Division of Commercial Fisheries
Sam Rabung, Director

Ketchikan Area Office
2030 Sea Level Dr. Suite 205
Ketchikan, AK 99901-6073

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

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

Advisory Announcement

***For Immediate Release:* November 20, 2019**

CONTACT: Andy Piston
Southeast Alaska Pink and Chum Salmon Project Leader
907-225-9677

2020 NOAA FISHERIES–ALASKA DEPARTMENT OF FISH AND GAME SOUTHEAST ALASKA PINK SALMON HARVEST FORECAST

The Southeast Alaska (SEAK) pink salmon harvest in 2020 is predicted to be in the *weak* range with a point estimate of **12 million fish (80% prediction interval: 7–19 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 59-year period 1960–2018:

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 50	60th to 80th
Excellent	Greater than 50	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. 1997). Since 2018, the SECM project has been conducted cooperatively by NOAA and the Alaska Department of Fish and Game (ADF&G), and the two agencies have combined efforts to produce a joint pink salmon harvest forecast using SECM data (Piston et al. 2019). The ADF&G research vessel *Medeia* is now used to conduct the SECM surveys and biologists from NOAA, ADF&G, and the regional aquaculture associations provided direct assistance to the sampling effort during the June, July, and August surveys. In the future, 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 2020 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 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 2019 juvenile pink salmon abundance index (monthly peak juvenile CPUE; standardized catch based on 20-minute trawl sets) of 1.20 was the third lowest in the 23 years of SECM surveys.

Forecasts were developed using an approach described by Murphy et al. (in press). A multiple regression model was developed using the juvenile pink salmon abundance index and associated environmental parameters. The model used is:

$$E(y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 X_2 + \varepsilon$$

where *E(y)* is the expected value for *y*, the natural log of Southeast Alaska pink salmon harvest, β_1 is the coefficient for the natural log of CPUE +1, β_2 is the coefficient for the natural log of the environmental covariate water temperature (e.g., summer water temperature indices in the upper 20 m in Icy Strait), β_3 is the interaction term, and ε represents the normally distributed error term. Leave-one-out cross validation (hindcast), Akaike Information Criterion for small sample sizes (Burnham and Anderson 2004), and the model performance metric mean absolute scaled error (MASE; Hyndman and Kohler 2006) were then used to evaluate forecast accuracy of alternative models. The 80% prediction intervals around the forecast were calculated using the car package in program R (Fox and Weisberg 2019).

Forecast Discussion:

The 2020 harvest forecast of 12 million pink salmon is approximately one third of the recent 10-year average harvest of 35 million pink salmon. A harvest near this forecast would also be approximately 60% of the average even-year harvest since 2006. The 2019 peak June–July juvenile pink salmon index value (1.20) ranked 21st out of the 23 years that SECM information has been collected. Pink salmon harvests associated with juvenile indices below a value of 2.0 have ranged from 8 to 37 million fish (mean=21 million fish).

The low juvenile abundance index in 2019 was not unexpected. Pink salmon escapements in the parent year (2018) were very poor throughout northern Southeast Alaska inside waters and the escapement goal was not met in that subregion, which may have resulted in below optimal egg deposition. Escapement and harvest of pink salmon in the Northern Southeast Inside subregion have been very poor since 2012 and the 2020 forecast indicates this pattern is likely to continue. Pink salmon escapement goals for the Southern Southeast and Northern Southeast Outside subregions were met in 2018, but harvests were well below average. The low juvenile abundance index in 2019 may also indicate that brood year 2018 pink salmon experienced poor freshwater and/or early marine survival. It is possible that drought conditions present in Southeast Alaska from the parent year 2018 spawn through the spring of 2019 reduced spawning success or negatively impacted overwinter survival of developing juvenile salmon, but the exact reasons for the low juvenile abundance are not known. Juvenile pink salmon caught in the 2019 SECM survey trawls, however, were among the largest (in length) in the 23-year time series (Figure 3) and were in good condition, which indicates favorable nearshore marine conditions in the spring. The size of juvenile pink salmon was similar to the large size of juveniles observed during the marine heat wave of 2014–2016 (Figure 3) and returns from those juvenile years were all below average.

Like many recent years, a potential source of uncertainty regarding the 2020 pink salmon return is the anomalously warm sea surface temperatures in the Gulf of Alaska in 2019. Warm temperatures that persisted throughout the Gulf of Alaska from fall 2013 through much of 2016 (Bond et al. 2015; Di Lorenzo and Mantua 2016; Walsh et al. 2018) returned in 2018 and strengthened in 2019. Compared to sea surface temperatures since 1997, when NOAA first started the SECM project, surface temperatures in the Gulf of Alaska in 2019, immediately offshore of Southeast Alaska, were the warmest of the time series in July, the 4th warmest in August, and 3rd warmest in September[1]. Sea surface temperatures were well above average across the entire Gulf of Alaska during that time[2]. Pink salmon that went to sea from 2014 to 2018 returned in numbers below expectation and below recent odd- and even-year averages. The impact of warm sea surface temperatures on the survival of pink salmon that went to sea in 2019 is unknown and adds uncertainty to the forecast.

The department will manage the 2020 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

Bond, N. A., M. F. Cronin, H. Freeland, and N. Mantua. 2015. Causes and impacts of the 2014 anomaly in the NE Pacific. Geophysical Research Letters 42: 3414–3420.

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

Di Lorenzo, E., and N. Mantua. 2016. Multi-year persistence of the 2014/15 North Pacific marine heatwave. Nature Climate Change 6:1042.

Fox, J., and S. Weisberg. 2019. An {R} Companion to Applied Regression, Third Edition. Thousand Oaks CA: Sage. ; https://socialsciences.mcmaster.ca/jfox/Books/Companion/

[1] https://www.ncdc.noaa.gov/data-access/marineocean-data/extended-reconstructed-sea-surface-temperature-ersst-v5.

[2] https://polar.ncep.noaa.gov/sst/rtg_high_res/archive/20190815/color_anomaly_NW_ophi0.png.

Hyndman, R. J., and A. B. Koehler. 2006. Another look at measures of forecast accuracy. International Journal of Forecasting 22: 679-688.

Murphy, J. M., E.A. Fergusson, A. Piston, A. Gray, and E. Farley. In Press. Growth and harvest forecast models for Southeast Alaska pink salmon. North Pacific Anadromous Fish Commission Technical Report No. 15.

Orsi, J. A., J. M. Murphy, and A. L. J. Brase. 1997. Survey of juvenile salmon in the marine waters of southeastern Alaska, May–August 1997. (NPAFC Doc. 277) Auke Bay Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service, NOAA, 11305 Glacier Highway, Juneau, AK 99801-8626, USA. 27 p.

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.

Walsh, J. E., and thirteen other authors. 2018. The high latitude marine heat wave of 2016 and its impacts on Alaska [supplement]. Bulletin of the American Meteorological Society. 99: s39–s43.

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.

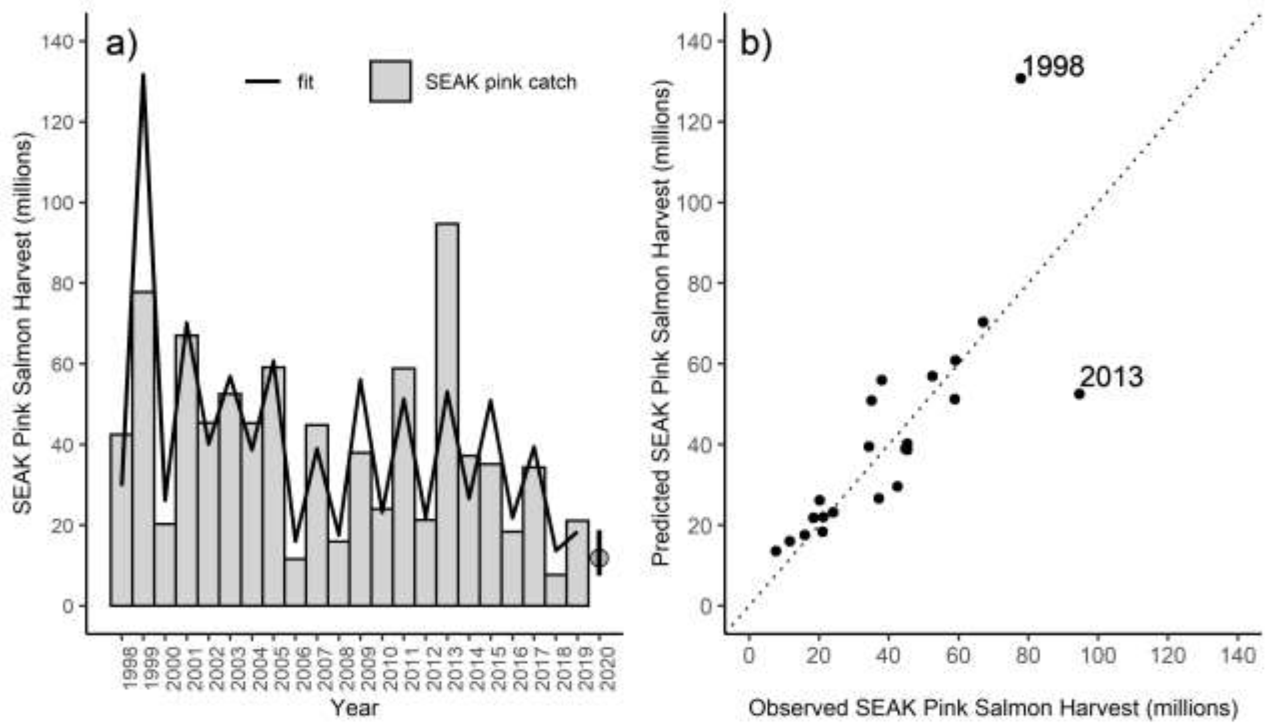

Figure 1. Forecast model fit (hindcasts) for total Southeast Alaska (SEAK) pink salmon harvest, 1998–2019 by year (a) and by the fitted values (b). The 2020 forecast is shown as a grey circle in panel a with the 80% prediction interval as a black vertical line. The observed SEAK pink salmon harvest is represented by the grey bars and the model fit is shown by the black line in figure a. The dotted line in panel b represents a one-to-one line; circles above the line represent hindcasts that would have been greater than the actual harvest and circles below the line represent hindcasts that would have been less than the actual harvest.

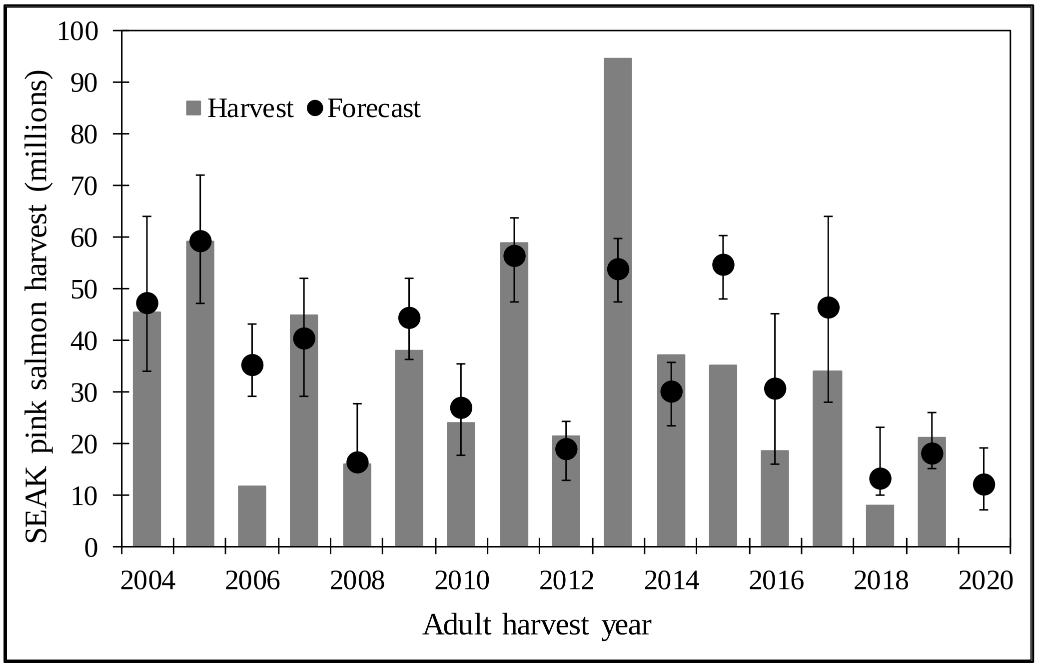

Figure 2. Annual harvests of pink salmon in SEAK compared to the actual preseason harvest forecasts, 2004–2020. The error bars represent the 80% confidence or prediction intervals of the forecasts.

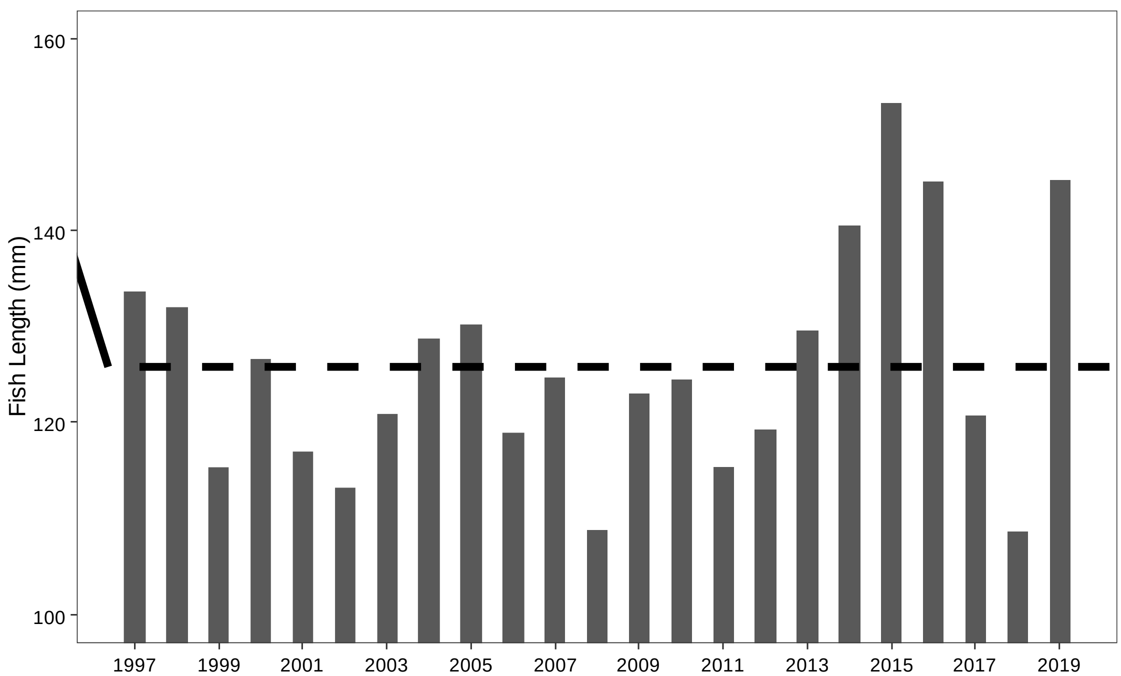

Figure 3. Average snout-to-fork length of juvenile pink salmon (standardized to 24 July) captured during trawl surveys in upper Chatham and Icy straits, 1997–2019. The dashed line represents the 1997–2019 average length.

Andy Piston, Steve Heinl, Sara Miller, and Rich Brenner, Alaska Department of Fish and Game
Jim Murphy, Charlie Waters, Andy Gray, and Emily Fergusson, NOAA, Auke Bay Lab, Alaska Fisheries Science Center

Advisory Announcement web site: http://www.adfg.alaska.gov/index.cfm?adfg=cfnews.main.

Office	*Ketchikan*	*Petersburg*	*Wrangell*	*Sitka*	*Juneau*	*Haines*	*Yakutat*
ADF&G	*225-5195*	*772-3801*	*874-3822*	*747-6688*	*465-4250*	*766-2830*	*784-3255*
AWT	*225-5111*	*772-3983*	*874-3215*	*747-3254*	*465-4000*	*766-2533*	*784-3220*