Run timing forecast models for Kuskokwim Chinook

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Abstract:

In-season management of Pacific salmon Oncorhynchus spp. fisheries is challenging because of uncertainty in run size and timing. Given a daily index of run abundance, such as a test fishery catch-per-unit-effort, it is difficult to discern between an early small run and a late large run without a priori information on run timing. Because of this uncertainty, in-season run size predictions based on average run timing may be biased due to deviation of the current year's timing from the average. The ability to predict the timing of the coming run could have great utility for in-season management. This need is especially felt in large drainage systems where escapement counts are not available until late in the season and daily in-season information is largely limited to test fishery indices. We propose to address this need for the Kuskokwim River Chinook salmon stock by (1) estimating predictive relationships between environmental variables (i.e., air/sea surface temperature, ice cover, and the Pacific Decadal Oscillation) and run timing for the development of pre-season run timing forecasts, (2) investigating relationships between run timing and run size, (3) assessing the value of run timing forecasts to in-season run size predictions, and (4) communicating our findings to stakeholders to increase awareness of how run timing forecasts can be used in management. We hypothesize that run timing can be reliably predicted from environmental variables and the utility of possessing these independent forecasts in-season is high. Anticipated deliverable products from the proposed study are (1) a run timing forecast model along with information on its predictive ability, (2) improved stakeholder understanding of the importance of run timing information to in-season management, and (3) publications in the scientific literature highlighting project results.

Project Objectives:

Objective 1: Quantify associations between run timing and environmental variables. We will investigate predictive relationships between run timing and environmental variables for Kuskokwim River Chinook salmon. First, we will quantify annual run timing at the Bethel gillnet test fishery. We will then investigate predictive relationships by fitting regression models between run timing quantities (median run date and duration) and potential environmental drivers of riverine entry. The environmental variables will include air temperature, sea surface temperature, ice cover, and the PDO index (Anderson and Beer 2009; Mundy and Evenson 2011; Kovach et al. 2015).

Objective 2: Assess relationships between run timing and run size. We will assess whether run timing is predictable from run size for Kuskokwim River Chinook salmon. This topic is one of interest to Kuskokwim area biologists and managers as we are unaware of any studies that relate run timing to run abundance. Although we hypothesize that there is no relationship between these quantities, these potential relationships should be investigated for two reasons. First, if substantial relationships exist, uncertainty in run timing could be reduced. Second, if the particularly

troublesome run timing and run size scenarios found by Adkison and Cunningham (2015) are prevalent (i.e., a positive relationship between timing and size: early small runs and late large runs), then this is critical information for managers to be aware of so it can be incorporated into decision making to avoid potential pitfalls.

Objective 3: Evaluate the utility of a run timing forecast model to in-season run size predictions. We will use a retrospective analysis to evaluate the degree to which using run timing forecasts would have increased the precision of in-season run size predictions for Kuskokwim River Chinook salmon for the years 2007 – 2016. There are well-developed methods to predict the anticipated run size by updating pre-season run size forecasts with in-season information from run indices (e.g., Fried and Hilborn 1988), however, they show substantial uncertainty in predicted run size due to inter-annual variation in run timing. We will evaluate the utility of incorporating run timing forecasts into in-season run predictions by comparing run prediction models that include the forecast with those that do not. We hypothesize that the inclusion of a forecast of the current year's run timing will substantially increase the precision and accuracy of these in-season run predictions by accounting for this inter-annual variation.

Objective 4: Increase stakeholder familiarity with how run timing forecasts could be used by managers. We will share our findings with area stakeholders and biologists at the 2018 Kuskokwim Region Interagency Meeting with two primary methods. First, we will present our findings on the predictive performance of run timing forecast models and their utility for in-season run size predictions via oral presentation. Second, we will develop a spreadsheet tool to show how in-season run size predictions function both with and without a run timing forecast model, which will elucidate to what extent run timing information is useful for in-season run predictions.