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Advisory Announcement

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2023 Bristol Bay Sockeye Salmon Forecast

FORECAST OF THE 2023 RUN:

TOTAL PRODUCTION:	Forecast (millions)	Forecast range (millions)
Total run	51.07	36.58–65.56
Escapement	13.01	
Total harvestable surplus	38.06	
Bristol Bay harvestable surplus	36.66	
South Peninsula	1.41	
Inshore Run	49.66	

The sockeye salmon total run forecast for Bristol Bay in 2023 is predicted to be **strong** with a point estimate of **51.07 million fish and a range of 36.58–65.56 million fish (80% confidence interval).** The categorical ranges of sockeye salmon total run strength were formulated from the 20th, 40th, 60th, and 80th percentiles of historical total runs over the 61-year time series (1961–2022; Table 1). Since 2001, the forecasts have on average under-forecast the run by 14%, ranging from 44% below the actual run in 2014 to 19% above the actual run in 2011 (Figure 1).

Table 1. Categorical ranges of sockeye salmon total run and this year's forecast in bold.

Category	Range (millions)	Percentile
Poor	Less than 19	Less than 20th
Weak	19 to 27	20th to 40th
Average	27 to 42	40th to 60th
Strong	**42 to 52**	**60th to 80th**
Excellent	Greater than 52	Greater than 80th

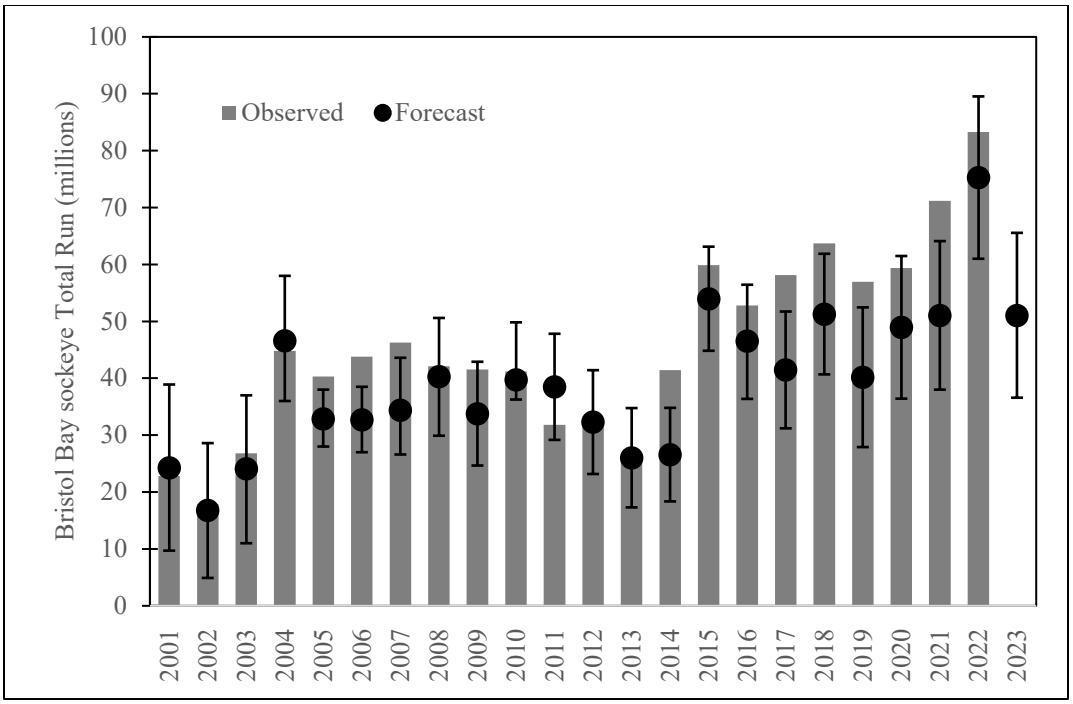

Figure 1. Annual observed total run of sockeye salmon in Bristol Bay compared to preseason total run forecasts, 2001–2023. Error bars represent 80% confidence intervals of forecasts.

METHODS

The 2023 Bristol Bay sockeye salmon forecast is the sum of individual predictions of 9 river systems (Kvichak, Alagnak, Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak, and Togiak Rivers) and four age classes (ages 1.2, 1.3, 2.2, and 2.3). Adult escapement and return data from brood years 1972–2019 were used in the analyses for most rivers.

Forecasts for each age class returning to a river system were derived from models based on the relationship between adult returns of that age class and either total returns or sibling returns from the same brood years. The average return over the last 5 years was also considered as a forecast model. In general, models with statistically significant parameters and/or the best past performance metrics were chosen. Performance was evaluated using mean absolute deviation, 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 75th percentile of the escapement goal range if the forecast is in the upper range of historical run sizes (Naknek, Egegik, Wood, Igushik, and Nushagak rivers in 2023), as the 50th percentile of the escapement goal range if the forecast is in the mid-range of historical run sizes (Togiak River in 2023), and as the 25th percentile of the escapement goal range if the forecast is in the lower range of historical run sizes (Kvichak and Ugashik rivers in 2023; Table 2). 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, an average of 2.76% 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.

RESULTS

A total of 51.07 million sockeye salmon (within a range of 36.58–65.56 million) are expected to return to Bristol Bay in 2023 (Table 2). This is 10% smaller than the most recent 10-year average of Bristol Bay total runs (57.24 million fish) and 40% greater than the long-term (1963–2022) average of 36.52 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 2005 through 2022.

A run of 51.07 million sockeye salmon would allow for a potential harvestable surplus of 38.06 million fish: 36.66 million fish in Bristol Bay and 1.41 million fish in the South Peninsula June fishery. A Bristol Bay harvest of this size is 3% less than the most recent 10-year average harvest of 37.81 million (ranging from 15.38 to 60.56 million), and 38% greater than the long-term average harvest of 22.79 million fish (1963 to 2022).

Age-specific forecasts for the 2023 run consists of 16.89 million age-1.2 fish (33% of the total run), 5.44 million age-2.2 fish (11% of the total run), 23.64 million age-1.3 fish (46% of the total run), and 4.77 million age-2.3 fish (9% of the total run; Table 2).

DISCUSSION

Forecasting future salmon returns is inherently difficult and uncertain. The department has 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, forecasts have, on average, under-forecast the run by 14% 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 15% since 2001.

Individual river forecasts have greater uncertainty compared to the baywide forecast. Since 2001, the department has on average, under forecast returns to the Alagnak (-32%), Togiak (-12%), Kvichak (-22%), Wood (-20%), Nushagak (-23%), Ugashik (-4%), and Naknek (-13%) rivers, and over forecast returns to the Igushik (9%) and Egegik rivers (12%). 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 support a world-class fishery management system and raise funds to support and maintain management. 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.

Table 2.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay River systems in 2023.

DISTRICT	Millions of Sockeye Salmon								
	Forecasted Production by Age Class					Forecasted		South	
River	1.2	2.2	1.3	2.3	Total	Escapement	Surplus	Peninsula [a]	BB Inshore
NAKNEK-KVICHAK									
Kvichak	2.77	1.20	3.76	0.41	8.14	4.00	3.91	0.22	7.91
Alagnak	1.62	0.17	2.19	0.20	4.18	2.06	2.01	0.12	4.07
Naknek	2.55	0.55	2.87	0.58	6.55	1.70	4.67	0.18	6.37
Total	6.94	1.91	8.82	1.19	18.86	7.76	10.59	0.52	18.34
EGEGIK	1.16	2.42	5.23	2.60	11.42	1.70	9.40	0.31	11.10
UGASHIK	1.36	0.54	1.25	0.20	3.35	0.73	2.53	0.09	3.26
NUSHAGAK									
Wood	4.85	0.43	2.27	0.46	8.01	1.53	6.27	0.22	7.79
Igushik	0.64	0.01	1.11	0.01	1.77	0.34	1.39	0.05	1.72
Nushagak	1.72	0.13	4.48	0.30	6.95 [b]	0.77	5.99	0.19	6.76
Total	7.21	0.57	7.87	0.77	16.74	2.63	13.64	0.46	16.27
TOGIAK	0.23	0.00	0.47	0.00	0.70	0.20	0.49 [c]	0.02	0.68
BRISTOL BAY	16.89	5.44	23.64	4.77	51.07	13.01	36.66	1.41	49.66
	33%	11%	46%	9%	100%				

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

[a] Projected harvest is based on the current 5-year running average exploitation rate of 2.76%.

[b] Nushagak River forecast total includes approximately 324,000 age-1.4 fish.

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