

## 2011 Bristol Bay Sockeye Salmon Forecast

**The 2011 Bristol Bay sockeye salmon forecast is 35.8 million fish.** This figure is the sum of individual predictions for each of the predominant age classes (1.2, 1.3, 2.2., 2.3) for all nine major river systems – Kvichak, Egegik, Ugashik, Naknek, Alagnak, Wood, Nushagak-Mulchatna, Igushik, and Togiak (Table 1). We also produced an estimate for total harvest of 27.9 million sockeye with an estimated weight of 160.7 million pounds (Table 2). To generate a forecast for total harvest we simply subtracted the mid point of escapement goals for each district from the predicted total return for each district and summed. Depending on all the escapement goals being achieved at their mid range level and industry's ability to harvest surplus fish, a catch of 27.9 million sockeye is the “potential” harvest for a run of 35.8 million fish. To determine the harvest in pounds for each age group we subtracted the escapement proportional to the age specific forecast then multiplied the forecasted catch by the long-term average weight of two or three ocean fish (5.0 lbs and 6.7 lbs respectively).

We used historical catch and escapement data recorded by the Alaska Department of Fish and Game from 1972 to present to generate this forecast. We have chosen that data set because 1978 (1978 return includes brood year production beginning in 1972) is commonly recognized as a point when long-term trends in productivity of the North Pacific and Bristol Bay sockeye stocks showed a dramatic increase. All 2011 forecast (36 individual forecast, nine rivers by four age groups) are based on prior returns of siblings. However, rather than simply choosing the best sibling relationship for each age and river, we use a technique that weights the forecasts for all potential sibling relationships according to how well they have performed in the past. While the best sibling relationship carries the most weight in our forecast we have found that there is information to be used in the other models (i.e. sibling models that include various age classes and combinations of). In some years for some river systems the best model does not necessarily perform well, and incorporating other models can improve forecast accuracy.

For several of the Bristol Bay river systems (Wood, Nushagak, Igushik, Kvichak, and Alagnak), some of the age classes returning were not exceptionally large compared to past run sizes, subsequently many of our individual forecast for 2011 are near or a little below average compared to observed return numbers for 2004 to 2010. Because 2-ocean fish make up half of the four major Bristol Bay age groups we forecast, jack returns (1 ocean males) inevitably play a large role in the forecast. In 2010, the 2.1 jack returns to Egegik and Naknek, and 1.1 jack returns to Ugashik were very high compared to the historical average. However the high jack returns to these river systems do not necessarily translate to exceptionally large forecast for the 2 ocean age classes in these rivers. For example Naknek typically is not characterized by large 2 ocean returns and thus the forecast reflects this with a moderate 2 ocean forecast for Naknek relative to its 2010 2.1 jack return. In contrast the Egegik system has produced large numbers of 2.2 fish in the past,

thus the forecast shows this trend with a large number of 2.2 fish expected in 2011 based on the 2.1 jacks in 2010. Ugashik has produced large numbers of 1.2 fish in the past, but the sibling relationship between 1.1s and 1.2s is not linear and is generally left skewed. The historical sibling relationship for Ugashik shows that the largest 1.2 returns tend to come from intermediate numbers of jacks. The largest jack returns typically see the right-hand side of the curve flattened out, thus despite very high jack returns for Ugashik in 2010 our subsequent 1.2 forecast for Ugashik is moderate.

Table 1. 2011 pre-season forecast of the number of sockeye salmon in millions returning to Bristol Bay, Alaska by river system and age class.

DISTRICT	RIVER	AGES				TOTAL	ESCAPEMENT	POTENTIAL
		1.2	1.3	2.2	2.3			HARVEST
<b>Naknek\Kvichak</b>		<b>3.25</b>	<b>5.32</b>	<b>2.03</b>	<b>1.99</b>	<b>12.60</b>	<b>4.12</b>	<b>8.47</b>
	Kvichak	1.49	1.51	0.88	0.66	4.53	2.27	2.27
	Naknek	1.19	3.16	0.94	1.26	6.55	1.10	5.45
	Alagnak	0.58	0.66	0.22	0.06	1.52	0.76	0.76
<b>Egegik</b>		<b>1.08</b>	<b>1.22</b>	<b>5.44</b>	<b>2.02</b>	<b>9.76</b>	<b>1.10</b>	<b>8.66</b>
<b>Ugashik</b>		<b>1.40</b>	<b>0.98</b>	<b>1.70</b>	<b>0.76</b>	<b>4.83</b>	<b>0.85</b>	<b>3.98</b>
<b>Nushagak</b>		<b>2.57</b>	<b>4.46</b>	<b>0.36</b>	<b>0.15</b>	<b>7.74</b>	<b>1.88</b>	<b>5.86</b>
	Wood	2.17	2.61	0.33	0.07	5.17	1.10	4.07
	Nushagak	0.18	1.16	0.01	0.04	1.59 <sup>b</sup>	0.55	1.04
	Igushik	0.22	0.69	0.02	0.04	0.98	0.23	0.75
				0.03				
<b>Togiak</b>		<b>0.19</b>	<b>0.64</b>	<b>0.03</b>	<b>0.06</b>	<b>0.92</b>	<b>0.15</b>	<b>0.77</b>
Totals		<b>8.48</b>	<b>12.62</b>	<b>9.55</b>	<b>4.98</b>	<b>35.85<sup>c</sup></b>	<b>8.10</b>	<b>27.74</b>

<sup>a</sup>The spawning goal for the Alagnak River was set by ADFG as the estimated escapement based on exploiting the return of sockeye to the Alagnak at the same rate as the return to the Kvichak

<sup>b</sup>The Nushagak River total forecast includes 200,000 age 0.3 and age 1.4 sockeye

<sup>c</sup>The 'Totals' category cannot be summed horizontally because the Nushagak 1.4's and 0.3's are not included in the 'Ages' part of the table.

Table 2. 2011 pre-season Bristol Bay sockeye forecast in millions of pounds by fishing district and age class.

DISTRICT	1.2	1.3	2.2	2.3	Total Harvest		Total Run (fish)
					lbs	# fish	
<b>Naknek\Kvichak</b>	10.94	23.99	6.83	8.97	<b>50.73</b>	8.47	12.60
<b>Egegik</b>	4.79	7.25	24.12	12.01	<b>48.17</b>	8.66	9.76
<b>Ugashik</b>	5.75	5.39	6.99	4.20	<b>22.33</b>	3.98	4.83
<b>Nushagak</b>	9.82	22.83	1.38	0.78	<b>34.82</b>	5.86	7.74
<b>Togiak</b>	0.75	3.47	0.10	0.32	<b>4.64</b>	0.77	0.92
<b>Totals</b>	32.05	62.93	39.43	26.28	<b>160.68</b>	27.74	35.85

Table 3. 2011 pre-season forecast of the number of sockeye salmon in millions returning to Bristol Bay, Alaska by river system and actual returns of sockeye salmon in millions by river system for 2010, 2009, 2008, and 2007.

RIVER	2011 Forecast	ACTUAL RETURNS			
		2010	2009	2008	2007
<b>Kvichak</b>	4.53	9.41	5.70	5.87	4.38
<b>Naknek</b>	6.55	5.82	4.66	6.52	9.05
<b>Alagnak</b>	1.52	2.64	2.57	6.16	4.43
<b>Egegik</b>	9.76	6.01	12.95	9.03	8.21
<b>Ugashik</b>	4.83	4.92	4.03	3.05	7.90
<b>Wood</b>	5.17	7.77	7.35	5.46	6.76
<b>Nushagak</b>	1.59	2.17	1.67	1.71	2.67
<b>Igushik</b>	0.98	1.38	0.95	3.43	1.83
<b>Togiak</b>	0.92	0.85	0.85	0.89	1.07
<b>TOTALS</b>	35.85	40.98	40.72	42.12	46.28