2013 Alaska Department of Fish and Game Southeast Alaska Pink Salmon Harvest Forecast

The Southeast Alaska pink salmon harvest in 2013 is predicted to be in the *excellent* range, with a point estimate of **54 million fish (80% confidence interval: 42–67 million fish).** The categorical ranges of pink salmon harvest in Southeast Alaska were formulated from the 20th, 40th, 60th, and 80th percentiles of historical harvest over the 50 year period 1960 to 2010:

Category	Range (millions)	Percentile
Poor	Less than 11	Less than 20th
Weak	11 to 19	20th to 40th
Average	19 to 29	40th to 60th
Strong	29 to 48	60th to 80th
Excellent	Greater than 48	Greater than 80th

Forecast Methods:

The 2013 forecast was produced in two steps: 1) a forecast of the trend in the harvest, and 2) the forecast trend adjusted using 2012 juvenile pink salmon abundance data. The forecast of the trend in pink salmon harvests was based on a time-series technique called *exponential smoothing.* This technique is similar to a running average, except that all harvests since 1960 were used in the forecast estimate. Recent harvest observations were given more weight in the analysis, while past harvest observations were increasingly down-weighted with time; i.e., the older the datum, the less influence it has on the forecast. If x_t, x_{t-1}, ... denotes the observed harvests in year t, t-1, and so on, then the forecast in year t+1 is given by,

$$\hat{x}_{t+1} = cx_t + (1-c)\hat{x}_t \ .$$

We estimated a value of c to be approximately 0.45, based on minimizing the sum of past squared errors in the entire data set (odd and even years combined).The forecast for year t, that is $\hat{x}_t$, is also a weighted average of the forecast made for year t-1 and the actual harvest in year t-1. This is a kind of recursive equation that contains all of the data in the series. Because the recent harvest series has developed an odd-year and even-year cycle, we let t be 2011, the parent year for the 2013 return. Since the formula used to calculate the forecast is a weighted average of the 2011 harvest and its associated forecast, which was also based on the associated parent year harvest and forecast, this forecast is based entirely on odd-year data. That is, we used all of the odd-year harvest data up to 2011, assuming that the 2011 parent year and other odd years in the series will better predict the 2013 return. This analysis produced a forecast of 52 million pink salmon (Figure 1).

We adjusted the forecast using peak June–July juvenile pink salmon catch-per-unit-effort (CPUE) statistics provided by the NOAA Fisheries, Alaska Fisheries Science Center, Auke Bay Laboratories (Joe Orsi, Auke Bay Laboratories, personal communication). These data were obtained from systematic surveys conducted annually in upper Chatham and Icy straits in conjunction with NOAA's Southeast Coastal Monitoring Project and are highly correlated with the harvest of adult pink salmon in the following year (see Wertheimer et al. 2011[1]). We developed a simple equation to predict the forecast

[1] We gratefully acknowledge the assistance and advice of Joe Orsi 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.

error in the exponential smooth by regressing the forecast error proportions from 1998 to 2012 on the corresponding NOAA CPUE data from 1997 to 2011 (Figure 2). The forecast error proportion was simply the forecast error (the exponential smooth forecast subtracted from the actual harvest) divided by the forecast point estimate. We predicted the 2013 forecast error and adjusted the exponential-smooth forecast upward, from 52 million to 54 million pink salmon (Figure 3). The forecast range (42–67 million) is based on an 80% confidence interval, calculated by cross-validation estimates of the forecast error.

Forecast Discussion:

The 2013 harvest forecast of 54 million pink salmon is well above the recent 10-year average harvest of 37 million pink salmon, but is close to the average harvest over the past five odd years. There are two primary reasons to expect that the harvest in 2013 will be higher than the recent average. First, biological escapement goals were met or exceeded in the parent year, 2011, and escapements were well distributed throughout the region. Management targets for pink salmon were met or exceeded for 14 of 15 Districts, and, at a finer scale, for 44 of the 46 pink salmon stock groups. In addition, the NOAA Auke Bay Lab's 2012 peak June–July juvenile pink salmon CPUE statistic from upper Chatham and Icy straits in northern Southeast Alaska ranked in the top third of the 15 previous years that NOAA has collected that information, which may indicate good freshwater and early marine survival for pink salmon set to return in 2013. Pink salmon harvests associated with the top third of indices in the NOAA data set ranged between 45 and 78 million fish.

The NOAA Auke Bay Laboratories continues to conduct research that has greatly improved our ability to forecast pink salmon harvests in Southeast Alaska. NOAA has been using juvenile pink salmon catch and associated biophysical data to forecast adult pink salmon harvest in SEAK since 2004. The 2013 NOAA forecast can be found at the following link:
http://www.afsc.noaa.gov/ABL/MSI/msi_sae_psf.htm.

ADF&G forecasts that were adjusted using NOAA's juvenile pink salmon data were much improved over previous forecasts (Figure 4). Hindcasts of past harvests (1998–2006) using this forecast method also exhibited fair to good performance in predicting the direction of forecast error (Figure 3). Even if these hindcast values were not always precise (e.g., in 2006), the ability to predict if the harvest will be greater than average or less than average is an immense improvement over past ADF&G forecasts. For these reasons, we are using this method to forecast the pink salmon harvest for a seventh consecutive year.

The department will manage the 2013 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.

Andy Piston, Pink and Chum Salmon Project Leader, Ketchikan
Steve Heinl, Regional Research Biologist, Ketchikan

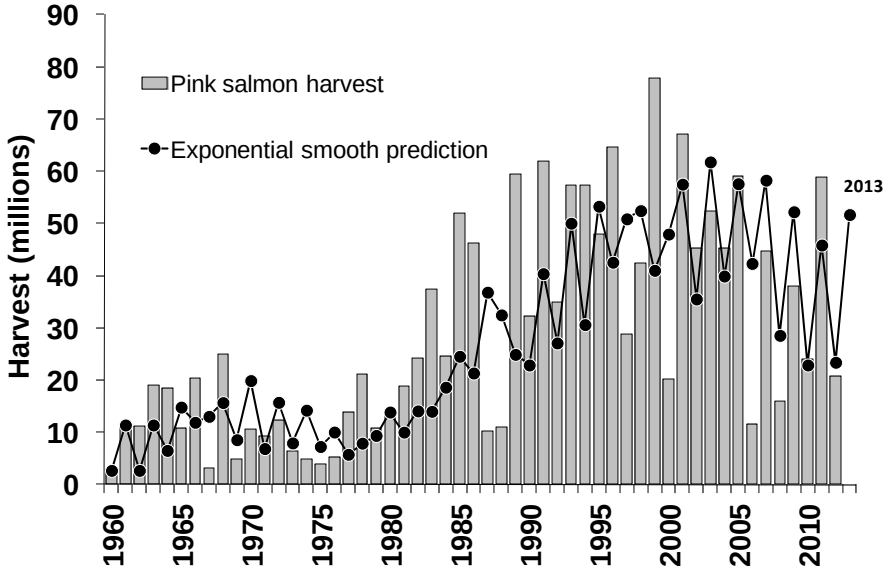

Figure 1. Comparison of the annual harvest of pink salmon in Southeast Alaska, and exponential smoothed hindcast values of the harvest used in the 2013 forecast model. This method produced a 2013 harvest forecast of 52 million pink salmon.

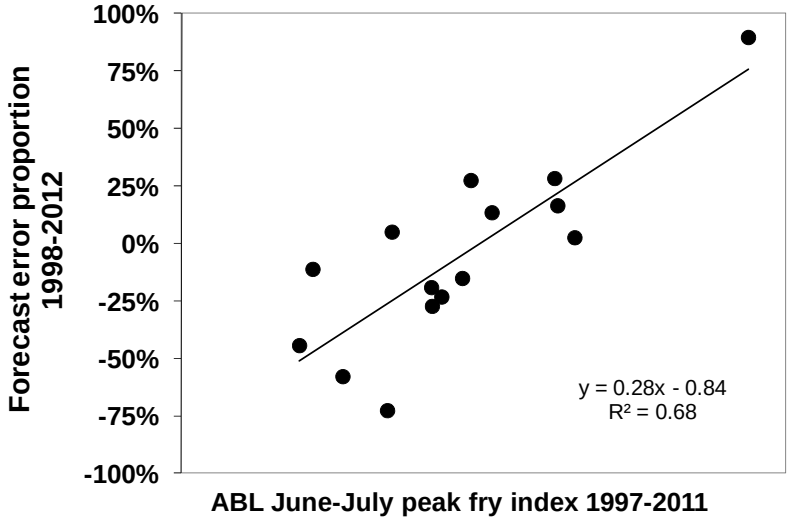

Figure 2. Regression of ADF&G forecast error proportion on the peak June–July juvenile pink salmon index from Icy Strait one year prior. (Pink salmon fry index data provided by Joe Orsi, NOAA Auke Bay Laboratory, pers. comm.). The forecast error is a proportion calculated by dividing the forecast error (the annual ADF&G forecast subtracted from the actual harvest) by the forecast point estimate.

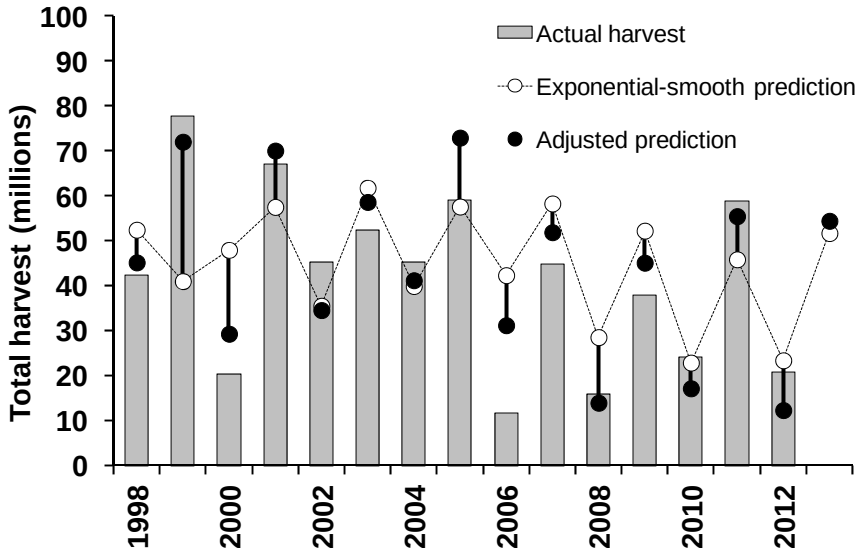

Figure 3. Annual harvest of pink salmon in Southeast Alaska, 1998–2012, compared to the exponential smoothed hindcast predictions of the harvest adjusted using NOAA Auke Bay Laboratory juvenile pink salmon data.

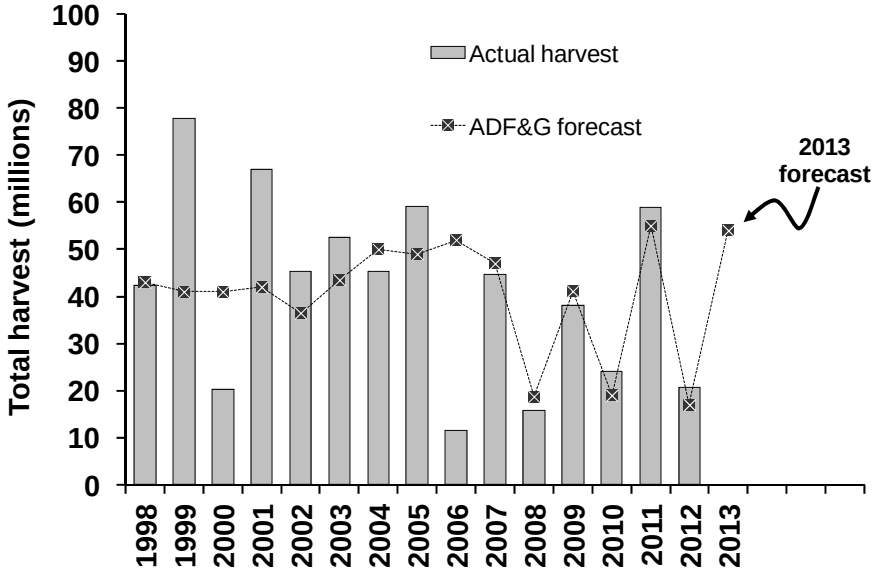

Figure 4. Annual harvest of pink salmon in Southeast Alaska compared to the ADF&G pre-season harvest forecast, 1998–2012. The 2007–2013 ADF&G harvest forecasts were adjusted using NOAA's juvenile pink salmon data.