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2018 Alaska Department of Fish and Game Southeast Alaska Pink Salmon Harvest Forecast

The Southeast Alaska (SEAK) pink salmon harvest in 2018 is predicted to be in the *average* range with a point estimate of **23 million fish (80% confidence interval: 3–44 million fish).** The categorical ranges of pink salmon harvest in SEAK were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest over the 57-year period 1960 to 2016:

Category	Range (millions)	Percentile
Poor	Less than 11	Less than 20th
Weak	11 to 19	20th to 40th
Average	19 to 34	40th to 60th
Strong	34 to 51	60th to 80th
Excellent	Greater than 51	Greater than 80th

Forecast Methods:

The 2018 SEAK pink salmon harvest forecast was based on the average of 5 recent even-year harvests (2008, 2010, 2012, 2014, and 2016). We first examined forecasts based on the general methods we have used since 2007: a simple trend forecast of the harvest that was then adjusted using juvenile pink salmon abundance indices provided by the NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratories. These data were obtained from systematic surveys conducted annually in upper Chatham and Icy straits in conjunction with NOAA's Southeast Coastal Monitoring Project (SECM) and are highly correlated with the harvest of adult pink salmon in the following year (see Wertheimer et al. 2011[1]). Juvenile pink salmon abundance indices obtained in 2017, however, were the lowest in the 21 years that NOAA has been conducting SECM surveys, and were well outside of the range of previous observations. Forecasts using these data and forecast models used in the past resulted in extremely low (<10 million fish) or negative predictions for 2018. As a result, we chose to use simpler trend models for the 2018 forecast.

Trend forecast methods examined included exponential smoothing and 5-, 3-, and 2-year running averages of past harvests. Each method was examined for odd and even years combined and for the even-year brood line only. We also produced forecasts for each of the three major subregions of SEAK separately (Northern Southeast Inside, Northern Southeast Outside, and Southern Southeast) and for SEAK as a whole using each method. Most of these methods produced SEAK harvest forecasts in the low-to-mid 20 million fish range. The forecast based on the 5-year average of even-year SEAK pink salmon harvests had the lowest mean percent error, mean absolute percent error, and mean absolute

[1] We gratefully acknowledge the assistance of Jim Murphy, Joe Orsi (retired) and Alex Wertheimer (retired) and their colleagues at the NOAA Auke Bay Laboratories. However, we accept responsibility for this forecast, and we accept sole responsibility for this use of their data. For a detailed description of these NOAA research activities see: Wertheimer, A. C., J. A. Orsi, E. A. Fergusson, and M. V. Sturdevant. 2011. Forecasting pink salmon harvest in Southeast Alaska from juvenile salmon abundance and associated environmental parameters: 2010 returns and 2011 forecast (NPAFC Doc. 1343) Auke Bay Lab., Alaska Fish. Sci. Cen., Nat. Mar. Fish. Serv., NOAA, 17109 Point Lena Loop Road, Juneau, AK 99801-8626, USA, 20 p.; http://www.npafc.org/new/pub_documents.html.

scaled error (Hyndman, R.J., and A.B. Koehler. 2006. Another look at measures of forecast accuracy. International Journal of Forecasting 22: 679-688) compared to forecasts based on exponential smoothing and 3-, and 2-year running averages of even-year regionwide pink salmon harvests, and was thus chosen as the best forecast for 2018 (Figure 1). The forecast range (3–44 million) is the 80% confidence interval calculated from the mean squared error of the hind-cast predictions.

Forecast Discussion:

The 2018 harvest forecast of 23 million pink salmon is below the recent 10-year average harvest of 38 million pink salmon, but is very close to the average even-year harvest since 1960 (25 million pink salmon). The NOAA Auke Bay Lab's 2017 peak June–July juvenile pink salmon index value (0.31) from upper Chatham and Icy straits in northern SEAK ranked 21st out of the 21 years that information has been collected and was approximately 25% of the previous lowest index value. There are no directly comparable values, but pink salmon harvests associated with juvenile indices below a value of 2.0 ranged from 16 to 37 million fish. Although NOAA trawl indices have worked relatively well for forecasting the region-wide pink salmon harvest, the data are more strongly correlated ($R^2 = 0.68$) with the harvest in the Northern Southeast Inside Subregion of SEAK where the surveys are conducted. The very low 2017 juvenile index value and very poor recent even-year harvests in the Northern Southeast Inside Subregion, strongly suggest harvests in the northern half of the region will be very low in 2018, particularly on inside waters away from the outer coast. Harvests in the Southern Southeast Subregion, however, averaged 19 million over the past five even years (range: 14–33 million pink salmon), and it is at least plausible that the harvest in 2018 will be in line with recent averages for southern SEAK.

One potential source of uncertainty regarding the 2018 pink salmon return is the anomalously warm sea surface temperatures that persisted throughout the Gulf of Alaska from fall 2013 through much of 2016. Pink salmon that went to sea from 2014 to 2016 returned in numbers below expectation and below recent odd- and even-year averages. Although sea surface temperatures moderated in the Gulf of Alaska in 2017, effects on the Gulf ecosystem may persist and pink salmon that went to sea in 2017 (and set to return in 2018) may have experienced reduced survival. In addition, weak even-year returns to northern Southeast inside waters have persisted since 2012 and there may be mechanisms that promote brood line dominance once it is established (*Krkosek, M., R. Hilborn, R. M. Peterman, and T. Quinn. 2011. Cycles, stochasticity and density dependence in pink salmon population dynamics. Proceedings of the Royal Society B 278:2060–2068*).

The NOAA Auke Bay Laboratories continues to conduct research that has improved our ability to forecast pink salmon harvests in SEAK. NOAA has been using juvenile pink salmon catch and associated biophysical data to forecast adult pink salmon harvest in SEAK since 2004. The 2018 NOAA forecast can be found at the following link: http://www.afsc.noaa.gov/ABL/EMA/EMA_PSF.htm. ADF&G forecasts have been adjusted using NOAA's juvenile pink salmon data since 2007 and overall forecast performance is much improved (mean absolute percent error = 30%) over forecasts made prior to 2007 (mean absolute percent error = 58%; Figure 2). Recent forecasts have also performed better than naïve forecasting models (e.g., 5-year running average, brood-year average harvest, unadjusted exponential smooth). Although we are not using NOAA's juvenile pink salmon data to adjust our 2018 forecast, the information is still valuable for predicting that the harvest in northern SEAK is likely to be very low. Once we can compare the record low 2017 juvenile abundance indices with the corresponding harvest of adults in 2018 we anticipate incorporating NOAA's data into our forecast for 2019.

The department will manage the 2018 commercial purse seine fisheries *inseason* based on the strength of salmon runs. Aerial escapement surveys and fishery performance data will continue, as always, to be essential in making inseason management decisions.

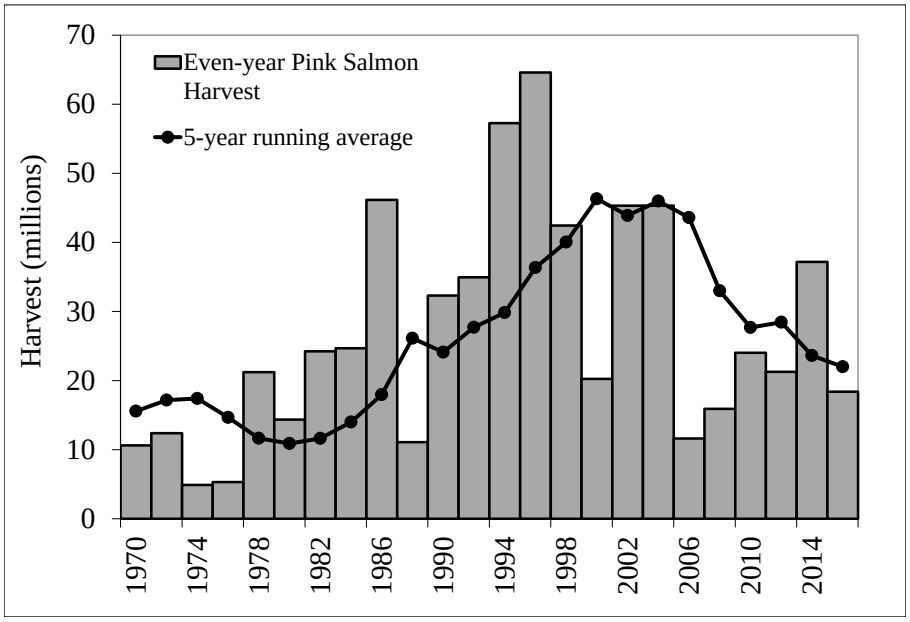

Figure 1. Comparison of the annual even-year harvest of pink salmon in SEAK and 5-year running average values of the harvest. This method produced a 2018 harvest forecast of 23 million pink salmon.

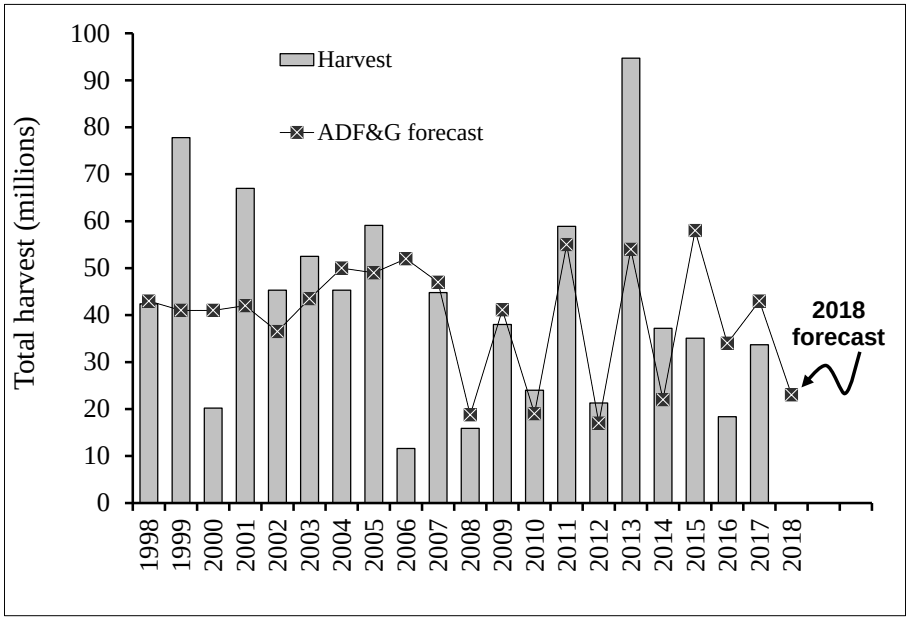

Figure 2. Annual harvest of pink salmon in SEAK compared to the ADF&G pre-season harvest forecast, 1998–2017. The 2007–2017 ADF&G harvest forecasts were adjusted using NOAA's juvenile pink salmon data.

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