Division of Commercial Fisheries
Sam Rabung, Director

Headquarters Office
PO Box 115526
Juneau, AK 99811-5526

Alaska Department of Fish and Game
Doug Vincent-Lang, Commissioner

PO Box 115526
Juneau, AK 99811-5526
www.adfg.alaska.gov

Advisory Announcement

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CONTACT: Teresa Fish
Southeast Alaska Pink and Chum Salmon Project Leader
teresa.fish@alaska.gov
907-225-9677

2024 NOAA FISHERIES–ALASKA DEPARTMENT OF FISH AND GAME SOUTHEAST ALASKA PINK SALMON HARVEST FORECAST

The Southeast Alaska (SEAK) pink salmon harvest in 2024 is predicted to be in the *average* range with a point estimate of **19 million fish (80% prediction interval: 12–32 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 63-year period 1960–2022:

Category	Range (millions)	Percentile
Poor	Less than 11	Less than 20th
Weak	11 to 19	20th to 40th
Average	19 to 33	40th to 60th
Strong	33 to 48	60th to 80th
Excellent	Greater than 48	Greater than 80th

Forecast Methods

The NOAA Alaska Fisheries Science Center, Auke Bay Laboratories (NOAA) initiated the Southeast Alaska Coastal Monitoring (SECM) project in 1997 to better understand the effects of climate and nearshore ocean conditions on year class strength of salmon and ecologically related species (Orsi et al. 2000). Since 2018, the SECM project has been conducted cooperatively by NOAA and the Alaska Department of Fish and Game (ADF&G) using the ADF&G research vessel *Medeia*, and the two agencies have combined efforts to produce a joint pink salmon harvest forecast using SECM data (Piston et al. 2019). We plan to continue working towards increased coordination between agencies and will continue to look for ways to focus and expand the SECM survey to provide a wide variety of valuable information to the fishing industry.

The 2024 SEAK pink salmon harvest forecast (Figures 1 and 2) was primarily based on juvenile pink salmon abundance indices collected by the SECM project in northern SEAK inside waters. These data were obtained from systematic surface trawl surveys conducted annually in June and July in upper Chatham and Icy Straits and are highly correlated with the harvest of adult pink salmon in the following year (Wertheimer et al. 2011). The 2023 juvenile pink salmon abundance index (natural log of monthly peak juvenile catch per unit effort (CPUE) +1; standardized catch based on 20-minute trawl sets) of 1.22 was below average for an odd-year juvenile index but was higher than the past three odd-year juvenile indices.

Forecasts were developed using an approach originally described by Wertheimer et al. (2006) and modified by 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 juvenile pink salmon CPUE (a proxy for abundance), along with potential biophysical variables including temperature data from the SECM survey (Piston et al. 2021) or from satellite sea surface temperature (SST) data (Huang et al. 2017); the parent year SEAK pink salmon escapement index; juvenile pink salmon condition in June and July; juvenile pink salmon energy density in June and July; average zooplankton in the total water column in May, June, or July; zooplankton density in May, June, or July; and the North Pacific Index (NPI) that were investigated. There were 37 individual models considered for the 2024 forecast. The general model used was:

$$E(y) = \alpha + \beta_1 X_1 + \cdots \beta_n X_n$$

where E(y) is the expected value for y, the natural log of SEAK pink salmon harvest, β_1 is the coefficient for the natural log of CPUE +1, and β_n is the coefficient for the biophysical parameter X. A one-step-ahead mean absolute percent error (MAPE) model performance metric for the most recent 10-year period was used to evaluate and compare the forecast accuracy of the models. Based upon the 10-year MAPE, AICc (Akaike Information Criterion corrected for small sample sizes; Burnham and Anderson 2004) values, significant parameters in the models, and the adjusted R-squared values, a model that included CPUE and the satellite SST variable from northern SEAK (Figure 3) in May was the best performing model. Using this model, the 2024 forecast would be in the average range with a point estimate of 19.2 million fish (80% prediction interval: 11.7 to 31.6 million fish).

Forecast Discussion

The 2024 harvest forecast of 19 million pink salmon is just below the recent 10-year average even-year harvest of 21 million pink salmon. A harvest of 19 million pink salmon would be near the parent year harvest in 2022 (18.3 million) and would be higher than the last 4 even-year harvests (mean = 13.2 million). The 2023 peak June–July juvenile pink salmon index value (1.22) ranked 22nd out of the 27 years that SECM information has been collected. Pink salmon harvests associated with juvenile indices below 2.0 have ranged from 8 to 48 million fish (mean = 20 million fish). The low juvenile abundance index in 2023 was not unexpected given recent even year harvests and poor escapements in much of northern Southeast Alaska in 2022. In SEAK, escapement indices did not meet management targets in 13 of 46 stock groups. Juvenile pink salmon caught in 2023 SECM survey trawls were below average in size (length) and energy density for the 27-year time series. Any further growth and survival will depend on favorable resources in the Gulf of Alaska.

Although forecast performance has been relatively good for even-years, odd-year forecast performance has been poor recently and the SEAK pink salmon harvest of nearly 48 million in 2023 greatly exceeded the preseason harvest forecast of 19 million fish. One possible explanation for the under forecast for 2023 may have been related in part to exceptional marine survival once juvenile pink salmon left SEAK inside waters. Pink salmon runs were generally large from Puget Sound in Washington, through the Gulf of Alaska, and extending to Russia, and runs exceeded forecasts in some other regions throughout the species range, including the Fraser River in southern British Columbia and Russia. In adjacent northern British Columbia, the Nass River saw a record return of nearly 3 million pink salmon, which greatly exceeded the forecast. If marine survival in the open ocean is much higher than average, we are likely to under forecast the return as our trawl survey only provides an index of what survived the freshwater and early marine environments.

Another potential reason considered for the poor performance of the 2023 forecast was the timing of the 2022 trawl surveys. In 2022, the June survey midpoint on June 19 was the earliest on record and 7 days earlier than average (survey dates range from June 18 to July 3 from 1997–2022). The July survey midpoint on July 31 was the latest on record but only two days later than average (survey dates range from July 19 to August 1 from 1997–2022), and the dates have been remarkably consistent through most of the time series. It is unlikely that these slight deviations from average survey dates would result in a large proportion of the juvenile pink salmon migration going undetected, but it is worth acknowledging, and we are taking steps to ensure future surveys occur as close to the mean survey dates as possible. We also examined whether variable tidal currents could influence migration, or the catchability of juvenile salmon, passing through Icy Strait. After examining 25 years of tidal data from an adjacent location, we found no difference in the distribution of juvenile pink salmon catch by tidal state. Many other potential factors may affect juvenile pink salmon CPUE including changes in juvenile salmon migration patterns.

Despite the uncertainties that surround every salmon forecast, the track record of our pink salmon harvest forecasts has been relatively good (Figure 2), especially considering the difficulties unique to forecasting pink salmon runs (Haeseker et al. 2005). The department will manage the 2024 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.

Literature Cited

Burnham, K. P., and D. R. Anderson. 2004. Multimodel inference: Understanding AIC and BIC in model selection. Sociological Methods & Research, Vol. 33(2): 261-304.

Haeseker, S. L., R. M. Peterman, and Z. Su. 2005. Retrospective evaluation of preseason forecasting models for pink salmon. North American Journal of Fisheries Management 25:897–918.

Huang, B., P. W. Thorne, V. F. Banzon, T. Boyer, G. Chepurin, J. H. Lawrimore, M. J. Menne, T. M. Smith, R. S. Vose, and H. M. Zhang. 2017. Extended reconstructed sea surface temperature, version 5 (ERSSTv5): upgrades, validations, and intercomparisons. Journal of Climate 30:8179–8205.

Miller, S. E., J. M. Murphy, S. C. Heinl, A. W. Piston, E. A. Fergusson, R. E. Brenner, W. W. Strasburger, and J. H. Moss. 2022. Southeast Alaska pink salmon forecasting models. Alaska Department of Fish and Game, Fishery Manuscript No. 22-03, Anchorage.

Murphy, J. M., E.A. Fergusson, A. Piston, S. Heinl, A. Gray, and E. Farley. 2019. Southeast Alaska pink salmon growth and harvest forecast models. North Pacific Anadromous Fish Commission Technical Report No. 15: 75–91.

Orsi, J. A., E. A. Fergusson, A. C. Wertheimer, E. V. Farley, and P. R. Mundy. 2016. Forecasting pink salmon production in Southeast Alaska using ecosystem indicators in times of climate change. N. Pac. Anadr. Fish Comm. Bull. 6: 483–499. (Available at https://npafc.org)

Orsi, J. A., M. V. Sturdevant, J. M. Murphy, D. G. Mortensen, and B. L. Wing. 2000. Seasonal habitat use and early marine ecology of juvenile Pacific salmon in Southeastern Alaska. North Pacific Anadromous Fish Commission Bulletin No. 2: 111–122.

Piston, A. W., J. Murphy, J. Moss, W. Strasburger, S. C. Heinl, E. Fergusson, S. Miller, A. Gray, and C. Waters. 2021. Operational Plan: Southeast coastal monitoring, 2021. Alaska Department of Fish and Game, Regional Operational Plan No. ROP.CF.1J.2021.02, Douglas.

Piston, A. W., S. Heinl, S. Miller, R. Brenner, J. Murphy, J. Watson, A. Gray, and E. Fergusson. 2019. Pages 46–49 [*In*] R. E. Brenner, A. R. Munro, and S. J. Larsen, editors. 2019. Run forecasts and harvest projections for 2019 Alaska salmon fisheries and review of the 2018 season. Alaska Department of Fish and Game, Special Publication No. 19-07, Anchorage.

Wertheimer A. C., J. A. Orsi, M. V. Sturdevant, and E. A. Fergusson (2006) Forecasting pink salmon harvest in Southeast Alaska from juvenile salmon abundance and associated environmental parameters. In Proceedings of the 22nd Northeast Pacific Pink and Chum Workshop. Edited by H. Geiger (Rapporteur). Pac. Salmon Comm. Vancouver, British Columbia. pp. 65–72.

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.

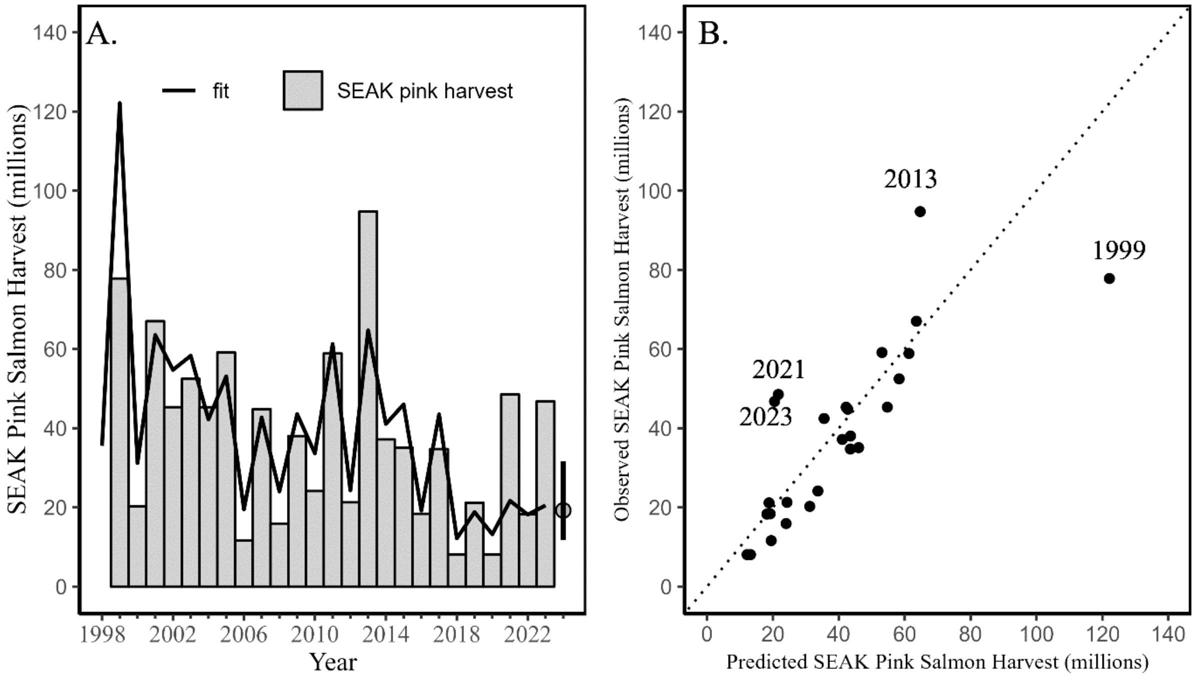

Figure 1. Forecast model fit (hindcasts) for total Southeast Alaska (SEAK) pink salmon harvest, 1998–2023 by year (A) and by the fitted values (B) for the model based on CPUE and May satellite sea surface temperature readings in northern Southeast Alaska inside waters. In panel A, the 2024 forecast is shown as a grey circle with the 80% prediction interval as a black vertical line. The observed SEAK pink salmon harvest is represented by the grey bars and the model fit is shown by the black line in panel A. In panel B, the dotted line represents a one-to-one line; circles above the line represent hindcasts that produced a point estimate lower than the actual harvest and circles below the line represent hindcasts that produced a point estimate higher than the actual harvest.

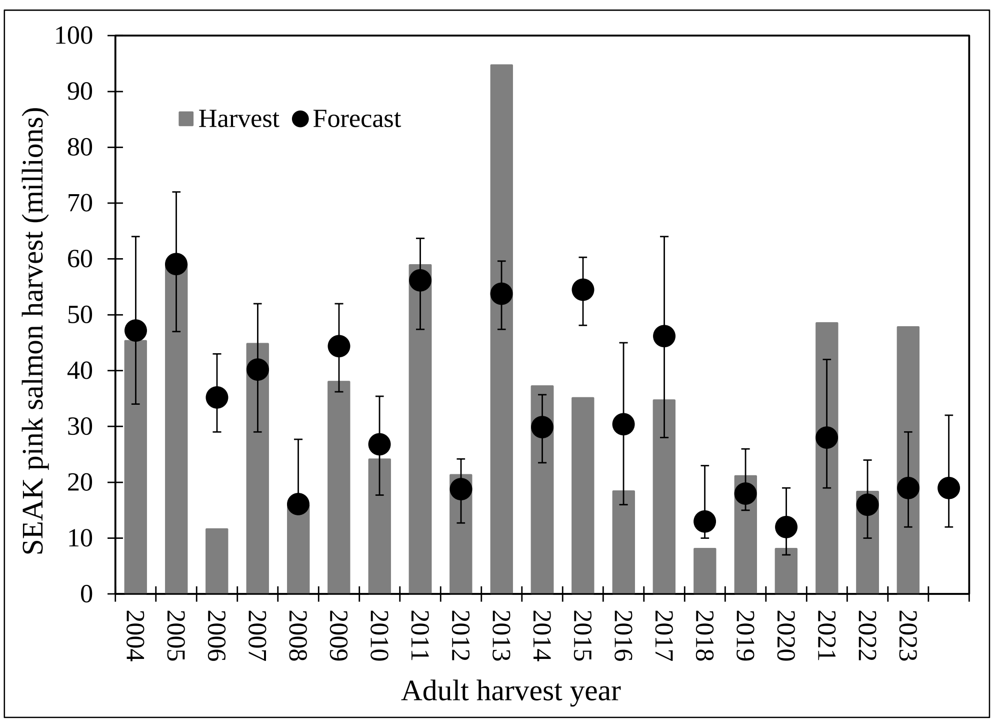

Figure 2. Preseason forecasts compared to the annual SEAK pink salmon harvest, 2004–2024. The error bars represent either 80% confidence or 80% prediction intervals of the forecasts, depending on the modeling method used.

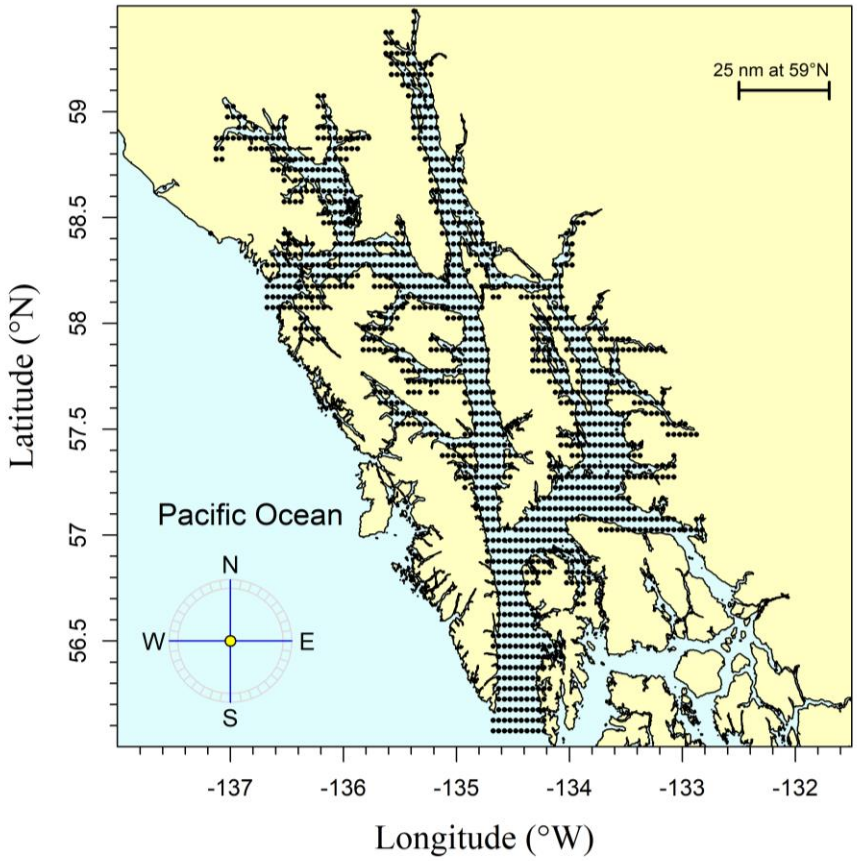

Figure 3. The northern Southeast Alaska (NSEAK) region encompasses northern Southeast Alaska inside waters from 59.475° to 56.075° north latitude and from -137.175° to -132.825° west longitude. There are 1,344 satellite sea surface temperature points (black circles) in the NSEAK region.

Teresa Fish, Andy Piston, and Sara Miller, Alaska Department of Fish and Game
Wesley Strasburger and Emily Fergusson, NOAA, Auke Bay Lab, Alaska Fisheries Science Center

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