2015: Preliminary Outlook and Forecast for Chinook Salmon Timing

Lower Yukon River (Area Y-1), May 4, 2015

Preliminary Outlook

The relatively mild winter of 2014 – 2015 has created expectations of earlier than average returns of Chinook salmon to the Yukon River, so this preliminary forecast is designed to give everyone concerned with Yukon River chinook the maximum lead time. The preliminary outlook for Yukon River Chinook salmon timing in 2015 calls for a **slightly early to average return** to the Yukon delta area, mainly because the April mean air temperature at Nome was slightly warmer than average. The first significant pulse (15% point) of Chinook is expected to cross the delta around **June 12.** The half-way point (50%) in the run will be reached about **June 20**. April mean air temperature is the basis for this outlook and forecast, as it is the earliest reasonably reliable indicator of Chinook salmon run timing. The strength of the effect of April mean air temperature in any given year is conditioned on marine sea ice cover and sea surface temperatures, SST, in May. Spring ice cover in marine areas of the northern Bering Sea during and after April influences timing, but its impacts can't be fully measured until the end of May. Ice cover since the equinox (March 20) has been trending toward an end point on May 31 that may be about average. Both the extent of sea ice and the April monthly sea ice concentration in the northern Bering Sea were close to long term averages (http://nsidc.org/arcticseaicenews/). The date of break-up of river ice at Alakanuk, 18 river miles from the Bering Sea, should be watched as a precursor of movement across the delta. **If Alakanuk break-up occurs by May 23, the first pulse (15%) of chinook across the delta could occur before June 12.** River ice may be followed on NOAA National Weather Service site; **(http://aprfc.arh.noaa.gov/). Updated outlook and forecast will be made available if environmental factors change enough to warrant it, otherwise the final forecast is to be out shortly after May 31.**

For more information, data and updates go to http://www.aoos.org/2015-yukon-chinook-forecasting/

Preliminary Forecast Based on April Mean Air Temperature at Nome 1961 - 2014

Given the historical relationship between the three percentiles (15%, 25%, 50%) and April Mean Air Temperature (C)), predictions are June 12 (15%), June 15 (25%), and June 20 (50%) in District Y-1 of the Lower Yukon River

Predicted % Points	2015
Fifteen	June 12
Twenty-five	June 15
Fifty	June 20

Statistical Analysis

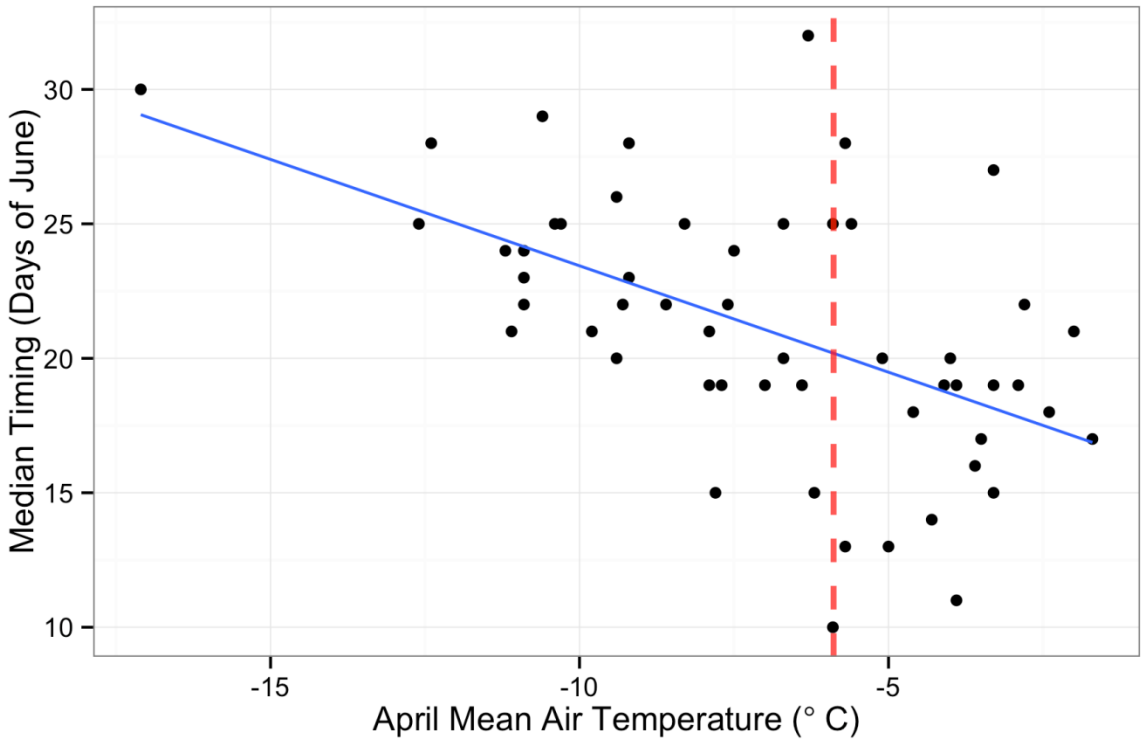
More information will be presented in the Final 2015 Outlook and Forecast issued on May 31. Here we present historical performance of timing as long term averages with standard deviations of dates of three percentage points of migration for Yukon chinook for the years 1961 – 2014.

N = 54	15%	25%	50%
Mean	**June 14**	**June 16**	**June 21**
s.d.	4.86	4.93	4.84
High	June 23	June 26	July 2
Low	June 5	June 6	June 10

The figure (on page following) shows the historical relationship between the date of the 50% point and AMATC. Added to the figure is a solid blue line representing the fit of a slope and intercept linear model and a dashed red line shows the 2015 value for AMATC. While there appears to be an inverse relationship between these two variables, that relationship is a weak one. For a value of AMATC like 2015's (-5.89°C), 50% point dates from the entire historical range (June 10 – July 2) have been observed. Note that as air temperatures gets warmer, the variability in its relation with timing gets larger. Air temperature is a more reliable indicator of timing at and below its long term mean (-7.1°C) than at warmer temperatures such as seen in 2015 (-5.89°C).

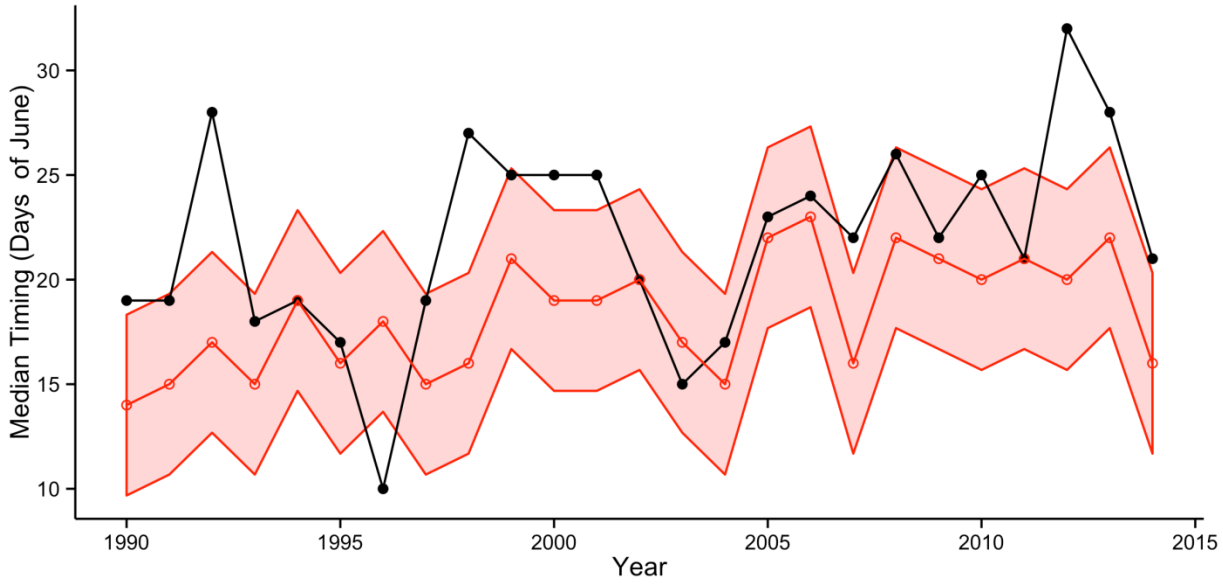
As the 2015 analysis indicates, when it is based on April mean air temperature alone, the forecast of timing of the Chinook salmon run is highly uncertain. It is necessary to use additional environmental factors occurring later in the spring in order to improve the utility of the forecast analysis for managers and the public. Spring ice conditions and May mean sea surface temperature have been added to the final analysis, expected shortly after May 31, primarily to improve predictive capabilities in warmer years when sea ice may not persist through May. In warmer years when absence of sea ice allows the wind to mix river water with marine waters, and to push pockets of brackish water offshore, the Chinook salmon appear to develop the ability to survive in freshwater more quickly than in years with persistent ice. Even in ice free conditions, if winds are weak, migrating Chinook salmon will pause at the edge of the river plume for some period of time before entering the river, making the run timing on the delta later. Based on 54 years of experience, timing of the run in warm years can be early or late, depending on the strength of wind-driven mixing of fresh and marine water in the coastal areas at the river's mouths. The forecast of May 31 should be more informative.

See Figure on following page



Understanding Uncertainty: How reliable is April mean air temperature as an indicator of Chinook salmon timing?

In order to understand the uncertainty and predictive capability of AMATC as an indicator of run timing, we (1) used hind-casting to arrive at a more accurate measurement of model performance, and (2) calculated mean absolute prediction error (MAPE) for the model from these hind-casts. We then used MAPE to generate prediction intervals based upon how the model actually performs rather than upon a model fit statistic such as standard error. MAPE is the average difference between the forecasted and observed run timings over the set of years included in the hind-cast and, here, hind-casting refers to calculating historical predictions using only the data that would have been available at the time that prediction was made. This has the benefit of approximating what would have happened if this model had been used in the past and we can extrapolate that performance to future years. The years 1990 through 2014 were hind-cast, resulting in values for MAPE of 3.6 (15%), 3.8 (25%), and 4.32 (50%) days. The following figure shows model performance from 1990 onward for predicting the 50% point of run timing.



(Above) Historical observations of median run timing (black) and predicted run timing (red). The ribbon corresponds to the prediction interval generated using MAPE. Above, the prediction interval using MAPE includes the observed median timing in 14 of the 25 years in the hind-cast (56%).

Credits

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