Special Publication 22-11

Run Forecasts and Harvest Projections for 2022 Alaska Salmon Fisheries and Review of the 2021 Season

Edited by

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and

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April 2022

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 2022 ALASKA SALMON FISHERIES AND REVIEW OF THE 2021 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.
Optimal 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 salmon run forecasts and harvest projections for 2022 as well as a detailed review of Alaska's 2021 commercial salmon season. The Alaska all-species salmon harvest for 2021 totaled nearly 235.0 million fish, about 44.7 million fish more than the preseason forecast of 190.1 million fish. This combined harvest was composed of approximately 275,500 Chinook salmon *Oncorhynchus tshawytscha*, 57.1 million sockeye salmon *O. nerka*, 2.8 million coho salmon *O. kisutch*, 161.4 million pink salmon *O. gorbuscha*, and 13.2 million chum salmon *O. keta*. The Alaska Department of Fish and Game is expecting a decrease in commercial salmon harvests in 2022. The 2022 total commercial salmon harvest (all species) projection of 160.6 million fish is expected to include 310,000 Chinook salmon, a record 74 million sockeye salmon, 3.6 million coho salmon, 67.2 million pink salmon, and 15.4 million chum salmon. Compared to 2021 commercial harvests, the projected 2022 commercial harvests are expected to be as follows: 94.2 million fewer pink salmon, 16.9 million more sockeye salmon, 0.8 million more coho salmon, and 2.2 million more chum salmon.

Keywords: 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 2022 as well as a detailed review of Alaska's 2021 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 supersede any data previously published.

ADF&G is expecting a decrease in overall commercial salmon harvest in 2022, mostly due to a decrease in pink salmon *Oncorhynchus gorbuscha* harvests compared to 2021. The 2022 total commercial salmon harvest (all species) projection of 160.6 million fish is expected to include 310,000 Chinook salmon *O. tshawytscha*, a record 74 million sockeye salmon *O. nerka*, 3.6 million coho salmon *O. kisutch*, 67.2 million pink salmon, and 15.4 million chum salmon *O. keta*. Compared to 2021 commercial harvests, the projected 2022 commercial harvests are expected to be as follows: 94.2 million fewer pink salmon, 16.9 million more sockeye salmon, 0.8 million more coho salmon, and 2.2 million more chum salmon.

There is a great deal of uncertainty in forecasting pink salmon returns due to their fixed 2-year life history and therefore limited information to serve as the basis for predictions (i.e., no siblings returning during prior years). As a result, pink salmon harvest forecasts are generally based on harvests from previous brood years. A notable exception is Southeast Alaska where a joint ADF&G and National Oceanic and Atmospheric Administration (NOAA) survey and juvenile pink salmon outmigration index is the basis for predicting harvests the following year. During recent decades, Alaska-wide pink salmon returns have tended to be larger during odd years than during adjacent even years, although there is much regional variation to this trend.

Table 1 shows specific harvest projection numbers by species and fishing area, and the "Preliminary Forecasts" section of this document provides forecast details for specific runs by 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.

Salmon productivity, survival, and resulting returns are probably influenced by many freshwater and marine drivers including spawning escapements, hatchery releases, temperature, and complex trophic interactions such as prey availability, predation, and competition. Although a review of this topic is well beyond the scope of this report, NOAA's Ecosystem Status Reports provide a summary of recent physical and ecological conditions encountered by a variety of species in the North Pacific, including salmon during their marine phase (Ferriss and Zador 2021, Siddon 2021; available at https://www.fisheries.noaa.gov/alaska/ecosystems/ecosystem-status-reports-gulf-alaska-bering-sea-and-aleutian-islands).

Table 1.–Projections of 2022 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		739[a]	1,167[a]	16,000	1,007	18,914
Hatchery production[b]	[c]	50	605	476	7,387	8,517
Southeast Region Total	241[c]	789	1,772	16,476	8,394	27,672
Prince William Sound						
Natural production[d]	8	1,135	271[a]	4,253	132	5,799
Hatchery production[e]		862	198	20,664	2,912	24,636
Lower Cook Inlet						
Natural production	0[a]	153[a]	3	1,148	35[a]	1,340
Hatchery production		239[f]	9	2,601		2,850
Upper Cook Inlet	4[a]	2,050	191[a]	391[a]	117[a]	2,753
Bristol Bay	27[a]	59,940	129[a]	658[g]	1,005[a]	61,760
Central Region Total	40	64,379	802	29,715	4,201	99,137
Kodiak						
Natural production	7[a]	3,039[h]	305[a]	14,938	655[a]	18,943
Hatchery production[i]		216	148	4,483	96	4,943
Chignik	2[a]	562[j]	112[a]	126[g]	162[a]	964
South Peninsula	17[a]	2,367[a]	329[a]	1,420	1,453[a]	5,586
North Peninsula	2[a]	2,657[k]	46[a]	18[g]	111[a]	2,834
Westward Region Total	28	8,842	939	20,984	2,477	33,271
Arctic-Yukon-Kuskokwim Total	1	2	75	50	345	472
Statewide Total	310	74,012	3,588	67,225	15,417	160,552

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

[a] Average harvest of the previous five years (2017–2021).

[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 9% 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 quote of 212,960 Chinook salmon and 27.88K "add on" harvest of fish from Alaska hatcheries.

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[d] Includes formal natural harvest estimates for Prince William Sound and Copper/Bering River districts; 10-year harvest average used when formal forecast was not available. Copper River Chinook commercial harvest forecast is 7K fish based on a 2-year average; a formal Chinook forecast will be published when it is available.

[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 even-year harvests (2012–2020).

[h] Total Kodiak harvest of natural run sockeye salmon 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] 5-year average harvest (2017–2021); includes formal forecasts for Bear River late run and Nelson River sockeye salmon stocks.

The Alaska all-species salmon harvest for 2021 totaled approximately 235.0 million fish, about 44.8 million more fish than the preseason forecast of 190.1 million fish. This combined harvest was comprised of approximately 275,000 Chinook, 57.1 million sockeye, 2.8 million coho, 161.4 million pink, and 13.2 million chum salmon. Table 2 shows 2021 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 whole pounds harvested. Tables 4–7 provide detailed information on the 2021 harvest by area and species.

Table 2.–2021 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,c]	226	1,124	1,568	48,534	7,416	58,868
Prince William Sound[a,d]	9	1,345	263	66,404	2,690	70,712
Lower Cook Inlet[a,e,f]	0	267	3	1,971	27	2,269
Upper Cook Inlet[f,g]	4	1,411	148	81	70	1,714
Bristol Bay[g]	7	41,979	48	4	204	42,242
Central Region Total	20	45,002	462	68,461	2,992	116,937
Kodiak Area[f,g]	9	3,291	306	26,180	409	30,196
Chignik[g]	1	119	84	1,321	43	1,569
South Peninsula[f,g]	14	4,599	333	16,550	2,241	23,736
North Peninsula	2	2,878	25	63	28	2,996
Westward Region Total	27	10,887	749	44,115	2,722	58,498
Arctic-Yukon-Kuskokwim Region Total[f,g]	3	115	21	290	109	538
Total Alaska	275	57,128	2,801	161,399	13,238	234,841

Note: Zeros indicate harvest activity but <500 fish.

Note: Columns may not total exactly due to rounding.

Note: Confidential data omitted.

[a] Chinook salmon adults and jacks are totaled.

[b] Catch accounting period for the 2021 Chinook salmon troll season spans from October 1, 2020, to September 30, 2021.

[c] Total includes fish that were confiscated, harvested in sport fisheries derbies and later sold, and harvested in test fisheries.

[d] Total includes hatchery sales for operating expenses and broodstock harvests.

[e] Total includes hatchery sales for operating expenses and hatchery donated fish but not broodstock.

[f] Total includes commercially harvested fish retained for personal use.

[g] Total includes commercial harvest that was discarded, confiscated, seized, or donated.

Table 3.–2021 Alaska commercial salmon harvests, by fishing area and species, in thousands of whole lb.

Fishing area	Species					Total
	Chinook	Sockeye	Coho	Pink	Chum	
Southeast Region Total[a,b,c]	2,913	6,407	9,861	134,453	49,470	203,104
Prince William Sound[a,d]	117	7,175	1,955	210,182	18,033	237,462
Lower Cook Inlet[a,e,f]	4	854	16	6,414	190	7,478
Upper Cook Inlet[f,g]	48	7,279	824	278	503	8,933
Bristol Bay[g]	65	201,334	300	12	1,088	202,799
Central Region Total	235	216,634	3,096	216,886	19,822	456,671
Kodiak Area[f,g]	63	14,843	2,092	81,979	2,752	101,730
Chignik[g]	10	616	531	4,166	279	5,603
South Peninsula[f,g]	107	19,047	1,929	49,929	10,533	81,545
North Peninsula	25	15,137	166	206	165	15,700
Westward Region Total	206	49,644	4,719	136,280	13,730	204,578
Arctic-Yukon-Kuskokwim Region Total[f,g]	30	703	141	804	801	2,479
Total Alaska	3,383	273,387	17,816	488,423	83,822	866,832

Note: Columns may not total exactly due to rounding.

Note: Confidential data omitted.

[a] Chinook salmon adults and jacks are totaled.

[b] Catch accounting period for the 2021 Chinook salmon troll season goes from October 1, 2020, to September 30, 2021.

[c] Total includes fish that were confiscated, harvested in sport fish derbies and later sold, and harvested in test fisheries.

[d] Total includes hatchery sales for operating expenses and broodstock harvests.

[e] Total includes hatchery sales for operating expenses and hatchery donated fish but not broodstock.

[f] Total includes commercially harvested fish retained for personal use.

[g] Total includes harvest that was discarded, confiscated, seized, or donated.

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.

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 2021 ALASKA COMMERCIAL SALMON FISHERIES

SOUTHEAST REGION

SOUTHEAST ALASKA AND YAKUTAT AREAS

The combined 2021 Southeast Alaska and Yakutat Area (SEAK) cumulative commercial salmon harvest, including hatchery cost recovery, was nearly 58.9 million fish (Table 4). Total common property commercial harvest was 52.9 million fish (90% of the total harvest). The 2021 overall harvest, in numbers of salmon, was nearly 4 times higher than the 2020 overall harvest (just under 14.6 million fish) and was the 16th highest harvest since 1962. The total commercial salmon harvest proportions by species were Chinook <1%, sockeye 2%, coho 3%, pink 82%, and chum salmon 13%. The 2021 combined-gear Chinook salmon harvest of approximately 226,000 fish was 83% of the 10-year average (2011-2020) of 272,000 fish and 78% of the long-term average (2005-2020) of 290,000 fish. The sockeye salmon harvest of approximately 1.1 million fish was like both the 10-year average and the long-term average. The coho salmon harvest of 1.5 million fish was approximately 63% of both the 10-year average and long-term average (approximately 2.4 million fish). The pink salmon harvest of 48.5 million fish was 99% of the 10-year average (2010-2019; odd years only) of approximately 49.0 million fish. The chum salmon harvest of 7.4 million fish was 74% of the 10-year average (10.0 million fish) and 75% of the long-term average (9.9 million fish). The all-species total harvest was 24% higher than the 10-year average (47.6 million fish) and 25% higher than the long-term average (47.0 million fish).

Chinook Salmon

Harvest Summary: The 2021 Chinook salmon harvest of 226,051 fish was below both the 10-year and long-term averages and is the 10th lowest harvest over the last 59 years. Preliminary harvests of coastwide Chinook salmon accountable under the Pacific Salmon Treaty included 156,000 fish by troll gear, 7,300 fish by purse seine gear, and 2,200 fish by gillnet gear. In 2021, a total of 40,200 Alaska hatchery-origin Chinook salmon were commercially harvested in the SEAK, and 16,000 hatchery-origin Chinook salmon were harvested in private hatchery cost-recovery fisheries.

Sockeye Salmon

Harvest Summary: The 2021 harvest of sockeye salmon was slightly higher than 1.1 million fish and ranks 30th of the 59 years since 1962. The Southeast Alaska Area purse seine fishery harvest of 793,869 fish accounted for approximately 71% of the regional total sockeye salmon harvest. The drift gillnet fishery harvest of 209,119 fish accounted for 19% of the regional total sockeye salmon harvest. The set gillnet fishery harvest of 87,850 fish accounted for 8% of the regional total harvest.

Coho Salmon

Harvest Summary: The 2021 coho salmon harvest of approximately 1.5 million fish ranks 48th since 1962. The coho salmon harvest in the troll fishery was 849,490 fish and accounted for approximately 54% of the regional coho salmon harvest. Total drift gillnet harvest of 193,269 fish accounted for approximately 12% of the regional coho salmon harvest; set gillnet harvest of 75,004 coho salmon accounted for less than 5% of the regional coho salmon harvest. Total purse seine harvests of 301,815 fish accounted for 19% of the regional coho salmon harvest.

Pink Salmon

Harvest Summary: The 2021 commercial pink salmon harvest was just over 48.5 million fish, approximately 82% of the total regional salmon harvest. The purse seine pink salmon harvest was 44.5 million fish, 92% of the total regional pink salmon harvest. This year's pink salmon harvest exceeded the preseason forecast of 28 million fish and ranked 16th since 1962.

Chum Salmon

Harvest Summary: The 2021 chum salmon harvest in the Southeast and Yakutat Area was 7.4 million fish. Most chum salmon harvest in the Southeast and Yakutat Area 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. Most chum salmon were harvested in the purse seine fishery (35%) followed by hatchery cost recovery (33%). Troll harvest of chum salmon made up 9% of the region's chum salmon harvest.

Summary by Troy Thynes, Southeast Region Salmon/Herring Fisheries Management Coordinator, ADF&G, Petersburg.

Table 4.–2021 Southeast Region commercial salmon harvests, by fishing area and species in thousands of fish.

	Species					
Fishery	Chinook[a,b]	Sockeye	Coho	Pink	Chum	Total
Purse seine						
Southern purse seine traditional	10	740	252	35,031	1,094	37,127
Northern purse seine traditional	0	52	46	9,435	204	9,737
Hatchery terminal	10	3	4	54	1,288	1,360
Total purse seine	21	794	302	44,520	2,587	48,223
Drift gillnet						
Tree Point	2	22	47	144	171	386
Prince of Wales	1	52	75	156	137	421
Stikine	0	1	12	6	49	69
Taku-Snettisham	1	46	21	137	186	390
Lynn Canal	1	79	26	160	224	489
Drift gillnet hatchery terminal	13	10	12	69	766	871
Total drift gillnet	17	209	193	673	1,532	2,625
Set gillnet (Yakutat)	1	88	75	28	0	192
Troll						
Hand troll						
Traditional	4	0	37	5	5	51
Hatchery terminal	0	–	1	0	0	2
Spring areas	1	0	0	0	0	1
Total hand troll	5	0	39	5	5	54
Power troll						
Traditional	142	5	802	90	582	1,621
Hatchery terminal	2	0	9	2	113	126
Spring areas	14	0	0	4	4	22
Total power troll	158	5	811	97	699	1,769
Total troll	163	5	849	101	704	1,823
Annette Island Reservation						
Seine	1	11	9	2,584	46	2,651
Drift gillnet	1	3	14	148	88	254
Troll	0	0	1	2	0	4
Hand troll	0	0	1	2	0	3
Power troll	0	–	0	0	0	0
Trap	–	–	–	–	–	–
Total Annette Island Reservation	2	13	27	2,736	134	2,912
Hatchery cost recovery	22	14	118	420	2,447	3,021
Miscellaneous[c]	1	1	3	55	12	72
Southeast Region Total	226	1,124	1,568	48,534	7,416	58,868

Note: Dashes indicate 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 2021 Chinook salmon troll season spans from October 1, 2020, to September 30, 2021.

[c] Total includes fish that were confiscated, harvested in sport fishery derbies and later sold, and harvested in test fisheries.

CENTRAL REGION

PRINCE WILLIAM SOUND AREA

The 2021 cumulative Prince William Sound Area (PWS) commercial common property fishery (CCPF) and hatchery salmon harvest was 70.7 million fish (Table 5). Overall harvest was composed of approximately 9,000 Chinook, 1.3 million sockeye, 263,000 coho, 66.4 million pink, and 2.7 million chum salmon. The CCPF accounted for 89% (nearly 63.0 million fish) of the total harvest; the remaining 11% of the harvest (7.7 million fish) was attributed to hatchery cost-recovery fisheries and broodstock collection.

Chinook Salmon

Run and Escapement Summary: The 2021 preseason common property fishery (CPF) harvest forecast for the Copper River District was 13,000 Chinook salmon. Preliminary Chinook salmon abundance estimates indicate spawning escapement was approximately 6,400 fish below the lower bound of the sustainable escapement goal (SEG) of 24,000 fish.

Harvest Summary: The CCPF harvest of 7,512 Chinook salmon in the Copper River District was the second smallest harvest since statehood and is approximately 43% below the 10-year average harvest of 13,100 fish.

Sockeye Salmon

Run and Escapement Summary: The 2021 preseason CCPF harvest forecast for the Copper River District was 652,000 sockeye salmon. Gulkana Hatchery was projected to contribute 51,000 fish to this CCPF harvest projection.

The 2021 Miles Lake sonar passage was 751,300 salmon, within the inriver run goal range of 605,000–995,000 fish. Considering preliminary projections of inriver harvest, the Copper River sockeye salmon escapement goal of 360,000–750,000 fish was probably achieved. Sockeye salmon escapement to the Copper River Delta was 87,100 fish, which is within the sustainable escapement goal (SEG) range of 55,000–130,000 fish.

The 2021 forecast of the sockeye salmon run to Coghill Lake was 282,000 fish, with 252,000 fish available for CPF harvest. Approximately 101,200 sockeye salmon passed through the Coghill River weir, 69% above the upper end of the SEG range of 20,000–60,000 fish.

Prince William Sound Aquaculture Corporation (PWSAC) forecast a run of nearly 1.1 million Main Bay Hatchery enhanced sockeye salmon in 2021.

Harvest Summary: The 2021 Copper River District CCPF sockeye salmon harvest was below average and was the seventh smallest CCPF harvest since 1976. The Copper River District sockeye salmon CCPF harvest of 404,653 fish was 68% less than the 10-year average harvest of 1.25 million fish. Sockeye salmon were also small: the average weight of 5.3 pounds in 2021 was 0.6 pounds smaller than the 30-year average (1991–2020) of 5.9 pounds. Wild sockeye salmon accounted for 86% (349,400 fish) of the CCPF harvest in the Copper River District. Of the remainder, 12% (47,100 fish) were from the Gulkana Hatchery, and 2% (8,100 fish) were from the Main Bay hatchery. The Gulkana Hatchery CCPF harvest was the fourth lowest in 20 years.

The Coghill District sockeye salmon CCPF harvest of 192,469 fish was 72% wild fish, 8% above the 10-year average of 184,000 fish.

The commercial common property fishery (CCPF) harvest of sockeye salmon in the Eshamy District gillnet (drift and set) fishery was 373,214 fish, 26% below the forecast. The proportion of wild sockeye salmon in the Eshamy District CCPF harvest was 6%. PWSAC harvested 255,837 sockeye salmon for cost recovery and broodstock.

The Unakwik District CCPF harvest of sockeye salmon was 8,362 fish, more than double the 10-year average of 3,500 fish.

Coho Salmon

Run and Escapement Summary: The Copper River District's 2021 preseason CCPF harvest forecast was 218,000 coho salmon. The Copper River Delta sum of peak escapement counts of 45,500 fish were within the SEG range of 32,000–67,000 fish. The Bering River District coho salmon spawning escapement counts of 19,500 fish were within the SEG range of 13,000–33,000 fish.

PWSAC forecasted a 2021 run of 89,000 coho salmon to Wally Noerenberg Hatchery.

The Valdez Fisheries Development Association (VFDA) enhanced coho salmon forecast was 87,700 fish, yielding a projected CCPF harvest of 31,600 fish.

Harvest Summary: The season total CCPF drift gillnet coho salmon harvest in the Copper River District of 145,629 fish was 33% below the 10-year average of 216,293 fish. Similarly, the Bering River District CCPF drift gillnet harvest of 42,058 coho salmon was 32% below the 10-year average harvest of 61,492 fish.

The Coghill District coho salmon CCPF harvest (purse seine and drift gillnet) of 2,874 fish was 94% below the 10-year average of 49,300 fish. This is second consecutive year with a CCPF harvest of less than 3,000 coho salmon in the Coghill District.

Enhanced coho salmon from VFDA are managed primarily as a sport fishery but the commercial fleet inadvertently harvests them throughout PWS. The CCPF of VFDA coho salmon was 59,500, which was 88% above the preseason forecast.

Pink Salmon

Run and Escapement Summary: There was a continuation of strong odd-year wild stock returns and above-average hatchery returns in PWS this season. The pink salmon forecast was for a total run of under 57.4 million fish, apportioned among 3 returns: 36% VFDA, 31% PWSAC, and 33% wild. The projected harvest was for 47.6 million pink salmon—after accounting for wild escapement, cost recovery, and broodstock.

The total observed run in 2021 was 69.4 million pink salmon, 21% above forecast. Both hatchery and wild runs were above forecast, resulting in an observed run composition of 30% VFDA, 34% PSWAC, and 36% wild. Compositions are based on otolith contributions. Pink salmon escapement goals were met in all PWS districts.

Combined with an aerial escapement index of 3.0 million fish, the estimated wild pink salmon return in 2021 was approximately 25.2 million fish, which is above the odd-year average of 20.8 million fish and was the second-largest wild odd-year return since 2000. The total run of 23.8 million PSWAC pink salmon was 32% above the forecast but 16% below the most recent 5-year, odd-year average of 28.3 million fish. In total, 20% (approximately 4.9 million fish) of the PWSAC run was collected for cost recovery and broodstock. The total run of nearly 20.4 million VFDA pink salmon was 1% below forecast but 5% above the odd-year average of 19.3 million fish. In

total, 10% (just under 2.0 million fish) of the VFDA run was collected for cost recovery and broodstock.

Harvest Summary: The 2021 PWS pink salmon harvest (including all CCPF harvest, hatchery cost recovery, broodstock, and raceway sales) was 66.4 million fish, 4% above the odd-year average (2011–2019) of 64.1 million fish. Approximately 58.6 million fish were harvested in the purse seine CCPF compared to the odd-year average purse seine harvest of 61.1 million fish. The number of permits fished in the PWS purse seine fishery dropped from 221 permits in 2020 to 212 permits in 2021.

Pink salmon CCPF drift gillnet harvest in the Coghill District was 666,347 fish. The proportion of wild pink salmon in the Coghill District CCPF harvest was 28%.

In the Eshamy District, 278,765 pink salmon were harvested in the CCPF gillnet (drift and set) fishery. All CCPF harvested pink salmon in the Eshamy District were assumed to be wild origin.

Chum Salmon

Run and Escapement Summary: The 2021 chum salmon total run forecast was approximately 2.7 million fish, with a commercial harvest forecast of under 1.7 million fish. Most of the total run forecast, 2.2 million (81%) fish, was attributed to PWSAC hatchery production, with 150,000 fish returning to the Armin F. Koernig hatchery (AFK) and 320,000 fish returning to Port Chalmers Subdistrict purse seine fisheries. Based on ADF&G's wild stock chum salmon forecast of 508,000 fish, there was a total commercial harvest forecast of 308,000 wild chum salmon. Managing for each district's escapement goal, ADF&G's objective was to secure a combined escapement total of 200,000 wild chum salmon to all 5 districts.

Wild chum salmon escapements were below average across PWS, with 4 out of the 5 district SEGs unmet.

Harvest Summary: The 2021 CCPF harvest of chum salmon was approximately 2.1 million fish, 24% above the preseason harvest forecast of under 1.7 million fish and approximately 20% below the 10-year average of 2.6 million fish. PWSAC harvested 622,769 chum salmon for cost recovery and broodstock.

The CCPF harvest of enhanced chum salmon at the Port Chalmers remote release site, based on contribution estimates, was 290,300 fish, 9% below the preseason forecast of 320,000 fish.

Summary by Jeremy Botz, Heather Scannell, and Kyle Gatt, Area Management Biologists, ADF&G, Cordova.

LOWER COOK INLET AREA

The 2021 Lower Cook Inlet Area commercial salmon harvest was nearly 2.3 million fish. Harvest was composed of approximately 300 Chinook, 267,00 sockeye, 3,000 coho, 2.0 million pink, and 27,000 chum salmon (Table 5), of which approximately 1.9 million fish (82%) were harvested in the commercial fishery, and 411,000 fish (18%) were harvested through hatchery cost recovery.

Chinook Salmon

Harvest Summary: The 2021 combined CCPF and hatchery cost-recovery harvest was 309 Chinook salmon, which was below the 10-year average harvest of 518 fish. The set gillnet harvest

for the Southern District (including homepack) was 238 fish, which was less than the 10-year average harvest of 380 fish. An additional 70 Chinook salmon were harvested by purse seine gear in the Southern and Outer districts. One Chinook salmon was harvested in Tutka Lagoon during hatchery cost-recovery operations.

Sockeye Salmon

Run and Escapement Summary: Cook Inlet Aquaculture Association (CIAA) forecasted a run of 30,000 sockeye salmon to the Kirschner Lake remote release site. CIAA also forecasted a total run of 211,700 sockeye salmon to Resurrection Bay facilities with all but 9,900 of these fish anticipated to be used for broodstock or cost-recovery purposes. An additional 122,700 fish were forecast to return to Kachemak Bay release sites with 44,200 of these fish anticipated to be used for cost recovery or brood harvest.

Sockeye salmon escapement in the Kamishak District was above the SEG range for Chenik Lake and the Amakdedori River and was below the SEG range at Mikfik Lake.

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

Escapement of 14,818 sockeye salmon through the weir at Bear Creek was above 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. CIAA harvested fewer broodstock than anticipated (3,500 fish), allowing 11,318 sockeye salmon to remain in the lake and spawn naturally. This is above the SEG for this system. The only other index stock in the Eastern District is Aialik Lake, where the final escapement of 2,352 fish was below the SEG range of 3,200–5,400 fish.

Harvest Summary: The 2021 CCPF purse seine harvest (including homepack) for the Southern District was 74,811 sockeye salmon, which was higher than the 10-year average harvest of 41,152 fish. The set gillnet harvest (including homepack) for the Southern District was 13,123 fish, which was just over half of the 10-year average harvest of 25,476 fish.

The Kamishak Bay District CCPF sockeye salmon harvest was 71,883 fish with 5 permit holders reporting deliveries. The 10-year average harvest is 45,790 fish.

The Outer District harvest was 225 sockeye salmon which is lower than the 10-year average harvest of 8,883 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 2021. Portions of Resurrection Bay were open for commercial harvest from June 22 through July 16. 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

Harvest Summary: The 2021 purse seine harvest (including homepack) for the Southern District was 1,753 coho salmon, which is above the 10-year harvest of 1,249 fish. The set gillnet harvest (including homepack) for the Southern District was 1,282 fish, which is considerably less than the 10-year average harvest of 2,720 fish.

The Kamishak Bay District CCPF harvest was 24 coho salmon. The 10-year average harvest is 1,319 fish.

The Outer District harvest was 313 coho salmon, which was lower than the 10-year average harvest of 361 fish.

Pink Salmon

Run and Escapement Summary: In the Southern District, the pink salmon SEGs for China Poot and Humpy Creeks were not achieved. The Tutka Creek SEG was exceeded. Escapement for the remaining pink salmon index streams—Barabara Creek, Seldovia Creek, and the Port Graham River—were within their assigned SEG ranges.

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

In the Outer District, pink salmon escapement was above the SEG range for Dogfish Bay Creeks, Port Chatham Creek, Windy Bay Creek Right, and Port Dick and Island Creeks. Index systems within SEG ranges were Windy Creek Left, Rocky River, South Nuka Island Creek, and Desire Lake Creek.

Harvest Summary: The 2021 purse seine harvest (including homepack) for the Southern District was 41,656 pink salmon, less than the 10-year average harvest of 143,865 fish. The set gillnet harvest (including homepack) for the Southern District was 3,500 fish, less than the previous 10-year average harvest of 21,149 fish.

The Kamishak Bay District CCPF pink salmon harvest was 62,598 fish and was above the 10-year average harvest of 40,725 fish.

The Outer District pink salmon harvest was 1.6 million fish, which was higher than the 10-year average harvest of 1.1 million fish.

Chum Salmon

Run and Escapement Summary: The chum salmon SEG was not met at the Port Graham River in the Southern District for the third consecutive year. Chum salmon escapement in the Outer District was above the SEG range for Rocky River and below for Island Creek. Escapement was within SEG ranges for Port Dick and Dogfish Creeks. In the Kamishak District, chum salmon escapement was below the SEG range at the McNeil River and above the minimum SEG at 6 other index streams.

Harvest Summary: The 2021 purse seine harvest (including homepack) for the Southern District was 380 chum salmon, which was lower than the 10-year average harvest of 1,215 fish. The set gillnet harvest (including homepack) for the Southern District was 2,252 chum salmon, which was less than the 10-year average harvest of 4,280 fish.

The Kamishak Bay District CCPF chum salmon harvest was 4,443 fish. This was below the 10-year average annual harvest of 10,111 fish.

The Outer District harvest was 20,334 chum salmon, which was much lower than the 10-year average harvest of 56,147 fish.

Summary by Glenn Hollowell, Area Management Biologist, ADF&G, Homer.

UPPER COOK INLET AREA

The 2021 Upper Cook Inlet (UCI) Area sockeye salmon estimated total run of 5.7 million fish was 1.3 million fish larger than the preseason forecast of 4.4 million fish. The commercial salmon fishery harvest of 1.7 million salmon was the third lowest harvest since 1975 and 42% less than the recent 10-year average harvest of 2.9 million fish. Harvest was composed of approximately 4,000 Chinook, 1.4 million sockeye, 148,000 coho, 81,000 pink, and 70,000 chum salmon (Table 5).

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 2021 season. As expected, the 2021 Chinook salmon run was below average but was even lower than the preseason forecasts. This led to both preseason and inseason conservation measures in all fisheries to reduce the harvest of Chinook salmon.

The 2021 preseason run forecast for Deshka River Chinook salmon of 11,464 fish suggested that harvest must be limited to achieve the SEG of 9,000–18,000 fish. The Division of Sport Fish issued 2 emergency orders implementing restrictions to catch and release angling only, with single unbaited hooks. Emergency order No. 2-KS-2-07-21 restricted angling in areas 1, 2, 3, 4, 5, and 6 of the Susitna River drainages (including Deshka River), and emergency order No. 2-KS-2-06-21 restricted angling in the Little Susitna River. The directed Chinook salmon fishery is normally 12 hours during Mondays each week, but because the Deshka River Chinook salmon sport fishery was restricted to no retention, commercial fishing time was reduced by 50% to 6 hours (emergency order 2S-01-21) as per the Northern District King Salmon Management Plan. 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 the Chuitna River. Late in the commercial fishing season, the restriction to hours was lifted (emergency order 2S-01-21) for the last Northern District Chinook salmon opening, after Chinook salmon abundances improved and sport fisheries were liberalized (emergency order 2KS-2-23-2). The final escapement estimate of Chinook salmon in the Deshka River was approximately 18,583 fish, which exceeds the SEG. The Little Susitna River Chinook salmon SEG of 2,100–4,300 fish was met in 2021 with the weir count of 3,121 Chinook salmon. Aerial goals of the various other Susitna drainage Chinook salmon systems are still preliminary and are pending data analysis to determine whether goals have been achieved.

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 set gillnet (ESSN) fishery. Kenai River late-run Chinook salmon were managed to meet the optimal escapement goal (OEG) of 15,000–30,000 large Chinook salmon. By regulation, if restrictions are implemented in the sport fishery to achieve the OEG, 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 2021 sonar count of large late-run Kenai River Chinook salmon was 11,832 fish with an escapement estimate of 12,176 fish, accounting for sport fishery harvest above the sonar site and spawning below the sonar site. Thus, neither the large fish OEG of 15,000–30,000 fish or the SEG of 13,500–30,000 fish, for Kenai River late-run Chinook

salmon was achieved. The 2021 preseason forecast was for a total run of 18,406 large Kenai River late-run Chinook salmon. Based on low preseason abundance projections for late-run Chinook salmon, the 2021 late-run Chinook salmon sport fishery in the Kenai River was restricted to no bait beginning July 1. Beginning June 20, the ESSN commercial fishery openings were first restricted, and later closed, as per the *Kenai River Late-Run King Salmon Management Plan*.

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 salmon systems, the SEG was achieved at 2 systems. The Anchor River count was 4,285 fish (SEG 3,800–7,600 fish) and the Ninilchik River wild run count was 808 fish (SEG 750–1,300 fish). The Deep Creek Chinook salmon run was not assessed due to lack of funding.

Harvest Summary: The 2021 UCI commercial harvest of Chinook salmon was 3,973 fish, which was 36% less than the previous 10-year average of 6,188 fish. Of this total, the ESSN fishery harvested 1,297 Chinook salmon, or 33% of the total UCI commercial harvest. The Chinook salmon harvested in the ESSN fishery included an estimated 208 fish, or 16%, that were large Kenai River late-run origin fish. This was 88% below the average of 1,631 large Kenai late run origin fish. The drift gillnet fishery harvested 217 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 2021 was 1,893 fish with approximately 1,481 fish harvested during the directed Chinook salmon fishery.

Sockeye Salmon

Run and Escapement Summary: The 2021 total run of sockeye salmon to UCI (including estimates of fishery harvests for commercial, sport, personal use, educational, subsistence, and escapement) of approximately 5.7 million fish was 1.3 million fish greater, or 30% more than the preseason forecast. Sockeye salmon run abundance to the Kenai River was greater than forecasted by approximately 1.5 million fish, and to the Kasilof River by 10,000 fish. Conversely, the number of sockeye salmon returning to Fish Creek was 44,000 fish less than forecasted, and in the Susitna River it was 103,000 fish less. For all other systems combined (minor systems), inseason abundance was only 8,000 fish above forecast. At the Kenai River sonar, the peak day of sockeye salmon passage occurred on August 2 with a count of 151,525 fish. This was the highest daily sockeye salmon passage recorded in August for the Kenai River sonar project, and the second latest peak of sockeye salmon passage recorded; 2020 was the latest. During the previous 10 years, the average date where 50% of the yearly sonar passage occurred in the Kenai River was July 26. In 2021 50% of the total passage did not occur until August 3, 8 days later than average, and approximately 62% of the run arrived in August. A weak Kenai River late Chinook salmon run resulted in paired restrictive actions in the Kenai River sport fishery and the ESSN commercial fishery in the Upper Subdistrict of the Central District. For the ESSN fishery, this meant less fishing time was allowed than was stipulated in sockeye salmon management plans. In addition, gear restriction options were also applied. The final passage estimate of approximately 2.4 million sockeye salmon exceeded the upper bound of the Kenai River sockeye salmon inriver goal range (1.0 million–1.2 million fish) by more than 1.2 million fish. Given typical sport fishery harvests at this inriver abundance level, the SEG (750,000–1,300,000 fish) was also probably exceeded.

The Kasilof River sockeye salmon sonar count of 521,859 fish exceeded the upper bound of the Kasilof River biological escapement goal (BEG) of 140,000–320,000 fish and the OEG of

140,000–370,000 fish, and was the third largest sockeye salmon passage recorded for the Kasilof River sonar project (39 years). The passage midpoint for Kasilof River occurred on July 19, which was 3 days later than the midpoint from the previous 10 years. Peak daily Kasilof River sockeye salmon passage of 24,773 fish occurred on July 20.

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

Harvest Summary: The 2021 total UCI commercial harvest of 1.4 million sockeye salmon was approximately 40% less than the 10-year average annual harvest of 2.4 million fish. The total 2021 sockeye salmon harvest in the ESSN fisheries was 407,007 fish. From June 23 through July 20, the Kasilof Section was open on 16 different days, with approximately 217,803 sockeye salmon harvested, which was 56% less than the previous 10-year average (excluding 2012, due to extensive fishery closures resulting from low Chinook salmon abundance that year) of 929,000 fish. From July 8 through August 15, the Kenai and East Foreland Sections were open on 5 different days, with a total of 187,887 sockeye salmon harvested. This was 47% less than the previous 10-year average (excluding 2012) annual sockeye salmon harvest of 355,000 fish for those sections. The total UCI drift gillnet harvest in 2021 was approximately 851,901 sockeye salmon, which was approximately 39% less than the 10-year average harvest of 1.4 million fish. The peak day of harvest for the drift gillnet fleet occurred on Monday, July 19, where 232 vessels harvested approximately 117,024 sockeye salmon, or 504 fish per boat. The 10-year average peak day harvest per boat was 850 fish. A comparative examination of the 2020 sockeye salmon harvest between the ESSN and drift gillnet fisheries showed the UCI drift gillnet harvest proportion was greater than the previous 10-year average, excluding 2012 which was impacted by Chinook salmon closures, and the highest proportion since 2014. The 2021 drift gillnet harvest of 851,901 sockeye salmon was 68% of the total harvest of those 2 fisheries, whereas the previous 10-year average was 60%. The ESSN fishery harvested approximately 407,007 fish, or 32% of the total sockeye salmon harvest in those 2 fisheries, and less than the previous 10-year average of 40%.

In 2021, approximately 20,144 sockeye salmon were harvested by set gillnetters in the Western Subdistrict. This was 49% less than the average annual harvest of approximately 39,492 fish during the previous 10 years.

Approximately 10,087 sockeye salmon were harvested in the Kustatan Subdistrict in 2021, of which 3,308 fish were harvested during the Big River fishery. Like 2020, the 2021 sockeye salmon harvest for the Kustatan Subdistrict was the largest harvest in the last 10 years, and more than double the average annual harvest of 3,851 fish during the previous 10 years.

In 2021, approximately 50,420 sockeye salmon were harvested from the Kalgin Island Subdistrict, with nearly 10,719 fish (21%) taken during the Big River sockeye salmon fishery. The average annual sockeye salmon harvest on Kalgin Island during the previous 10 years was approximately 49,906 fish, with roughly 8,450 fish harvested during the early season Big River fishery. In 2021, approximately 71,417 sockeye salmon were harvested in the Northern District. This harvest was 58% greater than the 10-year average annual harvest of 45,275 sockeye salmon but about equal to the 1985–2020 average of nearly 76,000 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 to assess escapement on the Fish Creek, Little Susitna River, and Deshka River; and McRoberts Creek is assessed with foot surveys.

Coho salmon escapement was counted at the Little Susitna weir from July 16 through August 28. The preliminary coho salmon escapement estimate in the Little Susitna River was 10,923 fish, achieving the SEG of 9,200–17,700 fish. Due to budget constraints, the Deshka River weir was pulled early on August 11, with a total of 3,338 coho salmon counted by that date. Based on average run timing, the SEG (10,200–24,100 fish) may not have been achieved for the Deshka River. The Fish Creek coho salmon SEG was 1,200–6,100 fish; however, due to budget constraints, this project was not operated. Finally, there is one coho salmon foot survey and established SEG of 250–700 fish for McRoberts Creek, which drains into Jim Creek of the Knik River drainage. In 2021, the McRoberts Creek foot survey produced a count of 1,499 fish, exceeding the upper bound of the SEG range.

Harvest Summary: The 2021 commercial harvest estimate of 147,602 coho salmon in UCI was 18% less than the previous 10-year average of approximately 180,000 fish. The 2021 drift gillnet harvest of 80,982 coho salmon was 22% less than the 10-year average of approximately 104,000 fish. The Northern District set gillnet fishery harvested 45,825 coho salmon, which was less than the 2020 harvest of 54,400 fish, but above the 10-year average of 41,600 fish.

Pink Salmon

Harvest Summary: Pink salmon runs in UCI are even-year dominant, with odd-year average harvests typically less than one-sixth of even-year harvests. The 2021 UCI commercial pink salmon harvest was estimated to be 81,360 fish, which was 10% lower than the average annual harvest of nearly 90,000 fish from the previous 10 years of odd-year harvests.

Chum Salmon

Run and Escapement Summary: An aerial survey of Chinitna River/Clearwater Creek was conducted on August 16. This survey produced an estimate of approximately 9,440 chum salmon within these streams, which was above 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 20.

Harvest Summary: The 2021 harvest of 70,242 chum salmon was 55% lower than the 10-year average annual harvest of 157,000 fish, and the second lowest harvest in the last 10 years.

Summary by Brian Marston and Alyssa Frothingham, Area Management Biologists, ADF&G, Soldotna.

BRISTOL BAY AREA

The 2021 inshore Bristol Bay sockeye salmon run of 67.7 million fish was the largest total run on record and was 64% above the 41.3 million fish average run for the latest 20-year period (2001–2020). Additionally, it was just the third time on record that the Bristol Bay inshore sockeye salmon

run exceeded 60.0 million fish. All sockeye salmon escapement goals were met or exceeded, with a total bay-wide escapement of 25.7 million fish.

The commercial harvest of nearly 42.0 million sockeye salmon was 15% above the 36.4 million preseason forecast, was the third largest harvest on record, and was the third time in the last 4 years harvest has exceeded 40.0 million fish. The harvest for other species was approximately 7,000 Chinook, 204,000 chum, 48,000 coho, and 4,000 pink salmon.

Chinook Salmon

Run and Escapement Summary: The Nushagak River Chinook salmon in-river run estimate at Portage Creek Sonar was 55,222 fish, which likely does not allow the escapement goal of 55,000–120,000 fish to be met when upstream harvest is eventually subtracted. However, it is likely that many Chinook salmon went undetected at the sonar because they were masked by the record high sockeye salmon passage. High sockeye salmon passage saturates the test fishing nets at the sonar project, a situation shown to bias the Chinook salmon count low in previous years. This is supported by reported inseason sport fishery catch rates along with postseason aerial surveys indicating that the run was larger than the final sonar count.

Harvest Summary: Chinook salmon harvested in Bristol Bay were incidentally caught during directed sockeye salmon fishing periods. The Nushagak District, which is the main contributor of Chinook salmon in Bristol Bay, was actively managed this season to reduce Chinook salmon harvest to ensure achievement of the established escapement goal for the Nushagak River. Overall, the 2021 Chinook salmon harvests were below average in all districts of Bristol Bay. A total of 6,944 Chinook salmon were harvested which is below the most recent 20-year average of 43,100 fish, and the lowest since 1955. The Nushagak District Chinook salmon harvest was 4,306 fish which is well below the 20-year average harvest of 34,600 fish.

Sockeye Salmon

Run and Escapement Summary: The 2021 inshore Bristol Bay sockeye salmon run of 67.7 million fish is the largest total run on record and was 64% above the 41.3 million average run for the latest 20-year period. Additionally, it was the third time on record that the Bristol Bay inshore sockeye salmon run exceeded 60.0 million fish. All sockeye salmon escapement goals were met or exceeded, with a total baywide escapement of 25.7 million fish. The 2021 Bristol Bay sockeye salmon run was 35% above the preseason inshore forecast of 50.0 million fish. Runs to every district, except Egegik, were larger than the preseason forecast.

Harvest Summary: The commercial harvest of nearly 42.0 million sockeye salmon was 15% above the 36.4 million fish preseason forecast, is the third largest harvest on record, and was the third time in the last 4 years harvest has exceeded 40.0 million fish.

Coho Salmon

Harvest Summary: The 2021 coho salmon harvest for the Bristol Bay Area was 48,206 fish, which was below the 20-year average of 95,600 fish. The Nushagak District is typically the largest producer of coho salmon, as was the case in 2021. Coho salmon harvest in the Nushagak District was 27,467 fish. Harvests of coho salmon can be variable from year to year depending on processor availability, market conditions, and overall fishing effort.

Pink Salmon

Harvest Summary: There was not a significant amount of pink salmon present in 2021, because they are typically an even-year dominant species in Bristol Bay. A total of 3,596 pink salmon were harvested in Bristol Bay in 2021.

Chum Salmon

Harvest Summary: The 2021 Bristol Bay chum salmon harvest was 204,137 fish, which was below the 20-year average of 1.1 million fish. The Nushagak District was the largest producer of chum salmon, where 108,046 fish were harvested. The Nushagak River chum salmon escapement of 125,400 fish was below the lower-bound escapement goal of 200,000 fish.

Summary by Tim Sands, Travis Elison, and Aaron Tiernan, Area Management Biologists, ADF&G, Dillingham and Anchorage.

Table 5.–2021 Central Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing area	Chinook[a]	Sockeye	Coho	Pink	Chum	Total
Drift gillnet						
Bering River District	0	0	42	–	0	43
Coghill District	0	192	2	666	1,192	2,054
Copper River District	8	405	146	34	9	600
Eshamy District	0	294	2	254	134	684
Montague District	–	–	–	–	–	–
Unakwik District	0	6	–	0	0	7
Purse seine						
Coghill District	0	6	1	4,181	2	4,189
Eastern District	0	22	34	22,914	100	23,070
Montague District	0	7	7	6,879	296	7,189
Northern District	0	19	6	10,678	13	10,717
Northwestern District	0	3	0	708	3	714
Southwestern District	0	49	17	12,461	297	12,823
Southeastern District	0	1	1	765	9	776
Unakwik District	–	6	–	0	0	7
Set Gillnet						
Eshamy District	0	79	0	25	12	116
Hatchery[b]	–	256	7	6,839	623	7,724
Prince William Sound Total	9	1,345	263	66,404	2,690	70,712
Southern District Purse Seine	0	75	2	42	0	119
Southern District Set Gillnet	0	13	1	4	2	20
Southern District Total	0	88	3	45	3	139
Kamishak District	–	72	0	63	4	139
Outer District	0	0	0	1,559	20	1,580
Eastern District				Confidential		
Hatchery[c]	–	107	0	304	0	411
Lower Cook Inlet Total[d,e]	0	267	3	1,971	27	2,269
Central District Drift Gillnet	0	852	81	67	65	1,066
Central District Set Gillnet	2	488	21	9	2	522
Central District Total	2	1,339	102	77	68	1,588
Northern District	2	71	46	5	3	127
Upper Cook Inlet Total[d,e]	4	1,411	148	81	70	1,714
Naknek-Kvichak District	1	9,254	1	0	34	9,290
Nushagak District	4	18,291	27	1	108	18,432
Egegik District	0	8,553	16	0	20	8,590
Ugashik District	0	5,206	0	0	20	5,227
Togiak District	1	676	4	2	21	704
Bristol Bay Total[e]	7	41,979	48	4	204	42,242
Central Region Total	20	45,002	462	68,461	2,992	116,937

Note: Dashes indicate no harvest, and zeros indicate harvest activity but <500 fish.

Note: Columns may not total exactly due to rounding.

Note: Confidential data omitted.

[a] Chinook salmon adults and jacks are totaled.

[b] Total includes hatchery sales for operating expenses and broodstock harvests.

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

[d] Total includes commercially harvested fish retained for personal use.

[e] Total includes harvest that was discarded, confiscated, seized, or donated.

ARCTIC-YUKON-KUSKOKWIM REGION

The Arctic-Yukon-Kuskokwim (AYK) Region 2021 harvests totaled just under 538,000 fish (Table 6). Cumulative all-gear commercial harvest included approximately 3,000 Chinook, 115,000 sockeye, 21,000 coho, 290,000 chum, and 109,000 pink salmon.

KUSKOKWIM AREA

Large-scale commercial fisheries occurred in Kuskokwim Bay Districts 4 (Quinhagak) and 5 (Goodnews Bay). The Kuskokwim Bay commercial fishing season began in early July and ended mid-August. The commercial fishing season was delayed from the normal start of June 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 2021 Kuskokwim River Chinook salmon forecast was for a range of 94,000–155,000 fish. The drainagewide Chinook salmon escapement goal is 65,000–120,000 fish. If the run came back as projected, the drainagewide and tributary escapement goals were expected to be achieved with a limited subsistence harvest. The 2021 season was managed in accordance with the *Kuskokwim River Salmon Management Plan* (5 AAC 07.365) with input from the Kuskokwim River Salmon Management Working Group (Working Group). It was the intent of ADF&G to manage all Kuskokwim River salmon stocks in a conservative manner, consistent with the *Policy for the Management of Sustainable Salmon Fisheries* under 5 AAC 39.222, to meet escapement goals and the subsistence priority.

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.

An early season gillnet subsistence fishing closure (i.e., "front-end closure") began on June 1, from the Yukon Delta National Wildlife Refuge (YDNWR) boundary at the mouth of the Kuskokwim River upriver 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 16-hour set gillnet opportunities with 6-inch or less mesh to allow subsistence fishers time to harvest nonsalmon species. These openings occurred on June 2, 5, and 9.

Between June 1 and July 22, a Federal Special Action (FSA) closed the Kuskokwim River gillnet fishery to non-Federally qualified users within the boundary of the YDNWR (Subsistence Sections 1–3). During the FSA, the United States Fish and Wildlife Services (USFWS) offered 6-inch setnet opportunities running concurrently to the 6-inch opportunities offered by ADF&G on June 2, 5, and 9. Additionally, USFWS offered six 12-hour gillnet fishing periods on June 12, 15, 19 and July 2, 9, and 16 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. USFWS offered two 48-hour set gillnet fishing periods on July 10 and 17. On June 19, USFWS opened those waters between the Kalskag Bluffs to the YDNWR boundary at Aniak to subsistence fishing until further notice with 6-inch or less mesh, 25 fathoms in length gillnets. ADF&G concurrently offered the same management actions within Subsistence Sections 1–3 with an additional opportunity provided on June 28. A

16-hour gillnet fishing period was provided on July 23 and a 50-hour setnet period was provided July 23–25 after the FSA was rescinded.

Chum salmon abundance was assessed to be extremely low based on Bethel Test Fishery catches, subsistence harvest reports, and Kuskokwim River Sonar passage, whereas sockeye salmon abundance was estimated to be from average to above average. Given the poor chum salmon run, continued fishing restrictions and gillnet closures in July were needed for chum salmon protection. Beginning July 2, the release of chum salmon captured in fish wheels and beach seines was required throughout the Kuskokwim River drainage.

Beginning June 12, subsistence fishing with the subsistence Chinook salmon permit was implemented in Subsistence Sections 4 and 5 (YDNWR boundary at Aniak upstream to the headwaters of the Kuskokwim River). On June 16, Section 5 (Holitna River mouth to headwaters) was opened to subsistence fishing until further notice with 6-inch or less mesh, 25 fathoms in length gillnets and all selective gear types. At that time, subsistence Chinook salmon permits were no longer required to subsistence fish in Subsistence Section 5. On June 19, Subsistence Section 4 (from the refuge boundary at Aniak to the Holitna River mouth) was opened to subsistence fishing until further notice with 6-inch or less mesh, 25 fathoms in length gillnets and subsistence king salmon permits were no longer required to subsistence fish.

Most salmon fishing restrictions were lifted at the end of July. On July 31, after an average of 99–100% of the Chinook salmon run, 99–100% of the sockeye salmon run, and 96–98% of the chum salmon run passed Bethel, the entire Kuskokwim River was opened to subsistence fishing with gillnets and most mainstem gear restrictions were rescinded. Tributary restrictions were rescinded August 31. The tributary restrictions were kept in place beyond the mainstem restrictions for the purpose of conservation while Chinook and chum salmon were on their spawning grounds.

Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2021 will not be available until after postseason harvest surveys have been completed, data have been analyzed, and preliminary harvest estimates are produced.

Chinook Salmon

Run and Escapement Summary: The preliminary Kuskokwim River total run estimate is 129,000 Chinook salmon (95% CI = 94,000–178,000 fish), and an estimated 101,000 Chinook salmon (95% CI = 66,000–150,000 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 2021 were met within the Kuskokwim River drainage. The established SEG range of 4,800–8,800 fish at Kogrukluk River weir was met (6,969 fish), as was the SEG range of 1,800–3,300 fish at George River (2,920 fish). Aerial surveys were not conducted in 2021 due to weather and pilot availability.

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 4,115 fish. The North Fork Goodnews River Chinook salmon aerial SEG of 640–3,300 fish was achieved with a count 2,273 fish.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2021 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 2,468 Chinook salmon were commercially harvested in District 4 and 114 Chinook salmon were commercially harvested in District 5. Chinook salmon harvest was below the long-term average (1968-2020).

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 13,534 sockeye salmon met the established SEG range of 4,400–17,000 fish. The Telaquana weir observed the fifth highest escapement of sockeye salmon since the project was established in 2010 with a count of 123,958 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 53,690 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 95,020 fish.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence sockeye salmon harvest in 2021 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 78,462 sockeye salmon were commercially harvested in District 4 and 35,963 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 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 2021. The George River weir coho salmon escapement of 31,491 fish was above the most recent 10-year average of 22,462 fish. The Kogrukluk River weir escapement of 14,373 coho salmon met the established SEG range of 13,000–28,000 fish.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2021 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 13,012 coho salmon were commercially harvested in District 4 and 1,192 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 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 escapements at all weir projects were the lowest on record. The escapement count of 4,153 fish at the Kogrukluk River weir did not meet the established SEG range of 15,000–49,000 fish.

Harvest Summary: Postseason subsistence harvest surveys are presently being conducted. An assessment of subsistence salmon harvest in 2021 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 5,310 chum salmon were commercially harvested in District 4 and 535 chum salmon were commercially harvested in District 5. Chum salmon harvest was well below long-term average.

Summary by Nick Smith, Area Management Biologist, ADF&G, Anchorage

YUKON AREA

No commercial fishing occurred in the Lower or Upper Yukon Areas during the summer or fall seasons in 2021 (Table 6).

The Yukon River summer season spans 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

Approximately 153,497 summer chum salmon were counted at the Pilot Station sonar (90% CI = 137,200–169,800 fish), which was well below the historical median from years with late run timing of 1.6 million fish. Season total counts of summer chum salmon at the Pilot Station sonar were the lowest in all the years of project operations (1995–2021) and were well below the previous lowest counts of 442,546 fish and 448,665 fish in 2001 and 2000 respectively. Forecasting models, even with some adjustments to account for poor age class returns, did not accurately predict this weak return.

Three pulses of summer chum salmon were detected at the sonar project; the largest group consisted of approximately 83,045 fish and passed by the sonar between July 6 and July 29. The first quarter point, midpoint, and third quarter point at the Pilot Station sonar were June 30, July 6, and July 11, respectively. This indicated that the summer chum salmon run was probably 9 days later than average and the latest on record based on the midpoint at the sonar project.

Chinook Salmon

Run and Escapement Summary: The cumulative passage estimate at the Pilot Station sonar was approximately 124,874 Chinook salmon (90% CI = 114,100–135,700 fish). This passage was below the historical average of approximately 146,066 fish for late run timing years, and the run appeared to come in toward the lower end of the outlook. Most of the Chinook salmon entered the river in 4 pulses consisting of approximately 22,550 fish, 53,670 fish, 20,760 fish, and 3,790 fish. However, like in 2020, the front end of the run had an unusually long and consistent flow of "tricklers" that lasted for almost 2 weeks before the more distinctive first pulse arrived. The first quarter point, midpoint, and third quarter point for Chinook salmon at the Pilot Station sonar project took place on June 19, June 29, and July 4, respectively. The 2021 Chinook salmon run appears to have been 6 days later than average based on the midpoint at the sonar project.

River conditions were favorable on the Chena and Salcha River systems this year, with below-average water levels during the summer season passage dates (late June to mid-August). Most assessment projects were able to get successful counts for nearly all days of operation. However, aerial surveys of the East and West Forks of the Andreafsky River, Anvik River, Nulato River, Gisasa River, and Henshaw Creek, were not conducted due to record levels of rain and sustained poor weather in western and interior Alaska during early August survey dates. Chinook salmon escapement into systems with escapement goals failed to meet those goals and was below average.

Passage at the U.S./Canada border was much lower than expected based on the inseason abundance estimate of approximately 59,000 Canada-origin salmon. The preliminary cumulative passage estimate at the Eagle sonar was 31,796 Chinook salmon (90% CI = 31,455–32,137 fish). This passage was not enough to meet the lower end of the interim management escapement goal (IMEG) range of 42,500–55,000 salmon and does not provide the Canadian harvest share as outlined in the Salmon Agreement with Canada. Fishing for Chinook salmon remained closed all season throughout the Yukon Area; however, a small number of fish were caught in test fisheries or as incidental harvest in nonsalmon gear.

Harvest Summary: For the 14th consecutive year, no commercial periods targeting Chinook salmon were allowed in the Yukon Management Area during the summer season.

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 153,497 summer chum salmon. Escapement at the East Fork Andreafsky weir was 2,351 fish, which was well below the goal of 40,000 fish. Anvik Sonar counts were 18,812 summer chum salmon, which was well below the goal of 457,457 fish. Escapement counts at other projects (Henshaw Creek weir, Chena and Salcha River sonars) were well below the historical medians.

Harvest Summary: No commercial fishing occurred in 2021. Subsistence fishing for chum salmon remained closed all season throughout the Yukon Area; however, a small number of fish were caught in test fisheries or as incidental harvest in nonsalmon gear.

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 provided an estimated passage of 37,376 coho salmon (90% CI = 33,257–41,138 fish), which is well below the historical average of 147,500 fish. The Delta Clearwater River has the only established escapement goal for coho salmon, an SEG of 5,200–17,000 fish. A boat survey conducted on the Delta Clearwater River in early November counted an estimated 913 coho salmon, which was well 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 1974–2020 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. Subsistence fishing for coho salmon remained closed for the majority of the season throughout the Yukon Area; however, a small number of fish were caught in test fisheries; an early season dipnet fishery for coho, pink, and sockeye salmon; or as incidental harvest in nonsalmon gear.

Fall Chum Salmon

Run and Escapement Summary: In 2021, the preliminary estimate of the drainagewide total run size was 95,200 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 94,500 fall chum salmon, which is well below the SEG range of 300,000–600,000 fish. This is the second year in a row the run was less than 300,000 fall chum salmon. Prior to 2020, this last occurred in the year 2000.

Considering 2021 was the smallest run recorded, none of the fall chum salmon escapement goals in Alaska (U.S.) were achieved (drainagewide, Teedriinjik/Chandalar and Delta Rivers) and neither were the treaty obligations with Canada on the upper Porcupine and the mainstem Yukon rivers. The Teedriinjik (Chandalar River) sonar operated in 2021 and provided an estimated passage of 21,200 fall chum salmon (estimate includes expansion beyond project termination). This level of fall chum salmon escapement in the Teedriinjik was well below the SEG range of 85,000–234,000 fish. The Delta River, a tributary of the Tanana River drainage, was monitored using replicate ground surveys, providing an escapement estimate of 1,600 fall chum salmon. This level of escapement in the Delta River was the lowest on record (since 1974) and well below the SEG range of 7,000–20,000 fish. Escapement in the Delta River has abruptly changed from the large escapements observed from 2013–2019, which averaged 37,000 fall chum salmon and were well above the upper end of the SEG.

In Canada, the upper Porcupine sonar (downstream of the Yukon Territory community of Old Crow) was operational in 2021 and provided a preliminary estimate of 3,500 fall chum salmon (no goal established for this location). In the Fishing Branch River (headwaters of the Porcupine River), a weir/video/sonar project provided an escapement estimate of 2,400 fall chum salmon. This level of escapement in the Fishing Branch River was the second lowest after 2020 and well below the lower end of the IMEG range of 22,000–49,000 fish. The production in the Fishing Branch River has been noted to be declining when compared to other monitored areas in Alaska and Canada.

The larger component of Canada-origin fall chum salmon stocks pass into Canada via the mainstem Yukon River. The fall chum salmon passage estimate at the mainstem Yukon River sonar project near Eagle was 19,668 fish (SE = 243 fish) for the dates September 1 through October 6. Because of continued passage at the termination of the project, the fall chum salmon estimate was subsequently adjusted to 23,170 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 zero harvest. The preliminary mainstem Yukon River escapement estimate was 23,170 fall chum salmon, which is the second lowest on record (lowest 1980) and the second time in the last 20 years the estimate fell below the IMEG range (70,000–104,000 fish).

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 3 strata between July 19 and September 7 (fall season) indicated that stocks represented approximately 31% summer fish. Within the fall components, the 3 main stock groupings were 42% Border U.S. (Teedriinjik/Sheenjek/Draanjik), 18% Canadian, and 40% Tanana. In 2021, the upper Yukon U.S. and the Tanana River stocks were higher, whereas the Canadian component was lower when compared to the 2004–2020 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. Subsistence fishing for fall chum salmon remained closed all season throughout the Yukon Area; however, a small number of fish were caught in test fisheries or as incidental harvest in nonsalmon gear. Subsistence harvest estimates will be available in early 2022.

Summary by Deena Jallen and Christy Gleason, Area Management Biologists, ADF&G, Fairbanks.

NORTON SOUND AREA

Poor runs of chum and coho salmon in 2021 resulted in low commercial salmon harvest for those species. Overall commercial harvest in the Norton Sound Area was near average due to above-average pink salmon harvest. The pink salmon run was near average; however, increased buyer interest led to this being the fifth largest harvest in the 61-year fishery history. Escapement goal ranges were reached for 1 of 5 chum salmon stocks, 1 of 2 coho salmon stocks, and all 3 pink salmon stocks. Escapement goals were not reached for Chinook or sockeye salmon. There were 131 commercial permits fished in 2021, slightly below the recent 5-year (140 permits) and 10-year (132 permits) averages. Total commercial salmon harvests in 2021 were approximately 15 Chinook, 470 sockeye, 7,000 coho, 290,000 pink, and 6,000 chum salmon (Table 6). In addition to the commercial harvest, 1 Chinook, 19 sockeye, 13 coho, 61 pink, and 4 chum salmon commercially harvested were retained for personal use.

Chinook Salmon

Harvest Summary: Commercial fishing targeting Chinook salmon was prohibited during the 2021 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 2021 commercial harvest of 473 fish, not including personal use, was less than one quarter of the record harvests of the last 5 years.

Coho Salmon

Harvest Summary: The 2021 coho salmon harvest of 7,189 fish, not including personal use, was 5% of the recent 5-year average (141,864 fish). Like last year, the average weight of coho salmon (5.7 lb) was the lowest on record, well below the 2019 average weight of 6.4 lb that was tied for the previous record low weight.

Pink Salmon

Harvest Summary: The pink salmon run was average, unlike the 5 previous years of record runs in Norton Sound. However, increased buyer interest resulted in a record odd-numbered year harvest of 289,912 pink salmon in 2021, which does not include personal use.

Chum Salmon

Harvest Summary: The 2021 chum salmon harvest of 6,410 (not including personal use) was 5% of the recent 5-year average (127,216 fish).

Summary by Jim Menard, Area Management Biologist, ADF&G, Nome.

KOTZEBUE SOUND AREA

There were 52 permit holders that commercially harvested fish in the Kotzebue Sound Area in 2021, which was the lowest effort since 2008. The highest fishing effort this season occurred on August 16 when 34 permit holders made landings.

Chinook Salmon

Harvest Summary: Permit holders retained 12 Chinook salmon for personal use in 2021.

Sockeye Salmon

Harvest Summary: Buyers in the Kotzebue Sound Area purchased 5 sockeye salmon in 2021. Permit holders retained 42 sockeye salmon for personal use.

Coho Salmon

Harvest Summary Buyers in the Kotzebue Sound area purchased 2 coho salmon in 2021. Permit holders retained 63 coho salmon for personal use.

Pink Salmon

Harvest Summary: Permit holders retained 192 pink salmon for personal use in 2021.

Chum Salmon

Run and Escapement Summary: No aerial surveys were flown in 2021. The Kobuk River test fish project was ineffective in catching fish because of flooding conditions.

Harvest Summary: The Kotzebue Sound chum salmon harvest of 96,492 fish was the lowest since 2007. The harvest was well below the forecast of 200,000–300,000 fish.

Summary by Jim Menard, Area Management Biologist, ADF&G, Nome.

Table 6.–2021 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	3	114	14	0	6	137
Kuskokwim Area Total[a,b,c]			Confidential			
Lower Yukon River	–	–	–	–	–	–
Upper Yukon River	–	–	–	–	–	–
Yukon River Total	–	–	–	–	–	–
Norton Sound[c]	0	0	7	290	6	304
Kotzebue Sound	–	0	0	–	96	96
AYK Region Total	3	115	21	290	109	538

Note: Dashes indicate 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 personal use.

[c] Total includes commercial harvest that was discarded, confiscated, seized, or donated.

WESTWARD REGION

KODIAK AREA

The 2021 commercial harvest in the Kodiak Management Area (KMA) was approximately 9,000 Chinook salmon, 3.3 million sockeye salmon, 306,000 coho salmon, 2.6 million pink salmon, and 400,000 chum salmon. The total KMA salmon harvest of 30.2 million fish was above the 2021 forecast and the previous 10-year average of approximately 23.0 million fish.

Commercial fishing effort in 2021 was below average compared to recent years. Of the 587 eligible commercial salmon permits, only 300 permit holders (51%) made commercial landings. By gear type, a total of 168 purse seine and 130 set gillnet permit holders made deliveries in 2021. Less than 3 beach seine permits were fished in 2021. Participation rates for purse seine gear was average (45%), but participation of set gillnet gear was below average (69%).

Chinook Salmon

Run and Escapement Summary: The total Chinook salmon escapement of 5,815 fish was below the 10-year average of 5,916 fish.

Escapement goals for Chinook salmon have been developed for the Karluk and Ayakulik rivers. The Chinook salmon escapement through the Karluk River weir (2,796 fish) was below the BEG range of 3,000–6,000 fish. Chinook salmon escapement through the Ayakulik River weir (2,961 fish) was below the biological escapement goal (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 salmon and pink salmon fisheries. By regulation, nonretention of Chinook salmon was implemented for the purse seine fleet areawide from June 1 through July 5. Due to poor Chinook salmon runs to both the Karluk and Ayakulik Rivers, nonretention of Chinook salmon was extended for the purse 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 2021 commercial harvest of Chinook salmon in the KMA totaled 9,065 fish, which was below the 10-year average (11,791 fish) but above the 2021 forecast (6,800 fish).

Sockeye Salmon

Run and Escapement Summary: Sockeye salmon runs in many systems in the KMA were strong. However, the escapement goals for one major system (Karluk River early-run) and one small system (Buskin Lake) were not achieved in 2021. All other established escapement goals were either met or exceeded. The KMA estimated sockeye salmon escapement of approximately 1.7 million fish was well above the previous 10-year average of 1.3 million fish and was the largest escapement estimate in 18 years.

Harvest Summary: The 2021 commercial harvest of sockeye salmon totaled approximately 3.3 million fish. The harvest was above the recent 10-year average (2.3 million fish) and the preseason forecast (2.0 million fish).

Early-season management for much of the Westside of Kodiak Island is driven by Karluk River early-run sockeye salmon. The 2021 Karluk River 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 River early-run sockeye salmon escapement goal (150,000 fish) was not achieved. A total of 100,412 sockeye salmon were harvested in early-season

Westside areas. Westside sockeye salmon harvest totals include an estimated contribution of 42,353 sockeye salmon from the enhanced Spiridon Lake sockeye salmon run harvested outside of the Spiridon Bay Special Harvest Area (SHA).

Late-season management for much of the Westside of Kodiak is driven by the Kodiak Island pink salmon fishery and the Karluk River late-run sockeye salmon run. Most of the wild pink salmon runs to the Westside of Kodiak Island were average, and weekly fishing time was allowed in July and early August. The Karluk River late-run sockeye salmon run was below average, but a large buildup of sockeye salmon in Karluk Lagoon in mid-August allowed for liberal fishing time in August and September. A total of 845,944 sockeye salmon were commercially harvested in late-season Westside areas opened based on Karluk River late-run sockeye salmon and Westside Kodiak pink and chum salmon abundance. Westside sockeye salmon numbers include an estimated contribution of 72,436 sockeye salmon from the enhanced Spiridon Lake sockeye salmon run, harvested outside of the Spiridon Bay SHA.

The Ayakulik River early-run sockeye salmon run was one of the largest on record and liberal fishing time was allowed in the Outer Ayakulik Section and Halibut Bay Sections of the Southwest Kodiak District during early-run sockeye salmon management. A total of 697,819 sockeye salmon were harvested in areas managed based on abundance of Ayakulik River early-run sockeye salmon. The Ayakulik River late-run sockeye salmon run was also one of the largest on record and liberal fishing time was allowed in the Outer Ayakulik Section of the Southwest Kodiak District. A total of 647,892 sockeye salmon were harvested in areas managed based on Ayakulik River late-run sockeye salmon. A total of 1,345,711 sockeye salmon were harvested from Westside sections opened based on abundance of Ayakulik River sockeye salmon, which was well above the 2021 forecast of 590,000 fish.

Upper Station early-run sockeye salmon escapement was one of the largest on record, and the traditional fishing areas of the Alitak District (i.e., purse seine and set gillnet sections) were open for most of June. The Frazer Lake sockeye salmon escapement was above average, allowing for Alitak District early-run sockeye salmon commercial salmon openings through July 15. The Alitak District early-run sockeye salmon harvest was the largest in 12 years at approximately 249,744 fish, well above the projected harvest of 26,000 fish. The Upper Station late-run sockeye salmon run was above average, and despite near continuous fishing time, set gillnet effort was below average. The Alitak District late-run sockeye salmon harvest was the largest in 17 years at 403,044 fish, well above the projected harvest of 152,000 fish. The total harvest of the Alitak District late-run sockeye salmon was 652,788 fish, which was well above the forecasted harvest of 178,000 fish.

Coho Salmon

Run and Escapement Summary: Although substantial coho salmon runs occur in the KMA, ADF&G no longer has the funds to monitor most stocks. The only established coho salmon escapement goals exist in the Northeast Kodiak and Eastside Kodiak District. Coho salmon runs in many systems in the KMA were strong in 2021. All escapement goals were met except for the American River escapement goal.

Harvest Summary: The commercial coho salmon harvest of 306,329 fish was below the forecast (426,000 fish) and below the previous 10-year average (338,014 fish). A majority of coho salmon were harvested in the Westside Kodiak fishery in August and September and at Kitoi Bay Hatchery in August and September.

Pink Salmon

Run and Escapement Summary: The KMA pink salmon escapement of approximately 5.0 million fish was slightly below the previous 10-year average of 5.7 million fish. Pink salmon escapement goals have been established as aggregate goals for the entire Kodiak Archipelago and the Mainland District. The escapement for the Kodiak Archipelago (over 4.5 million fish) was within the escapement goal range of 2.0–5.0 million fish. The Mainland District pink salmon escapement of 478,250 fish was average and within the established escapement goal range (250,000–1,000,000 fish).

Harvest Summary: The 2021 KMA pink salmon harvest of almost 26.2 million fish was above the forecast (22.5 million fish) and above the previous 10-year average harvest of 19.6 million fish. Pink salmon harvested in the areas managed on KMA wild stocks totaled nearly 15.7 million fish (11.6 million fish forecast).

The Kitoi Bay Hatchery pink salmon run was strong with just under 10.5 million pink salmon harvested in sections near the hatchery (10.9 million fish forecast). Kitoi-bound pink salmon are probably harvested along the west and east sides of Kodiak and Afognak Islands. Likewise, additional wild stock salmon are probably harvested in areas associated with Kitoi Bay Hatchery. ADF&G does not have a stock separation program for pink salmon and is unable to differentiate between KMA wild and hatchery stocks. Cost-recovery fish harvested by Kodiak Regional Aquaculture Association accounted for 30% of the harvest or approximately 3.0 million fish.

Chum Salmon

Run and Escapement Summary: The overall KMA chum salmon escapement of 309,003 fish was below the previous 10-year average (378,731 fish). Chum salmon runs were weak in many KMA districts. A peak indexed escapement goal based on 17 streams on Kodiak Island has been established; the 2021 peak indexed escapement of 113,000 fish was above 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. Many of the 2021 KMA chum salmon runs were weak, and closures were necessary to achieve escapement. The 2021 KMA chum salmon harvest of 409,339 fish was well below the 2021 forecast (777,500 fish). Additionally, the Kitoi Bay Hatchery chum salmon harvest of only 40,493 chum salmon was well below the forecast of 128,100 fish.

Summary by James Jackson, Geoff Spalinger, and Todd Anderson, Area Management Biologists, ADF&G, Kodiak.

CHIGNIK AREA

Commercial salmon fishing effort in the Chignik Management Area (CMA) was below average, with only 31 permits participating. Since 2018, the early run of sockeye salmon into the Chignik River watershed has failed to develop, and both the early and late runs failed to develop in 2018 and 2020; the failure of CMA sockeye salmon runs to develop is the major contributing factor to low participation. Prior to 2018, between 50 and 70 permits participated in CMA commercial fisheries on any given year.

The 2021 commercial harvest in the CMA was approximately 1,000 Chinook, 119,000 sockeye, 84,000 coho, 1.3 million pink, and 43,000 chum salmon (Table 7). The 2021 commercial sockeye salmon harvest in the CMA was effectively the lowest recorded harvest since 1960, behind only the 2018 harvest and the 2020 harvest when 128 sockeye salmon and 0 sockeye salmon were harvested, respectively.

The first day of harvest occurred on July 12 in select inner bay statistical areas and was directed at early pink and chum salmon returning to area streams in terminal harvest areas. The July 12 opener was for 48 hours, and weekly 48-hour openers occurred until early August, when sockeye salmon escapement into the Chignik River watershed started to trend in the upper 50th percentile of interim escapement objectives. Starting in early August all districts were opened to commercial salmon harvest effort, and extensions occurred multiple times based upon the strength of the late run of sockeye salmon into Chignik River. Ultimately, harvest effort ceased on August 26 when area processors discontinued buying operations.

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 2021 Chignik River Chinook salmon escapement (above the weir) of 1,172 fish did not meet the escapement goal and was below recent escapement averages. State subsistence and sport fishery harvest of Chinook salmon will not be known until permits and questionnaires are returned and tabulated.

Harvest Summary: A total of 1,420 Chinook salmon were harvested during the 2021 CMA commercial salmon fishing season. Most of the harvest took place in the Western and Central Districts, and all commercial harvest was incidental to targeted pink, chum, and sockeye salmon harvest effort. Due to the low escapement of Chinook salmon into the Chignik River watershed, management actions were taken in state and federally managed fisheries for the conservation of Chinook salmon; for much of the season, Chinook salmon caught in the Chignik Bay District that were 28 inches or greater were required to be returned to the water unharmed.

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: an early run and a later run. The early run starts in May, continues through June, and decreases in July, whereas the late run of sockeye salmon starts in June, continues through July, and decreases throughout August and into September. The early-run escapement was 244,384 fish and was well below the early-run BEG of 350,000–450,000 fish. The late-run estimated escapement of 396,558 fish met the late-run SEG range of 200,000–400,000 fish. Chignik Lake has an inriver run goal of 20,000 sockeye salmon: 10,000 sockeye salmon in August and 10,000 sockeye salmon in September. The inriver run goal is in addition to the SEG of 200,000 – 400,000 fish. The inriver run goal was met during 2021 with 142,183 fish escaping upriver in August and 20,583 fish escaping upriver in September.

Harvest Summary: Harvest opportunity targeting sockeye salmon in the CMA is based upon the escapement of both early and late-run sockeye salmon in the Chignik River watershed. Due to the

significant overlap of early and late runs of sockeye salmon, management must be able to allow opportunity to harvest surplus fish without jeopardizing either run.

The early run of sockeye salmon did not develop as expected, and as a result, no harvest opportunity specifically targeting sockeye salmon occurred in either June or July. The late run of sockeye salmon met all interim escapement objectives throughout the season but trended along the bottom half of interim escapement objectives until early August. Starting in early August, commercial harvest opportunity targeting sockeye salmon was allowed in all districts. A total of 118,785 sockeye salmon were harvested in the CMA, which was well below all recent averages and one of the lowest years on record.

Coho Salmon

Run and Escapement Summary: Coho salmon start to enter CMA drainages in mid-August and generally continue through November. In 2021 the weir ceased operations on August 16, and no coho salmon were observed escaping past the weir as a result. Late season coho salmon stream surveys were not conducted in the CMA in 2021 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: A total of 84,452 coho salmon were harvested during the 2021 commercial salmon fishing season. Coho salmon harvest was incidental to efforts targeting sockeye salmon. The most recent 10-year average harvest of coho salmon in the CMA is 92,644 fish.

Pink Salmon

Run and Escapement Summary: The CMA has an odd year areawide aggregate pink salmon escapement goal of 260,000–450,000 fish. The aggregate pink salmon escapement is the sum of pink salmon escapement into 8 different area streams. In 2021, the aggregate pink salmon escapement was 495,000 pink salmon, which met the SEG. Escapements into most other CMA streams were monitored via aerial surveys to assess areawide run timing and distribution.

Pink salmon were observed migrating past the Chignik River weir starting in mid-June. Substantial numbers of pink salmon continued to migrate past the weir up until August 16 when the weir was removed; the pink salmon escapement should be considered a minimum, because pink salmon runs continue through August and into September. An estimated total of 6,057 pink salmon were observed migrating past the Chignik River weir in 2021.

Harvest Summary: A total of 1.32 million pink salmon were harvested in the CMA during 2021, which was roughly half the 10 odd-year average harvest of 2.66 million pink salmon. The first day of fishing was on July 12 and occurred in inner bays to facilitate early harvest of pink and chum salmon. The last day of fishing occurred on August 26 when processors ceased buying operations. The majority (82%) of the pink salmon harvest occurred in the Western District in August.

Chum Salmon

Run and Escapement Summary: Chum salmon escaping into CMA streams were estimated via aerial surveys, except for the Chignik River, which was enumerated using the Chignik River weir. The chum salmon SEG range of 45,000–110,000 fish is based on escapement of 6 total index streams within 4 of the 5 districts. The 2021 estimated total peak chum salmon escapement for the 6 index streams was 122,000 fish, which was above the established SEG.

At the Chignik River weir, a total of 25 chum salmon were observed passing in 2021.

Harvest Summary: A total of 43,187 chum salmon were harvested in the CMA. The harvest of chum salmon was below the recent 10-year average of 163,786 fish. The majority of chum salmon harvest occurred in the Western District. The first day of harvest opportunity occurred on July 12 in inner bay terminal harvest areas, and the last occurred on August 26 when area processors ceased buying operations.

Summary by Reid Johnson, Area Management Biologist, ADF&G, Kodiak.

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

The 2021 commercial salmon harvest in the Alaska Peninsula, Aleutian Islands, and Atka-Amlia Islands Management areas totaled approximately 16,000 Chinook, 7.5 million sockeye, 357,000 coho, 16.6 million pink, and 2.3 million 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, 1,808 Chinook salmon were harvested, which was below the 10-year average harvest of 2,090 fish. The total commercial harvest for the South Peninsula fishery (including the Southeastern District Mainland [SEDM] from July 26 to October 31) was 14,314 Chinook salmon.

Sockeye Salmon

Run and Escapement Summary: The Orzinski Lake sockeye salmon escapement of 21,839 fish was slightly above the SEG range of 15,000–20,000 fish.

The South Peninsula sockeye salmon escapement of 59,699 fish was within the management objective range of 48,200–86,400 fish. Escapement into Mortensens Lagoon (1,500 fish) was below the SEG range of 3,200–6,400 fish. Escapement into Thin Point Lagoon (19,100 fish) was within the SEG range of 14,000–28,000 fish.

The 2021 sockeye salmon escapement in the Northwestern District was within the escapement objective range of 52,600–106,000 fish, with a total escapement of 90,800 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 (including 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 range 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 range 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 range 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 range 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 range 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 range 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 range of 36,000–94,000 fish.

Harvest Summary: The total commercial harvest for the South Peninsula fishery (including the SEDM from July 26–October 31) was approximately 4.6 million fish.

On the North Peninsula, a total of nearly 2.9 million sockeye salmon were harvested, which was above the 10-year average of 2.1 million fish.

Coho Salmon

Run and Escapement Summary: There were no coho salmon surveys flown on the South Peninsula streams in 2021. 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 total commercial harvest for the South Peninsula fishery (including the SEDM from July 26–October 31) was 332,048 fish.

A total of 25,432 coho salmon were harvested in the North Peninsula. One targeted coho salmon fishery took place in the Nelson Lagoon Section, and the rest of the coho salmon were incidentally harvested during sockeye salmon fisheries.

Pink Salmon

Run and Escapement Summary: The South Peninsula pink salmon total indexed escapement of 4.4 million fish was above 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 2021. A total of 71,452 pink salmon were observed in the Northern District in 2021, and 46,400 pink salmon were observed in the Northwestern District.

Harvest Summary: The total commercial harvest for the South Peninsula fishery (including the July 26 to October 31 SEDM fishery) was 16.5 million fish. A total of 62,785 pink salmon were commercially harvested in the North Peninsula Area fisheries.

Chum Salmon

Run and Escapement Summary: The South Peninsula Chum salmon indexed total escapement of 483,200 fish was above the cumulative district escapement goal range of 218,300–410,600 fish.

In the Northwestern District, the chum salmon escapement of 47,550 fish was below the SEG range of 100,000–215,000 fish.

The Northern District has a districtwide chum salmon escapement goal range of 119,600–239,200 fish. The 2021 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 total commercial harvest for the South Peninsula fishery (including the SEDM from July 26 to October 31) was approximately 2.2 million fish. During the 2021 commercial chum salmon fishery 28,070 fish were harvested in the North Peninsula.

Summary by Lisa Fox, Ross Renick, Bob Murphy, and Charles Russel, Area Management Biologists, ADF&G, Kodiak.

Table 7.–2021 Westward Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kodiak[a,b]	9	3,291	306	26,180	409	30,196
Chignik[b]	1	119	84	1,321	43	1,569
South Peninsula[a,b]	14	4,599	332	16,550	2,241	23,736
North Peninsula	2	2,878	25	63	28	2,996
Alaska Peninsula Total	16	7,477	357	16,613	2,269	26,733
Westward Region Total	27	10,887	748	44,115	2,722	58,498

Note: Columns may not total exactly due to rounding.

[a] Total includes commercially harvested fish retained for personal use.

[b] Total includes commercial harvest that was discarded, confiscated, seized, or donated.

SALMON SPECIES CATCH AND PROJECTIONS

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

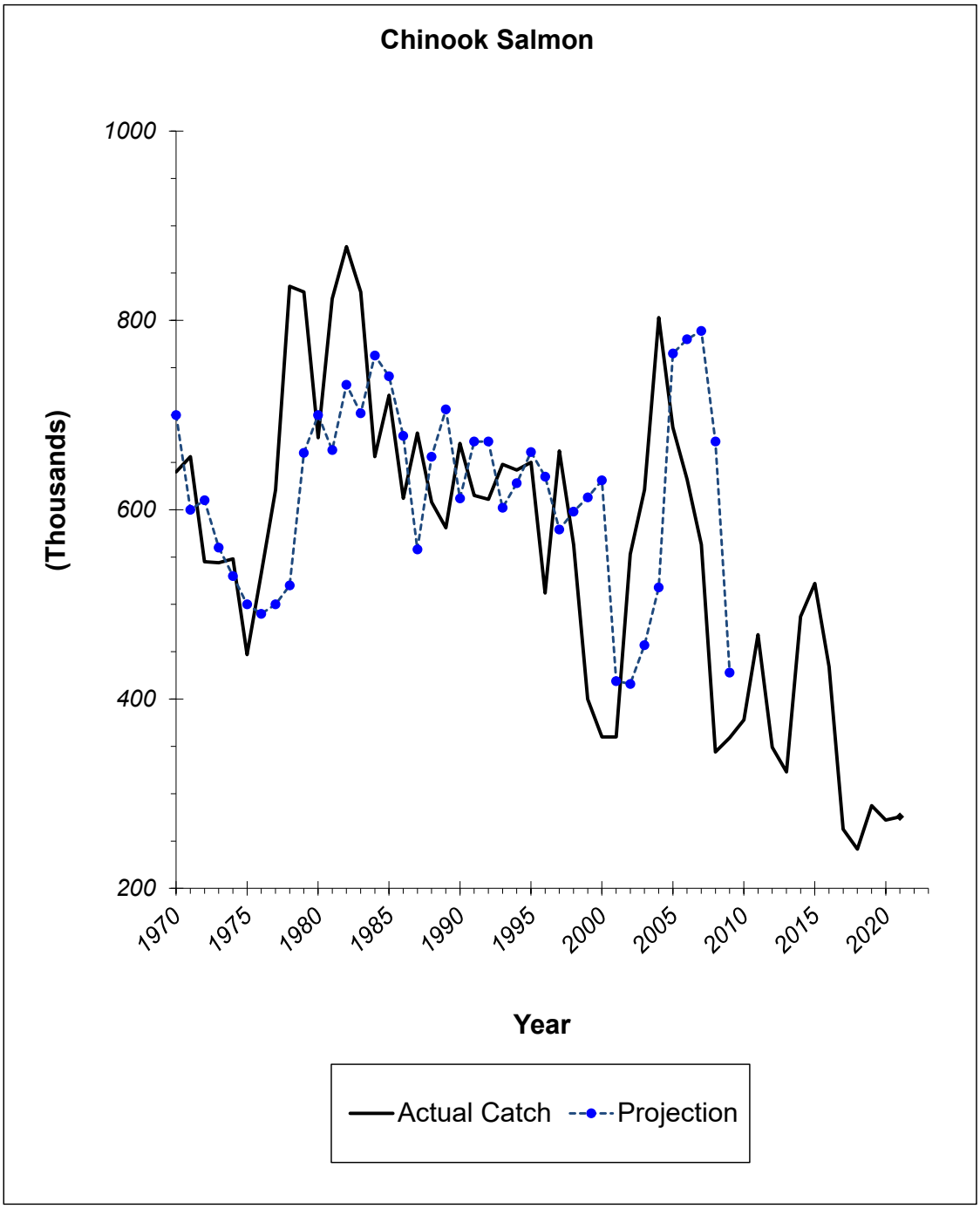

Figure 2.–Relationship between actual catch and projected catch in thousands, for Alaska Chinook salmon fisheries from 1970 to 2021; 2010–2022 projections are not available.

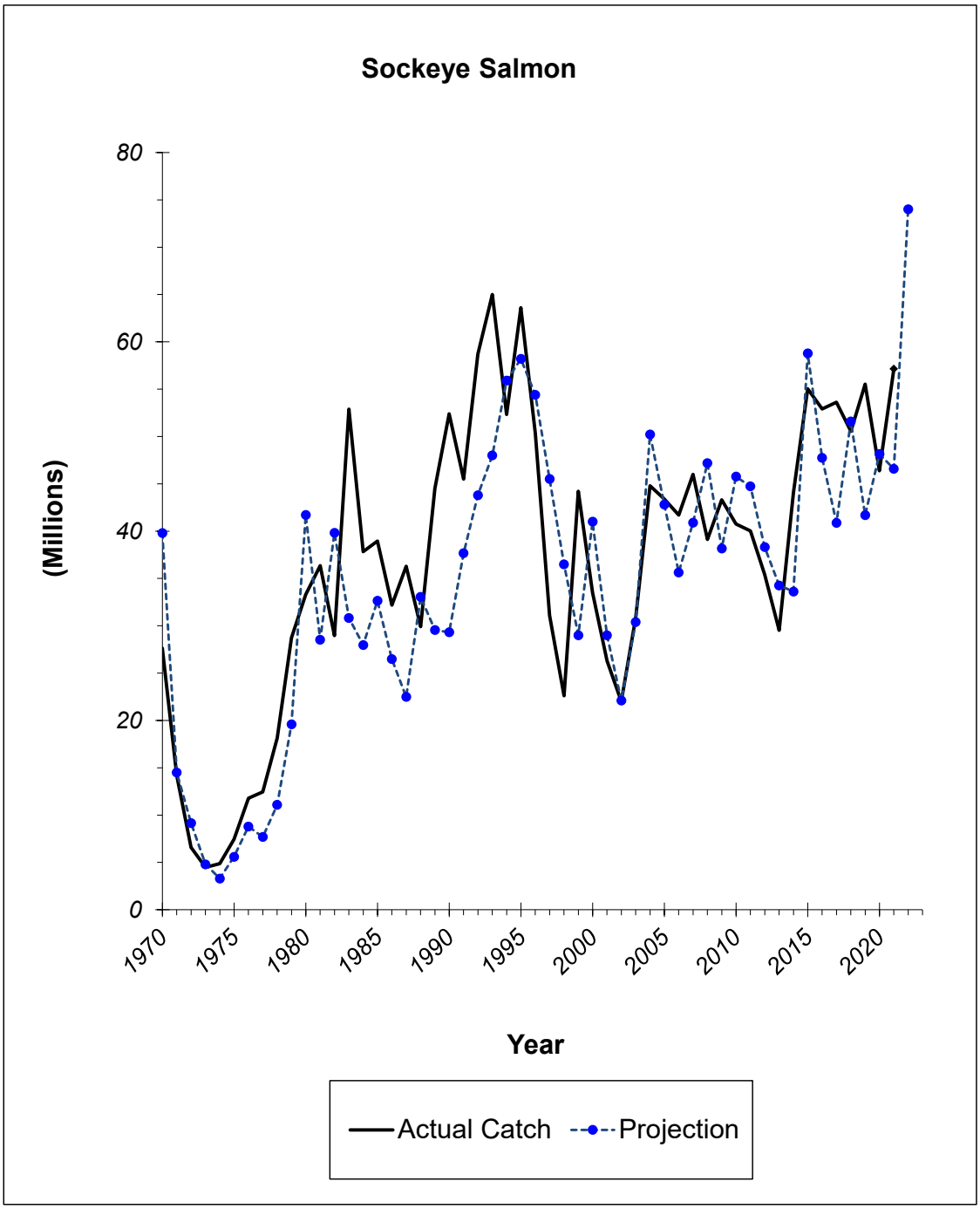

Figure 3.–Relationship between actual catch and projected catch in millions, for Alaska sockeye salmon fisheries from 1970 to 2021, with the 2022 projection.

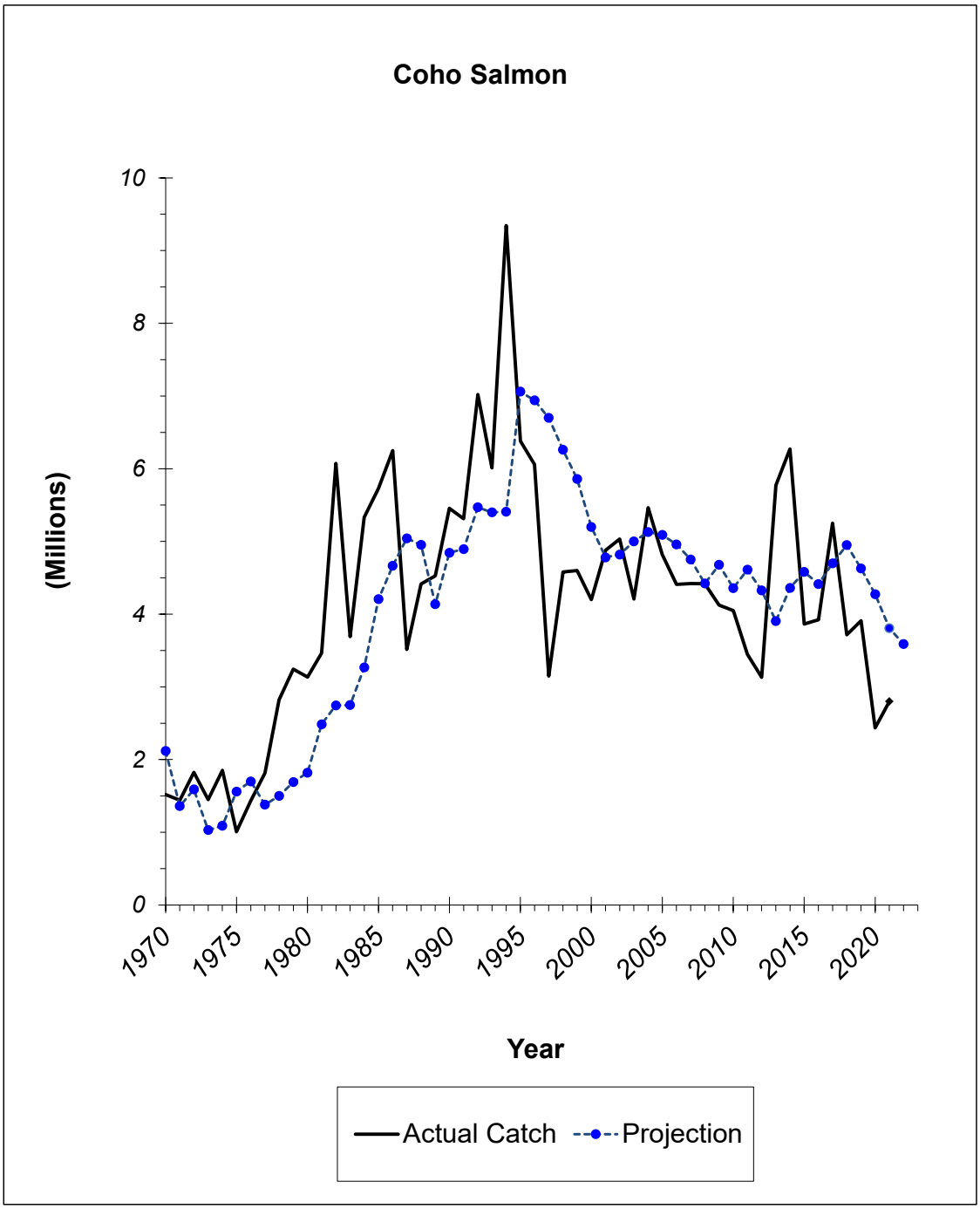

Figure 4.–Relationship between actual catch and projected catch in millions, for Alaska coho salmon fisheries from 1970 to 2021, with the 2022 projection.

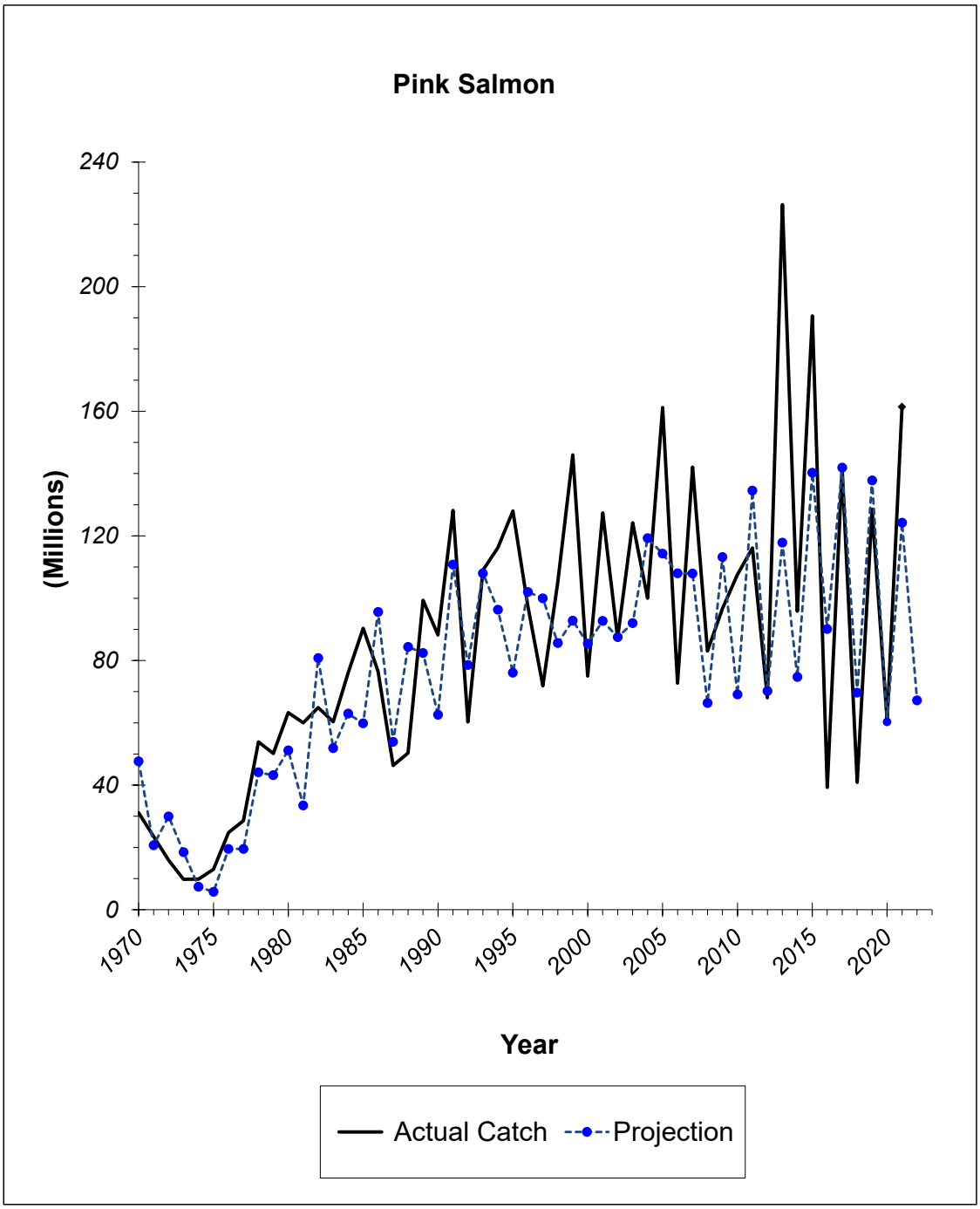

Figure 5.–Relationship between actual catch and projected catch in millions, for Alaska pink salmon fisheries from 1970 to 2021, with the 2022 projection.

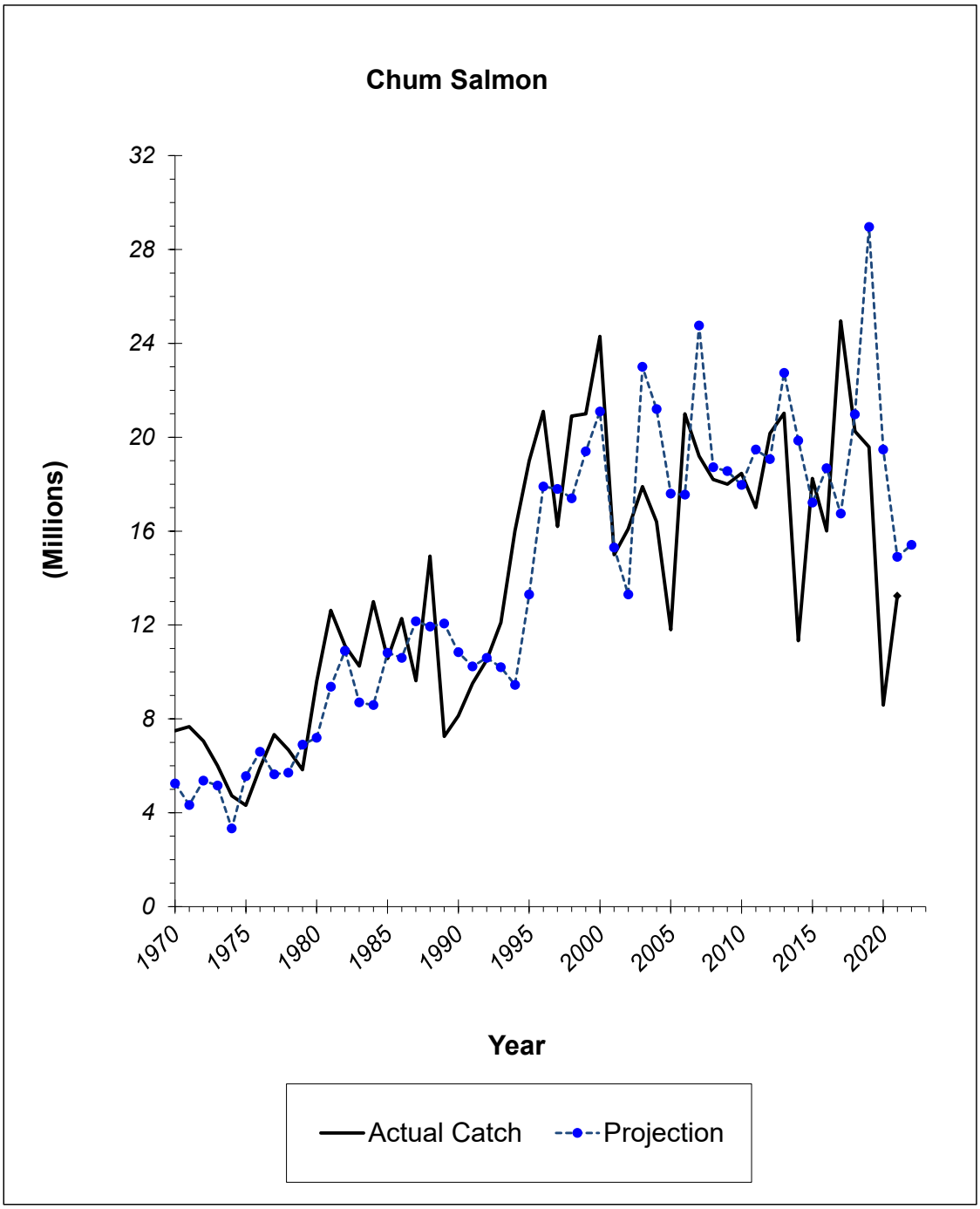

Figure 6.–Relationship between actual catch and projected catch in millions, for Alaska chum salmon fisheries from 1970 to 2021, with the 2022 projection.

PRELIMINARY FORECASTS OF 2022 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 2022 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 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 SEAK pink salmon harvest in 2022 is predicted to be in the *weak* range with a point estimate of 16 million fish (80% prediction interval: 10–24 million fish). The categorical ranges of pink salmon harvest in SEAK were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest over the 61-year period 1960–2020 (Table 9):

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 32	40th to 60th
Strong	32 to 48	60th to 80th
Excellent	Greater than 48	Greater than 80th

Forecast Methods: The NOAA Alaska Fisheries Science Center, Auke Bay Laboratories 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. 2000). 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 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 2022 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 2021 juvenile pink salmon abundance index (monthly peak juvenile CPUE; standardized catch based on 20-minute trawl sets) of 0.88 was the second lowest index in the 25 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:

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

where *E(y)* is the expected value for *y*, the natural log of SEAK 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. The model performance metric one-step-ahead mean absolute percentage error (MAPE; for the last 5 years), and significant coefficients (i.e., covariates) were used to evaluate the forecast accuracy of the 2 models considered (one with a temperature variable and

one without). The 80% prediction interval around the forecast was calculated using the *car* package (Fox and Weisberg 2019) in program R version 3.6.3 (R Core Team 2020).[1]

Forecast Discussion: The 2022 harvest forecast of 16 million pink salmon is approximately half of the recent 10-year average harvest of 34 million pink salmon. A forecast of 16 million pink salmon is an improvement over the previous even-year harvest in 2020 (8 million fish) and is just below the average even-year harvest since 2006 (18 million fish). The 2021 peak June–July juvenile pink salmon index value (0.88) ranked 24th out of the 25 years that SECM information has been collected. Pink salmon harvests associated with juvenile indices below 2.0 have ranged from 8 to 21 million fish (mean = 16 million fish).

The extremely low juvenile abundance index in 2021 may reflect low escapements of pink salmon in northern inside waters in 2020 and/or poor freshwater and early marine survival in SEAK. Pink salmon escapements in the parent year (2020) were poor throughout northern SEAK inside waters and the escapement goal was not met in that subregion. Conversely, pink salmon escapement goals for the Southern Southeast and Northern Southeast Outside subregions were met, and most of the low harvest of 8 million pink salmon occurred in the southern half of the region. A potential reason to be more optimistic about the 2022 pink salmon return is that juvenile pink salmon heading to sea in 2021 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 similarly cooler for fish that went to sea in 2020 and returned in above-average numbers in 2021.) Sea surface temperatures were near or below average in the summer and fall of 2021 through much of the Gulf of Alaska, and the summer water temperature index in the upper 20 m in Icy Strait was slightly below average, indicating moderate marine temperatures for juvenile salmon heading to sea in 2021.

Although the forecast for 2021 indicated that pink salmon run strength would improve over the parent year, our forecast did not capture the magnitude of the increase in run size (Figure 8). The reason for the underforecast of the 2021 harvest is unknown but may be related to improved offshore survival in the Gulf of Alaska, nonproportional regional representation of juvenile salmon in trawl catches, and/or additional local or basin-scale measures of the environment, unaccounted for in the model, that may better serve as indicators of processes that influence pink salmon survival. If improved survival in the Gulf of Alaska was the primary cause of the underforecast in 2021, the continued cool conditions in the Gulf of Alaska may result in a better-than-expected pink salmon run in 2022. Juvenile pink salmon caught in the 2021 SECM survey trawls were below the average size (in length) for the 25-year time series (Figure 9), and further growth and survival will depend on favorable resources in the Gulf of Alaska.

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 the forecast model. 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). In 2020 and 2021, we began exploring the potential use of satellite temperature data (available from the NOAA National Environmental

[1] The R project for statistical computing. http://www.r-project.org/index.html.

[2] https://www.ncei.noaa.gov/products/extended-reconstructed-sst

Satellite data and Information Service[3]) in our forecast models and may incorporate this type of data in our 2023 harvest forecast. Satellite data allows for averaging of temperature readings over an almost infinite variety of temporal and geographic units. Despite the uncertainties that surround every salmon forecast, the track record of our pink salmon harvest forecasts has been relatively good (Figure 8), especially considering the difficulties unique to forecasting pink salmon runs (Haeseker et al. 2005).

ADF&G will manage the 2022 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.

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

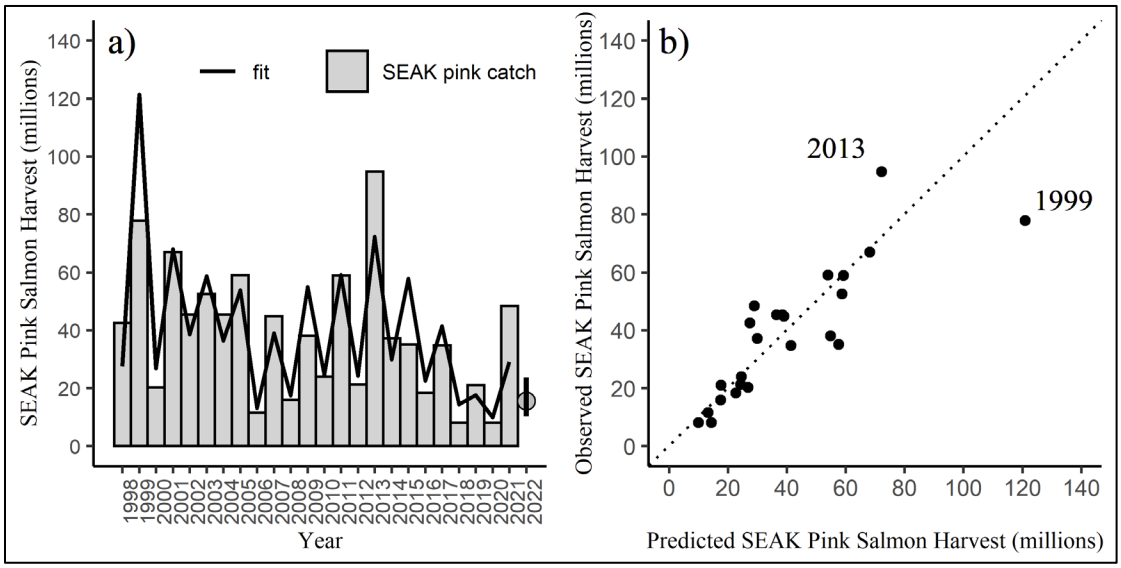

Figure 7.–Forecast model fit (hindcasts) for total Southeast Alaska (SEAK) pink salmon harvest, 1998–2021 by year (A) and by the fitted values (B). In panel A, the 2022 forecast is shown as a grey circle with the 80% prediction interval as a black vertical line. The observed SEAK pink salmon harvest is represented by the grey bars and the model fit is shown by the black line. In panel B, the dotted line 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.

[3] https://www.nesdis.noaa.gov/

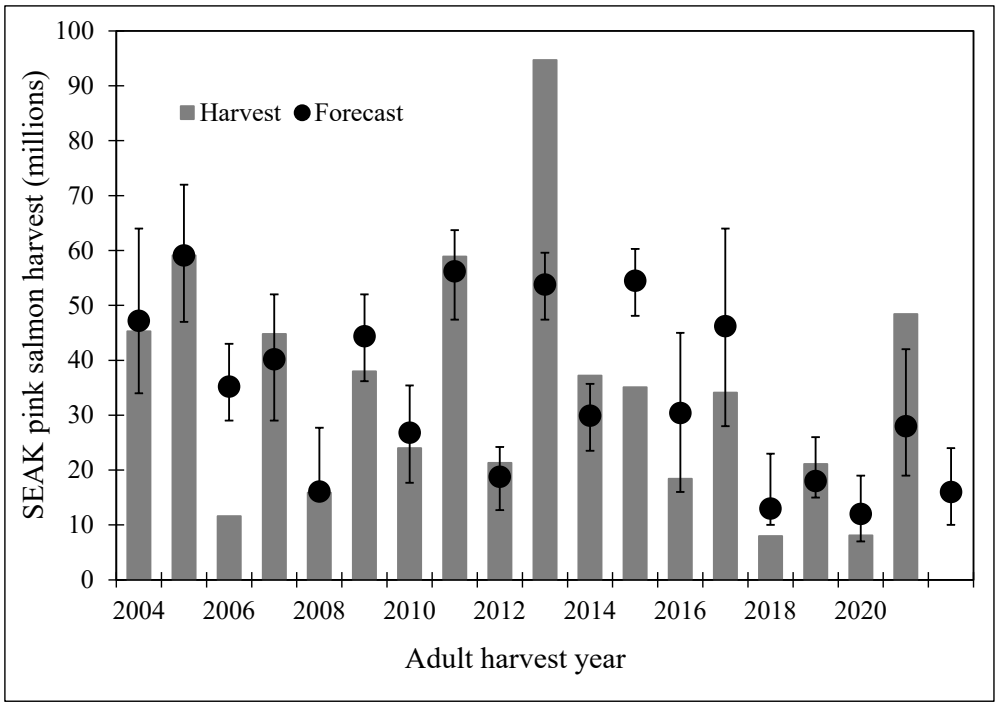

Figure 8.–Annual harvests of pink salmon in SEAK compared to the actual preseason harvest forecasts, 2004–2022. The error bars represent the 80% confidence or prediction intervals of the forecasts.

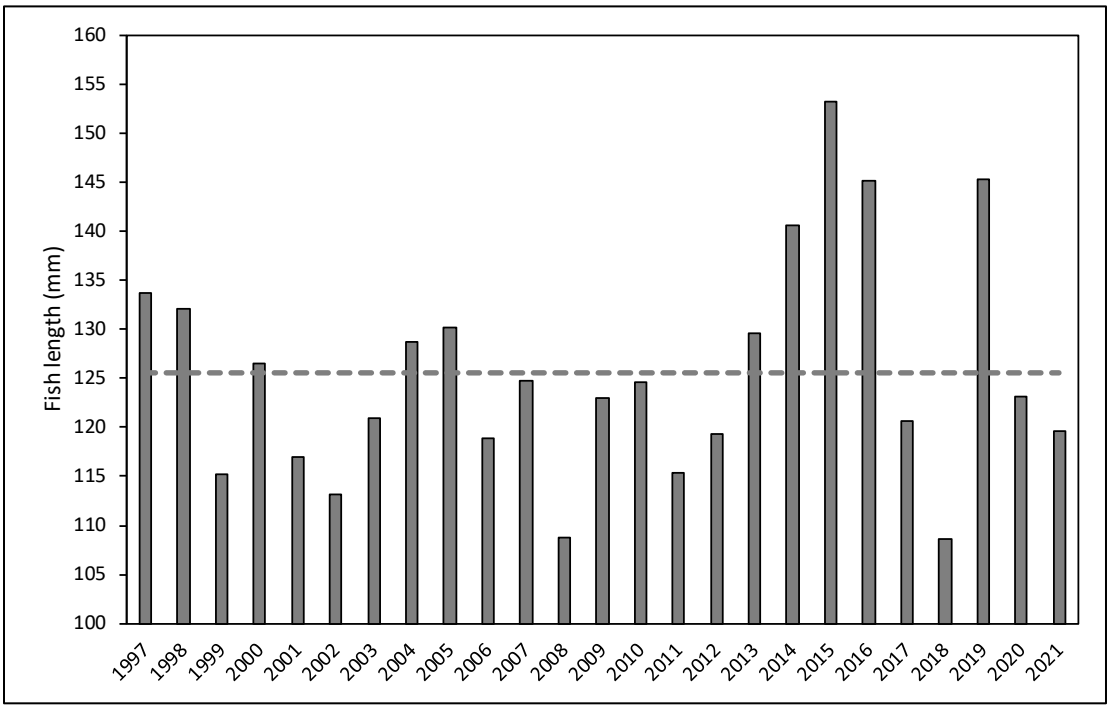

Figure 9.–Estimated mean fork length on a standard date (July 24th) of juvenile pink salmon captured during trawl surveys in Upper Chatham and Icy Straits, 1997–2021. Mean fork length was estimated within each year using a linear regression of length by date. The dashed line is the mean for the entire time series.

CENTRAL REGION

COPPER RIVER AND PRINCE WILLIAM SOUND

Forecasts of total run were calculated for Copper River wild sockeye salmon, Gulkana Hatchery sockeye salmon, Coghill Lake sockeye salmon, and for wild PWS pink and chum salmon. PWSAC and VFDA provide additional forecasts for hatchery-specific stocks (Table 10). In addition to forecasts, a summary of recent 10-year averages (2012–2021) of commercial 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 general magnitude of expected runs and set early-season harvest management strategy. In 2022, ADF&G will continue to manage PWS and Copper River 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.–2022 Prince William Sound Area formal salmon forecast summary (thousands of fish).

Area/Run Type	Species	Forecast Point	Forecast Range	% Above/Below 10-yr Average	Total Run 10-yr Average
Copper River					
Wild	Sockeye Salmon	1,379	852–1,906	29% Below	1,955
Gulkana Hatchery	Sockeye Salmon	53	33–73	74% Below	204
Total Run	Sockeye Salmon	1,432	905–1,959	34% Below	2,159
Coghill Lake					
Wild	Sockeye Salmon	414	337–491	110% Above	197
Prince William Sound					
Wild	Pink Salmon	5,036	1,156–11,910	36% Above	3,698
Wild	Chum Salmon	332	72–592	29% Below	467

Table 11.–Prince William Sound Area recent 10-year (2012–2021) average CCPF salmon harvest by species (thousands of fish).

Area/Run Type	Chinook	Sockeye	Coho	Pink	Chum	Total
Bering River						
Wild	0	4	60	0	0	64
Copper River						
Wild	13[a]	984	211	13[b]	15	1,236
Hatchery	0	170	0	0	0	170
Total	13	1,154	211	13[c]	15	1,406
Prince William Sound						
Wild	1	215	N/A[c]	2,773[b]	288	3,277
Area Totals						
Wild	14	1,203	271	2,786[b]	303	4,577

[a] Genetic sampling indicates that not all Chinook salmon harvested are of Copper River origin.

[b] Recent 10 even-year commercial harvest (2012–2021)

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

Table 12.–2022 PWS sockeye salmon forecast model summary. Models selected for inclusion in the run forecast (lowest MAPE) are shaded.

Stock/Age Class	Brood Year	Model	Prediction	MAPE
Copper River Wild Sockeye				
0.3		5-year mean	64,436	
1.1		5-year mean	2,062	
1.2	2018	log 1.2 R/S x BYE	242,874	65%
		log 1.2 x log 1.1	206,790	56%
1.3	2017	1.3 x BYE	1,077,712	51%
		log 1.3R/S x BYE	1,049,384	43%
		log 1.3 x log 1.2	979,267	33%
		log 1.3 x log 0.3	985,957	44%
		1.3 x 1.2	998,620	46%
2.2	2017	log 2.2 x BYE	24,803	68%
		log 2.2 x log 1.2	24,198	63%
2.3	2016	log 2.3 x log 2.2	102,273	63%
		log 2.3 x log 1.3	86,230	70%
Total			1,379,026	
Coghill Lake Sockeye				
1.1		10-year mean	5,880	
1.2	2018	log 1.2 R/S x BYE	30,087	172%
		log 1.2 x log 1.1	153,221	123%
1.3	2017	log R/S 1.3 x BYE	97,446	199%
		log 1.3 x log 1.2	242,609	71%
2.2		10-year mean	6,890	
2.3		10-year mean	5,659	
Total			414,259	

Note: R/S = return per spawner; BYE = brood year escapement

Table 13.–2022 PWS wild pink and chum salmon forecast model summary. Models selected as the run forecast—lowest mean absolute percentage error (MAPE)—are shaded.

Run		Prediction	MAPE
PWS Wild Pink			
	Exponential	6,008,333	4.71%
	2-year	6,264,921	4.64%
	3-year	5,035,784	4.36%
	5-year	4,281,780	4.78%
PWS Wild Chum			
	Exponential	367,633	39.7%
	2-year	331,946	32.7%
	3-year	462,137	34.2%
	5-year	545,095	35.3%

Copper River Area

Chinook Salmon

The preliminary 2022 Copper River Chinook salmon forecast is for a total run of approximately 39,000 fish and a commercial harvest of 7,000 fish based on the recent 2-year average harvest (2020

and 2021). Details about this forecast were not available in time for this report but will be published when they become available.

Sockeye Salmon

The projected 2022 wild Copper River sockeye salmon total run point estimate is 1,379,000 fish (80% prediction interval: 852,000–1,906,000 fish). Gulkana Hatchery sockeye salmon total run is predicted to be 53,000 fish (80% prediction interval: 33,000–73,000 fish) for a total Copper River sockeye salmon run (wild + hatchery production) of 1,432,000 fish (80% prediction interval: 905,000–1,959,000 fish). This is 34% below the recent 10-year average (2012–2021) total run of 2,159,000 fish. Total Copper River sockeye salmon harvest estimate (all fisheries) is predicted to be 928,000 fish (80% prediction interval: 561,000–1,295,000 fish) with a commercial harvest of 716,000 fish (80% prediction interval: 349,000–1,083,000 fish).

Forecast Methods: The 2022 forecast of wild sockeye salmon to the Copper River is the sum of individual forecasts 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 sockeye salmon. Forecasts of these 4 age classes were developed from the relationship between returns of each age class and returns of the age class one year younger from the same brood year (sibling model, Table 12). The predicted return of age-1.1 and -0.3 sockeye salmon were calculated as the 5-year (2017–2021) mean return of these age classes. The 2022 run to Gulkana Hatchery was estimated as the recent 5-year weighted average fry-to-adult survival estimate (0.37%) from all Gulkana I and Gulkana II hatchery releases combined (onsite and remote). The Gulkana Hatchery run was apportioned to brood year using a maturity schedule of 30% age-4 and 70% age-5.

The total harvest point estimate (all fisheries) was calculated by subtracting the Gulkana Hatchery broodstock, hatchery surplus, and wild stock escapement goal needs (upriver and Copper River Delta) from the total run forecast. The commercial harvest estimate was calculated by subtracting Copper River inriver goal categories (5 AAC 24.360(b)) and the lower bound of 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 2022. There are currently 57 years (1965–2021) of harvest, escapement, and age composition data available for this analysis. Total run 80% prediction intervals were calculated from the mean squared error (MSE) of the retrospective forecast predictions.

Prince William Sound Area

Sockeye Salmon

The 2022 Coghill Lake sockeye salmon total run point estimate is 414,000 fish (80% prediction interval: 337,000–491,00 fish). This is 110% above the 10-year average (2012–2021) total run of 197,000 fish. Subtracting the escapement target of 30,000 fish from the total run forecast results in a harvest point estimate (all fisheries) of 384,000 fish (range: 307,000–461,000 fish).

Forecast Method: The 2022 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 sockeye salmon (Table 12). These linear regression models were parameterized using the historical relationship between returns of age-1.3 sockeye salmon and returns of age-1.2 fish one year previous, and returns of age-1.2 sockeye salmon and returns of the age-1.1 fish one year previous (sibling models). For example, the model to predict the return of age-1.3 sockeye salmon in 2022 used the return of age-1.2 fish in 2021 as the input parameter. An estimated 102,000

age-1.2 sockeye salmon returned to Coghill Lake in 2021, 93% above the recent 10-year average run of 52,724 age-1.2 fish, resulting in a forecast of 242,600 age-1.3 fish for 2022. An estimated 29,849 age-1.1 sockeye salmon returned to Coghill Lake in 2021, over 10 times the 10-year average of 2,900 age-1.1 fish, resulting in a forecast of 153,200 age-1.2 fish for 2021. These 2021 run components (as illustrated in Table 12) are the primary drivers behind the 2022 forecast being more than double the recent 10-year total run avg of 197,000 fish. Predicted returns of age-1.1, -2.2, and -2.3 sockeye salmon were calculated as the 2012–2021 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 2017–2021 forecasts and actual runs as the forecast variance.

Pink Salmon (wild run only)

The 2022 PWS wild pink salmon total run point estimate is 5,036,000 fish (80% prediction interval: 1,156,000–11,910,000 fish). This is 36% above the recent 10 even-year average (2000–2020) PWS wild pink salmon total run of 3,698,000 fish. Subtracting the midpoint of the even-year SEG, 783,500, from the total run forecast results in a harvest point estimate of 4,253,000 fish (range: 773,000–11,127,000 fish).

Forecast Methods: Several models were examined for the 2022 PWS wild pink salmon total run forecast including exponential smoothing and 2-, 3-, and 5-year running averages of past even-year total runs. The 3-year running average forecast was selected for 2022 because it outperformed other forecast models by having the lowest mean absolute percentage error (MAPE; Table 13). 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. For this forecast, total run estimates were natural log-transformed. Hatchery and wild stock contributions were determined from thermal marked otolith recoveries (1997–2021), coded wire tag recoveries (1985–1996), or average fry-to-adult survival estimates multiplied by fry release numbers and estimated exploitation rates (1977–1984).

Chum Salmon (wild run only)

The 2022 PWS wild chum salmon total run point estimate is 332,000 fish (80% prediction interval: 72,000–592,000 fish). This is 29% below the recent 10-year average (2012–2021) PWS wild chum salmon total run of 467,000 fish. Subtracting the 10-year average escapement, 200,000 from the total run forecast results in a harvest point estimate of 132,000 fish (range: 0 to 392,000 fish).

Forecast Methods: The 2022 PWS wild chum salmon total run forecast uses the 2-year running average method. Several models were examined for the 2022 PWS wild chum salmon total run forecast including exponential smoothing and 2-, 3-, and 5-year running averages of past total runs (Table 13). For 2022, 2-year running average outperformed the other models by having the lowest MAPE, mean percentage error (MPE), mean absolute scaled error (MASE), and median

symmetrical accuracy. 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 pre-hatchery average natural runs (1998–2003) or thermally marked otolith estimates (2004–2021) for each district in PWS.

Forecast by Jenni Morella, Area Finfish Research Biologist, ADF&G, Cordova.

UPPER COOK INLET

Sockeye Salmon

The forecasts of the 2022 UCI sockeye salmon run and harvests are presented in Table 14, with a breakout by stock in Table 15, model comparisons in Table 16, and a ranking of the 2022 forecast in Table 17.

Table 14.–2022 Upper Cook Inlet sockeye salmon run and harvests.

	Forecast Estimate (millions)	Forecast Range (millions)
TOTAL PRODUCTION:		
Total run	4.97	3.30–10.11
Escapement	2.00	
Commercial harvest	2.05	
Other harvests	0.92	

Based on the absolute percentage error for the historical forecasted UCI runs compared with the estimated runs, there is an 80% probability that the 2022 UCI run forecast range falls between 3.30 million and 10.11 million fish. This UCI forecast predicts a weak run based on historical total run estimates from 1986 to present (Table 17). The UCI preseason forecast has overestimated the total run by an average of 5% over the past 5 years and has ranged between -45% to 27% of the observed total run (Table 18).

The Kenai River forecast of 2.90 million sockeye salmon is 794,000 (21%) less than the 20-year average run of 3.70 million but 19,000 less than the 5-year average of 2.92 million (Table 15). The Kenai forecast is for a weak run based on historical total run estimates from 1986 to present (Table 17). The Kenai preseason forecast has underestimated the total run by an average of 4% over the past 5 years with a range of -50% to 39% (Table 18). The predominant age classes in the 2022 run forecast are age-1.2 (12%) and age-1.3 (71%). For the age-1.2 forecast, a spawner-recruit/brood interaction model forecast a return of 342,000 sockeye salmon in 2022 (Table 15 and Table 16). The age-1.2 forecast is 65,000 (16%) and 40,000 (10%) less than the 20-year and 5-year averages, respectively (Table 15). A fry model based upon age-0 juvenile sockeye salmon that resided in Kenai and Skilak Lakes predicts a return of 2.06 million age-1.3 salmon in 2022

(Table 14 and Table 16). The age-1.3 forecast return is 178,000 less (8%) than the 20-year average and 128,000 more (7%) than the 5-year average (Table 15). It is notable for the age 1.3 forecast that the log sibling model forecasts a return of approximately 171,000 more fish than the chosen fry model, but it had slightly larger 5-year and 10-year MAPEs (Table 16).

The Kasilof River sockeye salmon run forecast is approximately 941,000 fish (Table 15). The Kasilof preseason forecast is for an average run based on historical total run estimates from 1986 to present (Table 17). The Kasilof preseason forecast has overestimated the total run by an average of 10% over the past 5 years with a range of -31% to 10% (Table 18). The 2022 forecast is 51,000 fish less (5%) than the 20-year average but is 168,000 fish greater (22%) than the 5-year average (Table 15). The predominant age classes in the 2022 run forecast are age-1.2 (33%), age-1.3 (43%), and age-2.2 (21%). A spawner-recruit model based on the spawning population in 2018 forecast a return of 312,000 age-1.2 salmon in 2022 (Table 15 and Table 16). The age-1.2 forecast is 44,000 fish less (12%) than the 20-year average return and is 90,000 fish less (22%) than the 5-year average return. A sibling model based upon the return of age-1.2 salmon in 2021 (548,000 fish; 356,000 fish 20-year average) was used to forecast a return of 407,000 age-1.3 salmon in 2022 (Table 15 and Table 16). The 2022 age-1.3 forecast return is 107,000 fish greater (36%) than the 20-year average and 216,000 fish greater (113%) than the 5-year average returns. A sibling model based upon the return of age-2.1 salmon in 2021 was used to forecast a return of 193,000 age-2.2 salmon in 2022. The 2022 age-2.2 forecast is 49,000 fish less (20%) less than the 20-year average and 58,000 fish greater (43%) than the 5-year average (Table 15).

The Susitna River sockeye salmon run forecast is 310,000 fish, which is 55,000 fish (15%) less than the 10-year average of 365,000 fish (Table 15). This forecast was derived using mean return per spawner by age class and mark–recapture estimates of spawner abundance for brood years 2006–2018. 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 predominant age classes in the 2022 Susitna sockeye salmon run forecast are estimated to be age-1.2 (25%) and age-1.3 (50%).

The Fish Creek sockeye salmon run forecast for 2022 is 89,000 fish. This forecast is approximately 3,000 fish (3%) greater than the 20-year average run of 86,000 (Table 15). Sibling models based upon the returns of age-1.1, -1.2, -2.1, and -2.2 salmon in 2021 were used to forecast the 2022 returns. The predominant age classes in the 2022 Fish Creek run forecast are estimated to be age-1.2 (57%) and age-1.3 (27%). The 10-year MAPE for the Fish Creek sockeye salmon run forecast is 76%.

Table 15.–2022 Sockeye salmon run forecasts, 20-year (10-year Susitna River), and 5-year average runs, and escapement goals (in thousands of fish) to individual freshwater systems in Upper Cook Inlet.

System		Major age classes 1.2	1.3	2.2	2.3	Total run[a]	Escapement goals[b]
Kenai River	Forecast	342	2,059	183	261	2,902	1,100 – 1,400[c]
	20-yr average	407	2,237	225	756	3,696	
	5-yr average	382	1,931	120	431	2,921	
Kasilof River	Forecast	312	407	193	9	941	140 – 320
	20-yr average	356	300	242	72	992	
	5-yr average	402	191	135	29	773	
Susitna River	Forecast	77	156	21	37	310	Lakes goals[d]
	10-yr average	114	171	25	33	365	
	5-yr average	122	143	22	29	319	
Fish Creek	Forecast	51	24	7	2	89	15 – 45
	20-yr average	55	18	6	2	86	
	5-yr average	73	8	6	0.5	94	
Unmonitored	Forecast	134	453	69	53	725	No Goal
	20-yr average	159	466	85	148	879	
	5-yr average	167	389	48	84	702	
Total Run	Forecast	916	3,099	473	361	4,967	
	20-yr average	1,091	3,192	584	1,011	6,019	
	5-yr average	1,146	2,662	332	572	4,808	

[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 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, Chelatna 20,000–45,000 and Judd 15,000–40,000. Chelatna Lake weir will not be operated in 2022.

Table 16.–2022 UCI forecast model, prediction, 10-year MAPE, 5-year MAPE. Boxes indicate values chosen for 2022 preseason forecast.

River	Age class	Model	Prediction	10-year MAPE	5-year MAPE
Kenai	1.2	Log R vs Log S	321,899	0.425	0.460
		Standard Ricker	355,107	0.413	0.463
		Brood Interaction Model	342,131	0.380	0.390
	1.3	Log R vs Log Fry	1,801,816	0.394	0.599
		Log R = Log Fry CFSWT	2,059,339	0.248	0.323
		Log Sibling	2,230,375	0.251	0.320
	2.2	Log R vs Log S	206,658	0.950	1.476
		Log Sibling	213,030	0.804	0.837
		Log Sibling AR1	183,299	0.530	0.690
		5-year average	119,950	0.861	0.918
	2.3	Sibling omit4	370,213	1.337	2.227
		Sibling	541,003	2.007	3.616
		Log Sibling	303,411	0.991	1.507
		Log Sibling omit4	260,661	0.868	1.246
		Fall Fry age-1 Smolt age-2	809,825	1.792	3.197
Kasilof	1.2	Log R vs Log S	311,609	0.326	0.277
		Log R vs Log S AR1	411,673	0.343	0.332
		Log Sibling	262,737	0.347	0.372
		Log Smolt	288,905	0.387	0.494
		Log Smolt AR2	493,734	0.472	0.298
	1.3	Log Sibling	407,203	0.650	0.825
		Log Sibling AR1	500,717	0.844	1.212
	2.2	Log R vs Log S	231,938	1.034	1.890
		Log R vs Log S AR1	91,311	0.504	0.830
		Sibling AR2	108,850	0.463	0.740
		Log Sibling	193,087	0.398	0.652
		Log Sibling AR1	70,928	0.399	0.541
	2.3	Sibling	38,030	5.061	9.096
		Sibling AR2	8,998	1.573	2.464
		Log Sibling	19,602	4.703	8.272
		Log Smolt	63,511	3.3444	6.127

Table 17.–Percentile range of Upper Cook Inlet estimated total runs from 1986 to 2021 by historical percentile and qualitative ranking. Boxed values indicate 2022 preseason forecast strength.

UCI run ranking	UCI Range (millions)	Kenai Range (millions)	Kasilof Range (millions)	Percentile
Poor	<3.90	<2.30	<0.68	<20th
Weak	3.90–5.00	2.30–3.10	0.68–0.80	20th to 40th
Average	5.00–5.77	3.10–3.63	0.80–0.95	40th to 60th
Strong	5.77–7.50	3.63–5.00	0.95–1.15	60th to 80th
Excellent	>7.50	>5.00	>1.15	>80th

Table 18.–Comparison of % error of UCI sockeye salmon forecasts vs observed run (millions) for UCI and Kenai and Kasilof river stocks (2017-2021).

	UCI			Kenai			Kasilof		
Year	Forecast	Total run estimate	% Error	Forecast	Total run estimate	% Error	Forecast	Total run estimate	% Error
2017	4.02	4.59	13	2.16	2.89	25	0.83	0.82	-1
2018	4.56	3.14	-45	2.49	1.66	-50	0.87	0.70	-24
2019	6.04	5.23	-15	3.81	3.63	-5	0.87	0.67	-31
2020	4.38	4.29	-2	2.23	2.55	13	0.72	0.80	10
2021	4.37	5.95	27	2.33	3.83	39	0.88	0.86	-2
Min	4.02	3.14	-45	2.16	1.66	-50	0.72	0.67	-31
Average	4.67	4.64	-5	2.60	2.91	4	0.83	0.77	-10
Max	6.04	5.95	27	3.81	3.83	39	0.88	0.86	10

Other Salmon Species

Forecast Methods: The recent 5-year average commercial harvest was used to forecast the harvest of chum, coho, and Chinook salmon for 2022 (Table 19). The forecast for pink salmon is based upon the average harvest during the previous 5 even-numbered years.

Table 19.–The forecast of the 2022 Upper Cook Inlet commercial harvest of other salmon species.

	Commercial harvest forecasts
Pink salmon	391,000
Chum salmon	117,000
Coho salmon	191,000
Chinook salmon	4,179

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, Division of Commercial Fisheries, Soldotna.

LOWER COOK INLET

Pink Salmon

The 2022 Lower Cook Inlet (LCI) wild pink salmon harvest is predicted to be in the *strong* range with a point estimate of 1,148,000 fish (80% prediction interval: 447–1,849,000 fish; Tables 20 and 21). The categorical ranges of pink salmon harvest in LCI were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest over the 62-year period 1960–2021 (Table 20).

Forecast Methods: A naïve forecast based on historical even-year pink salmon harvests (1960–2020) was used to predict the 2022 pink salmon CCPF harvest in LCI. Similar to methods used in PWS, 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 even-year CCPF harvests. Exponential smoothing and moving average models using log-transformed and nonlogged data inputs produced a wide range of point forecasts (345,100–1,731,400 fish). The 2-year running average model using even-year nonlogged data inputs outperformed the other models based on comparison of several performance metrics (e.g., bias, mean percent error [MPE], and MAPE). The 80% confidence intervals were calculated from the MSE of the retrospective forecast predictions.

Table 20.–The 2022 LCI area predicted pink salmon harvest categories.

LCI harvest category	Range (thousands)	Percentile
Poor	Less than 200	Less than 20th
Weak	200–360	20th to 40th
Average	361–700	40th to 60th
Strong	701–1,280	60th to 80th
Excellent	Greater than 1,280	Greater than 80th

Table 21.–Preliminary forecast of the 2022 LCI area pink salmon harvest.

	Forecast estimate (thousands)	Forecast range (thousands)
Commercial common property fishery (CCPF) harvest	1,148	447–1,849

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

Forecast Discussion: The 2022 CCPF harvest forecast of 1,147,600 pink salmon has a forecast range of 446,600–1,848,500 fish. If realized, a CCPF harvest of 1,147,600 pink salmon would be approximately 98% higher than the recent 5-year average CCPF harvest of 578,800 fish for even-year runs between 2012 and 2020.

Prior to 2018, the even-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 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 CCPF 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 one line over the other. In LCI overall, dominance of one 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 and line dominance can persist up to 9 generations (18 years) in some stocks. Overall, odd- and even-year runs across all stocks and years are only modestly dissimilar (odd-year runs ~18% higher). However, area-wide total runs exhibit 4–12 year periods during which production from one 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 2020, the parent year for the upcoming 2022 return, LCI experienced a wide range of escapements to pink salmon index streams. Four of 18 stocks (22%) with SEGs failed to achieve the low end of their respective escapement goal ranges, including one of the larger producers in the Outer District (Rocky River), although 9 stocks (50%) exceeded their SEG range, including some of the major producers in the Outer District (e.g., Dogfish, Windy Bay [Left and Right creeks], and Port Dick Creek). It is difficult to predict shifts in dominance between odd- and even-year lines of pink salmon before they occur. After a decade of odd-year dominance, the unexpectedly large 2020 run suggested a shift to even-year dominance may be forthcoming. However, the 2021 total run was 27% higher than 2020, implying odd-year dominance may continue. If so, the 2022 harvest of naturally produced pink salmon may come in closer to the low end, rather than the mid-point, of the forecast range (447–1,849 thousand fish).

Other Salmon Species

Forecast Method: Naïve forecasts based on historical harvests (1960–2021) were used to predict the 2022 CCPF harvest of other, less abundant salmon species in LCI. 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 CCPF harvests. Log-transformed and nonlogged historical harvest datasets were evaluated with each model and the final forecast for each species was selected based on comparison of several performance metrics (e.g., bias, MSE, root mean squared error [RMSE], MPE, MAPE, and MASE).

Table 22.–Preliminary forecast of the 2022 LCI CCPF 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	152,800	63,900–364,900	1% lower
Chum salmon	5-year running average	35,200	6,100–203,700	49% lower
Coho salmon	2-year running average	3,200	600–17,900	65% lower
Chinook salmon	Exponential smoothing	350	140–870	26% lower

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

Forecast Discussion: Prior to 2018, the recent 5-year average harvest was used to forecast the LCI sockeye, chum, coho, and Chinook salmon CCPF 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 CCPF harvest for each species is provided in the Table 22 above.

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

BRISTOL BAY AREA

Sockeye Salmon

Forecast Methods: The 2022 Bristol Bay sockeye salmon forecast is the sum of individual predictions of 9 river systems (Kvichak, Alagnak, Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak, and Togiak Rivers) and 4 age classes (ages 1.2, 1.3, 2.2, and 2.3). Adult escapement and return data from brood years 1972–2018 were used in the analyses for most rivers.

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 mean percent error 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 percentile of the escapement range if the forecast is above the trend experienced in recent years (Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak, and Togiak Rivers in 2022) and as the 25th percentile of the escapement goal range if the forecast is below the trend experienced in recent years (Kvichak River in 2022; Table 23). Because it is passively managed, the Alagnak River exploitation rate is assumed to be the same as the Kvichak River exploitation rate and, therefore, the escapement is projected to be the total run forecast minus expected harvestable surplus. Over the past 5 years, about 2.5% of the Bristol Bay return is thought to be harvested outside of Registration Area T in other fisheries. Preseason harvestable surplus projections are provided to aid industry in planning. Once the run begins to develop, the department relies on catch and escapement data for management decisions.

Table 23.–Preliminary forecast of the 2022 Bristol Bay area sockeye salmon run.

TOTAL PRODUCTION:	Forecast (millions)	Forecast range (millions)
Total run	75.27	61.01 – 89.54
Escapement	13.46	
Total harvestable surplus	61.82	
Bristol Bay harvestable surplus	59.94	
Harvest outside Registration Area T	1.88	
Inshore Run	73.40	

A total of 75.27 million sockeye salmon (within a range of 61.01–89.54 million fish) are expected to return to Bristol Bay in 2022 (Table 23). This is 44% larger than the most recent 10-year average of Bristol Bay total runs (52.09 million fish) and 111% greater than the long-term (1963–2021) average of 35.73 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 2004 through 2021.

A run of 75.27 million sockeye salmon would allow for a potential harvestable surplus of 61.82 million fish; 59.94 million fish in Bristol Bay and 1.88 million fish in fisheries outside of Registration Area T. A Bristol Bay harvest of this size is 75% greater than the most recent 10-year harvest of 34.24 million fish, which has ranged from 15.38 million fish to 42.94 million fish, and 170% greater than the long-term average harvest of 22.22 million fish (1963 to present).

Age-specific forecasts for the 2022 run consists of 30.68 million age-1.2 fish (41% of the total run), 6.39 million age-2.2 fish (8% of the total run), 35.58 million age-1.3 fish (47% of the total run), and 2.58 million age-2.3 fish (3% of the total run; Table 24).

Table 24.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay River systems in 2022.

	Millions of sockeye salmon								
	Forecasted production by age class					Forecasted		Outside	Bristol Bay
DISTRICT/River	1.2	2.2	1.3	2.3	Total	Esc.	Harvest	Area T [a]	Inshore
NAKNEK-KVICHAK									
Kvichak	4.36	1.24	2.57	0.19	8.37	4.00	4.16	0.21	8.16
Alagnak	1.93	0.09	2.05	0.16	4.23	2.02	2.10	0.11	4.12
Naknek	3.54	0.59	4.16	0.32	8.61	1.70	6.70	0.21	8.40
Total	9.83	1.92	8.78	0.68	21.21	7.72	12.96	0.53	20.68
EGEGIK	7.97	3.52	3.53	1.38	16.40	1.70	14.29	0.41	15.99
UGASHIK	1.95	0.69	3.27	0.35	6.25	1.18	4.92	0.16	6.10
NUSHAGAK									
Wood	7.00	0.18	2.33	0.11	9.63	1.53	7.86	0.24	9.39
Igushik	0.45	0.01	1.54	0.01	2.01	0.34	1.62	0.05	1.96
Nushagak [b]	3.10	0.06	15.33	0.06	18.60	0.77	17.37	0.46	18.13
Total	10.56	0.25	19.20	0.18	30.24	2.63	26.85	0.75	29.48
TOGIAK [c]	0.37	0.00	0.80	0.00	1.18	0.23	0.92	0.03	1.15
BRISTOL BAY	30.68	6.39	35.58	2.58	75.27	13.46	59.94	1.88	73.40
	41%	8%	47%	3%	100%				

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 2.5%.

[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: 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 have performed well when applied to Bristol Bay as a whole. Since 2001, our forecasts have, on average, underforecast the run by 12% and have ranged from 44% below the actual run in 2014 to 19% above the actual run in 2011. Forecasted harvestable surplus has had a MAPE of 16% since 2001.

Individual river forecasts have greater uncertainty compared to the bay-wide forecast. Since 2001, on average, we have underforecast returns to the Alagnak (-33%), Togiak (-14%), Kvichak (-21%), Wood (-20%), Nushagak (-25%), Ugashik (-5%), and Naknek (-15%) rivers, and overforecast returns to the Igushik (11%) and Egegik rivers (13%). Overforecasting returns to some rivers while 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, Canada-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 2022 Kuskokwim River Chinook salmon forecast is for a range of 99,000–161,000 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 2022 season.

Separate forecasts are prepared for Canadian-origin Yukon River Chinook salmon and total run. The Canada-origin run forecast is produced by a U.S./Canada Joint Technical Committee and presented to the Yukon River Panel. The 2022 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. A Bayesian integrated forecast was produced, weighing each contributing model such that models that best fit the observed historical run sizes are given more weight. The 2022 Canadian-origin Chinook salmon forecast is for a run size of 41,000–62,000 fish (80% credible interval). The IMEG for this stock component has been 42,500–55,000 fish since 2010, but this goal is scheduled to undergo review by the Yukon River Panel in April 2022. The Canadian-origin forecast informs the drainagewide Chinook salmon outlook, because the Canadian-origin run represents approximately 41% of the total run. Yukon River Chinook salmon is classified as a *stock of yield concern* under the Sustainable Salmon Fisheries Policy. Directed commercial harvest of Yukon River Chinook salmon is not expected during the 2022 season.

The 2022 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 far-below-average run of 162,000–542,000 fish (80% confidence interval). The drainagewide escapement goal for this stock is 500,000–1,200,000 fish. If the run comes back as forecasted, the 2022 run may not be large enough to provide for minimum drainagewide escapement needs and subsistence and commercial fisheries may be restricted or closed.

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, low Chinook and chum salmon abundance in 2022 is anticipated throughout the AYK

Region resulting in no or well below average commercial harvest forecasts for all species (Table 25).

Table 25.–The 2022 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	0	0	0
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 2022.

YUKON AREA

Fall Chum Salmon

Forecast Methods:

The forecast for the 2022 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 to 2015, production from incomplete brood years 2016 and 2017 was estimated based on return per spawner (R/S) from brood year returns, and the Ricker model was used to predict production from the 2018 and 2019 parent years.

Predicted returns were multiplied by corresponding average maturity schedules for even and odd-numbered parent years to estimate 2022 run size, rounded to the nearest thousand fish. The even/odd maturity schedule from 1974–2015 was used to estimate the 2022 return. The result from the Ricker model was a forecast point estimate of 643,000 fall chum salmon returning drainagewide. However, in attempts to produce a more accurate forecast, considering the recent drastic run failures of 2020 and 2021, the 2022 forecast point estimate of 110,000 fall chum salmon was developed based on the average forecast performance (i.e., ratio of observed to predicted; 17.1%) for 2020 and 2021. To provide the range of possibilities around the estimate both the individual percentages of observed to predicted for 2020 and 2021 (19.7% and 14.6% respectively) were used and resulted in the forecast range of 78,100–148,000 fall chum salmon (Table 26).

The 2022 projected run size of fall chum salmon for the Yukon Area is approximately 110,000 fish. This forecast is below run sizes for all years, except 2021, and is well below the SEG range of 300,000–600,000 fall chum salmon. Runs in the last 2 decades have fluctuated more widely and have produced runs as low as 95,000 fish in 2021 to as high as 2.3 million fish in 2017. If the run materializes as forecasted, abundance would be insufficient to meet escapement goals, including Canadian border passage and harvest sharing objectives, and there would be no surplus for subsistence, commercial, or personal use harvests, even at the upper end of the range.

Drainagewide escapements within the SEG provide a mean yield of 462,000 fall chum salmon. The mean subsistence harvest from 2008 to 2019 for Alaska (U.S.) subsistence and Canadian aboriginal harvests is 86,000 fall chum salmon (2020 was not included due to severe restrictions

and complete closure of the fishery). Management typically targets 450,000 fall chum salmon, the midpoint of the SEG range, and typically anticipates a subsistence harvest of no more than 100,000 fish (Table 26). Commercial harvests may be allowed only on a surplus above 550,000 fish based on inseason assessments of run size. In mid-July a projection based on the relationship of summer chum to fall chum salmon returns to the Yukon River will be developed and used for initial management. Should the fall chum salmon run rebound substantially, any fishing endeavors would be based on inseason assessment of run size as applied to the guidelines of the Alaska Fish and Game Laws and Regulations as outlined in 5 AAC 01.249 *Yukon River Drainage Fall Chum Salmon Management Plan*.

Table 26.–Preliminary forecast of the 2022 Yukon Area fall chum salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	110	78–148
Escapement goal	450	300–600
Harvest estimate	0	0

The forecasted total run of 110,000 fall chum salmon is expected to be composed of 92% age-4 and 4% age-5 fish, after the observed reduction in age-4 fish that returned in 2021. The age-4 component of fall chum salmon runs has varied widely, ranging from 37% (1992) to 94% (2005). Fall chum salmon exhibit an even-odd abundance cycle (averaging 816,000 fish in even-numbered years and 1,100,000 fish in odd-numbered years), and 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 even-odd cycle was restricted between 1993 and 2002, during which most years' (1993 and 1997–2002) stocks were severely depressed, with peaks of high returns occurring in 1995, 2005 and 2017. Age-4 fish contributed greater than 90% (record levels) during the runs in 2003, 2005, and 2021. However, based on this analysis, the extremely large escapement observed in 2005 only produced an estimated 0.26 (R/S). Further, from 1974 through 2015 brood years, escapements of over 800,000 fish have produced yields above replacement only 2 years out of 12.

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. In 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 42 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, 35% of the observed runs were within the range, 39% were below, and 26% were above. Returns of age-4 fish in even-numbered years are typically 21% lower than odd-numbered years. Sibling relationships for this stock are weak. The major contributor to the 2022 fall chum salmon run is anticipated to be age-4 fish returning from the 2018 parent year. The escapements in 2016 through 2018 all exceeded the upper end of the drainagewide escapement goal range (2019 was within the goal). Productivity was at its lowest in

2005 (0.26 R/S); however, 2016 and 2017 brood years are estimated to be substantially lower yet (0.13 and 0.07 R/S respectively). After the record production of 2001 (8.9 R/S), 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 ranked the fourth highest on record. Production from 2013 was well above replacement and is one of the 2 escapements over 800,000 fish that resulted in any yield. The forecasted run in 2022 is predicting a below-average age-4 return from parent year 2018. Based on the 2 primary parent years and recent record low production, the forecast is for a well below average (1974–2021) return in 2022, probably a near record low run. The forecasted run size of 110,000 fall chum salmon would provide no commercial harvest based on the current management plan.

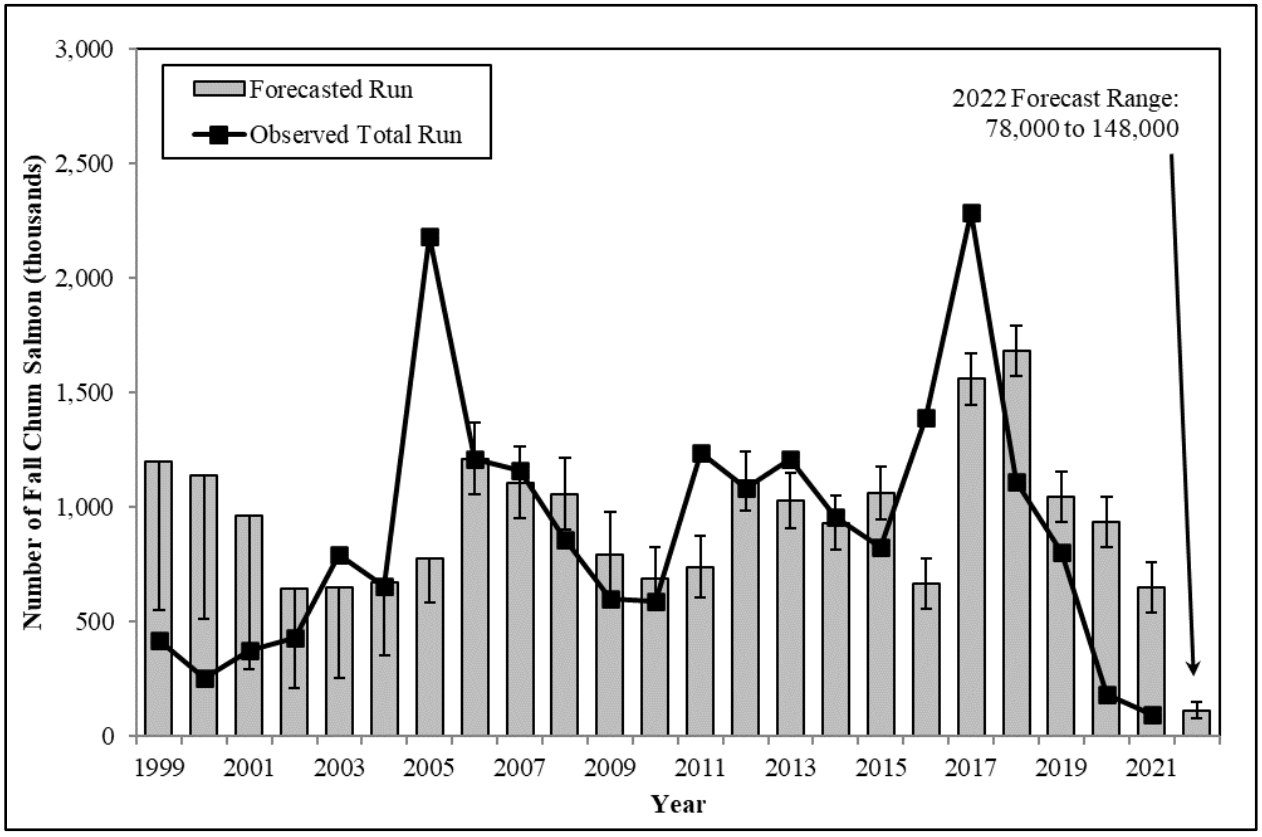

Figure 10.–Observed total run of fall chum salmon compared to the spawner-recruit estimates used in the annual forecast, Yukon River, 1999–2022.

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 2022 KMA predicted pink salmon harvest is expected to be in the *Average* category with a point estimate of 19.4 million fish combining the wild stock and Kitoi Bay Hatchery harvest estimates (Table 27). Harvest categories were delimited from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest in the KMA from 1988 to 2021.

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 fish). The total run estimates were derived from a combination of weir counts, aerial survey index, and harvest estimates.

The 2022 KMA wild stock pink salmon forecast (Table 28) was based on a simple linear regression model using environmental indices, mean district escapement, and previous year (lag-1) return fit to the even-year KMA returns from 1980 to 2020. The regression model utilizes a composite created from a series of forecast indices affecting pink salmon returns. Environmental 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. In addition, mean KMA district pink salmon escapement and the total KMA previous year pink salmon return total run correlation anomalies were used. A composite was constructed using all variables and regressed against total return; environmental indices, escapement, and previous year return were equally weighted in the composite.

Table 27.–The 2022 Kodiak Management Area predicted pink salmon harvest categories.

KMA Harvest Category	Range (millions)	Percentile
Poor	Less than 7.8	Less than 20th
Weak	7.8 to 14.1	21st to 40th
Average	14.1 to 21.0	41st to 60th
Strong	21.0 to 27.9	61st to 80th
Excellent	Greater than 27.9	81st to 100th

Table 28.–Preliminary forecast of the 2022 Kodiak Management Area pink salmon run.

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
KMA Wild Stock Total Run	19.9	12.6–27.2
KMA Escapement Goal [a]	5.0	
KMA Wild Stock Harvest	14.9	7.6–22.2
Kitoi Bay Hatchery Harvest [b]	4.5	3.3–5.7
Total KMA Pink Salmon Harvest	19.4	10.9–27.9

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

[a] The 2022 estimated escapement is within the range of the even-year aggregate escapement goals for the Kodiak Archipelago (3.0–7.0 million) and the Mainland District (0.25–1.0 million).

[b] This figure is the total expected return (4.9 million) minus the broodstock collection goal of 0.43 million fish; the Kitoi Bay Hatchery has yet to determine cost-recovery goals (if any) for 2022.

It is assumed that environmental conditions affect the survival at early life-history stages of pink salmon and the year class strength is primarily determined prior to outmigration. Monthly values (Kodiak airport) of mean air temperature, total precipitation, and peak precipitation from August to June were considered. The range was estimated as the overall 80% prediction intervals of the regression model.

The 2022 Kitoi Bay Hatchery pink salmon forecast was prepared by evaluating pink salmon survivals from even brood years 1995 through 2017 when releases from the facility were in excess of 100 million fry (excludes 2016). These brood years are particularly important to the forecasting model because all pink salmon fry were released on the same day to saturate the release area with fry (predator satiation). This release strategy has proven to significantly improve fry to adult survival.

The pink salmon return to Kitoi Bay Hatchery is 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 2022 relates to this 4-year cyclical return, which presents average strength even-year returns every fourth year. The midpoint estimate of 4.9 million fish reflects a marine survival of 3.84% for the 128 million fry released (0.84 g), near the traditional target size (0.8 g). The average survival was calculated using the weighted average of the last 4 years of cyclical returns (parent class 2006, 2010, 2014, and 2018). The range was calculated as (+/-) 25% of the predicted marine survival.

Forecast Discussion: The 2022 KMA wild stock pink salmon total run of 19.9 million fish is predicted to be an above-average return but less than the previous even-year return in 2020 (Figure 11). The environmental index predictor is below average in the even-year cycle since 2004 suggesting early life history conditions were not optimal; however, countering that were the 2020 district escapements, which were the strongest since 1991 at 10.9 million fish indexed as escapement.

The 2022 Kitoi Bay Hatchery pink salmon production is expected to be 4.9 million fish (Figure 12). The broodstock collection goal is 425,000 fish, resulting in a total hatchery harvest projection of about 4.5 million fish. As of this writing, it has not been determined whether cost-recovery will occur in 2022, but this will be decided in February.

Confidence in the 2022 forecast estimate is fair considering the refinement of the forecasting models in the past years. Despite the strength of the forecast model, the authors recognize that return corollaries are often fleeting due to the dynamic nature of the Gulf of Alaska. This forecast level will allow an initial weekly fishing period length of 81 hours (3½ days) for most of the KMA during the initial general pink salmon fisheries (beginning July 6, 2022). Harvests during the initial period provide important data to assess run strength and subsequent fishing periods will be adjusted by section and district to ensure escapement goals will be met.

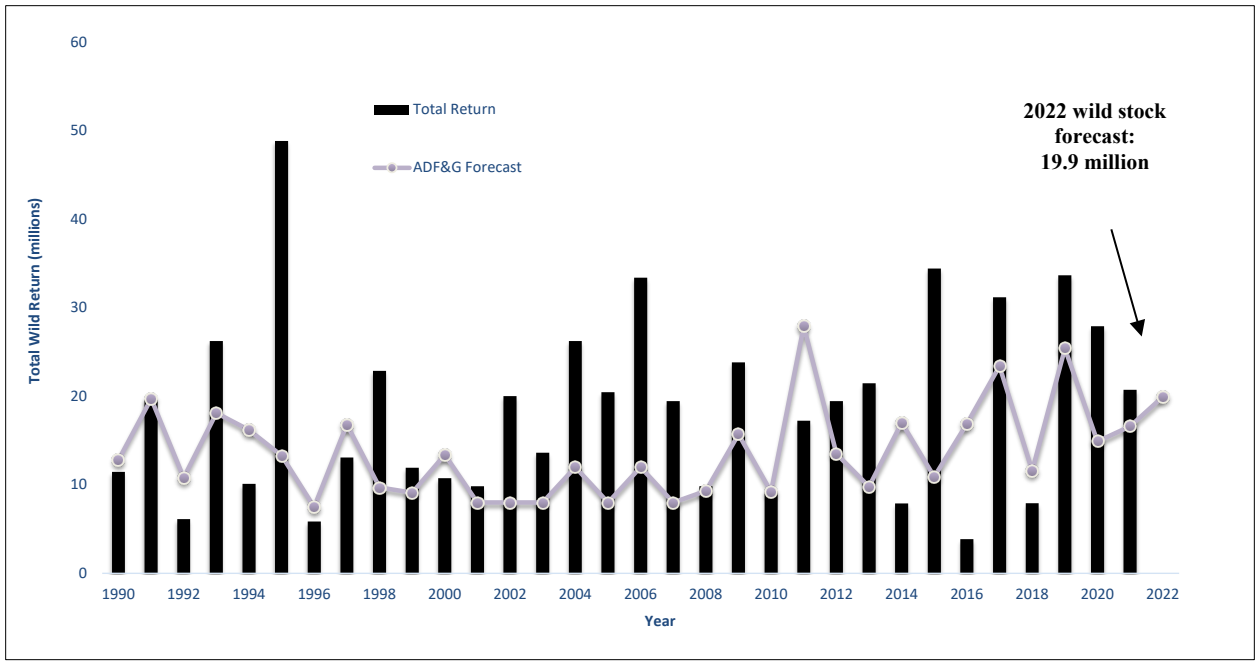

Figure 11.–Kodiak pink salmon wild stock total return compared to ADF&G forecasts, 1990 to 2021, and 2022 forecast.

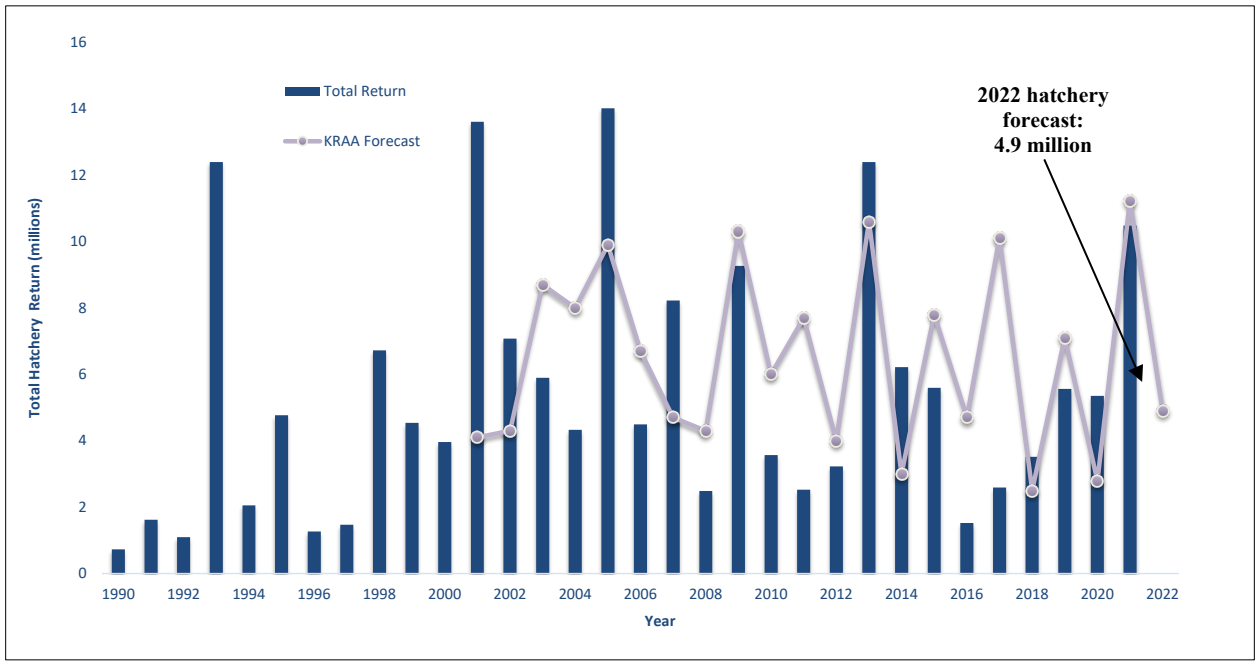

Figure 12.–Kitoi Bay hatchery pink salmon total return compared to KRAA forecasts, 1990 to 2021, and 2022 forecast.

Forecast by M. Birch Foster, Finfish Research Biologist, Westward Region; and Mike Wachter, Kitoi Bay Hatchery Manager, Kodiak Regional Aquaculture Association.

Ayakulik River

Sockeye Salmon

Forecast Methods: The 2022 Ayakulik River sockeye salmon forecast (Table 29) 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 29.–Preliminary forecast of the 2022 Ayakulik River sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	1,170	802–1,559
Escapement goal [a]	400	200–400
Harvest estimate	770	

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

The ocean-age-2 sockeye salmon were predicted from prior year ocean-age-1 returns (1991–present). Ocean-age-3 sockeye salmon were predicted from prior year ocean-age-2 returns (1990–present). Ocean-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 2022. The range was estimated as the sum of the individual 80% prediction intervals.

Forecast Discussion: The 2022 Ayakulik forecast of 1,170,000 sockeye salmon is about 189,000 less fish than the actual 2021 run estimate of approximately 1,358,000 fish, and about 555,000 fish more than the most recent 10-year average of approximately 614,000 fish. The 2022 run is estimated to be composed of approximately 58% ocean-age-3 fish. The 2-ocean predictor in 2021 is the highest on record thus outside the forecast range. The next highest observed value (1.1 million in 1990) was used for the 2022 projection to remain within the range of the regression. Since 2000, Ayakulik River sockeye salmon have shown an increasing tendency to only spend one year rearing in Red Lake; resulting returns have been demonstrating 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 2022 Ayakulik forecast is only fair. The projected harvest of 770,000 fish is based on the achievement of the upper end of the combined escapement goal ranges (400,000 fish). Ayakulik is managed based on both early- and late-run (post July 15) components. Based on brood-year escapement proportions from what will be the major contributing brood years (2016–2018), approximately 69% of the total run will occur in the early portion of the run.

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

Karluk River

Sockeye Salmon

Forecast Methods: The 2022 Karluk River sockeye salmon forecast (Table 30) was prepared primarily by investigating escapement, sibling age class relationships, moving average, and exponential smoothing methods.

Table 30.–Preliminary forecast of the 2022 Karluk River sockeye salmon run.

Total production		Forecast estimate (thousands)	Forecast range (thousands)
Early Run	Total Run Estimate	251	144–450
	Escapement Goal [a]	200	150–250
	Harvest Estimate	51	
Late Run	Total Run Estimate	927	508–1,285
	Escapement Goal [a]	325	200–450
	Harvest Estimate	602	
Total Karluk River	Total Run Estimate	1,178	652–1,735
System	Escapement Goal [a]	525	350–700
	Harvest Estimate	653	

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

[a] The escapement estimates are based on the midpoints of the early-run and 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 method since 1994. An exponential smoothing model was also fit to recent year early and late run total returns. Parameter estimates (early run $\alpha = 0.84$; 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 2022 forecast.

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

For the late run, ocean-age-2 sockeye salmon returns were predicted based on the abundance of the ln-transformed prior-year return of age-2.1 and -1.2 sockeye salmon (2004–present). The ocean-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 2022. 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 2022 sockeye salmon run to the Karluk River using sibling relationships is predicted to be approximately 1,178,000 fish. The early run is expected to be approximately 251,000 fish, which is about 44,000 fish below the recent 10-year average (295,000 fish) and 112,000 fish above the 2021 run (139,000 fish). The late run is expected to be approximately 927,000 fish which is 67,000 fish above the recent 10-year average (860,000 fish) and 142,000 fish more than the 2021 run (785,000 fish). The combined exponential smoothing estimates for the early and late runs is 923,000 fish for comparison.

The projected harvest estimate for the early run (51,000 fish) is based on achievement of the midpoint of the early-run escapement goal range. The projected harvest estimate for the late run (602,000 fish) is based on achievement of the midpoint of the late-run escapement goal. The Karluk sockeye salmon run is expected to be predominated by ocean-age-2 fish (76%). The overall confidence in the Karluk sockeye salmon forecast is fair.

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

Alitak District (Frazer Lake and Upper Station)

Sockeye Salmon

Forecast Methods: The 2022 sockeye salmon run to the Alitak District (Table 31) 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 31.–Preliminary forecast of the 2022 Alitak District sockeye salmon run.

Total production		Forecast estimate (thousands)	Forecast range (thousands)
Early Upper Station	Total run estimate	195	112–359
	Escapement goal [a]	93	43–93
	Harvest estimate [b]	102	
Late Upper Station	Total run estimate	487	283–817
	Escapement goal	186	120–265
	Harvest estimate [b]	301	
Frazer Lake	Total run estimate	437	228–637
	Escapement goal [c]	190	95–190
	Harvest estimate [b]	247	
Total Alitak District	Total run estimate	1,119	623–1,813
	Escapement goal	469	258–548
	Harvest estimate [b]	650	

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

[c] The Frazer Lake escapement goal (75,000–170,000) is increased here by an additional 20,000 fish, which is the 20-year median of the number of fish that escape the Dog Salmon weir but do not ascend the Frazer Lake fish pass.

Upper Station early-run ocean-age-2 fish were forecasted using prior year ocean-age-1 returns (outmigration years: 2003–2020) and the North Pacific Gyre Oscillation (NPGO) index for September in a multiple regression model. NPGO data were lagged to reflect climatic conditions prior to smolt outmigration. Upper Station early-run ocean-age-2 salmon were used to predict log transformed ocean-age-3 fish data from outmigration years 1992 to 2019. Upper Station late-run ocean-age-2 and log-transformed ocean-age-3 salmon returns were each predicted using their respective prior year ocean-age-1 and -2 returns (late-run outmigration years: 1998–2020 and 1983–2019 respectively). Upper Station early- and late-run ocean-age-1 and -4 returns were calculated using the pooled median contributions by stock and ocean age from the last 10 years. Frazer ocean-age-2 salmon were predicted using prior year ocean-age-1 returns (outmigration years: 2001–2020), Kodiak airport December air temperature, and the NPGO index for December in a multiple regression model. Air temperature data were lagged to correspond to winter freshwater rearing conditions in Frazer Lake and NPGO data were lagged to reflect conditions prior to smolt outmigration. Frazer ocean-age-3 salmon were predicted using prior year ocean-age-2 returns (outmigration years: 2003–2019). Frazer ocean-age-1 and -4 returns 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 2022. The combined Alitak District prediction interval was calculated by summing the lower and upper prediction bounds of the 3 runs.

Forecast Discussion: The 2022 sockeye salmon run to the Alitak District is expected to be approximately 1.12 million fish, approximately 422,000 more fish than the recent 10-year average run (697,000) and 134,000 less fish than the 2021 run (1.25 million fish). The Upper Station early run is expected to be approximately 195,000 fish, which is greater than the recent 10-year average run (80,000). The Upper Station late run is expected to be approximately 487,000 fish, which is greater than the recent 10-year average run (279,000). The Frazer Lake run is expected to be approximately 437,000 fish, which is greater than the recent 10-year average (339,000 fish). The 2022 Alitak District sockeye salmon run should be composed of approximately 67% ocean-age-2 fish, 26% ocean-age-3 fish, and 6% ocean-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 650,000 fish is based on achieving the upper range of the escapement goal for the Upper Station early run and S_{MSY} estimates for the late run and the upper range of the goal plus an additional 20,000 fish (20-year median of the number of fish that pass through the Dog Salmon weir 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, Westward Region.

Spiridon Lake

Sockeye Salmon

Forecast Methods: The 2022 Spiridon Lake sockeye salmon forecast (Table 32) is estimated by multiplying the estimated number of smolt released for both net pen and lake combined, by the mean smolt to adult survival proportions by ocean age and mean return by age proportion of each age class for completed BY 2010-2014. The Spiridon Lake and Telrod Cove range estimates the 95% confidence intervals created using the Goodman's variance equation (1960).

Table 32.–Preliminary forecast of the 2022 Spiridon Lake sockeye salmon run.

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	192	61 – 323
Spiridon	129	41 – 216
Telrod Cove Net Pen	64	20 – 107
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 192,000 fish in 2022 is more than the 2021 forecast (177,000 fish). A significant increase in harvest of sockeye salmon bound for Telrod Cove during common property fishing within the Spiridon Bay Section (statistical area 254-41) was recently discovered. Production estimates now incorporates the combined harvests of Spiridon Bay and Telrod Cove sections to better approximate the run strength and total enhancement production.

The majority of the 2022 run will probably be composed of 2 major age classes: 62.0% age-1.2 fish, 35.4% age-1.3 fish, and 1.5% age-2.2 fish. All other age classes will make up 1.2% of the remaining run estimate. If realized, this run will be below the recent 10-year average (2012 to 2021) run of 225,000 fish. The peak of the Spiridon Lake sockeye salmon run timing through the Westside fishery is typically in early to mid-July.

The 2022 season will mark the ninth year of adult returns to Telrod Cove originating from net-pen releases. Of the returning fish to Telrod Cove in 2022, 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, Kodiak Regional Aquaculture Association.

CHIGNIK AREA

Sockeye Salmon

Forecast Methods: Simple linear regressions models using age class relationships were used to forecast the 2022 early and late Chignik sockeye salmon runs (Table 33).

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

Table 33.–Preliminary Forecast of the 2022 Chignik area sockeye salmon run.

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run (Black Lake)	Total run estimate	639	278–1,469
	Escapement goal[a]	400	350–450
	Harvest estimate	239	
Late Run (Chignik Lake)	Total run estimate	633	267–1,195
	Escapement goal[a]	310	220–400
	Harvest estimate	323	
Total Chignik System	Total run estimate	1,272	545–2,664
	Harvest estimate[b]	562	
	Chignik Area	562	
	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 were forecasted in the Southeastern District Mainland and Cape Igvak during the regulatory timeframe through July 25 and July 5 respectively, and thus the harvest of Chignik-bound sockeye salmon in those areas is expected to be zero.

The early- and late-run regression and median estimates were summed to estimate the total Chignik River sockeye salmon run for 2022. 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 2022 Chignik sockeye salmon early run is forecasted to be 639,000 fish, which is 266,000 fish less than the 10-year average run of 905,000 fish and almost 394,000 fish more than the 2021 early run of 244,000 fish. The early run is predicted to be composed of approximately 76% ocean-age-3 and 23% ocean-age-2 fish. The late run is forecasted to be 633,000 fish, which is approximately 277,000 fish less than the 10-year average run of 910,000 fish and 118,000 fish more than the 2021 late run of 515,000 fish. The 2022 late run is predicted to be composed of approximately 80% ocean-age-3 and 18% ocean-age-2 fish. The 2022 total Chignik sockeye salmon run is expected to be 1,272,000 fish, which is approximately 543,000 fish less than the 10-year average of 1.82 million and roughly 512,000 fish more than the 2021 total run of 760,000 fish.

The projected 2022 early-run total harvest estimate of 239,000 fish is based on achievement of the midpoint of the early-run escapement goal range. The projected late-run harvest estimate of 323,000 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 2022, sockeye salmon harvests for both early and late runs in the Chignik Management Area were forecasted to not exceed a 600,000-fish surplus beyond escapement goals and if realized, by regulation, may preclude commercial fisheries from harvesting Chignik-bound fish in the Cape Igvak Section of the Kodiak Management Area during the regulatory period through July 5 and in the Southeastern District Mainland of the Alaska Peninsula Management Area during the regulatory period through July 25.

The wide confidence intervals around the point estimate of the 2022 forecasts reflect the uncertainty inherent in the forecast models. Given the sibling relationships used for forecasting both runs and the poor 2021 ocean-age 3 returns, the 2022 forecast may overestimate returns due to currently unknown environmental variables. 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, Westward Region.

ALASKA PENINSULA/ALEUTIAN ISLANDS AREA

Bear Lake (Late run)

Sockeye Salmon

Forecast Methods: The 2022 forecast of the Bear Lake sockeye salmon late run (Table 34) 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 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 34.–Preliminary forecast of the 2022 Bear Lake (late run) sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	394	225-692
Escapement goal[a]	156	117-195
Harvest estimate	238	

[a] The escapement estimate is the midpoint of the escapement goal range (117,000–195,000) in 2022.

Ocean-age-3 sockeye salmon were predicted from prior year ocean-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 2022. The forecast range was estimated using the sum of the 80% prediction intervals and 10th and 90th percentiles intervals for each age class forecasted.

Forecast Discussion: The 2022 Bear Lake late-run forecast of 394,000 sockeye salmon is 16,000 fish less than the 10-year average of approximately 410,000 fish and 17,000 fish more than the 2021 run of 376,000 sockeye salmon. The 2022 late run is expected to be composed of 4% ocean-age-1, 63% ocean-age-2, and 33% ocean-age-3 fish. The projected harvest of 238,000 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 52% 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 Charles Russell, Alaska Peninsula Assistant Area Management Biologist.

Nelson River

Sockeye Salmon

Forecast Methods: The 2022 Nelson River sockeye salmon run (Table 35) was forecasted using simple linear regression of ocean-age-class and parental escapement data from the past 19 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 35.–Preliminary forecast of the 2022 Nelson River sockeye salmon run.

Total production	Forecast estimate (thousands)	Forecast range (thousands)
Total run estimate	285	92–493
Escapement goal[a]	158	97–219
Harvest estimate	127	

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

[a] The escapement estimate is the midpoint of the escapement goal range (97,000–219,000) in 2022.

Ocean-age-2 sockeye salmon returns corresponding to the year of outmigration were forecasted with simple linear regression using parental escapement of age-3.2 fish from 2002 to 2019 to account for the overlap of freshwater rearing age classes. The ocean-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 2022. 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 2022 Nelson River forecast of 285,000 sockeye salmon is about 1260,000 fish less than the most recent 10-year average (2012–2021) of 411,000 fish and is approximately 79,000 fish more than the 2021 run of about 205,000 fish. The 2022 run should be composed mainly of ocean-age-2 (63%) and -3 (32%) fish. The projected harvest of 127,000 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 Charles Russell, Alaska Peninsula Assistant Area Management Biologist.

South Alaska Peninsula Aggregate

Pink Salmon

The 2022 South Alaska Peninsula predicted pink salmon harvest (Table 36) is expected to be in the *Poor* category (Table 37) with a point estimate of 1.42 million fish (upper bound of the *Poor* categorical ranking is 1.9 million fish). Harvest categories were calculated from the 20th, 40th, 60th, and 80th percentiles of historical post-June commercial harvest on the South Alaska Peninsula from 1982 to 2021.

Table 36.–Preliminary forecast of the 2022 South Alaska Peninsula aggregate pink salmon run.

Total production	Forecast Estimate (millions)	Forecast Range (millions)
Total run estimate [a]	3.17	0.5–9.9
Escapement goal [b]	1.75	1.75–4.0
Post-June harvest estimate	1.42	0–5.9

[a] Post-June harvest and escapement.

[b] The escapement estimate is the minimum of the aggregate goal range (1.75–4.0 million) in 2022.

Table 37.–The 2022 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 2021.

South Peninsula Harvest Category	Range (millions)	Percentile
Poor	Less than 1.9	Less than 20th
Weak	1.9 to 4.0	20th to 40th
Average	4.0 to 7.0	40th to 60th
Strong	7.0 to 9.9	60th to 80th
Excellent	Greater than 9.9	80th to 100th

Forecast Methods: The 2022 South Alaska Peninsula pink salmon harvest forecast is derived from a total run forecast minus the lower end (1.75 million fish) of the annual South Alaska Peninsula escapement goal range. The forecasted total run was fit with a damped Holt model and even-year South Alaska Peninsula pink salmon returns from 1964 through 2020. 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 even-year average harvest of pink salmon in June is approximately 1.0 million fish, with a range of 0.18–2.51 million fish.

The estimated 2022 South Alaska Peninsula pink salmon total harvest (1.42 million fish) is predicted to be weak. However, 2020 escapement for pink salmon was the highest observed for an even year since 2008. Additionally, 2020 had favorable environmental conditions for freshwater spawning. Conversely, there have not been consecutive increases in even-year runs in over 40 years. 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 been more accurate than even years. Due to this, confidence in the forecast is fair.

Forecast by Tyler Lawson, Alaska Peninsula–Aleutian Islands Assistant Area Management Biologist; and Heather Finkle, Finfish Research Biologist, Westward Region.

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REFERENCES CITED

Bond, N. A., M. F. Cronin, H. Freeland, and N. Mantua. 2015. Causes and impacts of the 2014 anomaly in the NE Pacific. Geophysical Research Letters 42(9):3414–3420.

Di Lorenzo, E., and N. Mantua. 2016. Multi-year persistence of the 2014/15 North Pacific marine heatwave. Nature Climate Change 6(11):1042–1047.

Ferriss, B. E., and S. Zador. 2021. Ecosystem Status Report 2021: Gulf of Alaska, Stock Assessment and Fishery Evaluation Report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501.

Fox, J., and S. Weisberg. 2019. An R companion to applied regression, 3rd edition. Sage Publications, Thousand Oaks, CA. https://socialsciences.mcmaster.ca/jfox/Books/Companion/ (Accessed March 2020).

Haeseker, S. L., R. M. Peterman, and Z. Su. 2005. Retrospective evaluation of preseason forecasting models for pink salmon. North American Journal of Fisheries Management 25(3):897–918.

Murphy, J. M., E. A. Fergusson, A. Piston, S. Heinl, A. Gray, and E. Farley. 2019. Southeast Alaska pink salmon growth and harvest forecast models. North Pacific Anadromous Fish Commission Technical Report No. 15:75–81, Vancouver, Canada.

Orsi, J. A., M. V. Sturdevant, J. M. Murphy, D. G. Mortensen, and B. L. Wing. 2000. Seasonal habitat use and early marine ecology of juvenile Pacific salmon in Southeastern Alaska. North Pacific Anadromous Fish Commission Bulletin No. 2: 111–122.

Piston, A. W., S. Heinl, S. Miller, R. Brenner, J. Murphy, J. Watson, A. Gray, and E. Fergusson. 2019. Run forecasts and harvest projections for 2019 Alaska salmon fisheries and review of the 2018 season. Pages 46–49 [*In*] R. E. Brenner, A. R. Munro, and S. J. Larsen, editors. Alaska Department of Fish and Game, Special Publication No. 19-07, Anchorage.

Siddon, E. 2021. Ecosystem Status Report 2021: Eastern Bering Sea, stock assessment and fishery evaluation report, North Pacific Fishery Management Council, 1007 West Third, Suite 400, Anchorage, Alaska 99501.

Walsh, J. E., et al. 2018. The high latitude marine heat wave of 2016 and its impacts on Alaska. Pages 39–43 [*In*] S. C. Herring, N. Christidis, A. Hoell, J. P. Kossin, C. J. Schreck III, and P. A. Stott, editors. Explaining extreme events of 2016 from a climate perspective. Bulletin of the American Meteorological Society 99(S):39–43.

Wertheimer, A. C., J. A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2011. Forecasting pink salmon harvest in Southeast Alaska from juvenile salmon abundance and associated environmental parameters: 2010 returns and 2011 forecast. NPAFC Doc. 1343. Auke Bay Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, Juneau. http://www.npafc.org/new/pub_documents.html (Accessed February 2021).

Wertheimer, A. C., J. A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2013. Forecasting pink salmon harvest in Southeast Alaska from juvenile salmon abundance and associated environmental parameters: 2012 returns and 2013 forecast. NPAFC Doc. 1486. Auke Bay Lab Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, Juneau. http://www.npafc.org/new/pub_documents.html (Accessed February 2021).