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Using the Pacific Ocean to predict Columbia River Chinook returns

Predicting future events is not for the faint of heart. A stockbroker can predict a stock will go up, but it goes down. A meteorologist might predict next Tuesday will be sunny, but it rains. And a fisheries forecaster can predict a bumper spring Chinook run in the Columbia River that turns out to be anemic. Fortunately, forecasts aren't typically made in a vacuum; there are a myriad of pieces of information that make predictions more than just hunches. The challenge, say forecasters, is knowing which predictors to rely on and which to minimize.



In the field of salmon harvest management, we may be getting a little closer to that goal of distinguishing the important predictors from the less important ones. A team of scientists from NOAA and Oregon State University have found that a wide range of *biological* indicators from the Pacific ocean are better predictors of adult salmon returns to the Columbia River than local or regional *physical* indicators. The accuracy of such predictions is invaluable to state and federal fishery managers in setting harvest limits and allocations.

The abundance of Pacific salmon has been highly variable over the last few decades and most forecasting models have been less than stellar. The scientists combined 31 indicators – ranging from the surface temperatures of the ocean to the amount of prey available to salmon – collected over 11 years to help predict adult spring Chinook salmon returns to the Columbia. They then assessed the accuracy of the predictions.

The researchers' goal was to determine the best combination of indicators to explain the abundance of spring Chinook returning to the Columbia River each year. Some indicators turned out to be far better predictors than others and the team said certain trends were clear. For example, the best predictors of spring Chinook returns were indicators like the abundance of food or the presence of prey in the ocean, especially when young salmon first arrive there. So-called local physical indicators like water temperature or coastal upwelling were less reliable predictors.

The scientists' computer model accurately predicted that 221,000 fish would return to the Columbia in 2011. For 2012, their model came up just shy, predicting almost 180,000 fish would return; the actual number was 203,000 returning adults. That's not bad for a forecast system that historically has considered 80 percent accuracy the norm.

Results, say the researchers, suggest that managing Pacific salmon effectively requires many types of information and no single indicator can represent the complexities of a salmon's life when it first enters the ocean. Moreover, the indicators that best apply to one stock or species may differ from those that best apply to another stock or species. Timing was important as well, the researchers said. For example, during a Chinook's first year in the ocean, the most reliable predictors collected in May were quite different from those just a month later in June.

"The ocean has historically been viewed as a 'black box' in the life of a salmon," said NOAA scientist Brian Burke, the study's lead author, "but this study opens that box just a little and shines an important scientific light on its contents."

He said managers can take advantage of this information in forecasting the size and timing of Chinook returns to the Columbia River basin, a particularly challenging task because harvest limits are typically set some months before the season starts.

The researchers findings are in a study, "Multivariate Models of Adult Pacific Salmon Returns," published in PLoS ONE at <http://dx.plos.org/10.1371/journal.pone.0054134>.

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