SEAK Pink Salmon Forecast

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Objective

To forecast the Southeast Alaska (SEAK) pink salmon commercial harvest in 2026. This document is for guidance as to what was done for the current forecast year. It is for internal use only.

Executive Summary

Forecasts were developed using an approach originally described in Wertheimer et al. (2006), and modified in Orsi et al. (2016) and Murphy et al. (2019), but assuming a log-normal error structure (Miller et al. 2022). This approach is based on a multiple regression model with the raw juvenile pink salmon catch-per-unit-effort (adj_raw_pink; a proxy for abundance), a vessel factor to account for the survey vessels through time, an odd and even year factor to account for potential odd and even year cycles of abundance, and temperature data from the Southeast Alaska Coastal Monitoring Survey (SECM; Piston et al. 2021; ISTI20_MJJ) or from satellite sea surface temperature (SST) data (Huang et al. 2017). The adj_raw_pink variable is not the same as the CPUE variable used in prior years that was adjusted by the pooled-species vessel calibration coefficient for the Cobb and was the maximum average from either June or July (whichever was higher). Instead, the CPUE term used in the 2025 forecast, the adj_raw_pink variable, is the natural logarithm of the maximum untransformed catch, adjusted to a 20 minute haul, from either June or July. The Stellar and Chellissa vessels were only used for one year each, 2008 and 2009, respectively, and so these two years are not used in the assessment (Table 1).

There were 36 individual models considered:

- adj_raw_pink model with a vessel interaction, an odd/even year factor, and a vessel factor (m1);
- adj_raw_pink model with a vessel interaction, an odd/even year factor, a vessel factor, and with temperature data from the the SECM survey (m2);

- 16 adj_raw_pink models with a vessel interaction, an odd/even year factor, a vessel factor, and with satellite SST data (m3-m18);
- adjusted CPUE, and an odd/even year factor (m1a);
- adjusted CPUE, an odd/even year factor, and with temperature data from the the SECM survey (m2a);
- 16 adjusted CPUE models with an odd/even year factor, and with satellite SST data (m3a-m18a);

The model performance metrics one-step ahead mean absolute percent error (MAPE) for the last five years (MAPE5; forecast years 2021 through 2025) was used to evaluate the forecast accuracy of the 36 individual models, the AICc values were calculated for each model to prevent over-parameterization of the model, and the adjusted R-squared values, significant terms, and overall p-value of the model were used to the determine fit. Based upon the performance metric the 5-year MAPE, the AICc values, significant parameters in the models, and the adjusted R-squared values, model xx (a model that included xx; Appendix B) was the best performing model and the 2026-forecast using this model has a point estimate of xx million fish (80% prediction interval: xx to xx million fish).

Analysis

Individual, multiple linear regression models

Biophysical variables based on data from Southeast Alaska were used to forecast the harvest of adult pink salmon in Southeast Alaska, one year in advance, using individual, multiple linear regression models (models m1-m18 and models m1a–m18a). The two simplest regression model (model m1 and model m1a) consisted of the predictor variable juvenile adj_raw_pink (X_1) with a vessel factor interaction (X_V), an odd/even year factor(X_B), and a vessel factor(X_V) (model m1) and adjusted CPUE and an odd/even year factor(X_B) (model m1a). The other 34 regression models (models m1-m18 and models m1a-m18a) also included a temperature index (X_2). The general model structure was

$$E(Y) = \hat{\beta}_0 + \hat{\beta}_{1V} X_V X_1 + \hat{\beta}_2 X_2 + \hat{\beta}_B X_B$$

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The odd/even year factor adjusts the model intercept by $\hat{\beta}_0 + \beta_B$ as $X_B = 0$ for even years (no adjustment to intercept, defaults to model intercept) and $X_B = 1$ for odd years (adjustment for odd years based on β_B). The vessel interaction adjusts the model slope. For example, during years when the survey vessel was the Cobb, the slope is adjusted by the $\hat{\beta}_{1COBB}$ which is then multiplied by the adj_raw_pink term in that year.