a] Chinook salmon adults and jacks are totaled.

[b] Catch accounting period for the 2020 Chinook salmon troll season goes from October 1, 2019, to September 30, 2020.

[c] Does not include broodstock.

[d] Total includes commercially harvested fish retained for homepack.

Table 3.–2020 Alaska commercial salmon harvests, by fishing area and species, in thousands of whole lb.

	Species					
Fishing area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region Total[a,b]	2,915	2,355	7,975	28,439	35,102	76,786
Prince William Sound[a]	93	4,359	2,396	82,764	15,073	104,685
Lower Cook Inlet[c,d]	43	4,382	853	10,697	366	16,341
Upper Cook Inlet[d]	37	3,482	828	1,284	227	5,859
Bristol Bay	97	202,726	628	237	1,790	205,477
Central Region Total	269	214,948	4,706	94,982	17,456	332,362
Kodiak Area	48	7,024	3,138	74,083	2,505	86,797
Chignik						
South Peninsula and Aleutians	111	5,102	1,129	15,230	5,076	26,648
North Peninsula	22	9,463	324	100	403	10,311
Westward Region Total	180	21,589	4,590	89,414	7,983	123,756
Arctic-Yukon-Kuskokwim Region Total[d]	58	778	409	27	1,566	2,837
Total Alaska	3,422	239,670	17,680	212,861	62,106	535,741

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

Note: Columns may not total exactly due to rounding.

[a] Chinook salmon adults and jacks are totaled.

[b] Catch accounting period for the 2020 Chinook salmon troll season goes from October 1, 2019, to September 30, 2020.

[c] Does not include broodstock.

[d] Total includes commercially harvested fish retained for homepack.

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 commercial 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.

Although 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 2020 commercial salmon season. We normally release it before final catch figures are available to provide preliminary information to the Alaska Board of Fisheries, 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.

REVIEW OF THE 2020 ALASKA COMMERCIAL SALMON FISHERIES

SOUTHEAST REGION

SOUTHEAST ALASKA AND YAKUTAT AREAS

The combined 2020 Southeast Alaska and Yakutat area cumulative commercial salmon harvest, including hatchery cost recovery, was 14.6 million fish (Table 4). Total common property commercial harvest was 11.5 million fish (79% of the total harvest). The 2020 overall harvest, in numbers of salmon, was approximately 56% lower than the 2019 overall harvest (just under 33.5 million fish). The total commercial salmon harvest proportions by species were Chinook 1%, sockeye 3%, coho 8%, pink 55%, and chum salmon 32%. The 2020 combined-gear Chinook salmon harvest of 215,000 fish was 77% of the most recent 10-year average and 74% of the long-term average. The sockeye salmon harvest of 458,000 fish was 41% of the recent 10-year average and 35% of the long-term average. The coho salmon harvest of approximately 1.2 million fish was 46% of the recent 10-year average and 54% of the long-term average. The pink salmon harvest of 8.1 million fish was 23% of the 10-year average and 27% of the long-term average. The chum salmon harvest of 4.7 million fish was 45% of the 10-year average and 76% of the long-term average. The all-species total harvest was 29% of the recent 10-year average and 36% of the long-term average.

Chinook Salmon

Harvest Summary: The 2020 Chinook salmon harvest of 215,000 fish was below both the recent 10-year and long-term averages and is the 5th lowest harvest over the last 58 years. The average annual total Chinook salmon harvest since 1962 is 287,000 fish. Preliminary harvests of coastwide Chinook salmon accountable under the Pacific Salmon Treaty included 165,000 fish by troll gear, 5,500 fish by purse seine gear, and 3,000 fish by gillnet gear. In 2020, a total of 36,000 (15% of total Chinook salmon harvests) hatchery-origin Chinook salmon were commercially harvested in Southeast Alaska/Yakutat, and 5,670 hatchery-origin Chinook salmon were harvested in private hatchery cost-recovery fisheries.

Sockeye Salmon

Harvest Summary: The 2020 harvest of sockeye salmon was 458,000 fish. This was below both the recent 10-year average of 1.1 million fish and the long-term average of 1.3 million fish. The 2020 sockeye salmon harvest ranks 57th of the 58 years since 1962. The Southeast Alaska Area purse seine fishery harvest of 237,000 fish was below the recent average and long-term averages and accounted for 52% of the regional total harvest. The drift gillnet fishery harvest of 102,000 fish was below the recent and long-term averages, the lowest harvest since at least 1962, and accounted for 22% of the regional total harvest. The set gillnet fishery harvest of 26,000 fish was below the recent and long-term averages, the lowest harvest since at least 1962, and accounted for 6% of the regional total harvest.

Coho Salmon

Harvest Summary: The 2020 coho salmon harvest was 1.2 million fish. This harvest was lower than both the long-term and recent averages and ranks 48th since 1962. The coho salmon harvest in the troll fishery was approximately 751,000 fish. This was below both the long-term and recent averages and accounted for 65% of the total harvest. Purse seine, drift, and set gillnet harvests of coho salmon were below long-term and recent averages.

Pink Salmon

Harvest Summary: The 2020 commercial pink salmon harvest was 8.1 million fish, 55% of the total regional salmon harvest. The purse seine pink salmon harvest was approximately 6 million fish, 74% of the total Southeast Alaska/Yakutat harvest. This year's pink salmon harvest was below the recent and long-term averages and ranks 53rd since 1962.

Chum Salmon

Harvest Summary: The 2020 chum salmon harvest of just under 4.7 million fish was below the recent and long-term averages. Most chum salmon harvest 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 fish.

Table 4.–2020 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	6	233	64	5,367	417	6,087
Northern purse seine traditional	0	2	6	510	473	991
Hatchery terminal	12	2	7	82	1,124	1,228
Total purse seine	18	237	77	5,958	2,015	8,305
Drift gillnet						
Tree Point	2	9	20	186	136	354
Prince of Wales	1	11	44	128	144	328
Stikine	3	3	21	12	54	92
Taku-Snettisham	1	28	16	65	110	220
Lynn Canal	1	46	17	67	174	306
Drift gillnet hatchery terminal	12	4	6	43	445	511
Total drift gillnet	19	102	125	501	1,062	1,810
Set gillnet (Yakutat)	0	26	82	15	0	123
Troll						
Hand troll						
Traditional	4	0	22	2	0	28
Hatchery terminal	0		1	0	0	1
Spring areas	1		0		0	1
Total hand troll	5	0	23	2	0	30
Power troll						
Traditional	153	2	717	40	40	952
Hatchery terminal	1	0	11	1	39	51
Spring areas	11	0	0	0	0	12
Total power troll	165	2	728	41	79	1,015
Total troll	170	2	751	43	79	1,045
Annette Island Reservation						
Seine	0	12	2	381	19	414
Drift gillnet	1	2	6	149	57	214
Troll	0		0	0	0	0
Hand troll	0		0	0		0
Power troll	0		0		0	0
Trap						
Total Annette Island Reservation	1	15	8	530	76	629
Hatchery cost recovery	6	74	119	996	1,458	2,653
Miscellaneous[b]	0	2	1	40	7	50
Southeast Region Total	215	458	1,163	8,083	4,696	14,615

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 2020 Chinook salmon troll season goes from October 1, 2019, to September 30, 2020.

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

CENTRAL REGION

PRINCE WILLIAM SOUND AREA

The 2020 Prince William Sound (PWS) Area commercial salmon harvest was 26.3 million fish (Table 5). Overall harvest was composed of 6,878 Chinook, 941,807 sockeye, 288,617 coho, 23.0 million pink, and 2.0 million chum salmon. The 2020 harvest included 21.0 million (80%) commercial common property fishery (CCPF) fish, and just under 5.3 million (20%) hatchery cost-recovery and broodstock fish.

Chinook Salmon

Run and Escapement Summary: The 2020 preseason common property fishery (CPF) harvest forecast for the Copper River District was 36,000 Chinook salmon. Preliminary Chinook salmon abundance estimates indicate that spawning escapement was approximately 2,000 fish below the lower bound sustainable escapement goal (SEG) of 24,000 fish.

Harvest Summary: The commercial harvest of 6,878 Chinook salmon was the smallest commercial harvest since statehood and is approximately 50% below the 10-year average harvest of 13,400 fish.

Sockeye Salmon

Run and Escapement Summary: The 2020 preseason commercial harvest forecast for the Copper River District was 771,000 sockeye salmon. Gulkana Hatchery was projected to contribute 109,000 fish to this CCPF harvest projection.

The Miles Lake sonar passage estimate of 530,300 salmon was below the inriver goal of 661,000–1,050,000 fish. The final Copper River sockeye salmon escapement estimate was 355,000 fish, which was below the SEG range of 360,000–750,000 fish. Spawning escapement to Copper River Delta index systems based on aerial survey peak counts was 55,600 sockeye salmon, within the SEG range of 55,000–130,000 fish. The aerial escapement index of 15,700 sockeye salmon for the Bering River District was above the SEG range of 15,000–33,000 fish.

The 2020 forecast of the sockeye salmon run to Coghill Lake was 175,000 fish with 145,000 fish available for the CPF harvest. Approximately 53,800 sockeye salmon passed through the Coghill River weir, which is within the SEG range of 20,000–60,000 fish.

Prince William Sound Aquaculture Corporation (PWSAC) forecast a run of approximately 1.1 million Main Bay Hatchery enhanced sockeye salmon in 2020.

Harvest Summary: The Copper River had one of the weakest sockeye salmon runs on record with minimal fishing opportunity and the third smallest commercial harvest in the past 50 years. The sockeye salmon commercial harvest of 102,269 fish was 92% less than the 10-year harvest average of 1.3 million fish. The commercial sockeye salmon season was open for 84 hours in 2020 compared to 648 hours fished in 2019 (a near-average run). Sockeye salmon average weight of 5.1 lb was equal to the record small size seen in 2018 and 0.8 lb smaller than the 30-year average (1990–2019) of 5.9 lb. The number of wild sockeye salmon in the Copper River District commercial harvest was 87,224 fish or 85% of the total.

The CCPF drift gillnet harvest of sockeye salmon in the Coghill District was 111,000 fish. The proportion of wild sockeye salmon in the Coghill District CCPF harvest was 46%.

The CCPF harvest of sockeye salmon in the Eshamy District gillnet (drift and set) fishery was 449,894 fish, 57% below the forecast. The proportion of wild sockeye salmon in the Eshamy District CCPF harvest was 5%. PWSAC harvested approximately 168,900 sockeye salmon for cost recovery and used 9,700 of them for broodstock.

The Unakwik District CCPF harvest was 764 sockeye salmon which was below the 10-year average (2010–2019) of 3,152 fish.

Coho Salmon

Run and Escapement Summary: The 2020 preseason commercial harvest forecast for the Copper River District was 235,000 coho salmon. Copper River Delta peak escapement counts of 37,225 fish were within the SEG range of 32,000–67,000 fish. Bering River District coho salmon spawning escapement counts of 25,825 fish were within the SEG range of 13,000–33,000 fish.

PWSAC forecasted a 2020 run of 115,000 coho salmon to Wally Noerenberg Hatchery.

The Valdez Fisheries Development Association (VFDA) enhanced coho salmon forecast was 82,300 fish, yielding a projected CCPF harvest of 41,000 fish.

Harvest Summary: The season total drift gillnet coho salmon harvest in the Copper River District of 168,524 fish was 24% below the previous 10-year average (2010–2019) harvest of 222,200 fish. The Bering River District drift gillnet harvest of 64,712 coho salmon was above the previous 10-year average harvest of 63,000 fish.

The Coghill District drift gillnet coho salmon commercial harvest of 2,475 fish was 95% below the 10-year average of 49,600 fish. The CPF harvest was 98% below forecast and the 6th year out of the last 10 years with fewer than 15,000 coho salmon harvested.

Data for the estimated total VFDA coho salmon run are not yet available. The CCPF purse seine harvest of coho salmon in PWS was approximately 30,000 fish, with approximately 18,000 fish harvested in the Eastern District.

Pink Salmon

Run and Escapement Summary: There was a continuation of strong even-year wild stock returns and below average hatchery returns in the 2020 PWS pink salmon season. The pink salmon forecast was for a total run of 33.6 million fish, apportioned among 3 returns: 43.5% VFDA, 43.5% PWSAC, and 13% wild. The projected harvest was for 26.0 million pink salmon—after accounting for wild escapement, cost recovery, and broodstock.

The total observed run in 2020 was 23.7 million pink salmon, 30% lower than forecast. The hatchery runs were below forecast, and the wild runs were above forecast. This resulted in an observed run composition of 36% VFDA, 36% PSWAC, and 28% wild. Compositions are based on otolith contributions. Pink salmon escapement goals were met in all PWS districts.

Harvest Summary: The total CPF harvest, (including all commercial harvest, hatchery cost recovery, broodstock, and raceway sales) in 2020 was 23.0 million pink salmon, which was 36% below the recent even-year average (2010–2018) of 35.9 million fish. Of these 23.0 million pink salmon, 17.8 million of them were harvested in the purse seine fishery. The even-year average (2010–2018) pink salmon commercial purse seine harvest was 30.2 million fish. The number of permits fished in the PWS purse seine fishery dropped from 238 permits in 2019 to 219 permits in 2020.

The CCPF harvest of 5.8 million wild fish was above the even-year average (2010–2018) of 2.8 million wild fish and was the largest even-year harvest since 1998. Combined with an aerial escapement index of 771,000 fish, the estimated wild pink salmon return in 2020 was 6.5 million fish. The total run of 6.5 million wild pink salmon was above the recent even-year average (2010–2018) of 4.1 million fish and was the largest wild even-year return since 2000. The total run of 8.5 million PSWAC pink salmon was 40% below the forecast, and 54% below the even-year average (2010–2018) of 18.5 million fish. In total, 30% (2.6 million) of the PSWAC run was collected for cost recovery and broodstock. The total run of 8.6 million VFDA pink salmon was 41% below forecast and 41% below the even-year average of 14.7 million fish. In total, 17% (1.4 million) of the VFDA run was collected for cost recovery and broodstock.

Pink salmon CCPF drift gillnet harvest in the Coghill District was 651,000 fish. The proportion of wild pink salmon in the Coghill District CCPF harvest was 22%.

In the Eshamy District, 352,100 pink salmon were harvested in the CCPF gillnet (drift and set) fishery. The proportion of wild pink salmon in the Eshamy District CCPF harvest was 70%.

Chum Salmon

Run and Escapement Summary: PWSAC forecasted a 2020 run of 2.6 million chum salmon to Wally Noerenberg Hatchery and required 1.3 million fish (50%) for cost recovery and broodstock. The total chum salmon return to Wally Noerenberg Hatchery was 1.1 million fish, 58% below forecast.

PWSAC forecasted a 2020 run of 500,000 chum salmon at Armin F. Koernig Hatchery and 810,000 chum salmon at the Port Chalmers remote release site, which would be available for harvest by the purse seine fleet.

Wild chum salmon escapements and harvests were below average across PWS, with the Northern District not achieving the lower end of its escapement goal.

Harvest Summary: The drift gillnet CPF harvest of chum salmon in the Coghill District was 229,406 fish, 82% below the forecast harvest projection. PWSAC harvested 816,600 chum salmon for cost recovery and broodstock. This was the lowest CPF chum salmon harvest since 2014. The proportion of wild chum salmon in the Coghill District CPF harvest was low (5%).

Approximately 193,700 Armin F. Koernig Hatchery chum salmon were harvested in the PWS CPF, 61% below the preseason forecast of 500,000 fish. The Armin F. Koernig Hatchery chum salmon program has produced fewer returns than the preseason forecast in 8 of the past 10 years (2011–2020). The PWS CPF harvest of Port Chalmers enhanced chum salmon was 579,000 fish, 29% below the preseason forecast.

LOWER COOK INLET AREA

The 2020 Lower Cook Inlet (LCI) Area commercial salmon harvest was approximately 2.7 million fish (Table 5). The harvest was composed of approximately 1,000 Chinook, 181,000 sockeye, 4,000 coho, 2.5 million pink, and 14,000 chum salmon. Out of the total salmon harvest in LCI, approximately 896,000 fish (32.3%) were attributed to hatchery cost-recovery harvest.

Chinook Salmon

Harvest Summary: The 2020 purse seine harvest for the Southern District, including homepack, was 158 Chinook salmon, greater than the previous 10-year average harvest of 110 fish. The set

gillnet harvest for the Southern District, including homepack, was 420 fish, which was higher than the previous 10-year average harvest of 341 fish.

Sockeye Salmon

Run and Escapement Summary: Cook Inlet Aquaculture Association (CIAA) forecasted a run of 34,500 sockeye salmon to the Kirschner Lake remote release site. CIAA also forecasted a total run of 494,200 sockeye salmon to Resurrection Bay facilities with all but 144,400 of these fish anticipated to be used for broodstock or cost-recovery purposes. An additional 92,400 fish were forecast to return to Kachemak Bay release sites with 49,400 of these fish anticipated to be used for cost recovery or brood harvest.

The preliminary passage estimate at the English Bay River weir was 31,486 sockeye salmon, exceeding the SEG range for this system (6,000–13,500 fish) despite the set gillnet fishery being open in this subdistrict.

Sockeye salmon escapement was above the minimum SEG for 2 of 3 stocks in the Kamishak Bay District, except for Mikfik Lake. For the second consecutive year, sections of Mikfik Creek dried up in late June, blocking significant upstream migration. Overall, only 314 sockeye salmon were counted entering Mikfik Lake, which is below the SEG range of 3,400–11,000 fish.

Sockeye salmon escapements to both Delight and Desire Lakes in the Outer District were within their respective SEG ranges for those systems.

Escapement of 12,760 sockeye salmon through the weir at Bear Creek was within the desired inriver passage goal of 5,620–13,220 fish. This goal is the combination of the SEG (700–8,300 fish) and the estimated 4,920 fish required for broodstock for the CIAA Resurrection Bay sockeye salmon program at the Trail Lakes Hatchery. The only other index stock in the Eastern District is Aialik Lake, where the final escapement of 4,020 fish was within the SEG range of 3,200–5,400 fish.

Harvest Summary: The 2020 commercial purse seine harvest for the Southern District, including homepack, was 67,959 sockeye salmon, which was higher than the previous 10-year average harvest of 37,717 fish. The set gillnet harvest for the Southern District, including homepack, was 12,507 fish, which was under half of the previous 10-year average harvest of 25,705 fish. In addition, 15,892 sockeye salmon were harvested by CIAA from special harvest areas (SHAs) in this district for cost-recovery purposes.

Due to the small number of participants, State of Alaska confidentiality requirements prohibit release of the harvest information for the Kamishak Bay District. However, 11,506 sockeye salmon were harvested by CIAA from the Kirschner Lake SHA for cost-recovery purposes.

The Outer District harvest was 200 sockeye salmon which is lower than the previous 10-year average annual harvest of 9,161 fish.

Due to small runs during the previous 10 years, no wild sockeye salmon were forecast to be available for commercial harvest from the Eastern District in 2020. Total cost-recovery harvest from the Eastern District was 62,414 sockeye salmon. In addition, 99 fish collected at the Bear Creek weir in Resurrection Bay were donated to members of the public.

Portions of Resurrection Bay were open for commercial harvest from June 29 through July 17. Due to the small number of participants, State of Alaska confidentiality requirements prohibit release of the harvest information from this fishing period.

Coho Salmon

Harvest Summary: The 2020 purse seine harvest for the Southern District was 537 coho salmon (including homepack), which is lower than the previous 10-year average harvest of 1,317 fish. The set gillnet harvest for the Southern District (including homepack), was 2,813 fish, which is higher than the previous 10-year average harvest of 2,457 fish.

Due to the small number of participants, State of Alaska confidentiality requirements prohibit release of the harvest information from the Kamishak Bay District.

The Outer District harvest was 108 coho salmon, which was lower than the previous 10-year average annual harvest of 391 fish.

In the Eastern District, 701 coho salmon were donated at the Bear Creek weir to members of the public.

Pink Salmon

Run and Escapement Summary: In the Southern District, China Poot and Humpy Creeks did not achieve their pink salmon SEGs. The remaining 4 index streams (Tuka Creek, Barbara Creek, Seldovia, and Port Graham River) exceeded the upper end of their pink salmon SEG ranges.

In the Kamishak Bay District, pink salmon escapement was within the SEG range in the Bruin River and Sunday Creek, and was above the SEG range at Brown's Peak Creek.

In the Outer District, preliminary estimates show that pink salmon escapement was below the SEG range for the Rocky River and Desire Lake, within the range for Port Chatham, Island Creek, and South Nuka Creek, and above the SEG range for Windy Bay Left and Right Creeks, Port Dick Creek, and Dogfish Lagoon creeks.

Harvest Summary: The 2020 purse seine harvest for the Southern District (including homepack) was 120,886 pink salmon, fewer than the 10-year average harvest of 145,965 fish. The set gillnet harvest for the Southern District (including homepack) was 35,160 fish, greater than the previous 10-year average harvest of 17,943 fish. In addition, 795,068 fish were harvested by CIAA from SHAs in this district for cost-recovery purposes.

Due to the small number of participants, State of Alaska confidentiality requirements prohibit release of the pink salmon harvest information from the Kamishak Bay District CCPF.

The Outer District pink salmon harvest was approximately 1.5 million fish, which was higher than the previous 10-year average annual harvest of 1.0 million fish.

Chum Salmon

Run and Escapement Summary: The chum salmon SEG was not met at the Port Graham River for the second consecutive year. Chum salmon escapement in the Outer District was above the SEG range for Rocky River and below the SEG range for Island, Port Dick, and Dogfish creeks. In the Kamishak District, chum salmon escapement was below the SEG range at Cottonwood and Ursus Creeks, and the McNeil River, and above the minimum SEG at 4 other index streams.

Harvest Summary: The 2020 purse seine harvest for the Southern District (including homepack) was 1,075 chum salmon, which was lower than the previous 10-year average harvest of 1,230 fish. The set gillnet harvest for the Southern District (including homepack) was 1,918 chum salmon, which was fewer than the previous 10-year average harvest of 3,239 fish.

Due to the small number of participants, State of Alaska confidentiality requirements prohibit release of the chum salmon harvest information from the Kamishak Bay District CCPF.

The Outer District harvest was 11,181 chum salmon, which was much lower than the previous 10-year average annual harvest of 57,391 fish.

UPPER COOK INLET AREA

The 2020 Upper Cook Inlet (UCI) commercial harvest of approximately 1.2 million salmon was 65% less than the recent 10-year average harvest of 3.2 million fish.

Chinook Salmon

Run and Escapement Summary: In UCI, there are 2 commercial fisheries where most Chinook salmon are harvested. These include the set gillnet fisheries in the Northern District and in the Upper Subdistrict of the Central District. Chinook salmon runs were expected to be below average across Southcentral Alaska for the 2020 season. As predicted, the 2020 Chinook salmon run was below average, and even lower than the preseason forecasts, leading to both preseason and inseason conservation measures in all fisheries to reduce the harvest of Chinook salmon.

The 2020 preseason run forecast for Deshka River Chinook salmon was approximately 10,570 fish, which suggested harvest must be very limited to achieve the SEG of 9,000–18,000 fish. Based on this low forecast and recent low Chinook salmon production throughout the Susitna drainage, ADF&G issued 2 emergency orders (2-KS-2-08-20 and 2-KS-2-09-20) prohibiting retention of Chinook salmon in Areas 1, 3, 4, 5, and 6 of the Susitna River drainage (including Deshka River) and closing Area 2 entirely to Chinook salmon fishing. At the 2020 UCI Board of Fisheries meeting, new regulations were adopted pairing restrictive actions in the Deshka River Chinook salmon sport fishery with the Northern District commercial Chinook salmon fishery. Changes included (1) restricting the Northern District directed fishery to 9 hours if the Deshka River sport Chinook salmon fishery is restricted to no bait, and (2) restricting the Northern District directed fishery to 6 hours if the Deshka River sport Chinook salmon fishery is restricted to no retention. Therefore, the weekly commercial fishing period on Mondays was reduced from 12 to 6 hours. Additionally, the area of the Northern District from the wood chip dock to the Susitna River was closed to commercial fishing in conjunction with the sport fishery closure of Chuitna River. The estimated 2020 final escapement of Chinook salmon in the Deshka River was approximately 10,638 fish, just above the lower end of the SEG. The Little Susitna River Chinook salmon SEG of 2,100–4,300 fish was also met in 2020, with a weir count of 2,445 Chinook salmon. Aerial goals of the Susitna drainage Chinook salmon stock complex systems are still preliminary. Chinook salmon stock complex escapement goals for the Yentna and Talkeetna stocks were not met, but the stock complex escapement goal for Eastside Susitna was met.

Late-run Chinook salmon returning to the Kenai River and Chinook salmon in the Kasilof River are the primary Chinook salmon stocks that are harvested in the eastside setnet (ESSN) fishery. Kenai River late-run Chinook salmon were managed to meet an optimal escapement goal (OEG) of 15,000–30,000 large Chinook salmon set by the Board of Fisheries in 2020. If restrictions are implemented in the sport fishery to achieve the OEG (from July 1 through August 15), restrictive "paired" actions are also required in the ESSN fishery and can begin on June 20.

Late-run Chinook salmon passage in the Kenai River was counted at the river mile 14 sonar site from July 1 through August 20. The preliminary 2020 sonar count of large late-run Kenai River Chinook salmon was 11,499 fish with an escapement estimate of 11,908 fish, accounting for sport

fishery harvest above the sonar site and spawning below the sonar site. Neither the large fish OEG (15,000–30,000 fish), nor the SEG (13,500–30,000 fish) for Kenai River late-run Chinook salmon was achieved in 2020.

The 2020 preseason forecast was for a total run of 22,807 large Kenai River late-run Chinook salmon. Based on low preseason abundance projections for late-run Chinook salmon and low observed abundance of the early-run Chinook salmon stock, the 2020 late-run Chinook salmon sport fishery in the Kenai River was restricted to no retention of fish over 34 inches beginning July 1. Beginning June 20, the ESSN commercial fishery was restricted to fishing no more than 36 hours per week by emergency orders only, with a 36-hour continuous closure per week beginning between 7:00 p.m. Thursday and 7:00 a.m. Friday, and gear restrictions were implemented. Beginning August 1, if the sport fishery remained restricted to achieve the OEG, the ESSN fishery would be restricted to 36 hours per week by emergency orders including a Friday-no-fishing window, but low abundance of Chinook salmon in the Kenai River resulted in the entire ESSN fishery being closed from July 24 through the end of the season on August 15.

Other smaller streams with Chinook salmon south of the Kenai and Kasilof Rivers include the Anchor River, Deep Creek, and Ninilchik River. Of the 3 southern Chinook systems, only the Anchor and Ninilchik Rivers have escapement goals. In 2020, only the Ninilchik River Chinook salmon SEG of 750–1,300 fish was achieved with a weir count of 835 fish.

Harvest Summary: The 2020 UCI commercial harvest of all Chinook salmon stocks was 3,008 fish, which was 56% less than the previous 10-year average (2010–2019) annual harvest of 6,848 fish, and the second lowest harvest on record. Of this total, the ESSN fishery harvested 769 Chinook salmon, or 27% of the harvest. The 769 Chinook salmon harvested in the ESSN fishery included an estimated 221 (29%) large Chinook salmon of all stocks, which included a total of 152 (69%) that were large Kenai River late-run origin fish. The total ESSN harvest of large Kenai River Chinook salmon is 1% of the preliminary total run estimate of 12,132 fish. The drift gillnet fishery harvested 181 Chinook salmon of all sizes and all stocks.

In the Northern District, the directed Chinook salmon set gillnet fishery was opened, but fishing time was reduced by 50% to 6 hours, 1 day per week. The estimated total Chinook salmon harvest in the Northern District in 2020 was 1,658 fish with approximately 1,474 harvested during the directed Chinook salmon fishery.

Sockeye Salmon

Run and Escapement Summary: The 2020 total run of sockeye salmon to UCI (including estimates of fishery harvests for commercial, sport, personal use, educational, subsistence, and escapement) of approximately 4.4 million fish was 93,000 (2%) more fish than the preseason forecast. Sockeye salmon run abundance to the Kenai River was higher than forecasted by approximately 321,000 fish and to the Kasilof River by 98,000 fish. The number of sockeye salmon returning to Fish Creek, however, was 47,000 fewer fish than forecasted, and in the Susitna River and all other systems (minor systems) inseason abundance was 23–39% less than forecasted for 2020.

At the Kenai River sonar, the peak day of sockeye salmon passage occurred on August 17, with a count of 134,874 fish. This was the highest daily sockeye salmon passage recorded in August at the Kenai River sonar, and the latest peak of sockeye salmon movement recorded. During the previous 10 years, the average date where 50% of the yearly sonar passage occurred in the Kenai River was July 25. In 2020, 50% of the total passage did not occur until August 6 and

approximately 61% of the run arrived in August. An exceptional abundance of pink salmon (see pink salmon section) also occurred during the 2020 sockeye salmon run. The sonar count data are currently being analyzed to determine if the apportionment of pink and sockeye salmon from the sonar count can be improved. Weak Kenai River Chinook salmon runs resulted in paired restrictive actions in the sport fishery and the ESSN fishery of the Upper Subdistrict. For the ESSN fishery, this resulted in less fishing time than what is allowed as per the sockeye salmon management plans, and gear restriction options were also applied. The final passage estimate of 1.8 million sockeye salmon exceeded the upper end of the Kenai River sockeye salmon inriver goal range (1.0–1.2 million fish) by more than 600,000 fish. Given typical sport fishery harvests at this inriver abundance level, the SEG (750,000–1,300,000 fish) was also likely exceeded.

The Kasilof River sockeye salmon sonar count of 545,654 fish exceeded the upper bound of the Kasilof River biological escapement goal (BEG) of 140,000–320,000 fish (prior to inriver harvest) and was the largest recorded sockeye salmon passage for the Kasilof River sonar project (38 years). The passage midpoint for Kasilof River occurred on July 19, which was 3 days later than the midpoint from the previous 10 years, and the peak daily passage of 17,472 fish occurred on July 28.

Sockeye salmon escapement objectives were exceeded at Fish Creek, were met at Judd and Packers Lakes, and were below at Larson Lake.

Harvest Summary: The 2020 UCI commercial harvest of 695,754 sockeye salmon was approximately 73% less than the 2010–2019 average annual harvest of 2.6 million fish. The 2020 sockeye salmon commercial harvest was the second smallest harvest in the past 50 years.

The total 2020 sockeye salmon harvest in the ESSN fisheries was 282,177 fish. From June 23 through July 22 the Kasilof Section was open on 16 different days, harvesting approximately 177,209 sockeye salmon, which was 61% less than the previous 10-year (excluding 2012, due to extensive fishery closures that year) average of 460,100 fish. From July 8 through August 15, the Kenai and East Foreland Sections were open on 5 different days, producing a total sockeye salmon harvest of 104,968 fish. This was 74% less than the previous 10-year (excluding 2012) average annual sockeye salmon harvest of 397,000 fish for those sections.

The total UCI drift gillnet harvest in 2020 was 283,727 sockeye salmon, which was approximately 81% less than the previous 10-year average harvest of 1.5 million fish. The peak day of harvest for the drift gillnet fleet occurred on Thursday, July 16, when 237 vessels harvested approximately 42,863 sockeye salmon (181 fish per boat). The previous 10-year average peak day harvest per boat was 919 fish.

A comparative examination of the 2020 sockeye salmon harvest between the ESSN and drift gillnet fisheries showed the drift gillnet fishery proportion of the harvest was less than the previous 10-year average, excluding 2012. The 2020 drift gillnet harvest (283,727 sockeye salmon) was approximately 41% of the total harvest between the 2 gear types; the previous 10-year average was 56%. The ESSN fishery harvest (approximately 282,177 sockeye salmon) was 51% of the sockeye salmon harvest of the 2 groups; the previous 10-year average was 44%.

In 2020, approximately 24,888 sockeye salmon were harvested by set gillnetters in the Western Subdistrict. This was less than the 10-year (2010–2019) average annual harvest of approximately 42,685 fish.

Approximately 8,116 sockeye salmon were harvested in the Kustatan Subdistrict in 2020, of which 1,315 fish were harvested during the Big River fishery. The 2020 sockeye salmon harvest for Kustatan Subdistrict was more than double the 10-year (2010–2019) average annual harvest of 3,193 fish.

In 2020, approximately 35,842 sockeye salmon were harvested from the Kalgin Island Subdistrict, with nearly 5,970 (17%) of those fish taken during the Big River sockeye salmon fishery. The 10-year (2010–2019) average annual sockeye salmon harvest on Kalgin Island was approximately 52,991 fish, with roughly 11,500 of those fish harvested during the early season Big River fishery.

In 2020, approximately 47,822 sockeye salmon were harvested in the Northern District. This harvest was slightly greater than the 2010–2019 average annual harvest of 44,510 fish. As in past years, restrictions to the Northern District salmon fishery that restricted the number of nets allowed were implemented from July 20 to August 6, to conserve Susitna River sockeye salmon.

Coho Salmon

Run and Escapement Summary: In UCI, there are 4 coho salmon systems with escapement goals. Weirs are used on the Fish Creek, Little Susitna River, and Deshka River; and McRoberts Creek is assessed with foot surveys.

The Little Susitna River coho salmon SEG of 9,200–17,700 fish was updated in 2020. Coho salmon escapement was counted at the Little Susitna weir from July 17 through August 31. The preliminary coho salmon escapement estimate in the Little Susitna River was 9,931 fish.

Due to budget constraints, the Deshka River weir was pulled early on August 13; a total of 5,368 fish were counted by that date. Based on average run timing the SEG (10,200–24,000 fish) was likely achieved on Deshka River.

The Fish Creek coho salmon SEG is 1,200–6,100 fish. A preliminary estimate of 4,559 coho salmon were counted from July 25 to August 14 indicating the SEG was achieved.

Finally, there is a coho salmon foot survey and SEG of 250–700 fish for McRoberts Creek, which drains into Jim Creek of the Knik River drainage. In 2020, the McRoberts Creek foot survey produced a count of 735 fish, exceeding the upper bound of the SEG range.

Harvest Summary: The 2020 harvest estimate of approximately 139,240 coho salmon in all UCI commercial fisheries was 25% less than the previous 10-year average (2010–2019) annual harvest of approximately 186,000 fish. The 2020 drift gillnet harvest of 48,803 coho salmon was 55% less than the previous 10-year average of approximately 109,000 fish. However, the Northern District set gillnet harvest of 54,453 coho salmon was the third largest harvest since 2000 and was approximately 36% greater than the 10-year (2010–2019) average annual harvest of 40,000 fish. The increase in Northern District set gillnet coho salmon harvest may be due to less overall fishing time in the drift gillnet fishery—management actions kept the drift gillnet fleet in the Expanded Corridors during July and August to target Kenai and Kasilof sockeye salmon and to avoid Northern District coho salmon.

Pink Salmon

Harvest Summary: Pink salmon runs in UCI are even-year dominant, with odd-year average annual harvests typically fewer than one-sixth of even-year harvests. The 2020 UCI commercial pink salmon harvest was estimated to be 345,072 fish, slightly above the 10-year (2010–2019) average annual even-year harvest of nearly 343,943 fish. Conversely, the abundance of pink salmon

estimated in 2020 during sockeye salmon assessments in the Kenai River, was more than twice (1.5 million) its previous high count on record (660,000 fish).

Chum Salmon

Run and Escapement Summary: An aerial survey of Chinitna River/Clearwater Creek was conducted on August 11. This survey produced an estimate of approximately 3,970 chum salmon within these streams, which was within the SEG range of 3,500–8,000 fish. Therefore, Chinitna Bay was opened to set and drift gillnetting on Tuesdays and Fridays beginning on August 18. Regularly scheduled Monday and Thursday drift gillnet fishing periods for Drift Gillnet Areas 3 and 4 began August 17.

Harvest Summary: The 2020 harvest of 29,217 chum salmon was approximately 83% lower than the previous 10-year average annual harvest of 177,000 fish.

BRISTOL BAY AREA

The 2020 commercial inshore harvest of 39.6 million sockeye salmon (Table 5) was 14% more than the 34.6 million preseason forecast and is the 5th largest harvest on record. The harvest of 10,006 Chinook salmon was the lowest on record. The harvests for other species were approximately 293,000 chum, 114,000 coho, and 72,000 pink salmon.

Chinook Salmon

Run and Escapement Summary: The preliminary estimate for the 2020 Chinook salmon escapement into the Nushagak River was 36,876 fish, which was below the escapement goal range of 55,000–120,000 fish.

Harvest Summary: The 2020 Chinook salmon harvests in Bristol Bay were below average for all districts except the Ugashik District. All Chinook salmon were caught during directed sockeye salmon periods in all commercial districts and a total of 10,006 fish were harvested, which was 75% below the 20-year average (2000–2019) of 30,590 fish and was the lowest harvest on record.

Sockeye Salmon

Run and Escapement Summary: The 2020 inshore Bristol Bay sockeye salmon run of 58.3 million fish is the 4th largest on record and was 49% more than the 39.0 million fish average run for the latest 20-year (2000–2019) period. This was the sixth consecutive year that inshore sockeye salmon runs exceeded 50 million fish. The 2020 Bristol Bay sockeye salmon run was 25% larger than the preseason inshore forecast of 46.6 million fish. Runs to all districts, except the Ugashik and Togiak Districts, were larger than the preseason forecast.

All districts observed relatively late run timing this season. Unlike the most recent 3 years, the timing was such that large harvests were seen in the Nushagak, Naknek-Kvichak, and Egegik Districts simultaneously. This resulted in several days of harvest over 2.5 million sockeye salmon and subsequently, some processors placed temporary restrictions on their fleet's harvest. The Bristol Bay sockeye salmon run was dominated by fish with 1 year of freshwater residence (age-1.2 and age-1.3 fish). Fish with 2 years of freshwater residence (age-2.2 and age-2.3 fish) were below preseason expectations, particularly in the Egegik and Kvichak Rivers. Age-1.3 fish were above preseason expectations in all rivers on the east side of Bristol Bay, and the Egegik River had a record return of approximately 12.4 million fish.

All sockeye salmon escapement goals were met or exceeded, with a total baywide escapement of approximately 18.7 million fish.

Harvest Summary: The 2020 harvest of approximately 39.6 million fish was 46% higher than the recent 20-year average (2000–2019) of 27.0 million fish for all districts.

Coho Salmon

Harvest Summary: The total coho salmon harvest in 2020 was 114,421 fish, which was above the latest 20-year average (2000–2019) of 92,752 fish. In the Nushagak District, which is typically the largest producer of coho salmon, 76,133 fish were harvested. This was above the 20-year (2000–2019) average of 62,306 fish.

Pink Salmon

Harvest Summary: The total pink salmon harvest in 2020 was 71,913 fish, which was below the latest even 20-year average (2000–2019) of 510,266 fish.

Chum Salmon

Harvest Summary: The 2020 Bristol Bay chum salmon harvest was 292,890 fish, which was below the latest 20-year average (2000–2019) of approximately 1.1 million fish. The Nushagak District was the largest producer of chum salmon, where 136,605 fish were harvested.

Table 5.–2020 Central Region commercial salmon harvests, by fishing area and species, in thousands of fish.

Fishing area	Species					Total
	Chinook[a]	Sockeye	Coho	Pink	Chum	
Drift gillnet						
Bering River District	0	0	65			65
Coghill District	0	111	2	651	229	995
Copper River District	6	102	169	1	1	279
Eshamy District	0	358	1	317	71	747
Montague District						
Unakwik District	0	1		0	0	1
Purse seine						
Coghill District	0	1	0	1,109	7	1,117
Eastern District	0	3	18	8,964	55	9,040
Montague District	0	2	1	268	592	864
Northern District	0	2	3	3,425	6	3,436
Northwestern District	0	12	0	921	12	946
Southwestern District						
Southeastern District	0	19	7	3,113	223	3,362
Unakwik District						
Set Gillnet						
Eshamy District	0	92	0	35	4	131
Hatchery[b]		237	22	4,199	817	5,275
Prince William Sound Total	7	942	289	23,004	2,017	26,258
Southern District Purse Seine	0	68	1	121	1	191
Southern District Set Gillnet	0	13	3	35	2	53
Southern District Total	1	80	3	156	3	243
Kamishak District			Confidential			
Outer District	0	0	0	1,564	11	1,575
Eastern District		2				2
Hatchery[c]		99	1	796	0	896
Lower Cook Inlet Total[d,e]	1	181	4	2,516	14	2,716
Central District Drift Gillnet	0	284	49	294	25	652
Central District Set Gillnet	1	364	36	24	2	427
Central District Total	1	648	85	318	27	1,079
Northern District	2	48	54	27	2	134
Upper Cook Inlet Total[d]	3	696	139	345	29	1,212
Naknek-Kvichak District	1	14,311	1	1	36	14,351
Nushagak District	6	8,860	76	26	137	9,106
Egegik District	1	13,365	26	2	50	13,444
Ugashik District	1	2,598	1	0	16	2,617
Togiak District	1	446	10	42	54	552
Bristol Bay Total	10	39,580	114	72	293	40,069
Central Region Total	20	41,399	547	25,937	2,353	70,255

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

Note: Columns may not total exactly due to rounding.

[a] Prince William Sound Chinook salmon adults and jacks are totaled.

[b] Hatchery sales for operating expenses and broodstock harvests.

[c] LCI hatchery harvest includes hatchery cost recovery and hatchery donated fish but not broodstock.

[d] Total includes commercially harvested fish retained for homepack.

[e] Confidential information not included.

ARCTIC-YUKON-KUSKOKWIM REGION

Arctic-Yukon-Kuskokwim (AYK) Region 2020 harvests totaled 418,000 fish (Table 6). Cumulative all-gear commercial harvest included approximately 6,000 Chinook, 145,000 sockeye, 55,000 coho, 200,000 chum, and 13,000 pink salmon.

KUSKOKWIM AREA

The 2020 season marked the first large-scale commercial salmon fishery in the Kuskokwim Area since 2015. The commercial fishery occurred in Kuskokwim Bay Districts 4 (Quinhagak) and 5 (Goodnews Bay). The Kuskokwim Bay commercial fishing season began in late June and ended early September. The commercial fishing season was delayed from the normal start of June 15 and subsistence mesh size was restricted to 6-inch or less between June 1 and July 15 to allow for Chinook salmon escapement. There were no commercial buyers or processors in the Kuskokwim River. Therefore, commercial fishing opportunities were limited to individuals registered as catcher-sellers who had secured their own markets.

The 2020 Kuskokwim River Chinook salmon forecast was for a range of 193,000–261,000 fish. A run of this magnitude was anticipated to support a full subsistence harvest and achieve the drainagewide SEG of 65,000–120,000 fish. However, since this was the first encouraging Chinook salmon forecast in a decade, ADF&G's intent was to take a precautionary management approach during the early part of the 2020 season, with short duration fishing periods, based on input from the Kuskokwim River Salmon Management Working Group.

Preseason management actions that were intended to achieve Kuskokwim River escapement goals included early season subsistence fishing closures, tributary closures, time and area restrictions, gillnet mesh size and length restrictions, and live release requirements. The Kuskokwim River Salmon Management Working Group voted to support these management actions.

An early season gillnet subsistence fishing closure (i.e., "front-end closure") began on June 1 and extended from the Yukon Delta National Wildlife Refuge (YDNWR) boundary at the mouth of the Kuskokwim River up to the Tuluksak River; June 3 from Tuluksak River up to the Yukon Delta Refuge Boundary at Aniak; June 9 from the Yukon Delta boundary at Aniak up to the Holitna River mouth; and upstream of Holitna River mouth beginning June 11. With the closure came additional restrictions, including tributary closures and required live release of Chinook salmon captured in selective gears. During the front-end closure there were three 24-hour set gillnet opportunities with 6-inch or less mesh to allow subsistence fishers time to harvest nonsalmon species. These openings occurred on June 3, 6, and 9.

Between June 1 and July 1, a Federal Special Action closed the Kuskokwim Chinook salmon fishery to non-Federally qualified users within the boundary of the YDNWR. During the Special Action, the United States Fish and Wildlife Service (USFWS) offered 6-inch or less mesh setnet opportunities running concurrently to the 6-inch opportunities offered by ADF&G on June 3, 6, and 9. Additionally, USFWS offered four 12-hour gillnet fishing periods on June 12, 15, 18, and 24 with 6-inch or less mesh, 25 fathoms in length above the Johnson River mouth and 50 fathoms in length below the Johnson River mouth. On June 18, USFWS opened those waters between the Kalskag Bluff and the YDNWR boundary at Aniak to subsistence fishing until further notice with 6-inch or less mesh, 25 fathoms in length gillnets. In coordination with the USFWS inseason manager, ADF&G concurrently offered the same management actions within waters of the YDNWR to provide Alaska Wildlife Troopers with enforceable regulations. The 3 setnet and

4 drift gillnet opportunities offered by USFWS resulted in an estimated harvest of 23,210 Chinook, 6,710 sockeye, and 5,590 chum salmon by Federally qualified users within the YDNWR (excluding the section between Akiak and Aniak).

On June 12, ADF&G opened Section 4 (from the refuge boundary at Aniak to the Holitna River mouth) and Section 5 (Holitna River mouth to headwaters) to subsistence fishing until further notice with 6-inch or less mesh, 25 fathoms in length gillnets. These sections are located outside the YDNWR boundary and not subject to the Federal Special Action.

Inriver chum and sockeye salmon began to outnumber Chinook salmon in the lower Kuskokwim River on June 27. However, inseason assessment indicated that the Chinook and chum salmon runs were materializing below expectations, and with late run timing. On July 7, after chum and sockeye salmon became the clear dominant species and inseason projections indicated that the drainagewide Chinook salmon escapement goal and the chum salmon escapement goal on the Kogrukluk River would be achieved, ADF&G opened sections 1–3 of the Kuskokwim River (YDNWR boundary at the mouth of the Kuskokwim River upstream to the boundary at Aniak) to 6-inch or less mesh, 25 fathoms in length gillnets above the Johnson River mouth, and 50 fathom in length gillnets downstream of the Johnson River mouth. When the July 7 emergency order was issued, the entirety of the mainstem Kuskokwim River was open to subsistence fishing. The Kuskokwim River Salmon Management Working Group voted to support these management actions.

Mainstem gear restrictions were rescinded on August 1. Tributary restrictions were rescinded August 31. The tributary restrictions were kept in place beyond the mainstem restrictions for the purpose of conservation while Chinook salmon were on their spawning grounds.

Chinook Salmon

Run and Escapement Summary: The preliminary Kuskokwim River total run estimate is 116,000 Chinook salmon (95% CI = 95,000–143,000 fish), and an estimated 88,000 Chinook salmon (95% CI = 66,000–114,000 fish) escaped Kuskokwim River fisheries, which met the drainagewide SEG of 65,000–120,000 fish.

All weir-based escapement goals for Chinook salmon assessed in 2020 were met within the Kuskokwim River drainage. The established SEG range of 4,800–8,800 fish at Kogrukluk River weir was met (5,645 fish), as was the SEG range of 1,800–3,300 fish at George River (2,418 fish). Five of the 6 tributaries with aerial survey SEGs were assessed in 2020. Three of the 5 aerial survey SEGs were met.

Within Kuskokwim Bay, the Chinook salmon aerial survey escapement SEG of 3,500–8,000 fish for the Kanektok River was achieved with an estimate of 4,405 fish. The North Fork Goodnews River Chinook salmon aerial SEG of 640–3,300 fish was achieved with a count 1,098 fish.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2020 will not be available until after postseason harvest surveys have been completed, data have been analyzed, and preliminary harvest estimates are produced. Average subsistence Chinook salmon harvest on the Kuskokwim River is 84,000 fish.

A total of 4,345 Chinook salmon were commercially harvested in District 4 and 442 Chinook salmon were commercially harvested in District 5. Chinook salmon harvest was below the long-term average.

Sockeye Salmon

Run and Escapement Summary: Overall, sockeye salmon escapement was mixed throughout the drainage with above average lake-type sockeye salmon escapement and below average river-type sockeye salmon escapement. The Kogrukluk River weir escapement of 9,923 sockeye salmon met the established SEG range of 4,400–17,000 fish. The Telaquana weir observed the third highest escapement of sockeye salmon since the project was established in 2010 with a count of 177,509 fish.

Within Kuskokwim Bay, the sockeye salmon aerial survey SEG for the Kanektok River of 14,000–34,000 fish was exceeded with an estimate of 52,886 fish. The sockeye salmon aerial survey SEG for the North Fork Goodnews River of 5,500–19,500 fish was exceeded with an estimate of 55,110 fish.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence sockeye salmon harvest in 2020 will not be available until after postseason harvest surveys have been completed, data have been analyzed, and preliminary harvest estimates are produced. Average subsistence sockeye salmon harvest on the Kuskokwim River is 43,000 fish.

A total of 113,849 sockeye salmon were commercially harvested in District 4 and 28,859 sockeye salmon were commercially harvested in District 5. Sockeye salmon harvest was above the long-term average.

Due to the lack of a large-scale commercial buyer/processor in the Kuskokwim River, short commercial fishing opportunities directed at sockeye salmon were provided only to those commercial fishery participants who had registered as catcher-sellers and had secured their own markets. Commercial fishing opportunities were provided in late July and early to mid-August and resulted in well below average harvests. Due to the small number of participants during these commercial fishing periods, State of Alaska confidentiality requirements prohibit release of the harvest information.

Coho Salmon

Run and Escapement Summary: Coho salmon escapement was evaluated at 2 middle Kuskokwim River weirs in 2020. The George River weir coho salmon escapement of 21,426 fish was near the most recent 10-year average (2010–2019) of 21,511 fish. The Kogrukluk River weir experienced numerous out-of-operation events in early September during the peak of the run, and at this time, the total escapement goal cannot be assessed. Observed escapement at the weir was 9,856 fish; this number is a minimum escapement count since estimates of missed passage are not included.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2020 will not be available until after postseason harvest surveys have been completed, data have been analyzed, and preliminary harvest estimates are produced. Average subsistence coho salmon harvest on the Kuskokwim River is 36,000 fish.

A total of 29,374 coho salmon were commercially harvested in District 4 and 10,928 coho salmon were commercially harvested in District 5. Coho salmon harvest was below the long-term average.

Due to the lack of a large-scale commercial buyer/processor in the Kuskokwim River, short commercial fishing opportunities directed at coho salmon were provided only to those commercial fishery participants who had registered as catcher-sellers and had secured their own markets.

Commercial fishing opportunities were provided in late July and early to mid-August and resulted in well below average harvests. Due to the small number of participants during these commercial fishing periods, State of Alaska confidentiality requirements prohibit release of the harvest information.

Chum Salmon

Run and Escapement Summary: Chum salmon escapement at all weir projects was weak, but adequate to meet escapement needs. The escapement count of 19,020 fish at the Kogrukluk River weir met the established SEG range of 15,000–49,000 fish. Preliminary data indicate that the low escapements at Kuskokwim River assessment projects are due to poor returns of age-4 (2016 spawning event) chum salmon.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2020 will not be available until after postseason harvest surveys have been completed, data have been analyzed, and preliminary harvest estimates are produced. Average subsistence chum salmon harvest on the Kuskokwim River is 65,000 fish.

A total of 6,531 chum salmon were commercially harvested in District 4 and 3,037 chum salmon were commercially harvested in District 5. Chum salmon harvest was below long-term average.

YUKON AREA

The 2020 Yukon River total commercial harvest was 13,955 summer chum and 4,845 pink salmon (Table 6). These fish were harvested in Districts 1 and 2 of the Lower Yukon Area. No commercial fishing occurred in the Upper Yukon Area. No commercial harvests of Chinook, fall chum, or coho salmon occurred in the summer or fall seasons for the Alaska portion of the Yukon River drainage.

The Yukon River summer season runs from early May through July 15 in District 1. On July 16, management in District 1 transitions to the fall season and becomes focused on fall chum and coho salmon entering the mouth of the Yukon River. However, summer season management continues beyond this date in upper river districts as Chinook and summer chum salmon migration progresses upstream. The subsequent transition of upriver districts to the fall season is based on the migration timing of fall chum salmon.

Summer Season

The summer chum salmon run was a week late entering the river and the start of the summer chum salmon commercial season was delayed until late June. Three openings were announced with selective gear and 3 with gillnets. The processor did not buy during the final gillnet opening due to low abundance and catches. The commercial harvest of summer chum salmon was the lowest since 2003. Incidental catches of Chinook salmon were low, because the bulk of the run had passed the lower river and fishing time was limited.

Chinook Salmon

Run and Escapement Summary: In 2020, many assessment projects did not operate due to COVID-19 concerns. The Chena River (tower and sonar) experienced high water and the projects were only operational for part of the season. Aerial survey counts were conducted on 3 systems with SEGs (Anvik, West Fork Andreafsky, and Nulato Rivers); these counts were all below the SEG ranges and historical averages. Survey conditions were good, but counts may have been

affected by high water washing carcasses downstream. The cumulative passage estimate at the mainstem Yukon River Eagle sonar project was approximately 33,550 Chinook salmon (90% CI = 33,190–33,910 fish). However, this is not considered a true escapement estimate because it does not account for harvest in Eagle or Canada. The lower end of the interim management escapement goal for Canada of 42,500–55,000 fish was not met. The passage at the U.S./Canada border was much lower than expected based on inseason estimates at the lower river mainstem Pilot Station sonar project. A total of 162,252 Chinook salmon were counted, of which 77,000 were estimated to be Canadian-origin salmon based on genetic proportions. Preliminary subsistence and personal use harvest estimates of 22,780 Chinook salmon do not account for the divergence in counts from Pilot Station and Eagle sonar projects.

Harvest Summary: For the 13th consecutive year, no commercial periods targeting Chinook salmon were allowed in the Yukon Management Area during the summer season.

Commercial fishery participants were required to report any Chinook salmon released live or caught but not sold. During the summer chum salmon commercial season in Districts 1 and 2, a total of 795 Chinook salmon were released live from selective gear openings from June 27 to July 1. During gillnet openings, 362 Chinook salmon were retained for subsistence from July 4 to July 5.

Chum Salmon

Run and Escapement Summary: Three escapement goals exist for summer chum salmon: a drainagewide goal of 500,000–1,200,000 fish (established in 2016), and goals at the East Fork Andreafsky and the Anvik Rivers. The estimated drainagewide escapement was 724,000 summer chum salmon. The East Fork Andreafsky weir and Anvik sonar projects did not operate this season due to COVID-19 travel restrictions; therefore, the escapement goals could not be evaluated. Aerial surveys were conducted on both these systems in addition to several others; counts were all below historical averages. The Chena River tower and sonar project stopped operating due to high water before most of the summer chum salmon run was expected to arrive at the project.

Harvest Summary: The cumulative summer chum salmon commercial harvest for Districts 1 and 2 combined was 13,960 fish. The Lower Yukon Area summer chum salmon harvest was 96% less than the recent 5-year average (2015–2019) harvest of 388,183 fish and was the lowest harvest since 2003. The 2020 summer chum salmon commercial harvest was 97% less than the Yukon Area recent 5-year average (2015–2019) harvest of 448,994 fish.

Fall Season

There was no commercial fishing for salmon in the Yukon Area during the fall season because of poor returns of both fall chum and coho salmon.

Coho Salmon

Run and Escapement Summary: There are few coho salmon spawning escapement assessment projects in the Yukon River drainage because of funding limitations and late timing relative to onset of winter. The sonar in the mainstem Yukon River near Pilot Station was operated through September 7 and had an estimated passage of 107,680 coho salmon, which is well below the historical average of 159,000 fish. The Delta Clearwater River has the only established escapement goal for coho salmon, a SEG of 5,200–17,000 fish. A boat survey conducted on the Delta Clearwater River in early November counted an estimated 2,557 coho salmon, which was below the escapement goal. Escapement count estimates for coho salmon were conducted by aerial

surveys in the Nenana River drainage where 4 spawning areas are monitored; all escapements were below their 1974–2019 averages.

Harvest Summary: There was no commercial fishing for salmon in the Yukon Area during the fall season because of poor returns of both fall chum and coho salmon.

Fall Chum Salmon

Run and Escapement Summary: Because many of the escapement projects could not be operated due to COVID-19, the total run size of fall chum salmon was estimated based on the mainstem Yukon River sonar operated near Pilot Station and downstream harvest. In 2020, the preliminary estimate of the drainagewide total run size was 194,000 fall chum salmon, which is the lowest on record since 1974. The drainagewide escapement (after preliminary harvest estimates from U.S. and Canada were removed) was estimated to be 187,000 fall chum salmon, which is below the SEG range of 300,000–600,000 fish. This is the first time since the year 2000 that the run was below 300,000 fish.

The sonar on the Teedriinjik (Chandalar) River was not operated in 2020 and therefore the SEG range of 85,000–234,000 fish could not be evaluated. Additionally, the Porcupine River border sonar downstream of Old Crow (border passage is determined after removal of harvests) was not operated in 2020. The Fishing Branch River weir estimate was 4,785 fall chum salmon, which was similar to escapements observed in the year 2000 and well below the lower end of the interim management escapement goal of 22,000–49,000 fish. The fall chum salmon passage estimate at the mainstem Yukon River sonar project near Eagle was 20,766 fish (SE = 177 fish) for the dates August 28 through October 6. Because of continued passage at the termination of the project, the fall chum salmon estimate was subsequently adjusted to 23,512 fish. The preliminary escapement for the mainstem Yukon River in Canada is derived by subtracting the upstream U.S. and Canadian harvests from the expanded sonar estimate, which is currently reported as 0 harvest. The preliminary mainstem Yukon River escapement estimate was 23,512 fall chum salmon; the first time in 18 years the estimate falls below the interim management escapement goal range (70,000–104,000 fish). The Delta River, a tributary of the Tanana River drainage, was monitored using replicate ground surveys, providing an escapement estimate of 9,854 fall chum salmon. This level of escapement was within the SEG of 7,000–20,000 fish and was much higher than the 3,000 fall chum salmon observed in the year 2000, the last time escapement fell below the range.

Stock composition estimates, provided by USFWS Conservation Genetics Laboratory, were determined using tissue samples (fin clips) collected from chum salmon captured in the mainstem Yukon River sonar test net fishery. Chum salmon genetic samples processed from 4 strata between July 19 and September 7 (fall season) indicated that stocks represented approximately 30% summer fish. Within the fall components, the 3 main stock groupings were 33% Border U.S. (Teedriinjik/Sheenjek/Black), 23% Canadian, and 44% Tanana. In 2020, the upper Yukon stocks were lower and the Tanana River stocks were higher when compared to the 2004–2019 averages (36% Border U.S., 34% Canadian, and 30% Tanana).

Harvest Summary: There was no commercial fishing for salmon in the Yukon Area during the fall season because of poor returns of both fall chum and coho salmon.

NORTON SOUND AREA

Poor runs of chum and coho salmon in 2020 resulted in low commercial salmon harvest. Escapement goal ranges were reached for 1 of 2 Chinook salmon goals, 2 of 5 chum salmon goals,

1 of 2 coho salmon goals, both sockeye salmon goals, and all 3 pink salmon goals. There were 122 commercial permits fished in 2020, slightly below the recent 5-year (140 permits) and 10-year (132 permits) averages. Total commercial salmon harvests in 2020, including commercially harvest fish retained for personal use, were 986 Chinook, 2,062 sockeye, 14,689 coho, 7,919 pink, and 26,379 chum salmon (Table 6).

Chinook Salmon

Harvest Summary: Commercial fishing targeting Chinook salmon was prohibited during the 2020 season. Although lower than last year, the run was higher than most runs in the previous decade.

Sockeye Salmon

Harvest Summary: Although sockeye salmon harvest accounts for a small portion of the overall harvest in Norton Sound, the 2020 commercial harvest of 1,808 fish, not including personal use, was the 6th highest on record.

Coho Salmon

Harvest Summary: The 2020 coho salmon harvest of 14,651 fish, not including personal use, was fewer than 10% of the recent 5-year average (169,720 fish) and was well under the forecast of 200,000–250,000 fish. The average weight of coho salmon (5.7 lb) was the lowest on record, well below the 2019 average weight of 6.4 lb.

Pink Salmon

Harvest Summary: The pink salmon runs continued to be strong in most of Norton Sound. However, buyer interest was minimal. The total 2020 pink salmon harvest was 6,950 fish, which does not include personal use.

Chum Salmon

Harvest Summary: The 2020 chum salmon harvest of 26,366 fish (not including personal use) was below the forecast (180,000–230,000 fish) and was fewer than 20% of the recent 5-year average (151,442 fish).

KOTZEBUE SOUND AREA

There were 68 permit holders that commercially harvested fish in the Kotzebue Sound Area in 2020. The highest fishing effort occurred on August 11 when 47 permit holders made landings.

Chinook Salmon

Harvest Summary: Buyers in the Kotzebue Sound area purchased 3 Chinook salmon in 2020. Permit holders retained 33 Chinook salmon for personal use.

Sockeye Salmon

Harvest Summary: Buyers in the Kotzebue Sound area purchased 9 sockeye salmon in 2020. Permit holders retained 63 sockeye salmon for personal use.

Coho Salmon

Harvest Summary Permit holders retained 15 coho salmon for personal use in 2020.

Pink Salmon

Harvest Summary: Permit holders retained 873 pink salmon for personal use in 2020.

Chum Salmon

Run and Escapement Summary: No aerial surveys were flown in 2020. The Kobuk River test fish chum salmon catch index ranked third lowest out of 28 years.

Harvest Summary: The Kotzebue Sound chum salmon harvest of 149,808 fish was the lowest since 2007. The harvest was well below the forecast of 450,000–650,000 fish.

Table 6.–2020 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			Confidential			
Kuskokwim Bay	5	143	40	0	10	197
Kuskokwim Area Total[a]			Confidential			
Lower Yukon River				5	14	19
Upper Yukon River						
Yukon River Total				5	14	19
Norton Sound	1	2	15	8	26	52
Kotzebue Sound	0	0			150	150
AYK Region Total[b]	6	145	55	13	200	418

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

Note: Columns may not total exactly due to rounding.

[a] Confidential information not included.

[b] Total includes commercially harvested fish retained for homepack.

WESTWARD REGION

KODIAK AREA

The 2020 commercial harvest (not including personal use or ADF&G test fishery) in the Kodiak Management Area (KMA) was 8,000 Chinook, 1.5 million sockeye, 441,000 coho, 21.6 million pink, and 368,000 chum salmon (Table 7). The total KMA harvest of 23.9 million salmon was above the 2020 forecast as well as the previous 10-year average of approximately 21.8 million fish.

Commercial fishing effort was below average compared to recent years. Of the 587 eligible commercial salmon permits, only 277 (47%) made commercial landings. By gear type, a total of 149 purse seine and 126 set gillnet permit holders made deliveries in 2020. Less than 3 beach seine permits were fished in 2020. Participation rates for all gear types were below the previous 10-year average.

Chinook Salmon

Run and Escapement Summary: The total Chinook salmon escapement of 5,746 fish was below the previous 10-year average of 6,193 fish.

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 (3,344 fish) was within the BEG range of 3,000–6,000 fish. Chinook salmon escapement through the Ayakulik River weir (2,402 fish) was below the BEG range of 4,800–8,400 fish.

Harvest Summary: There are no directed Chinook salmon commercial fisheries in the KMA, but incidental commercial harvest occurs during targeted sockeye and pink salmon fisheries. The Karluk and Ayakulik Rivers both support small populations of Chinook salmon. By regulation, nonretention of Chinook salmon was implemented for the seine fleet areawide from June 1 through July 5. Due to a poor Chinook salmon run to Ayakulik, nonretention of Chinook salmon was extended for the seine fleet from July 6 until the end of the season along the Westside of Kodiak from the latitude of Cape Kuliuk to the latitude of Low Cape. The 2020 commercial harvest of Chinook salmon in the KMA totaled 8,018 fish, which was below the previous 10-year average (12,413 fish) but above the 2020 forecast (6,700 fish).

Sockeye Salmon

Run and Escapement Summary: Sockeye salmon runs in many systems in the KMA were average to below average. The major sockeye salmon systems of the KMA all met their established escapement goals, although 1 small system (Malina Lake) did not achieve its escapement goal. The entire KMA estimated sockeye salmon escapement of 1.2 million fish was slightly below the previous 10-year average of 1.3 million fish.

Harvest Summary: The 2020 commercial harvest of sockeye salmon totaled 1.5 million fish. The harvest was below the recent 10-year average (2.3 million fish) and the preseason forecast (1.8 million fish).

Early-season management for much of the Westside of Kodiak Island is driven by Karluk early-run sockeye salmon. The 2020 Karluk early run was weak, and minimal fishing time was allowed along much of the Westside of Kodiak until the management focus turned to pink salmon (July 6).

The lower value of the Karluk early-run sockeye salmon escapement goal (150,000 fish) was not achieved until July 7. A total of 149,554 fish were harvested in early-season Westside areas based on Karluk early-run sockeye salmon. Westside numbers include an estimated contribution of 35,544 fish from the enhanced Spiridon Lake sockeye salmon run harvested outside of the Spiridon Bay SHA.

Late-season management for much of the Westside of Kodiak is driven by the Kodiak Island pink salmon fishery and the Karluk late-run sockeye salmon run. Most of the pink salmon runs to the Westside of Kodiak Island were very strong (particularly in the Southwest Kodiak District), and liberal fishing time was allowed in July and August. The Karluk late-run sockeye salmon run was average and a large buildup of sockeye salmon in Karluk Lagoon in late August allowed for liberal fishing time. A total of 614,394 sockeye salmon were commercially harvested in late-season Westside areas opened based on Karluk late-run sockeye and Westside Kodiak pink and chum salmon. Westside sockeye salmon numbers include an estimated contribution of 27,214 fish from the enhanced Spiridon Lake sockeye salmon run, harvested outside of the Spiridon Bay SHA.

The Ayakulik early-run sockeye salmon run was below average, allowing for only 3 fishing periods in the Outer Ayakulik and Halibut Bay Sections of the Southwest Kodiak District during early-run sockeye salmon management. A total of 72,623 fish were harvested in areas managed based on Ayakulik early-run sockeye salmon. The strength of the Ayakulik late-run sockeye salmon was average, but the Ayakulik pink salmon run was one of the largest on record and there was liberal fishing time in the Outer Ayakulik and Halibut Bay Sections of the Southwest Kodiak District. A total of 174,606 sockeye salmon were harvested in areas managed based on Ayakulik late-run sockeye salmon and Ayakulik pink salmon. A total of 247,229 sockeye salmon were harvested from Westside sections opened based on the Ayakulik sockeye salmon and pink salmon runs, which was above the 2020 forecast of 108,000 fish.

Upper Station early-run sockeye salmon escapement was weak, and the traditional fishing areas of the Alitak District (i.e., seine and set gillnet sections) were closed for much of June. Eventually, the minimum Upper Station early-run sockeye salmon escapement goal of 43,000 fish was achieved, and the Frazer Lake sockeye salmon escapement was adequate, allowing for Alitak District early-run sockeye salmon commercial fishing openings. The Alitak District early-run sockeye salmon harvest was approximately 67,490 fish, well below the projected harvest of 132,000 fish. The Upper Station late-run sockeye salmon run was average, and despite liberal fishing time, set gillnet effort was at near record low levels. The Alitak District late-run sockeye salmon harvest was 188,188 fish, below the projected harvest of 231,000 fish. The total harvest of the Alitak District late-run sockeye salmon was 255,678 fish, which was below the forecasted harvest of 363,000 fish.

Coho Salmon

Run and Escapement Summary: Although the KMA has substantial coho salmon runs, the only established coho salmon escapement goals occur in the Northeast Kodiak and Eastside Kodiak districts for the following systems: American (400 fish), Olds (1000 fish), Buskin (4,700–9,600 fish), and the Pasagshak Rivers (1,200 fish).

Harvest Summary: The commercial coho salmon harvest of 440,809 fish was slightly above the forecast (437,900 fish) and above the previous 10-year average (320,521 fish). The majority of the coho salmon were harvested in the Westside Kodiak fishery in August and September and at Kitoi Bay Hatchery in August.

Pink Salmon

Run and Escapement Summary: The KMA pink salmon escapement of 10.9 million fish was above the previous 10-year average of 4.5 million fish and the second largest pink salmon escapement on record. 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 (9.4 million fish) exceeded the upper end of the escapement goal range of 3.0–7.0 million fish. More than 58% (or 5.5 million fish) of the total Kodiak Archipelago pink salmon escapement occurred in the 3 major systems of Karluk, Sturgeon, and Ayakulik Rivers. Karluk River alone escaped 3.1 million pink salmon. For a second straight year, low water conditions caused a large amount of prespawn mortality and commercial salmon closures were necessary for escapement, particularly on the Eastside of Kodiak Island and Afognak.

The Mainland District pink salmon escapement of 1.4 million fish was above average, above the established escapement goal range (250,000–1,000,000 fish), and the second highest on record. The Mainland District north of Puale Bay had well above average pink salmon escapement.

Harvest Summary: The 2020 KMA pink salmon harvest of 21.6 million fish was above the forecast (12.2 million fish) and above the previous 10-year average harvest of 18.3 million fish. Pink salmon harvested in the areas managed on KMA wild stocks were approximately 17.0 million fish (9.9 million forecast). Most of the pink salmon were harvested on the Westside of Kodiak Island (12.3 million fish), particularly the Southwest Kodiak District. The 3 major systems of Karluk, Sturgeon, and Ayakulik Rivers all had extremely large pink salmon runs and record or near record pink salmon escapement. The 2020 season was the largest pink salmon harvest ever in the Southwest Kodiak District with 7.9 million fish harvested.

The Kitoi Bay Hatchery pink salmon run was stronger than expected with 4.8 million fish harvested in sections near the hatchery (2.3 million fish forecast). Kitoi-bound pink salmon are likely harvested along the west and east sides of Kodiak and Afognak islands. Likewise, additional wild stock salmon are likely harvested in areas associated with Kitoi Bay Hatchery. However, ADF&G does not have a stock separation program for pink salmon and is unable to differentiate the stocks. No cost recovery was conducted by the Kodiak Regional Aquaculture Association (KRAA) for the 2020 commercial salmon season.

Chum Salmon

Run and Escapement Summary: The overall KMA chum salmon escapement of 212,320 fish was well below the previous 10-year average (387,477 fish). Chum salmon runs were weak in every KMA district. A peak indexed escapement goal based on 17 streams on Kodiak Island has been established; the 2020 peak indexed escapement of 72,100 fish was below the goal of 101,000 fish.

Harvest Summary: Most of the KMA wild chum salmon are harvested during the directed pink and chum salmon fisheries in July. The 2020 chum salmon runs were very weak, and closures were necessary to achieve escapement. The 2020 KMA chum salmon harvest of 368,250 fish was well below the 2020 forecast (809,600 fish). Additionally, the Kitoi Bay Hatchery chum salmon harvest of only 20,852 fish was well below the forecast of 86,600 fish.

CHIGNIK AREA

The 2020 Chignik Management Area (CMA) did not prosecute a commercial fishery during the entire season. The sockeye salmon return to the Chignik River watershed was the worst return in history dating back to 1922. Escapement goals for Chinook, sockeye, pink, and chum salmon were not achieved during the 2020 season. As a result, no commercial harvest opportunity was provided, and no revenue was generated by the commercial fishery.

Chinook Salmon

Run and Escapement Summary: 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 BEG for Chinook salmon into the Chignik River watershed is 1,300–2,700 fish. The 2020 Chignik River Chinook salmon escapement (above the weir) of 1,278 fish did not meet the escapement goal and was below all recent escapement averages. State subsistence and sport fishery harvest of Chinook salmon will not be known until permits and questionnaires are returned and tabulated in the spring of 2021.

Harvest Summary: There were no Chinook salmon commercially harvested in 2020. Chinook salmon harvested in the CMA are typically harvested during commercial openings for sockeye, pink, and chum salmon. The most recent 10-year average harvest of Chinook salmon in the CMA is 7,064 fish.

Sockeye Salmon

Run and Escapement Summary: The Chignik River watershed supports 2 genetically distinct sockeye salmon runs that traditionally provide most directed harvest opportunities within the CMA. The overall 2020 sockeye salmon run was the lowest return on record dating back to 1922. The 2020 estimated total Chignik River watershed sockeye salmon escapement (330,978 fish) was below all recent averages. The early-run escapement was estimated at 137,213 fish and was well below the early-run BEG of 350,000–450,000 fish. The late-run estimated escapement of 193,765 fish was also below the late-run SEG range of 220,000–400,000 fish. The late-run escapement includes a postweir estimate for August 27 to September 30 of 21,276 sockeye salmon.

Harvest Summary: Due to poor escapement of sockeye salmon throughout the entire season, no commercial harvest opportunity was provided for sockeye salmon within the CMA. The most recent 10-year average harvest of sockeye salmon within the CMA is approximately 1.3 million fish.

Coho Salmon

Run and Escapement Summary: Coho salmon enter CMA drainages in mid-August and generally continue through November. The 2020 Chignik River coho salmon escapement estimate through August 26 was 6,964 fish. Due to the removal date of the Chignik weir, a majority of the coho salmon run was not counted in 2020. Late season coho salmon stream surveys were not conducted in the CMA in 2020 due to inclement weather in September and staff departure from Chignik.

Due to late season run timing and limited directed effort, escapement goals for coho salmon have not been established in the CMA.

Harvest Summary: There were no coho salmon commercially harvested in the CMA in 2020. The most recent 10-year average harvest of coho salmon in the CMA is 108,564 fish.

Pink Salmon

Run and Escapement Summary: Pink salmon began entering the Chignik River in late June and peaked in mid-August with a total escapement of 10,614 fish. The 2020 Chignik River pink salmon escapement was above all recent even-year averages.

Escapements into other CMA streams were monitored via aerial surveys. During the season, streams that have been historically monitored for pink salmon were surveyed and compared to historical run timing and distribution. The current even-year index SEG of 170,000–280,000 pink salmon is composed of 8 index streams in 4 of the 5 districts in the CMA. The 2020 calculated peak escapement, based on aerial surveys of 8 index streams, was below the even-year SEG with 118,675 fish, but was above the most recent 10-year average of 81,328 fish.

Harvest Summary: There were no pink salmon commercially harvested in the CMA in 2020. Pink salmon escapement was below minimum escapement goals throughout the season and no commercial opportunity was provided to target local stocks of pink salmon. The most recent 10-year average harvest of even-year pink salmon is 224,104 fish.

Chum Salmon

Run and Escapement Summary: A limited number of chum salmon return to the Chignik River, mainly in late-July and August. The 2020 Chignik River chum salmon escapement was 118 fish, which was below all recent average escapements.

Chum salmon escapements to other CMA streams were estimated via aerial surveys. The chum salmon SEG of 45,000–110,000 fish is based on escapement of 6 total index streams within 4 of the 5 districts. The 2020 estimated total peak chum escapement for the 6 index streams was 39,675 fish, which is below the established SEG.

Harvest Summary: There were no chum salmon commercially harvested in the CMA in 2020. Chum salmon escapement was below minimum escapement goals throughout the season and no commercial opportunity was provided to target local chum salmon stocks. The most recent 10-year average harvest of chum salmon is 221,919 fish.

ALASKA PENINSULA, ALEUTIAN ISLANDS, AND ATKA-AMLIA ISLANDS AREAS

The 2020 commercial salmon harvest in the Alaska Peninsula, Aleutian Islands, and Atka-Amlia Islands Management areas totaled approximately 23,000 Chinook, 2.8 million sockeye, 231,000 coho, 5.1 million pink, and 970,000 chum salmon (Table 7).

Chinook Salmon

Run and Escapement Summary: Nelson River is the only river in the South Alaska Peninsula and Aleutian Islands (Area M) with a Chinook salmon escapement goal. At the Nelson River weir, a total of 2,498 Chinook salmon escaped, meeting the escapement goal of 2,400–5,000 fish. The total Northern District Chinook salmon escapement of 10,755 fish was comparable to the most recent 10-year average of 11,502 fish.

Harvest Summary: On the North Alaska Peninsula, 1,223 Chinook salmon were harvested, which was above the previous 10-year average (2010–2019) of 2,090 fish. The South Unimak and Shumagin Islands commercial salmon harvest for the June fishery consisted of 2,594 Chinook salmon. The total commercial harvest for the South Peninsula post-June fishery (including the Southeastern District Mainland [SEDM] from July 26 to October 31) was 18,768 Chinook salmon.

Sockeye Salmon

Run and Escapement Summary: The Orzinski Lake sockeye salmon record low escapement of 6,819 fish was well below the SEG of 15,000–20,000 fish.

The South Peninsula sockeye salmon escapement of 34,169 fish was below the management objective range of 48,200–86,400 fish. Escapement into Mortensens Lagoon (800 fish) was well below the SEG range of 3,200–6,400 fish. Escapement into Thin Point Lagoon (10,450 fish) was below the SEG range of 14,000–28,000 fish.

The 2020 sockeye salmon escapement in the Northwestern District was below the escapement objective range of 52,600–106,000 fish, with a total escapement of 51,200 fish.

In the Northern District, the 2020 North Creek escapement estimate of 8,200 sockeye salmon met the escapement goal of 7,500–10,000 fish.

The Nelson Lagoon Section was opened for all weekly fishing periods with many extensions in fishing time. The Nelson (Sapsuk) River total run of 277,040 sockeye salmon (includes harvest and escapement) was below the estimated forecast of 362,000 fish. From the total run, 92,040 fish were harvested in Nelson Lagoon and 185,000 fish escaped in the Nelson River. The 2020 escapement met the BEG of 97,000–219,000 fish.

The Bear River early-run (through July 31) sockeye salmon escapement of 299,198 fish exceeded the escapement goal of 176,000–293,000 fish. The Bear River late-run (after July 31) sockeye salmon escapement of 208,802 fish exceeded the escapement goal of 117,000–195,000 fish. The Bear River season sockeye salmon escapement was 500,000 fish, surpassing the combined early- and late-run sockeye salmon escapement goal of 293,000–488,000 fish.

The Sandy River sockeye salmon escapement of 60,000 fish met the escapement goal range of 34,000–74,000 fish.

The Ilnik River system sockeye salmon escapement through the weir was 41,000 fish, meeting the Ilnik River escapement goal of 40,000–60,000 fish.

Aerial escapement surveys of the Meshik River began on June 19. Subsequent surveys occurred throughout the season and the final sockeye salmon escapement into the Meshik River system was 64,550 fish, meeting the escapement goal of 48,000–86,000 fish. This estimate includes escapement into the Meshik River and tributaries, as well as Red Bluff and Yellow Bluff Creeks.

The total Cinder River (including Mud Creek) sockeye salmon escapement estimate of 116,500 fish exceeded the escapement goal of 36,000–94,000 fish.

Harvest Summary: The South Unimak and Shumagin Islands commercial sockeye salmon harvest for the June fishery was 339,293 fish. There were no commercial openings in the SEDM between June 1 and July 25. Between July 26 and October 31, 67,562 sockeye salmon were harvested in the SEDM. The total commercial harvest for the South Peninsula post-June fishery (including the SEDM from July 26–October 31) was 729,383 fish.

On the North Peninsula, a total of approximately 1.8 million sockeye salmon were harvested, which was below the 10-year average of 2.1 million fish. Out of that harvest, a total of 16,630 fish were harvested in the Northwestern District; 92,040 fish were harvested in the Nelson Lagoon Section; 191,460 fish were harvested in the Bear River Section; 201,935 fish were harvested in the

Three Hills Section; 473,393 fish were harvested in the Ilnik Section; and 787,771 fish in the Outer Port Heiden Section.

Coho Salmon

Run and Escapement Summary: There were no coho salmon surveys flown on the South Peninsula streams in 2020. 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 preventing aerial surveys from being conducted.

Coho salmon surveys were conducted on most Northern District streams in early September before the peak of the run. Although coho salmon runs continue through September and October, budgetary and logistical constraints do not permit coho salmon surveys to take place later in the fall. Escapement estimates that are tabulated from aerial surveys are considered minimum estimates. The total coho salmon escapement in the Northern District was 163,400 fish. Both the Nelson and Ilnik Rivers have coho salmon lower bound escapement goals. The Nelson River escapement of 23,000 coho salmon exceeded the lower-bound SEG of 18,000 fish. A total of 45,000 coho salmon were observed during early September in the Ilnik River, exceeding the lower-bound SEG of 9,000 fish. It is expected that more coho salmon entered the Ilnik and Nelson River systems during September and October. Coho salmon escapement into the Cinder River was 42,000 fish, and aerial surveys observed 33,000 fish escaping into the Meshik River system.

Harvest Summary: The South Unimak and Shumagin Islands commercial salmon harvest for the June fishery consisted of 262 coho salmon. The total commercial harvest for the South Peninsula post-June fishery (including the SEDM from July 26–October 31) was 182,801 fish.

During the 2020 commercial coho salmon fishery, 731 fish were harvested in the Northwestern District. In the Northern District, a targeted coho salmon fishery took place in the Nelson Lagoon Section, and 18,838 fish were harvested. In the entire Northern District, 47,445 coho salmon were harvested, most of which were incidentally harvested during sockeye salmon fisheries.

Pink Salmon

Run and Escapement Summary: The South Peninsula pink salmon total indexed escapement of 3.2 million fish was within the SEG range of 1.75–4.0 million fish.

There are no escapement goals for pink salmon on the North Peninsula. In some years, depending on market conditions, a directed pink salmon fishery may occur; however, this did not happen in 2020. A total of 71,452 pink salmon were observed in the Northern District in 2020, and 46,400 pink salmon were observed in the Northwestern District.

Harvest Summary: The South Unimak and Shumagin Islands commercial harvest for the June fishery consisted of approximately 1.8 million pink salmon. The total commercial harvest for the South Peninsula post-June fishery (including the July 26 to October 31 SEDM fishery) was 3.3 million fish. During 2020 in the Northwestern District commercial pink salmon fishery, the harvest was 5,051 fish.

Chum Salmon

Run and Escapement Summary: The South Peninsula Chum salmon indexed total escapement of 285,650 fish was within the cumulative district escapement goal range of 218,300–410,600 fish.

In the Northwestern District, the chum salmon escapement of 62,100 fish was below the SEG of 100,000–215,000 fish.

The Northern District has a districtwide chum salmon escapement goal of 119,600–239,200 fish. The 2020 escapement estimate of 118,815 fish was just below the lower end of the districtwide escapement goal. Most of the chum salmon escapement occurred in the Herendeen–Moller Bay Section (68,350 fish) and in the Meshik River (19,650 fish).

Harvest Summary: The South Unimak and Shumagin Islands commercial salmon harvest for the June fishery consisted of 490,128 chum salmon. The total commercial harvest for the South Peninsula post-June fishery (including the SEDM from July 26 to October 31) was 423,276 fish. During 2020 commercial chum salmon fishery, a total of 43,128 fish were harvested in the Northwestern District, and 13,024 fish were harvested in the Northern District.

Table 7.–2020 Westward Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kodiak	8	1,524	441	21,551	368	23,892
Chignik[a]						
South Peninsula and Aleutians Islands	21	1,069	183	5,050	913	7,237
North Peninsula	1	1,780	48	30	56	1,916
Alaska Peninsula Total	23	2,849	231	5,081	970	9,153
Westward Region Total	31	4,373	671	26,632	1,338	33,045

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

Note: Columns may not total exactly due to rounding.

[a] No commercial harvest in 2020.

SALMON SPECIES CATCH AND PROJECTIONS

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

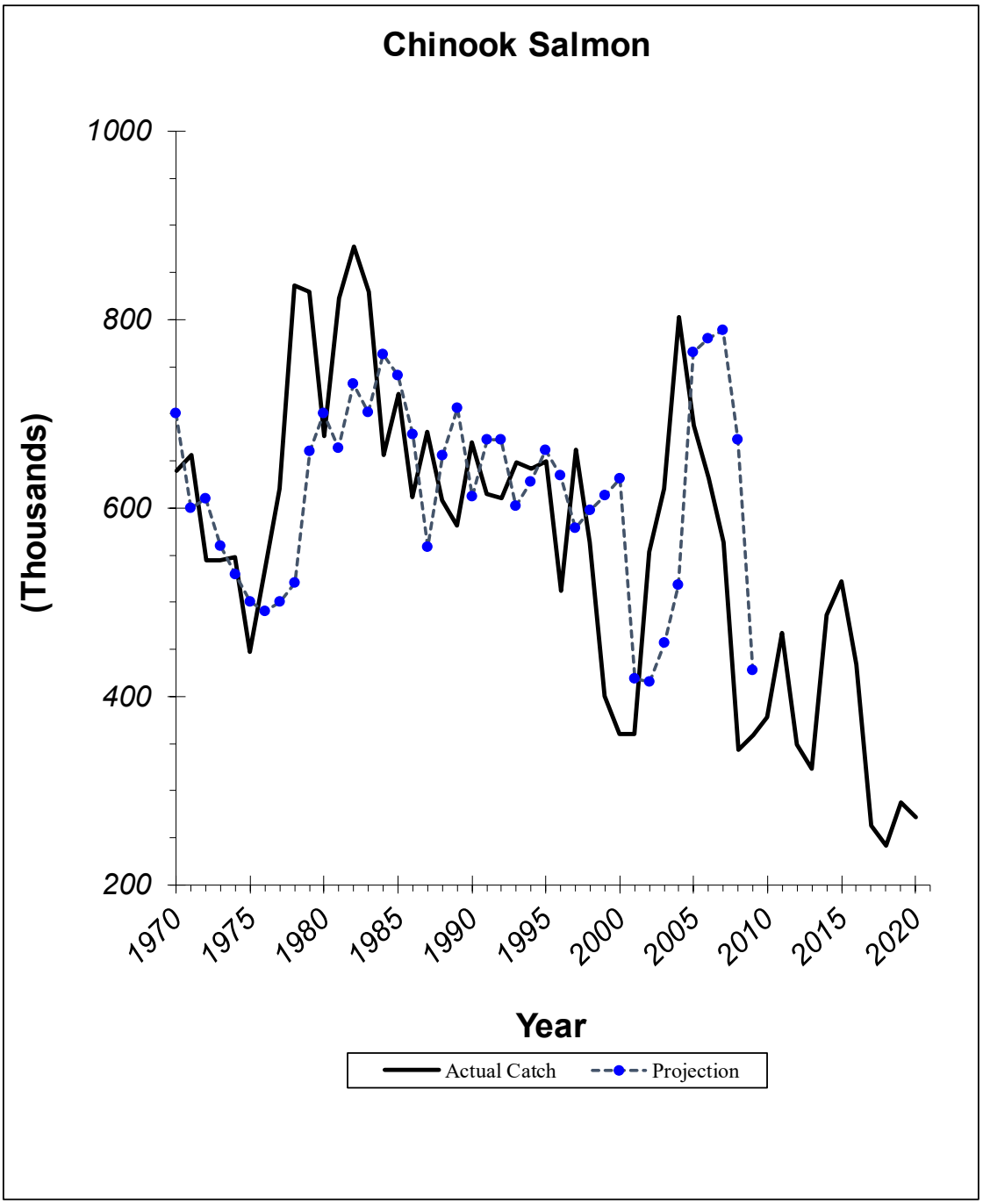

Figure 2.–Relationship between actual catch and projected catch in thousands, for Alaska Chinook salmon fisheries from 1970 to 2020; 2010–2021 projections are not available.

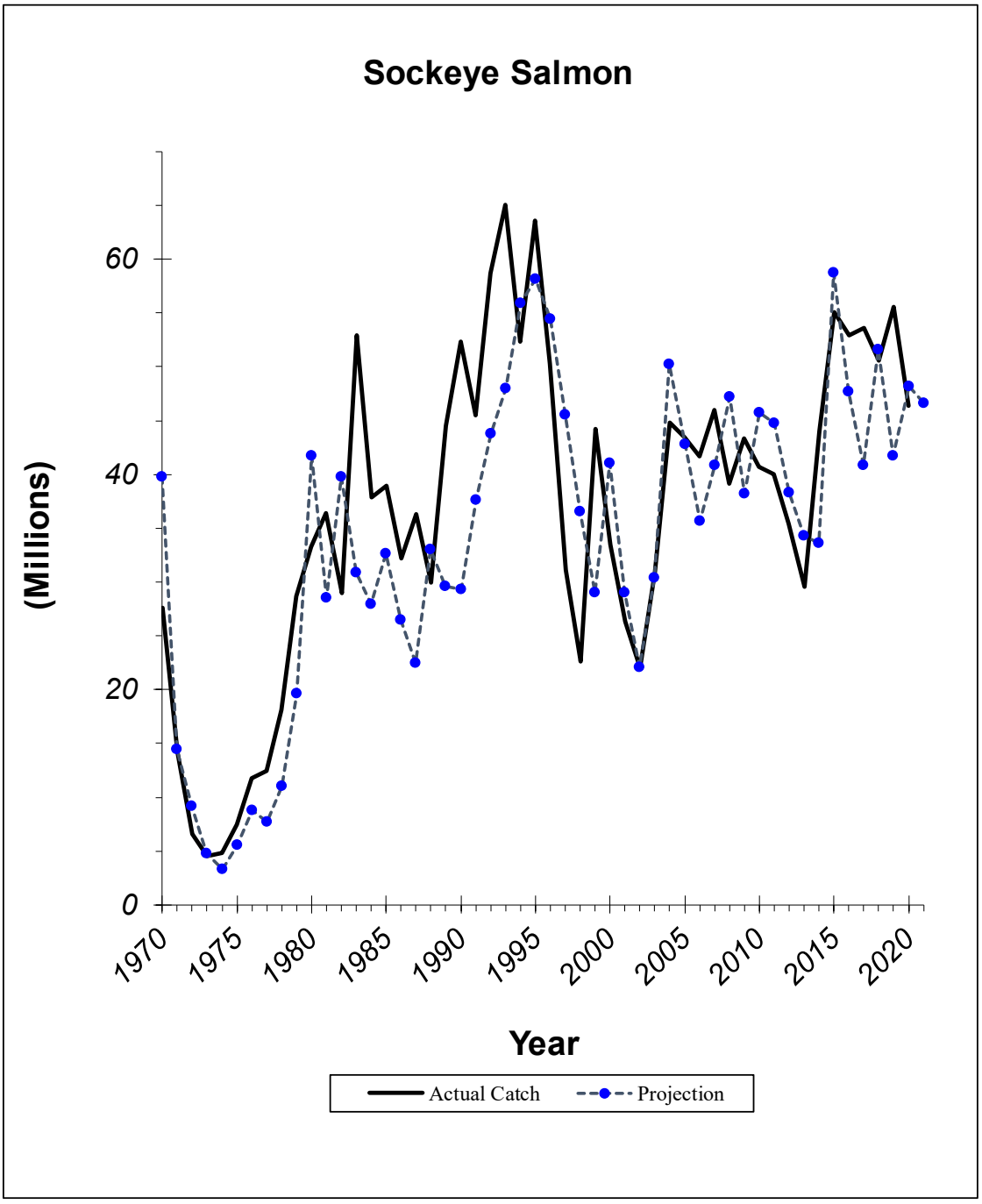

Figure 3.–Relationship between actual catch and projected catch in millions, for Alaska sockeye salmon fisheries from 1970 to 2020, with the 2021 projection.

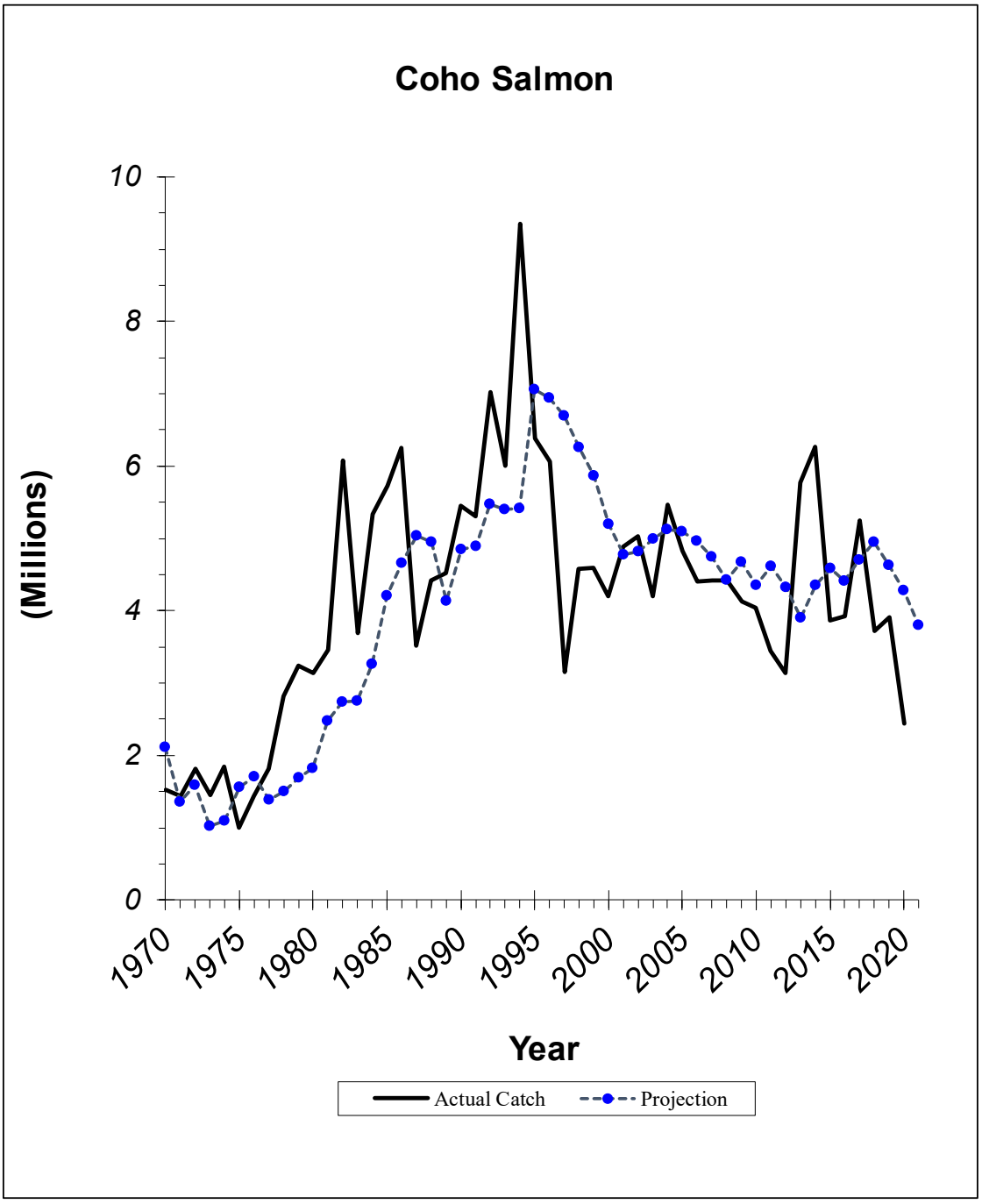

Figure 4.–Relationship between actual catch and projected catch in millions, for Alaska coho salmon fisheries from 1970 to 2020, with the 2021 projection.

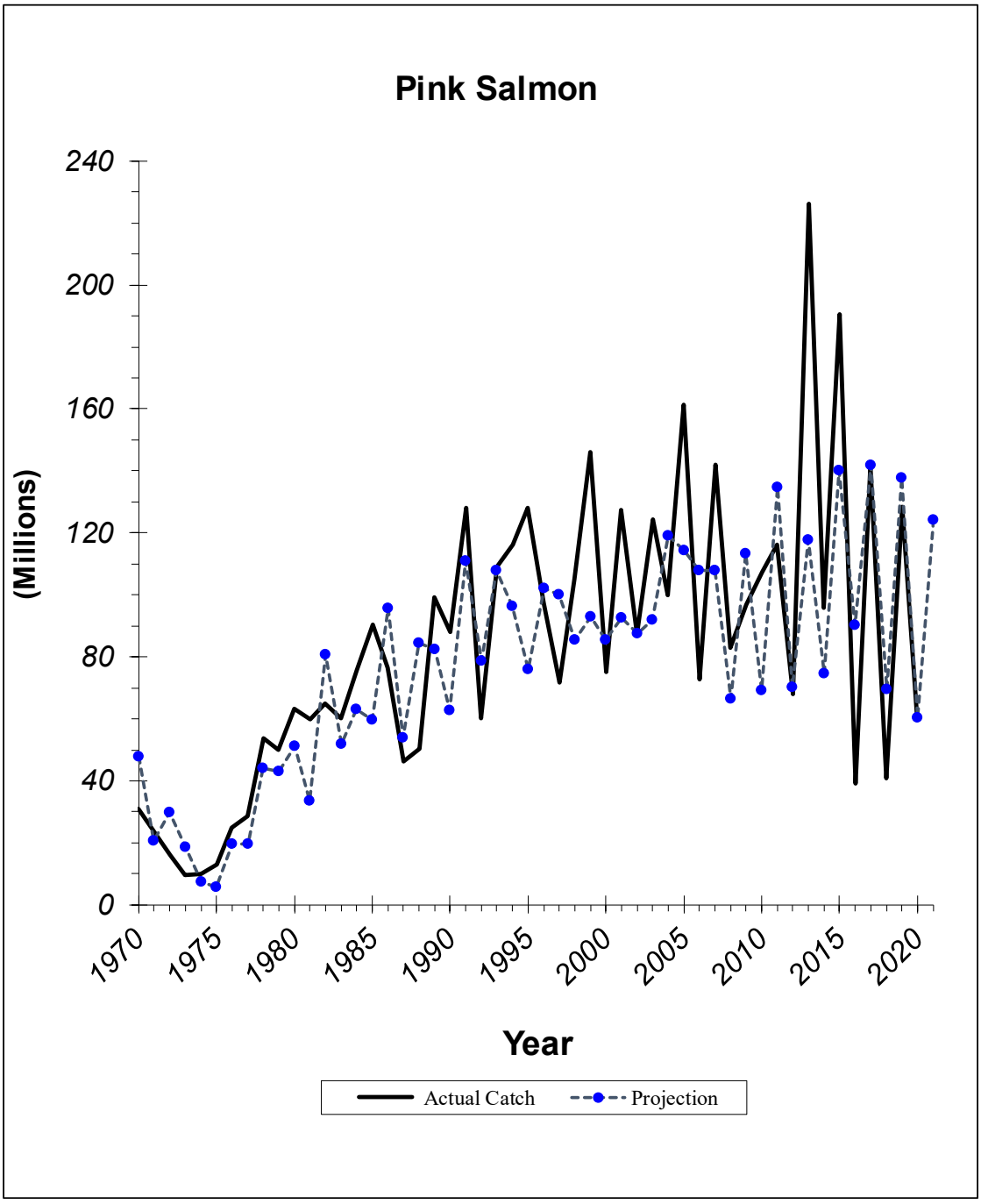

Figure 5.–Relationship between actual catch and projected catch in millions, for Alaska pink salmon fisheries from 1970 to 2020, with the 2021 projection.

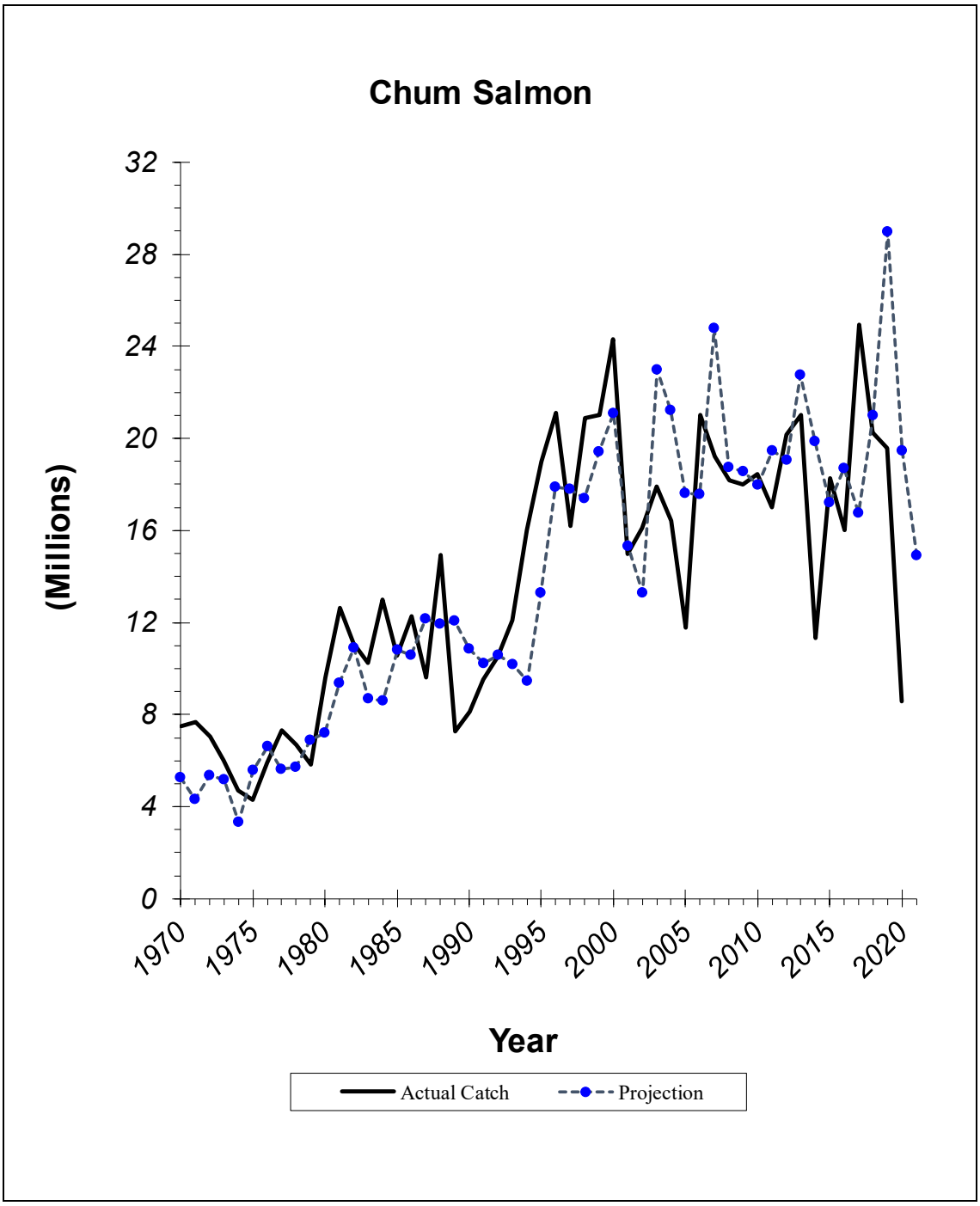

Figure 6.–Relationship between actual catch and projected catch in millions, for Alaska chum salmon fisheries from 1970 to 2020, with the 2021 projection.

PRELIMINARY FORECASTS OF 2021 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 (Table 8).

Table 8.–Forecast fisheries for the 2021 fishing year.

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

A variety of information is used to forecast salmon runs and associated harvests. The escapement of parental stocks is an important first determinant of future run strength potential; however, other information that might be considered in forecasts includes 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, the actual run can be expected to fall within the range (between the lower and upper limits) less than half the time.

Harvest 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 harvest projections are made based on harvests levels from previous years and are reflective of fishing effort; thus, harvests are reflective of both market conditions and salmon run strength.

SOUTHEAST REGION

Pink Salmon

The Southeast Alaska (SEAK) pink salmon harvest in 2021 is predicted to be in the *average* range with a point estimate of 28 million fish (80% prediction interval: 19–42 million fish; Table 9). The categorical ranges of pink salmon harvest in SEAK were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest over the 60-year period 1960–2019.

Table 9.–Southeast Region pink salmon harvest categories.

Category	Range (millions)	Percentile
Poor	Less than 11	Less than 20th
Weak	11 to 19	20th to 40th
Average	19 to 33	40th to 60th
Strong	33 to 49	60th to 80th
Excellent	Greater than 49	Greater than 80th

Forecast Methods: The NOAA Alaska Fisheries Science Center, Auke Bay Laboratories (NOAA) initiated the Southeast Alaska Coastal Monitoring (SECM) project in 1997 to better understand the effects of climate and nearshore ocean conditions on year class strength of salmon and ecologically related species (Orsi et al. 1997). Since 2018, the SECM project has been conducted cooperatively by NOAA and ADF&G, and the 2 agencies have combined efforts to produce a joint pink salmon harvest forecast using SECM data (Piston et al. 2019). The ADF&G research vessel *Medeia* is now used to conduct the SECM surveys and biologists from NOAA, ADF&G, and the regional aquaculture associations provided direct assistance to the sampling effort during the June and July surveys. We plan to continue working towards increased coordination between agencies and will continue to look for ways to focus and expand the SECM survey to provide a wide variety of valuable information to the fishing industry.

The 2021 SEAK pink salmon harvest forecast (Figures 7 and 8) was primarily based on juvenile pink salmon abundance indices collected by the SECM project in northern SEAK inside waters. These data were obtained from systematic surveys conducted annually in June and July in upper Chatham and Icy Straits and are highly correlated with the harvest of adult pink salmon in the following year (Wertheimer et al. 2011). The 2020 juvenile pink salmon abundance index (monthly peak juvenile CPUE; standardized catch based on 20-minute trawl sets) of 2.15 was below the average of 2.63 in the 24 years of SECM surveys.

Forecasts were developed using an approach described by Murphy et al. (2019). A multiple regression model was developed using the juvenile pink salmon abundance index and temperature. The model used is as follows:

$$E(y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \varepsilon,$$

where $E(y)$ is the expected value for y, the natural log of Southeast Alaska pink salmon harvest; β_1 is the coefficient for the natural log of CPUE +1; β_2 is the coefficient for water temperature (e.g., May–July water temperature index in the upper 20 m in Icy Strait); and ε represents the normally distributed error term. Leave-one-out cross validation (hindcast), Akaike Information Criterion for small sample sizes (Burnham and Anderson 2004), and the model performance metric mean absolute scaled error (Hyndman and Kohler 2006) were then used to examine alternative models.

The 80% prediction interval around the forecast was calculated using the *car* package (Fox and Weisberg 2019) in program R version 3.6.3.[1]

Forecast Discussion: The 2021 harvest forecast of 28 million pink salmon is just below the recent 10-year average harvest of 34 million pink salmon. A forecast of 28 million pink salmon is an improvement over the previous odd-year harvest in 2019 (21 million) and is just over half of the average odd-year harvest since 2001. The 2020 peak June–July juvenile pink salmon index value (2.15) ranked 16th out of the 24 years that SECM information has been collected. Pink salmon harvests associated with juvenile indices between a value of 2.0 and 2.5 have ranged from 12 to 42 million fish (mean = 29 million fish).

The juvenile abundance index in 2020 was higher than in the past 3 years and may reflect improved freshwater and early marine survival in Southeast Alaska. Pink salmon catches were well distributed throughout the Upper Chatham and Icy Strait stations in 2020, which resulted in a higher average log-transformed abundance index in 2020 than 2019, although the total catches were similar between these 2 years. Juvenile pink salmon caught in the 2020 SECM survey trawls were near the average size (in length) for the 24-year time series (Figure 9), and further growth and survival will be dependent on favorable resources being available over winter in the Gulf of Alaska. Unlike many recent years, the juvenile pink salmon heading to sea in 2020 did not experience the anomalously warm sea surface temperatures that persisted throughout the Gulf of Alaska from fall 2013 through much of 2016 (Bond et al. 2015; Di Lorenzo and Mantua 2016; Walsh et al. 2018) and in 2018 and 2019.[2] Sea surface temperatures were still modestly above average in the summer and fall of 2020 through much of the Gulf of Alaska, but the summer water temperature index in the upper 20 m in Icy Strait was slightly below average, indicating more moderate marine temperatures for juvenile salmon heading to sea in 2020.

Point estimates of our forecasts have been above the actual harvest in 5 of 6 years since 2015 (Figure 8), and there is some concern that the actual harvest may be below our forecast estimate for 2021. The reason for the tendency to overforecast in recent years is unknown but may be related to increased offshore mortality in the Gulf of Alaska, error introduced in vessel calibrations and calculation of the juvenile abundance index, and/or error in how temperature is incorporated in the forecast model. Pink salmon escapements in the parent year (2019) were poor throughout northern Southeast Alaska inside waters and the escapement goal was not met in that subregion. The poor run in 2019 was a dramatic departure from what have generally been strong odd-year runs. Pink salmon escapement goals for the Southern Southeast and Northern Southeast Outside subregions were met in 2019, and most of the region's harvest occurred in the southern half of the region. It will be challenging to reach a regionwide harvest of 28 million fish in 2021 without a strong rebound in northern inside waters. As noted above, the total catch of juvenile pink salmon in the 2020 trawl surveys was similar to the total catch in 2019, which produced a very low forecast and harvest in 2020. The distribution of juvenile salmon in the trawl catches has a large impact on the average log-transformed juvenile abundance index. Conceptually, consistent catches of juvenile pink salmon in most trawls conducted over a wide geographic area (as occurred in 2020) would reasonably relate to higher overall juvenile abundance compared to a survey in which 1 or 2 trawls accounted for most of the catch and many trawls captured few or no fish (as occurred in 2019); however, the low raw juvenile pink salmon catches in 2020 are still concerning.

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[1] The R project for statistical computing. http://www.r-project.org/index.html (Accessed March 2021).

[2] https://www.ncdc.noaa.gov/data-access/marineocean-data/extended-reconstructed-sea-surface-temperature-ersst-v5 (Accessed March 2021).

Temperature has been included in most historical NOAA pink salmon forecast models and several different measures of temperature have been used since 2004 (Wertheimer et al. 2013). Temperature is a significant negative covariate in our forecast model and the negative linear relationship between temperature and harvest, as well as the positive effect of temperature on pink salmon growth, suggests that temperature may affect forecasts through effects on juvenile distribution and migration (Murphy et al. 2019). Recently, we began exploring the potential use of satellite temperature data (available from the NOAA National Environmental Satellite data and Information Service https://www.nesdis.noaa.gov/) in our forecast models and preliminary results have been encouraging. Satellite data allows for averaging of temperature readings of an almost infinite variety of temporal and geographic units. An initial model run incorporating satellite sea surface temperature data at the location of the upper Chatham Strait SECM trawl stations produced a lower forecast range for the 2021 pink salmon harvest than we presented here. We plan to examine alternative approaches for incorporating temperature data and alternative power transformations of the catch data in greater detail prior to the 2022 forecast. Despite the uncertainties that surround every salmon forecast, the track record of our pink salmon harvest forecasts has been good (Figure 8), especially considering the difficulties unique to forecasting pink salmon (Haeseker et al. 2005).

ADF&G will manage the 2021 commercial purse seine fisheries inseason based on the strength of salmon runs. Aerial escapement surveys and fishery performance data will continue, as always, to be essential in making inseason management decisions.

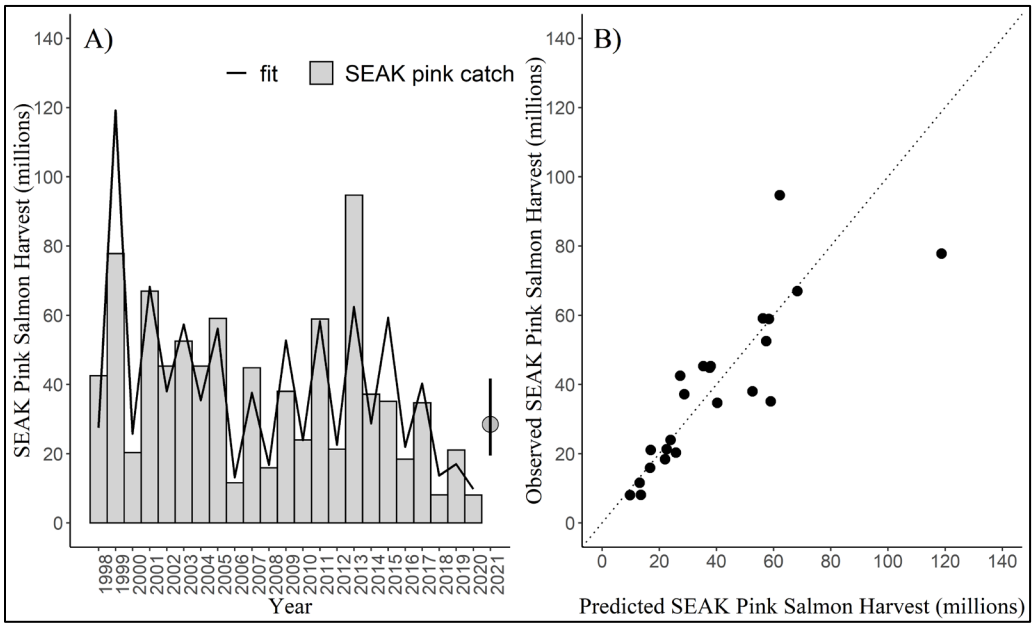

Figure 7.–Forecast model fit (hindcasts) for total Southeast Alaska (SEAK) pink salmon harvest, 1998–2020 by year (A) and by the fitted values (B). The 2021 forecast is shown as a grey circle in panel A with the 80% prediction interval as a black vertical line. The observed SEAK pink salmon harvest is represented by the grey bars and the model fit is shown by the black line in panel A. The dotted line in panel B represents a one-to-one line; circles above the line represent hindcasts that would have been less than the actual harvest and circles below the line represent hindcasts that would have been more than the actual harvest.

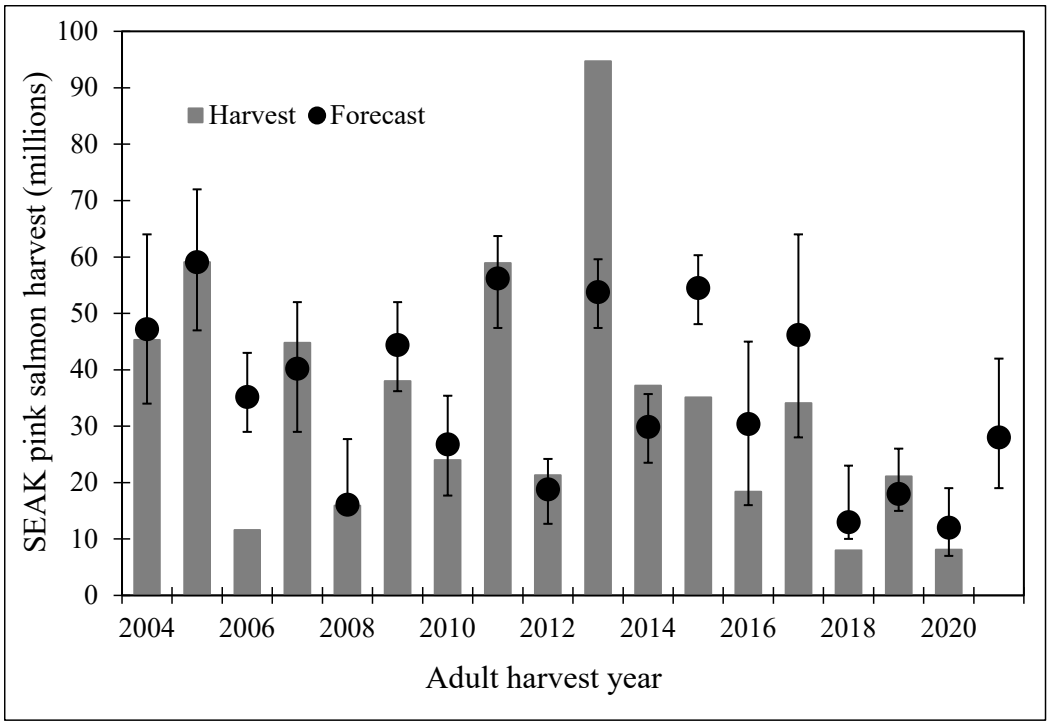

Figure 8.–Annual harvests of pink salmon in SEAK compared to the actual preseason harvest forecasts, 2004–2021. The error bars represent the 80% confidence or prediction intervals of the forecasts.

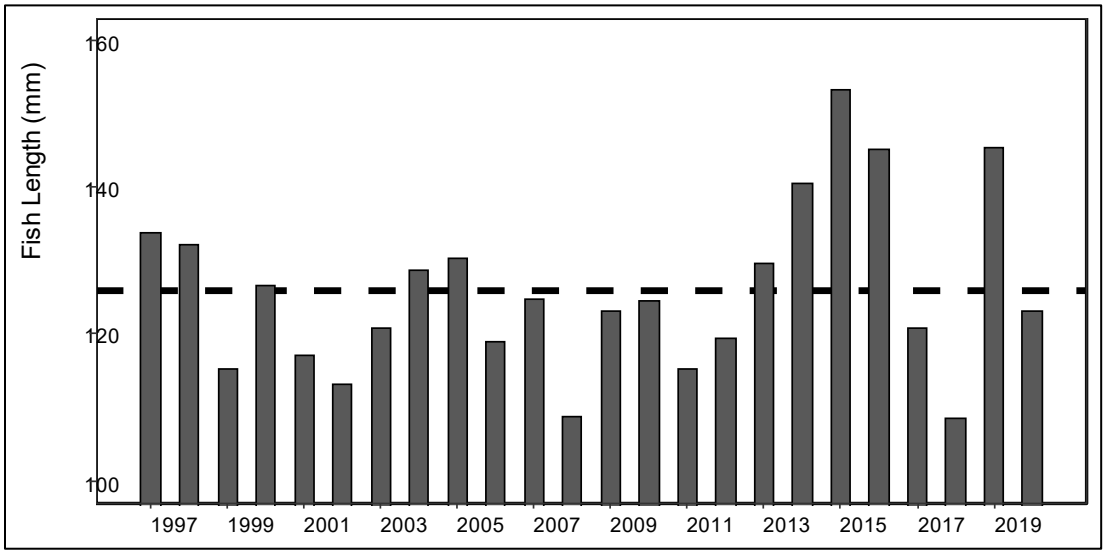

Figure 9.–Average snout to fork length of juvenile pink salmon (standardized to July 24) captured during trawl surveys in upper Chatham and Icy Straits, 1997–2020. The dashed line represents the 1997–2020 average length.

Forecast by Andy Piston, Steve Heinl, Sara Miller, and Rich Brenner, ADF&G; and Jim Murphy, Jamal Moss, Wes Strasburger, Emily Fergusson, and Andrew Gray, NOAA, Auke Bay Lab, Alaska Fisheries Science Center.

CENTRAL REGION

COPPER RIVER AND PRINCE WILLIAM SOUND

Forecasts of total run were calculated for Copper River wild Chinook and sockeye salmon, Gulkana Hatchery sockeye salmon, Coghill Lake sockeye salmon, and for wild PWS pink and chum salmon (Table 10). PWSAC and VFDA provide additional forecasts for hatchery-specific stocks. In addition to forecasts, a summary of recent 10-year averages (2011–2020) of Commercial Common Property Fishery (CCPF) harvest for most wild stocks and Gulkana Hatchery production is included (Table 11). Salmon forecasts are inherently uncertain and are primarily used to gauge the magnitude of expected runs and set early-season harvest management strategy. In 2021, ADF&G will continue to manage PWS Area commercial salmon fisheries inseason based primarily on the strength of salmon abundance indices including sonar counts, weir passage, aerial escapement surveys, and fishery performance data.

Table 10.–2021 Prince William Sound Area formal salmon forecast summary (thousands of fish).

Area/Production Type	Species	Forecast type	Forecast point	Forecast range	% above/below 10-yr avg.
Copper River					
Wild Production	Chinook salmon	Total run	37	22–53	22.4% below
Wild Production	Sockeye salmon	Total run	1,296	724–1,869	37.4% below
Gulkana Hatchery Production	Sockeye salmon	Total run	51	28–73	81.1% below
Total Production	Sockeye salmon	Total run	1,347	749–1,945	
Coghill Lake					
Wild Production	Sockeye salmon	Total run	282	190–375	45.4% above
Prince William Sound					
Wild Production	Pink salmon	Total run	19,187	10,088–28,286	27.5% above
Wild Production	Chum salmon	Total run	508	246–769	4.7% above

Table 11.–Prince William Sound Area recent 10-year (2011–2020) average CCPF salmon harvest by species (thousands of fish).

Area/Production Type	Chinook	Sockeye	Coho	Pink	Chum	Total
Bering River						
Wild Production	0	4	61	0	0	65
Copper River						
Wild Production	13	1,048	218	61[b]	16	1,347
Hatchery Production	0	182	0	0	0	182
Total Production	13	1,230	218	61[b]	16	1,529
Prince William Sound						
Wild Production	1	213	N/A[a]	11,946[b]	282	12,442
Area Totals						
Wild Production	14	1,265	280	11,998	298	13,854

[a] Estimates of wild coho salmon harvests in are not available due to limited samples of thermally marked coho otoliths from the commercial harvest.

[b] Recent 20 odd-year CCPF harvest (2001–2019).

Copper River Area

Chinook Salmon

The 2021 Copper River Chinook salmon total run point estimate is 37,000 fish (80% prediction interval: 22,000–53,000 fish). The recent 10-year average (2011–2020) Copper River Chinook salmon total run is 48,000 fish. Subtracting the lower-bound SEG of 24,000 fish from the total run forecast results in a common property harvest point estimate (all fisheries) of 13,000 fish (range: 0–29,000 fish).

Forecast Methods: For 2021, the Copper River Chinook salmon state-space model was chosen as the forecast method. This model simultaneously reconstructs runs and fits a spawner-recruit model to estimate total return, escapement, and recruitment of Copper River Chinook salmon from 1999 to 2020. Methods and details of this analysis are covered in separate reports (Joy et al. 2021; Savereide et al. 2018). The model uses harvest, age composition, and direct measures of inriver run abundance to estimate parameters that describe the spawner-recruit relationship for this stock. Uncertainty from the run reconstruction is passed through to the spawner-recruit analysis and all relevant data are considered and weighted by their precision. The model accommodates missing data, measurement error in the data, and changes in age at maturity.

Several forecast methods were examined for the 2021 Copper River Chinook salmon total run forecast including exponential smoothing, 2-, 3-, and 5-year running averages of total run, and projections from the Copper River Chinook salmon state-space model. The state-space model performed similarly when compared retrospectively to the simple average-based methods historically used to forecast this stock, but it used more biological information to predict future runs. The state-space model outperformed the average-based models by having a lower mean absolute percentage error (MAPE), mean squared error (MSE), and mean percentage error (MPE) when compared retrospectively. 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. There are currently 22 years (1999–2020) of inriver abundance estimates available for this analysis. The 80% prediction intervals were calculated from the posterior distributions of the model parameters, including the predicted run size for 2021.

Sockeye Salmon

The 2021 wild Copper River sockeye salmon total run point estimate is 1,296,000 fish (80% prediction interval: 724,000–1,869,000 fish). The recent 10-year average (2011–2020) Copper River wild sockeye salmon total run is 2,070,000 fish. Gulkana Hatchery sockeye salmon total run is predicted to be 51,000 fish (80% prediction interval: 28,000–73,000 fish) for a total Copper River sockeye salmon run (wild + hatchery production) of 1,347,000 fish (80% prediction interval: 749,000–1,945,000 fish). Total Copper River sockeye salmon common property harvest (all fisheries) is predicted to be 844,000 fish (80% prediction interval: 429,000–1,259,000 fish) with a CCPF harvest of 652,000 fish (80% prediction interval: 237,000–1,067,000 fish).

Forecast Methods: The 2021 forecast of wild 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, -2.2, and -2.3 fish. These 4 age classes were predicted from the relationship between returns of each age class and returns of the age class 1 year younger from the same brood year. Predicted return of age-1.1 and -0.3 sockeye salmon were calculated as the 5-year (2016–2020) mean return of those age classes. The 2021 run to Gulkana Hatchery was

estimated as the recent 5-year weighted average fry-to-adult survival estimate (0.50%) from all Gulkana I and Gulkana II Hatchery releases combined (onsite and remote). The run was apportioned to brood year using a maturity schedule of 30% age-4 and 70% age-5.

The total common property (all fisheries) 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 CCPF harvest estimate was calculated by subtracting inriver goal categories (5 AAC 24.360(b)) and the Copper River Delta spawning escapement goal from the total run forecast. An estimated exploitation rate of 70% was used to project the total harvest of Gulkana Hatchery stocks in 2021. There are currently 56 years (1965–2020) of harvest, escapement, and age composition data available for this analysis. Total run 80% prediction intervals were calculated from the MSE of the retrospective forecast predictions.

Prince William Sound Area

Sockeye Salmon

The 2021 Coghill Lake sockeye salmon total run point estimate is 282,000 fish (80% prediction interval: 190,000–375,000 fish). Subtracting the escapement target of 30,000 fish from the total run forecast results in a common property harvest point estimate (all fisheries) of 252,000 fish (range 160,000–345,000 fish). The recent 10-year average (2010–2019) Coghill Lake sockeye salmon total run is 194,000 fish.

Forecast Method: The 2021 sockeye salmon run forecast to Coghill Lake is the total of estimates for 5 age classes. Linear regression models with log-transformed data were used to predict returns of age-1.3 and -1.2 fish. These linear regression models were parameterized using the historical relationship between returns of age-1.3 fish and returns of age-1.2 fish 1 year previously, and returns of age-1.2 fish and returns of age-1.1 fish 1 year previously (sibling models). For example, the model to predict the return of age-1.3 fish in 2021 used the return of age-1.2 fish in 2020 as the input parameter. An estimated 69,800 age-1.2 sockeye salmon returned to Coghill Lake in 2020, 42% above the recent 10-year average run of 49,000 age-1.2 fish, resulting in a forecast of 187,000 age-1.3 fish for 2021 (66% of the predicted 2021 total run). An estimated 6,600 age-1.1 sockeye salmon returned to Coghill Lake in 2020, above the recent 10-year average run of 2,500 age-1.1 fish, resulting in a forecast of 84,000 age-1.2 fish for 2021 (30% of the predicted 2021 total run). Predicted returns of age-1.1, -2.2, and -2.3 sockeye salmon were calculated as the 2011–2020 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 reduce forecast reliability. Therefore, only data collected since 1974 were used. Total run by year was estimated as the total commercial harvest contribution combined with the Coghill River weir escapement count. The 80% prediction intervals for the Coghill Lake sockeye salmon total run were calculated using the squared deviations between the 2016–2020 forecasts and actual runs as the forecast variance.

Pink Salmon (natural run only)

The 2021 PWS wild pink salmon total run point estimate is 19,187,000 fish (80% prediction interval: 10,088,000–28,286,000 fish). The recent 10 odd-year average (2001–2019) of PWS wild pink salmon total run is 15,053,000 fish.

Forecast Methods: The 2021 PWS wild pink salmon total run forecast uses the exponential smoothing method. Several models were examined for 2021 including exponential smoothing and 2-, 3-, and 5-year running averages of past odd-year total runs. Exponential smoothing and moving average models produced similar forecast results in the 19.2–24.0 million fish range. Exponential smoothing and 2-year running average forecasts had very similar performance and outperformed 3- and 5-year running average models when compared retrospectively. The exponential smoothing forecast was selected for 2021 because it marginally outperformed the 2-year running average forecast by having a slightly lower MSE, MPE, and bias when compared retrospectively. The exponential smoothing technique is similar to a running average except that all observations of odd-year total run since 1981 were used in the forecast estimate. Recent observations of total run were weighted more heavily in the analysis and past total run observations were increasingly downweighted with time, resulting in older total run observations having less influence on the forecast than more recent observations. The 80% prediction intervals were calculated from the MSE of the retrospective forecast predictions.

Total wild run of pink salmon by year was estimated as the total wild (nonhatchery) contribution to commercial harvests combined with stream escapement indices. The stream escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. Hatchery and wild stock contributions were determined from thermal marked otolith recoveries (1997–2019), coded wire tag recoveries (1985–1996), or average fry-to-adult survival estimates multiplied by fry production and estimated exploitation rates (1977–1984).

There is considerable uncertainty regarding the spawning success of wild pink salmon returning to PWS in 2019 due to severe drought conditions that persisted through much of pink salmon spawn timing. Prespawn mortality, lack of water in spawning streams, and high water temperatures were observed in 2019. This forecast does not integrate environmental indices or other indicators of spawning success and the 2021 prediction takes no account of the anomalous conditions observed during the parent year.

Chum Salmon (natural run only)

The 2021 PWS wild chum salmon total run point estimate is 508,000 fish (80% prediction interval: 246,000–769,000 fish). The recent 10-year average (2011–2020) PWS wild chum salmon total run is 485,000 fish.

Forecast Methods: The 2021 PWS wild chum salmon total run forecast uses the 2-year running average method. Several models were examined for the 2021 PWS wild chum total run forecast including exponential smoothing and 2-, 3-, and 5-year running averages of past total runs. For 2021, 2-year running average outperformed the other models by having the lowest mean absolute percentage error MAPE, MSE, and MPE, MASE, median symmetrical accuracy, and relatively low bias when compared retrospectively. The 80% prediction intervals were calculated from the MSE of the retrospective forecast predictions.

Total wild run of chum salmon by year was estimated as the total wild (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. Hatchery and wild stock contributions were estimated using prehatchery average natural runs (1998–2003) or thermally marked otolith estimates (2004–2020) for each district in PWS.

Forecast by Stormy Haught, Area Finfish Research Biologist, ADF&G, Cordova.

UPPER COOK INLET

Sockeye Salmon

The forecasts of the 2021 UCI sockeye salmon run and harvests are presented in Table 12.

Table 12.–2021 Upper Cook Inlet sockeye salmon run and harvests.

Total production	Forecast estimate (millions)	Forecast range (millions)
Total Run	4.37	2.89–8.99
Escapement	2.00	
Commercial fishery harvest	1.64	
Other Harvests	0.72	

Forecast Methods: The major sockeye salmon systems in 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 model types were evaluated to forecast the total run of sockeye salmon to UCI in 2021: (1) the relationship between adult returns and spawners, (2) the relationship between adult returns and fall fry, (3) the relationship between adult returns and emigrating smolt, and (4) the relationship between sibling returns. Several forecast models were evaluated for each stock and age class. Models that provided the smallest MAPE between the forecasts and actual runs over the past 10 years were selected for the 2021 forecast; however, the 5-year MAPE was used for model selection in cases where the 10-year MAPE values were nearly identical.

For Kenai River sockeye salmon, the return of age-1.3 fish in 2021 was forecasted using a sibling model. The sibling model prediction of the return of age-1.3 fish was based on the abundance estimate of age-1.2 fish that returned to the Kenai River in 2020. A spawner-recruit model was used to predict the age-1.2 fish return based upon the spawning escapement in 2017. The Kenai River return of age-2.2 fish was forecasted using a sibling model based upon the abundance of age-2.1 fish that returned in 2020, and the return of age-2.3 fish was forecasted using a sibling model based upon the abundance of age-2.2 fish that returned in 2020.

For Kasilof River sockeye salmon, returns of age-1.3, -2.2, and -2.3 fish in 2021 were all forecasted using sibling models based upon returns of age-1.2, -2.1, and -2.2 fish in 2020. The return of age-1.2 fish was forecasted using a smolt model of age-1 smolt emigrating in spring 2017.

For Susitna River sockeye salmon, returns of age-0.3, -1.2, -1.3, -2.2, and -2.3 fish in 2021 were forecasted using mean return per spawner by age class for brood years 2006–2017. Mark–recapture estimates of inriver run and genetic estimates of commercial harvest were available for these brood years.

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

The estimated total harvest of sockeye salmon by all user groups was calculated by subtracting the aggregate escapement from the total run forecast for all stocks. Aggregate escapement was estimated as the sum of the midpoints of the escapement goal ranges for each of the monitored

sockeye salmon-producing systems (Table 13) and the escapement into unmonitored systems, which was estimated as 17% of the escapement to the monitored systems.

The 2021 total UCI run forecast point estimate is 4.37 million sockeye salmon. Based on the absolute percentage error for the historical forecasted UCI runs compared with the actual runs, there is an 80% probability that the 2021 UCI forecast range falls between 2.89 million and 8.99 million fish.

For comparison, the 2020 sockeye salmon run (4.36 million fish) was 2% above forecast (4.27 million fish). In 2020, the estimated total run was 2.55 million fish to the Kenai River, 821,000 fish to the Kasilof River, 380,000 fish to the Susitna River, and 74,000 fish to Fish Creek. The 2020 run forecast was 2.23 million fish to the Kenai River, 723,000 fish to the Kasilof River, 571,000 fish to the Susitna River, and 121,000 fish to Fish Creek. In 2020, the commercial harvest of 700,000 sockeye salmon in UCI was 1.15 million fewer fish than the preseason forecast of 1.85 million.

*Forecast Discussi*on: In 2021, a run of approximately 4.37 million sockeye salmon is forecasted to return to UCI with an estimate of 2.37 million fish available for harvest (commercial, sport, personal use, subsistence).

The run forecast for the Kenai River is approximately 2.33 million sockeye salmon, which is 1.29 million fewer (36%) than the 20-year average run of 3.61 million fish, but only 500,000 fewer than the 5-year average (Table 13). For the age-1.2 forecast, a spawner-recruit model forecast a return of 367,000 sockeye salmon in 2021 (Tables 13 and 14). The age-1.2 forecast lies between the 20-year and 5-year averages (Table 13). A sibling model based upon the return of age-1.2 fish predicts a return of 1.67 million age-1.3 fish in 2021 (Tables 13 and 14). The age-1.3 forecast return is 24% less than the 20-year average and 9% less than the 5-year average (Table 13). A sibling model based on the return of age-2.1 fish in 2020 forecast a return of 120,000 age-2.2 fish for 2021 (Tables 13 and 14). The age-2.2 return forecast is 47% less than the 20-year average but is about 2% greater than the 5-year average return (Table 13). A sibling model based upon the return of 74,000 age-2.2 fish in 2020 (vs 20-year average of 225,000) predicts a return of 122,000 age-2.3 fish (Table 13). The age-2.3 return forecast is substantially less than both the 20-year average return (83%) and 5-year average return (77%; Table 13). The predominant age classes in the 2021 run forecast are age-1.2 (16%) and age-1.3 (72%). The 10-year MAPE for the set of models used for the 2021 Kenai sockeye salmon run forecast is 17%.

The Kasilof River sockeye salmon run forecast is 881,000 fish. The 2021 forecast is 105,000 (12%) fewer fish than the 20-year average and 168,000 (24%) more fish than the 5-year average (Table 13). A smolt model based on the emigration of age-1 smolt in 2018 forecast a return 383,000 age-1.2 fish in 2021 (Tables 13 and 14). The age-1.2 forecast is 13% larger than the 20-year average return and is 18% greater than the 5-year average return. A sibling model based upon the return of age-1.2 salmon in 2020 (493,000; 340,000 20-year average) was used to forecast a return of 390,000 age-1.3 salmon in 2021 (Tables 13 and 14). The 2021 age-1.3 forecast return is 27% and 125% greater than the 20-year and 5-year average returns. A sibling model based upon the return of age-2.1 fish in 2020 was used to forecast a return of 73,000 age-2.2 fish in 2021. The 2021 age-2.2 forecast is 70% less than the 20-year average (Table 13) and 56% less than the 5-year average (Table 13). The predominant age classes in the 2021 run forecast are age-1.2 (44%), age-1.3 (44%), and age-2.2 (8%). The 10-year MAPE for the set of models used for the 2021 Kasilof sockeye salmon run forecast is 22%.

The Susitna River sockeye salmon run forecast is 436,000 fish, which is 59,000 (16%) more fish than the 10-year average of 377,000 fish (Table 13). This forecast was derived using mean return per spawner by age class and mark–recapture estimates of spawner abundance for brood years 2006–2016. Sonar estimates of spawner abundance were not used because mark–recapture studies have shown that the Yentna River sonar project underestimated sockeye salmon escapement, causing estimates of adult returns to also be underestimated. The 5-year MAPE for this forecast method is 26%. The predominant age classes in the 2021 Susitna sockeye salmon run forecast are estimated to be age-1.2 (21%) and age-1.3 (53%).

The Fish Creek sockeye salmon run forecast for 2021 is 92,000 fish. This forecast is approximately 6,000 (7%) more fish than the 20-year average run of 86,000 fish (Table 13). Sibling models based upon the returns of age-1.1, -1.2, -2.1, and -2.2 fish in 2020 was used to forecast the 2021 returns. The predominant age classes in the 2021 Fish Creek run forecast are estimated to be age-1.2 (67%) and age-1.3 (18%). The 10-year MAPE for the Fish Creek sockeye salmon run forecast is 79%.

Table 13.–2021 Sockeye salmon run forecasts, 20-year and 5-year average runs and escapement goals (in thousands of fish) to individual freshwater systems in Upper Cook Inlet.

		Major age classes					
System		1.2	1.3	2.2	2.3	Total run[a]	Escapement goals[b]
Kenai River	Forecast	367	1,670	120	122	2,325	1,100–1,400[c]
	20-yr average	396	2,184	225	738	3,615	
	5-yr average	328	1,828	118	527	2,854	
Kasilof River	Forecast	383	390	73	17	881	140–320
	20-yr average	340	307	246	73	986	
	5-yr average	324	173	167	33	713	
Susitna River	Forecast	91	233	31	44	436	Lakes Goals[d]
	10-yr average	103	186	25	30	377	
	5-yr average	107	155	24	24	322	
Fish Creek	Forecast	62	17	6	1	92	15–45
	20-yr average	51	19	6	2	86	
	5-yr average	61	22	4	1	91	
Unmonitored	Forecast	154	395	39	31	639	No Goal
	20-yr average	152	461	86	144	866	
	5-yr average	139	368	53	99	677	
Total Run	Forecast	1,057	2,705	269	216	4,373	
	20-yr average	1,043	3,157	589	987	5,929	
	5-yr average	959	2,534	366	684	4,657	

[a] Total run includes all age classes.

[b] Specific goal types are as follows: Kenai River, inriver; Kasilof River, biological escapement goal (BEG); Susitna River (3 weir goals) and Fish Creek, sustainable escapement goal (SEG).

[c] Inriver goal for sockeye salmon runs greater than 2.3 million fish measured using sonar at river mile 19 on the Kenai River.

[d] Susitna sockeye salmon are managed to achieve escapement goals at Larson, Chelatna and Judd Lakes weirs. Current escapement goals for these lakes are Larson 15,000–35,000 fish, Chelatna 20,000–45,000 fish, and Judd 15,000–40,000 fish. Chelatna Lake weir may not be operated in 2021.

Table 14.–2021 UCI forecast model, prediction, 10-year MAPE, 5-year MAPE, *P-value* and adjusted R-square. Boxed values chosen for 2021 preseason forecast.

River	Age class	Model	Prediction	10-year MAPE	5-year MAPE	*P-value*	Adj R-square
Kenai	1.2	Log R vs Log S	358,319	0.441	0.573	<0.0001	0.2911
		Standard Ricker	370,382	0.426	0.576	<0.0001	0.2727
		Brood Interaction Model	366,582	0.416	0.482	0.0001	0.2574
	1.3	Log R vs Log Fry	2,064,295	0.472	0.599	0.0124	0.1693
		Log R = Log Fry CFSWT	2,526,074	0.279	0.332	0.0001	0.4680
		Log Sibling	1,670,361	0.278	0.285	<0.0001	0.5478
	2.2	Log R vs Log S	211,015	0.925	1.586	0.0367	0.0717
		Log Sibling	194,809	0.804	1.408	0.0073	0.1392
		Log Sibling AR1	119,890	0.524	0.815	<0.0001	NA
		5-year average	115,913	0.892	1.238	NA	NA
	2.3	Sibling omit4	267,229	1.372	1.467	0.0001	0.2878
		Sibling	446,300	2.067	3.648	0.0837	0.0442
		Log Sibling	142,722	1.004	1.473	<0.0001	0.3064
		Log Sibling omit4	122,488	0.880	1.219	<0.0001	0.4096
		Fall Fry age-1 Smolt age-2	644,924	1.836	3.183	0.0005	0.3254
Kasilof	1.2	Log R vs Log S	289,305	0.496	0.267	0.0002	0.2496
		Log R vs Log S AR1	406,476	0.427	0.332	0.0072	NA
		Log Sibling	244,623	0.449	0.337	0.0116	0.1094
		Log Smolt	268,949	0.370	0.319	0.0106	0.1574
		Log Smolt AR2	382,998	0.299	0.294	0.0024	NA
	1.3	Log Sibling	389,903	0.582	0.808	<0.0001	0.4205
		Log Sibling AR1	452,734	0.762	1.124	0.0019	NA
	2.2	Log R vs Log S	162,720	0.812	1.361	<0.0001	0.4891
		Log R vs Log S AR1	84,664	0.435	0.651	0.2345	NA
		Sibling AR2	90,712	0.379	0.589	0.0006	NA
		Log Sibling	72,833	0.253	0.383	0.0029	0.1594
		Log Sibling AR1	78,961	0.322	0.459	<0.0001	NA
	2.3	Sibling	49,419	4.983	9.162	0.0001	0.2664
		Sibling AR2	16,858	4.216	7.685	0.0322	NA
		Log Sibling	34,559	4.692	8.525	<0.0001	0.3977
		Log Smolt	68,821	3.243	3.580	0.6668	-0.0252

Other Salmon Species

Forecast Methods: The recent 5-year average commercial harvest was used to forecast the harvest of chum, coho, and Chinook salmon in 2021 (Table 15). The forecast for pink salmon is based upon the average harvest during the previous 5 odd-numbered years.

Table 15.–The forecast of the 2021 Upper Cook Inlet commercial harvest of other salmon species.

Species	Commercial harvest forecasts
Pink salmon	74,000
Chum salmon	127,000
Coho salmon	191,000
Chinook salmon	5,390

Forecast Discussion: The recent 5-year average commercial harvest was used in the forecast, because harvests in these years likely best represent harvests under current regulations.

Forecast by Bob DeCino and Brian Marston, ADF&G, Soldotna. For more information they can be reached at (907) 262-9368.

LOWER COOK INLET

Pink Salmon

Forecast Methods: A naïve forecast based on historical odd-year pink salmon harvests (1961–2019) was used to predict the 2021 pink salmon CPF harvest in LCI (Table 16). Similar to methods used in PWS and SEAK, several trend forecast models were evaluated to determine which best fit the data, including exponential smoothing and 2-, 3-, and 5-year running averages of past odd-year CPF harvests. Exponential smoothing and moving average models using log-transformed data inputs produced a wide range of point forecasts (536,600–2,451,300 fish). The 2-year running average model using odd-year data inputs outperformed the other models based on comparison of several performance metrics (e.g., bias, MSE, root mean squared error [RMSE], and MASE). The 80% confidence intervals were calculated from the MSE of the retrospective forecast predictions.

Table 16.–Preliminary forecast of the 2021 Lower Cook Inlet area pink salmon harvest.

	Forecast estimate (thousands)	Forecast range (thousands)
Common property fishery (CPF) harvest	1,851	338–3,365

Note: CPF harvest refers to fish available for harvest outside of hatchery special harvest areas (SHAs); no prediction of fishing effort is made. Additional CPF and hatchery cost-recovery harvests may be expected from hatchery returns in and around SHAs. Lower Cook Inlet hatchery forecasts are available from Cook Inlet Aquaculture Association: http://www.ciaanet.org.

Forecast Discussion: The 2021 CPF harvest forecast of 1,851,500 pink salmon has a forecast range of 338,200–3,364,800 fish. If realized, a CPF harvest of 1,851,500 fish would be approximately 11% lower than the recent 5-year average CPF harvest of 2,083,000 fish for odd-year runs between 2011 and 2019.

Prior to 2019, the odd-year LCI pink salmon forecast consisted of a wild stock total run forecast based on a logarithmic regression of total run and escapement from over 50 years of observations on 10 index streams, and a hatchery/supplemental production forecast provided by Cook Inlet Aquaculture Association (CIAA). However, preliminary results from otolith sampling in LCI during 2014–2020 suggest high proportions of hatchery-marked fish in the harvest and escapement samples collected from some index streams may confound the viability of spawner-recruit based run forecasts. Consequently, the decision was made to produce a CPF harvest forecast in lieu of the total run forecast.

Because pink salmon exhibit a 2-year life cycle, comparisons of run size are stratified by odd and even years to account for dominance of 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. Odd/even year dominance is not synchronous across individual stocks within years and odd- and even-year runs across all years are only modestly dissimilar (odd-year runs are ~14% higher). However, areawide total runs exhibit 4–12 year periods during which production from 1 line is 19–56% higher than the other, on average. So, 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 these short-term dominance cycles. The odd-year brood line

has been dominant in LCI since 2011 (5 generations); however, the 2020 total run was considerably larger than forecast and may indicate a pending shift away from odd-year dominance.

In 2019, the parent year for the upcoming 2021 return, LCI experienced a wide range of escapements to pink salmon index streams. Three of 18 stocks with SEGs failed to achieve the low end of their escapement goal ranges, including one of the larger producers in the Southern District (Seldovia River), but 10 stocks exceeded their SEG range, including most of the major producers in the Outer District (e.g., Dogfish, Port Chatham, Windy Bay (Right Creek), Rocky River, Port Dick, and Island Creek). It is difficult to predict shifts in dominance between odd- and even-year lines of pink salmon before they occur. However, if the unexpectedly large 2020 run indicates a shift to even-year dominance is occurring in LCI, then it is likely the 2021 harvest of naturally produced pink salmon may be less than the midpoint of the forecast range.

Other Salmon Species

Forecast Method: Naïve forecasts based on historical harvests (1960–2020) were used to predict the 2021 CPF harvest of other, less abundant salmon species in LCI (Table 17). Similar to methods used in PWS and SEAK, several trend forecast models were evaluated to determine which best fit the data, including exponential smoothing and 2-, 3-, and 5-year running averages of past CPF harvests. Log-transformed and nonlogged historical harvest datasets were evaluated with each model and the final forecast was selected based on comparison of several performance metrics (e.g., bias, MSE, RMSE, MPE, MAPE, and MASE).

Forecast Discussion: Prior to 2018, the recent 5-year average harvest was used to forecast the LCI sockeye, chum, coho, and Chinook salmon CPF harvest for the coming year. Beginning in 2018, for consistency, we transitioned to the same trend forecast methods we used for LCI pink salmon. Context for how the current harvest forecast compares to the recent 5-year average CPF harvest for each species is provided in Table 17.

Table 17.–Preliminary forecast of the 2021 Lower Cook Inlet area CPF harvest of other, less abundant salmon species

Species	Model	Forecast (point)	Forecast (range)	% above/below 5-yr average
Sockeye salmon[a]	5-year running average	132,700	54,900–320,600	4% lower
Chum salmon	Exponential smoothing	33,500	6,100–185,400	56% lower
Coho salmon	2-year running average	6,400	1,200–34,800	29% lower
Chinook salmon	2-year running average	610	150–1,070	4% lower

[a] Additional CPF and hatchery cost-recovery harvests of sockeye salmon may be expected from hatchery returns in and around hatchery special harvest areas (SHAs). Lower Cook Inlet hatchery forecasts are available from Cook Inlet Aquaculture Association: http://www.ciaanet.org.

Forecast by Edward O. Otis, Area Finfish Research Biologist, ADF&G, Homer; and Glenn J. Hollowell, Area Finfish Management Biologist, ADF&G, Homer.

BRISTOL BAY AREA

Sockeye Salmon

Forecast Methods: The 2021 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 (age-1.2, -1.3, -2.2, and -2.3; and age-0.3 and -1.4

for the Nushagak River). Adult escapement and return data from brood years 1972–2017 were used in the analyses (Table 18).

Table 18.–Preliminary forecast of the 2021 Bristol Bay area sockeye salmon run.

Total production	Forecast (million)	Forecast range (millions)
Total run	51.06	38.00–64.11
Escapement	13.69	
Commercial harvest	37.37	
Bristol Bay harvest	36.35	
South Peninsula harvest	1.02	
Inshore run	50.04	

Forecasts for each age class returning to a river system were derived from models based on the relationship between adult returns of that age class and either total returns or sibling returns from the same brood years. The average return over the last 5 years was also considered as a forecast model. In general, models with statistically significant parameters and/or the best past performance metrics were chosen. Performance was evaluated using mean absolute deviation, MAPE, mean arctangent absolute percent error, and MPE between forecasted and observed returns measured across the most recent 3- and 5-year time frames. In certain cases, competing models were averaged in a weighted hybrid model approach.

Where practical, ADF&G will manage escapements proportional to the run size and relative to the historical record (5 AAC 06.355(d)(1)). Escapement is projected as the 75th quartile of the escapement range if the forecast is above the historical average (Naknek, Egegik, Ugashik, Wood, and Nushagak Rivers in 2021), as the midpoint (50th quartile) of the escapement range if the forecast is in line with the historical average (Igushik and Togiak Rivers in 2021), and as the 25th quartile of the escapement goal range if the forecast is below the recent historical average (Kvichak River in 2021; Table 19). 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. About 2% of the Bristol Bay return is thought to be intercepted in the South Peninsula in June and that interception in other areas is trivial for the purposes of run reconstruction and forecasting. Preseason harvest projections are provided to aid industry in planning. Once the run begins to develop, ADF&G relies on catch and escapement data for management decisions.

A total of 51.06 million sockeye salmon (range of 38.00–64.11 million fish) are expected to return to Bristol Bay in 2021. This is 6% larger than the most recent 10-year average of Bristol Bay total runs (48.14 million) and 45% greater than the long-term (1963–2020) average of 35.12 million fish. All systems are expected to meet their spawning escapement goals. 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 2003 through 2020.

A run of 51.06 million sockeye salmon would allow for a potential total harvest of 37.37 million fish: 36.35 million fish in Bristol Bay and 1.02 million fish in the South Peninsula fisheries. A Bristol Bay harvest of this size is 13% greater than the most recent 10-year harvest of 32.23 million fish (range 15.38–42.94 million), and 40% greater than the long-term average harvest of 21.88 million fish (1963 to present).

The sockeye salmon run forecast for each district and river system is as follows: 17.35 million fish to Naknek-Kvichak District (6.37 million to the Kvichak River, 3.75 million to the Alagnak River, and 7.23 million to the Naknek River); 11.18 million fish to the Egegik District; 6.66 million fish to the Ugashik District; 15.06 million fish to the Nushagak District (7.94 million to the Wood River, 5.76 million to the Nushagak River, and 1.35 million to the Igushik River); and 820,000 fish to the Togiak District (Table 19).

We forecast that the 2021 run will consist of 23.82 million age-1.2 fish (47% of the total run), 5.25 million age-2.2 fish (10% of the total run), 19.93 million age-1.3 fish (39% of the total run), and 2.01 million age-2.3 fish (4% of the total run; Table 19).

Table 19.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay river systems, 2021.

	Millions of sockeye salmon								
	Forecasted production by age class					Forecasted		South	Bristol Bay
DISTRICT/River	1.2	2.2	1.3	2.3	Total	Esc.	Harvest	Peninsula[a]	Inshore
NAKNEK-KVICHAK									
Kvichak	3.21	0.55	2.54	0.07	6.37	4.00	2.24	0.13	6.24
Alagnak	1.70	0.12	1.84	0.09	3.75	2.35	1.32	0.07	3.67
Naknek	3.19	0.27	3.45	0.32	7.23	1.70	5.39	0.14	7.09
Total	8.10	0.94	7.82	0.48	17.35	8.05	8.95	0.35	17.00
EGEGIK	4.33	3.51	2.05	1.29	11.18	1.70	9.26	0.22	10.96
UGASHIK	3.89	0.64	1.97	0.16	6.66	1.18	5.35	0.13	6.52
NUSHAGAK									
Wood	5.31	0.12	2.47	0.04	7.94	1.53	6.26	0.16	7.79
Igushik	0.39	0.01	0.94	0.01	1.35	0.28	1.05	0.03	1.32
Nushagak	1.48	0.03	4.17	0.02	5.76[b]	0.77	4.88	0.11	5.65
Total	7.19	0.15	7.59	0.07	15.06	2.57	12.19	0.30	14.76
TOGIAK	0.31	0.01	0.50	0.00	0.82	0.20	0.60 [c]	0.02	0.80
BRISTOL BAY	23.82	5.25	19.93	2.01	51.06	13.69	36.35	1.02	50.04

Note: This table is a summary. Slight differences may appear due to rounding.

[a] Projected harvest is based on the current 5-year running average exploitation rate of 2.0%.

[b] Nushagak River forecast total includes approximately 52,000 age-0.3 and age-1.4 fish.

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

Forecast Discussion: Historically, sockeye salmon runs to Bristol Bay have been highly variable. The Bristol Bay total run has averaged 35.12 million fish from 1963 through 2020 and has averaged 48.14 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—which has performed well when applied to Bristol Bay as a whole. Since 2001, our forecasts have, on average, underforecast the run by 11% and have ranged from 36% below the actual run in 2014 to 21% above the actual run in 2011. Forecasted harvests have had a MAPE of 15% since 2001.

Individual river forecasts have greater uncertainty compared to baywide forecasts. Since 2001, on average, we have underforecast returns to the Alagnak (-32%), Togiak (-14%), Kvichak (-20%),

Wood (-18%), Nushagak (-21%), Ugashik (-1%), and Naknek (-16%) Rivers, and overforecast returns to the Igushik (+13%) and Egegik Rivers (+12%). Overforecasting returns to some rivers and underforecasting returns to other rivers means that the overall Bristol Bay forecast is often more accurate than the forecast to any individual river.

Forecast by Greg Buck, Jordan Head, and Stacy Vega, ADF&G, Division of Commercial Fisheries, Bristol Bay.

ARCTIC-YUKON-KUSKOKWIM REGION

All Salmon

ADF&G prepares formal run forecasts annually for the following stocks in the AYK Region: Kuskokwim River Chinook salmon, Yukon River Chinook salmon, Canadian-origin Yukon River Chinook salmon, Yukon River summer chum salmon, and Yukon River fall chum salmon. Of these, only the Yukon River fall chum salmon forecast method and discussion is presented in this report. For the remaining stocks, a brief summary is provided.

The Kuskokwim River Chinook salmon run forecast is based on the estimated run size from the prior year (midpoint), and uncertainty is represented as the recent 7-year average percent error between forecasted and actual run estimates. The preliminary 2021 Kuskokwim River Chinook salmon forecast is for a range of 85,000–145,000 fish. The drainagewide Chinook salmon escapement goal is 65,000–120,000 fish. If the run comes back as projected, the drainagewide escapement goal is expected to be achieved and a limited subsistence harvest may be realized. There is currently no commercial buyer in the Kuskokwim Area, and commercial harvest of Chinook salmon is not expected during the 2021 season.

Separate forecasts are prepared for Canadian-origin Yukon River Chinook salmon and total run. The Canadian-origin run forecast is produced by a U.S./Canada Joint Technical Committee and presented to the Yukon River Panel. The 2021 forecast is based on projections of brood year returns, sibling relationships, and juvenile abundance estimates from marine trawl surveys conducted in the northeastern Bering Sea. An integrated forecast was produced by weighting each contributing model such that models that best fit the observed historical run sizes are given more weight. The 2021 Canadian-origin Chinook salmon forecast is for a run size of 42,000–77,000 fish (80% confidence interval). The interim management escapement goal for this stock component is 42,500–55,000 fish. The Canadian-origin forecast informs the drainagewide Chinook salmon outlook, because the Canadian-origin run represents approximately 40% of the total run. Yukon River Chinook salmon is classified as a *stock of yield concern* under the Sustainable Salmon Fisheries Policy. Direct commercial harvest of Yukon River Chinook salmon is not expected during the 2021 season.

Historically, the Yukon River drainagewide summer chum salmon forecast was developed by forecasting the run size of the Anvik River component and then scaling up based on the historical contribution of the Anvik River to the total run. The Anvik River sonar did not operate in 2020 due to COVID-19 related travel restrictions. The 2021 Yukon River summer chum salmon run forecast is based on drainagewide projections of brood year returns, sibling relationships, age class proportions, and the average of the 5 most recent returns by age class. The drainagewide summer chum salmon forecast is for a below average run of 700,000–1,700,000 (80% confidence interval). The large uncertainty in the 2021 forecast is due to the range of models used. Sibling-based models projected a small run size due to a very poor return of age-4 fish in 2020, which suggests a poor return of age-5 fish in 2021. Whereas models based on recent year average age class returns indicated the 2021 run size may be closer to average. The drainagewide escapement goal for this stock is 500,000–1,200,000 fish. The 2021 run is anticipated to provide for escapements, a normal subsistence harvest, and at least a small surplus for commercial harvest. The 2021 commercial harvest of summer chum salmon is expected to be affected by measures taken to protect Chinook salmon from incidental harvest in chum salmon-directed fisheries.

ADF&G does not produce formal run forecasts for other salmon stocks returning to the Kuskokwim Area or Yukon Area, or any salmon stocks returning to the Norton Sound Area or Kotzebue Management Area. Consequently, commercial harvest outlooks for these stocks 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 given the fishery management plans in place and commercial processing capacity. Currently, southeastern Norton Sound Chinook salmon stocks are classified as *stocks of yield concern*. In general, management for anticipated low Chinook salmon abundance in 2021, small processing capacity in some areas, and lack of a confirmed commercial buyer in the Kuskokwim area will probably result in chum and sockeye salmon harvests that are lower than the outlook projections in the AYK Region (Table 20).

Table 20.–The 2021 Arctic-Yukon-Kuskokwim area all-salmon commercial harvest outlook by management area, in thousands of fish.

	Salmon species					
Management area	Chinook	Sockeye	Coho	Pink	Summer chum	Fall chum
Kuskokwim River	0	0	0	0	0	0
Kuskokwim Bay	0	0	0	0	0	0
Kuskokwim Area Total[a]	0	0	0	0	0	0
Yukon	0	0	0–50	0	0–570	0–212
Norton Sound	0–1	1–2	50–100	25–75	70–120	0
Kotzebue Sound	0	0	0	0	0	200–300

[a] Currently, there is not a confirmed commercial buyer in the Kuskokwim area in 2021.

YUKON AREA

Fall Chum Salmon

Forecast Methods: The forecast for the 2021 Yukon Area fall chum salmon run is based on run reconstruction of 5 river systems (Tanana, Teedriinjik/Chandalar, Sheenjek, Fishing Branch, and the mainstem Yukon River in Canada) and 4 age classes (age-3 through age-6, with age-4 fish dominating followed by age-5 fish). Adult escapement and return data were used from the complete brood years (1974–2014), production from incomplete brood years (2015 and 2016 was estimated based on return per spawner from brood year returns), and the Ricker model (used to predict returns from the 2017 and 2018 parent years).

Predicted returns were multiplied by corresponding average maturity schedules for odd- and even-numbered parent years to estimate 2021 run size, rounded to the nearest thousand fish. The odd/even maturity schedule from 1974–2014 was used to estimate the 2021 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 2020.

The 2021 projected run size of fall chum salmon for the Yukon Area is approximately 652,000 fish. This forecast is below average for odd-numbered year runs; however, recent runs have fluctuated more widely and have produced runs as low as 252,000 fish in 2000 to as high as 2.2 million fish in 2005. The 80% confidence bounds for the 2021 forecast range from 542,000 to 762,000 fall chum salmon (Table 21). 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 limited surplus for commercial harvest.

Table 21.–Preliminary forecast of the 2021 Yukon Area fall chum salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	652	542–762
Escapement goal	450	300–600
Harvest estimate[a]	200	100–312

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

Drainagewide escapements between 300,000 and 600,000 fall chum salmon provide a mean yield of 462,000 fish. The mean subsistence harvest from 2008 to 2019 for Alaskan subsistence and Canadian aboriginal harvests is 86,000 fish. Targeting the midpoint of the escapement goal of 450,000 fish, ADF&G anticipates a subsistence harvest of no more than 100,000 fish and an available commercial harvest of 0 fish. Commercial harvests may be allowed only on the amount above 550,000 fish based on inseason assessments of run size. 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 given to fishing effort and buying capacity.

The forecasted total run of 652,000 fall chum salmon is expected to be composed of 88% age-4 fish and 7% age-5 fish after the observed reduction in age-4 fish that returned last year. The age-4 component of fall chum salmon runs has varied widely, ranging from 37% (1992) to 94% (2005). Fall chum salmon exhibit an odd-even abundance cycle (averaging 1.2 million fish in odd-numbered years and 816,000 fish in even-numbered years); this pattern was most consistent between 1974 and 1992. Since 1993, the cycle has deteriorated and now wide swings in production are being observed. These swings are primarily thought to be due to conditions in the marine environment, although density dependence may also contribute in some years. The effect of the odd-even cycle was restricted between 1993 and 2002, during which most years' (1993 and 1997–2002) stocks were severely depressed; however, peaks of high returns occurred in 1995, 2005, and 2017. 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 0.26 return per spawner (R/S). Further, from 1974 through 2014 brood years, escapements of over 800,000 fish produced yields above replacement only 2 years out of 11.

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 through 2021, 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 10). High and low cycles in production have changed approximately 34-fold (based on 41 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; 36% of the observed runs were within the range, 36% were below, and 27% were above. Returns of age-4 fish in odd-numbered years are typically 16% higher than in even-numbered years. Sibling relationships for this stock are weak. The major contributor to the 2021 fall chum salmon run is anticipated to be age-4 fish returning from the

2017 parent year. The escapements in 2016 and 2017 both exceeded the upper end of the drainagewide escapement goal range. Productivity was at its lowest in 2005; however, 2016 brood year may be just as poor. The following peak was in the 2009 brood year (2.47 R/S) and was followed by the 2011 brood year which was below replacement (0.76 R/S), showing yet another wide swing in production. The most recent peak occurred from the 2013 brood year (2.64 R/S), which is the fourth highest on record. Production from 2013 was well above replacement and is 1 of the 2 escapements over 800,000 that resulted in any yield. The forecasted run in 2021 is predicting 0.47 R/S—a lower-than-average age-4 component from parent year 2017. Based on the 2 primary parent years, the forecast is for a below average (1974–2019) return in 2021. The forecasted run size of 652,000 fall chum salmon would support a limited commercial harvest of 100,000 fish based on the current management plan.

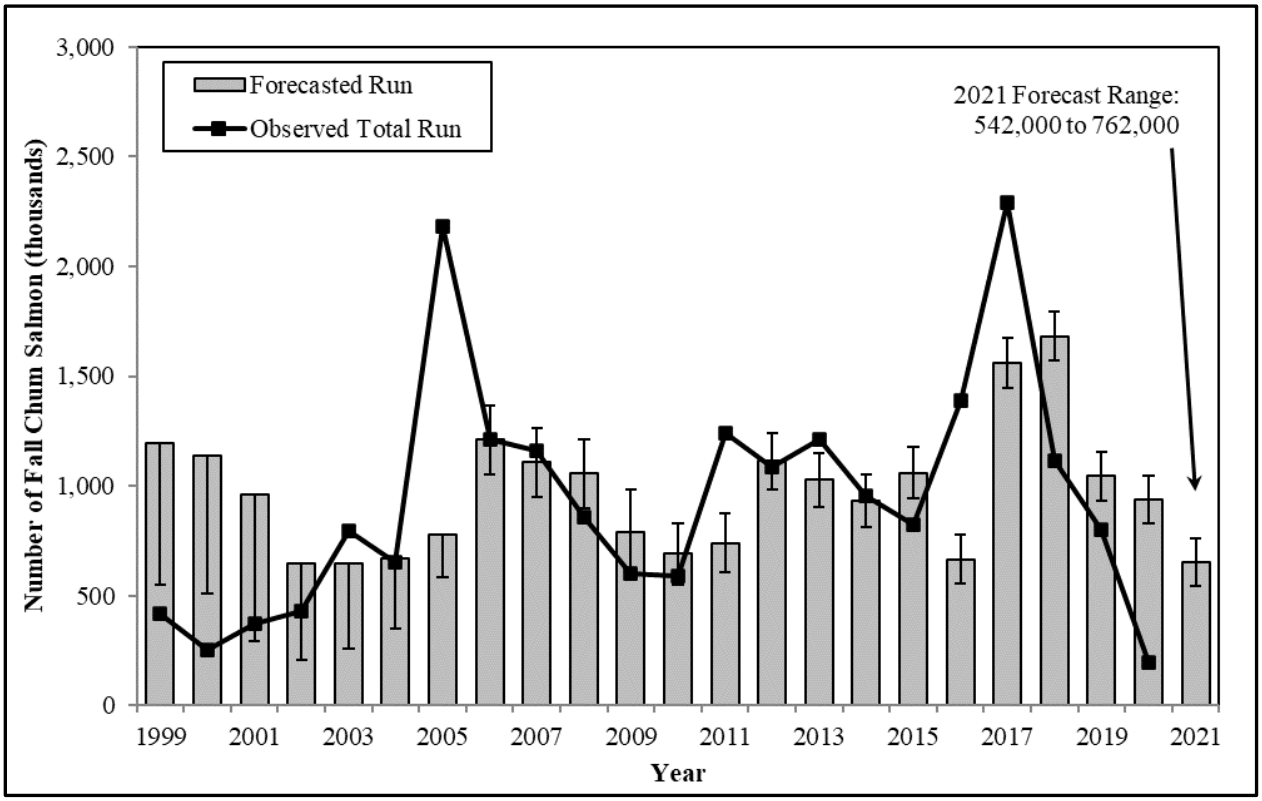

Figure 10.–Observed total run of fall chum salmon compared to the spawner-recruit estimates used in the annual forecast, Yukon River, 1999–2021.

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

Forecast by Bonnie Borba, Yukon Area Fall Season Research Biologist, ADF&G, Fairbanks.

WESTWARD REGION

KODIAK MANAGEMENT AREA

Pink Salmon

The 2021 KMA predicted pink salmon harvest is expected to be in the *Strong* category with a point estimate of 22.5 million fish combining the wild stock and Kitoi Bay Hatchery harvest estimates (Table 22). Harvest categories were delimited from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest in the KMA from 1978 to 2020.

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, Ayakulik, and Dog Salmon Creek weir counts, aerial survey indices, and harvest estimates.

The 2021 KMA wild stock pink salmon forecast (Table 23) was based on a simple linear regression model using environmental indices fit to the odd-year KMA returns from 1981 to 2019. An alternative trend forecast based on single exponential smoothing was also calculated for comparative purposes. The regression model utilizes a composite created from a series of forecast indices affecting pink salmon survival. Variables used include mean monthly air temperature (September to June), total precipitation (September to June) and peak precipitation (August to September) total run correlation anomalies. A composite was constructed using all variables and regressed against total return.

Table 22.–The 2021 Kodiak Management Area predicted pink salmon harvest categories.

KMA harvest category	Range (millions)	Percentile
Poor	Fewer than 7.6	Less than 20th
Weak	7.6 to 11.0	21st to 40th
Average	11.0 to 16.8	41st to 60th
Strong	16.8 to 26.6	61st to 80th
Excellent	Greater than 26.6	81st to 100th

Table 23.–Preliminary forecast of the 2021 Kodiak Management Area pink salmon run.

Total production	Forecast estimate (millions)	Forecast range (millions)
KMA wild stock total run	16.6	9.1–24.2
KMA escapement goal[a]	5.0	
KMA wild stock harvest	11.6	4.1–19.2
Kitoi Bay Hatchery harvest[b]	10.9	8.1–13.7
Total KMA pink salmon harvest	22.5	12.2–32.8

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

[a] The 2021 estimated escapement is within the range of the even-year aggregate escapement goals for the Kodiak Archipelago (2.0–5.0 million fish) and the Mainland District (250,000–1.0 million fish) and approximates the average.

[b] This figure is the total expected return (11.3 million) minus the broodstock collection goal of 430,000 fish; the Kitoi Bay Hatchery has yet to determine cost-recovery goals (if any) for 2021.

It is assumed that environmental conditions affect pink salmon survival at early life stages and the year class strength is primarily determined prior to outmigration. Monthly values (Kodiak airport) of mean air temperature, total precipitation, and peak precipitation from August to June were

considered. Forecast range was estimated using the 80% confidence intervals of the absolute percent error of the composite model hindcast estimates.

The 2021 Kitoi Bay Hatchery pink salmon forecast was prepared by evaluating pink salmon survivals from odd brood years 1995–2017 when releases from the facility were in excess of 100 million fry. Brood years 1995–2017 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 that 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 2021 relates to this 4-year cyclical return which is the stronger of the 2 odd-year cycles. The midpoint estimate of 11.3 million fish reflects a marine survival of 6.44% for the 175 million fry released (0.91 g) above the traditional target size (0.8 g). The average survival was calculated using the last 4-year cyclical returns (parent class 2003, 2007, 2011, and 2015). The range was calculated as (+/–) 25% of the predicted marine survival.

Forecast Discussion: The 2021 KMA wild stock pink salmon total run (16.6 million fish) is predicted to be an *Average* return, probably less than the magnitude of the last 3 odd-year returns in 2015, 2017, and 2019 (Figure 11). The environmental index predictor anomalies are fairly neutral, suggesting early life history conditions correlated with average returns. The exponential smoothing model predicts a very strong return with an estimate of 32.3 million fish. The KMA escapement index of 5.6 million fish in 2019 was above average (4.8 million in odd years).

The 2021 Kitoi Bay Hatchery pink salmon production is expected to be 11.3 million fish (Figure 12). The brood stock collection goal is 425,000 fish, resulting in a total hatchery harvest projection of about 10.9 million fish. Cost-recovery harvest estimates are not set yet but may be between 2.0 and 3.0 million pink salmon in Kitoi Bay in 2021.

Confidence in the 2021 forecast estimate is only fair considering the refinement of the forecasting models in past years and higher variance seen in the environmental index. Mechanisms driving pink salmon year class strength are incredibly complicated and environmental correlations are often fleeting due to the dynamic nature of the Gulf of Alaska. The KMA wild stock harvest prediction will allow an initial weekly fishing period length of 105 hours (4½ days) for most of the KMA during the initial general pink salmon fisheries (beginning July 6, 2021). By the third week of July, fishing time could be liberalized as the true magnitude of the return becomes apparent.

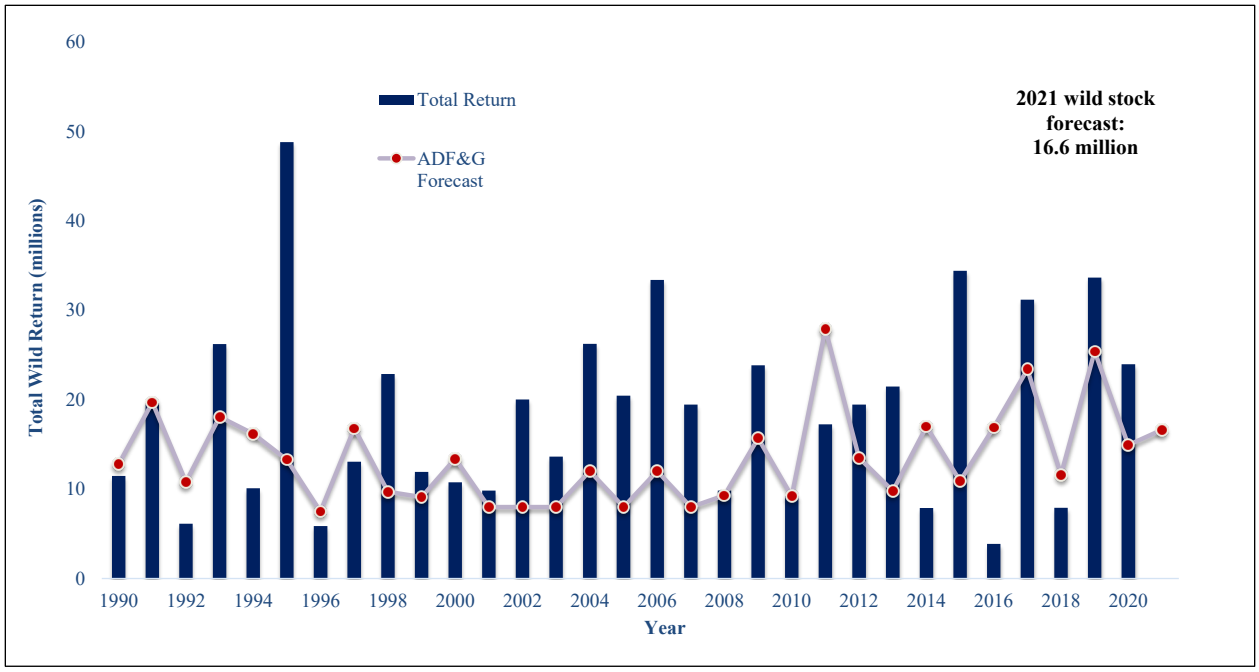

Figure 11.–Kodiak pink salmon wild stock total return compared to ADF&G forecasts, 1990–2020, and 2021 forecast.

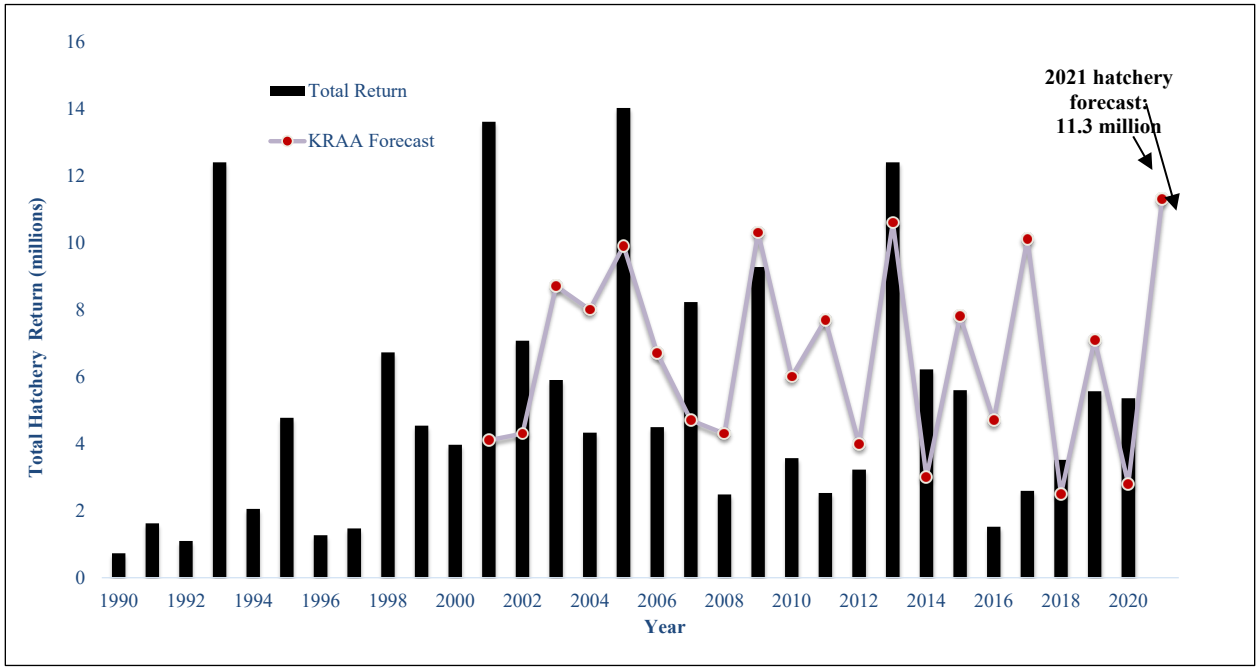

Figure 12.–Kitoi Bay hatchery pink salmon total return compared to Kodiak Regional Aquaculture Association (KRAA) forecasts, 1990–2020, and 2021 forecast.

Forecast by M. Birch Foster, Finfish Research Biologist, ADF&G, Westward Region; and Mike Wachter, Kitoi Bay Hatchery Manager, KRAA.

Ayakulik River

Sockeye Salmon

Forecast Methods: The 2021 Ayakulik River sockeye salmon forecast (Table 24) was prepared primarily by investigating simple linear regression models utilizing recent outmigration year 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.

Table 24.–Preliminary forecast of the 2021 Ayakulik River sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	801	613–1,088
Escapement goal[a]	300	200–400
Harvest estimate	501	

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

The age-.2 sockeye salmon were predicted from prior year age-.1 returns using outmigration years (1997–present). Age-1.3 sockeye salmon were predicted from prior year age-1.2 returns using outmigration years (1997–present). Age-.1 and all other age classes were predicted by the 20-year median return. Regression and median estimates were summed to estimate the total Ayakulik sockeye salmon run for 2021. The range was estimated as the sum of the individual 80% prediction intervals.

Forecast Discussion: The 2021 Ayakulik forecast of 801,000 sockeye salmon is about 284,000 more fish than the actual 2020 run estimate of approximately 517,000 fish, and about 279,000 fish more than the most recent 10-year average of approximately 522,000 fish. The 2021 run is estimated to be composed of approximately 66% age-.2 fish. The age-.1 predictor in 2020 is the highest in the data range used (since 1997) but was higher in 1987 with comparable results to the projection, so the predictor was retained for the 2021 projection. Since 2000, Ayakulik River sockeye salmon have shown an increasing tendency to only spend 1 year rearing in Red Lake; resulting returns have shown increasing proportions of age-1.1, -.2, and -.3 fish. With a major shift in life history such as this, forecasting could become more difficult. Thus, confidence in the 2021 Ayakulik forecast is only fair. The projected harvest of 501,000 fish is based on achieving the midpoint of the combined escapement goal ranges (300,000 fish). Ayakulik River 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 (2015–2017), approximately 70% of the total run will occur in the early portion of the run.

Forecast by M. Birch Foster, Finfish Research Biologist, ADF&G, Westward Region.

Karluk River

Sockeye Salmon

Forecast Methods: The 2021 Karluk River sockeye salmon forecast (Table 25) was prepared primarily by investigating escapement, sibling age class relationships, moving average, and exponential smoothing methods.

Table 25.–Preliminary forecast of the 2021 Karluk River sockeye salmon run.

Total production		Forecast estimate (thousands)	Forecast range (thousands)
Early run	Total run estimate	192	84–395
	Escapement goal[a]	150	150–250
	Harvest estimate	42	
Late run	Total run estimate	739	361–1,135
	Escapement goal[a]	325	200–450
	Harvest estimate	414	
Total Karluk River system	Total run estimate	931	445–1,529
	Escapement goal[a]	475	350–700
	Harvest estimate	456	

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

[a] Escapement estimates are based on the lower end of the early-run and midpoint of the late-run escapement goals and summed for the total run.

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 been a good prognosticator of the near future at Karluk River. Utilizing sibling age class relationships and regression models has been the preferred forecasting method since 1994. An exponential smoothing model was also fit to recent year early- and late-run total returns. Parameter estimates (early run $\alpha = 0.83$; and late run $\alpha = 0.66$) placed heavy weight on recent returns and outperformed 2-, 3-, and 5-year moving averages. However, the sibling age class forecasts for the early, late, and total outperformed the exponential smoothing model hindcast estimates (1994 to present) in terms of MSE. Therefore, the sibling age class methods were used for the 2021 forecast.

For the early run, age-.2 sockeye salmon returns were predicted based on the abundance of the prior-year return of age-.1 fish using outmigration years (2005–present). The age-.1, -.3, and -.4 return predictions were calculated using their pooled 10-year median contribution.

For the late run, age-.2 sockeye salmon returns were predicted based on the abundance of the prior year return of age-2.1 and -1.2 fish using recent outmigration years (2004–present). The age-.1, -.3, and -.4 return predictions were calculated using their pooled 10-year median contribution.

Regression and median estimates were summed to estimate the total Karluk sockeye salmon run for 2021. The range was estimated as the overall 80% prediction intervals. 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 2021 sockeye salmon run to the Karluk River using sibling relationships is predicted to be approximately 931,000 fish. The early run is expected to be approximately 192,000 fish, which is about 98,000 fewer fish than the recent 10-year average (291,000 fish) and 11,000 more fish than the 2020 run (181,000 fish). The late run is expected to be approximately 739,000 fish, which is 70,000 fewer fish than the recent 10-year average (809,000 fish) and 23,000 more fish more than the 2020 run (716,000 fish). The combined exponential smoothing estimates for the early and late runs is similar in magnitude (949,000 fish) with only 18,000 more fish more our sibling relationship estimates.

The projected harvest estimate for the early run (42,000 fish) is based on achievement of the lower end of the early-run escapement goal range. The projected harvest estimate for the late run

(414,000 fish) is based on achieving the midpoint of the late-run escapement goal. The majority of the Karluk sockeye run are expected to be age-.2 fish (75%). The overall confidence in the Karluk sockeye salmon forecast is fair.

Forecast by M. Birch Foster, Finfish Research Biologist, ADF&G, Westward Region.

Alitak District (Frazer Lake and Upper Station)

Sockeye Salmon

Forecast Methods: The 2021 sockeye salmon run to the Alitak District (Table 26) was forecasted with linear regression models using ocean age class relationships by system from recent outmigration years and environmental indices. 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.

Table 26.–Preliminary forecast of the 2021 Alitak District sockeye salmon run.

Total production		Forecast estimate (thousands)	Forecast range (thousands)
Early Upper Station	Total run estimate	70	37–124
	Escapement goal[a]	65	43–93
	Harvest estimate[b]	5	
Late Upper Station	Total run estimate	306	175–422
	Escapement goal	186	120–265
	Harvest estimate[b]	120	
Frazer Lake	Total run estimate	190	0–467
	Escapement goal[c]	137	95–190
	Harvest estimate[b]	53	
Total Alitak District	Total run estimate	566	212–1,013
	Escapement goal	388	258–548
	Harvest estimate[b]	178	

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

[a] The Alaska Board of Fisheries removed the Upper Station early-run optimal escapement goal (OEG) of 30,000 fish in 2017; the Upper Station early run is now managed for a biological escapement goal (BEG) of 43,000–93,000 fish.

[b] 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 fish) is increased here by an additional 20,000 fish, which is the 20-year median of the number of fish that pass through the Dog Salmon weir but do not ascend the Frazer Lake fish pass.

Upper Station early-run age-.2 fish were forecasted using prior year age-.1 returns (outmigration years 2003–2019), Kodiak Airport April precipitation, and the North Pacific Gyre Oscillation (NPGO) index for September in a multiple regression model. Precipitation data were lagged to correspond to freshwater rearing conditions in Olga Lake and smolt outmigration events and NPGO data were lagged to reflect marine rearing conditions that would affect parental escapement. Upper Station early-run age-.2 fish were used to predict log-transformed age-.3 fish data from outmigration years 1992 to 2018. Upper Station late-run age-.2 and log-transformed age-.3 salmon returns were each predicted using their respective prior year age-.1 (late-run outmigration years 1998–2019) and -.2 returns (late-run outmigration years 1999–2018). Upper Station early- and late-run age-.1 and -.4 returns were calculated using the pooled median contributions by stock and

ocean age from the last 10 years. Frazer Lake age-.2 salmon were predicted using prior year age-.1 returns (outmigration years 2003–2019), Kodiak Airport April precipitation and December air temperature, annual average Frazer Lake water temperature at 3 m, and the NPGO index for September in a multiple regression model. Precipitation and air temperature data were lagged to correspond to winter and spring freshwater rearing conditions in Frazer Lake, and lake temperature and NPGO data were lagged to reflect conditions at smolt outmigration. Frazer Lake age-2.3 salmon were predicted using prior year age-2.2 returns (outmigration years 2000–2015). Frazer Lake age-.1, -.4, and remaining age-.3 returns (age-0.3, -1.3, 3.3, and -4.3) were calculated using the pooled median contributions from the last 15 years.

Regression and median estimates were summed to estimate the total Alitak District sockeye salmon run for 2021. The combined Alitak District prediction interval was calculated by summing the lower and upper prediction bounds of the 3 runs.

Forecast Discussion: The 2021 sockeye salmon run to the Alitak District is expected to be approximately 566,000 fish, approximately 65,000 fewer fish than the recent 10-year average run of 631,000 fish, and 90,000 fewer fish than the 2020 run of 656,000 fish. The Upper Station early run is expected to be approximately 70,000 fish, which is greater than the recent 10-year average run of 65,000 fish. The Upper Station late run is expected to be approximately 306,000 fish, which is greater than the recent 10-year average run of 233,000 fish. The Frazer Lake run is expected to be approximately 190,000 fish, which is fewer than the recent 10-year average of 333,000 fish. The 2021 Alitak District sockeye salmon run should be composed of approximately 75% age-.2 fish, 16% age-.3 fish, and 9% age-.1 fish. Overall, our confidence in the forecast is fair based on the strength of the regression models and the large prediction intervals.

The projected harvest estimate of 178,000 fish is based on achieving the maximum sustainable yield (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.

Forecast by Heather Finkle, Finfish Research Biologist, ADF&G, Kodiak.

Spiridon Lake

Sockeye Salmon

Forecast Methods: The 2021 Spiridon Lake sockeye salmon forecast (Table 27) is estimated by multiplying the estimated number of smolt released for both net pen and lake combined, the mean smolt-to-adult survival proportions by ocean age, and mean return by age proportion of each age class for completed brood years 2009–2013. The Spiridon Lake and Telrod Cove range estimates the 95% confidence interval created using the Goodman's variance equation (1960).

Table 27.–Preliminary forecast of the 2021 Spiridon Lake sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	177	88–265
Spiridon	93	46–141
Telrod Cove net pen	83	42–125
Escapement goal	0	

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

Forecast Discussion: Sockeye salmon are prevented from returning to Spiridon Lake because barrier falls block upstream migrations in the outlet creek (Telrod Creek). Therefore, all returning adult sockeye salmon are available for harvest, primarily in the Central Section of the Northwest Kodiak District and in the Spiridon Bay SHA in Telrod Cove. The point estimate forecast of 177,000 fish in 2021 is more than the 2020 forecast of 115,000 fish. A significant increase in harvest of sockeye salmon bound for Telrod Cove during common property fishing within the Spiridon Bay Section (254-41) was recently discovered. Production estimates now incorporate the combined harvests of Spiridon Bay and Telrod Cove sections to better approximate the run strength and total enhancement production.

The majority of the 2021 run will likely be made up of 2 major age classes: 83% age-1.2 fish and 15% age-1.3 fish, followed by 2% all other age classes. If realized, this run will be below the recent 10-year average (2011–2020) run of 216,000 fish. The peak of the Spiridon Lake sockeye salmon run timing through the Westside fishery is typically in early to mid-July.

The 2021 season will mark the eighth year of adult returns to Telrod Cove originating from net-pen releases. Of the returning fish to Telrod Cove in 2020, age-1.1, -1.2, -1.3, -1.4 sockeye salmon will be apportioned between lake and net pen production through evaluation of differential otolith marks created during hatchery incubation.

Forecast by Nate Weber, Research and Monitoring Manager, KRAA.

CHIGNIK AREA

Sockeye Salmon

Forecast Methods: Simple linear regression models using age class relationships were used to forecast the 2021 early and late Chignik sockeye salmon runs (Table 28).

Table 28.–Preliminary forecast of the 2021 Chignik Area sockeye salmon run.

Total production		Forecast estimate (thousands)	Forecast range (thousands)
Early run (Black Lake)	Total run estimate	437	145–1,320
	Escapement goal[a]	400	350–450
	Harvest estimate	37	
Late run (Chignik Lake)	Total run estimate	438	37–1,042
	Escapement goal[a]	310	220–400
	Harvest estimate	128	
Total Chignik system	Total run estimate	875	182–2,362
	Harvest estimate[b]	165	
	Chignik Area	165	
	SEDM Area	0	
	Cape Igvak Section	0	

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

[a] Harvest represents the midpoint of the escapement goal. An inriver run goal of 20,000 sockeye salmon is added to the lower bound of the late-run escapement goal.

[b] A harvestable surplus of Chignik River system sockeye salmon is forecast to be below 600,000 fish in the Chignik Area; therefore, as outlined in regulations 5 AAC 09.360 and 5 AAC 18.360, no commercial fisheries are anticipated in the Southeastern District Mainland and Cape Igvak during the regulatory timeframes, thus the harvest of Chignik-bound sockeye salmon in those areas is projected to be zero.

Each regression model was assessed with standard regression diagnostic procedures. Data were log transformed to address nonnormality or unequal variance. Prediction intervals (80%) for the regression estimates were calculated using the variances of the regression models. Age class returns not estimated with statistical models utilized pooled medians with data from 1995 to the present; median prediction intervals were calculated from the 10th and 90th percentiles of the data.

For the early run, prior year log-transformed age-.2 returns predicted log-transformed age-.3 returns using data from the 1995 outmigration year to the present. Prior year early-run age-.1 returns predicted log-transformed age-.2 returns (outmigration years 1998 to present). For the late run, prior year age-.2 returns predicted age-.3 returns using data from the 2007 outmigration year to the present.

The early- and late-run regression and median estimates were summed to estimate the total Chignik River sockeye salmon run for 2021. 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 2021 Chignik sockeye salmon early run is forecasted to be 437,000 fish, which is 747,000 fewer fish than the 10-year average run of 1.18 million fish and almost 300,000 fish more than the 2020 early run of 137,000 fish. The early run is predicted to be composed of approximately 59% age-.3 and 39% age-.2 fish. The late run is forecasted to be 438,000 fish, which is approximately 473,000 fewer fish than the 10-year average run of 911,000 fish and 244,000 fish more than the 2020 late run of 194,000 fish. The 2021 late run is predicted to be composed of approximately 72% age-.3 and 26% age-.2 fish. The 2021 total Chignik sockeye salmon run is expected to be 875,000 fish, which is approximately 1.22 million fewer fish than the 10-year average of 2.10 million, and roughly 544,000 fish more than the 2020 total run of 331,000 fish.

The projected 2021 early-run total harvest estimate of 37,000 fish is based on achieving the midpoint of the early-run escapement goal range. The projected late-run harvest estimate of 128,000 fish is based on achieving the midpoint (310,000 fish) of the late-run goal, which includes the inriver run goal of 20,000 fish added to the lower bound (200,000 fish) of the escapement goal. For 2021, it is projected that sockeye salmon harvests for both early and late runs in the Chignik Management Area will not exceed a 600,000 fish surplus beyond escapement goals and, by regulation, preclude commercial fisheries from harvesting Chignik-bound fish in the Cape Igvak Section of the Kodiak Management Area and in the Southeastern District Mainland of the Alaska Peninsula Management Area during the regulatory period through July 5.

The wide confidence intervals around the point estimate of the 2021 forecasts reflect the uncertainty inherent in the forecast models. Given the sibling relationships used for forecasting both runs and the poor 2020 age-.3 returns, the 2021 forecast may overestimate returns if environmental variables, which are unknown at this time, remain spurious. Due to the range of variation in the relationships used in these forecasts and their historical accuracy, our confidence in them is fair.

Forecast by Heather Finkle, Finfish Research Biologist, ADF&G, Westward Region.

ALASKA PENINSULA/ALEUTIAN ISLANDS AREA

Bear Lake (Late run)

Sockeye Salmon

Forecast Methods: The 2021 forecast of the Bear Lake sockeye salmon late run (Table 29) was prepared using simple linear regressions of sibling age classes. 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.

Table 29.–Preliminary forecast of the 2021 Bear Lake (late run) sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	363	94–684
Escapement goal[a]	156	117–195
Harvest estimate	207	

[a] The escapement estimate is the midpoint of the escapement goal range (117,000–195,000 fish) in 2021.

Age-.3 sockeye salmon were predicted from prior year age-.2 returns from outmigration years 1990 to present. Remaining age class components of the run were predicted by calculating median returns from the most recent 10 years.

Regression and median estimates were summed to estimate the total Bear Lake late-run sockeye salmon run for 2021. The range was estimated as the sum of the 80% prediction intervals and the 10th and 90th percentiles intervals for each age class forecasted.

Forecast Discussion: The 2021 Bear Lake late-run forecast of 363,000 sockeye salmon is 30,000 fewer fish than the 10-year average of approximately 393,000 fish, and 6,000 fewer fish than the 2020 run of 369,000 fish. The 2021 late run is expected to be composed of 4% age-.1 fish, 63% age-.2 fish, and 33% age-.3 fish. The projected harvest of 207,000 fish is based on achieving the midpoint of the late-run escapement goal range (156,000 fish) and adequate run strength. Bear River late-run sockeye salmon returns have shown a general decline in the total run since 1990. The wide range around the point forecast is a result of large fluctuations in age-2.2 sockeye salmon returns. Over the last 10 years, age-2.2 fish have made up an average of 51% of the annual run, but this proportion has varied from 16% (2011) to 78% (2014). Based on uncertainty associated with the variable predictive capabilities of sibling age class, our confidence in this forecast is fair.

Forecast by Reid Johnson, Assistant Area Management Biologist, ADF&G, Alaska Peninsula; and Sarah Power, Biometrician, ADF&G, Juneau.

Nelson River

Sockeye Salmon

Forecast Methods: The 2021 Nelson River sockeye salmon run (Table 30) was forecasted using simple linear regression of ocean age class and parental escapement data from the past 20 years. Standard regression diagnostics were used to evaluate each model. Prediction intervals (80%) for regression estimates were calculated using the variances of the regression models. Age classes that could not be estimated with modeling 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.

Table 30.–Preliminary forecast of the 2021 Nelson River sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	333	137–546
Escapement goal[a]	158	97–219
Harvest estimate	175	

[a] The escapement estimate is the midpoint of the escapement goal range (97,000–219,000 fish) in 2021.

Age-.2 sockeye salmon returns corresponding to the year of outmigration were forecasted with simple linear regression using parental escapement of predominant age-2.2 fish from 2002 to 2018. The age-.1, -.3, and -.4 returns were calculated from median estimates for each ocean age class using run data from the previous 10 years.

Regression and median estimates were summed to estimate the total Nelson River sockeye salmon run for 2021. The range was estimated as an overall 80% prediction interval and calculated from the sum of the 80% prediction intervals for each age class forecasted.

Forecast Discussion: The 2021 Nelson River forecast of 333,000 sockeye salmon is about 74,000 fewer fish than the most recent 10-year average (2011–2020) of 407,000 fish and is approximately 56,000 fish more than the 2020 run of about 277,000 fish. The 2021 run should be composed mainly of age-.2 (69%) and -.3 (27%) fish. The projected harvest of 175,000 fish is based on achieving the midpoint (158,000 fish) of the escapement goal range.

The Nelson River sockeye salmon run has been notoriously unpredictable; therefore, confidence in this forecast is fair.

Forecast by Reid Johnson, Assistant Area Management Biologist, ADF&G, Alaska Peninsula; and Sarah Power, Biometrician, ADF&G, Juneau.

South Alaska Peninsula Aggregate

Pink Salmon

The 2021 South Alaska Peninsula predicted pink salmon harvest is expected to be in the *Excellent* category with a point estimate of 12.9 million fish (range of 3.8–28.1 million fish; Table 31). Harvest categories were calculated from the 20th, 40th, 60th, and 80th percentiles of historical post-June commercial harvest on the South Alaska Peninsula from 1981 to 2020 (Table 32).

Table 31.–Preliminary forecast of the 2021 South Alaska Peninsula aggregate pink salmon run.

Total production	Forecast estimate (millions)	Forecast range (millions)
Total run estimate[a]	16.9	7.8–32.1
Escapement goal[b]	4.0	1.75–4.0
Post-June harvest estimate	12.9	3.8–28.1

[a] Post-June harvest and escapement.

[b] The escapement estimate is the upper bound of the aggregate goal range (1.75–4.0 million) in 2021.

Table 32.–The 2021 South Alaska Peninsula pink salmon harvest categories, calculated from the 20th, 40th, 60th, and 80th percentiles of historical post-June commercial harvest on the South Alaska Peninsula from 1981 to 2020.

South Peninsula harvest category	Range (millions)	Percentile
Poor	Fewer than 2.0	Less than 20th
Weak	2.0 to 4.0	20th to 40th
Average	4.0 to 6.7	40th to 60th
Strong	6.7 to 9.3	60th to 80th
Excellent	Greater than 9.3	80th to 100th

Forecast Methods: The 2021 South Alaska Peninsula pink salmon harvest forecast is derived from a total run forecast minus the upper end (4 million fish) of the annual South Alaska Peninsula escapement goal range. The forecasted total run was fit with a damped Holt model and odd-year South Alaska Peninsula pink salmon returns from 1963 through 2019. The damped Holt time series model takes trends into account but limits their effects.

Forecast Discussion: June harvest of pink salmon has been omitted from the South Alaska Peninsula aggregate pink salmon forecast due to the variability of pink salmon harvest that occurs during the June fishery, and the origin of these fish are unknown. The 5-year odd-year average harvest of pink salmon in June is approximately 2.5 million fish.

The estimated 2021 South Alaska Peninsula pink salmon total harvest (12.9 million fish) is predicted to be *Excellent*. Strong escapement and favorable freshwater spawning environmental conditions in 2019 support the predicted forecast. 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. This has been emphasized with changing ocean conditions and recent years' average temperatures both outside the ranges of the historical dataset; therefore, the forecast's predictive power has been diminished. Due to this, confidence in the forecast is fair.

Forecast by Tyler Lawson, Assistant Area Management Biologist, ADF&G, Alaska Peninsula–Aleutian Islands; and Sarah Power, Biometrician, ADF&G, Juneau.

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