Special Publication 12-01

Run Forecasts and Harvest Projections for 2012 Alaska Salmon Fisheries and Review of the 2011 Season

Edited by

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and

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February 2012

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
fathom *spell out*	
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm
metric ton mt (*spell out)*	

Weights and measures (English)

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

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	©
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.
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
United States Code	U.S.C.
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour (*spell out for 24-hour time of day*)	h
minute	min
second	s
week	*spell out*
year	*spell out*

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
chi-square	χ^2
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 2012 ALASKA SALMON FISHERIES AND REVIEW OF THE 2011 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 ADF&G has determined should be allowed to escape the fishery to spawn to achieve the maximum yield (human use). This determination is based on biological information about the fish stock in question. (Also see optimum escapement goal.)
Commercial harvest	Harvests of fish that are used for commercial purposes. This includes fish caught by the commercial common property fishery (see below) and by hatchery operators for cost recovery; it excludes sport, subsistence, and personal use harvests.
Commercial common property harvest	Harvests taken by traditional, competitive commercial fisheries (gillnet, purse seine, and troll), as opposed to commercial harvests resulting from hatchery cost recovery, fishing derbies, and sale of confiscated fish.
Common property harvest	Harvests taken by the commercial common property fisheries (see above), as well as the sport, subsistence, and personal use fisheries. This category excludes hatchery cost recovery harvests.
Cost recovery harvest	Harvests of salmon by hatchery operators in specially designated areas to fund the operation of hatcheries and other enhancement activities.
Enhancement of runs	Hatcheries and other means of artificial propagation to create salmon runs or make existing salmon runs larger. Enhancement includes remote fish stocking, fertilization of lakes, and other techniques.
Escapement, spawning population, or brood stock	The portion of a salmon run that is not harvested and survives to reach the spawning grounds or hatchery.
Harvest projections or harvest outlooks	Harvest outlooks are the best available estimates of upcoming harvest levels. Prepared by local biologists, outlooks are based on formal run forecasts, when available. At other times outlooks are based on historical average catches, subjectively adjusted based on recent trends and local knowledge.
Optimum escapement goal	The number of salmon in a particular stock that should be allowed to spawn to achieve sustainable runs based on biological needs of the stock, as well as consideration of social and allocative needs.
Run forecast	Forecasts of a run (harvest + escapement) are estimates of the fish that will return in a given year based on such information as parent-year escapements, subsequent fry abundance, and spring seawater temperatures. Run forecasts are generally thought to be more reliable than harvest outlooks, but run forecasts are provided only for selected areas.
Salmon run	Run refers to the total number of mature fish returning in a given year from ocean-rearing areas to spawn.
Return	Return refers to an aggregation of salmon over several or more years that represent the surviving adult offspring from a single brood year.

NAMES FOR ALASKA'S PACIFIC SALMON SPECIES

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

ABSTRACT

This report contains a detailed review of Alaska's 2011 commercial salmon season as well as run forecasts and harvest projections for 2012. The Alaska all-species salmon harvest for 2011 totaled 177.1 million, which was about 26.4 million less than the preseason forecast of 203.5 million. This combined harvest was composed of 468,000 Chinook salmon *Oncorhynchus tshawytscha*, 40 million sockeye salmon *O. nerka*, 3.5 million coho salmon *O. kisutch*, 116.1 million pink salmon *O. gorbuscha*, and 17 million chum salmon *O. keta*. Alaska Department of Fish and Game is expecting a decrease in commercial salmon catches in 2012 due to the projected decrease in pink salmon *Oncorhynchus gorbuscha* harvests. The 2012 total commercial salmon catch (all species) projection of 132.1 million is expected to include 120,000 Chinook salmon in areas outside Southeast Alaska, 38.4 million sockeye salmon, 4.3 million coho salmon, 70.2 million pink salmon, and 19.1 million chum salmon. The projected pink salmon harvest is about 40% lower than the harvest experienced in 2011 (116 million). The projected sockeye salmon harvest is about 4% lower than the harvest in 2011. The projected chum salmon harvest is expected to 12 % higher than the harvest in 2011.

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

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

INTRODUCTION

This report contains salmon run forecasts and harvest projections for 2012 as well as a detailed review of Alaska's 2011 commercial salmon season. Salmon escapement and harvest estimates reported in this document were summarized from the Alaska Department of Fish and Game (ADF&G) escapement and fish ticket databases. Data provided in this report are preliminary and supersede any data previously published.

ADF&G is expecting a decrease in commercial salmon catches in 2012 due to the projected decrease in pink salmon *Oncorhynchus gorbuscha* harvests. The 2012 total commercial salmon catch (all species) projection of 132.1 million is expected to include 120,000 Chinook salmon *O. tshawytscha* in areas outside Southeast Alaska, 38.4 million sockeye salmon *O. nerka*, 4.3 million coho salmon *O. kisutch*, 70.2 million pink salmon, and 19.1 million chum salmon *O. keta*. The projected pink salmon harvest is about 40% lower than the harvest experienced in 2011 (116 million). The projected sockeye salmon harvest is about 4% lower than the harvest in 2011. The projected chum salmon harvest is expected to 12 % higher than the harvest in 2011.

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

Table 1.–Projections of 2012 Alaska commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species				
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Alaska						
Natural Production		1,045	2,386	17,000	2,117	22,548
Hatchery Production[a]					8,466	8,466
Southeast Region Total	[b]	1,045 [c]	2,386 [c]	17,000	10,583	31,014
Prince William Sound						
Natural Production	27	1,532 [d]	334 [e]	2,400	36	4,329
Hatchery Production[f]		1,084	373	32,444	2,400	36,300
Upper Cook Inlet	12 [c]	4,400	159 [c]	334 [c]	113 [a]	5,018
Lower Cook Inlet						
Natural Production	1 [c]	21 [c]	3 [c]	318	50 [c]	393
Hatchery Production		245 [g]				275
Bristol Bay	30	21,760	70 [c]	1 [h]	1,554 [c]	23,415
Central Region Total	69	29,042	940	35,497	4,153	69,701
Kodiak						
Natural Production	19 [c]	2,408 [i]	122 [c]	9,500 [j]	590 [c]	12,639
Hatchery Production[k]		314 [k]	160	3,700 [h]	241	4,415
Chignik[l]	5	1,371	116	1,443	279	3,214
South Alaska Peninsula and Aleutians	6 [c]	1,927 [c]	189 [c]	2,901 [m]	992 [c]	6,015
North Alaska Peninsula	3 [c]	2,184 [n]	69 [c]	26 [c]	204 [c]	2,486
Westward Region Total	33	8,204	656	17,569	2,305	28,7681
Arctic-Yukon-Kuskokwim Region Total	17	80	345	125	2,003	2,570
Statewide Total	120	38,371	4,327	70,191	19,044	132,053

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

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

[b] Southeast Chinook treaty forecast not available. The allowable catch of Chinook salmon in Southeast Alaska is determined by the Pacific Salmon Commission and the Commission has not published the quota for 2012. Release of the 2012 Chinook salmon quota for Southeast Alaska is expected in late March or early April.

[c] Average harvest for the 5-year, 2007–2011, period.

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

[e] 10-year average harvest (2002–2011) in the Copper River and Bering River districts.

[f] Hatchery projections made by Prince William Sound Aquaculture Corporation and Valdez Fisheries Development Association.

[g] Includes common property plus cost recovery harvests.

[h] Average previous 5 even-year harvests, 2002–2010 period.

[i] Total Kodiak harvest of 2.408 million natural run sockeye includes projected harvests from formally forecasted systems, projected Chignik harvest at Cape Igvak (217,000), and projected total harvest from additional minor systems (833,000).

[j] See formal pink forecast.

[k] Consists of sockeye hatchery projections (143,000) developed by the Kodiak Regional Aquaculture Corporation and enhanced Spiridon sockeye run harvest forecast (171,000) developed by ADf&G staff.

[l] Chignik Chinook, coho, pink, and chum salmon harvests based on 5-year (2007–2011) average harvests (postcooperative fishery) Chignik sockeye based on a formal forecast with projected harvest at Cape Igvak and Southeastern District Mainland excluded.

[m] Based on South Alaska Peninsula formal forecast and the Aleutian Islands average previous three even-year harvests, 2006–2010 period.

[n] 10-year average (2002–2011); sockeye includes formal forecasts for Bear late run (126,000) and Nelson stocks (153,000).

The Alaska all-species salmon harvest for 2011 totaled 177.1 million, which was about 26.4 million less than the preseason forecast of 203.5 million. This combined harvest was composed of 468,000 Chinook, 40 million sockeye, 3.5 million coho, 116.1 million pink, and 17 million chum salmon. Table 2 shows 2011 harvest numbers by salmon species and fishing area, in units of fish harvested, and Table 3 provides this information in units of pounds harvested. Tables 4–7 provide detailed information on the 2011 harvest by species and area.

Table 2.–Preliminary 2011 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	346[a]	1,243	2,269	59,071	10,702	73,630
Prince William Sound	20	3,541	371	33,356	1,910	39,199
Upper Cook Inlet	11	5,277	95	34	129	5,547
Lower Cook Inlet	0	393	0	362	32	788
Bristol Bay	38	21,880	14	0	739	22,671
Central Region Total	70	31,092	480	33,753	2,810	68,205
Kodiak	19	2,269	190	16,649	825	19,952
Chignik	7	2,497	77	905	270	3,755
South Alaska Peninsula and Aleutians	7	1,921	153	5,369	979	8,700
North Alaska Peninsula	2	926	19	109	294	1,350
Westward Region Total	35	7,613	440	23,302	2,368	33,757
AYK Region Total	18	77	255	7	1,125	1,482
Total Alaska	468	40,024	3,444	116,133	17,004	177,074

Note: Missing data indicates no harvest, and zeros indicate harvest activity but <1,000.
Note: Columns may not total exactly due to rounding.
[a] Total commercial harvest of Chinook salmon for the October 1, 2010–September 30, 2011 catch accounting period.

Table 3.–Preliminary 2011 Alaska commercial salmon harvests, by fishing area and species, in thousands of pounds.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region Total	4,616[a]	7,529	13,772	219,210	81,792	326,919
Prince William Sound	388	21,637	2,619	99,799	14,152	138,596
Upper Cook Inlet	227	34,239	542	110	860	35,978
Lower Cook Inlet	2	1,993	1	1,042	214	3,251
Bristol Bay	492	135,655	93	3	5173	141,416
Central Region Total	1,109	193,524	3,255	100,954	20,399	319,241
Kodiak Area	175	13,444	1,271	53,441	5,566	73,897
Chignik	75	17,891	520	2,883	1,858	23,226
South AK Peninsula and Aleutians	91	11,541	931	18,554	6,509	37,626
North Alaska Peninsula	37	5,259	138	375	2,056	7,864
Westward Region Total	377	48,136	2,859	75,253	15,988	142,613
AYK Region Total	222	502	1,800	20	7,933	10,477
Total Alaska	6,324	249,691	21,686	395,437	126,112	799,250

Note: Missing data indicates no harvest, and zeros indicate harvest activity but <1,000.
Note: Columns may not total exactly due to rounding.
[a] Total commercial harvest of Chinook salmon for the October 1, 2010–September 30, 2011 catch accounting period.

Look for inseason harvest information, postseason statistics, and other information about salmon in Alaska on the World Wide Web at http://www.Fishing.adfg.alaska.gov.

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

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

This report contains a detailed review of Alaska's 2011 commercial salmon season. We normally release it before final catch figures are available to provide preliminary information to the Alaska Board of Fisheries, the fishing industry, and the public.

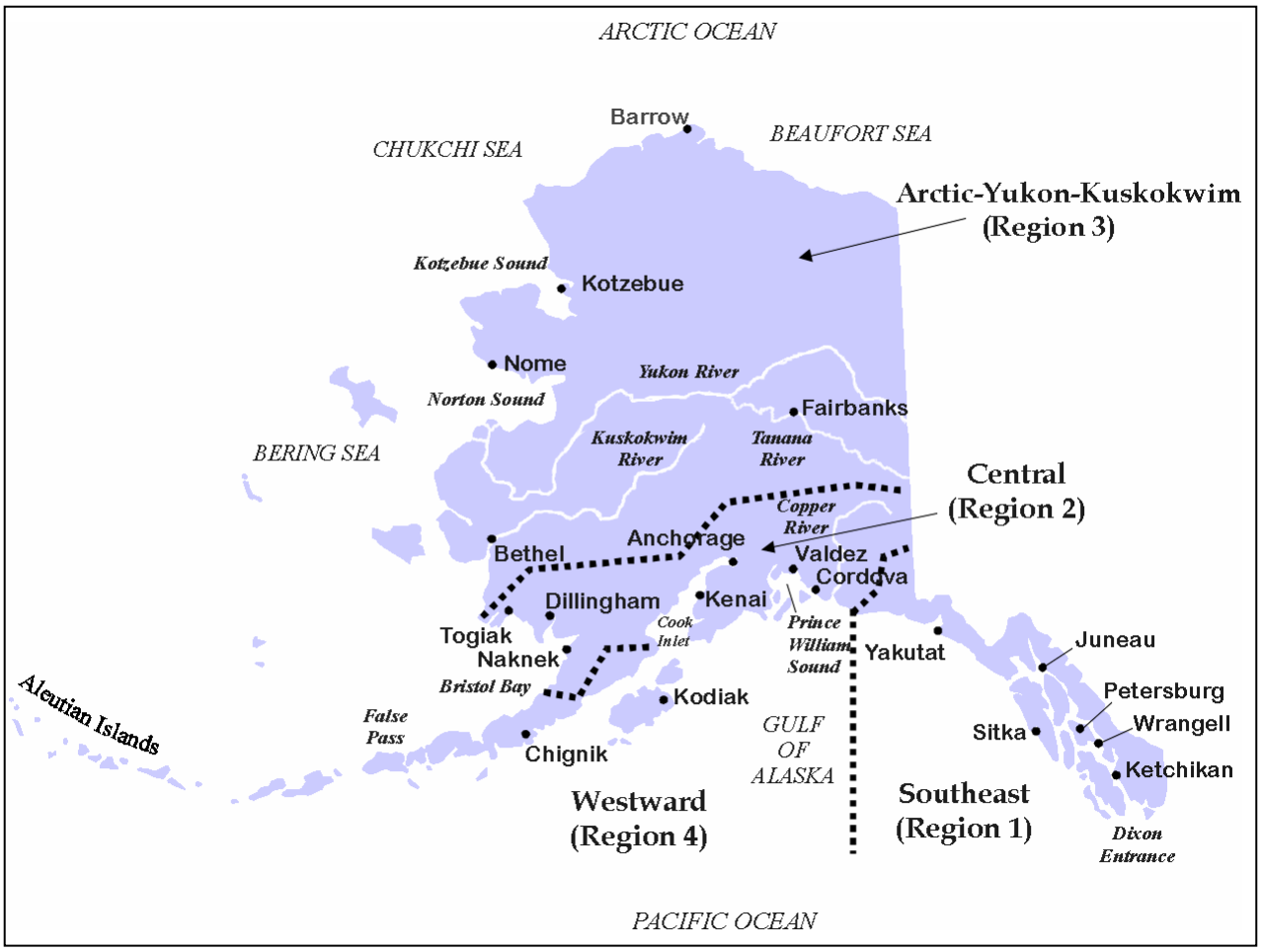

Figure 1.–The four ADF&G fishery management regions (Southeast, Central, Arctic-Yukon-Kuskokwim, and Westward) of the Division of Commercial Fisheries.

PRELIMINARY REVIEW OF THE 2011 ALASKA COMMERCIAL SALMON FISHERIES

SOUTHEAST ALASKA AND YAKUTAT REGION

Region I salmon harvests totaled 73.6 million salmon and an estimated 327 million pounds in 2011 (Tables 2 and 3). The initial estimate of exvessel value based on prices reported on fish tickets is $200 million; however, this estimate is expected to increase following the Commercial Fisheries Entry Commission analysis after Commercial Annual Operator Reports are submitted by fish buyers. The total harvest in 2011 was 35% above the recent 10-year average harvest of 54.4 million, and well over the long-term average harvest since 1962 of 38.6 million. The total harvest increased from 37.2 million in 2010 consistent with a recent cycle of weaker even-year and stronger odd-year pink salmon returns. The 2011 harvest increased compared with the previous odd-year harvest of 51.6 million in 2009, and the overall harvest in numbers of fish ranked as fifth highest since statehood. The total of 327 million pounds landed was well above the 211 million pounds in 2010. Average fish weights were lower in 2011 for all species except sockeye salmon. Compared with recent 10-year average weights, pink and sockeye salmon were just over the average, while Chinook, chum and coho salmon were below average. Total harvests included 346,000 Chinook, 1.2 million sockeye, 2.3 million coho, 59.1 million pink, and 10.7 million chum salmon. The proportional harvest composition by species included <1% Chinook, 2% sockeye, 3% coho, 80% pink, and 15% chum salmon. With strong pink and chum salmon harvests, average pink and chum salmon weights, and strong prices, the exvessel value of $200 million was a record for the region since statehood. A total of 1,928 limited entry permit holders participated in the 2011 salmon fisheries—up 4% from the 2010 season.

Chinook Salmon

The regional Chinook salmon harvest included 346,000 fish (including 339,000 large fish) for the October 1, 2010–September 30, 2011 catch accounting year. This harvest was well above the long-term average harvest of 298,000, and just below the recent 10-year harvest of 349,000. In 2011 the all-gear treaty Chinook salmon quota for Southeast Alaska was 294,800 based on the coastwide Chinook salmon model under the Pacific Salmon Treaty. Quota allocations of treaty fish included 218,060 to troll fisheries, 12,676 to purse seine fisheries, 9,549 to drift and set gillnet fisheries, and 54,515 to sport fisheries. There were no directed fisheries on the transboundary Taku or Stikine rivers in 2011 due to low forecasts and returns. In addition to Chinook salmon harvests managed to target coastwide stocks under the Pacific Salmon Treaty, spring troll fisheries are managed throughout the region to harvest Alaska hatchery-produced Chinook salmon along with treaty fish. The total Chinook salmon harvest of 346,000 apportioned by commercial fisheries included 70% to troll gear, 12% to hatchery cost recovery, 8% to purse seine, and 9% to drift gillnet. The initial exvessel value of the total Chinook salmon harvest is estimated at $17.7 million based on harvests of 4.6 million pounds and an average price of $3.80/lb. Yearly troll harvests of 250,000 included 51,000 during the winter season, 39,000 during the spring season, and 160,000 during the summer season. Troll price for winter-caught Chinook averaged $7.33/lb.

Sockeye Salmon

The sockeye salmon harvest of 1.2 million was just below the long-term and recent 10-year average harvest of 1.3 million. Sockeye salmon have generally contributed only 3% in numbers of fish to regional harvests over the past 10-year period; this year they contributed just 1.7%. Regional harvests included 499,000 (40%) from the purse seine fisheries, 518,000 (42%) from the drift gillnet fisheries, and 168,000 (13%) from the Yakutat set gillnet fisheries. Sockeye escapement goals were met for 12 out of 13 stocks that have escapement goals. The Chilkat Lake escapement of 64,000 was 91% of the lower bound of the goal. The upper range of sockeye escapement goals was exceeded for 5 out of 13 stocks. Sockeye salmon contributed an estimated $11.5 million to the regional exvessel value based on a harvest of 7.5 million pounds and an average price of $1.53/lb. Notable for 2011 was that McDonald Lake sockeye salmon, designated a stock of management concern in 2009 by the Alaska Board of Fisheries, reached its escapement goal in 2011 for the second consecutive year and was near the upper end of the goal range.

Coho Salmon

The regional harvest of coho salmon was 2.3 million in 2011. This harvest was above the long-term average harvest of 2.1 million but was below the recent 10-year average harvest of 2.7 million. Troll fisheries harvested 1.3 million coho salmon (58%), followed by purse seine (15%), drift gillnet (10%), hatchery cost recovery (10%), and Yakutat set gillnet (6%). Twelve out of thirteen coho salmon escapement goals in the region were either met or exceeded in 2011. The initial fish ticket value for the coho salmon harvest was $16.4 million based on harvests of 13.8 million pounds and an average price of $1.27/lb. Troll fisheries received an average price of $1.50/lb. for summer coho salmon, and this accounted for 34% of the seasonal troll fishery exvessel value of $30.4 million. Troll average weights were notably small in 2011, averaging 5.3 pounds. Small coho salmon sizes and lower-than-average catch rates led many troll fishermen to target chum salmon in 2011, and this contributed to lower overall coho salmon harvests.

Pink Salmon

The 2011 pink salmon harvest of 59.1 million was above both the long-term average of 29.4 million (1962–2010) and the recent 10-year average harvest of 40.4 million (2000–2010). The preseason ADF&G harvest forecast for 2011 was 55 million with an 80% confidence interval range of 43 to 67 million. Pink salmon are predominantly harvested by the purse seine fishery. The Southeast purse seine fishery accounted for 94% of the regional pink salmon harvest and the drift gillnet fishery harvested 3%. Pink salmon weights averaged 3.7 pounds. Based on an average price of $0.42/lb and 219 million pounds harvested, the initial exvessel value for pink salmon was $94 million. Seine harvest distribution included 11.6 million in southern districts and 47.2 million in northern districts. Common property seine harvests by district from high to low included 20.0 million in District 12, 8.6 million in District 13, 7.0 million in District 9, 6.4 million in District 14, 3.7 million in District 10, 4.1 million in District 3, 2.4 million in District 4, 800,000 in District 2, 500,000 in District 1, and less than 100,000 in District 7. This strong dichotomy between returns to northern and southern regions was not expected, since southern districts have generally been more productive over time. The returns to Districts 12 and 13 were records for pink salmon since statehood. The three subregion biological escapement goals (BEG) for pink salmon were met or exceeded, escapement targets were met in 14 of 15 districts, and 44 of 46 stock group escapement targets were met or exceeded.

Chum Salmon

The total commercial chum salmon harvest was 10.7 million in 2011. The harvest was above recent 10-year average harvest of 9.6 million as well as the long-term average harvest of 5.4 million (1962–2009). The major harvests included 2.8 million (26%) in drift gillnet fisheries, 2.7 million (25%) in purse seine fisheries, and 4.1 million (38%) in hatchery cost-recovery harvests. A total of 50% of chum salmon harvests took place in terminal areas in either cost-recovery or common property terminal area fisheries. A large portion of chum salmon harvests in the region result from hatchery production, including harvest outside of terminal areas as hatchery returns pass through traditional fisheries. The regional chum salmon harvest of 10.7 million was just above the projected return of around 10.1 million, based on forecasts by the three major hatchery operators plus an allowance of around 2.0 million expected for wild production. Total enhanced chum salmon harvests were 8.3 million to the four enhancement organizations: 3.5 million to SSRAA release sites, 600,000 to NSRAA release sites, 4.0 million to DIPAC release locations, and 200,000 to the Armstrong-Keta, Inc. SHA. Wild summer chum salmon escapement indices, based on three recently established SEG thresholds, were above goal in the Southern Southeast and in the Northern Southeast Outside areas, and just below goal Northern Southeast Inside area. Fall chum salmon escapements were good in most systems monitored but slightly below goal in one area. The chum salmon harvest, based on 82 million pounds landed and an average price $0.81/lb, were worth $60 million exvessel value. Chum salmon were the second most valuable species for the Southeast Alaska region after pink salmon in 2011 and contributed 30% to the overall salmon value.

Table 4.–Preliminary 2011 Southeast Region commercial salmon harvests, by fishing area and species in thousands of fish.

Fishery	Chinook[a]	Sockeye	Coho	Pink	Chum	Total [b, c]
Purse Seine						
Southern Purse Seine Traditional	6	284	106	9,566	1,130	11,092
Northern Purse Seine Traditional	3	212	228	45,519	986	46,947
Hatchery Terminal	19	4	13	149	585	770
Total Purse Seine	28	499	347	55,234	2,701	58,809
Drift Gillnet						
Tree Point	2	89	29	336	340	795
Prince of Wales	3	146	118	337	158	762
Stikine	5	51	21	65	143	285
Taku-Snettisham	2	100	28	339	668	1,137
Lynn Canal	1	58	33	331	853	1,276
Drift Gillnet Hatchery Terminal	18	74	10	233	639	973
Total Drift Gillnet	31	518	238	1,641	2,801	5,228
Set Gillnet (Yakutat)	1	168	126	205	1	501
Troll						
Hand Troll						
Traditional	11	0	97	24	12	144
Hatchery Terminal	0	0	1	0	0	1
Spring Areas	7	0	1	2	1	11
Total Hand Troll	18	0	99	26	13	157
Power Troll [d]						
Traditional	190	5	1,194	299	537	2,224
Hatchery Terminal	2	0	10	4	4	21
Spring Areas	32	0	8	167	149	357
Total Power Troll	224	5	1,213	470	689	2,601
Total Troll	242	5	1,311	496	703	2,757
Annette Island Reservation						
Seine	0	12	5	499	140	656
Drift Gillnet	1	17	10	242	264	534
Troll	0	0	0	0	0	0
Hand Troll	0	0	0	0	0	0
Power Troll						
Trap						
Total Annette Island Reservation	2	29	15	741	404	1,190
Hatchery Cost Recovery	41	22	231	698	4,087	5,080
Miscellaneous [e]	1	1	1	57	6	65
Southeast Region Total	346	1,243	2,269	59,071	10,702	73,630

[a] Chinook salmon adults and jacks are totaled.
[b] Missing data indicates no harvest, and zeros indicate harvest activity but <500.
[c] Columns may not total exactly due to rounding error.
[d] Catch accounting period for the 2011 Chinook salmon season goes from October 1, 20109 to September 30, 2011.
[e] Includes salmon that were confiscated or caught in sport fish derbies or commercial test fisheries and sold.

CENTRAL REGION

PRELIMINARY 2011 PRINCE WILLIAM SOUND SALMON SEASON SUMMARY

The following is an overview of the 2011 Prince William Sound (PWS) Area commercial salmon season. Fishing has been completed in all districts and preliminary harvest totals should be representative for all species. It should be noted that numbers in the narrative are expressed in rounded terms for simplicity and that all data are considered preliminary.

The 2011 PWS Area commercial salmon harvest was 39.2 million. The harvest was composed of 33.4 million pink, 3.5 million sockeye, 1.9 million chum, 371,000 coho, and 20,000 Chinook salmon. The 2011 harvest was composed of 32.3 million (82%) commercial common property fishery (CPF), and 6.9 million (18%) hatchery cost recovery and broodstock fish.

Gillnet Fisheries

Copper River District

The 2011 preseason commercial harvest forecast for the Copper River District was 9,000 Chinook, 1.2 million sockeye, and 293,000 coho salmon. Gulkana Hatchery was expected to contribute 320,000 sockeye salmon to the 2011 CPF harvest. The commercial salmon fishing season in the Copper River District began on Monday, May 16. The 2011 sockeye salmon harvest of 2.1 million was almost double the previous 10-year (2001–2010) harvest average of 1.14 million. The preliminary harvest composition was 1.4 million (76%) wild, 489,000 (24%) Gulkana Hatchery, and 6,000 (0.3%) Main Bay Hatchery (MBH) sockeye salmon. The CPF harvest of 20,000 Chinook salmon was below the previous 10-year (2001–2010) average harvest of 30,000. The coho salmon commercial harvest of 128,000 was below the previous 10-year (2001–2010) average harvest of 291,000. The 2011 inriver goal for salmon passing the Miles Lake sonar site was 622,380–822,380. The 2011 preliminary sonar escapement estimate was 914,231 salmon. Spawning escapement to Copper River delta systems based on aerial survey indices was 77,000 sockeye salmon, and was within the sustainable escapement goal (SEG) range of 55,000–130,000. Coho salmon spawning escapement to the Copper River Delta based on aerial survey indices was 39,000 and was within the SEG range (32,000–67,000).

Bering River District

The Bering River District in 2011 was initially closed to commercial sockeye salmon harvest due to aerial survey counts from 2006 to 2010 that were below the SEG range (23,000–35,000). Inseason aerial survey counts below weekly anticipated goals led to continued closure of the district for sockeye salmon fishing. The 2011 aerial escapement index of 21,000 sockeye salmon was below the SEG range. The coho salmon commercial harvest of 20,000 was below the previous 10-year (2001–2010) harvest average of 54,000. Aerial surveys of coho salmon produced an escapement index of 19,000 that was within the SEG range of (13,000–33,000).

Coghill District (Drift Gillnet)

Prince William Sound Aquaculture Corporation (PWSAC) forecasted a run of 2.6 million chum salmon to Wally Noerenberg Hatchery (WNH) in 2011. Approximately 588,000 chum salmon (23%) of the forecast 2.6 million WNH run were designated for corporate cost recovery and broodstock. The 2011 CPF harvest of chum salmon in the Coghill District was 1.1 million. PWSAC harvested 464,000 chum salmon for corporate cost recovery and broodstock. The

Coghill River weir passed 98,000 sockeye salmon, well above the SEG range (20,000–40,000). The total CPF harvest of sockeye salmon in the Coghill District was 199,000, 73% of which were enhanced stock (predominately MBH) origin and 27% were wild stock origin. The total CPF harvest of coho salmon in the Coghill District was 96,000, the majority of which were likely enhanced stock (predominately WNH) origin. Pink salmon CPF harvest in the Coghill District was 2.4 million, 92% enhanced stock (predominately WNH) and 8% wild stock.

Eshamy District

The department's preseason forecast for Eshamy Lake was 35,000 wild sockeye salmon and PWSAC forecasted a run of 935,000 MBH enhanced sockeye salmon. The CPF harvest of sockeye salmon in the Eshamy District was 1.2 million. Enhanced sockeye salmon contribution to the Eshamy District CPF harvest was 92%. Additionally, MBH sockeye salmon were harvested in the Copper River (6,000) and Coghill (144,000) districts. Sockeye salmon escapement to Eshamy Lake was 23,000 when the weir was removed on August 28. This was within the BEG range (13,000–28,000).

Unakwik District

The department's 2011 preseason harvest forecast for the Unakwik District was 7,000 sockeye salmon. The Unakwik District CPF harvest was 1,000 sockeye salmon, which was below the 10-year average of 7,000.

Montague District, Port Chalmers Subdistrict

PWSAC forecasted a run of 624,000 chum salmon to the Port Chalmers remote release site in 2011. The CPF harvest of chum salmon in the Montague District was 104,000. The drift gillnet gear group had access to the Port Chalmers Subdistrict in 2011 under the Prince William Sound Management and Salmon Enhancement Allocation Plan. The 2011 harvest was below the 5-year (2006–2010) CPF average of 667,000 chum salmon. Approximately 4% of the chum salmon harvested in the Port Chalmers Subdistrict were of wild stock origin.

Purse Seine Fisheries

Coho Salmon

The 2011 Valdez Fisheries Development Association (VFDA) coho salmon return was anticipated to be 189,000. VFDA's broodstock objective was 1,000 coho salmon. As of October 4, VFDA harvested 38,000 coho salmon for cost recovery. In 2011 the total CPF harvest of coho salmon in PWS (excluding Copper River and Bering River districts) was 93,000. The majority of CPF coho salmon harvested in the Eastern (32,000) and Coghill (17,000) districts are assumed to be of enhanced stock origin.

Pink Salmon

The 2011 pink salmon total return forecast for PWS was 46.9 million. This estimate included 5.6 million wild stock fish, 15.5 million VFDA hatchery fish, and 25.8 million PWSAC hatchery fish. Approximately 4.5 million (17%) of the 25.8 million pink salmon return forecast to the PWSAC hatcheries were projected for cost recovery and broodstock. The remaining 21.3 million PWSAC fish were expected to be available for CPF harvest. Approximately 4.8 million (31%) of the projected 15.5 million pink salmon return forecast to VFDA's Solomon Gulch Hatchery (SGH) were projected for cost recovery and broodstock. The remaining 10.7 million VFDA fish

were expected to be available for CPF harvest. A total harvest of 3.6 million wild stock pink salmon was forecasted for CPF in 2011 leaving 2.0 million fish for escapement in PWS.

The 2011 CPF harvest of 26.9 million pink salmon, composed of approximately 20% wild stock and 80% enhanced stock, was the 10th highest PWS pink salmon harvest since 1971. Total pink salmon harvest for 2011 was 33.7 million, including 6.4 million (4.1 million for PWSAC and 2.3 million for VFDA) fish for hatchery cost recovery and broodstock. Enhanced pink salmon contributions by aquaculture associations to total harvest were 41% VFDA and 42% PWSAC. VFDA cost recovery and broodstock harvest represented approximately 18% of the total pink salmon return to SGH. PWSAC cost recovery and broodstock harvest was approximately 32% of the total pink salmon return to PWSAC hatcheries.

Inseason pink salmon aerial survey escapement estimates remained above minimum anticipated escapement thresholds in all districts for much of the season, which allowed for targeted fishing effort on wild pink salmon. The area-under-the-curve estimate of pink salmon escapement used for direct comparison with the SEG range is not yet available, but considering that inseason pink salmon escapement indices were above anticipated aerial survey counts, overall escapement was likely within the even-year SEG range (1.3–2.8 million). The preliminary PWS wild stock pink salmon harvest of 5.6 million was the 18th highest wild stock harvest by number since 1960; average annual harvest over this same time frame was 5.4 million.

Chum Salmon

The 2011 chum salmon total run forecast for PWS was 3.9 million. The majority of the forecast, 3.5 million (90%), were projected to be of PWSAC hatchery origin. PWSAC forecasted a run of 2.6 million to WNH, 624,000 to Port Chalmers, and 280,000 to Armin F. Koernig Hatchery (AFK). All Port Chalmers and AFK chum salmon were available for harvest in the CPF. Based on the department's wild chum salmon forecast of 400,000, there was a potential CPF harvest of 200,000 wild stock chum salmon in PWS.

The 2011 chum salmon CPF harvest in PWS was 1.4 million, which was 2.5 million below the CPF preseason forecast. The 2011 purse seine CPF harvest of 63,000 chum salmon in the Southwestern District was composed of approximately 11% wild and 89% hatchery fish. Purse seine chum salmon harvest in PWS was predominantly from the AFK hatchery terminal harvest area (THA) and special harvest area (SHA).

COOK INLET

Lower Cook Inlet

The 2011 Lower Cook Inlet (LCI) area commercial salmon harvest was 787,000. The harvest was composed of 362,000 pink, 393,000 sockeye, 32,000 chum, 155 coho, and 141 Chinook salmon. The 2011 harvest was composed of 628,000 (80%) commercial CPF fish, and 159,000 (20%) hatchery cost recovery fish.

Southern District

The 2011 preseason commercial harvest forecast for natural production in the Southern District was 40,000 sockeye and 8,300 pink salmon. Hatchery releases from previous years at Leisure Lake, Hazel Lake, Tutka Bay, Port Graham and English Bay were anticipated to contribute 42,000 sockeye salmon to the 2011 CPF harvest. The commercial salmon fishing season in the Southern District began on Thursday, June 2. Purse seine harvest for the 2011 season of 9,945

sockeye and 512 pink salmon was below the 10-year harvest averages of 87,553 sockeye and 21,448 pink salmon. The set gillnet harvest of 22,782 sockeye and 2,643 pink salmon was also below the previous 10-year harvest averages of 31,169 sockeye and 4,805 pink salmon. Pink salmon escapement in index systems was 67,900 versus a cumulative SEG range (59,700–178,500). The weir at the English Bay River passed 12,036 sockeye salmon. This met the SEG (6,000–13,500) for this system in addition to providing 3,800 sockeye salmon for Cook Inlet Aquaculture Association (CIAA) broodstock.

Outer District

The 2011 preseason commercial harvest forecast for the Outer District was 19,200 sockeye and 491,300 pink salmon. The commercial salmon fishing season began in this district on Monday, July 25. Overall harvest was 46,356 sockeye, 357,472 pink and 25,763 chum salmon. This harvest was similar to the previous 10-year averages of 10,657 sockeye, 391,537 pink and 21,613 chum salmon. Escapement survey indices for pink salmon were 61,276 (SEG range 54,500–237,200) and for chum were 18,936 (SEG range 12,850–34,600). Aerial surveys of Desire Lake documented 13,526 sockeye salmon. This is within the SEG range (8,800–15,200). The Delight Lake weir passed 13,270 sockeye salmon. This is within the SEG range (7,500–17,650).

Eastern District

The 2011 preseason commercial forecast for the Eastern District was 6,000 wild stock sockeye salmon. The CIAA forecasted a return of 130,000 sockeye salmon to Resurrection Bay facilities. Total harvest from this district was 206,547 sockeye salmon with 56,111 harvested in the CPF and 154,267 harvested by CIAA for cost recovery (150,436) and broodstock (3,831). This compares favorably with the previous 10-year average CPF harvest of 16,542 sockeye salmon. Escapement through the weir at Bear Creek (13,220) was sufficient to meet the "desired inriver return" of 5,620–13,220 sockeye. This goal is the combination of the SEG (700–8,300) as well as the 4,920 sockeye salmon required for broodstock for the CIAA sockeye salmon program. In addition, 3,470 sockeye salmon were documented during aerial surveys in Aialik Lake which was below the SEG range (3,700–8,000).

Kamishak Bay District

The 2011 preseason commercial forecast for the Kamishak Bay District was 24,700 sockeye and 449,700 pink salmon. CIAA forecasted a return of 11,800 sockeye salmon to the Kirschner Lake remote release site. Total harvest from this district was 99,288 sockeye, 1,050 pink and 3,850 chum salmon. This compares to a previous 10-year average of 52,857 sockeye, 57,850 pink and 60,628 chum salmon. Aerial survey escapement indices for pink salmon were 3,535 (SEG range 25,950–203,400) and for chum salmon were 60,535 (SEG range 65,550–141,600). Video enumeration of sockeye salmon returning to Chenik and Mikfik lakes documented 10,330 to Chenik Lake (SEG range 3,500–14,000) and 291 to Mikfik Lake (SEG range 6,300–12,150).

Upper Cook Inlet

The 2011 Upper Cook Inlet (UCI) commercial harvest of 5.5 million salmon ranks as the fourth largest overall harvest in the past 20 years. The 2011 UCI commercial exvessel value of approximately $51.6 million was the fifth highest value in the UCI fishery since 1960, and represents the highest exvessel value since 1992. While all five species of Pacific salmon are present in UCI, sockeye salmon are the most valuable, accounting for approximately 77% of the exvessel value in the commercial fishery since 1960, and nearly 93% of the total value during the

past 20 years. Sockeye salmon escapement goals have historically been monitored in six systems in UCI. In 2009, the Yentna River sonar goal was replaced with SEGs monitored by weirs on three lake systems within the Susitna River, those being Judd and Chelatna lakes in the Yentna River drainage and Larson Lake in the mainstem Susitna River drainage. Packers Lake escapement was monitored via remote video in 2011; however, these data have not yet been processed. For the 2011 season, three of seven sockeye salmon goals were met, falling within the established goal range, while three exceeded and one fell below the goal objective.

Chinook Salmon

Approximately 11,000 Chinook salmon were harvested in 2011 (Table 5), which was about 34% less than the long-term average harvest of 15,600. The two fisheries where Chinook salmon are harvested in appreciable numbers in UCI are the Northern District and Upper Subdistrict set gillnet fisheries.

At the 2011 Alaska Board of Fisheries meeting, many Chinook salmon stocks in the Northern District of UCI were found to be stocks of management concern. Based on this finding, an action plan was developed to reduce Chinook salmon harvests by both sport and commercial fisheries. In the commercial fishery, that portion of the General Subdistrict of the Northern District from a point at the wood chip dock located approximately three miles south of Tyonek north to the Susitna River was closed to fishing for the entire directed Chinook salmon fishery. The estimated harvest in the Northern District during the directed king salmon season was approximately 2,130, or about 200 less than the previous 10-year average annual harvest of 2,330.

The Deshka River is the only system in northern Cook Inlet where Chinook salmon escapement is monitored inseason with a weir. The 2011 Chinook salmon escapement at the Deshka River of 19,026 was very similar to the 2010 escapement of 18,600, with both years' counts falling within the escapement range (13,000–28,000).

Recent late-run Kenai River Chinook salmon runs have been characterized as below average. At the 2011 board meeting, the Division of Sport Fish notified the board and all user groups that the standard target-strength sonar estimate of passage would not be used during the 2011 season to monitor daily Kenai River Chinook salmon passage. Instead, the department would rely on a number of "indices" of Chinook salmon abundance. During the 2011 season, this suite of indices indicated the Chinook salmon run was below average and on July 25 bait was removed from the inriver recreational fishery. As stated in the sockeye salmon section of this summary, the concern about low Chinook salmon abundance in the Kenai River resulted in conservative use of the Upper Subdistrict set gillnet fishery in order to reduce Chinook salmon harvests. All of the no-fishing windows required in the management plans were implemented and only about 64% of the additional hours that could have been fished were utilized in the full Upper Subdistrict fishery. The estimated Chinook salmon harvest in the Upper Subdistrict set gillnet fishery of 6,900 represented the smallest harvest in this fishery since 1975 and was approximately 58% less than the previous 10-year average annual harvest of more than 16,000. As previously stated, a postseason analysis of Kenai River late-run Chinook salmon escapement indicated the SEG was met (estimate of 29,800 for the SEG of 17,800–35,700).

In 2011, the estimated exvessel value of $518,000 for Chinook salmon was approximately 1.0% of the total UCI commercial fishery.

Sockeye Salmon

The preseason forecast for the 2011 season projected a total run of 6.4 million sockeye salmon, with a harvest estimate (sport, personal use and commercial) of 4.4–4.8 million. The total run to the Kenai River, generally the largest producer in UCI, was forecast to be 3.9 million. This resulted in managing for an inriver sonar goal range in the Kenai River of 1.0–1.2 million. In the Upper Subdistrict set gillnet fishery, two regularly scheduled 12-hour fishing periods per week, plus up to 51 hours of additional fishing time, were allowed for this run size under the abundance-based escapement goals for the Kenai River.

While the fishing season opens in most of UCI in mid- to late June, participation and harvests remain fairly low until early July. In 2011, sockeye salmon harvests in the Central District up to July 14 were well below average, especially in the Upper Subdistrict set gillnet fishery. The July 14 cumulative harvest of 269,000 was more than 43% lower than the average harvest of 475,000 (2000–2010). However, beginning on Thursday, July 14, the sockeye salmon run strength changed quickly. First, the July 14 drift gillnet harvest of approximately 685,000 sockeye salmon, or more than 1,600 fish per boat, was a record CPUE for one day in UCI history. There had been an indication from the Offshore Test Fishery (OTF) project that a significant number of fish had moved into the district. For example, the OTF cumulative index (CPUE) went from 227 on July 9, which was just above the historic low of 119, to a cumulative index of 1,369 through July 14, which was just below the historic record high of 1,433. The OTF daily index on July 15 was 378, which was the largest single day CPUE in the history of the project. Moreover, the number of consecutive days the OTF daily index exceeded 100 reached nine (July 10–18), which also was a record for this program. A mandatory 36-hour no fishing window was implemented in the Upper Subdistrict set gillnet fishery from 7:00 p.m. on Thursday, July 14, until 7:00 a.m. on Saturday, July 16. A survey of eastside beaches throughout the day on Friday, July 15, revealed that the body of fish the drifters had encountered on July 14 were now pushing hard toward the Kenai and Kasilof rivers. Therefore, even though the cumulative sonar passage in the Kenai River through July 15 had reached only 64,000 (in a system with a minimum inriver goal at the time of 1.0 million), an emergency order was issued opening the Upper Subdistrict set gillnet fishery, as well as drift gillnetting in the Expanded Kenai and Expanded Kasilof sections, on Saturday, July 16, from 7:00 a.m. until 10:00 p.m. The sockeye salmon harvest from the Upper Subdistrict set gillnet fishery on July 16 was more than 450,000, which turned out to be a single-day harvest record for this fishery. In addition, drifters captured more than 200,000 fish in the expanded corridor. It soon became apparent that the number of sockeye salmon that had entered the Kenai River during the closed fishing window, and days afterwards, was significant. From July 17–24 (8 days), more than 950,000 fish were estimated to have passed the sonar. On July 17, a single-day sonar passage record of more than 230,000 sockeye salmon occurred, followed by more than 177,000 on July 18.

On July 22, department staff made an inseason assessment of the sockeye salmon run, with the determination being that the final Kenai River run would be more than 4.6 million. This triggered changes in management of the commercial fishery. First, the new inriver escapement goal range increased to 1.10–1.35 million. In addition, the maximum number of additional hours the Upper Subdistrict set gillnet fishery could be fished each week increased from 51 to 84 hours. Finally, the mandatory Tuesday 24-hour no-fishing window was eliminated, but the 36-hour Friday window remained in effect.

For the remainder of the fishing season, the primary management challenge was how to slow down the escapement of sockeye salmon into the Kenai River while at the same time attempting to minimize Chinook salmon harvests. The Kenai River late-run Chinook salmon run was categorized as below average, resulting in bait being removed from the inriver sport fishery on July 25. Because of the below average Chinook salmon run, the Upper Subdistrict set gillnet fishery never fished the additional hours that were available per the management plans. Moreover, Chinook salmon conservation was also addressed by implementing all of the no-fishing window periods. Meanwhile, in order to attempt to harvest the large sockeye salmon run, the drift gillnet fleet was fished on four different days in the expanded corridor when the Upper Subdistrict set gillnet fishery was closed. The final sockeye salmon sonar estimate of passage in the Kenai River was approximately 1.6 million, exceeding the upper range of the inriver goal by approximately 250,000. Post season analysis indicated the Kenai River Chinook salmon escapement estimate for 2011 was approximately 29,800 (the escapement goal range is 17,800–35,700).

The total sockeye salmon run to UCI in 2011 was estimated to be 8.4 million, which was 31% more than forecast. Based on OTF data, the run was two days late, which is consistent with large Kenai River runs. Runs to Fish Creek, and the Kenai and Susitna rivers were better than forecast, while sockeye salmon runs to the Crescent and Kasilof rivers and minor systems were all slightly below forecast. The UCI commercial harvest of 5.3 million sockeye salmon was approximately 21% above the preseason forecast harvest estimate of 4.2 million and nearly 2.2 million more than the average annual harvest since 1966. In only one year since 1999 (13 total years), when the abundance based escapement goal to the Kenai River was developed, has commercial fisheries management ended up in the same tier as the preseason forecast.

Coho Salmon

The 2011 coho salmon harvest estimate of 95,000 (Table 5) was the second smallest harvest in UCI history and approximately 51% lower than the recent 10-year average annual harvest of 188,000. In the drift gillnet fishery, only 37,000 coho salmon were harvested in 2011, which was 65% less than the previous 10-year average annual harvest of 105,000. Reduced commercial harvests of coho salmon in 2011 were likely due to restrictions in fishing area put in regulation by the Alaska Board of Fisheries to reduce the drift fleet coho salmon harvest, but also were the result of a very poor coho salmon run to many parts of UCI. Monitored coho salmon escapements in UCI are the Little Susitna River, Fish Creek and Jim Creek (McRoberts Creek). In 2011, the escapement in the Little Susitna River of 4,825 was less than half of the lower end of the SEG range (10,100–17,700). At the 2011 board meeting, the Fish Creek coho salmon SEG (1,200–4,400) was reinstated. The weir was pulled on August 15, before the entire coho salmon run was complete. The count at that time (1,428) was within the SEG. This is a minimum estimate, accounting for 35% to 40% of the escapement. The final Fish Creek coho salmon escapement projection was approximately 3,700. The escapement for Jim Creek (McRoberts Creek) was 261 coho salmon with a goal of 450–700.

Beginning Saturday, August 27, the Division of Sport Fish prohibited fishing for coho salmon in all waters of the Knik Arm Management Area, excluding Fish Creek and the Eklutna Tailrace. The estimated total commercial coho salmon harvest in the General Subdistrict (west side) of the Northern District after the sport fish closure was nine fish.

The exvessel value of coho salmon to the commercial fishery was approximately $385,000, or 0.7 % of the total exvessel value in Upper Cook Inlet.

Pink Salmon

Pink salmon runs in UCI are even-year dominant, with odd-year average annual harvests typically less than one-seventh of even-year harvests. The commercial harvest of pink salmon in 2011 was estimated to be approximately 34,000 (Table 5), which is 63% less than the average annual harvest during the previous 10 odd-years (1991–2009). Pink salmon escapements are not monitored in UCI to an appreciable degree, but it appears the 2011 pink salmon run, even by odd-year standards, was a weak return. Prices paid for pink salmon were approximately $0.25/lb, resulting in an exvessel value for this species of $25,000, or approximately 0.05% of the total exvessel value.

Chum Salmon

The 2011 harvest of 129,000 chum salmon (Table 5) was about 8% above the previous 10-year average annual harvest of 116,000. There is only one chum salmon escapement goal in UCI, which is an SEG in Chinitna Bay on Clearwater Creek. The upper range of that goal was exceeded in 2011. The exvessel value of chum salmon to the commercial fishery was approximately $692,000, or 1.3 % of the total exvessel value.

BRISTOL BAY

The 2011 inshore Bristol Bay sockeye salmon run of approximately 30.3 million and catch of 21.9 million sockeye ranks 14th over the last 20 years (1991–2010) and was 18% below the average run of 37.1 million for those years. This year's run to the Bay was 21% below the preseason forecast of 38.5 million. Togiak was the only district to exceed preseason expectations with a run that was 9% higher than forecast, while Naknek–Kvichak District was 8% below, Egegik 35% below, Ugashik District 28% below, and Nushagak 27% below forecast. The commercial harvest of sockeye salmon was 27% below the 28.5 million preseason forecast. Total Bristol Bay escapement was 8.5 million sockeye salmon.

Approximately 37,800 Chinook salmon were harvested in Bristol Bay in 2011, which is 59% of the average harvest for the last 20 years. The chum salmon harvest of 739,000 was 27% below the 20-year average of 1 million. Coho salmon harvest of 13,700 was 84% below the 20-year average of 88,000. Reported pink salmon harvest was 811.

The 2011 harvest of all salmon species in Bristol Bay was approximately 22.7 million. These figures represent an estimate since the contribution of future price adjustments, loyalty bonuses, and differential prices for refrigerated versus nonrefrigerated fish were not included. The calculated preliminary exvessel value of the 2011 Bristol Bay salmon fishery is approximately $137.7 million, which is 17% above the 20-year average, and ranks sixth over that same period.

Chinook Salmon

Chinook salmon harvests in Bristol Bay were below average in every district. No directed Chinook fishing periods were permitted in the Nushagak District, but incidental harvest of Chinook during directed sockeye periods did occur with a preliminary total of 29,811. Over the course of the season, the sport fishing seasonal bag limit was reduced to two fish greater than 20 inches in the Nushagak River. Chinook salmon escapement into the Nushagak River was 59,728, surpassing the minimum escapement goal (40,00)0. Chinook salmon harvests in Bristol Bay were below average in every district. No directed Chinook salmon fishing periods were permitted in the Nushagak District, but incidental harvest of Chinook salmon during directed

sockeye salmon periods did occur with a preliminary total of 29,811. Over the course of the season, the sport fishing seasonal bag limit was reduced to two fish greater than 20 inches in the Nushagak River. Chinook salmon escapement into the Nushagak River was 59,728, surpassing the minimum escapement goal (40,000).

Sockeye Salmon

The 2011 inshore sockeye salmon run of 30.3 million was 21% below the preseason forecast of 38.5 million. Escapements to all systems were within established ranges.

The 2011 Bristol Bay sockeye salmon run can be characterized as early and weaker than forecast. However, in comparison to patterns dating back to statehood the run was close to long-term averages. Temperatures in the Bering Sea were slightly warmer earlier in the spring than the last several years. Entry patterns into fishing districts in the Bay were atypical in that in most districts there was a strong early component followed by a rapid decline in abundance in early July. Given the projected harvest of 28.5 million sockeye salmon, the department planned to allow more fishing time early in the run. At the December 2009 Alaska Board of Fisheries meeting the board also changed regulations with the goal of encouraging early season fishing. The board adopted regulations allowing fishermen to fish eastside districts prior to June 25 without having to register their permit or vessel, which allows fishermen a chance to participate early in the run without the penalty of having to wait 48 hours to transfer between districts. The effort to encourage early participation seemed successful in 2011, particularly in Egegik. The total sockeye harvest was 27% below and total inshore run was 21% below forecast. Also of significance in 2011, both the Naknek River SHA and the Wood River SHA were not utilized; only the fourth time since 1995 that the Naknek River SHA was not opened to commercial fishing.

Coho Salmon

The baywide harvest of 13,655 coho salmon was 85% below the recent 20-year average of 88,000. Over half of the coho salmon harvest was in the Togiak District, where most fish were caught from mid-July to mid-August.

Pink Salmon

Pink salmon runs are strong during even years in Bristol Bay. 2011 was an off cycle year for pink salmon with a reported harvest of 811.

Chum Salmon

The 2011 preliminary Bristol Bay chum salmon harvest was approximately 739,000. Naknek-Kvichak District produced a harvest above the 20-year average, while Egegik, Ugashik, Nushagak and Togiak districts produced less chum salmon than their 20-year averages. The Nushagak District was the largest producer of chum salmon, where over 340,000 were harvested.

Table 5.– Preliminary 2011 Central Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Purse Seine						
Eastern District	0	8	33	13,317	29	13,387
Northern Dist.	0	3	13	2,783	2	2,801
Coghill Dist.	0	0	17	1,675	0	1,692
Northwestern Dist.		2	0	252	1	255
Southwestern Dist.	0	48	28	6,807	63	6,944
Montague Dist.	0	0	1	781	0	783
Southeastern Dist.	0	2	1	505	12	520
Unakwik Dist.						
Drift Gillnet						
Bering River District	0	0	20	0		20
Copper River Dist.	20	2,061	128	24	13	2,246
Coghill Dist.	0	199	80	722	1,093	2,093
Eshamy Dist.	0	902	6	79	96	1,083
Montague Dist.	0	2	0	4	103	110
Unakwik Dist.		1		0	0	1
Set Gillnet						
Eshamy Dist.	0	313	0	18	25	357
Hatchery [a]			44	6,389	472	6,905
Prince William Sound Total	20	3,541	371	33,356	1,910	39,199
Southern District	0	41	0	4	2	47
Kamishak District	0	99	0	1	4	104
Outer District	0	46	0	357	26	430
Eastern District	0	207	0	0	0	207
Lower Cook Inlet Total	0	393	0	360	32	788
Central District	9	5,242	73	33	123	5,480
Northern District	2	35	22	1	7	67
Upper Cook Inlet Total	11	5,277	95	34	129	5,547
Naknek-Kvichak District	0	8,896	0	0	206	9,103
Nushagak District	30	4,953	5	0	341	5,329
Egegik District	0	4,682	0	0	41	4,724
Ugashik District	0	2,601	0	0	38	2,639
Togiak District	7	748	8	0	113	876
Bristol Bay Total	38	21,880	14	0	739	22,671
Central Region Total	70	31,092	480	33,571	2,810	68,205

Note: Missing data indicates no harvest and zeros indicate harvest activity but <1,000.

Note: Columns may not total exactly due to rounding.

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

ARCTIC-YUKON-KUSKOKWIM REGION

Arctic-Yukon-Kuskokwim (AYK) Region harvests totaled 1.482 million salmon and 10.477 million pounds in 2011 (Tables 3 and 6). The exvessel value was estimated to be $7.9 million. Cumulative all-gear commercial harvest included 18,000 Chinook, 77,000 sockeye, 255,000 coho, 1.125 million chum, and 7,000 pink salmon. Chinook salmon harvests were considerably below average while chum and coho salmon harvests were above average. Improved chum and coho salmon markets and corresponding higher prices resulted in larger harvests and exvessel value in the region. Poor pink salmon markets resulted in a substantially lower harvest than available surplus. Landings were made by 1,168 limited entry permit holders in 2011.

KUSKOKWIM AREA

The Kuskokwim Area commercial salmon harvest in 2011 was 17,528 Chinook, 76,598 sockeye, 119,923 coho, 236,406 chum, and 1 pink salmon for a total of 450,456. A total of 510 permit holders participated and the exvessel value was estimated to be $2,286,815.

Overall Chinook, chum and coho salmon harvests were similar to what was expected, and sockeye salmon was below the expected harvest range in the Kuskokwim Area in 2011. Escapement was adequate for all species at monitored locations except for Chinook salmon, which only met 4 of 10 escapement goals. Amounts necessary for subsistence use are expected to have been met. In general, run timing throughout Kuskokwim area for Chinook and coho salmon was characterized as average, sockeye salmon was considered early, while chum salmon were considered to be late.

KUSKOKWIM RIVER

In 2011 the following preseason and inseason management actions were taken in an attempt to conserve and achieve Chinook salmon escapement goals.

Subsistence Chinook salmon fishing with hook and line gear was closed and subsistence fishing was restricted to the use of gillnets with 4-inch or less mesh not to exceed 60 feet in the following waters of the Kuskokwim River Drainage: (1) Kuskokuak Slough between ADF&G regulatory markers located at the upstream and downstream mouth of the slough, including all waters of the Old Kuskokuak Slough, the Kisaralik, Kasigluk, and the Kwethluk river drainages to their confluence with Kuskokuak Slough, and (2) the Tuluksak River drainage including its confluence with the Kuskokwim River and the Kuskokwim River mainstem downstream to the upstream side of Mishevik Slough.

Subsistence fishing was closed in District 1 from June 16–19 as Bethel test fishing abundance indices of Chinook salmon continued to indicate low abundance of Chinook salmon and escapement goals were unlikely to be met. This action was supported by the Kuskokwim River Salmon Management Working Group.

Subsistence fishing was closed in District 1 from June 23–28 as Bethel test fishing continued to indicate lower than adequate abundance of Chinook salmon and that escapement goals were unlikely to be met. This action was supported by the Kuskokwim River Salmon Management Working Group.

From June 29 through July 7, 2011, ADF&G restricted subsistence salmon fishing to 6-inch or smaller mesh gillnets in District 1 of the Kuskokwim River drainage. This action was taken for

conservation of Chinook salmon while still providing opportunity to harvest more abundant sockeye and chum salmon. This conservation measure was unanimously supported by the Kuskokwim River Salmon Management Working Group.

However, federal management special actions contained in 3-KS-01-11 and 3-KS-02-11 preempted state management emergency orders from June 30 to July 2, 2011. The area of the Kuskokwim River within the Federal Conservation Unit was closed to subsistence fishing using gillnets with mesh greater than 4 inches, exceeding 45 meshes in depth, and longer than 60 feet from 12:01 a.m. Thursday, June 30 until 11:59 p.m. Saturday, July 2, 2011. The area closed extended from the mouth of the Kuskokwim River upstream to the confluence of the Aniak and Kuskokwim rivers, including all tributary rivers in between.

Inseason reports during Kuskokwim River Salmon Management Working meetings suggested that many subsistence fishermen met their harvest needs. Postseason subsistence harvest surveys are presently being conducted.

There were 19 commercial fishing periods in District 1 between July 5 and August 22. Processing capacity limited all commercial openings to one subdistrict per period. Therefore, the department alternated commercial fishing periods between Subdistricts 1-A and 1-B. Processing capacity did allow for 2-hour extensions of fishing time in the Lower Section of Subdistrict 1-B. A total of 49 Chinook, 13,482 sockeye, 118,256 chum and 74,108 coho salmon were harvested. A total of 748 Chinook salmon were harvested during the commercial fishery, but 699 of those were retained for personal use as the buyers agreed not to purchase Chinook salmon because of the poor return. A total of 413 individual permit holders (making at least one recorded landing) participated in the District 1 commercial fishery. Chum and sockeye salmon harvests were above the most recent 10-year average, while Chinook and coho salmon harvest were below the most recent 10-year average. The chum salmon harvest was the highest since 1998. Total exvessel value of the fishery in District 1 was $764,358, approximately 150% above the most recent 10-year average value.

Chinook salmon abundance in 2011 was poor. Chinook salmon escapements were evaluated through aerial surveys on five index streams throughout the drainage and by weirs on six tributary streams. Only three of nine escapement goals were achieved.

Sockeye salmon escapements were monitored at each of the seven tributary weir projects, although sockeye are not a prominent species in many of these systems. Kogrukluk and Telaquana rivers have the largest sockeye salmon escapements and were characterized as below average in 2011. The one established escapement goal in the Kuskokwim River was met.

Chum salmon escapements were monitored at six tributary weirs and one tributary sonar project and indicate overall abundance was above average. Of the two established SEGs, one was within the escapement goal range and one exceeded the escapement goal range.

Coho salmon escapements were monitored at four tributary weirs. Escapement at the Kogrukluk River weir was within the escapement goal range. Escapements at the other monitored locations were characterized as average to above average.

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

Subsistence fishing in Kuskokwim Bay area was allowed seven days per week throughout the season with the exception of closed periods associated with commercial fishing. Subsistence

harvests results are not available for 2011, but amounts necessary for subsistence use is expected to have been achieved.

The District 4 commercial salmon fishing season opened June 20. Because of late Chinook salmon run timing and abundance concerns, the commercial fishing season was postponed by about five days in District 4. District 5 opened on June 27, which is about one week later than normal due to concerns for Chinook salmon abundance. Chinook salmon harvests and catch rates were below average to average throughout the season in both districts. By July 4, the sockeye salmon harvest in both districts had exceeded the Chinook salmon harvest and, by regulation, management was directed towards sockeye salmon. Because of high sockeye salmon abundance early in the run, additional fishing time was provided in both districts the week of July 4. By July 9 in District 5, sockeye salmon harvests and escapements had dramatically decreased. Due to concerns for meeting the Middle Fork Goodnews River weir sockeye salmon BEG there were no commercial fish periods in District 5 from July 14–28. Overall, sockeye salmon harvest was below average in both districts.

District 4 chum salmon harvests in 2011 were the second highest on record, and District 5 chum salmon harvests were average. Coho salmon harvest exceeded sockeye salmon harvest in District 4 on July 27, and in District 5 on August 8. On those dates, each district shifted to coho salmon management. In District 4, from August 1 to August 12, commercial fishing opportunity was reduced to two periods per week due to concerns for coho salmon abundance. Coho salmon harvests and catch rates were below average in District 4 and average in District 5.

In 2011, 219 individual permit holders recorded landings during 26 commercial periods in District 4. The total commercial harvest of 189,346 was composed of 15,387 Chinook, 38,543 sockeye, 104,959 chum, and 30,457 coho salmon. The exvessel value of the District 4 commercial fishery was estimated to be $1,176,435.

A total of 48 individual permit holders recorded landings in District 5 during 21 commercial periods. The District 5 total commercial harvest of 55,214 was composed of 2,092 Chinook, 24,576 sockeye, 13,191 chum, and 15,358 coho salmon. The exvessel value of the District 5 commercial fishery was estimated to be $346,022.

Fish passage through the Kanektok River weir during its operation from June 27 through August 15 was 5,032 Chinook, 84,805 sockeye, and 50,908 chum salmon. Escapement estimates for coho and pink salmon are incomplete because the project does not operate through the entire coho and pink salmon runs. No formal escapement goals for any species have been established at the weir.

Fish passage through the Middle Fork Goodnews River weir was 1,861 Chinook, 17,946 sockeye, 19,974 chum, 23,826 coho, and 1,394 pink salmon. The weir was operational from June 24 through September 18. An aerial survey of the North Fork of the Goodnews River was flown on July 3 with 853 Chinook salmon and 14,140 sockeye salmon observed. Chinook salmon escapement goals were met. The sockeye salmon aerial survey SEG was met while escapement at the weir was slightly below the lower end of the BEG range. Chum and coho salmon lower bound SEG ranges were achieved at the weir.

Yukon Area

The 2011 Yukon River total commercial harvest was 82 Chinook, 275,161 summer chum, 238,979 fall chum, and 76,315 coho salmon for the Alaskan portion of the drainage. A total of 82

Chinook, 266,510 summer chum, 228,466 fall chum, and 69,531 coho salmon were harvested in the Lower Yukon River (Districts 1–3) and 0 Chinook, 8,651 summer chum, 10,513 fall chum, and 6,784 coho salmon were harvested in the Upper Yukon River (Districts 4–6). A total of 446 permit holders sold fish in 2011 and the exvessel value was approximately $3,441,943.

Summer Season

The 2011 Yukon River Chinook salmon run was projected to be poor to below average. Due to the uncertainty concerning Chinook salmon run strength and the need to fulfill the Canadian border passage obligation, meet Alaska escapement goals, and provide for subsistence uses, management of the Chinook salmon commercial fishery followed a conservative preseason management strategy. The regulatory windowed subsistence salmon fishing schedule began June 6 in District 1 and was implemented chronologically in upriver districts. Subsistence fishing was closed during the first pulse of Chinook salmon. Beginning in District 1, one fishing period was closed (approximately 5-day closure) and this action was implemented in upriver fishing districts and subdistricts based on migratory timing. A 5-day subsistence fishing closure was also implemented on the second pulse of Chinook salmon.

A surplus of summer chum salmon above escapement and subsistence needs occurred in 2011; however, the extent of the summer chum salmon commercial fishery was limited by the poor Chinook salmon run. No commercial periods targeting Chinook salmon were allowed in 2011. Sale of incidental Chinook salmon harvested during summer chum commercial fishing periods was prohibited by emergency order during the summer season because subsistence fishing had been restricted during the season in Districts 1–5. Fishermen could release any incidentally caught live Chinook salmon or use them for subsistence purposes. The prohibition of Chinook salmon sales was lifted partway through the fall season.

In an effort to further reduce incidental harvest of Chinook salmon during a poor run, the summer chum commercial salmon fishery was delayed until near the midpoint in the Chinook salmon run at the Lower Yukon test fishery. A substantial surplus of approximately 1 million summer chum salmon was projected based on Pilot Station sonar. The first summer chum directed commercial periods took place June 24 in District 1 and June 26 in District 2. Gillnet gear was restricted to 6-inch or smaller mesh. Concurrent subsistence and commercial fishing periods in Districts 1 and 2 were instituted intermittently throughout the season, primarily early in the summer chum salmon commercial season when the subsistence schedule was still in effect. The intent of these concurrent openings was to decrease the amount of time that Chinook salmon were susceptible to harvest.

When it appeared the third pulse of Chinook salmon was not developing as expected, the department took further measures to provide commercial summer chum salmon harvest opportunities while still protecting Chinook salmon. Commercial fishing was restricted in District 1 to only the South Mouth below Head of Passes, including Black River, Kwiguk Pass, and coastal waters from Chris Point to one mile north of Kwiguk Pass during four periods during the end of June. This action was taken because Chinook salmon were entering the river primarily through the North and Middle mouths and abundance was low in the South Mouth. The harvest from these four South Mouth openings was 76,500 summer chum and a reported 573 incidental Chinook salmon. The third commercial fishing period in District 2 was delayed until July 6 because of the abundance of Chinook salmon in the district. Once it was expected that most of the third pulse of Chinook salmon was in the upstream portion of District 2, the department

scheduled 2 periods in which the fishing area was limited to the lower half of the district. There were a total of 11 commercial fishing periods in District 1 and 9 in District 2. The cumulative harvest for Districts 1 and 2 combined was 266,510 summer chum salmon, which was the highest since 1992, and 163% above the 10-year (2001–2010) average harvest of 104,579.

District 6 is managed using inseason assessment information provided by multiple projects operated in the Tanana River drainage. Run assessment was difficult this season due to high water and drift that hampered the operation of tower counting projects on the Chena, Salcha and Goodpaster rivers. However, a harvestable surplus of summer chum salmon was identified based upon subsistence harvest reports and information from lower river genetic stock identification and run assessment data. The first commercial fishing period to target chum salmon in District 6 was on July 18. As in Districts 1 and 2, the sale of incidentally caught Chinook salmon was not allowed. The department scheduled eleven commercial fishing periods and the cumulative harvest was 8,651 summer chum salmon.

A total of 408 permit holders participated in the summer chum salmon fishery, which was approximately 15% below the 2001–2010 average of 532. The Lower Yukon Area (Districts 1-3) and Upper Yukon Area (Districts 4–6) are separate Commercial Fisheries Entry Commission permit areas. A total of 403 permit holders fished in the Lower Yukon Area in 2011, which was approximately 21% below the 2001–2010 average of 513. In the Upper Yukon Area, five permit holders fished, which was approximately 71% below the 2001–2010 average of 17. The exvessel value was an estimated $1.3 million for the summer season with $0.75/lb paid for summer chum salmon in the lower river the highest on record. However, the fishery value was approximately 31% below the 2001–2010 average of $1.9 million.

Chinook salmon escapement goals for the East Fork and West Fork Andreafsky rivers were achieved. However, the Anvik River escapement goal was not met. Season cumulative counts on the Gisasa and Henshaw rivers were above average. High water conditions on the Chena, Salcha, and Goodpaster rivers precluded counting for much of the season. An aerial survey of the Salcha River was conducted on July 21. A total of 3,664 Chinook salmon were counted during this survey, which meets the lower end of the Salcha River tower escapement goal. Preliminary Chinook salmon passage at Eagle sonar was 51,271, yielding a preliminary border passage of approximately 50,888, which provided for harvest sharing agreement with Canada and was within the interim management escapement goal (42,500–55,000).

Most summer chum salmon producing tributaries experienced above average escapement. The East Fork Andreafsky SEG and Anvik BEG were achieved. Counts at the Gisasa and Henshaw rivers were above average. Salcha River escapement as assessed by tower counts was near average; however, because this project experienced problems due to high water conditions, it is likely that these counts were very conservative. Escapement on the Chena River was impossible to assess because of environmental conditions.

Fall Season

The fall season began by regulation on July 16 in District 1. Subsistence fishing in Districts 1, 2 , 3, and Subdistrict 5-D were open seven days a week, 24 hours a day, while District 4 and Subdistricts 5-A, 5-B, and 5-C were open five days a week. A limited commercial harvest was allowed in Districts 1 and 2 during the transition time between the summer and fall seasons. By the last week of July, run assessment indicated that the 2011 run was below average, and no commercial fishing occurred during that time.

The first and largest pulse of fall chum salmon entered Yukon River on July 30. Run assessment indicated that there was a surplus available for commercial harvest and commercial fishing in Districts 1 and 2 continued through the remainder of the season. Fall chum salmon continued to enter Yukon River over four additional pulses through September 7, and projections indicated a surplus of fall chum salmon for commercial harvest. Attempts were made to align commercial openings with pulses as they entered the river. In between pulses, commercial openings occurred on a set schedule. Limited commercial fishing also occurred in Subdistricts 5-B and 5-C in early August, and in District 6 in September and October. Coho salmon were harvested incidentally in fall chum salmon directed commercial openings. Three commercial openings in District 1 in September targeted coho salmon. Subsistence fishing was liberalized to seven days a week, 24 hours a day on August 30 in District 4, on September 12 in Subdistricts 5-A, 5-B, and 5-C, and on September 30 in District 6.

There were a total of 31 commercial periods in 2011 with majority of commercial fishing occurring in the lower river districts. The 2011 total commercial harvest for the Yukon River fall season in the Alaskan portion of the drainage was 238,979 fall chum and 76,303 coho salmon (12 additional coho salmon were harvested during the summer season). The fall chum salmon harvest was the largest since 1995 and the coho salmon harvest was the largest since 1991. All salmon were sold in the round and no salmon roe was sold separately. The average price for fall chum and coho salmon in the lower river was $1.00/lb, which was well above average. The exvessel value of the total harvest was a record $2,122,649; $1,643,689 for fall chum and $478,960 for coho salmon. A total of 410 individual permit holders participated in the 2011 fall chum and coho salmon fishery; 403 in Districts 1 and 2 combined and 7 in Districts 4, 5, and 6 combined. Participation in all districts was above recent averages.

The preliminary 2011 fall chum salmon run size is estimated to be between 946,000 and 1.067 million which is above the upper end of the preseason forecast range (605,000–870,000). Drainagewide fall chum salmon escapement is estimated to be between 620,000 and 740,000, which is above the upper end of the BEG range (300,000–600,000). Fall chum salmon escapement goals were either achieved or exceeded throughout the drainage except for the Fishing Branch River in Canada.

The estimated passage of 119,000 coho salmon at Pilot Station sonar was below the historical average of 146,000. The Delta Clearwater River has the only established escapement goal for coho salmon, an SEG of 5,200–17,000. Surveys observed approximately 6,000 coho salmon which is within the SEG range.

NORTON SOUND AREA

Highlights of the 2011 Norton Sound District commercial salmon fishery included (1) the second highest chum salmon harvest since 1986, trailing only last year's chum salmon harvest by 6,000; (2) the highest chum salmon harvests in Subdistricts 2 (Golovin), 3 (Elim) and 4 (Norton Bay) since the 1980s; (3) a record coho salmon harvest in Subdistrict 4; and a record $1.27 million in exvessel value. Disappointments in 2011 were the poor runs of Chinook and sockeye salmon as were forecasted.

Commercial salmon fishing began with a 24-hour opening on June 20, in Subdistricts 2 and 3, directed at chum salmon. This June start date was the earliest commercial chum salmon fishing opening in over a decade in Norton Sound. Commercial catches were above average for the first

opening and escapement was expected to be met in both subdistricts, so additional commercial fishing periods were announced dependent on buyer availability.

Subdistrict 4 first opened on July 13, but severe weather kept fishermen from fishing until July 18. Well above average catches of chum salmon allowed the department to continue commercial fishing periods throughout the remainder of the month when there was buyer availability. In Subdistrict 5 (Shaktoolik) commercial fishing began on July 3 with one 24-hour fishing period, and in Subdistrict 6 (Unalakleet) commercial fishing began on July 2 with one 24-hour fishing period. Commercial fishing was delayed to conserve a poor Chinook salmon run. Both the Subdistrict 5 and 6 fishing periods targeted chum salmon with gillnets restricted to 6-inch or less mesh size. Fishing periods for the remainder of July in Subdistricts 5 and 6 ranged from 24 to 72 hours, as the buyer attempted to keep up with one of best chum salmon runs to Norton Sound since the 1980s.

During late July in Subdistricts 4–6, and during early August in Subdistricts 2 and 3, the department switched to coho salmon management. The coho salmon run in Subdistrict 2 was weak compared to most years and the fishery was closed in mid-August. However, coho salmon runs overall in Norton Sound were above average compared to the historical average, if the record runs in the latter half of the 2000s were excluded. Coho salmon harvest in Subdistrict 3 was the third highest on record and a record coho salmon harvest occurred in Subdistrict 4. Coho salmon harvest in Subdistrict 5 was the seventhth highest on record and in Subdistrict 6 was the 19th highest on record.

All chum, pink, and coho salmon goals were achieved or exceeded at the escapement counting projects in Norton Sound. The Unalakleet River test fish project had the highest chum salmon catch index in its 27-year history. Aerial survey goals were achieved or exceeded for coho salmon. Chinook salmon escapement goals failed to be reached in Norton Sound. The aerial survey goal was reached for sockeye salmon at Salmon Lake, but no survey was attempted at Glacial Lake because of weather conditions.

The Norton Sound District combined commercial harvest of all salmon species was third highest in the last 10 years. The number of commercial permits fished (123) was the highest since 1993. The 2011 exvessel value was a record $1,269,730 and the average value per permit holder of $10,323 was the second highest on record, trailing only last year by a few hundred dollars.

The average price paid was $3.01/lb for Chinook salmon, $1.04/lb for sockeye salmon, $1.70/lb for coho salmon, $0.25/lb for pink salmon, and $0.68/lb for chum salmon.

KOTZEBUE SOUND AREA

The overall chum salmon run to Kotzebue Sound in 2011 was estimated to be above average to well above average based on the commercial harvest rates, subsistence fishermen reporting good catches, and the Kobuk test fish index being the second highest in the 19-year project history. The commercial harvest of 264,321 chum salmon was the second highest since 1995 and only trailed last year's harvest by about 6,000. Harvested during the commercial fishery and kept for personal use were 35 Chinook salmon, 10 sockeye salmon, 98 pink salmon, 23 coho salmon, 400 Dolly Varden and 453 sheefish. There were likely some additional fish kept for personal use not reported on fish tickets.

The commercial fishery was opened on July 11 and the schedule allowed for fishing from 9:00 p.m. to 5:00 a.m. daily. Eight-hour fishing periods continued daily during the following week, but with a start time of 8:00 p.m. During the last week of July the start time reverted again to

9:00 p.m. Throughout the season there was a closure from Saturday morning's period end until Sunday evening because of aircraft schedules. The evening fishing hours that occurred this year were in response to the often nightly runway closures at the airport.

Strong commercial and test fish catches in July indicated a very large chum salmon run and the department continued to open fishing any time requested by buyers. In August, closures lasting several days, of the main runway at the airport limited fishing time. Despite the closures, catch volume was high in August. As a consequence, the major buyer requested fishing periods as short as three hours and the fishing time was switched from overnight to early evening hours to ensure that buying capacity was not exceeded.

A total of 2,158,365 pounds of chum salmon (average weight 8.2 pounds) were sold at an average of $0.40/lb. There were 89 permit holders that fished in 2011 and this number was well above the 67 permit holders who fished last year and was the highest number since 1995. The higher participation in the fishery this year may have been the result of the change to evening fishing hours for the first time since the mid-1990s. The total exvessel value was $867,085. The average value for each participating permit holder was $9,743. The total exvessel value represents 148% of the $586,591 historical average.

Table 6.–Preliminary 2011 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 [b]
Kuskokwim River	0	13	74	0	118	206
Kuskokwim Bay	17	63	46		118	245
Kuskokwim Area Total	18	77	120	0	236	450
Lower Yukon River	0		70		495	569
Upper Yukon River	0		7		19	26
Yukon River Total	0		76		514	590
Norton Sound	0	0	59	7	111	177
Kotzebue Sound					264	264
AYK Region Total	18	77	255	7	1,125	1,482

[a] Missing data indicates no harvest and zeros indicate harvest activity but <1,000.
[b] Columns and rows may not total exactly due to rounding error.

WESTWARD REGION

KODIAK MANAGEMENT AREA

The 2011 Kodiak Management Area (KMA) commercial salmon fishery began on June 9 and the last commercial landing occurred on September 16. Harvests by fishing area and species are summarized in Table 7.

Table 7.–Preliminary 2011 Westward Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total[a,b]
Kodiak	19	2,269	190	16,649	825	19,952
Chignik	7	2,497	77	905	270	3,755
South Peninsula and Aleutian Islands	7	1,921	153	5,369	979	8,700
North Peninsula	2	926	19	109	294	1,350
Alaska Peninsula Total	10	2,847	173	5,746	1,273	10,050
Westward Region Total	35	7,613	440	23,302	2,368	33,757

[a] Missing data indicates no harvest and zeros indicate harvest activity but <1,000.
[b] Columns and rows may not total exactly due to rounding error.

Commercial fishing effort increased again during the 2011 commercial salmon season and was the highest it has been since 2000. Of the 593 eligible commercial salmon permits, 339 (57%) made commercial landings.

By gear type, a total of 157 set gillnet, 175 purse seine and 7 beach seine permit holders fished in 2011. Permit holder participation (all types) was above the previous 10-year average. During 2011, both beach seine and purse seine permit holder participation was higher than in 2010. The number of permits actually fished at any given time varied throughout the season.

The 2011 commercial harvest in the KMA was 18,615 Chinook, 2,269,302 sockeye, 190,483 coho, 16,648,792 pink and 824,562 chum salmon for a total of approximately 20.0 million salmon, which is below the previous 10-year (2001-2010) average of 24.3 million salmon.

The estimated total exvessel value of the 2011 fishery was approximately $44.2 million, which is higher than any year since 1990, and well above the 10-year average exvessel value of $22.6 million.

Purse seine fishermen accounted for 95% of the total number of salmon harvested and averaged $224,349 per fished permit. The exvessel value increased from the 2010 season, and was higher than the previous 10-year average ($120,161) for purse seine permit holders.

Set gillnet fishermen accounted for 5% of the total number of salmon harvested. Earnings averaged approximately $31,137 per fished permit, which was also an increase from 2010, but below the previous 10-year average permit holder earnings ($34,650).

Beach seine participation was the highest it’s been since 1995. Earnings averaged approximately $13,572 per fished permit.

2010 Commercial Harvest Summary

Chinook Salmon

There are no directed Chinook salmon commercial fisheries in the KMA but incidental commercial harvest occurs during targeted sockeye salmon fisheries. The Ayakulik and Karluk river systems support the largest Chinook salmon populations in the KMA. No commercial openings were allowed in the Inner Karluk and Outer Karluk sections in June or July. Nonretention of Chinook salmon was implemented during the fishing periods allowed prior to noon on July 13 in that portion of the Central Section south of the latitude of Cape Kuliuk, and in the Inner Ayakulik and Outer Ayakulik sections. After July 13, it became apparent that both Karluk and Ayakulik rivers would have adequate Chinook salmon escapement. The 2011 commercial harvest of Chinook salmon in the KMA totaled 18,615 which was very near the previous 10-year average (18,138) and below the 2011 forecast (20,000).

Sockeye Salmon

The 2011 commercial harvest of sockeye salmon in the KMA totaled 2,269,302. The harvest was below the recent 10-year average (2,431,652) but above the forecast (2,053,228).

By regulation, management for much of the westside fisheries of Kodiak Island through July 5 is based on the run strength of Karluk early-run sockeye salmon. Due to poor returns, only two short fishing periods were allowed targeting Karluk early-run sockeye salmon. Approximately 191,652 sockeye salmon were harvested in early season (through July 15) westside fisheries, which was above the Karluk early-run sockeye salmon projected harvest of 99,926, although this harvest includes a (yet to be estimated) contribution from the enhanced Spiridon Lake sockeye salmon run. Approximately 118,649 sockeye salmon were harvested in the late-season westside fishery which was below the Karluk late-run sockeye salmon point forecast of 139,845.

The Ayakulik River was forecasted to have a surplus of sockeye salmon (412,662) available to commercial fishing in 2011. A short sockeye salmon fishery was allowed in the Inner Ayakulik and Outer Ayakulik sections in June and starting in mid-July, a more liberal fishing schedule was allowed on the late run. Approximately 148,401 sockeye salmon were harvested in the Inner Ayakulik and Outer Ayakulik sections during the 2011 season.

Generally, the early-run sockeye salmon appear in Upper Station earlier than they do in the Frazer system. The intent of the early opening was to allow an opportunity to harvest Upper Station early-run sockeye salmon prior to the Frazer Lake sockeye salmon peak run timing. Initially, the Upper Station early-run sockeye salmon came in as expected and a commercial salmon fishery was prosecuted on June 9 as a 33-hour test fishery. The resulting sockeye salmon harvest was lower than anticipated. As the season progressed, it became evident that the early-run sockeye salmon to Upper Station was weak. The 2011 forecast for Frazer Lake was estimated at 329,000 with a harvestable surplus of approximately 181,000. The Frazer Lake run came in about as expected. By July 5, the lower sockeye salmon goal was achieved through the Dog Salmon weir. The Alitak District early-run sockeye salmon commercial harvest was 68,203, well below the projected harvest (140,424).

Cape Igvak Salmon Management Plan

This regulatory management plan (5 AAC 18.360) allocates up to 15% of the total Chignik-bound sockeye salmon harvest to KMA fishermen in the Cape Igvak Section. Based on

regulations, 90% of all sockeye salmon caught prior to July 25 in the Cape Igvak Section are considered to be Chignik-bound.

In 2011, the early Chignik sockeye salmon run was stronger than it has been in many years and the allocative and biological criteria were met to allow fishing in the Cape Igvak Section beginning June 9. Eleven days of fishing was allowed in June during the early run to Chignik. The Chignik late-run sockeye salmon run was weaker than expected and no fishing was allowed after the overlap period through July 25.

Through July 25, the Cape Igvak harvest of sockeye salmon considered to be Chignik-bound (90%) was approximately 494,538. This Cape Igvak sockeye salmon harvest represented 16.9% of the total Chignik sockeye salmon harvest (15% allocation). Overall, the total sockeye salmon harvest in the Cape Igvak Section through July 25 was 549,487, which was above the forecast (229,379).

North Shelikof Sockeye Salmon Management Plan

From July 6 to July 25, this regulatory management plan (5 AAC 18.363) places harvest limits on two areas of the KMA bordering northern Shelikof Strait to limit interception of sockeye salmon that are considered Cook Inlet-bound. During the period that this management plan is in effect, KMA fisheries are targeting local pink salmon runs and the fishing periods are based on the projected pink salmon run strength. If it appears that the sockeye salmon harvest will meet or exceed limits set by the Alaska Board of Fisheries, then fisheries are to be restricted to inshore "Shoreward Zones" only, and offshore "Seaward Zones" are closed. In 2011, a department biologist was present on the grounds to determine the sockeye salmon catch and facilitate orderly, short notice closures if the harvest limits were met.

A Seaward Zone closure was implemented in the North Shelikof Unit at 1:00 p.m. July 22 when it was estimated that the cumulative sockeye salmon had approached the 15,000 limit. The total harvest from July 6 to July 25 in the North Shelikof Unit was 26,821 sockeye salmon, which includes both the Shoreward Zone and Seaward Zone harvests. A Seaward Zone closure was not required in the Southwest Afognak Section as the harvest cap of 50,000 sockeye salmon was not met. The July 6–25 harvest in the Southwest Afognak Section was 14,672 sockeye salmon.

Terminal and Special Harvest Areas

Some fisheries occur in areas where salmon enhancement projects create surplus production. Sockeye salmon harvests occurred as follows:

There was above average effort and harvest in the both Waterfall and Foul Bay SHAs with a total of 81,205 sockeye salmon harvested in both SHAs.

In the Spiridon SHA (Telrod Cove), 111,459 sockeye salmon were harvested. This includes a cost recovery of 20,241 by KRAA. The harvest in the Spiridon SHA represents only a portion of the total harvest of Spiridon enhancement fish; the remainder is harvested in traditional net fisheries along the westside of the KMA. The total Spiridon sockeye salmon commercial harvest has not been estimated at this time.

The KBH harvest was an estimated 238,593 sockeye salmon, and was above the point forecast of 67,000. This includes the commercial harvest of both enhanced and wild salmon from the Inner Kitoi Bay, Outer Kitoi Bay, Duck Bay, and Izhut Bay sections. Additional enhanced sockeye salmon may have been harvested in adjacent sections, but stock separation data are not available.

Coho Salmon

The commercial coho salmon harvest of 190,000 was below forecast (373,048) and below the 2001–2010 average (389,496).

The largest portion of the coho salmon commercial harvest occurred in those sections associated with Kitoi Bay Hatchery (Inner Kitoi Bay, Outer Kitoi Bay, Duck Bay, and Izhut Bay sections), with a total harvest of 68,575 which was below the projected harvest (156,000).

Pink Salmon

Overall, the 2011 pink salmon harvest of 16,648,792 was well below the forecast (29.3 million), and well below the past five odd-year (2001–2009) average harvest (23,246,051), and also the previous 10-year average harvest (20,534,551).

Wild stock pink salmon harvests were below forecast (21.9 million) with 14,471,149 harvested in the KMA. Westside fisheries (Southwest Afognak to Ayakulik) accounted for 832,530, the Alitak District had a harvest of 4,896,501, and the eastside and the north end of Kodiak Island had a harvest of 8,275,432.

The Kitoi Bay Hatchery pink salmon return was weaker than expected. In those sections near the hatchery 2,171,288 pink salmon were harvested compared to a projected harvest of 7.4 million. Additional Kitoi-bound pink salmon were likely harvested along the west side and east side of Kodiak and Afognak islands. However, the department does not have a stock separation program for pink salmon and is unable to differentiate stocks. There was a cost-recovery fishery near the hatchery, with Kitoi pink, coho, chum and sockeye salmon harvested and sold by the Kodiak Regional Aquaculture Association.

Chum Salmon

The chum salmon harvest of 824,562 was well below the forecast (1,139,578) and slightly below the 2001-2010 average (886,441). The eastside and the north end of Kodiak Island accounted for 187,862, the Mainland District had a harvest of 112,168 and the west side fisheries (Southwest Afognak to Ayakulik) had a harvest of 79,526. KBH chum salmon production was weaker than expected, with 320,579 harvested, below the 2011 forecast (411,000).

2010 Escapement Summary

During the 2011, KMA commercial salmon season fish counting weirs were operated on nine systems, including the Karluk, Ayakulik, Litnik, Upper Station, Frazer, Buskin, Saltery, Pasagshak, and Big Bay systems. In addition, four observers flew over 37 aerial surveys, and several observers conducted foot and skiff survey escapement estimates. Foot surveys are still being conducted on road system streams, primarily by the Division of Sport Fish.

Chinook Salmon

The total Chinook salmon escapement (7,820) was below the previous 10-year average (14,329; Table 4). Escapement goals for Chinook salmon have been developed for the Karluk and Ayakulik rivers and the escapements are estimated using fish counting weirs.

The Chinook salmon escapement through the Karluk weir (3,420) was within the range of the established escapement goal range (3,000–6,000). Chinook salmon escapement through the Ayakulik weir (4,316) was within the established escapement goal range (4,000–7,000).

Sockeye Salmon

The 2011 sockeye salmon returns to systems in the KMA were varied. The Karluk early-run sockeye salmon and Upper Station early- and late-run sockeye salmon escapements did not meet established minimum escapement goals. Pasagshak, Buskin, Little River, Malina, Frazer, Afognak, Uganik, Saltery, Ayakulik (both early- and late-run sockeye salmon), and the Karluk late-run sockeye salmon escapements were within established escapement goal ranges. The entire KMA estimated sockeye salmon escapement (1,014,090) was below the previous 10-year average (1,381,712).

Coho Salmon

The only established coho salmon escapement goals occur in the Northeast Kodiak and Eastside Kodiak districts in the following rivers: American (400), Olds (1,000), Buskin (3,200–7,200) and the Pasagshak rivers (1,200). The Buskin River weir was removed early due to high water and surveys in the other streams are not yet concluded.

For the entire KMA, the estimated coho salmon escapement is incomplete and it is expected that more coho salmon enter KMA systems throughout the fall after the conclusion of foot surveys and removal of weirs. At this time the KMA has very little coho salmon monitoring, (the last aerial surveys were conducted in mid-October) and the lack of stock status information will further hamper the management of coho salmon in the KMA.

Pink Salmon

Overall KMA pink salmon escapement (2,780,208) was well below the previous five odd-year average (4,043,350) and below the previous 10-year average (5,006,407). Pink salmon escapement goals have been established as an aggregate goal for the entire Kodiak Archipelago and the Mainland District. The escapement goal range (2.0–5.0 million) was met for the Kodiak Archipelago (2,506,708). The Mainland District pink salmon escapement of 273,500 was within the established escapement goal range (250,000–750,000).

Chum Salmon

Overall chum salmon escapement (422,130) was slightly above the recent 10-year average (414,561). Escapement goals have been established in Kodiak Archipelago and the Mainland District. The Kodiak Archipelago escapement (estimage 283,530) was above the escapement goal (151,000), and the Mainland District escapement (138,600) was also above the escapement goal (104,000).

CHIGNIK MANAGEMENT AREA SEASON SUMMARY

The Chignik River watershed supports two distinct sockeye salmon runs which traditionally provide the majority of directed harvest opportunities within the CMA. In 2011, the combined early- and late-run was the third largest Chignik-bound sockeye salmon run since 1970. The CMA was open to commercial salmon fishing for 74 days (June 5–August 29) and a total of 65 permits were fished.

Escapement Summary

Escapement through the Chignik River weir was monitored using underwater digital video equipment. Two underwater gates in the weir were open to provide uninterrupted escapement. The numbers of fish passing the weir were counted, by species, for the first 10 minutes of each

hour. The counts were expanded to obtain hourly escapement estimates, and then summed to provide an estimate of daily fish passage. A digital video archive was kept of each 10-minute counting period in the 2011 season with the first count occurring on May 31 when weir installation was complete, and the last weir count of the season took place on September 2, after which the weir was removed.

Aerial surveys were flown throughout the season to monitor escapement into CMA streams. Peak aerial survey counts, by index stream and species, were summed and compared to available escapement goals established by Nemeth et al. (2010). Pink and chum salmon escapements were measured against established area wide SEGs.

Chinook Salmon

The Chignik River is the only Chinook salmon-producing stream within the CMA and one of the largest Chinook salmon streams on the South Alaska Peninsula and Chignik areas. The BEG for Chinook salmon in the Chignik River watershed is 1,300–2,700 (Nemeth et. al. 2010). The 2011 Chignik River Chinook salmon escapement, through the weir, of 2,728, was above the 5-year average but below the 10-year average. Subsistence and sport fishery harvest of Chinook salmon above the weir will not be known until permits and questionnaires are returned and tabulated by the spring of 2012

Sockeye Salmon

Sockeye salmon escapement to the Chignik River is managed based on separate escapement objectives for both early- and late-run sockeye salmon. Despite one of the earliest commercial salmon fishing openers and the longest initial fishing period (37 days) in CMA history, the early-run SEG (350,000–400,000) through July 4 was exceeded with an estimated early-run escapement of 488,930.

The late-run objectives include an additional 50,000 sockeye salmon which are incorporated into the late-run SEG to provide for additional freshwater subsistence fishing opportunity. The late-run (post-July 4) SEG (250,000–400,000) was met with an estimated escapement of 264,887. Post-weir sockeye salmon escapement estimates were produced for the September 3–15 (5,275) and the September 16–30 (1,310) periods, which were included in the total late-run escapement estimate.

Early run escapement was above the prior 5- and 10-year average escapement. The late run sockeye salmon escapement was below the prior 5- and 10-year averages. Sockeye salmon escapements into other CMA streams were relatively minor.

Coho Salmon

Coho salmon begin to enter CMA drainages in mid-August and continue through November. The coho salmon run is generally building when the weir is removed; therefore, coho salmon escapement estimates are considered incomplete. The 2011 Chignik River coho salmon escapement estimate through Sept 2 was 5,293. This was below prior 5- and 10-year average escapements. Although no coho salmon escapement goals have been established for the CMA (Nemeth et. al. 2010), coho salmon escapement throughout the CMA appears to be consistent with past years and sustainable at this level.

Pink Salmon

An estimated 16,298 pink salmon passed the Chignik River weir in 2011, which was above previous 5- and 10-year average escapements. Pink salmon escapements into other CMA streams were estimated via aerial survey and summarized by district. The odd-year upper end of the SEG for all districts combined (800,000; Nemeth et al. 2010) was exceeded with an estimated total peak escapement of 986,248.

Chum Salmon

The 2011 Chignik River chum salmon escapement was 145, which was average for the Chignik River. Chum salmon escapements to other CMA streams were estimated via aerial survey and summarized by district. The lower bound SEG of all districts combined (57,400; Nemeth et al. 2010) was exceeded with an estimated total peak escapement of 278,145.

Commercial Fishery Summary

The CMA was open to commercial salmon fishing for 74 days during the 2011 commercial salmon season. The first fishing period occurred on June 5 and the CMA closed to commercial salmon fishing shortly after processors ceased operations. In 2011, 65 permit holders (including the department's test fishery permit) made a total of 2,617 landings.

Harvest Summary

Chinook Salmon

A total of 7,000 Chinook salmon were commercially harvested (excluding home pack and the department's test fishery) in 2011, which was above recent average harvests. The majority of the 2011 CMA Chinook salmon harvest occurred in the Central and Western districts, with much of the remainder harvested in the Chignik Bay District. Most of the Chinook salmon harvest occurred from late June until the end of July.

Sockeye Salmon

A total of 2.497 million sockeye salmon were commercially harvested (excluding home pack and the department's test fishery) in the CMA during 2011, which was well above the prior 10-year average harvest and approximately 1.495 million (150%) more than the prior 5-year average harvest. The majority of the 2011 CMA sockeye salmon harvest came from the Chignik Bay District, although there were a substantial number of sockeye salmon harvested in the Central District.

In 2011, SEDM and Cape Igvak opened to commercial salmon fishing for the first time on June 9. A total of 195,796 (156,637 considered Chignik-bound) sockeye salmon were harvested in SEDM through the end of the allocation period, on July 25. Cape Igvak fisherman harvested 549,487 (494,538 considered Chignik-bound) during the allocation period.

Coho Salmon

A total of 76,775 coho salmon were commercially harvested in 2011, which was lower than the prior 5-year and similar to the prior 10-year average harvest. The majority of the coho salmon harvest in 2011 took place during July and August in the Western District.

Pink Salmon

A total of 905,108 pink salmon were commercially harvested in 2011, which was below the 5-year average and similar to the 10-year average harvest. The largest portion of the CMA pink salmon harvest came from the Western District, although the Central and Perryville districts also yielded a substantial portion of the CMA catch. Most pink salmon were harvested between late June and mid-August.

Chum Salmon

A total of 270,000 chum salmon were commercially harvested in 2011, which was above both 5- and 10-year average harvests. The majority of the chum salmon harvest in 2011 took place in the Central District, although the Western and Eastern districts also yielded substantial catches. Most chum salmon were harvested between late June and mid-August.

Economic Value Summary

The exvessel value of the 2011 CMA commercial salmon fishery was about $23.8 million. The approximately $371,327 per active permit holder was the highest dollar amount ever in the CMA, although this amount is not adjusted for inflation. A majority of the value was from the sale of sockeye salmon (90%), with a total of approximately $335,456 per active permit holder. The harvest provided approximately $16,254 (pink salmon), $14,369 (chum salmon), $4,350 (coho salmon), and $899 (Chinook salmon), per active permit holder.

Department Test Fishery Summary

The department conducted test fisheries on three occasions in 2011. Data from these test fisheries were used to assess the buildup of sockeye salmon in Chignik Lagoon. An estimated 6,545 sockeye salmon were harvested, which provided approximately $47,000 that was used to offset the cost of vessel charters and operating the Chignik weir.

Subsistence Summary

At this writing subsistence harvest numbers for 2011 have not been finalized.

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

The following is an overview of the 2011 Alaska Peninsula, Aleutian Islands, and Atka-Amlia Islands Areas commercial salmon fishing season. Total harvest presented from the 2011 commercial salmon fishing season should closely approximate final harvest numbers for all species. The 2011 commercial salmon harvest in the Alaska Peninsula, Aleutian Islands, and Atka-Amlia Islands Management Areas totaled 9,585 Chinook, 2,846,726 sockeye, 172,945 coho, 5,747,523 pink, and 1,273,270 chum salmon. Subsistence salmon harvest will be reported in the 2011 annual management report. Data detailed in this report are considered preliminary. Preliminary exvessel value of salmon harvested in Area M totaled $25,741,579. Exvessel value information was generated from fish tickets and does not include postseason adjustments paid to fishermen.

South Unimak and Shumagin Islands June Fisheries

The South Unimak and Shumagin Islands fishing season began at 6:00 a.m. on June 7 with an 88-hour fishing period for all gear types (purse seine, drift gillnet, and set gillnet gear). During

the June fishery, there were four 88-hour periods and one 64-hour fishing period. The commercial salmon harvest for the June fishery consisted of 3,464 Chinook, 1,359,441 sockeye, 124 coho, 723,135 pink, and 423,335 chum salmon.

Southeastern District Mainland

Due to a strong commercial salmon harvest in the CMA, the SEDM opened to commercial salmon fishing on June 18. During the SEDM allocation openings, 348 Chinook, 195,796 sockeye, 2,107 coho, 43,423 pink, and 46,762 chum salmon were harvested.

Beginning July 1, the Northwest Stepovak Section (NWSS) of the SEDM is managed on the strength of the Orzinski Lake sockeye salmon run. The return of sockeye salmon to Orzinski Lake was adequate to allow limited commercial harvest opportunity in the NWSS. From July 1 through July 25, there were 47 Chinook, 26,719 sockeye, 193 coho, 3,752 pink, and 4,734 chum salmon harvested in the NWSS. The cumulative sockeye salmon escapement of 16,764, through the Orzinski Lake weir, was within the SEG (15,000–20,000).

From July 26 to August 31, the SEDM is managed based on the abundance of local salmon stocks and 30 Chinook, 16,200 sockeye, 4,379 coho, 417,351 pink, and 25,999 chum salmon were harvested.

From September 1 to September 30 the SEDM is open concurrently with the remainder of the Southeastern District based on the abundance of coho salmon stocks. In September, 3 Chinook, 4,754 sockeye, 3,366 coho, 587 pink, and 2,236 chum salmon were harvested in the SEDM.

South Peninsula post-June fishery

Prior to the South Peninsula post-June fishery, the department conducts a test fishery to determine immature salmon abundance in the Shumagin Islands. Test fishing occurred on July 3, 4, and 5 which resulted in 11 (July 3), 21 (July 4), and 14 (July 5) immature salmon per set, which were below the threshold of 100 immature salmon per set.

From July 6 to July 21, there were six fishing periods, each consisting of a 24-hour opening followed by a 48-hour closure. From July 22 to July 31, there were three fishing periods that consisted of a 36-hour opening followed by a 48-hour closure. During August, the post-June fishery is managed based on the abundance of local stocks. In September and October, management focuses on coho salmon returns, though the status of local pink and chum salmon returns may also be taken into consideration.

The total commercial harvest for the South Peninsula post-June fishery (including the SEDM from July 26 to October 31) was 3,348 Chinook, 334,589 sockeye, 150,662 coho, 4,221,915 pink, and 502,891 chum salmon.

Commercial salmon fishing was allowed in the South Central District and the Shumagin Islands portion of the Southeastern District for 37 hours from 8:00 a.m. Wednesday, August 3, until 9:00 p.m. Thursday, August 4. An additional 37-hour commercial salmon fishery was allowed in the Shumagin Islands portion of the Southeastern District from 8:00 a.m. Saturday, August 6, until 9:00 p.m. Sunday, August 7. Continuous commercial salmon fishing was permitted in the South Central District and the Shumagin Islands portion of the Southeastern District from 8:00 a.m. Tuesday, August 16 until 9:00 p.m. Wednesday, August 31.

The Unimak and Southwestern districts had one 37-hour commercial salmon fishing period from 8:00 a.m. Friday, August 5, until 9:00 p.m. Saturday, August 6. Due to low pink and chum

salmon escapement into the Unimak and Southwestern districts, commercial salmon was not permitted for most of August. A 61-hour commercial salmon fishing period was permitted from 8:00 a.m. Monday, August 29 until 9:00 p.m. Wednesday, August 31.

Commercial salmon fishing during the post-June SEDM (July 26–October 31) fishery remained closed for most of August due to low pink and chum salmon escapement. One commercial salmon fishing period was permitted from 8:00 a.m. Wednesday, August 24 to 9:00 p.m. Wednesday, August 31.

In September there were three 59-hour commercial salmon fishing periods in the South Central, Southwestern, and Unimak districts. There were three 59-hour and one 83-hour commercial salmon fishing period in the Southeastern District during the month of September.

Aleutian Islands Fishery

The department opened the Aleutian Islands Area to commercial salmon fishing by seine gear on August 4. Commercial harvest of salmon occurred in Unalaska and Makushin bays, with a total harvest of 2 Chinook, 1,863 sockeye, 2 coho, 632,889 pink, and 235 chum salmon. Currently there is no escapement goal for pink salmon in the Aleutian Islands area. However, an aerial survey was conducted on August 5 by the department of Unalaska and Makushin bays to provide escapement information for inseason management purposes and to monitor the abundance of pink salmon in this area. An estimated 31,000 pink salmon were observed as escapement. No additional salmon escapement surveys were conducted in the Aleutian Islands during 2011.

South Peninsula Escapement

The South Peninsula indexed sockeye salmon escapement of 59,794 was within end of the management objective range (48,200–86,400). Pink salmon total escapement of 2,494,950 was within end of the odd-year goal range (1,637,800–3,275,700). Chum salmon indexed total escapement of 497,725 was within the escapement goal range (330,400–660,800). A total of 3,100 coho salmon were documented in South Peninsula streams. Some of the major coho salmon systems are typically not surveyed or surveyed during off-peak times. There are few escapement goals on the South Peninsula for coho salmon due to their late-run timing. A lack of escapement information for coho salmon is due to the departure of management staff from the South Peninsula region prior to peak coho salmon runs, and poor weather conditions during the peak coho salmon runs preventing aerial surveys from being conducted.

North Alaska Peninsula

The total 2011 commercial harvest for the North Alaska Peninsula fishery was 2,369 Chinook, 925,628 sockeye, 19,461 coho, 108,863, pink and 293,848 chum salmon. In 2011, 171 Area M permit holders participated in commercial salmon fisheries along the North Alaska Peninsula. There was no effort by Area T permit holders. The numbers of Area M and Area T permit holders participating in 2011 were far below the historic numbers observed during the 1990s.

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

In 2011, the North Alaska Peninsula harvest of Chinook, sockeye, and coho salmon were below the previous 10-year (2001–2010) average, while the harvest of pink and chum salmon were

above the previous 10-year average. Similarly, the harvest of Chinook, sockeye, and coho salmon were all below projected levels, while pink and chum salmon were well above projected levels. In addition, the total 2011 North Alaska Peninsula sockeye salmon harvest was the lowest harvest in over 30 years.

Northwestern District

In the 2011 Northwestern District commercial salmon fishery a total of 20,113 sockeye, 2,447 coho, 108,495 pink, and 229,398 chum salmon were harvested (Table 9). A total of 33 permit holders participated in the fishery, consisting of 5 purse seiners, 27 drift gillnetters, and 1 set gillnetter.

In the Northwestern District, chum salmon escapement totaled 151,400. The Northwestern District chum salmon escapement goal (100,000–215,000) was met, with a majority of the escapement occurring in the Izembek-Moffet Bay Section. The Urilia Bay Section had an escapement of 37,700 sockeye salmon.

Nelson Lagoon Section

The Nelson Lagoon Section total run of 187,808 sockeye salmon (includes harvest and escapement) was well below the estimated forecast of 484,000. From the total run, 74,808 were harvested in Nelson Lagoon and 113,000 escaped, of which 89,000 returned to the Nelson (Sapsuk) River, and 24,000 were observed in other tributaries of Nelson River such as David's (18,000) and Caribou (6,000) rivers. The sockeye salmon escapement into Nelson River did not meet the BEG (97,000–219,000).

Bear River and Three Hills Sections

By regulation, the Bear River Section opens to commercial salmon fishing on May 1 while the Three Hills Section opens June 25. Both areas are managed based on the sockeye salmon run strengths into Bear and Sandy rivers. In 2011 a portion of the Bear River Section and the entire Three Hills Section were closed to commercial salmon fishing to protect Sandy River sockeye salmon, which struggled to meet the interim escapement objectives throughout the season.

The Bear River early-run (through July 31) sockeye salmon escapement of 207,451 was within the escapement goal (176,000–293,000). The Bear River late-run (after July 31) sockeye salmon escapement of 132,549 (includes postweir estimate of 33,538) was also within the late-run escapement goal (117,000–195,000). After the weir was removed on August 26, the postweir estimate of 33,538 brought the Bear River season sockeye escapement to 340,000, which was within the season escapement goal (293,000–488,000). Although the late run met its season ending escapement goal, it struggled to meet interim escapement objectives and the Bear River Section was closed to commercial salmon fishing during part of the late run. In 2011, 75,234 sockeye salmon were harvested from the Bear River late-run, bringing the total late-run (catch plus escapement) to 207,783, which was below the forecast estimate (462,000).

In 2011, the Port Moller Bight, Bear River, Three Hills, and Ilnik sections (Figure 3) were closed from July 21 to August 19. During this time period the Bear River early run is ending and the late run is beginning. Test fisheries were conducted on August 2, August 9, and August 14 to assess the run strength. The test fisheries did not show a substantial buildup of sockeye salmon in the vicinity of Bear River. Due to uncertainty of the sockeye salmon buildup and low escapement levels in Bear River, commercial salmon fishing remained closed. Increased weir counts in the

subsequent days allowed the commercial salmon fishery to reopen in the Port Moller Bight, Bear River, Three Hills, and Ilnik sections on August 20. To protect milling fish destined for Bear River, a large buffer area restricting commercial fishing was implemented in the vicinity of Bear River. Typically the late run peaks between August 15 and August 20. Due to the steady daily escapement into Bear River, the buffer area restricting commercial fishing was reduced on August 23, when it was assured the late run would meet the season ending escapement objective.

The final 2011 Sandy River sockeye salmon escapement consisted of 30,000 fish counted at the weir site and 7,500 spawning sockeye salmon counted during aerial surveys after the weir was removed. The total escapement of 37,500 sockeye salmon met the season ending escapement goal range (34,000–74,000). To help increase escapement into the Sandy River, the Three Hills section did not open to commercial salmon fishing until August 20 when sockeye salmon management is based on the Bear River sockeye salmon run strength.

Ilnik Section

The Ilnik River sockeye salmon escapement of 43,000 met the escapement goal (40,000–60,000), although it was well below the previous 10-year (2001–2010) average of 75,700. By regulation, the Ilnik Section can open to commercial salmon fishing on June 20. However, due to the variability in escapement counts and difficulty in assessing the run strength into the Ilnik River, the area did not open until June 25. Beginning July 21, the Ilnik Section was closed to commercial salmon fishing to protect Bear River bound sockeye salmon and reopened to commercial fishing on August 20 when it was assured the Bear River late run would meet the season ending escapement objective.

In 2011, a total of 125 permit holders harvested 303,064 sockeye salmon in the Ilnik Section from June 25 until August 31. Within the Ilnik Section, about 32% of this commercial harvest occurred southwest of Unangashak Bluffs (98,254), and 68% was harvested between Unangashak Bluffs and Strogonof Point (204,810). The peak daily catch in the southern portion of the Ilnik Section was on July 26 when 13,378 fish were harvested. The largest daily harvest in the northern portion of the Ilnik Section occurred on June 27, when 34,749 sockeye salmon were harvested.

Beginning August 15, the Ilnik Section is managed for coho salmon runs into Ilnik Lagoon. No directed coho salmon fisheries occurred in the Ilnik Section during 2011. Commercial fisheries in the Ilnik Section continued targeting sockeye salmon while coho salmon were harvested incidentally in the sockeye salmon fisheries. There was no harvest in the Ilnik Lagoon section in 2011.

Inner and Outer Port Heiden Sections

Aerial escapement surveys began on the Meshik River on June 18 and were conducted about once weekly throughout the fishery. A survey conducted on July 2 documented 34,000 sockeye salmon in the Meshik River, meeting the season-ending escapement goal (25,000–100,000). The final escapement in the Inner Port Heiden Section (including Meshik River, Red Bluff and Yellow Bluff creeks and tributaries) was 94,200.

Fishing time in the Outer Port Heiden Section is based on Meshik River sockeye salmon abundance unless management actions are taken for the conservation of Ugashik River sockeye salmon in the Egegik District. By regulation, the Outer Port Heiden Section can open to commercial salmon fishing from June 20 to July 31. The weekly fishing periods in the Outer Port

Heiden Section are scheduled from 6:00 a.m. Monday to 6:00 p.m. Wednesday. The Outer Port Heiden Section opened on June 23 and had consistent openings of 2½ days per week throughout July until the section closed for the season on July 20. In 2011, a total of 107 permit holders harvested 375,128 sockeye salmon from the Outer Port Heiden Section. The peak daily catch was on July 2 when 45,659 sockeye salmon were harvested. No commercial fishing occurred in the Inner Port Heiden Section in 2011.

Cinder River Section

There was no harvest reported in the Cinder River Section in 2011.

PRELIMINARY FORECASTS OF 2012 SALMON RUNS TO SELECTED ALASKA FISHERIES

ADF&G prepares forecasts for salmon runs that affect major fisheries around the state. Salmon runs to be forecasted are selected using several criteria, including economic importance, feasibility, compatibility with existing programs, and management needs. For the 2012 fishing year, forecast fisheries are as follows:

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

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

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

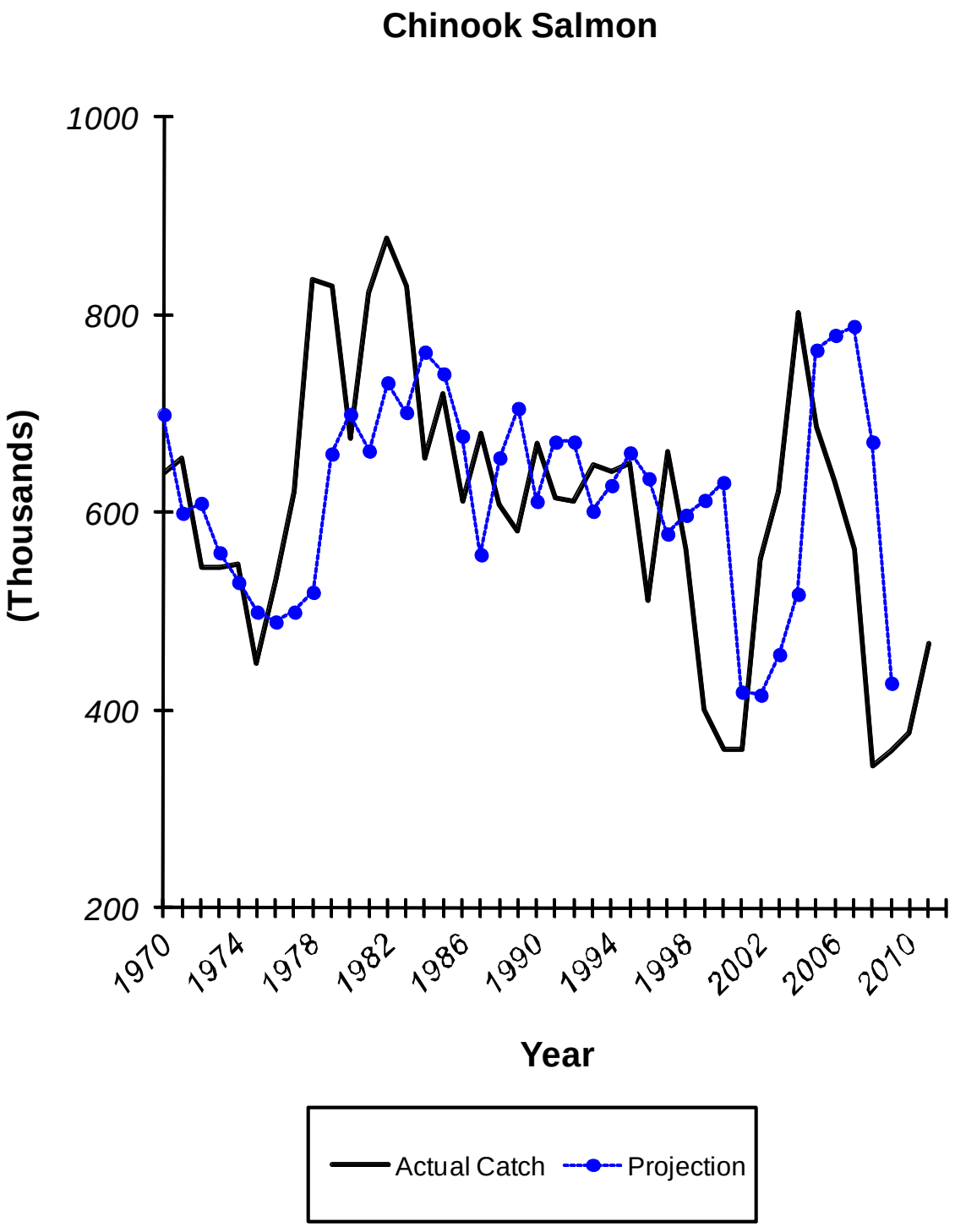

Figure 2.–Relationship between actual catch and projected catch in thousands, for Alaskan Chinook salmon fisheries from 1970 to 2011, 2011–2012 projection not available.

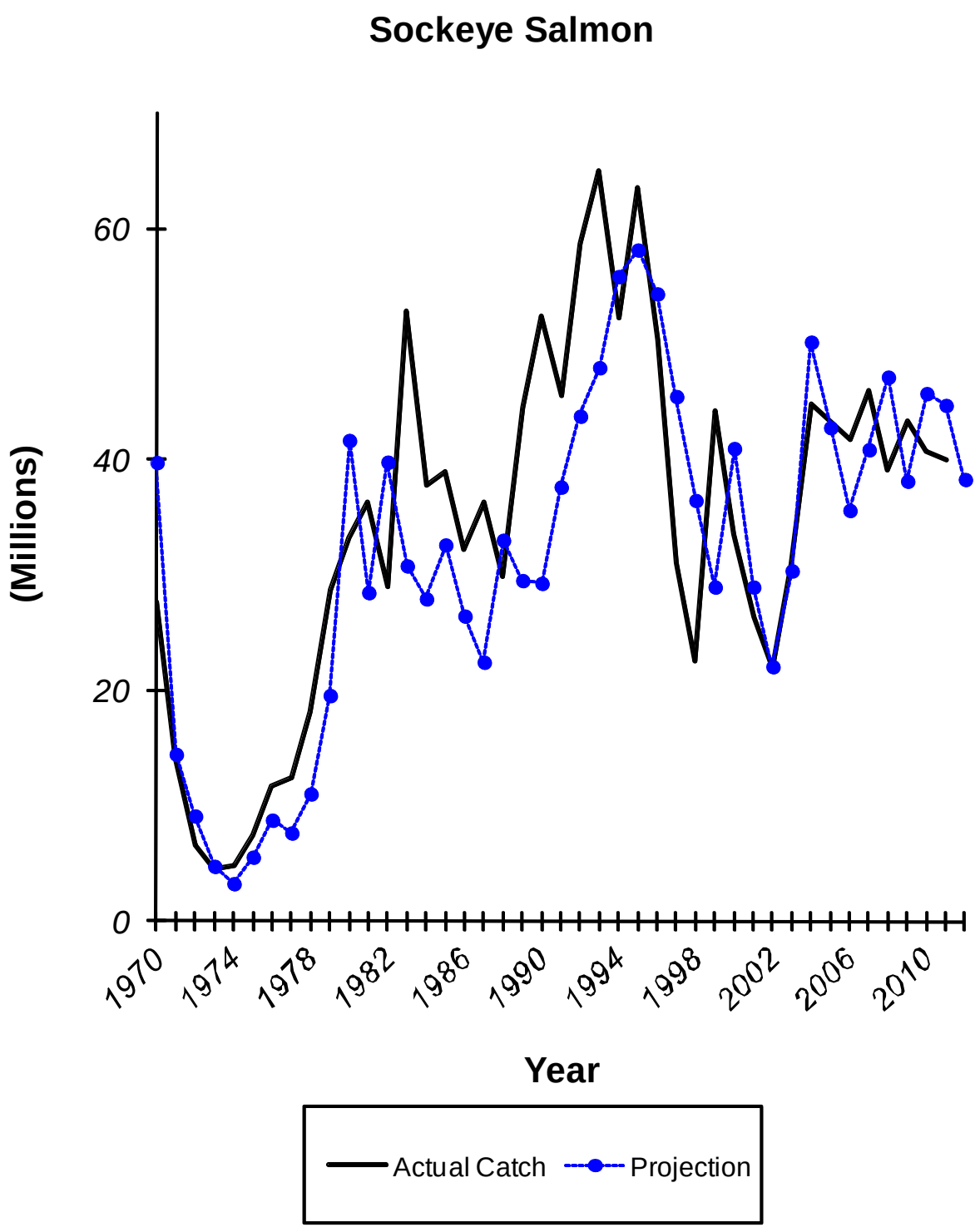

Figure 3.–Relationship between actual catch (millions) and projected catch (millions) for Alaskan sockeye salmon fisheries from 1970 to 2011, with the 2012 projection.

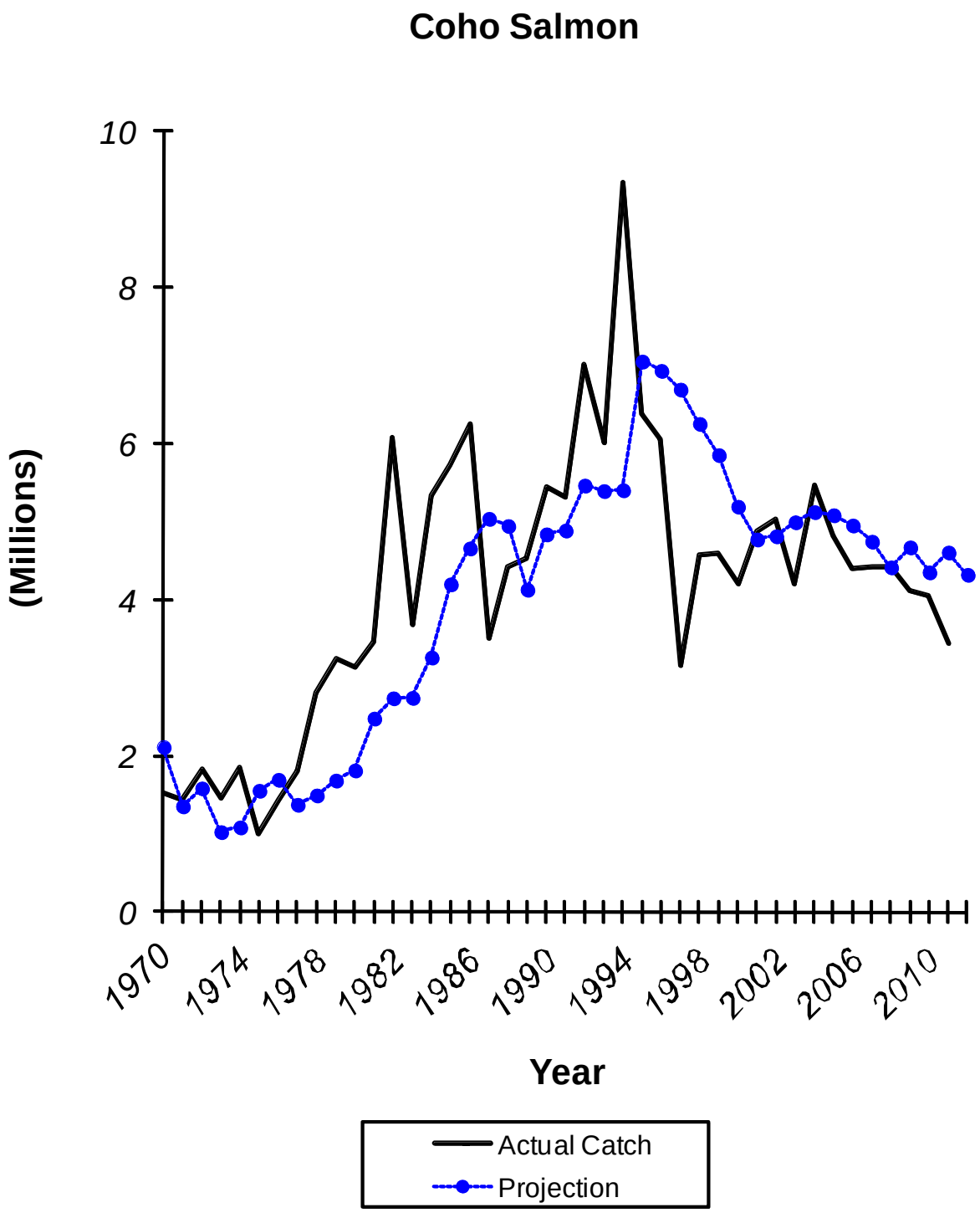

Figure 4.–Relationship between actual catch (millions) and projected catch (millions) for Alaskan coho salmon fisheries from 1970 to 2011, with the 2012 projection.

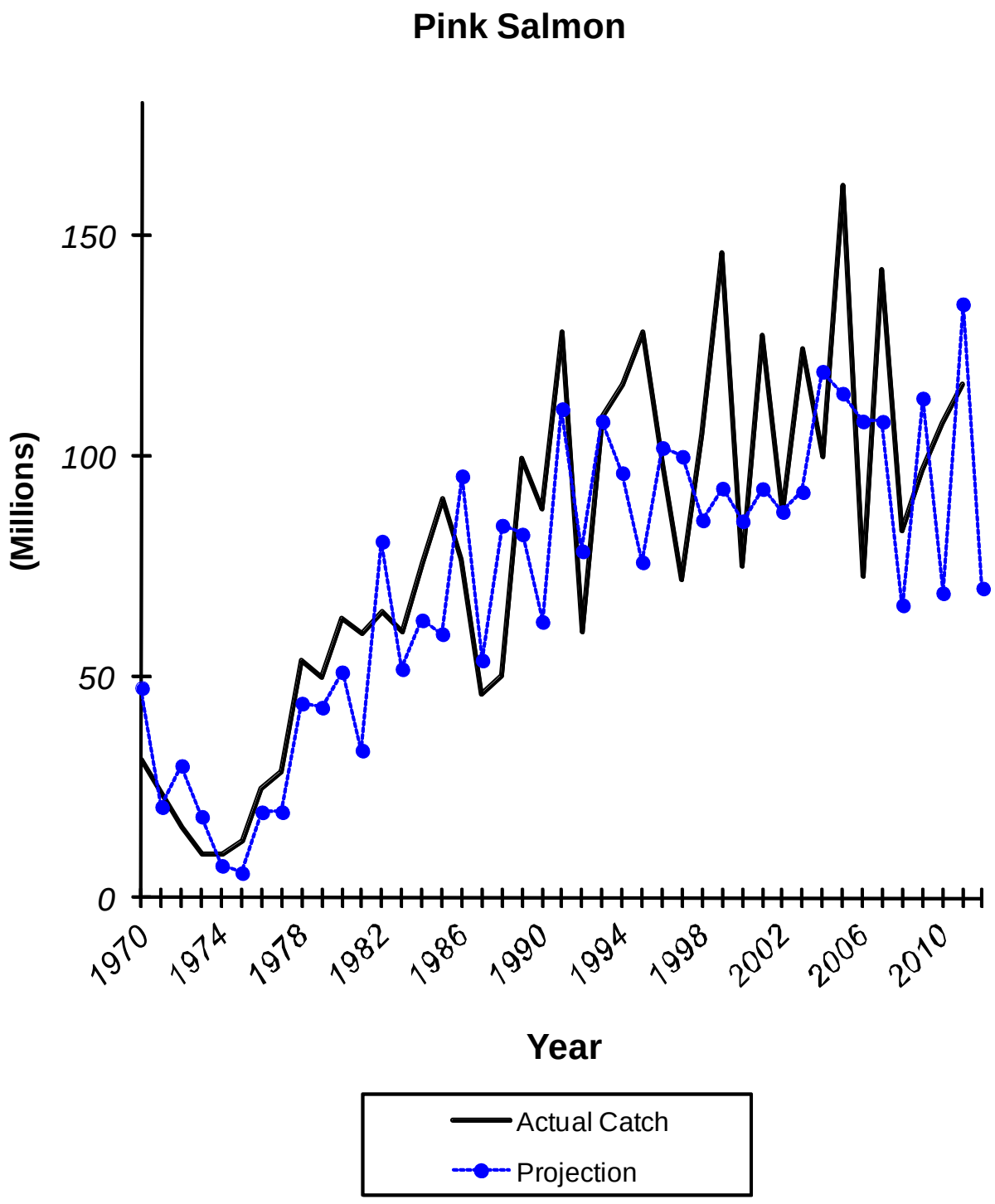

Figure 5.–Relationship between actual catch (millions) and projected catch (millions) for Alaskan pink salmon fisheries from 1970 to 2011, with the 2012 projection.

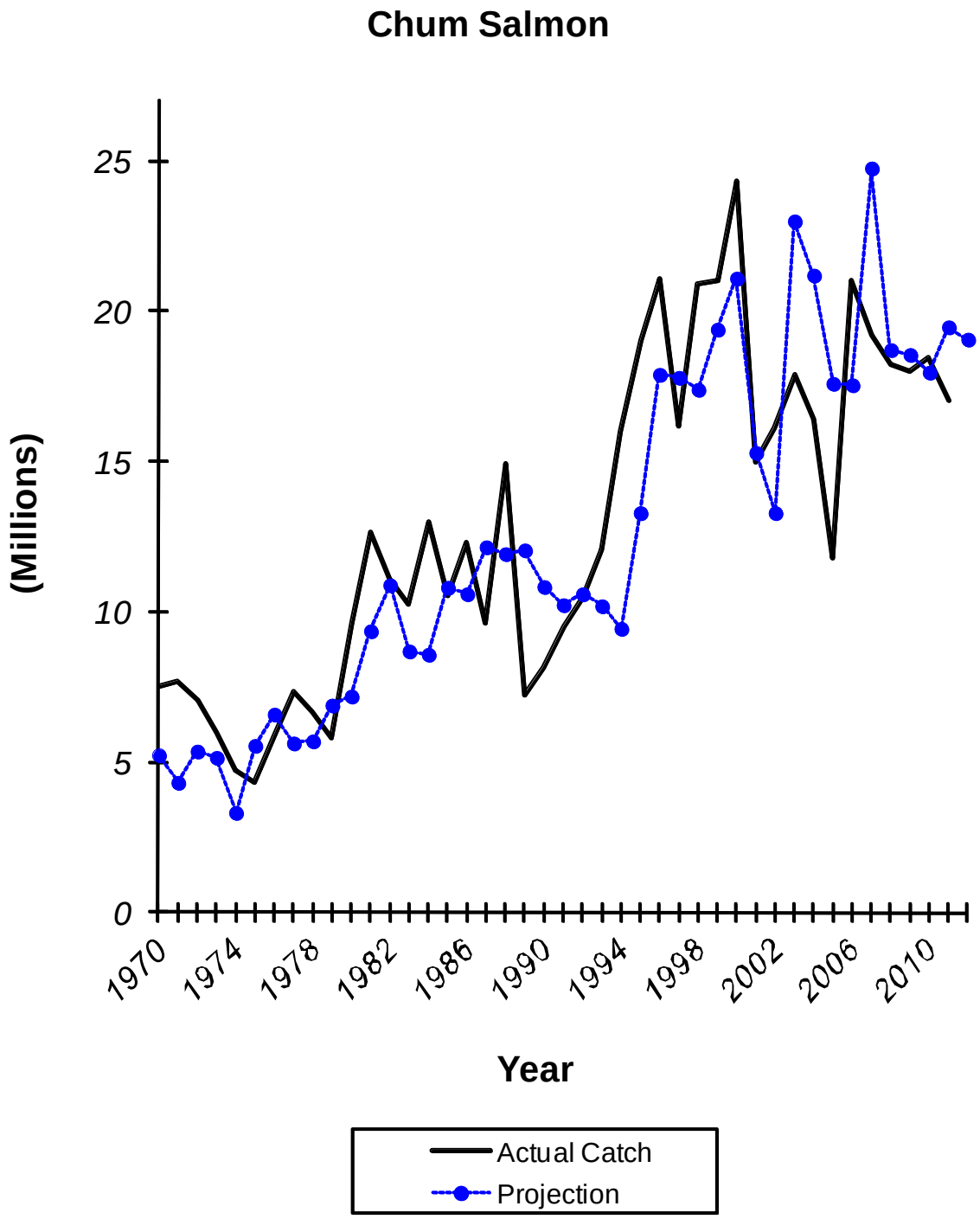

Figure 6.–Relationship between actual catch and projected catch in millions, for Alaskan chum salmon fisheries from 1970 to 2011, with the 2012 projection.

APPENDICES

Forecast Area: Southeast Alaska
Species: Pink Salmon

The Southeast Alaska pink salmon harvest in 2012 is predicted to be in the *weak* range, with a point estimate of 17 million (80% confidence interval: 10–29 million). The categorical ranges of pink salmon harvest in Southeast Alaska were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest from 1960 to 2010 below.

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

Forecast Methods

The 2012 forecast is an average of two forecasts: (1) a forecast of the trend in the harvest, and (2) the forecast trend adjusted using 2011 juvenile pink salmon abundance data. The forecast of the trend in pink salmon harvests was based on a time-series technique called *exponential smoothing.* This technique is similar to a running average, except that all harvests since 1960 were used in the forecast estimate. Recent harvest observations were given more weight in the analysis, while past harvest observations were increasingly down-weighted with time; i.e., the older the datum, the less influence it has on the forecast. If x_t, x_{t-1}, ... denotes the observed harvests in year t, t-1, and so on, then the forecast in year t+1 is given by,

$$\hat{x}_{t+1} = cx_t + (1-c)\hat{x}_t \ .$$

We estimated a value of c to be approximately 0.45, based on minimizing the sum of past squared errors in the entire data set (odd and even years combined).The forecast for year t, that is $\hat{x}_t$, is also a weighted average of the forecast made for year t-1 and the actual harvest in year t-1. This is a kind of recursive equation that contains all of the data in the series. Because the recent harvest series has developed an odd-year and even-year cycle, we let t be 2010, the parent year for the 2012 return. Since the formula used to calculate the forecast is a weighted average of the 2010 harvest and its associated forecast, which was also based on the associated parent year harvest and forecast, this forecast is based entirely on even-year data. That is, we used all of the even-year harvest data up to 2010, assuming that the 2010 parent year and other even years in the series will better predict the 2012 return. This analysis produced a forecast of 23 million pink salmon (Figure A1).

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

following year (see Orsi et al. 2006[a]). We developed a simple equation to predict the forecast error in the exponential smooth by regressing the forecast error proportions from 1998 to 2011 on the corresponding NOAA CPUE data from 1997 to 2010 (Figure A2). The forecast error proportion was simply the forecast error (the exponential smooth forecast subtracted from the actual harvest) divided by the forecast point estimate. We predicted the 2012 forecast error and adjusted the exponential-smooth forecast downward, from 23 million to 10 million pink salmon (Figure A3).

Finally, we gave equal weight to both the exponential-smooth forecast (23 million) and the adjusted forecast (10 million), and present the point estimate of 17 million pink salmon as the 2012 pink salmon harvest forecast. We used this "equal-weight" approach to produce hindcast predictions for 1998–2011, and calculated the sum of the squared errors of the log of the observed values minus the log of the predicted values. The 80% confidence interval (10–29 million) was calculated as the harvest forecast plus or minus the root-mean-squared error times the appropriate *t*-value (1.350).

Forecast Discussion

The 2012 harvest forecast of 17 million pink salmon is well below the recent 10-year average harvest of 40 million, but is equal to the average harvest over the past three even years. There are two primary reasons to expect that the harvest in 2012 will be smaller than the recent average. First, although biological escapement goals were met in the parent year, 2010, escapement indices were below average on inside waters north of Sumner Strait. Management targets for pink salmon were not met in Districts 112, 113 inside, 114, and 115, and, at a finer scale, for 7 of the 24 pink salmon stock groups in this area. In addition, the NOAA Auke Bay Lab's 2011 peak June–July juvenile pink salmon CPUE statistic from upper Chatham and Icy straits in northern Southeast Alaska ranked in the bottom third of the 14 previous years that NOAA has collected that information, which may indicate poor freshwater and early marine survival for pink salmon set to return in 2012. Pink salmon harvests associated with the bottom third of indices in the NOAA data set ranged between 12 and 20 million.

The NOAA Auke Bay Laboratories continues to conduct research that has greatly improved our ability to forecast pink salmon harvests in Southeast Alaska. NOAA has been using juvenile pink salmon catch and associated biophysical data to forecast adult pink salmon harvest in Southeast Alaska since 2004. The 2012 NOAA forecast can be found at the following link:

http://www.afsc.noaa.gov/ABL/MSI/msi_sae_psf.htm.[b]

ADF&G forecasts that were adjusted using NOAA's juvenile pink salmon data were much improved over previous forecasts (Figure A4). Hindcasts of past harvests (1998–2006) using this forecast method also exhibited fair to good performance in predicting the direction of forecast error (Figure A3). Even if these hindcast values were not always precise (e.g., in 2006), the ability

[a] We gratefully acknowledge the assistance and advice of Joe Orsi and Alex Wertheimer (retired) and their colleagues at the NOAA Auke Bay Laboratories. However, we accept responsibility for this forecast, and we accept sole responsibility for this use of their data. For a detailed description of these NOAA research activities see: Orsi, J. A., E. A. Fergusson, M. V. Sturdevant, B. L. Wing, A. C. Wertheimer, and W. R. Heard. 2006. Annual Survey of Juvenile Salmon and Ecologically Related Species and Environmental Factors in the Marine Waters of Southeastern Alaska, May–August 2005 (NPAFC Doc. 955) Auke Bay Lab., Alaska Fisheries Science Center., National Marine Fisheries Service., NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA, 108 p.; http://www.npafc.org/new/pub_documents.html. Accessed February 7, 2012.

[b] Accessed February 14, 2012.

to predict if the harvest will be greater than average or less than average is an immense improvement over past ADF&G forecasts. For these reasons, we are using this method to forecast the pink salmon harvest for a sixth straight year.

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

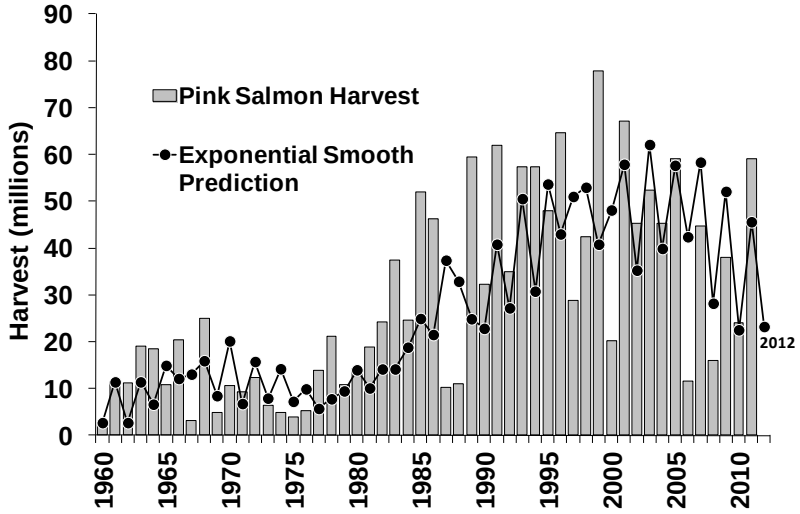

Figure A1. Comparison of the annual harvest of pink salmon in Southeast Alaska, and exponential smoothed hindcast values of the harvest used in the 2012 forecast model. This method produced a 2012 harvest forecast of 23 million pink salmon.

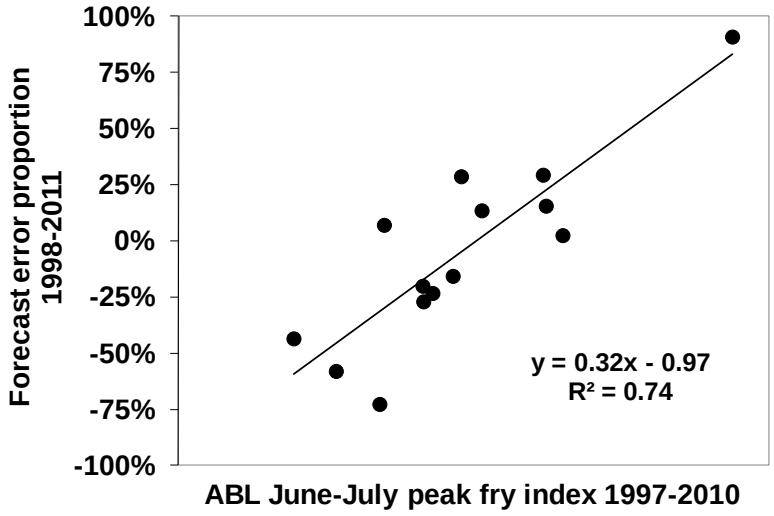

Figure A2. Regression of ADF&G forecast error proportion on the peak June–July juvenile pink salmon index from Icy Strait one year prior. (Pink salmon fry index data provided by Joe Orsi, NOAA Auke Bay Laboratory, pers. comm.). The forecast error is a proportion calculated by dividing the forecast error (the annual ADF&G forecast subtracted from the actual harvest) by the forecast point estimate.

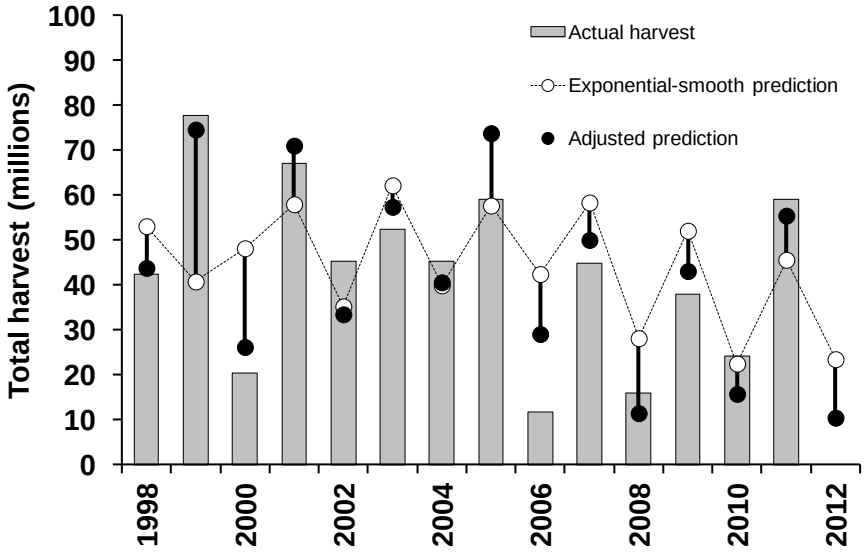

Figure A3. Annual harvest of pink salmon in Southeast Alaska, 1998–2011, compared to the exponential smoothed hindcast predictions of the harvest adjusted using NOAA Auke Bay Laboratory juvenile pink salmon data.

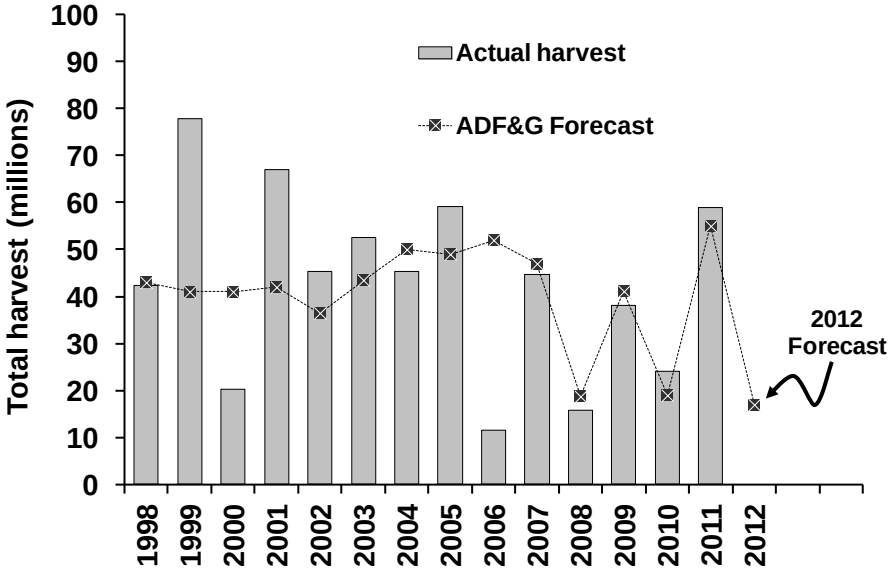

Figure A4. Annual harvest of pink salmon in Southeast Alaska compared to the ADF&G pre-season harvest forecast, 1998–2011. The 2007–2011 ADF&G harvest forecasts were adjusted using NOAA's juvenile pink salmon data.

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

Forecast Area: Prince William Sound
Species: Pink Salmon (Wild Only)

Preliminary Forecast of the 2012 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound General Districts		
Total Run	4,400	2,800–7,900
Escapement Goal [a]	1,900	
Harvest Estimate [b]	3,210	1,610–6,7,10

[a] The escapement goal of 1.19 million pink salmon is the sum of the median values of the SEGs for all districts in PWS. The escapement goals were changed in 2011 from a single SEG to district and brood line specific SEG goals (first implementation in 2012). The sum of the district specific SEG ranges for the even years brood line is now 793,000 to 1.701 million pink salmon.

[b] This total includes the harvests from commercial, subsistence, and sport fisheries.

Forecast Methods

The total natural run by year was estimated as the total natural (nonhatchery) contribution to commercial harvests combined with the stream escapement index. The stream escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. No adjustments to the escapement index were made for aerial observer efficiency, the proportion of the total escapement represented by the index streams, or the number of hatchery strays in streams. The natural pink salmon contributions to the commercial CPF were estimated by subtracting hatchery contributions from the CPF total. Hatchery contributions were determined by thermal marked otolith recoveries (1997–2011), coded wire tag recoveries (1985–1996), or average fry-to-adult survival estimates multiplied by fry release numbers and estimated exploitation rates. The 2012 forecast differs from the 2011 forecast that used exponential smoothing, the 2010 and 2008 method that used averages of previous even brood year total runs, and the 1997–1999 method that used linear regressions of adult production versus brood year escapement index. Prior to 1997, forecast methods employed surveys of pre-emergent fry; however, these surveys ended in 1995. The forecast model for 2012 was selected by comparing the mean absolute percentage error (MAPE) and the standard deviation of the MAPE among the models examined. The total run forecast range was calculated by multiplying the forecast and the upper and lower values of the percent error of forecasts generated using the same method for 2004–2010.

Forecast Discussion

The predicted natural total run of pink salmon in 2012 is a naïve forecast that uses the 2010 run estimate as the forecast of the 2012 total run. Beginning in 2004, the department stopped producing hatchery pink salmon forecasts because the hatchery operators were already producing forecasts for their releases. Forecast methods examined for the 2012 natural run included (1) the previous even-brood-year total run (most naïve forecast method), (2) total run averages with 2–10 years of data (even brood years), and (3) linear regression of log-transformed total PWS escapement versus log-transformed total PWS return by brood line, (4) exponential total PWS return by brood line, (4) exponential smoothing models using all years or just odd smoothing models using

all years or just even brood years, (5) exponential smoothing forecasts corrected with juvenile survey CPUE, (6) juvenile survey CPUE vs. total run, and (7) the inclusion of Pacific Decadal Oscillation (PDO; http://jisao.washington.edu/pdo/)[a] and the Nortern Gulf of Alaska Termerature/Salinity Time Series web page (GAK1; http://www.ims.uaf.edu/gak1/)[b] water temperature data in regression models. The 2012 forecast was estimated from the previous even-year run size because the model forecasts had the lowest MAPE and the second lowest standard deviation of the MAPE. None of the models examined for natural pink salmon returning in even years produced forecasts with MAPE values below 100%.

The brood year 2010 escapement index (1.9 million) was within the SEG range (1.25–2.75 million) and ranked fifth of the observed even-year escapements since 1960. If the 2012 total run forecast (4.4 million) is realized, it will be the 13th largest among the 26 even brood year returns since 1960. Environmental factors, which likely play a role in determining pink salmon returns in PWS, have been quite dynamic during the past four or five years. A warm regime, coinciding with generally high productivity of salmon, began in approximately 1977. Beginning in 2007, ocean temperatures at GAK1 along the Seward line were well below average (http://www.ims.uaf.edu/gak1/). The last few years have also been one of the longest periods of cold conditions, as measured by PDO index values, since the 1970s (http://jisao.washington.edu/pdo/). However, an El Nino event that spanned 2009 and 2010 corresponded to a period of positive PDO index values (http://www.elnino.noaa.gov/index.html) and the pink salmon returning to PWS in 2010 spent much of their ocean lives in warmer El Nino conditions. With the passing of the 2009 and 2010 El Nino, PDO values again became negative in June of 2010 and remain negative through November 2011. The ongoing La Nina event (http://www.elnino.noaa.gov/lanina.html)[c] will likely keep ocean temperatures colder than normal in the northern Pacific through at least the spring of 2012. Pink salmon returning in 2012 entered the ocean in increasingly negative PDO conditions. Through November, the 2011 average PDO index rank as the sixth most negative (coldest) in the last 100 years. Because cold ocean conditions are generally associated with lower salmon productivity, the pink salmon run in 2012 may be smaller than projected. It will not be known for several more years if the recent period of relatively cold ocean conditions signals the beginning of a new cold regime.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Rich Brenner, Finfish Research Biologist, Cordova

[a] Accessed on February 14, 2012.
[b] Accessed on February 14, 2012.
[c] Accessed on February 14, 2012.

Forecast Area: Prince William Sound
Species: Chum Salmon (Wild Only)

Preliminary Forecast of the 2012 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound General Districts		
Total Run	236	101–383
Escapement Goal [a]	200	
Harvest Estimate	36	0–182

[a] ADF&G intends to manage each district with an existing lower-bound SEGs for the long-term average escapement to the district (total of 200,000 chum salmon for the Eastern, Northern, Coghill, Northwestern, and Southeastern districts combined). The sum of the lower-bound SEGs for all districts with escapement goals is 91,000.

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

Forecast Methods

We evaluated several naïve methods for the 2012 PWS wild chum salmon forecast, including average run size for the previous 2, 3, 4, 5 and 10 years and total run size from the previous year. From these models, total run size from the previous year had the lowest MAPE and was chosen as the forecasting method for 2012. The total natural run by year was estimated as the total commercial harvest contribution combined with the escapement index. The escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. No adjustments to the escapement index were made for aerial observer efficiency, the proportion of the total escapement represented by the index streams, or the number of hatchery strays in streams. The CPF harvest contributions of natural stock chum salmon were estimated using prehatchery average wild runs (2002 and 2003) or thermally marked otolith estimates (2004–2011) for each district in PWS. The range for the total run forecast was calculated by multiplying the forecast with the upper and lower values of the maximum prediction error of the actual runs from published forecast runs (1990–2011):

$$\pm \hat{y}_{t+1} \times (\hat{y}_{t+1} / (\sigma_m - 1))$$

with

$$\sigma_i = (y_i - \hat{y}_i) / y_i$$

Where $\hat{y}_{t+1}$ is the forecast for the following year based on the previous year's total run size, σ_i is the proportional forecast error for individual previous years, σ_m is the minimum and maximum proportional errors from all previous forecasts (largest and smallest σ_i) and y_i and $\hat{y}_i$ are the actual and forecast total run sizes for individual previous years, respectively.

Forecast Discussion

Beginning in 2004, the department stopped producing hatchery chum salmon forecasts because the hatchery operators were already producing forecasts for their releases. Our ability to accurately forecast natural chum salmon stocks is limited by the small amount of data available. Estimates of natural stock contributions to CPF were unavailable prior to 2003. From 2003 to 2011

natural chum salmon contribution estimates based on thermally marked otoliths were available for the Coghill and Montague districts. Contribution estimates from thermal marked otoliths in other districts have been available since 2004. Historical chum salmon age data from escapements and CPF harvests are unavailable for most districts of PWS. If the 2012 wild chum salmon forecast of 235,500 is realized, it would be the second smallest since 1970. For comparison, the estimated total run size was well over 1.3 million from 1981 to 1988, but has not surpassed 1.0 million since 1988.

The cold ocean temperatures and negative PDO index values discussed previously for pink salmon may also negatively affect the run of chum salmon in 2012.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Rich Brenner, Finfish Research Biologist, Cordova

Forecast Area: Prince William Sound
Species: Sockeye Salmon (Wild Only)

Preliminary Forecast of the 2012 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Prince William Sound, Coghill Lake		
Total Run	321	184–458
Escapement Goal[a]	30	
Harvest Estimate[b]	291	154–428
Prince William Sound, Eshamy Lake		
Total Run	53	29–77
Escapement Goal[c]	21	
Harvest Estimate[b]	33	9–57
Total Production		
Run Estimate	374	230–510
Escapement Goal	51	
Common Property Harvest[b,d]	324	180–460

[a] The escapement goal of 30,000 for Coghill Lake is the median of historical escapement estimates and the SEG range is 20,000–60,000. The upper end was increased in 2011 from 40,000 to 60,000.

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

[c] The escapement goal of 20,500 for Eshamy Lake is the midpoint of the BEG range (13,000–28,000).

[d] The total PWS harvest estimate does not include the average annual commercial harvest of approximately 6,600 sockeye salmon in Unakwik District.

Forecast Methods

The natural sockeye salmon run forecast to Coghill Lake is the total of estimates for five age classes. A linear regression model with natural log-transformed data was used to predict returns of age-1.3 sockeye salmon. This linear regression model was parameterized using the historical relationship between returns of age-1.3 sockeye salmon and returns of the age-1.2 fish one year previous (sibling model), which are from the same brood year. For example, the model to predict the return of age-1.3 sockeye salmon in 2012 used the return of age-1.2 fish in 2011 as the input parameter. We used a similar regression model to predict the total return of age-1.2 sockeye salmon returning to Coghill Lake. Predicted returns of age-1.1, -2.2, and -2.3 sockeye salmon were calculated as the 1974–2010 mean return of that age class. Harvest, escapement, and age composition data are available for Coghill Lake sockeye salmon runs since 1962; however, inclusion of escapements prior to the installation of a full weir in 1974 reduced forecast reliability. Therefore, only data collected since 1974 were used to estimate model parameters, calculate individual age class forecasts, and generate 80% prediction intervals. An approximate 80% prediction interval for the total run forecast was calculated using the squared deviations between the 2007–2011 forecasts and actual runs as the forecast variance:

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

where $\hat{y}$ is the forecast prediction from the linear regression model described above, t is the critical value, n is the sample size and MSE is the mean squared error. Historically, sibling model estimates of age-1.3 returns to Coghill Lake have a much lower MAPE (~34%) than the sibling model used to predict returns of age-1.2 fish (~92%).

The forecast of the natural sockeye run to Eshamy Lake has historically been based on the assumption that returns followed a 4-year cycle with leap years the strongest year. However, this apparent cycle has broken down in recent years and the 2012 forecast is simply the average annual returns since 1989. Eshamy Lake escapement has been enumerated at a weir since 1950, except 1987 and 1998. Commercial harvest data are available for the same period, but age composition data are available for only some years after 1962. Data collected since 1970, excluding 1987 and 1998, were used to calculate the forecast. The 80% prediction interval was calculated using the equation described for Coghill Lake wild sockeye.

PWS total run and common property harvest forecasts were calculated from the sum of Coghill and Eshamy lakes midpoint forecasts. The 80% prediction intervals were calculated as the sum of the point estimates plus/minus the square root of the sum of the squared differences between the individual point estimates and 80% prediction intervals for Coghill and Eshamy lakes.

Forecast Discussion

Beginning in 2004, the department stopped forecasting hatchery runs of sockeye salmon to MBH because hatchery operators were already producing forecasts. Coghill Lake has dynamic limnological characteristics that significantly impact the sockeye salmon population. Studies conducted in the mid-1980s and early 1990s indicated the lake may be zooplankton limited. As a result, the BEG midpoint was lowered in 1992 (from 40,000 to 25,000) to allow zooplankton populations to recover. Fertilizers were added to the lake (1993–1996) in a cooperative project with the U.S. Forest Service to improve the forage base for rearing sockeye salmon juveniles. In 2005, current data were reviewed and the midpoint escapement goal remained unchanged while the goal type was changed from a BEG to an SEG. Also, in 2002 the department began collecting limnological data to monitor basic lake characteristics. In 2011, the upper end of the Coghill Lake SEG was increased from 40,000 to 60,000 (new range = 20,000–60,000). The department will manage for the long-term median of 30,000 beginning in 2012. The Coghill Lake natural run escapement has been within or above the escapement goal range every year since 1995. If achieved, the 2012 total run forecast midpoint (321,000) would be the largest run since 1988. The majority (298,000) of the overall Coghill Lake wild sockeye salmon forecast is predicted to come from age-1.3 fish from the 2007 brood year. This brood year has produced a record return of age-1.1 fish in 2010 and substantial numbers of age-1.2 fish (105,000) in 2011. Other factors that may influence the Coghill Lake wild sockeye salmon run in 2012 are the 2009–2010 El Nino event (http://www.elnino.noaa.gov/index.html) and the trend towards cooler ocean temperatures since 2007 (http://jisao.washington.edu/pdo/).

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

and 1998 because of budget reductions. The ongoing Eshamy River weir operation and thermal otolith marking of MBH sockeye salmon should produce more accurate estimates of total Eshamy Lake natural runs.

The escapement goal for Eshamy Lake was reviewed in 2008 and the range was changed. The new BEG range is 13,000–28,000 (midpoint 20,500). The old range was 20,000–40,000.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Rich Brenner, Finfish Research Biologist, Cordova

Forecast Area: Copper River
Species: Chinook Salmon

Preliminary Forecast of the 2012 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	54	33–87
Escapement Goal[a]	27	
Harvest Estimate[b]	27	6–60

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

[b] The harvest by all fisheries (subsistence, personal use, sport, and commercial) while still achieving the average spawning escapement. The projected commercial common property harvest is 19,800.

Forecast Methods

Forecast methods examined for the Chinook salmon forecast included (1) a pseudo-sibling model using commercial harvest age data and inriver abundance estimated as the Miles Lake sonar count multiplied by the proportion of Chinook salmon in the Chitina Subdistrict personal use fishery (brood years 1977–2005), (2) a pseudo-sibling model using commercial harvest age data and inriver abundance data from the mark-recapture program (brood years 1993–2005), (3) the previous year's run size (most naïve method), and (4) mean total run size estimates (2-, 3-, 4-, and 5-year averages). The first pseudo-sibling model using log transformed data produced reasonable model fits for age 1.2 to predict age 1.3 ($p < 0.01$), but marginal fits for the model using age 1.3 to predict age 1.4 (p=0.08). Additionally, retrospective forecasts using the pseudo-sibling models had larger MAPE than mean run size models. Retrospective forecasts using the previous year's run size had a smaller MAPE (27%) and a smaller standard deviation of the MAPE (15%) than other mean run forecasts and was used as the forecast for 2012.

The range for the total run forecast was calculated as:

$$\pm \hat{y}_{t+1} \times (\hat{y}_{t+1} / (\sigma_m - 1))$$

with

$$\sigma_i = (y_i - \hat{y}_i) / y_i$$

Where $\hat{y}_{t+1}$ is the forecast for the following year based on the previous year's total run size, σ_i is the proportional forecast error for individual previous years, σ_m is the minimum and maximum proportional errors from all previous forecasts (largest and smallest σ_i), and for individual previous years y_i is the actual total run size and $\hat{y}_i$ is the forecast total run size.

The harvest forecast is the total run estimate minus the average escapement of 27,000 since 1980 as determined from catch-age analysis and mark–recapture point estimates.

Forecast Discussion

The department did not generate a formal Chinook salmon total run forecast between 1998 and 2007 because of inadequate number of inriver abundance or spawning escapement estimates.

Forecasts made prior to 1998 used aerial survey indices adjusted to approximate the total escapement. These forecasts performed poorly, especially after the number of aerial surveys was significantly reduced in 1994. In 1999 the ADF&G Division of Sport Fish began a mark–recapture program to estimate the inriver abundance of Chinook salmon. The Native Village of Eyak became a collaborator on the project and eventually took the lead in its operation. There are currently 13 years (1999–2011) of inriver abundance estimates.

The 2012 total run forecast point estimate of 54,000 is ~18,000 below the 13-year average (1999–2011 average = 72,000). The age-6 component of this forecast could be reduced from two significant flood events in August and October of 2006 and the generally cooler ocean conditions measured in the North Pacific since 2007. If realized, the 2012 forecast total run would be the 26th largest since 1980.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Rich Brenner, Finfish Research Biologist, Cordova

Forecast Area: Copper River
Species: Sockeye Salmon

Preliminary Forecast of the 2012 Run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	1,810	1,060–2,560
Escapement Goal[a]		
Upper Copper River	450	
Copper River Delta	169	
Common Property Harvest[b]	1,190	520–1,860
Hatchery And Supplemental Production		
PWSAC - Gulkana Hatchery		
Hatchery Run	330	200–470
Broodstock Needs	20	
Supplemental Escapement[c]	80	
Common Property Harvest[b]	230	100–370
Total Production		
Run Estimate	2,150	1,250–3,040
Natural Escapement Goal	619	
Broodstock Needs	20	
Supplemental Escapement[c]	80	
Upper Copper River Inriver Goal	676	
All Harvest[d,f]	1,430	730–2,120

[a] The upper Copper River escapement goal of 450,000 is the historical average spawning escapement. The new SEG adopted in 2011 is 360,000–750,000. The Copper River delta escapement goal is the average aerial survey peak count (84,500) multiplied by 2 to adjust for proportion of the total number of fish observed by aerial observers (SEG = 55,000–130,000).

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

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

[d] The upper Copper River inriver goal categories include spawning escapement (sockeye and other salmon); sport, subsistence, and personal use fishery harvests; and hatchery broodstock and supplemental escapement (5 AAC 24.360 (b)). The inriver goal estimate is preliminary until upriver harvest estimates for 2011 are available.

[e] The commercial common property harvest midpoint estimate is 1.23 million sockeye salmon and the 80% PI is 530,000–1,930,000. The point estimate for all harvests combined is calculated as the total run estimate minus the sockeye salmon portion of the inriver goal and the Copper River Delta escapement goal.

Forecast Methods

Forecast methods for 2012 are similar to those used since 1998. The forecast of natural sockeye salmon to the Copper River is the total of estimates for six age classes. Linear regression models with log-transformed data were used to predict returns for age-1.2, -1.3, and -2.2 sockeye salmon. These three age classes were predicted from the relationship between returns of that age class and returns of the age class one year younger from the same brood year (sibling model). The predicted return of age-1.1, -0.3, and -2.3 sockeye salmon were calculated as the 5-year (2007–2011) mean return of those age classes. The total common property harvest forecast was calculated by subtracting the Gulkana Hatchery broodstock, hatchery surplus, and wild stock escapement goal needs (upriver and delta) from the total run forecast. The commercial common

property estimate was calculated by subtracting from the total run a preliminary estimate of the inriver goal categories (5 AAC 24.360(b)) and the Copper River Delta spawning escapement goal. The 80% prediction bounds for the total run and harvest forecast were calculated using the method described previously for Coghill Lake sockeye salmon, except only the years 1983–2010 were used in the calculation of mean squared error.

Supplemental production from Gulkana Hatchery remote releases to Crosswind and Summit lakes was predicted using age specific smolt-to-adult survival estimates from brood years 1995–1998. The survival estimates were calculated using coded wire tag recoveries in harvests and enumerated adult escapements. Supplemental production from Gulkana I and Gulkana II hatcheries was estimated from fry releases and a fry-to-adult survival of 1.5%. The run was apportioned to brood year using a maturity schedule of 13% age 4 and 87% age 5. An estimated exploitation rate of 70% was used to project the total harvest of Gulkana Hatchery stocks in 2012. The 80% prediction interval for the forecast of supplemental production was calculated using the mean square error estimate of the total run described above for Coghill Lake sockeye salmon.

Forecast Discussion

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

Historical estimates of Gulkana Hatchery production prior to 1995 are considered imprecise. Improved contribution estimates for brood years 1995–1998 indicated large contributions from supplemental production and smolt-to-adult survival estimates for Crosswind Lake releases that averaged about 20%. Fish marked with strontium chloride (Sr) began returning in 2003 (age-4 fish) and the majority of the adult run (age-4 and age-5 fish) was marked beginning in 2004. Fish from all release locations (Gulkana I and Gulkana II hatchery sites and Crosswind and Summit lakes) are now marked, but all fish have the same mark. We can estimate the total contribution of enhanced fish from all Gulkana Hatchery releases, but unless different marks for individual releases can be developed, forecasts will soon be limited to using fry-to-adult survival estimates and estimated maturity schedules to forecast total enhanced production.

The spawning escapement goals for the upper Copper River and Copper River delta were reviewed in 2011. The upper Copper River spawning escapement goal was changed from an SEG of 300,000–500,000 to an SEG of 360,000–750,000. This change was because of the conversion of Bendix sonar counts to DIDSON sonar equivalent counts and an update in the years used in the goal calculation. There was no change to the Copper River delta SEG (55,000–130,000).

The 2012 run will be composed primarily of returns from brood years 2007 and 2008. Five-year-old fish (brood year 2007) are expected to predominate Copper River delta and upper Copper River runs. The Miles Lake cumulative sonar count for 2007 was above the cumulative objective

by early June and exceeded the cumulative anticipated by 65,000 on June 10. The 2008 Miles Lake cumulative count did not exceed the minimum anticipated until July 4 although the commercial fishery had 6-day and 18-day closures in June. By the season's end, the total counts exceeded the cumulative objective (2007: 919,600 actual vs. cumulative objective of 566,918 and 2008: 718,344 actual vs. cumulative objective of 601,125). The Copper River delta escapement indices for 2007 (88,285) and 2008 (67,950) were within the SEG range (55,000–130,000).

The Gulkana Hatchery run will include fish from Crosswind Lake smolt migrations of more than 1 million fish in 2009 (1.1 million) and 2008 (1.7 million or third largest). The brood year 1993–2008 average migration from Crosswind Lake is 1.3 million smolt. The run will also include 4-year-old fish from the eighth largest Summit Lake smolt outmigration (416,000) and 5-year-old fish from the ninth largest smolt outmigration (412,500).

The 2012 total run forecast (2.1 million) is about 100,000 below the recent 10-year average (2.2 million). If realized, the 2012 forecast total run would be the 13th largest since 1980. The 1.81 million natural run would be below the recent 10-year average (1.90 million), and a 330,000 Gulkana Hatchery run would be approximately 90,000 above the 10-year average (250,000). The natural run forecast is driven by the large 4-year-old (age-1.2) fish estimate in 2011 (fourth largest since 1965) and the subsequent prediction for 5-year-old (age-1.3) fish in 2012. There have only been five additional years with estimates of age-1.2 fish greater than approximately 400,000. The return of age-1.3 fish the following year has been significantly above the regression mean in four of the five years. The enhanced run forecast is driven by smolt outmigration numbers from both Crosswind and Summit lakes. The influence of environmental factors including the cooler ocean temperatures that have predominated since September 2007, and the warmer ocean temperature from the El Nino event (August 2009–May 2010) are factors that increase the uncertainty in the 2012 run projection.

Steve Moffitt, Area Finfish Research Biologist, Cordova
Rich Brenner, Finfish Research Biologist, Cordova

Forecast Area: Upper Cook Inlet
Species: Sockeye Salmon

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
Total Run	6.2	4.0–10.0
Escapement	1.8	
Harvest Estimate	4.4	

Forecast Methods

The major sockeye salmon systems of UCI are the Kenai, Kasilof, Susitna, and Crescent rivers, and Fish Creek. Escapement (spawner abundance), return, sibling, fry, and smolt data, if available, were examined for each system. Four models were used to forecast the run of sockeye salmon to UCI in 2012: (1) the relationship between adult returns and spawners, (2) the relationship between adult returns and fry, (3) the relationship between adult returns and smolts, and (4) the relationship between sibling adult returns. Several forecast models were evaluated for each stock and age class. Models providing the smallest MAPE between the forecast and actual runs over the past 10 years were generally used. In most cases, these were sibling models. Forecast model predictions based on spawners, fry, smolt or siblings were compared to evaluate uncertainty.

The returns of age-1.3 and -2.2 sockeye salmon to the Kenai River in 2012 were forecasted using sibling models. For example, the sibling-model prediction of the return of age-1.3 sockeye salmon was based on the abundance of age-1.2 sockeye salmon in 2011. A spawner-recruit model prediction of the age-1.2 sockeye salmon return was based upon escapement in 2008. The return of age-2.3 sockeye salmon to the Kenai River was forecasted using a fry-smolt model based upon age-1 fall fry abundance in Skilak and Kenai lakes and smolt data when available (after brood year 2002). Smolt models were used to forecast the returns of age-1.2, -1.3, and -2.3 sockeye salmon to the Kasilof River. The return of age-2.2 sockeye salmon to the Kasilof River was forecasted using a sibling model based upon the abundance of age-2.1 sockeye salmon in 2011.

The total escapement of sockeye salmon to the Susitna River was forecasted using the recent 5-year average aggregate escapement into Judd, Shell, Chelatna, and Larson lakes expanded to the entire Susitna River watershed using mark–recapture abundance estimates from 2006 to 2010. The total run of Susitna River sockeye salmon to UCI was forecasted using the escapement and the mean harvest rate estimated from genetic stock composition of the commercial harvest from 2007 to 2010.

The sockeye salmon forecast for unmonitored systems in UCI was estimated as 15% of the aggregate forecast for the five major stocks. The fraction of the total run destined for unmonitored systems was estimated using genetic estimates of the stock composition of offshore test fishery harvests.

The 2012 total harvest by all user groups was estimated by subtracting the aggregate escapement from the total run forecast for all stocks. Aggregate escapements were estimated from the sum of

the midpoints of the escapement goal ranges for each of the major sockeye salmon-producing systems in UCI and the escapement into unmonitored systems (estimated as 15% of the aggregate escapement into monitored systems). The estimated sport harvest upstream of the sonar at river mile 19 on the Kenai River was subtracted from the aggregate escapement into monitored systems. The total run forecast range was calculated by multiplying the forecast with the upper and lower values of the percent error of the actual runs from published forecast runs from 2002 through 2011.

Forecast Discussion

In 2011, the harvest of sockeye salmon by all user groups in UCI was 6.1 million, while the preseason forecast was 4.4–4.8 million. The higher than expected harvest in 2011 was largely due to an above forecast run of age-2.3 sockeye salmon to the Kenai River (actual run 2.9 million; sibling model forecast was 275,000). In 2011, the total run was 5.9 million to the Kenai River; 860,000 to the Kasilof River; 564,000 to the Susitna River; 126,000 to the Crescent River; and 203,000 to Fish Creek. The 2011 run forecast was 3.9 million to the Kenai River; 929,000 to the Kasilof River; 463,000 to the Susitna River; 131,000 to the Crescent River; and 105,000 to Fish Creek.

A run of 6.2 million sockeye salmon is forecasted to return to UCI in 2012, with a harvest by all user groups of 4.4 million. The forecasted harvest in 2012 is 400,000 above the 20-year average harvest by all user groups of 4.0 million.

The run forecast for the Kenai River is approximately 4.0 million, which is 6% greater than the 20-year average run of 3.8 million. Age-1.3 sockeye salmon typically comprise about 63% of the run to the Kenai River. A sibling model based upon the return of age-1.2 sockeye salmon in 2011 (290,000; 20-year average is 358,000) predicted a return of 2.0 million age-1.3 sockeye salmon. A fry model based upon the abundance of age-0 fry rearing in Skilak and Kenai lakes in the fall of 2008 (20.1 million; 20-year average is 17.9 million) predicted a return of 2.2 million age-1.3 sockeye salmon. The sibling model was used for this forecast because the 10-year MAPE was lower for the sibling model (27%) than the fry model (53%). Age-2.3 sockeye salmon typically comprise about 19% of the run to the Kenai River. A sibling model based upon the return of age-2.2 sockeye salmon in 2011 (241,000; 20-year average is 246,000) predicted a return of 466,000 age-2.3 sockeye salmon in 2012. A fry-smolt model based upon the abundance of age-2 smolt emigrating from the Kenai River in spring 2009 (5.3 million: 95% confidence interval 2.6–8.0 million) predicted a return of 1.4 million age-2.3 sockeye salmon. The fry-smolt model was used for this forecast due to the high age-2 smolt abundance in 2009 and the failure of the sibling model to accurately predict large returns of age-2.3 sockeye salmon like that seen in 2011. However, there is considerable uncertainty in the age-2.3 sockeye salmon forecast due to the large difference between the sibling and smolt model forecasts and uncertainty in the 2009 smolt abundance estimate. The forecasted age-2.3 return is 194% greater than the 20-year average return for this age class (736,500). The predominant age classes in the 2012 run should be age 1.3 (50%), age 1.2 (8%), and age 2.3 (35%). The 10-year MAPE for the set of models used for the 2012 Kenai sockeye salmon run forecast was 23%.

The sockeye salmon run forecast for the Kasilof River is 754,000, which is 21% less than the 20-year average run (950,000). Age-1.3 sockeye salmon typically comprise about 35% of the run to the Kasilof River. The forecast for age-1.3 sockeye salmon is 255,000, which is 23% less than the the 20-year average return (332,000) for this age class. A smolt model based upon the abundance

of age-1 sockeye salmon smolts in 2009 was used to forecast the return of age-1.3 sockeye salmon in 2012. The abundance of age-1 smolts in 2009 was 2.1 million, which is 51% less than the 20-year average abundance (4.3 million) for this age class. A sibling model predicted a return of 187,000 age-1.3 sockeye salmon. The smolt model was used for this forecast because the 10-year MAPE was lower for the smolt model (21%) than the sibling model (26%). Age-1.2 sockeye salmon typically comprise about 30% of the run. The forecast for age-1.2 sockeye salmon is 148,000, which is 47% less than the 20-year average return (280,000) for this age class. A smolt model based upon the abundance of age-1 smolts (1.8 million) in 2010 was used to forecast the return of age-1.2 sockeye salmon in 2012. A sibling model forecasted a return of 114,000 age-1.2 sockeye salmon. The smolt model was used for this forecast because the 10-year MAPE was lower for the smolt model (47%) than the sibling model (63%). Age-2.2 sockeye salmon typically comprise about 24% of the run. The forecast for age-2.2 sockeye salmon is 253,000, which is 12% greater than the 20-year average return (227,000) for this age class. A sibling model based upon the abundance of age-2.1 sockeye salmon in 2011 was used to forecast the return of age-2.2 sockeye salmon in 2012. The sibling model was used for this forecast because the 10-year MAPE was lower for the sibling model (34%) than the smolt model (38%). The smolt-model forecast for age-2.2 sockeye salmon was 186,000. The predominant age classes in the 2012 run should be age 1.2 (20%), age 1.3 (34%), and age 2.2 (34%). The 10-year MAPE for the set of models used for the 2012 Kasilof sockeye salmon run forecast was 17%.

The sockeye salmon run forecast for the Susitna River (463,000) is 61% less than the 20-year average run (780,000). This forecast was derived from historical aggregate weir counts rather than sonar and age composition catch allocation models, because recent mark–recapture studies have shown that the Yentna sonar project underestimated sockeye salmon escapement, causing estimates of adult returns to also be underestimated. Since this is only the second year a weir-based method has been used, no MAPE can be estimated. However, the 2010 forecast was 112% greater than the estimated actual run. The 20-year average run was calculated by expanding sonar abundance estimates using mark–recapture and genetic stock composition estimates.

The sockeye salmon run forecast for Fish Creek is 84,000, which is 27% less than the 20-year average run (116,000). Age-1.2 and -1.3 sockeye salmon typically comprise 78% of the run to Fish Creek. A fry model based upon the estimated abundance of age-0 fry entering Big Lake in 2009 (2.8 million; 15-year average is 10.3 million) predicted a return of 37,000 age-1.2 sockeye salmon. A sibling model based upon the abundance of age-1.2 sockeye salmon returning in 2011 predicted a return of 28,000 age-1.3 sockeye salmon in 2012. The age-1.2 forecast is 38% less than the 20-year average return (61,000) for this age class, while the age-1.3 forecast is 5% less than the 20-year average return (30,000) for this age class. The predominant age classes in the 2012 run should be age 1.2 (44%), age 1.3 (34%), and age 2.2 (14%).

The sockeye salmon run forecast for Crescent River is 81,000, which is 27% less than the 20-year average run (110,000). Age-1.3 and -2.3 sockeye salmon typically comprise 75% of the run to Crescent River. Sibling models based upon returns of age-1.2 and -2.2 sockeye salmon in 2011 were used to forecast returns of age-1.3 (37,000) and -2.3 (21,000) sockeye salmon in 2012. The predominant age classes in the 2012 run should be age 1.3 (46%) and age 2.3 (26%).

Run forecasts to individual freshwater systems are as follows.

System	Run	Inriver Goals
Crescent River	81,000	30,000–70,000
Fish Creek	84,000	20,000–70,000
Kasilof River	754,000	160,000–340,000
Kenai River	4,026,000	1,000,000–1,200,000[a]
Susitna River[b]	443,000	
Larson Lake	NA	15,000–50,000
Chelatna Lake	NA	20,000–65,000
Judd Lake	NA	25,000–55,000
Unmonitored Systems	808,000	NA
Total	6,196,000	

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

[b] Susitna sockeye salmon are managed to achieve escapement goals at Larson, Chelatna and Judd lakes.

Mark Willette, Research Project Leader, Upper Cook Inlet

Forecast Area: Upper Cook Inlet
Species: Other Salmon Species

Preliminary Forecast of the 2012 Commercial Harvest

Natural Production	Forecast Estimate (thousands)
Pink Salmon	334
Chum Salmon	113
Coho Salmon	159
Chinook Salmon	12

Forecast Methods

The recent 5-year average commercial harvest was used to forecast the harvest of chum, coho, and Chinook salmon in 2012. The forecast for pink salmon was based upon the average harvest during the past five even-numbered years.

Forecast Discussion

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

Mark Willette, Research Project Leader, Upper Cook Inlet

Forecast Area: Lower Cook Inlet
Species: Pink Salmon

Preliminary forecast of the 2012 run

Natural Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run	622	311–1,075
Escapement	304	102–551
Commercial Harvest	318	209–524

Note: Columns may not total exactly due to rounding to the nearest thousand fish.
Note: Commercial Harvest is Total Run – Escapement.
Note: Additional harvests may be expected from systems not included in the forecast.

Forecast Methods

The forecast of wild pink salmon runs to nine harvest areas in the LCI Management area was based on a logarithmic regression of total run and escapement for 38–46 years of observations. The total run forecast for LCI natural production was the sum of the nine individual harvest area forecasts. Upper and lower bounds around the total run forecast, however, were derived by multiplying the forecast times the upper and lower values of the percent error ([actual return-forecast return]/actual return) observed during the previous 10 years (excluding 2004). Forecasted commercial harvest ranges were obtained by subtracting corresponding escapement goals from the upper and lower bounds of the forecast range. The forecasted aggregate escapement was the sum of mid-points from the individual escapement goals. The total forecasted commercial harvest was the total run minus the aggregated escapement.

Forecast Discussion

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

In 2010, the last even-numbered year, four of nine forecasted systems had runs within the forecast range. The 2012 forecast for natural production of 622,000 pink salmon has a forecast range of 311,000–1,075,000. Variable strength parent-year escapements in 2010 and modest return per spawner ratios in recent years suggest there is only a fair likelihood of reaching the point estimate of this forecast range. If realized, a natural run of 622,000 pink salmon would be 26% lower than the mean run size of 841,000 for even-year returns between 1962 and 2010. The pink salmon cumulative escapement goal is 337,000 (range 124,000–551,000) for systems with a forecast. If the total run comes in as forecasted, the midpoint of the cumulative escapement goal range should be met for all index streams except Port Chatham, Rocky Bay, Bruin Bay River, and Ursus/Rocky Cove, which will fall 8,900 (Port Chatham), 300 (Rocky Bay), 14,500 (Bruin Bay River), and 9,400 (Ursus/Rocky cove) fish short of their respective goals. The resulting cumulative escapement forecast would then be 304,000 pink salmon.

Four districts make up the LCI management area. The harvestable surplus of naturally produced pink salmon in Southern District is projected to be 62,000, with 40,000 coming from Humpy Creek and the balance from Seldovia and Port Graham bays. Hatchery production of pink salmon in LCI recently resumed after several years of inactivity. Brood stock was taken in 2011 and the first enhanced returns are expected in 2013. Consequently, no supplemental harvest of enhanced pink salmon will occur in 2012.

In Outer District, the number of naturally produced pink salmon available for harvest is projected to be 256,000, with almost 90% (231,000) of the harvest expected to occur in Port Dick Subdistrict. If realized, the Port Dick harvest would be slightly more than the mean even-year catch since 1962. The remainder of the harvest is projected to occur in Windy Bay (25,000), while Port Chatham and Rocky bays are expected to fall short of their escapement goals.

No pink salmon harvest is expected from Eastern District in 2012. Commercial fishing specifically directed at pink salmon has not been allowed in Eastern District in recent years due to a combination of low production and potential conflicts with the Resurrection Bay Salmon Management Plan, which limits commercial interference with the sport coho salmon fishery.

Poor returns are forecasted for both of the major pink salmon producers in Kamishak Bay District. Escapement shortfalls are expected for Bruin Bay and Ursus and Rocky Cove Subdistricts. Therefore, no commercial harvest of pink salmon is anticipated for Kamishak Bay District in 2012.

Edward O. Otis, Area Finfish Research Biologist, Homer
Lee F. Hammarstrom, Area Finfish Management Biologist, Homer

Forecast Area: Kodiak

Species: Pink Salmon

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (millions)	Forecast Range (millions)
KMA Wild Stock Total Run	13.5	9.8–18.5
KMA Escapement Goal [a]	4.0	
KMA Wild Stock Harvest	9.5	5.8–14.5
Kitoi Bay Hatchery Harvest [b]	3.7	2.6–4.7
Total KMA Pink Salmon Harvest	13.2	8.4–19.2

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

[a] The 2012 estimated escapement is near the lower bound of the combined even-year aggregate escapement goals for the Kodiak Archipelago (3.0–7.0 million) and the Mainland District (250,00–1.0 million).

[b] This figure is the total expected return (4 million) minus the broodstock collection goal of 350,000; the Kitoi Bay Hatchery cost recovery harvest is expected to be roughly 1.0 to 1.5 million.

The 2012 KMA predicted pink salmon harvest is expected to be in the Average category with a point estimate of 13.2 million fish combined from the wild stock and KBH harvest estimates. Harvest categories were delimited from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest in the KMA from 1978 to 2011 and will be used to determine the length of initial fishing periods.

Total KMA Harvest Category	Range (millions)	Percentile
Poor	Less than 7.8	Less than 20th
Weak	7.8–10.9	21st to 40th
Average	10.9–14.9	41st to 60th
Strong	14.9–21.7	61st to 80th
Excellent	Greater than 21.7	81st to 100th

Forecast Methods

The KMA wild stock pink salmon harvest forecast is derived from a total run forecast minus the 4.0 million fish anticipated for escapement. Total run estimates were derived from a combination of Karluk and Ayakulik weir counts, aerial survey indices, and harvest estimates.

For the 2012 KMA wild stock pink salmon forecast, a generalized Ricker model (Quinn and Deriso 1999) was fit to the even-year KMA returns from 1980 to 2010, using pink salmon escapements to the Karluk and Ayakulik rivers for the spawner index. Four additional terms were included in this generalized Ricker model: (1) KMA pink salmon indexed escapement (total escapement minus Karluk and Ayakulik escapement), (2) November–February average air temperature, (3) total precipitation in fall (August–October) and spring (March–June), (4) summed multivariate ENSO (El Niño/Southern Oscillation) index July–October (Figure E1).

This generalized model assumes that the first three environmental conditions affect the survival at early life history stages of pink salmon and thus were lagged correspondingly. The fourth condition, ENSO, is assumed to affect ocean survival of pink salmon. All environmental conditions were estimated from Kodiak Airport (http://www.airnav.com/airport/ADQ; PADQ)[a] climate observations. In constructing and evaluating the regression model, standard regression

[a] Accessed February 14, 2012.

diagnostic procedures were used. The range was estimated as the 80% prediction intervals based on the generalized Ricker model.

The 2012 KBH pink salmon forecast was prepared by evaluating pink salmon survivals from even brood years 1996–2008, when releases from the facility were in excess of 100 million fry. Brood years 1996–2008 are particularly important to the hatchery 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 KBH is odd-year dominant and exhibits higher than average strength returns every fourth year and average returns in between. The total return estimate of 4.0 million reflects a marine survival of 2.76% and is an average of the previous four cyclical returns (2008, 2004, 2000, and 1996).

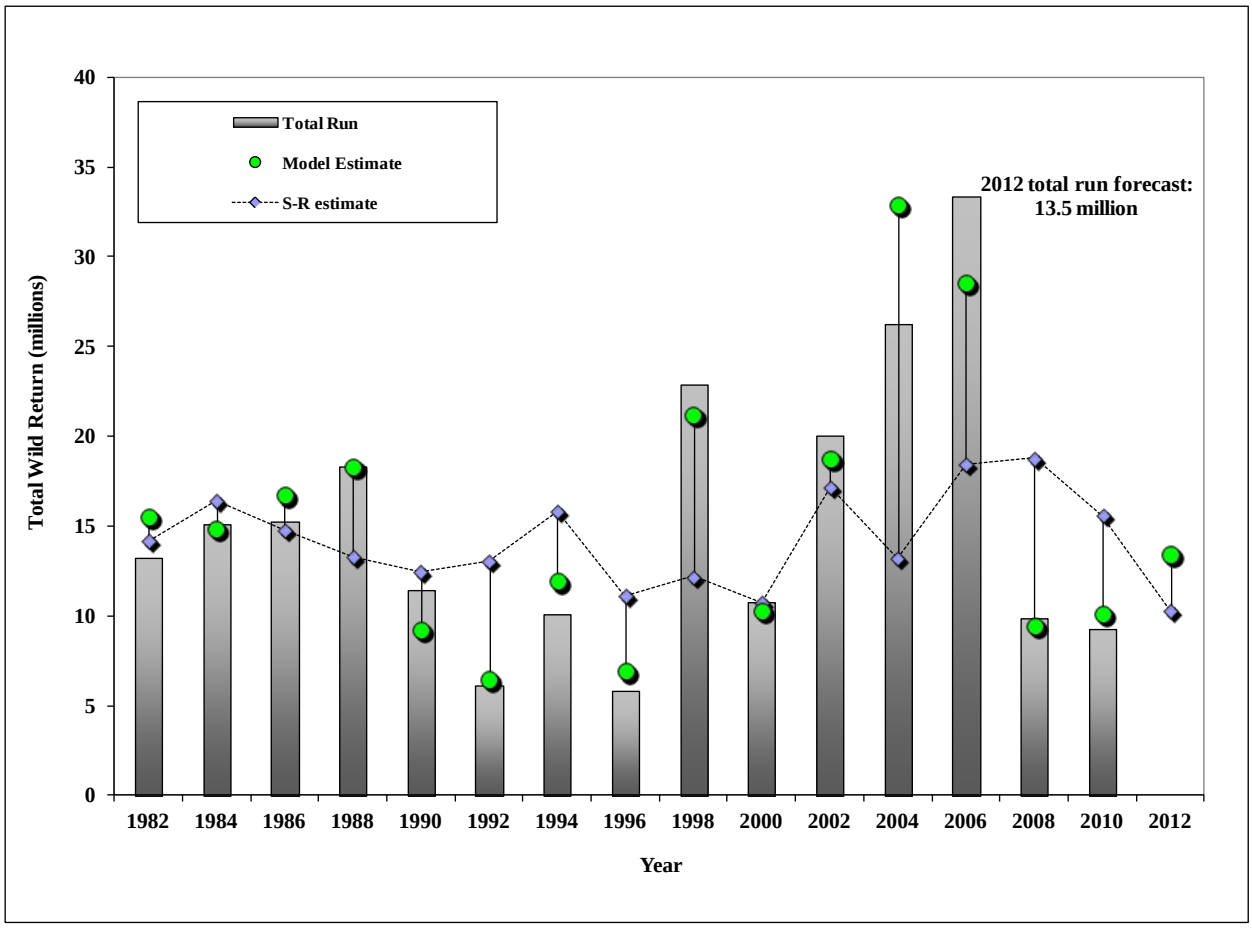

Figure E1.– Kodiak even-year pink salmon wild stock total return 1982–2010 and forecast for 2012, showing hindcast predictions of the generalized Ricker model and unadjusted base Ricker stock-recruit estimates.

Forecast Discussion

The 2012 KMA wild stock pink salmon total run (13.5 million) will be an average even-year return. The winter air temperature affecting the even-year model was average and the fall/spring precipitation was favorable but the 2010 escapement and the ENSO index were both slightly unfavorable. The prediction of an Average wild stock total run is supported by ancillary information provided by the 2011 ADF&G Arnie Shaul Memorial pink salmon fry abundance index estimated in Kodiak area harbors. Arnie Shaul worked as an ADF&G Area Management Biologist on the Alaska Peninsula from 1973 until 2005 and often predicted pink salmon abundance based on prior-year pink fry indices estimated in the near shore waters. Confidence in the 2012 forecast estimate is excellent due to the relatively high strength of the model.

The 2012 KBH pink salmon production is expected to be 4.0 million. The brood stock collection goal is 350,000, resulting in a total hatchery harvest projection of about 3.7 million (Table 2). The KRAA board of directors has yet to set a cost recovery goal for 2012, but it is estimated that 1.0–1.5 million will be harvested in the cost recovery fishery. In 2011, 146.5 million fry were released, close to the average number released in recent years (2007–2010). Above average water temperatures at Kitoi Bay Hatchery resulted in early emergence and above average size fry (0.85 g).

This forecast allows for an initial July 6, 2012, general pink salmon opening of 57 hours (2½ days) followed by two weekly openings of 81 hours (3½ days). After the third general opening, fishing time could be restricted, by district or section, to ensure escapement objectives will be met. Most of the wild stock harvest will be concentrated on the Westside of the KMA (Kodiak and Afognak islands).

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

Forecast Area: Kodiak, Spiridon Lake
Species: Sockeye Salmon

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	173	61–282
Escapement Goal	0	
Harvest Estimate	171	61–280

Forecast Methods

The 2012 Spiridon Lake sockeye salmon forecast was prepared primarily by investigating simple linear regression models, using 1999–2009 outmigration-to-return relationships for three age classes. Standard regression diagnostic procedures were used to construct and evaluate each regression model. Prediction intervals (80%) for regression estimates were calculated using regression model variances. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

Age-1.2, -2.2, and -1.3 fish were predicted from smolt outmigration estimates. All other age classes were predicted by calculating the pooled median contribution (2001–2011). The total run forecast was calculated by summing individual and median age class estimates. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted.

Forecast Discussion

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 171,000 in 2012 (Table 1) is 38,000 more than the 2011 forecast (133,000) and 4,000 more than the actual 2011 run estimate (167,000). The 2012 run will likely be composed of approximately 51% age-1.2 fish and 22% age-2.2 fish. Confidence in this forecast is good due to the strength of the regression models. If realized, this run will be about 75,000 less than the recent 10-year average (2002–2011) run (246,000). The peak of the Spiridon Lake sockeye salmon run timing through the Westside fishery is typically in July.

Michelle L. Moore, Finfish Research Biologists, Kodiak

Forecast Area: Kodiak, Ayakulik River
Species: Sockeye Salmon

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	821	637–1,006
Escapement Goal	300	
Harvest Estimate	521	

[a] The escapement estimate is the the midpoint of the combined escapement goals for the early (140,000–280,000) and late runs (60,000–120,000) in 2012.

Forecast Methods

The 2012 Ayakulik River sockeye salmon forecast was prepared primarily by investigating simple linear regression models using recent outmigration year ocean-age-class relationships. Standard regression diagnostic procedures were used to construct and evaluate each regression model. Prediction intervals (80%) for regression estimates were calculated using regression model variances. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

Age-.2 sockeye salmon, typically the dominant age class, were predicted from prior year age-.1 returns using outmigration years 1989–2009. Age-.1, -.3, and -.4 sockeye salmon were predicted using the median return for each age class over the most recent 10 years. Regression and median estimates were summed to estimate the total Ayakulik sockeye salmon run for 2012. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecast.

Forecast Discussion

The 2012 Ayakulik forecast of 821,000 sockeye salmon is 108,000 more than the 2011 forecast (713,000) and about 390,000 more than the actual 2011 run estimate (432,000). The 2012 run will likely be composed of approximately 85% age-.2 fish and 14% age-.3 fish. If realized, this run will be 494,000 more than the recent 10-year average (2002–2011) and the largest since 1999. The confidence in the 2012 Ayakulik forecast is good, due to the strong regression relationships. The projected harvest of 521,000 is based on the achievement of the midpoint (300,000) of the combined escapement goal range for both the early and late runs (200,000–400,000; Table 1). Reverting to a historic management strategy, Ayakulik is now managed based on both an early and late run (before and after July 15). Most of the fish in 2012 will arrive during the early run, based on return timing of age-.1 siblings in 2011.

M. Birch Foster, Finfish Research Biologist, Kodiak

Forecast Area: Kodiak, Karluk River
Species: Sockeye Salmon

Preliminary Forecast of the 2012 Run

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run	Total Run Estimate	261	88–434
	Escapement Goal [a]	175	
	Harvest Estimate	86	
Late Run	Total Run Estimate	637	275–999
	Escapement Objective [a]	270	
	Harvest Estimate	367	
Total Karluk	Total Run Estimate	898	363–1,433
River System	Escapement Objective [a]	445	
	Harvest Estimate	453	

[a] The escapement estimates are the approximate midpoints of escapement goals for the early (110,000–250,000), late (170,000–380,000), and total combined runs in 2012.

Forecast Methods

Forecasts of Karluk River sockeye salmon runs in 2012 were based on outmigration year 1988 to present. Multiple regressions were modeled using outmigration year ocean age-class relationships, ocean age-class proportions in brood year, and zooplankton biomass of Karluk Lake. Standard regression diagnostic procedures were used to construct and evaluate each regression model. Prediction intervals (80%) for regression estimates were calculated using regression model variances. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

For both early and late runs, age-.2 sockeye salmon returns were predicted based on the prior-year return of age-.1 fish (corrected for parent year proportion of age-.3 spawners) and the average biomass of zooplankton in Karluk Lake (the entire lake for early run fish, the main basin only for late run fish) during the two summers prior to outmigration, using multiple regression. Also for both runs, age-.1 and -.4 returns were predicted using their pooled median contribution. For the early run, age-.3 sockeye salmon returns were predicted based on the abundance of the prior-year return of age-.2 sockeye salmon (corrected for parent year proportion of age-.3 spawners) and the average annual biomass of zooplankton in Karluk Lake during the 2 summers prior to outmigration, using multiple regression relationship. For the late run, age-.3 sockeye salmon returns were predicted based on the proportion of age-.3 fish in their parent year escapement and the average biomass of the zooplankton (*Diaptomus*) in Karluk Lake (main basin only) during the three summers prior to outmigration, using multiple regression.

Regression and median estimates were summed to estimate the total Karluk sockeye salmon run for 2012. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted. The combined early- and late-run 80% prediction interval was calculated by summing the lower prediction bounds and upper prediction bounds of the two runs.

Forecast Discussion

The total 2012 sockeye salmon run to the Karluk River is expected to be approximately 898,000. The early run is expected to be approximately 261,000, which is about 153,000 below the recent 10-year average (413,000) and 167,000 above the 2011 run (94,000). The late run is expected to be approximately 637,000, which is 16,000 below the recent 10-year average (654,000) and 371,000 more than the 2011 run (265,000).

The projected harvest estimate for the early run (86,000) is based on achieving the early-run SMSY (175,000). The projected harvest estimate for the late run (367,000) is based on achieving the late-run SMSY (270,000). The majority of both runs is expected to be age-.2 fish.

It appears that the Karluk River sockeye salmon run's phase of low productivity will improve, but it continues to be difficult to forecast. Our confidence in the forecast is good.

M Birch Foster, Finfish Research Biologist, Kodiak

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

Preliminary Forecast of the 2012 Run

Total Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Upper Station River	Total Run Estimate	85	47–122
	Escapement Goal [a]	25	
	Harvest Estimate [c]	60	
Late Upper Station River	Total Run Estimate	257	132–382
	Escapement Goal [b]	186	
	Harvest Estimate [c]	71	
Frazer Lake	Total Run Estimate	410	222–597
	Escapement Goal	157	
	Harvest Estimate [c]	253	
Total Alitak District	Total Alitak Run Estimate	752	401–1,101
	Alitak Escapement	368	
	Alitak Harvest Estimate	384	

[a] The escapement estimate for the Upper Station early run is the lower bound of the escapement goal range (43,000–93,000). The Alaska Board of Fisheries instituted an optimal escapement goal of 25,000 in 1998, this goal takes priority over the BEG.

[b] The escapement estimate for the Upper Station late run is the S_{MSY} estimate of the escapement goal (120,000–265,000).

[c] 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 Bay District.

Forecast Methods

The 2012 sockeye salmon run to the Alitak District was forecast with simple linear regression models using ocean age-class relationships by system from recent outmigration years. Standard regression diagnostic procedures were used to construct and evaluate each regression model. Prediction intervals (80%) for regression estimates were calculated using regression model variances. 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.

Both early and late runs of Upper Station sockeye salmon were predicted using the same methods for each age class. Age-.2 sockeye salmon were predicted based on the prior year age-.1 returns. Age-.3 sockeye salmon were predicted from prior year age-.2 returns. Age-.1 and -.4 returns were predicted using the pooled median contributions. Frazer Lake age-.3 sockeye salmon were predicted from two years prior age-.1 returns. Frazer Lake age-.1 and -.4 returns were predicted using their pooled median contribution.

Regression and median estimates were summed to estimate the total Alitak District sockeye salmon run for 2012. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted. The combined Alitak District 80% prediction interval was calculated by summing the lower and upper prediction bounds of both runs.

Forecast Discussion

The 2012 sockeye salmon run to the Alitak District is expected to be approximately 752,000, which is approximately 10,000 more than the recent 10-year average run (742,000) and 161,000 more than the 2011 run (591,000). The Upper Station early run is expected to be approximately 85,000, which falls slightly below the recent 10-year average (92,000). The Upper Station late run is expected to be approximately 257,000, which is also below the recent 10-year average (292,000). The Frazer Lake run is expected to be approximately 410,000, which is above the recent 10-year average (358,000). The 2012 Alitak District sockeye salmon run should be composed of approximately 60% age-.2 fish. Our confidence in the forecast is fair, based on the strength of the regression models and the large confidence interval.

The projected harvest estimate of 384,000 is based on achieving the lower bound of the escapement goal of the Upper Station early run, the S_{MSY} estimate of the Upper Station late run, and the S_{MSY} estimate for the Frazer Lake run plus an additional 40,000 fish that typically do not ascend the fish pass into Frazer Lake.

Michelle L. Moore, Finfish Research Biologist, Kodiak

Forecast Area: Chignik
Species: Sockeye Salmon

Preliminary Forecast of the 2012 Run

Toal Production		Forecast Estimate (thousands)	Forecast Range (thousands)
Early Run (Black Lake)	Total Run Estimate	1,084	430–1,738
	Escapement Goal	350	
	Harvest Estimate [b]	735	
Late Run (Chignik Lake)	Total Run Estimate	1,201	747–1,655
	Escapement Goal [c]	250	
	Harvest Estimate [b]	951	
Total Chignik System	Total Run Estimate	2,285	1,177–3,393
	Escapement Objective [b]	600	
	Harvest Estimate	1,685	
	Chignik Area	1,371	
	SEDM Area	87	
	Cape Igvak Section	217	

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

[b] The forecast escapement for the Chignik River early run in 2012 is the lower end of the SEG.

[c] The Chignik Lake late-run escapement goal is 200,000–400,000, resulting in an escapement goal of 550,000–800,000 for both runs combined. However, managers try to achieve an additional inriver goal of 50,000 in August and September to be added to the lower bound of the escapement goal.

Forecast Methods

Simple and multiple linear regressions using age-class relationships and escapement data from 1977 to the present were used to forecast the 2012 early and late Chignik sockeye salmon runs. Each regression model was evaluated with standard regression diagnostic procedures. Prediction intervals (80%) for the regression estimates were calculated using regression model variances. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

For the early run, simple linear regression of sibling relationships was used to predict age-1.3 and -2.3 sockeye salmon which make up a vast majority of the run. Age-1.3 fish were estimated based on the abundance of age-1.2 fish from the prior year. Age-2.3 sockeye salmon were predicted from age-2.2 fish from the prior year. Remaining age-class components of the run were predicted by calculating median returns since the 1981 outmigration year.

The 2012 late run was predicted using ocean-age-class relationships, sibling-age-class relationships, and parental escapement. Simple linear regression was used to predict age-.2 fish from prior year age-.1 fish, and age-.4 fish from prior year age-.3 fish. Sibling-relationship simple linear regression was used to predict age-1.3 fish from prior-year age-1.2 fish. Multiple regression was used to predict age-2.3 fish from prior-year age-2.2 fish and parent escapement. Remaining age-classes were predicted by calculating median returns since the 1981 outmigration year (1.4% of the run).

Early- and late-run regression and median estimates were summed to estimate the total Chignik River sockeye salmon run for 2012. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecasted. The combined early- and late-run 80% prediction interval was calculated by summing the lower prediction bounds and upper prediction bounds of both runs.

Forecast Discussion

The 2012 Chignik sockeye salmon run is expected to be approximately 1.08 million for the early run and 1.20 million for the late run. The total predicted run of nearly 2.29 million in 2012 is approximately 320,000 more than the recent 10-year average run (1.97 million) and 1.61 million less than the 2011 run (3.90 million).

The projected early-run harvest estimate of 734,000 is based on achieving the lower end of the early-run escapement goal range of 350,000. The projected late-run harvest estimate of 951,000 is based on achieving the lower end of the late-run goal of 250,000 (Table 1). Harvest estimates for both runs include Chignik-bound sockeye salmon harvested in the Cape Igvak Section of the KMA and the SEDM of the Alaska Peninsula Management Area.

Due to a range of variation in the relationships used in this forecast, our confidence in it is fair. Exploratory analysis using time series data, a smolt-based forecast, and other sibling relationships yielded results similar to this formal forecast.

Adam StSaviour, Finfish Research Biologist, Chignik

Forecast Area: Bristol Bay
Species: Sockeye Salmon

Forecast of the 2012 Run

Total Production	Forecast (millions)	Forecast Range (millions)
Total Run	32.3	23.17–41.42
Escapement	9.47	
Commercial Common Property Harvest	22.83	
Bristol Bay Harvest	21.76	
South Peninsula Harvest	1..07	

Forecast Methods

The forecast for the sockeye salmon run to Bristol Bay in 2012 is the sum of individual predictions for nine river systems (Kvichak, Alagnak, Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak-Mulchatna, and Togiak rivers) and four age classes (ages 1.2, 1.3, 2.2, and 2.3, plus ages 0.3 and 1.4 for Nushagak River). Adult escapement and return data from brood years 1976 to 2008 were used in the analyses.

Predictions for each age class returning to a river system were calculated from models based on the relationship between adult returns and spawners or siblings from previous years. Tested models also included simple linear regression and recent year averages. All models were evaluated for time series trends. Models chosen were those with statistically significant parameters having the greatest past reliability (accuracy and precision) based on mean absolute deviation, MAPE, and mean percent error between forecasts and actual returns for the years 2009–2011.

The forecast range was the upper and lower values of the 80% confidence bounds for the total run forecast. The confidence bounds were calculated using deviations of actual runs from published predictions for the years 2001–2011.

Forecast Results

A total of 32.30 million sockeye salmon are expected to return to Bristol Bay in 2012. This prediction is 14% lower than the previous 10-year mean of total runs (37.61 million; range of 17.83–46.04 million). The forecast range is 23.17–41.42 million. All systems are expected to meet their spawning escapement goals.

A run of 32.30 million sockeye salmon can potentially produce a total harvest of 22.83 million if escapement goals are met for managed stocks and industry is capable of taking the surplus fish. The projected harvest includes 21.76 million in Bristol Bay and 1.07 million in the South Peninsula fisheries. A Bristol Bay harvest of 21.76 million would be 11% lower than the previous 10-year mean harvest (24.33 million; range of 10.66–30.89 million).

The run forecast to each district and river system is as follows: 14.96 million to Naknek-Kvichak District (6.84 million to Kvichak River; 1.90 million to Alagnak River; 6.22 million to Naknek River); 6.72 million to Egegik District; 3.09 million to Ugashik District; 6.76 million to Nushagak District (4.64 million to Wood River; 1.40 million to Nushagak River; 720,000 to Igushik River); and 780,000 to Togiak District (Table G1).

The total run forecast of 32.30 million sockeye salmon is expected to be comprised of 13.23 million age-1.3 fish (41%) followed by 8.50 million age-2.2 fish (26%), 6.22 million age-1.2 fish (19%), 4.26 million age-2.3 fish (13%), 67,000 age-1.4 fish (<1%), and 21,000 age-0.3 fish (<1%; Table G1).

Forecast Discussion

Prediction or forecasting is very difficult, especially if it is about future salmon returns. We have used similar methods since 2001 to produce the Bristol Bay sockeye salmon forecast. These forecast methods have performed fairly well when looking at the overall Baywide forecast. The forecast in 2011 was 22% above the total run and forecasts since 2001 have averaged 7% below the actual total run. Run forecast differences have ranged from 26% below actual run in 2007 to 22% above actual run in 2011. Forecasted harvests have averaged 3% below actual harvest since 2001 and harvest differences have ranged from 22% below actual harvest in 2009 to 36% above actual harvest in 2011.

There is a much greater amount of uncertainty in our forecasts of returns to individual rivers. Since 2001, on average, we have underforecast the returns to the Alagnak (–30%), Togiak (–20%), Nushagak (–16%), Naknek (–7%), and Wood (–6%) rivers and overforecast returns to Igushik (25%), Egegik (24%), and Kvichak (14%) rivers. An example of the large variability can be observed in the forecasts to the Kvichak River. We overforecast the returns to Kvichak River by an average of 97% from 2001 through 2004 during an unusually unproductive period and underforecast the returns to the Kvichak River by an average of –32% from 2005 through 2010 during a higher period of productivity. In large part, an individual river's forecast error is reflective of its current production as it relates to average historical production.

Even though there is large amount of variability around the forecasts to the individual rivers, the overall Baywide forecasts have been fairly accurate since 2001. This appears to have been the result of overforecasting returns to some rivers and underforecasting returns to other rivers. The forecasts to individual rivers have been offsetting each other such that the overall Baywide forecast has been more accurate than the individual forecasts.

We anticipate the 2012 run will be dominated by age-1.3 sockeye salmon (41%), followed by age-2.2 (26%), age-1.2 (19%), and age-2.3 (13%) sockeye salmon. There is always some uncertainty in our forecast of returns by age class. However, we expect the overall uncertainty in 2012 to be similar to what occurred in 2011. Our forecasts were close for age-1.2 (24% forecast compared to 21% observed) and age-1.3 (38% compared to 42% observed) sockeye salmon. We overforecast age-2.2 (25% forecast compared to 16% observed) and underforecast age-2.3 (13% forecast compared to 21% observed) sockeye salmon in 2011.

Historically, total runs of sockeye salmon to Bristol Bay have been highly variable. The 2012 forecast of 32.30 million is above the long-term historical average of 30.63 million (1956–2011), but below the more recent historical average of 40.50 million (2004–2011). We had seven consecutive years from 2004 to 2010 where total run was close to or exceeded 40 million sockeye salmon. In 2011, total run dropped to 31.68 million sockeye salmon. We expect the 2012 run to be similar to the total run in 2011.

Tim Baker, Fred West, and Greg Buck, Bristol Bay Fishery Research Staff, Anchorage

Table G1.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay river systems in 2012.

DISTRICT	Millions of Sockeye Salmon							
	Forecasted Production by Age Class					Forecasted		South
River	1.2	2.2	1.3	2.3	Total	Escapement	Harvest	Peninsula [a]
NAKNEK-KVICHAK								
Kvichak	1.72	3.17	1.52	0.43	6.84	3.42	3.19	0.23
Alagnak	0.48	0.20	1.13	0.09	1.90	0.95 [b]	0.89	0.06
Naknek	1.20	0.88	3.31	0.83	6.22	1.10	4.91	0.21
Total	3.40	4.25	5.96	1.35	14.96	5.47	8.99	0.49
EGEGIK	0.57	2.89	1.14	2.12	6.72	1.10	5.39	0.22
UGASHIK	0.51	1.10	0.86	0.62	3.09	0.85	2.14	0.10
NUSHAGAK [c]								
Wood	1.30	0.17	3.09	0.08	4.64	1.10	3.38	0.15
Igushik	0.11	0.03	0.56	0.03	0.72	0.23	0.47	0.02
Nushagak	0.18	0.02	1.09	0.03	1.40 [d]	0.55	0.80	0.05
Total	1.59	0.21	4.74	0.14	6.76	1.88	4.66	0.22
TOGIAK [e]	0.16	0.04	0.53	0.04	0.78	0.18	0.57	0.03
BRISTOL BAY	6.22	8.50	13.23	4.26	32.30	9.47	21.76	1.07
	19%	26%	41%	13%	100%			

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

[a] The projected harvest accounts for the harvest of Bristol Bay sockeye salmon in the South Peninsula commercial salmon fisheries. The South Peninsula harvest has averaged 3.3% of the total Bristol Bay sockeye salmon production during the last 5 years.

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

[c] Forecast for Snake River system was not included (1971–1991 average escapement was 18,000).

[d] Nushagak River forecast includes age-0.3 (21,000) and age-1.4 (67,000) fish.

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

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

Forecast Area: Bristol Bay, Nushagak District
Species: Chinook Salmon

Forecast of the 2012 Harvest

Total Production	Forecast (thousands)	Forecast Range (thousands)
Commercial Common Property Harvest	30	19–44

Forecast Methods

The anticipated commercial harvest of Nushagak River Chinook salmon in 2012 is 30,000, with the projected to range between 16,000 and 44,000. These projections are based on the most recent 5-year average and the observed MAPE of 46% during that same time period. The actual harvest has ranged between 19,000 (2008) and 51,000 (2007) during the most recent 5-year period.

Previously, it has been our practice to forecast Chinook salmon total run and from that, the projected harvest. However, our total run forecast models have not performed well in recent years.

Various factors account for our inability to accurately forecast future Chinook salmon runs to the Nushagak River. One of the most likely factors may be in our assessment of the escapement portion of the total run. We believe that the sonar project provides a fairly good estimate of returning sockeye salmon which migrate close to shore. However, Chinook salmon, and to a lesser extent, chum salmon, migrate further offshore. Historically, this project has counted salmon in the nearshore areas of the river and has never counted salmon across the entire river. We know that some portion of the returning Chinook salmon migrate up the middle of the river. Our assumption has been that we count a consistent proportion of the returning Chinook salmon and that this index provides a basis from which to forecast. However, the low return of Chinook salmon in recent years and the recent poor performance of the forecast have cast doubt on that assumption. Additional concerns include recent changes made to the sonar equipment and the methods used to apportion counts to salmon species with gillnets. Research that begun in 2011 will attempt to address some of the uncertainties associated with estimating Chinook salmon abundance. We hope these studies will eventually improve our ability to assess the total run of Chinook salmon in the Nushagak River and produce reliable forecasts in the future.

Even with the difficulties in assessing and forecasting the total run of Chinook salmon in the Nushagak River, we believe the 2012 run will be large enough to meet the inriver goal of 75,000 Chinook salmon and provide for commercial, sport, and subsistence harvest opportunities. The Nushagak River Chinook salmon run appears to have declined to a low point in 2010, started increasing in 2011, and should continue to increase in 2012 based on long-term historical trends. It is anticipated that the 2012 Chinook salmon run will be primarily comprised of age-1.3 (~50%), followed by age-1.4 (~27%), and age-1.2 (~21%) fish.

Tim Baker, Fred West, and Greg Buck, Bristol Bay Fishery Research Staff, Anchorage

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

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	243	0–458[b]
Escapement Goal	117	
Harvest Estimate	126	

[a] The forecast escapement for the Bear Lake late run in 2012 is the lower end and range of the BEG (117,000–195,000).

[b] The inclusion of zero fish reflects the relatively wide range of uncertainty around the point estimate of 243,000.

Forecast Methods

The 2012 forecast of late-run sockeye salmon to Bear Lake was prepared using simple and multiple linear regression and median estimates. Ocean-age-class relationships and relationships with environmental data over the past 21 years were examined. Models were evaluated with standard regression diagnostics. Prediction intervals (80%) for regression estimates were calculated using regression model variances. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates

Age-.3 sockeye salmon returns were predicted from previous-year age-.2 returns using simple linear regression. Returns of age-.2 sockeye salmon were predicted using a multiple regression of average winter (October–April) air temperatures and October precipitation. This index used temperatures from the year of outmigration and the three years prior to outmigration, and total inches of October precipitation in the year of outmigration. Air temperature and precipitation data were obtained from the Cold Bay airport climate database. Returns of age-.1 and age-.4 sockeye salmon were predicted from median values for each of the age class run estimates using data from the last 21 years. The 80% prediction intervals for these median values were calculated using the 10th and 90th percentiles of the data.

Regression and median estimates were summed to estimate the total Bear Lake late-run sockeye salmon run for 2012. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecast.

Forecast Discussion

The 2012 Bear Lake late-run forecast of 243,000 sockeye salmon (Table 1) is about 219,000 less than the 2011 forecast (462,000) and about 67,000 more than the estimated 2011 run (177,000). The 2012 run is expected to be 54% lower than the 10-year average (528,973). The dominant age class has historically been age-2.2 fish, accounting for an average of 53% of the run in the past 10 years. Age-2.2 fish that return in 2012 will have incubated as eggs in November and December of 2007, when 30 cm of precipitation was recorded at the Cold Bay airport, causing landslides and acute turbidity events throughout the region. Bear Lake remained turbid through the winter and much of the following growing season (H. Finkle, personal communication), and

therefore egg incubation and larval foraging may have been negatively impacted. Because the age-2.2 component of the 2012 run was likely heavily impacted by this event, the 2012 run is expected to be a near-record low, perhaps near the lower end of the forecast range. The projected harvest of 126,000 is based on achieving the lower bound of the escapement goal range (117,000; Table 1). Based on the inability of models to capture single events and uncertainty associated with the variable predictive capabilities of sibling data, our confidence in this forecast is fair.

Adam StSaviour, Finfish Research Biologist, Alaska Peninsula

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

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	252	45–458
Escapement Goal	100	
Harvest Estimate	152	

[a] The forecast escapement for the Nelson River run in 2011 is the lower end of the the escapement goal (97,000–219,000).

Forecast Methods

The 2012 Nelson River sockeye salmon run was forecast using simple linear regression and generalized Ricker models of ocean-age-class, air temperature, and precipitation data from the past 25 years. Precipitation and air temperature indices were constructed from Cold Bay airport data. Standard regression diagnostics were used to evaluate each model. Prediction intervals (80%) for regression estimates were calculated using regression model variances. Age classes that could not be estimated with one of these models were estimated using pooled medians and the 10th and 90th percentiles of the data were used to calculate the prediction interval of the median estimates.

Age-.2 sockeye salmon returns were forecast with a generalized Ricker model that used a spawner index of escapements from 1992 to 2007, December precipitation anomalies corresponding to the outmigration year, and temperature anomalies of averaged November air temperatures from the year prior to and the year during outmigration. This model assumed that these environmental conditions affect survival of juvenile sockeye salmon and thus age-.2 return data were lagged correspondingly. Both environmental variables were negatively related to age-.2 returns.

Age-.3 sockeye salmon returns were predicted by linear regression of the ratio between age-.3 and -.2 fish (same outmigration year) on an index of annual average summer (May–September) air temperatures. Age-.3 returns were negatively correlated with the average summer air temperature. The remaining age-.1 and -.4 returns were calculated from median estimates for each ocean age class using run data from 1989 to the present.

Regression and median estimates were summed to estimate the total Nelson River sockeye salmon run for 2012. The range was estimated as the overall 80% prediction intervals and calculated as the square root of the sum of the squared 80% prediction intervals for each age class forecast.

Forecast Discussion

The 2012 Nelson River forecast of 252,000 (Table 1) is about 232,000 less than the 2011 forecast (484,000) and about 89,000 more than the actual 2011 run (about 163,000). The 2012 Nelson River sockeye salmon run is expected to be about 252,000 less than the recent 10-year average run (504,000), and be composed mainly of age-.2 (61%) and -.3 (36%) fish. Relatively few age-.2 fish are predicted to return in 2012, due to a severe storm in December 2007 that impacted freshwater rearing conditions on the Alaska Peninsula when these fish were rearing as

juveniles or incubating as eggs. Because the regression relationships predicting age-.2 and -.3 sockeye salmon are significant and represent a vast majority of the run, confidence in this forecast is fair. The projected harvest of 152,000 is based on achieving the lower end (100,000) of the escapement goal range (Table 1).

Heather Finkle, Finfish Research Biologist, Alaska Peninsula

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

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate(millions)	Forecast Range (millions)
South Peninsula Total Run	4.2	0.1–8.2
South Peninsula Escapement	1.9	
South Peninsula Harvest	2.3	0–6.3

The 2012 South Alaska Peninsula predicted pink salmon harvest is expected to be in the Poor-Weak category with a point estimate of 2.3 (0.0–6.3) million fish. Harvest categories were delimited from the 20th, 40th, 60th, and 80th percentiles of historical commercial harvest on the South Alaska Peninsula from 1978 to 2011.

S. Alaska Peninsula Pink Harvest Category	Range (millions)	Percentile
Poor	Less than 3.3	Less than 20^{th}
Weak	3.3–5	21^{st} to 40^{th}
Average	5–7.2	41^{st} to 60^{th}
Strong	7.2–9.3	61^{st} to 80^{th}
Excellent	Greater than 9.3	81^{st} to 100^{th}

Forecast Methods

The South Alaska Peninsula pink salmon harvest forecast of 2.3 million is derived from a total run forecast of 4.2 million minus the lower end (1.9 million) of the even-year South Alaska Peninsula escapement goal range (Table 2). The total run estimates were derived from a combination of aerial survey index and harvest estimates. For the 2012 South Alaska Peninsula pink salmon forecast, a linear regression of the South Alaska Peninsula pink salmon returns from 1975 to 2011 versus the multivariate ENSO index averaged from November to October of the early life history of the returning pink salmon. Because the 2012 predictor value is highly negative (–1.03 and unfavorable) and the lowest since 1975, only index values less than 0.10 were used for prediction. In constructing and evaluating the regression model standard regression diagnostic procedures were used. The range was estimated as the 80% prediction intervals based on the generalized Ricker model.

Forecast Discussion

The 2012 South Alaska Peninsula pink salmon forecast is for a total run that will be below average and the lowest since 2010, driven by both low parent escapements and poor environmental conditions thereafter. The parent year escapement in 2010 was only 743,000, the lowest since 1975. Environmental conditions used in the model suggest that the subsequent early life survival of the 2012 pink salmon run was then below average. Due to a relative lack of strength in the regression model, confidence in the forecast is only fair.

M. Birch Foster, Finfish Research Biologist, Kodiak

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

ADF&G does not produce formal run forecasts for most salmon runs in the AYK Region. Salmon run outlooks presented in this report are qualitative because of a lack of information necessary for more rigorous forecasts. Harvest outlooks are based upon available parent year spawning escapement indicators, age composition, recent trends, and expected level of commercial harvest given fishery management plans. Commercial harvest outlooks provide a general expectation, but fisheries management is based on inseason run assessment. Specific forecasts of Yukon fall chum and Kuskokwim Chinook salmon are provided. A Canadian-origin Yukon River Chinook salmon forecast will be made for the U.S./Canada Yukon River Panel meeting in the spring of 2012.

In the AYK Region, salmon production notably decreased for many stocks from 1998 to 2002, rebuilt rapidly beginning in 2003 with record and near record runs in 2005 and 2006, and has shown a general decline since 2007. Chinook salmon have shown a marked decline in abundance since 2007. Currently, Yukon River and Eastern Norton Sound Chinook salmon and Northern Norton Sound chum salmon stocks are classified as stocks of yield concern.

The Bering Arctic Subarctic Integrated Surveys (BASIS) provides information on Western Alaskan juvenile Chinook and chum salmon prior to their first winter at sea. Northern Bering shelf surveys (2002–present) primarily catch Chinook and chum salmon originating in the Yukon River and Norton Sound Area. For Chinook salmon, 2009 and 2008 were juvenile survey years corresponding to primary returns of age-5 and age-6 fish in 2012. Unfortunately, there was no survey information from 2008, and thus abundance information for age-6 fish is missing. Juvenile Chinook salmon information in 2009 indicated abundance levels in the middle of those observed in the eight survey years. For chum salmon, 2009 and 2008 were juvenile survey years corresponding to primary returns of age-4 and age-5 fish in 2012. Again, no survey information from 2008 and no abundance indicators for age-5 returns were obtained, but age-4 return strength is promising. The 2009 juvenile chum salmon index was one of the highest recorded. A collaborative effort between ADF&G and NOAA is in progress to test the applicability of BASIS juvenile salmon indices for run size forecasting.

In general, management for anticipated low Chinook salmon abundance, and limited processing capacity in some areas, will result in chum salmon harvests that are lower than the outlook projections. In Norton Sound, up to 2 million pink salmon will likely be surplus in 2012. However, lack of pink salmon markets will likely result in a much lower harvest as projected.

Table I1.Arctic-Yukon-Kuskokwim commercial salmon harvest outlook for 2012.

	Projected salmon harvest by species (thousands of fish)					
Management Area	Chinook	Sockeye	Coho	Pink	Chum	Fall Chum
Kuskokwim River	0–3	10–30	100–200	0	100–500	
Kuskokwim Bay	12–17	40–80	40–80	0	75–150	
Yukon	0–2	0	40–80	0	500–1,000	400–600
Norton Sound	0	0	60–90	100–150	70–100	
Kotzebue Sound					250–280	

Forecast Area: Yukon Area
Species: Fall Chum Salmon

Preliminary Forecast of the 2012 Run

Total Production	Forecast Estimate (thousands)	Forecast Range (thousands)
Total Run Estimate	1100	986–1,200
Escapement Goal		300–600
Harvest Estimate		400–600

Forecast Methods

The forecast for the 2012 Yukon Area fall chum salmon run is based on run reconstruction of five river systems (Tanana, Chandalar, Sheenjek, and Fishing Branch rivers, and the mainstem Yukon River in Canada), including four age classes, age-3 through age-6. Age-4 fish are dominant, followed by age-5 fish. Adult escapement and return data were used from the complete brood years 1974–2005, production from incomplete brood years 2006 and 2007 was estimated based on return per spawner from brood year returns, and an auto-regressive Ricker model was used to predict returns from the 2008 and 2009 parent years.

Predicted returns were multiplied by corresponding average maturity schedules for even and odd-numbered parent years to estimate 2012 run size, and rounded to the nearest thousand fish. The even/odd maturity schedule from 1984 to 2005 was used to estimate the 2012 return, since current production is reduced from the pre-1984 level. The forecast range is the upper and lower 80% confidence bounds for the total run forecast. Confidence bounds were calculated using deviation of the run projection point estimates from the observed returns from 1987 to 2011.

The 2012 projected run size for fall chum salmon for the Yukon Area is approximately 1.1 million fish. This projection is above average for even-numbered runs; however, recent runs have fluctuated more widely and have produced runs as low as 300,000 in 2000 to as high as 1.1 million in 2006. The 2012 forecast range (80% confidence bounds) is 986,000–1.2 million fall chum salmon. If the run materializes as forecasted, abundance will be sufficient to meet escapement goals, including Canadian border passage and harvest sharing obligations, provide an average subsistence harvest, and provide opportunity for a commercial harvest.

Drainagewide escapements between 300,000 and 600,000 fall chum salmon provide a mean yield of 520,000. The mean subsistence harvest between 1974 and 2010, including both Alaskan subsistence and Canadian aboriginal harvests, is 143,000. Commercial harvests are prosecuted on numbers above 500,000, based on inseason assessments of run size. ADF&G anticipates a subsistence harvest of about 100,000 and commercial harvest to be between 400,000 and 600,000. The preseason forecast will be modified into a projection in mid-July to be used for inseason management based on the relationship to summer chum salmon returns to the Yukon River. The actual harvest will be dependent on inseason assessment of run size and application to 5 AAC 01.249 Yukon River Drainage Fall Chum Salmon Management Plan. The forecasted total run of 1.1 million fall chum salmon is expected to be composed of 65% age-4 and 32% age-5 fish. The age-4 component of fall chum salmon runs has varied widely, ranging from 37% (1992) to 94% (2005). Fall chum salmon also exhibit a strong even-odd abundance cycle (averaging 1.0 million in odd-numbered years and 687,000 in even-numbered years) that was

fairly regular between 1974 and 1992. Since 1993 the odd-even abundance relationship has severely deteriorated with wide swings in production that are primarily thought to be due to conditions in the marine environment, although density dependence may have had some influence in 2005. The effect of the odd-even cycle was restricted between 1993 and 2002 during which most years' (1993 and 1997–2002) stocks were severely depressed. Peak runs occurred in 1995 and 2005. Age-4 fish contributed greater than 90% (record levels) of the runs in 2003 and 2005. However, based on preliminary analysis, the extremely large escapement observed in 2005 only produced an estimated 0.25 returns per spawner (R/S).

Forecast Discussion

Point projections for expected returns have been developed since 1987 for fall chum salmon in the Yukon River drainage. Forecast methods were changed to provide ranges around the point estimates beginning in 1999. Additionally, in attempt to reflect poor runs and improvements in some runs, adjustments to the point estimates were made by reducing them by the average ratio of observed to predicted returns through 2005. From 2006 through 2012 the ranges were developed around the point estimate, based on the 80% confidence bounds developed using the standard deviation between the annual point estimates and observed returns. High and low cycles in production have changed approximately 36-fold (based on 32 brood year returns) with the most drastic fluctuations occurring between brood years 2001 and 2005; therefore, forecasts of run size remain extremely difficult to predict.

Since forecasted ranges were established in 1999, 54% of the observed runs were within the range, 23% were below, and 23% were above. Returns of age-4 fish in even-numbered years are typically 19% less than in odd-numbered years. Sibling relationships for this stock are weak, and the strong showing of age-3 fish in 2010 did not contribute as much to the return as the sheer size of the parent year escapement in combination with improved production. The age-4 component is returning from an escapement above the upper end of the drainage-wide goal in 2008, and is anticipated to carry the run in 2012. If improved production continues, both the age-4 and age-5 components are expected to be above average. The 2012 point estimate of 1.1 million fall chum salmon is largely reliant on the age-4 component returning at a higher production level (1.66 R/S) than observed in both the 2007 (1.44) and 2006 (0.89) parent years. This run size would provide for a commercial harvest of approximately 600,000.

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

Forecast Area: Kuskokwim River
Species: Chinook Salmon

Preliminary Forecast of the 2012 Run

	Point estimate (thousands)	Range (thousands)
Projected total run	182	161-202
Escapement goal	Individual tributaries	
Projected harvest		0-3

Forecast Methods

The outlook for the 2012 Kuskokwim River Chinook salmon run is based on a preliminary run reconstruction and three major age classes, age-4 through age-6, Age-5 fish are dominant, followed by age-6 fish. Adult escapement and return data was used from the complete brood years.

The outlook for each age class was calculated from models based on the relationship between adult returns and spawners or siblings from previous years. Tested models included various linear regressions and simple averages. The models chosen were those with statistically significant parameters having the greatest past reliability (accuracy and precision) based on mean absolute deviation, MAPE, and mean percent error between forecasts and actual returns for the years 2009–2011.

The 2012 projected run size of Chinook salmon for the Kuskokwim River is approximately 182,000. This projection is well below average and recent runs have fluctuated more widely and have produced total runs as low as 123,000 in 2010 to as high as 410,000 in 2004. The 90% confidence bounds for the 2012 outlook range are from 161,000 to 202,000. If the run materializes as projected, abundance will be insufficient to meet all current tributary escapement goals and provide an average subsistence harvest.

Drainage-wide spawning escapements between 78,000 and 350,000 provide a mean yield of 97,000. The mean subsistence harvest since 2000 is 72,900 Chinook salmon. Directed Chinook salmon commercial fishing was discontinued in 1987 by regulation. However, Chinook salmon are taken incidental to the chum salmon directed commercial fishery. Kuskokwim River Chinook salmon are harvested primarily for subsistence use and fishery management is challenging. Even with preseason management actions taken to conserve Chinook salmon, ADF&G anticipates a subsistence harvest of about 75,000 fish and commercial harvest between 0 and 3,000 fish.

The outlook total run of 182,000 Chinook salmon is expected to be composed of 23% age-4, 43% age-5, 30% age-6 fish. The age-5 and age-6 component of Chinook salmon runs has varied widely, ranging from 29% to 59%. Since the 1990s abundance of Chinook salmon has had wide swings in production with highs (1994 and 2004) and lows (2000 and 2010) every six years that are primarily thought to be due to environmental conditions, although density dependence may have also been a factor. Chinook salmon stocks were depressed in the late 1990s and early 2000s which led to a stock of concern designation. Based on preliminary analysis, extremely large escapements observed in 1994 and 2004 produced only estimated 0.44 and 0.48 returns per spawner (R/S) whereas the very low 2000 spawning escapement of 84,000 produced an estimated 5.62 R/S and similar low spawning escapements in the early 1980s produced an average R/S of 3.12.

Forecast Discussion

This is the first formal forecast for Chinook salmon in the Kuskokwim River drainage. There is always uncertainty when producing a formal outlook for any salmon species. The greatest uncertainty in the 2012 outlook is predicting the return of age-5 and age-6 Chinook salmon. Hind casting 2010 and 2011 we would have overprojected the total run in in 2010 by 62% and 2011 by 73%. Recent trends of high and low cycles in production have changed approximately 14-fold (based on 29 brood year returns) with the most drastic fluctuations occurring between brood years 1994 and 2000.

The age-5 and age-6 components are returning from relatively large spawning escapements in 2007 and 2006, and are anticipated to carry the run. The 2012 Chinook salmon outlook is largely reliant on the age-5 and age-6 components returning at a higher production level than observed in both the 2006 and 2005 parent years, therefore, projections of run size remain extremely difficult to predict. Given that the previous two years forecasts were biased high and that there was only a slight increase in abundance from 2010 to 2011 the forecast range for 2012 uses only the lower and midpoint value of the actual total run forecast.

Kevin Schaberg, Kuskokwim Area Research Biologist, Anchorage
Chuck Brazil, Kuskokwim Area Management Biologist, Anchorage

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