

# Bristol Bay Sockeye Salmon

## UW-FRI

### Inseason Report #1

*June 18, 2020*

#### 1 Introduction

During the 2020 season, UW-FRI inseason forecast methods will use three primary sources of information to generate run size estimates:

1) UW-FRI preseason forecast, 2) Port Moller catch per unit effort (CPUE) and associated age and genetic composition information, and 3) catch + escapement to date (C+E). Given the sensitivity of inseason predictions based on these data to inshore run timing, we will also use the distribution of Port Moller catches to inform estimates of run timing and update forecasts accordingly.

Throughout 2019 we developed and tested a fully Bayesian version of the inseason forecast model that integrates the data sources listed above to generate predictions for Bristol Bay run size. This “Bayesian updating” inseason forecast model shares many similarities with the traditional “weighted inseason” model in that it: (1) weights forecasts based on past performance on a given date, and (2) updates those weights across the season as different data become more informative. The *main difference* is that this “Bayesian updating” approach estimates the relative probability of different 2020 run sizes conditioned on current observations of salmon abundance and timing (data), our “prior” prediction of run size from the preseason forecast, and the uncertainty in predictions based on the different sources of information (uncertainty).

Retrospective performance testing (i.e. re-running daily forecasts 2000-2019 and comparing predictions to the true run size) and parallel comparison of this model with predictions from the traditional “weighted inseason model” during the 2019 season both indicate that this new Bayesian updating approach provides more accurate inseason predictions and reduced sensitivity to

variation in run timing, by permitting a broader diversity of prediction methods.

In addition to our inseason forecast reports, we provide an online supplement with up-to-date versions of several standard graphs often included in our reports. This webpage displays C+E and Port Moller test fishery data, and is intended to track the daily progression of the 2020 season compared with the preseason forecast and recent years. The online supplement provides a quick reference on the progress of the Bristol Bay run compared to expectations and will be updated whenever new data become available, as opposed to the 4 to 6-day cycle for inseason reports. The online supplement is available at the following link:

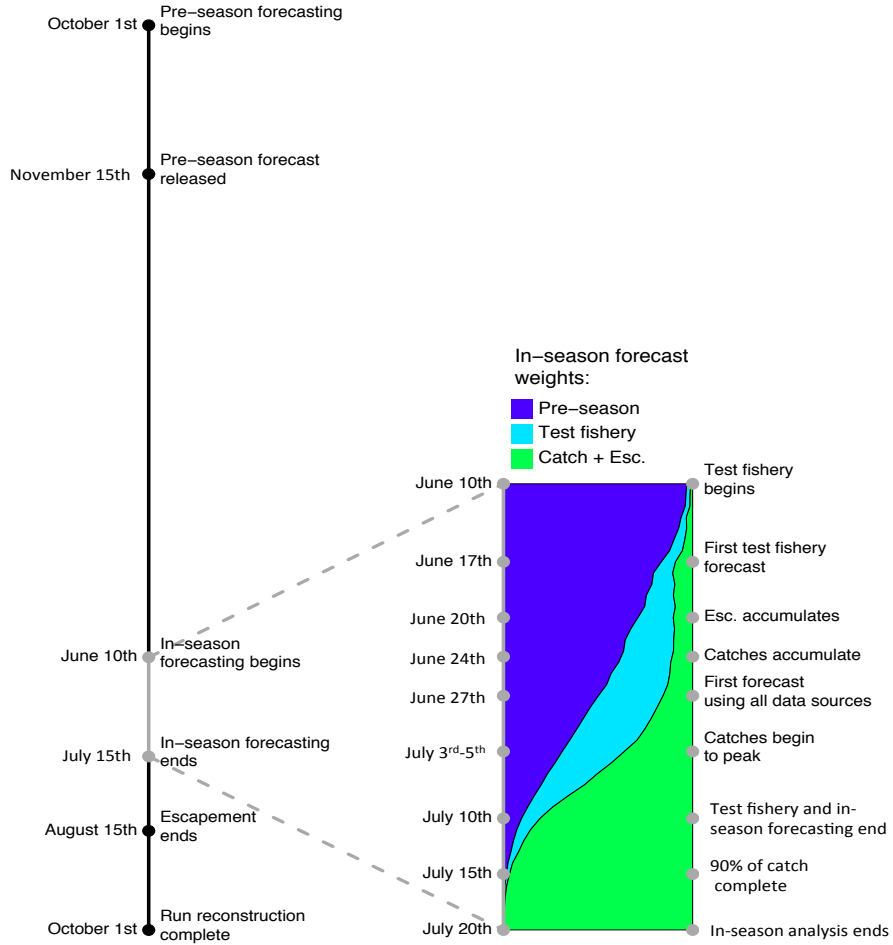
<https://alaskasalmonprogram.org/bristol-bay-daily-updates/>

Figure 1 (page 3) shows a timeline of the UW-FRI forecasting process and accompanying data sources. The vertical line on the left of the figure is the entire year beginning with preseason forecasting in October, through run reconstruction at the end of September. The expansion of the inseason portion of the timeline generally illustrates how different inseason data types are weighted in our overall forecast methods, as they become available and more reliable across the season.

On any particular day, run size estimates based on one type of data will differ from those based on other sources of information. In addition, the accuracy of forecasts based on C+E and Port Moller data change (become more reliable) as the season progresses. The run size forecast generated from each data type contributes to our overall Bristol Bay forecast in proportion to how well forecasts based on that data type have performed historically, on the current date. The width of the shaded area for a particular forecast type in the expanded portion of the inseason forecasting timeline (Figure 1, page 3), indicates the reliability of this type of information relative to other data types available at that time and the *approximate* weight it receives in the overall forecast.

For instance, at the beginning of the season the preseason forecast is the most reliable source of information, as indicated by the width of the dark blue area on June 10-15. This is due to the fact that the Port Moller test fishery has just started and there is very little or no catch and escapement information through that date. However, by the middle of the season, July 3-5, all three sources of information are equally reliable. Late in the season, when a large proportion

of sockeye have returned, catch and escapement data are the best estimator for total run size.



**Figure 1. Data and forecasting time-line:** The area plot for the inseason forecasting portion of the year describes the relative weight given to each source of information in the overall weighted UW-FRI forecast.

## 2 Forecast summary

The *Forecast summary* section will include our inseason run size estimate and the preseason forecast for reference. Figure 2 (page 5) compares the 2020 preseason forecast with runs 1970-2019. After this first report the *Forecast summary* will become Section 1.

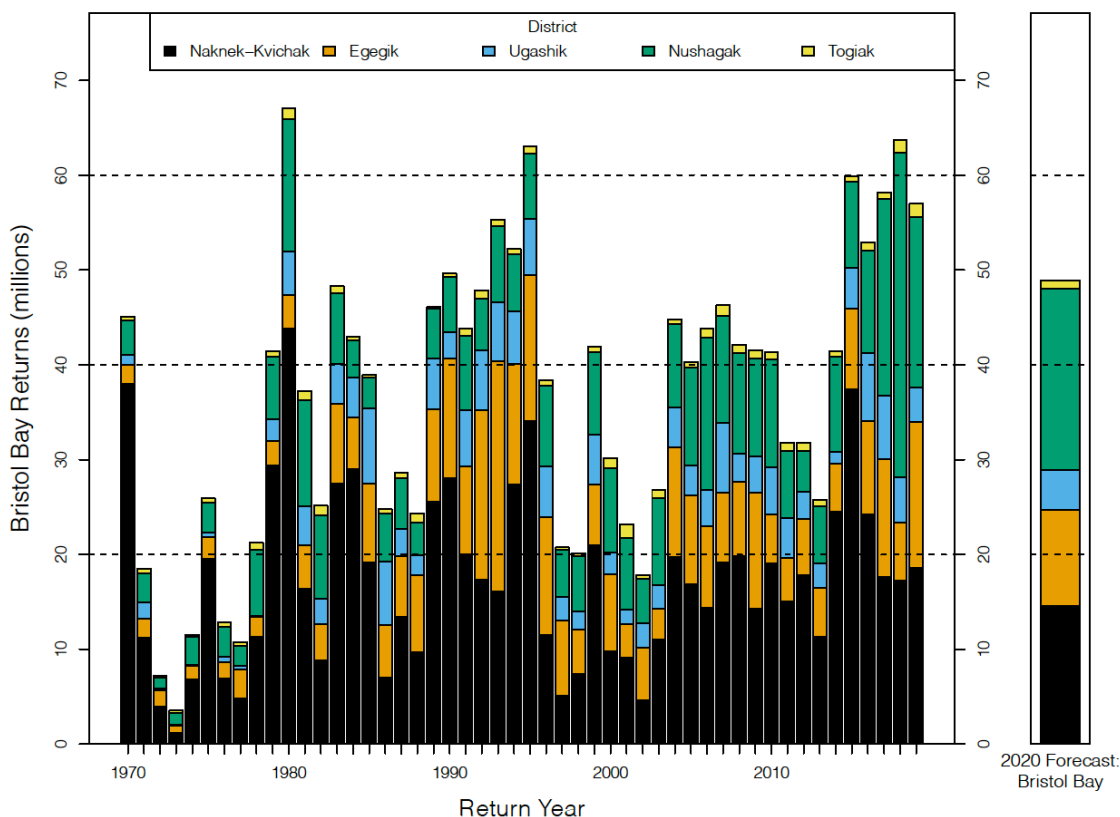
**Table 1: 2020 UW-FRI inseason forecast summary (in thousands).**

Forecast	Sockeye	Projected harvest
Preseason forecast	48,920	36,220
Inseason model	48,920	36,220

**Table 2: 2020 UW-FRI preseason sockeye salmon forecast (in thousands).**

DISTRICT	RIVER	AGES				TOTAL
		1.2	1.3	2.2	2.3	
Nak\Kvi		4,495	8,387	1,132	497	14,511
	Kvichak	2,624	2,773	470	106	5,973
	Naknek	959	4,070	600	367	5,996
	Alagnak	912	1,544	62	24	2,542
Egegik		1,554	6,076	1,366	1,189	10,185
Ugashik		2,437	1,383	359	44	4,223
Nushagak		11,985	6,696	241	80	19,118
	Wood	10,690	3,147	215	45	14,097
	Nushagak	984	2,903	14	27	4,044
	Igushik	311	646	12	8	977
Togiak		145	716	19	3	883
Totals		20,616	23,258	3,117	1,813	48,920

\*The Nushagak River total includes 116,000 0.3 and 1.4 age fish not included in the body of the table



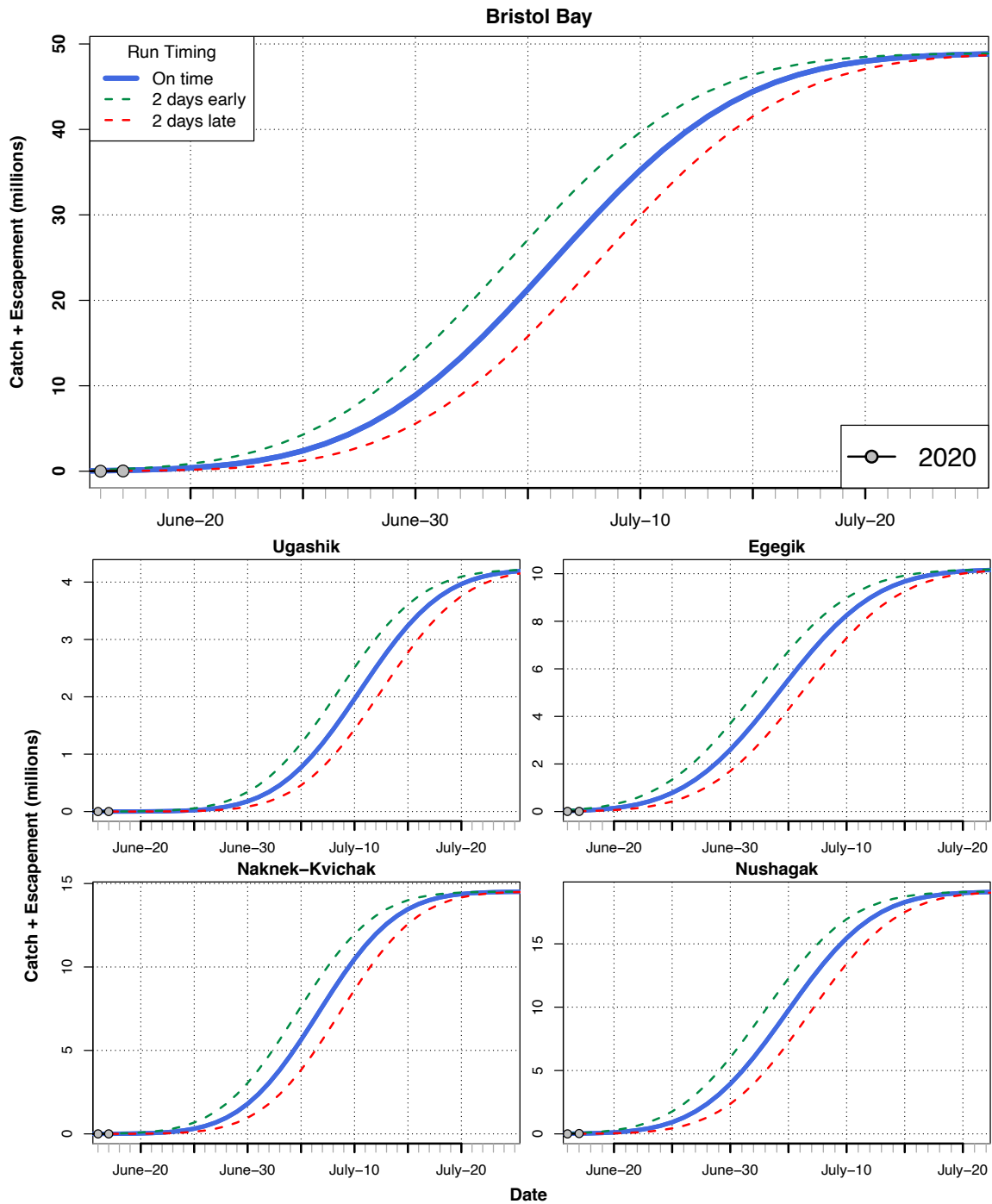
**Figure 2. 2020 Bristol Bay Preseason Forecast:** Comparison of the 2020 UW-FRI preseason forecast with run sizes 1970-2019.

### 3 Catch and escapement

The *Catch and escapement* section will include tables and figures that compare current catch and escapement (C+E) data with what is expected (preseason forecast) and C+E to date in previous years.

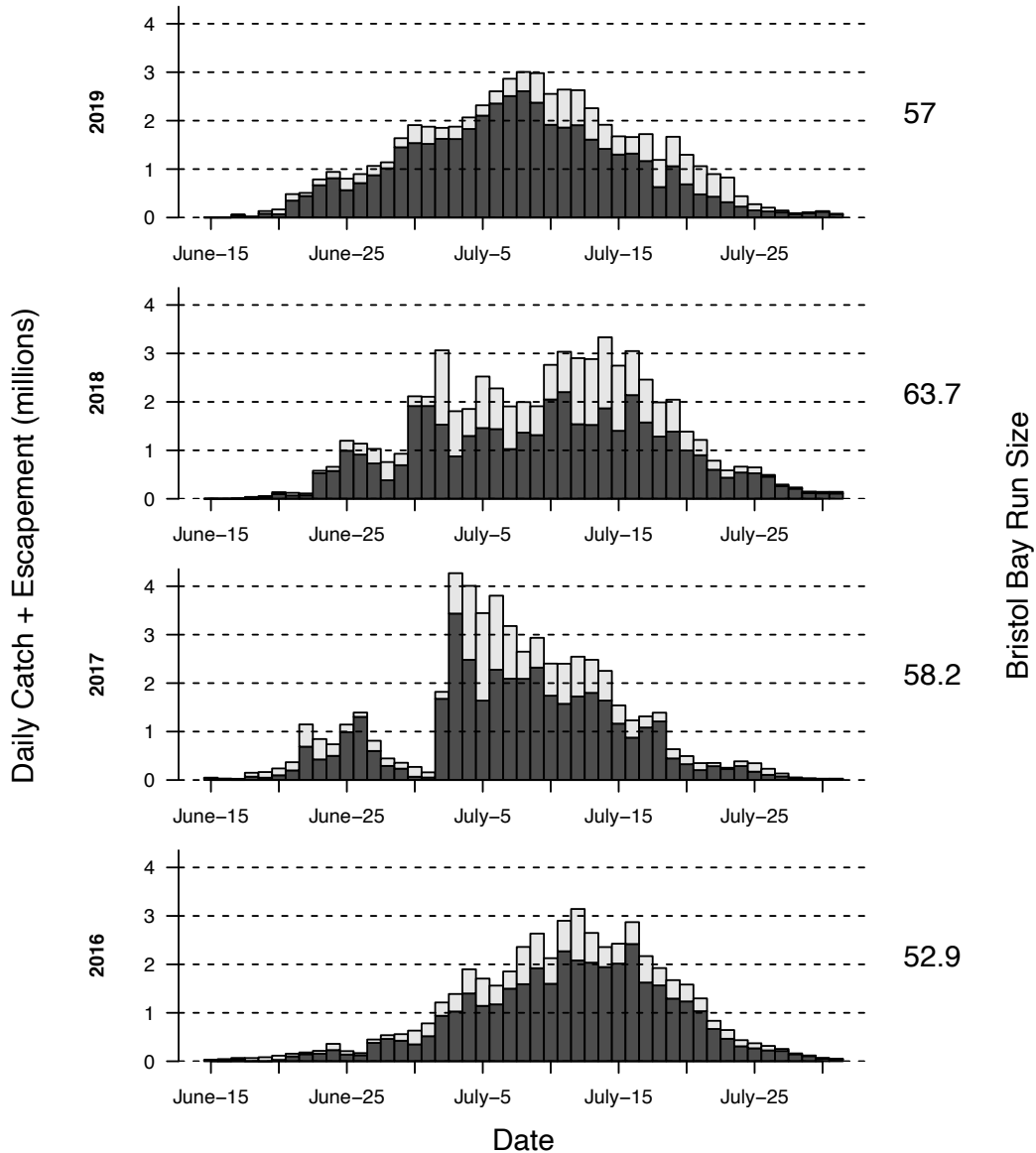
Figure 3 (page 6) displays cumulative C+E to date in 2020 (grey dots), relative to a Bristol Bay run that coincides with the preseason forecast (blue curve), with average run timing and run compression. Figure 3 also shows expected cumulative C+E for runs arriving inshore 2 days early (green dashed line) and 2 days late (red dashed line). The four panels below display this same information for the Ugashik, Egegik, Naknek-Kvichak, and Nushagak districts. Figure 3 indicates that for a Bristol Bay run totaling 48.9 million sockeye, with average run timing, we should expect to have 9 million sockeye inshore (as catch or escapement) by June 30, 21 million sockeye by July 5, and 35 million sockeye by July 10. This figure will be updated daily as part of the online supplement at:

<https://alaskasalmonprogram.org/bristol-bay-daily-updates/>



**Figure 3. Cumulative C+E Comparison:** Comparison of daily cumulative C+E observed for Bristol Bay in 2020, and expected daily values (blue curve). Expected daily values are calculated relative to the 2020 preseason forecast and the average distribution of inshore arrivals (1980–2019). Connected gray dots show the 2020 observed daily cumulative C+E. Green dashed line represents expectations if the run is 2 days early, red dashed line if the run is 2 days late.

Figure 4 (page 7), illustrates daily catch and escapement (non-cumulative) for Bristol Bay 2016–2019. These graphs are a conventional way to look at the distribution of the Bristol Bay sockeye run across seasons, and compare run timing and run compression with previous years. As daily catch and escapement data become available, this figure will be updated with a top panel showing 2020 for comparison purposes, and included with the online supplement.

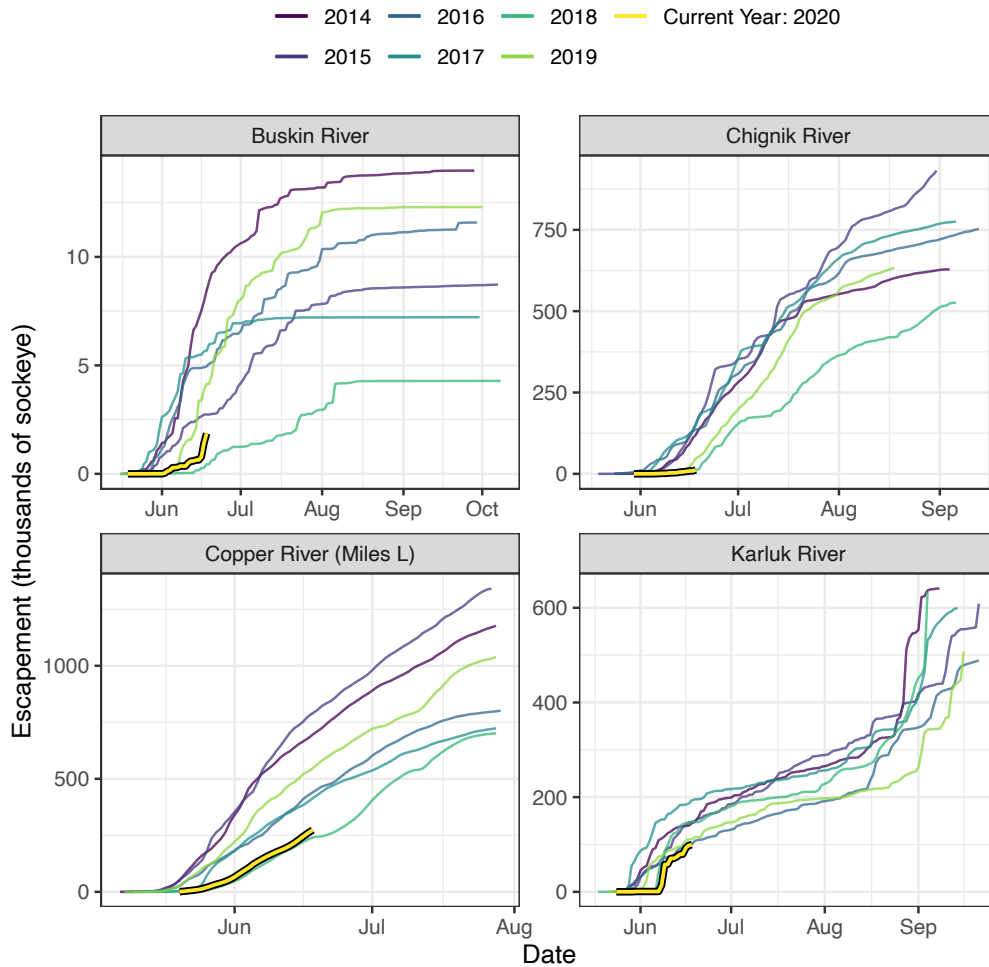


**Figure 4. Daily Catch and Escapement:** Observed catch and escapement for years 2016–2019 as stacked bars. Escapements are in light gray and catches in dark gray. Total run for Bristol Bay is shown in millions of sockeye on the right hand axis.

## 4 Gulf of Alaska sockeye escapement

Early in the season we consider sockeye salmon returns to other parts of Alaska as early indicators of what we might expect in Bristol Bay, under the assumption that these stocks may have experienced similar ocean temperature and productivity conditions. Figure 5 (page 8) shows cumulative sockeye salmon escapement to each river in 2020 compared with 2014-2019. The observation of low escapement combined with little or no harvest, indicates that the 2018 sockeye run to many Gulf of Alaska stocks may be either late or small in number.

However, the correlation between cumulative escapement for these Gulf of Alaska sockeye stocks and the abundance or timing of the Bristol Bay sockeye run is extremely limited, at best, as evidenced by 2018.



**Figure 5. GOA Sockeye Escapement:** 2014-2020 cumulative sockeye escapement to select Gulf of Alaska river systems.



## Contributing Authors:

Curry Cunningham  
Chris Boatright  
Ray Hilborn

## Acknowledgements

The Alaska Department of Fish and Game collects the catch, escapement, and age composition data integral to these analyses. The Bristol Bay Science and Research Institute (BBSRI) operates the Port Moller test fishery, data from which becomes a substantial part of the analysis included in UW-FRI inseason reports. The Alaska Department of Fish and Game Gene Conservation Laboratory analyzes genetic samples collected during the Port Moller test fishery. We thank both BBSRI and ADF&G for making these data available to us prior to and during the Bristol Bay season. We appreciate all of the hard work by individuals collecting data at counting towers, dockside, and on the test fishery boat.