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Advisory Announcement

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2021 Bristol Bay Sockeye Salmon Forecast

FORECAST AREA: Bristol Bay

SPECIES: Sockeye salmon

FORECAST OF THE 2021 RUN:

| TOTAL PRODUCTION: | Forecast (millions) | Forecast range (millions) |
|-------------------------|------------------------|------------------------------|
| Total run | 51.06 | 38.00 – 64.11 |
| Escapement | 13.69 | |
| Commercial harvest | 37.37 | |
| Bristol Bay harvest | 36.35 | |
| South Peninsula harvest | 1.02 | |
| Inshore run | 50.04 | |

METHODS

The 2021 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, plus ages 0.3 and 1.4 for the Nushagak River). Adult escapement and return data from brood years 1972–2017 were used in the analyses.

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 department will manage escapements proportional to the run size and relative to the historical record (5AAC 06.355(d)(1)). Escapement is projected as the 75th quartile of the escapement range if the forecast is above the historical average (Naknek, Egegik, Ugashik, Wood, and Nushagak rivers in 2021), as the midpoint (50th quartile) of the escapement range if the forecast is in line with the historical average (Igushik and Togiak rivers in 2021), and as the 25th quartile of

the escapement goal range if the forecast is below the recent historical average (Kvichak River in 2021; 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 harvest. About 2% of the Bristol Bay return is thought to be intercepted in the South Peninsula in June and that interception in other areas is trivial for the purposes of run reconstruction and forecasting. Preseason harvest 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 51.06 million sockeye salmon (within a range of 38.00–64.11 million) are expected to return to Bristol Bay in 2021. This is 6% larger than the most recent 10-year average of Bristol Bay total runs (48.14 million) and 45% greater than the long-term (1963–2020) average of 35.12 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 2003 through 2020.

A run of 51.06 million sockeye salmon would allow for a potential total harvest of 37.37 million fish: 36.35 million fish in Bristol Bay and 1.02 million fish in the South Peninsula fisheries. A Bristol Bay harvest of this size is 13% greater than the most recent 10-year harvest of 32.23 million which has ranged from 15.38 million to 42.94 million, and 40% greater than the long-term average harvest of 21.88 million fish (1963 to present).

The run forecast for each district and river system is as follows: 17.35 million to Naknek-Kvichak District (6.37 million to the Kvichak River, 3.75 million to the Alagnak River, and 7.23 million to the Naknek River); 11.18 million to the Egegik District; 6.66 million to the Ugashik District; 15.06 million to the Nushagak District (7.94 million to the Wood River, 5.76 million to the Nushagak River, and 1.35 million to the Igushik River); and 0.82 million to the Togiak District (Table 1).

We forecast that the 2021 run will consist of 23.82 million age-1.2 fish (47% of the total run), 5.25 million age-2.2 fish (10% of the total run), 19.93 million age-1.3 fish (39% of the total run), and 2.01 million age-2.3 fish (4% of the total run; Table 1).

DISCUSSION

Historically, sockeye salmon runs to Bristol Bay have been highly variable. The Bristol Bay total run has averaged 35.12 million from 1963 through 2020 and has averaged 48.14 million fish during the most recent 10-year period. 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 11% and have ranged from 36% below the actual run in 2014 to 21% above the actual run in 2011. Forecasted harvests have had a mean absolute percent error of 15% since 2001.

Individual river forecasts have greater uncertainty compared to bay-wide forecasts. Since 2001, on average, we have under forecast returns to the Alagnak (-32%), Togiak (-14%), Kvichak (-20%), Wood (-18%), Nushagak (-21%), Ugashik (-1%), and Naknek (-16%) rivers, and over forecast returns to the Igushik (13%) 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 funding assistance in 2020. The BBFC began in 2016 and is an agreement between ADF&G and the 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. This agreement is supported by ADF&G, BBSRI, Bristol Bay Regional Seafood Development Association (BBRSDA), setnet fishermen, processors, municipalities, villages, support industries and other stakeholders. BBFC provided \$600,000 towards Bristol Bay management in 2020. 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 2020 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.

Greg Buck, Jordan Head and Stacy Vega
Bristol Bay Commercial Fisheries Division Research Staff

Table 1.–Forecast of total run, escapement, and harvest of major age classes of sockeye salmon returning to Bristol Bay river systems in 2021.

| DISTRICT | River | Millions of sockeye salmon | | | | | | | South Peninsula ^a | BB Inshore |
|----------------|----------|------------------------------------|------|-------|------|-------------------|------------|-------------------|------------------------------|------------|
| | | Forecasted production by age class | | | | Total | Forecasted | | | |
| | | 1.2 | 2.2 | 1.3 | 2.3 | | Escapement | Harvest | | |
| NAKNEK-KVICHAK | | | | | | | | | | |
| | Kvichak | 3.21 | 0.55 | 2.54 | 0.07 | 6.37 | 4.00 | 2.24 | 0.13 | 6.24 |
| | Alagnak | 1.70 | 0.12 | 1.84 | 0.09 | 3.75 | 2.35 | 1.32 | 0.07 | 3.67 |
| | Naknek | 3.19 | 0.27 | 3.45 | 0.32 | 7.23 | 1.70 | 5.39 | 0.14 | 7.09 |
| | Total | 8.10 | 0.94 | 7.82 | 0.48 | 17.35 | 8.05 | 8.95 | 0.35 | 17.00 |
| EGEGIK | | | | | | | | | | |
| | | 4.33 | 3.51 | 2.05 | 1.29 | 11.18 | 1.70 | 9.26 | 0.22 | 10.96 |
| UGASHIK | | | | | | | | | | |
| | | 3.89 | 0.64 | 1.97 | 0.16 | 6.66 | 1.18 | 5.35 | 0.13 | 6.52 |
| NUSHAGAK | | | | | | | | | | |
| | Wood | 5.31 | 0.12 | 2.47 | 0.04 | 7.94 | 1.53 | 6.26 | 0.16 | 7.79 |
| | Igushik | 0.39 | 0.01 | 0.94 | 0.01 | 1.35 | 0.28 | 1.05 | 0.03 | 1.32 |
| | Nushagak | 1.48 | 0.03 | 4.17 | 0.02 | 5.76 ^b | 0.77 | 4.88 | 0.11 | 5.65 |
| | Total | 7.19 | 0.15 | 7.59 | 0.07 | 15.06 | 2.57 | 12.19 | 0.30 | 14.76 |
| TOGIK | | | | | | | | | | |
| | | 0.31 | 0.01 | 0.50 | 0.00 | 0.82 | 0.20 | 0.60 ^c | 0.02 | 0.80 |
| BRISTOL BAY | | | | | | | | | | |
| | | 23.82 | 5.25 | 19.93 | 2.01 | 51.06 | 13.69 | 36.35 | 1.02 | 50.04 |
| | | 47% | 10% | 39% | 4% | 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 2.0%.

^b Nushagak River forecast total includes approximately 52,000 age-0.3 and age-1.4 fish.

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