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## Advisory Announcement

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## 2022 Bristol Bay Sockeye Salmon Forecast

FORECAST AREA: Bristol Bay

SPECIES: Sockeye salmon

FORECAST OF THE 2022 RUN:

	Forecast (millions)	Forecast range (millions)
<b>TOTAL PRODUCTION:</b>		
Total run	75.27	61.01 – 89.54
Escapement	13.46	
Total harvestable surplus	61.82	
Bristol Bay harvestable surplus	59.94	
South Peninsula harvest	1.88	
Inshore run	73.40	

## METHODS

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

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

Where practical, the Alaska Department of Fish and Game (department) will manage escapements proportional to the run size and relative to the historical record (5 AAC 06.355(d)(1)). Escapement is projected as the 75<sup>th</sup> percentile of the escapement range if the forecast is above the trend experienced in recent years (Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak, and Togiak

Rivers in 2022) and as the 25<sup>th</sup> percentile of the escapement goal range if the forecast is below the trend experienced in recent years (Kvichak River in 2022; Table 1). Because it is passively managed, the Alagnak River exploitation rate is assumed to be the same as the Kvichak River exploitation rate and therefore, the escapement is projected to be the total run forecast minus expected harvestable surplus. Over the past five years, about 2.5% of the Bristol Bay return is thought to be harvested in the South Peninsula fisheries in June. Preseason harvestable surplus projections are provided to aid industry in planning. Once the run begins to develop, the department relies on catch and escapement data for management decisions.

## RESULTS

A total of 75.27 million sockeye salmon (within a range of 61.01–89.54 million) are expected to return to Bristol Bay in 2022 (Table 1). This is 44% larger than the most recent 10-year average of Bristol Bay total runs (52.09 million) and 111% greater than the long-term (1963–2021) average of 35.73 million fish. All systems are expected to meet their spawning escapement goals. The forecast range is the upper and lower values of the 80% confidence interval for the total run forecast. The confidence bounds were calculated from the deviation of actual runs and run forecasts from 2004 through 2021.

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

Age-specific forecasts for the 2022 run consists of 30.68 million age-1.2 fish (41% of the total run), 6.39 million age-2.2 fish (8% of the total run), 35.58 million age-1.3 fish (47% of the total run), and 2.58 million age-2.3 fish (3% of the total run; Table 1).

## DISCUSSION

Forecasting future salmon returns is inherently difficult and uncertain. We have used similar methods since 2001 to produce the Bristol Bay sockeye salmon forecast which have performed well when applied to Bristol Bay as a whole. Since 2001, our forecasts have, on average, under forecast the run by 12% and have ranged from 44% below the actual run in 2014 to 19% above the actual run in 2011. Forecasted harvestable surplus has had a mean absolute percent error of 16% since 2001.

Individual river forecasts have greater uncertainty compared to the baywide forecast. Since 2001, on average, we have under forecast returns to the Alagnak (-33%), Togiak (-14%), Kvichak (-21%), Wood (-20%), Nushagak (-25%), Ugashik (-5%), and Naknek (-15%) Rivers, and over forecast returns to the Igushik (11%) and Egegik rivers (13%). Over forecasting returns to some rivers while under forecasting returns to other rivers means that the overall Bristol Bay forecast is often more accurate than the forecast to any individual river.

The department would like to thank the Bristol Bay Fisheries Collaborative (BBFC) for providing funding for fisheries assessment over the past several years during the department's time of budget shortfalls. Without their support, assessment projects integral to the construction of brood tables and in turn this forecast could have been lost. The BBFC began in 2016 and is an agreement between the department and Bristol Bay Science and Research Institute (BBSRI) to work together with stakeholders to restore a world-class fishery management system and raise funds to support and maintain management. We look forward to continuing the collaboration with BBSRI and the

BBFC as we continue to work towards a world-class fishery management system. A list of organizations that committed financial support to the BBFC, as well as additional information about this agreement can be found at <https://www.bbsri.org/bbfc>.

Due to the COVID-19 pandemic, there were many logistical challenges the department faced during the 2021 salmon season in Bristol Bay. Without the generosity of processors and Bristol Bay communities who provided access for our technicians to collect data, critical information needed to develop this forecast would not have been available. The department would like to extend its gratitude for keeping our crews safe and our data collection continuous.

Table 1.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay River systems in 2022.

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

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

<sup>a</sup> Projected harvest is based on the current 5-year running average exploitation rate of 2.5%.

<sup>b</sup> Nushagak River forecast total includes approximately 52,000 age-0.3 and age-1.4 fish.

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