



Advisory Announcement
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2022 Prince William Sound and Copper River Salmon Forecast

Forecasts of total run were calculated for Copper River wild sockeye salmon, Gulkana Hatchery sockeye salmon, Coghill Lake sockeye salmon, and for wild Prince William Sound (PWS) pink and chum salmon. Prince William Sound Aquaculture Corporation (PWSAC) and Valdez Fisheries Development Association (VFDA) provide additional forecasts for hatchery-specific stocks. In addition to forecasts, a summary of recent 10-year averages (2012–2021) of commercial harvest for most wild stocks and Gulkana Hatchery production is included (Table 2). Salmon forecasts are inherently uncertain and are primarily used to gauge the general magnitude of expected runs and set early-season harvest management strategy. In 2022, the department will continue to manage PWS and Copper River area commercial salmon fisheries inseason based primarily on the strength of salmon abundance indices including sonar counts, weir passage, aerial escapement surveys, and fishery performance data.

Table 1. 2022 Prince William Sound Area Salmon Run Forecast Summary (thousands of fish)

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

2022 COPPER RIVER CHINOOK SALMON FORECAST SUMMARY

The 2022 Copper River Chinook salmon forecast will be published later this month.

2022 COPPER RIVER SOCKEYE SALMON FORECAST SUMMARY

The 2022 wild Copper River sockeye salmon total run point estimate is **1,379,000 fish (80% prediction interval: 852,000–1,906,000 fish)**. Gulkana Hatchery sockeye salmon total run is predicted to be **53,000 fish (80% prediction interval: 33,000–73,000 fish)** for a total Copper River sockeye salmon run (wild + hatchery production) of **1,432,000 fish (80% prediction interval: 905,000–1,959,000 fish)**. This is 34% below the recent 10-year average (2012–2021) total run of

2,159,000 fish. Total Copper River sockeye salmon harvest estimate (all fisheries) is predicted to be **928,000 fish (80% prediction interval: 561,000–1,295,000 fish)** with a commercial harvest of **716,000 fish (80% prediction interval: 349,000–1,083,000 fish)**.

FORECAST METHODS

The 2022 forecast of wild sockeye salmon to the Copper River is the sum of individual forecasts for six age classes. Linear regression models with log-transformed data were used to predict returns for age-1.2, -1.3, -2.2, and -2.3 sockeye salmon. Forecasts of these four age classes were developed from the relationship between returns of each age class, and returns of the age class one year younger from the same brood year (sibling model, Table 4). The predicted return of age-1.1, and -0.3, sockeye salmon were calculated as the 5-year (2017–2021) mean return of these age classes. The 2022 run to Gulkana Hatchery was estimated as the recent 5-year weighted average fry-to-adult survival estimate (0.37%) from all Gulkana I and Gulkana II hatchery releases combined (onsite and remote). The Gulkana Hatchery run was apportioned to brood year using a maturity schedule of 30% age-4 and 70% age-5.

The total harvest point estimate (all fisheries) was calculated by subtracting the Gulkana Hatchery broodstock, hatchery surplus, and wild stock escapement goal needs (upriver and Copper River Delta) from the total run forecast. The commercial harvest estimate was calculated by subtracting Copper River inriver goal categories (5 AAC 24.360(b)) and the lower bound of the Copper River Delta spawning escapement goal, from the total run forecast. An estimated exploitation rate of 70% was used to project the total harvest of Gulkana Hatchery stocks in 2022. There are currently 57 years (1965–2021) of harvest, escapement, and age composition data available for this analysis. Total run 80% prediction intervals were calculated from the mean squared error of the retrospective forecast predictions.

2022 COGHILL LAKE SOCKEYE SALMON FORECAST SUMMARY

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

FORECAST METHODS

The 2022 sockeye salmon run forecast to Coghill Lake is the total of estimates for five age classes. Linear regression models with log-transformed data were used to predict returns of age-1.3 and -1.2 sockeye salmon (Table 4). These linear regression models were parameterized using the historical relationship between returns of age-1.3 sockeye salmon and returns of age-1.2 fish one year previous, and returns of age-1.2 sockeye salmon and returns of the age-1.1 fish one year previous (sibling models). For example, the model chosen to predict the return of age-1.3 sockeye salmon in 2022 used the return of age-1.2 fish in 2021 as the input parameter. An estimated 102,000 age-1.2 sockeye salmon returned to Coghill Lake in 2021, 93% above the recent 10-year average run of 52,724 age-1.2 fish, resulting in a forecast of 242,600 age-1.3 fish for 2022. An estimated 29,849 age-1.1 sockeye salmon returned to Coghill Lake in 2021, over ten times the 10-year average of 2,900 age-1.1 fish, resulting in a forecast of 153,200 age-1.2 fish for 2021. Both of these 2021 run components (as illustrated in table 4) are the primary drivers behind the 2022 forecast being more than double the recent 10-yr total run avg of 197,000 fish. Predicted returns of age-1.1, -2.2, and -2.3 sockeye salmon were calculated as the 2012–2021 mean return of that age class.

Harvest, escapement, and age composition data are available for Coghill Lake sockeye salmon runs since 1962; however, inclusion of escapements prior to the installation of a full weir in 1974 reduce forecast reliability. Therefore, only data collected since 1974 were used. Total run by year was estimated as the total commercial harvest contribution combined with the Coghill River weir escapement count. The 80% prediction intervals for the Coghill Lake sockeye salmon total run were calculated using the squared deviations between the 2017–2021 forecasts and actual runs as the forecast variance.

2022 PWS EVEN-YEAR WILD PINK SALMON FORECAST SUMMARY

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

FORECAST METHODS

Several models were examined for the 2022 PWS wild pink salmon total run forecast including exponential smoothing and 2-, 3-, and 5-year running averages of past even-year total runs. The 3-year running average forecast was selected for 2022 because it outperformed other forecast models by having the lowest mean absolute percent error (MAPE) and mean squared error (MSE) (Table 3). The 80% prediction intervals were calculated from the mean squared error of the retrospective forecast predictions.

Total wild run of pink salmon by year was estimated as the total wild (non-hatchery) contribution to commercial harvests combined with stream escapement indices. The stream escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. For this forecast, total run estimates were natural log-transformed. Hatchery and wild stock contributions were determined from thermal marked otolith recoveries (1997–2021), coded wire tag recoveries (1985–1996), or average fry-to-adult survival estimates multiplied by fry release numbers and estimated exploitation rates (1977–1984).

2022 PWS WILD CHUM SALMON FORECAST SUMMARY

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

FORECAST METHODS

The 2022 PWS wild chum salmon total run forecast uses the 2-year running average method. Several models were examined for the 2022 PWS wild chum total run forecast including exponential smoothing and 2-, 3-, and 5-year running averages of past total runs (Table 3). For 2022, 2-year running average outperformed the other models by having the lowest MAPE, MPE, mean absolute squared error (MASE) and median symmetrical accuracy. The 80% prediction intervals were calculated from the mean squared error of the retrospective forecast predictions.

Total wild run of chum salmon by year was estimated as the total wild (non-hatchery) contribution to commercial harvests combined with the stream escapement index. The stream escapement index is calculated as the area under the curve of weekly aerial escapement surveys adjusted for estimates of stream life. Hatchery and wild stock contributions were estimated using pre-hatchery average natural runs (1998–2003) or thermally marked otolith estimates (2004–2021) for each district in PWS.

Table 2.– PWS Area recent 10-Year (2012–2021) average commercial salmon harvest (thousands of fish)

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

^a Genetic sampling indicates that not all Chinook harvested are of Copper River origin

^b Estimates of wild coho salmon harvests are not available due to limited samples of thermally marked coho otoliths from the commercial harvest

^c Recent 10 even-year commercial harvest (2002–2020)

Table 3.– 2022 PWS Wild Pink and Chum Salmon forecast model summary. Models selected as the run forecast (lowest MAPE) are shaded.

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

Table 4.– 2022 PWS Sockeye Salmon forecast model summary. Models selected for inclusion in the run forecast (lowest MAPE) are shaded.

Stock/Age Class	Brood Year	Model	Prediction	MAPE
Copper River Wild Sockeye				
0.3		5-year mean	64,436	
1.1		5-year mean	2,062	
1.2	2018	log 1.2 R/S x BYE	242,874	65%
		log 1.2 x log 1.1	206,790	56%
1.3	2017	1.3 x BYE	1,077,712	51%
		log 1.3R/S x BYE	1,049,384	43%
		log 1.3 x log 1.2	979,267	33%
		log 1.3 x log 0.3	985,957	44%
		1.3 x 1.2	998,620	46%
2.2	2017	log 2.2 x BYE	24,803	68%
		log 2.2 x log 1.2	24,198	63%

2.3	2016	log 2.3 x log 2.2	102,273	63%
		log 2.3 x log 1.3	86,230	70%
Total			1,379,026	

Coghill Lake Sockeye

1.1		10-year mean	5,880	
1.2	2018	log 1.2 R/S x BYE	30,087	172%
		log 1.2 x log 1.1	153,221	123%
1.3	2017	log R/S 1.3 x BYE	97,446	199%
		log 1.3 x log 1.2	242,609	71%
2.2		10-year mean	6,890	
2.3		10-year mean	5,659	
Total			414,259	

Note: R/S = Return per spawner; BYE = Brood year escapement