

Bristol Bay Sockeye Salmon

UW-FRI

Inseason Report #5

July 10, 2023

1 Forecast Summary

The current UW-FRI inseason forecast for Bristol Bay run size is **49.1 million** sockeye, with a projected harvest of **36.3 million** sockeye based on current harvest rates (Table 1, page 2). At this point in the season, total C+E corrected for run timing based on Port Moller Test Fishery CPUE is the most reliable predictor of run size. Our inseason model suggests there is 5% chance of a 2023 run size **less than** 40 million sockeye, 56% chance of a run size **less than** 50 million, and a 95% chance of a run size **less than** 60 million sockeye.

During July 6-8 daily catch+escapement declined across the Nushagak, Egegik, and Naknek-Kvichak districts. However, Port Moller Test Fishery daily catch per unit effort (CPUE) remained high across the period June 28-July 3 (Figure 3, page 6; Appendix 4, page 18). The distribution of test fishery CPUE in 2023 suggests that inshore run timing is less than 1 day early (current estimate: 0.34 days early; Figure 4, page 7) and 34% of inshore catch+escapement is yet to arrive inshore. If this is true, we anticipate that daily C+E will rise July 10-12 above 1.5 million fish per day following the forecasted change in wind direction on Tuesday.

The genetic stock composition of Port Moller Test Fishery catch has continued to indicate 26-33% Egegik-bound sockeye through July 3-7, which combined with the high proportion of the 2.3 age class in both test fishery catches and Egegik catch and escapement (Figure 9, page 13), suggests the 2023 Egegik run is likely to exceed its preseason forecast of 11.6 million sockeye salmon.

Based on the current UW-FRI inseason forecast (Table 1, page 2) and the age and genetic composition of Port Moller Test Fishery catches, we provide the estimated “run remaining” (C+E left to come) to each fishing district after July 9, in Table 3 (page 3). We anticipate that 39% of the remaining run is bound

for the Naknek-Kvichak District, 27% for Egegik District, 24% for the Nushagak District, 7% for the Ugashik District, and 3% for the Togiak District.

Table 1. 2023 UW-FRI inseason forecast (in thousands) summary.

Forecast	Sockeye	Projected harvest
Preseason forecast	49,984	34,950
Weighted model	49,065	36,300

Table 2. 2023 UW-FRI preseason sockeye salmon forecast (in thousands).

DISTRICT	RIVER	AGES				TOTAL
		1.2	1.3	2.2	2.3	
Nak\Kvi		6,115	9,324	1,242	1,136	17,817
	Kvichak	1,901	5,497	566	498	8,462
	Naknek	2,686	2,249	559	423	5,917
	Alagnak	1,528	1,578	117	215	3,438
Egegik		2,003	6,199	1,530	1,829	11,561
Ugashik		1,181	1,302	403	282	3,168
Nushagak		6,655	9,364	160	445	16,838
	Wood	5,244	2,703	80	279	8,306
	Nushagak	800	5,403	71	159	6,647
	Igushik	611	1,258	9	7	1,885
Togiak		114	472	11	3	600
Totals		16,068	26,661	3,346	3,695	49,984

*The Nushagak River total includes 214,128 0.3 and 1.4 age fish not included in the body of the table

The UW-FRI online supplement is updated daily and available at:
<https://alaskasalmonprogram.org/bristol-bay-daily-updates/>

2 Catch and Escapement

The total (i.e. cumulative) catch plus escapement (C+E) through July 9 of 28.7 million sockeye is **higher** than the historical average (1980-2022) of 26.6 million. Total C+E through July 9 was 54.0 million sockeye in 2022 (run size: 83.3 million), 42.3 million in 2021 (run size: 71.2 million), and 26.2 million in 2020 (run size: 58.8 million).

Through July 6, total Bristol Bay C+E was very close to the level expected for a run size equal to the preseason forecast (50 million) with average run timing, however lower than expected catches in the Egegik, Nushagak, and Naknek-Kvichak districts on July 7-8 have caused total 2023 C+E (grey dots) to fall below expectations (blue line) by 13.3% (Figure 1, page 4).

Based on our current inseason forecast for Bristol Bay of 49.1 million sockeye salmon, the age and genetic composition of test fishery catches, and current total C+E, we have estimated the run remaining to arrive inshore to each fishing district (Table 3, below). In Table 3, the “Run remaining” is the total C+E projected for each district after July 9 (i.e. July 10+).

Table 3. Projected Run Remaining by District: The preseason forecast, observed total catch plus escapement (C+E) through July 9, and our current inseason run size projection are shown by district (in thousands). The run remaining is the projected number of sockeye yet to arrive to each district in 2023, after July 9.

	DISTRICT					Total
	Ugashik	Egegik	Nak/Kvi	Nushagak	Togiak	
Preseason forecast	3,168	11,559	17,817	16,843	603	49,991
Observed inshore C+E through 7/9	807	7,813	7,857	12,147	80	28,704
Current inseason run size prediction	2,220	13,380	15,858	16,989	618	49,065
Run remaining	1,413	5,566	8,001	4,842	538	20,361

At this point in the season cumulative (total) C+E becomes an increasingly reliable predictor of total Bristol Bay run size. Figure 2 (page 5) shows the relationship between total C+E through July 9 (horizontal axis) and total run size (vertical axis), in millions of sockeye. Each point is an individual year 1980-2022. The blue diagonal line is the average relationship between cumulative C+E and annual run size to each fishing district, and the dashed red line indicates the prediction for 2022 assuming average run timing.

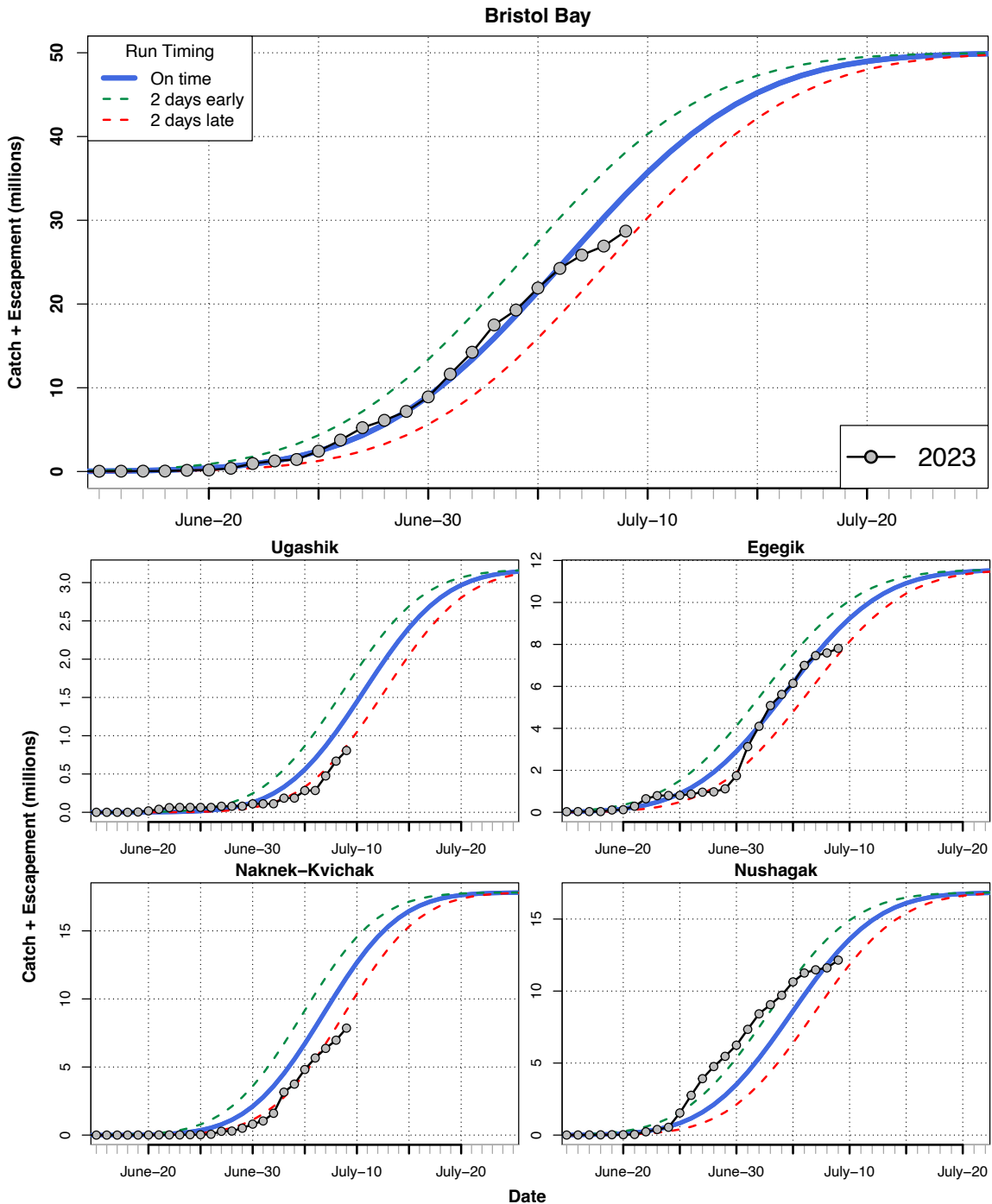


Figure 1. Cumulative C+E Comparison: Comparison of daily cumulative C+E observed for Bristol Bay in 2023, and expected daily values (blue curve). Expected daily values are calculated relative to 2023 preseason forecasts and the average distribution of inshore arrivals (1980–2022). Connected gray dots show the 2023 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.

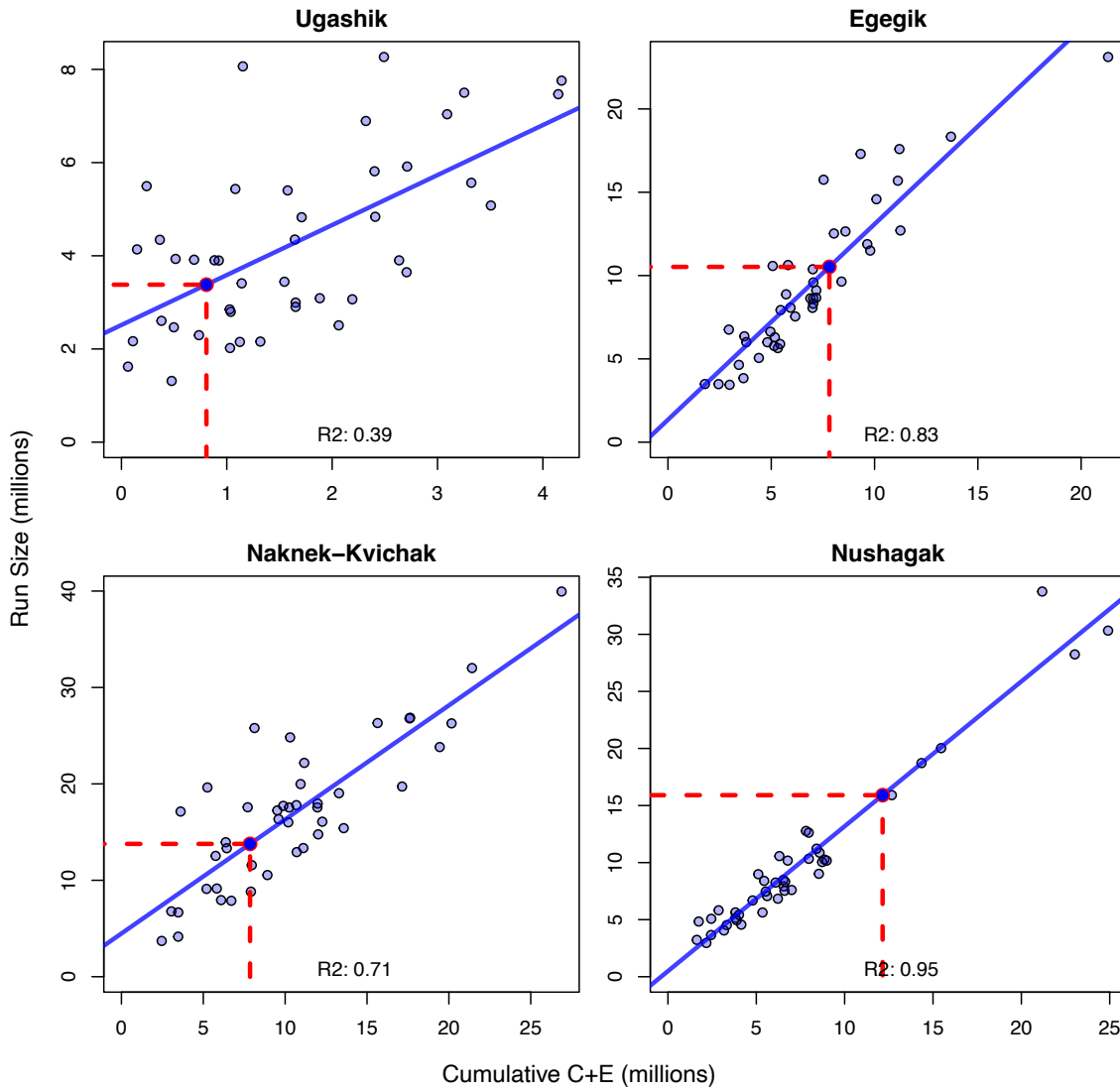


Figure 2. District Run Size Predictions Based On Cumulative C+E: Predictions for run size by district based on cumulative C+E through July 9 *assuming average run timing*. Points are the individual years 1980-2022 and the blue line is the average relationship between cumulative catch + escapement (C+E) through this date and total run size for each year.

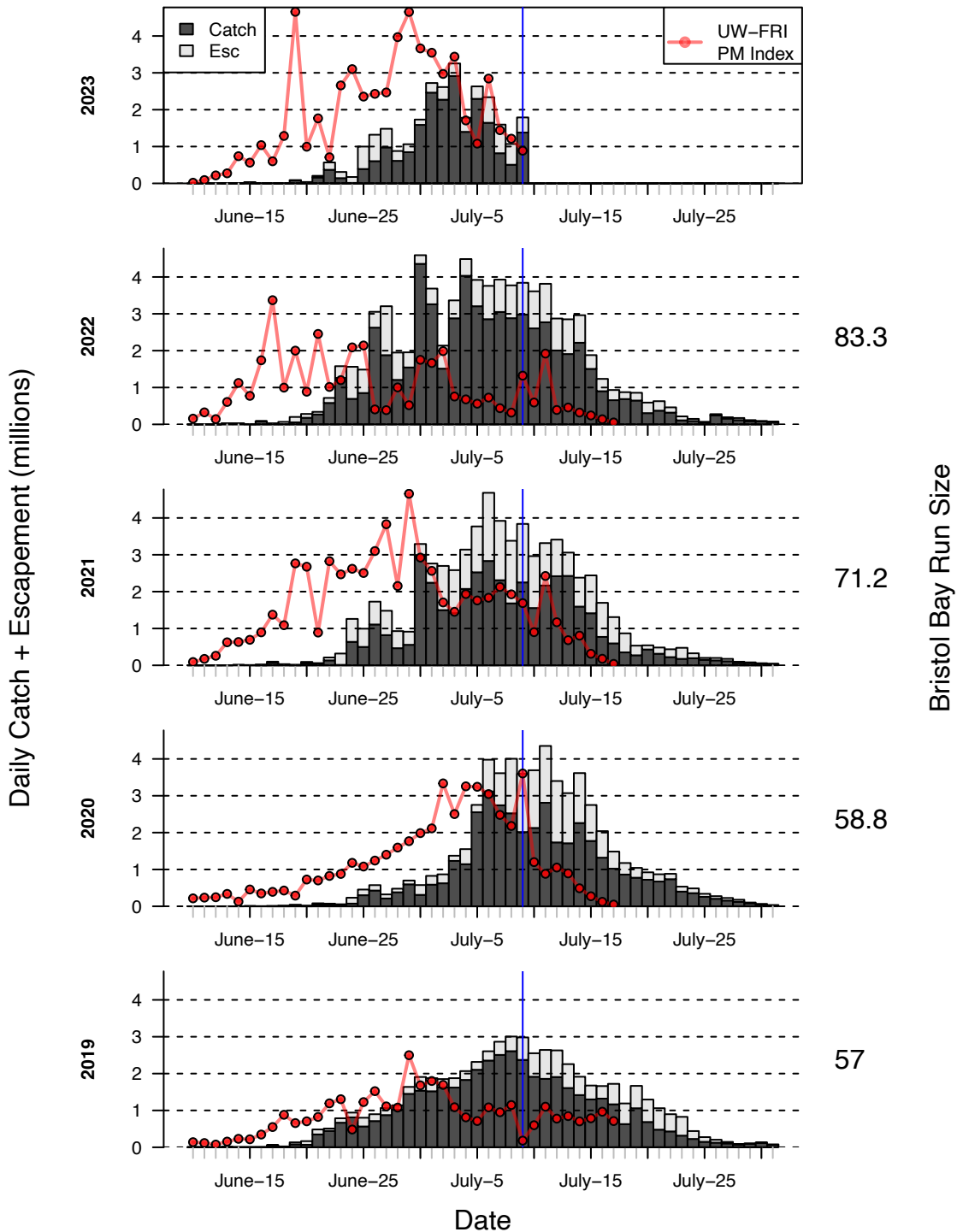


Figure 3. Daily C+E and Port Moller Index: Observed catch and escapement for years 2019-2023 as stacked bars and the daily UW-FRI Port Moller Index (observed and interpolated) as a red dotted line. Escapements are in light gray and catches in dark gray. Total Bristol Bay run size in millions of sockeye is shown at the right. Daily Port Moller indices (red) are scaled relative to the maximum across years.

3 Port Moller CPUE

Daily Port Moller Test Fishery CPUE (catch per unit effort) indicated strong passage of sockeye salmon into Bristol Bay June 28-July 3 before beginning to decline after July 3 (Figure 5, page 8). The distribution of daily Port Moller CPUE suggests the midpoint of fish passing the test fishery transect occurred on June 28-30 or very close to the 1990-2022 average. This suggests inshore run timing for Bristol Bay is likely very close to average (current estimate: 0.34 days early), placing the median date (i.e. date on which 50% of season total C+E was observed) on July 6-7 (Figure 4, below).

The relationship between the timing of the “peak” or midpoint in Port Moller CPUE and the proportion of season total C+E observed through July 9 in past years is shown in Figure 6 (page 9). Based on this relationship (red line and shaded 50% and 95% confidence intervals) it appears most likely that 66% of the total 2023 run was recorded inshore as C+E through July 9, with at least 34% of the run yet to arrive inshore.

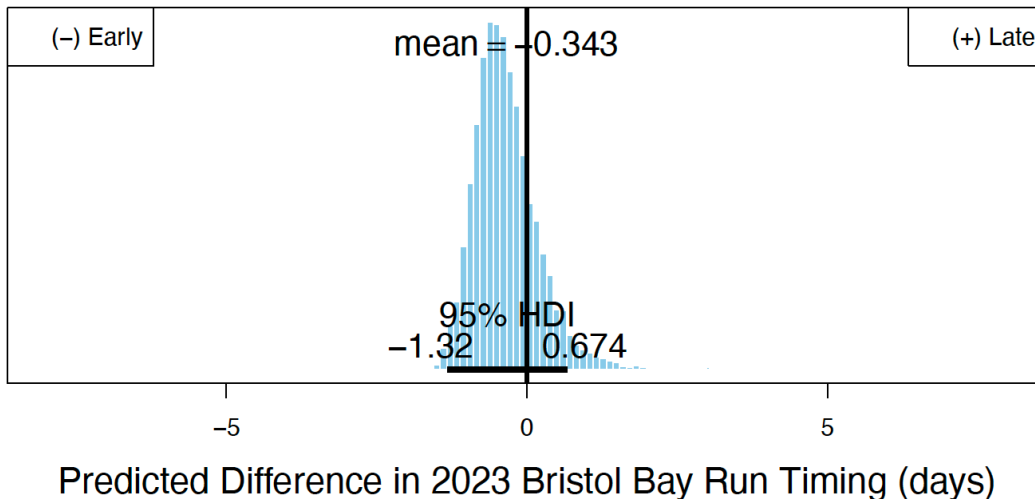


Figure 4. Probability Distribution for 2023 Bristol Bay Arrival Timing: Height of bars show the relative probability of differences between the 2023 Bristol Bay median date and the 1990-2022 average. 95% HDI describes the range of run timings with 95% of probability (1.32 days early – 0.67 days late). The most likely value (mean) for 2023 Bristol Bay run timing is 0.34 days earlier than the recent (1990-2022) average.

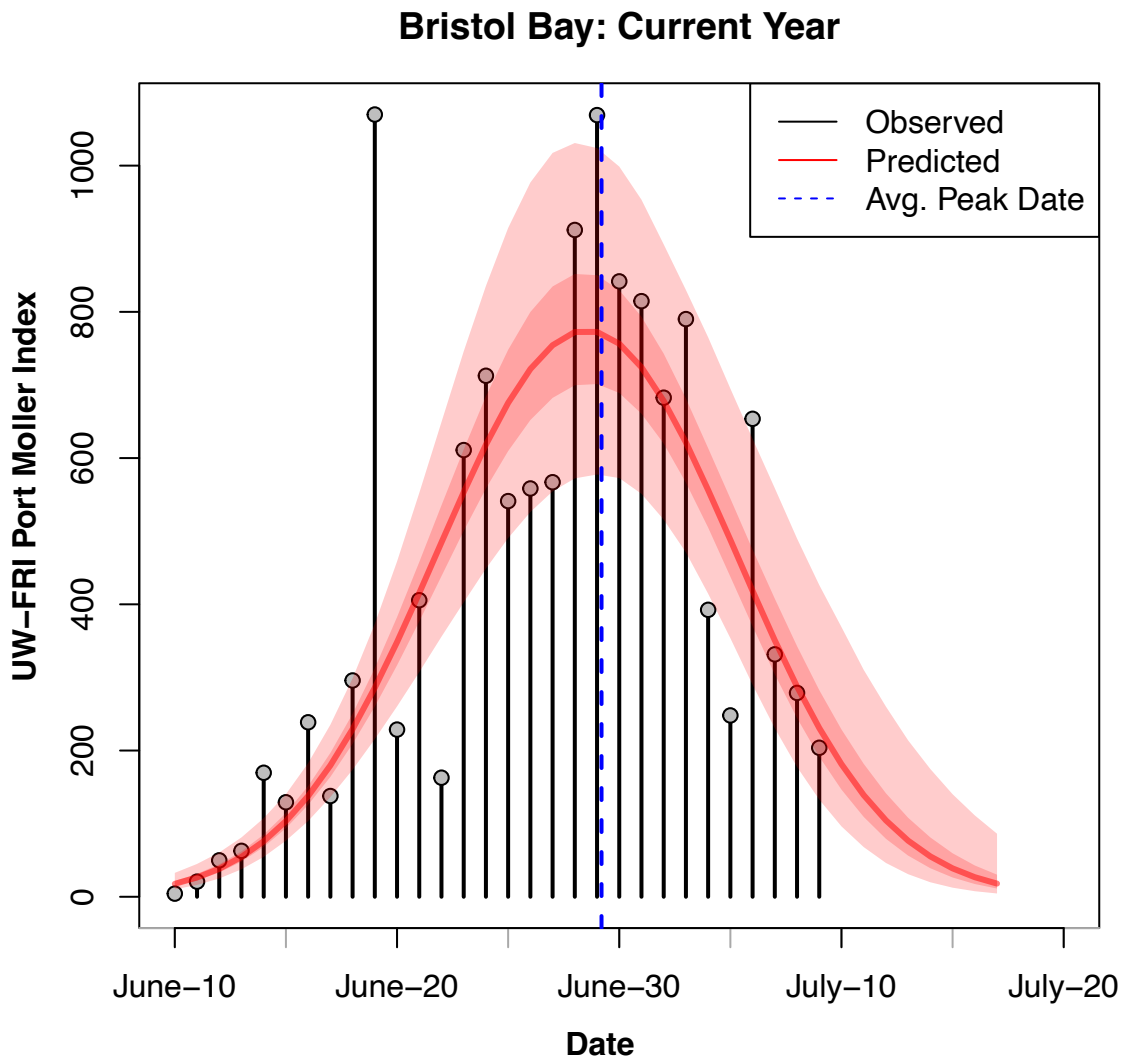


Figure 5. Predicted Port Moller Distribution: The daily UW-FRI Port Moller index (grey points and vertical black bars) and the predicted distribution of fish passing the test fishery transect (red line and shaded 50% and 95% credible intervals). The average “peak” (midpoint) date (1990-2022) of fish passing the Port Moller transect (June 29-30) is identified by a vertical dashed blue line. A “peak” in the predicted distribution (red) to the left of the average “peak” date (blue dashed line) indicates earlier than average run timing, while a “peak” to the right of the of average “peak date” would indicate later-than-average run timing.

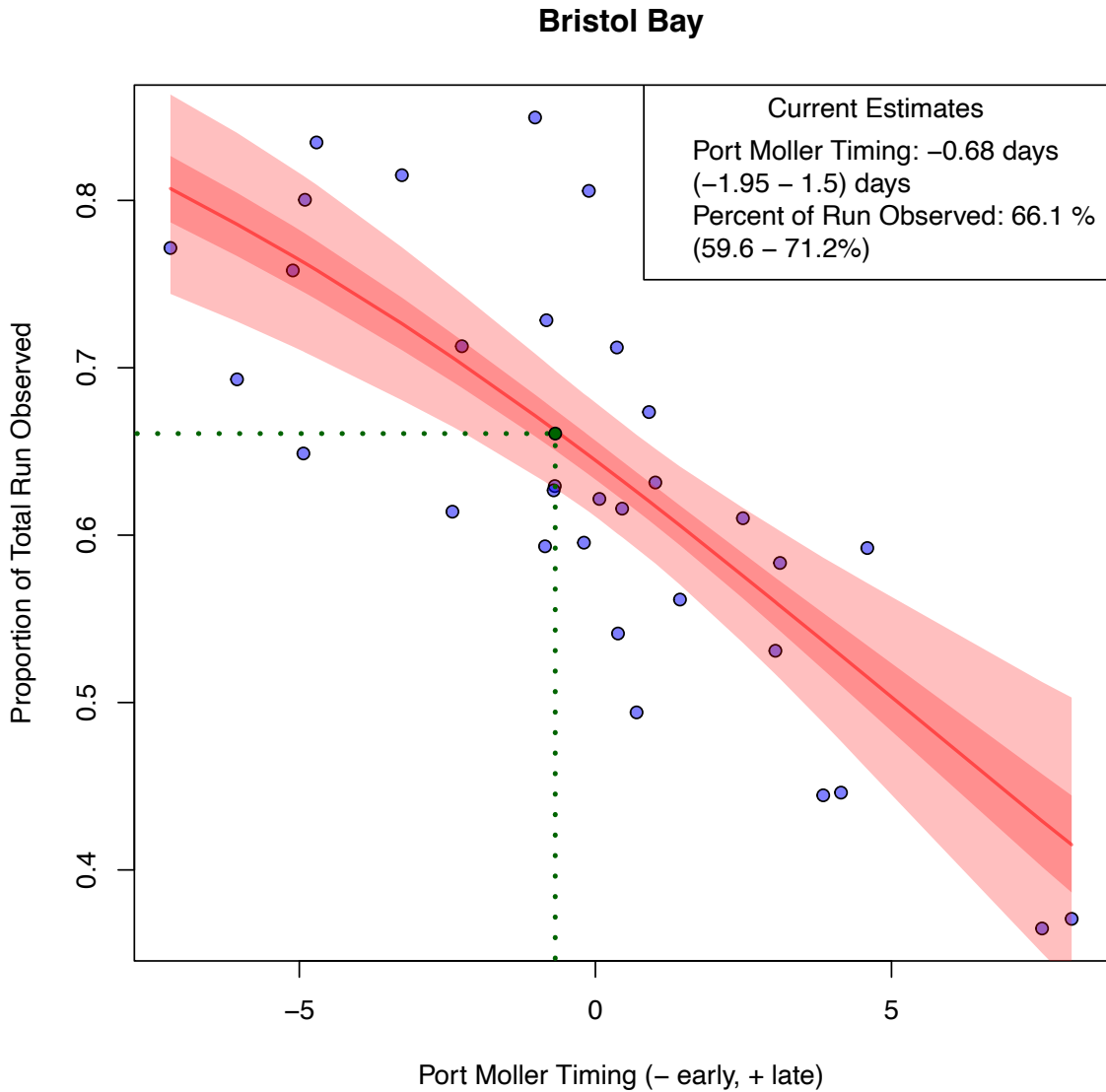


Figure 6. Relationship Between Port Moller Timing and the Run Proportion Observed: The x-axis describes the difference in the midpoint of Port Moller Test Fishery CPUE from the long-term average (June 29-30, set to 0). The y-axis describes the proportion of the total run observed through July 10. Each blue point is an individual year (1990-2022). The red line and shaded region describe the average relationship and uncertainty, between the timing of fish passing the Port Moller test fishery (- early, + late) and the proportion of the run observed through July 9. The green dotted lines highlight our current estimate for the midpoint in test fishery CPUE (x-axis) and the resulting prediction for the proportion of the 2023 run observed as C+E through July 9 (y-axis). Ranges in parentheses are the 95% credible intervals (i.e. uncertainty) for estimates of the Port Moller midpoint and proportion of run observed.

4 Port Moller Genetics

Port Moller Test Fishery genetic composition estimates from samples collected thus far (June 14 – July 7) remain very close to the district percentages expected from the preseason forecast, when adjusted for run timing. The adjusted percentages are based on the consistent historical differences between the observed stock proportions in test fishery catches and the eventual inshore run each year, due to run timing. Thus, we list both the actual cumulative percentages as well as the “adjusted” percentages, showing by district what Bristol Bay stocks are passing the test fishing transect, and what this suggests about the percentage each district is likely to represent of the 2023 Bristol Bay run as a whole (Figure 7, page 11).

Figure 7 (page 11) and Table 4 (below) compare the percentage each district represented in our preseason forecast (black bar), with the percentage of each district in fish to have passed through the Port Moller Test Fishery to date (yellow bar), and the estimated percentage of the total run that each district will represent after adjustment for run timing (blue bars).

Table 4. Run Proportions by District: Comparison of predictions for 2023 Bristol Bay run percentages by district with cumulative inshore catch and escapement and cumulative genetic samples collected in the Port Moller test fishery through July 6-7. Predictions are based on the pre-season forecast and cumulative genetic samples collected in the Port Moller test fishery, adjusted for historical over/under-representations by district through the current date.

	DISTRICT				
	Ugashik	Egegik	Nak/Kvi	Nushagak	Togiak
Preseason forecast	6.3%	23.1%	35.6%	33.7%	1.2%
Cumulative Port Moller genetic samples	3.3%	31.0%	27.5%	37.7%	0.4%
Average historical deviation	1.2%	5.8%	-9.1%	3.5%	-1.3%
<i>Adjusted Port Moller genetic estimate</i>	<i>2.2%</i>	<i>25.3%</i>	<i>36.7%</i>	<i>34.3%</i>	<i>1.6%</i>
Observed inshore C+E	2.8%	27.2%	27.4%	42.3%	0.3%

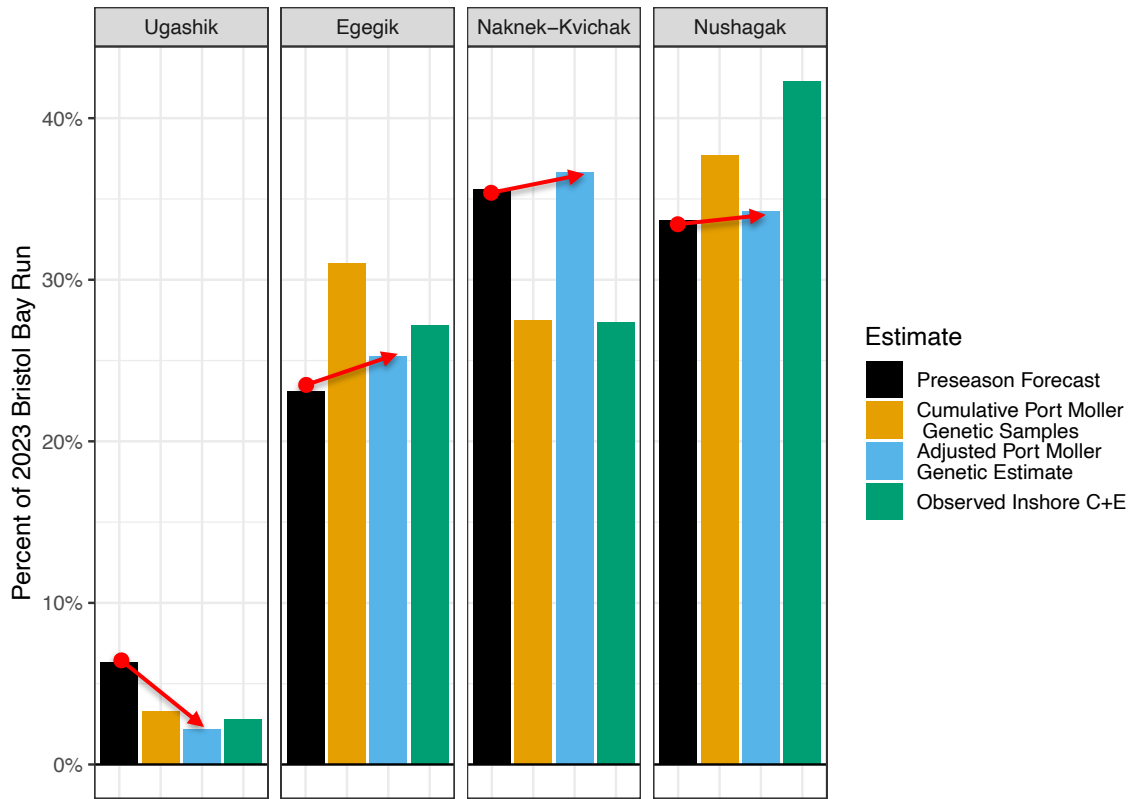


Figure 7. Bristol Bay Proportions by District: Comparison of predictions for 2023 Bristol Bay run proportions by district with cumulative genetic samples collected in the Port Moller test fishery through July 6-7 and the adjusted Port Moller genetic estimate. Current predictions (Adjusted Port Moller Genetic Estimate) are based on the cumulative genetic samples collected in the Port Moller test fishery, adjusted for historical over/under-representations by district relative to season total proportions, through the current date. Red arrows indicate the difference between district proportions in the preseason forecast (black bars) and our current inseason estimates (blue bars).

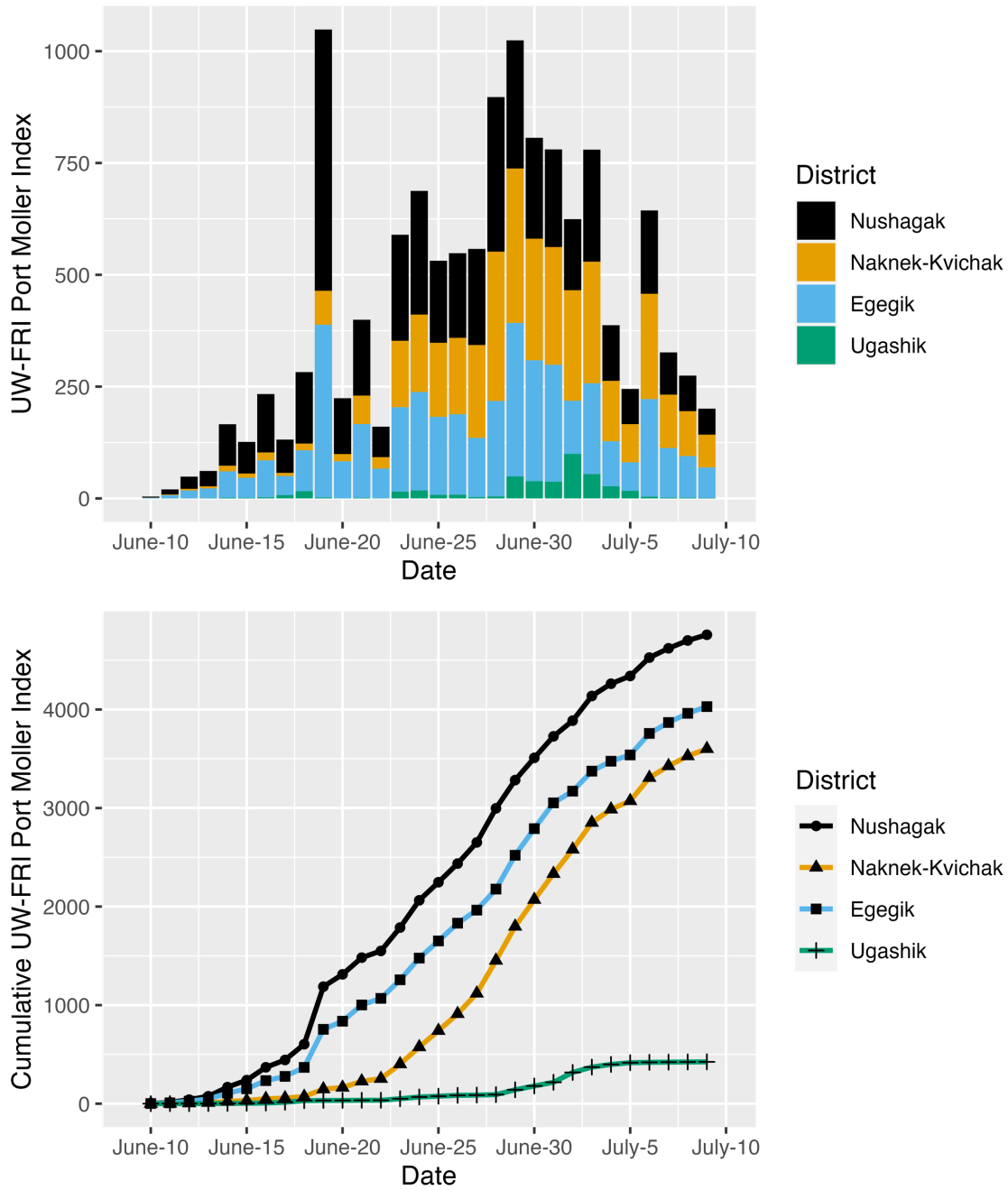


Figure 8. District-specific Port Moller Indices: Top panel shows the daily UW-FRI Port Moller index by district, partitioned using genetic composition data through July 6-7. Bottom panel shows the cumulative UW-FRI Port Moller index by district.

5 Port Moller Age Composition

Age composition samples from the Port Moller Test Fishery through July 5 have continued to show the following consistent pattern (Figure 9, below):

- Declining but higher than expected proportion of age 1.3 sockeye
- Higher than expected proportion of age 2.3 sockeye
- Lower than expected (by more than half) proportion of age 1.2 sockeye

The continued high proportion of 2.3 sockeye and the genetic composition of test fishery catch provide support for the idea that a considerable number of Egegik bound fish have continued to pass the test fishery in July, and are yet to arrive inshore. In-district age composition samples appear to indicate that a small part of the surplus 2.3 production has gone to the Naknek-Kvichak District. The lower-than-expected percentage of 1.2 sockeye might suggest lower than forecasted returns to the Wood and Naknek rivers, but this deficit should be made up for in part by a surplus of 3-ocean (1.3 and 2.3) sockeye.

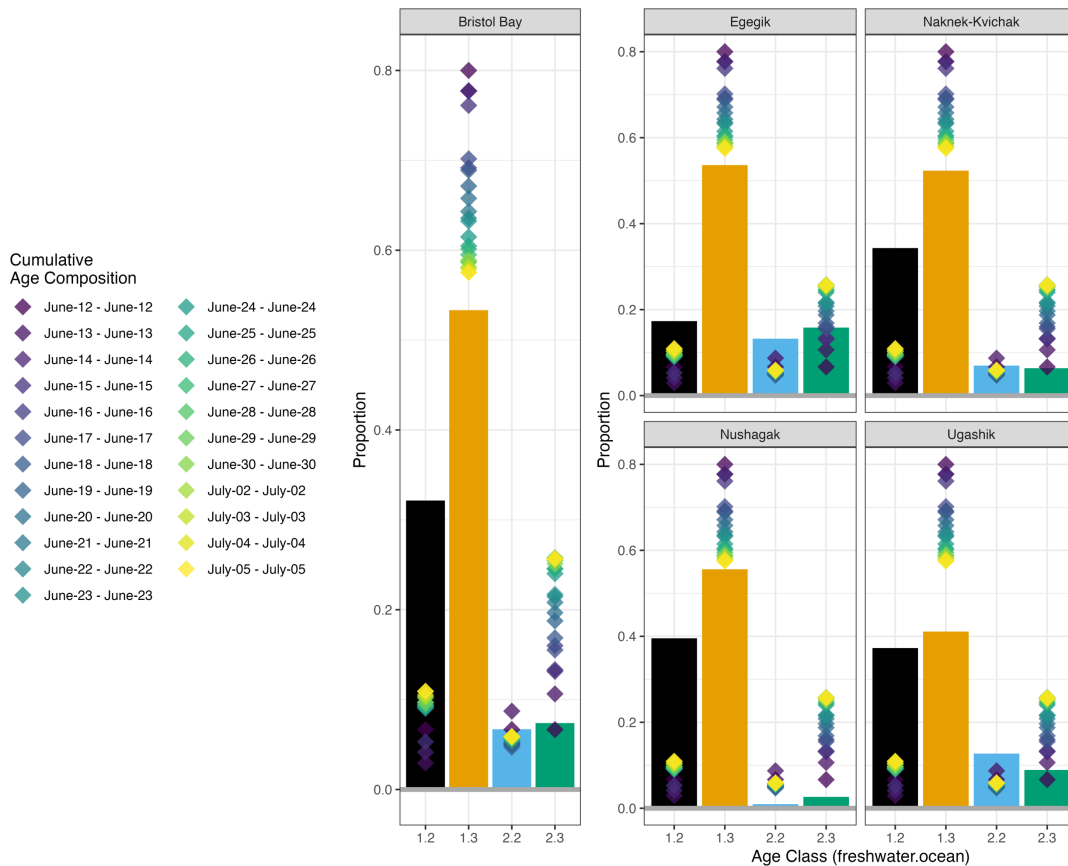


Figure 9. Age Composition from Port Moller and Preseason Forecast: Comparison of expected age class proportions of the 2023 run to each district from the preseason forecast (bars) with the cumulative Port Moller age composition through July 5 (diamonds).

Contributing Authors

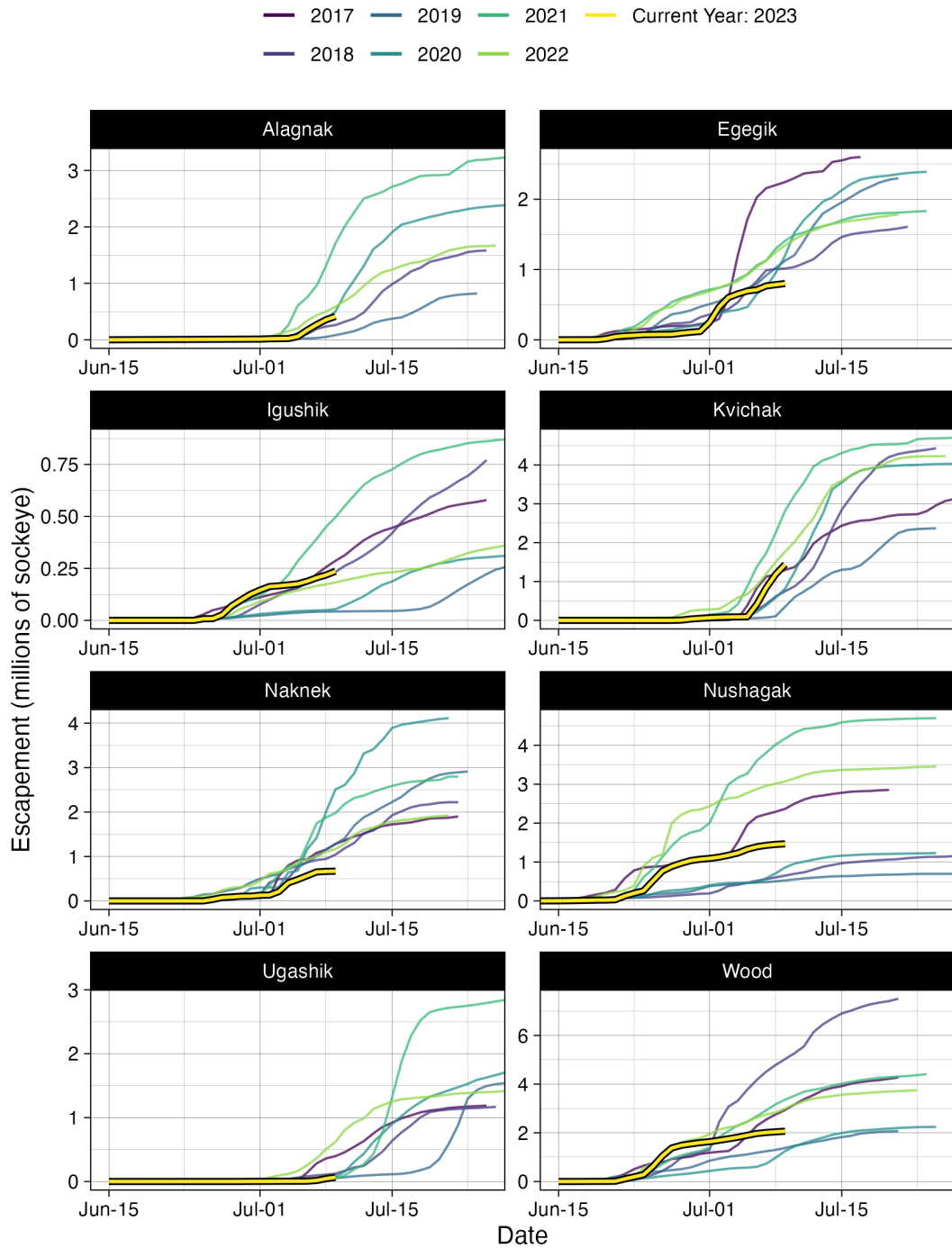
Curry Cunningham
Chris Boatright
Ray Hilborn
Daniel Schindler

Acknowledgements

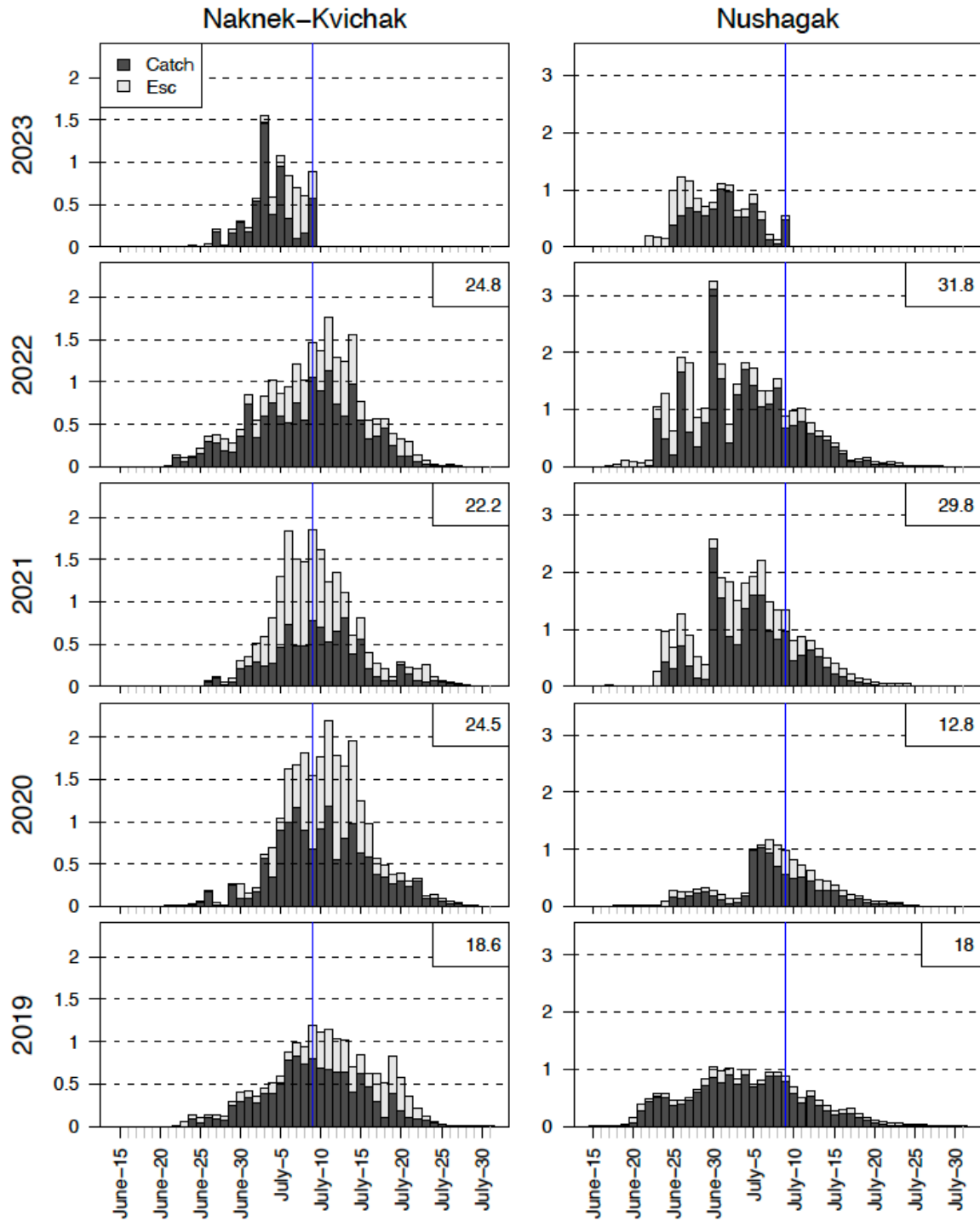
The Alaska Department of Fish and Game collects the catch, escapement, and age composition data integral to these analyses. The Bristol Bay Science and Research Institute (BBSRI) operates the Port Moller test fishery, data from which becomes a substantial part of the analysis included in UW-FRI inseason 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.

Appendices

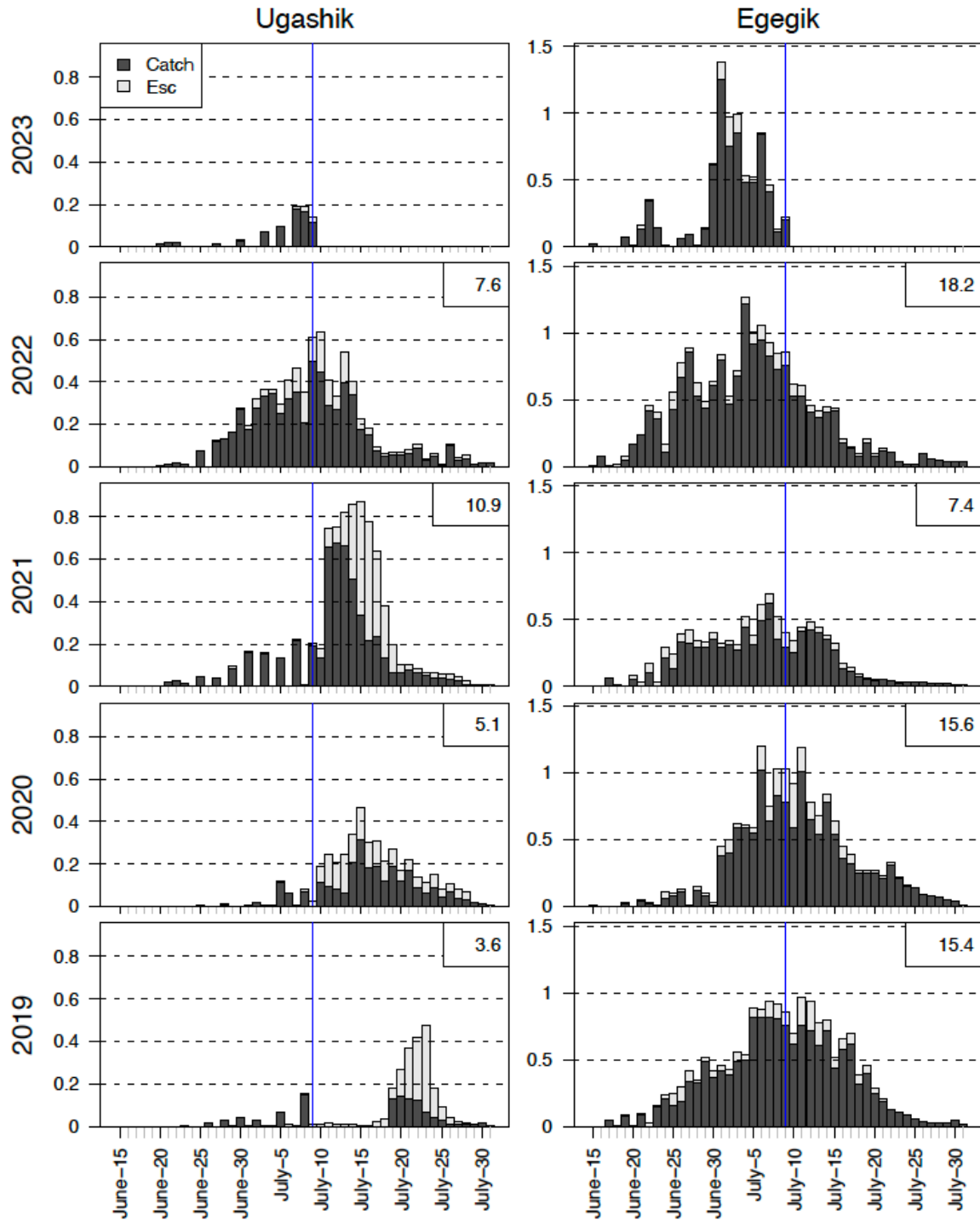
A1. Bristol Bay Sockeye Escapement: 2017-2023 cumulative sockeye salmon escapements to Bristol Bay river systems.



A2. Daily Naknek-Kvichak and Nushagak District C+E: Observed daily catch and escapement by district for years 2019–2023 as stacked bars. Escapements are in light gray and catches in dark gray. Total run for each district and year is listed in the upper right corner in millions of sockeye.



A3. Daily Ugashik and Egegik District C+E: Observed daily catch and escapement by district for years 2019–2023 as stacked bars. Escapements are in light gray and catches in dark gray. Total run for each district and year is listed in the upper right corner in millions of sockeye.



A4. Comparison of Expected & Observed Daily Port Moller Index: 2023 observed and interpolated (gray and black bars) UW-FRI Port Moller Index is compared with expected daily index values (red line and shaded area) for a Bristol Bay run equal to the preseason forecast with average run timing, and exhibiting average Port Moller to inshore travel time (TT) and run-per-index (RPI). Expected daily index values for a run at the preseason forecast, with TT and RPI equal to those observed in 2018-2021 are plotted with blue lines and symbols.

