

Scientific and Statistical Committee's Salmon Subcommittee Report 2025 Salmon Methodology Review

Pacific Fishery Management Council
Online Meeting

October 9, 2025

The Scientific and Statistical Committee's Salmon Subcommittee (SSC-SSC, Appendix A) met online October 9, 2025, in conjunction with the Salmon Technical Team (STT), to conduct a Salmon Methodology Review for two items; "Modification to the Oregon Production Index Hatchery (OPI-H) coho salmon forecast methodology" and "2025 Technical Revision to the Marine Survival Forecast of the Oregon Coast Natural (OCN) Coho Work Group Harvest Matrix." Cassie Leeman (ODFW), Thomas Buehrens (WDFW), and Shannon Conley (WDFW) discussed analyses undertaken to address OPI-H forecast methodology. Erik Suring (ODFW) and Cassie Leeman discussed analyses undertaken to mitigate the loss of two life cycle monitoring sites for OCN Coho. Due to a federal furlough, federal members of both the SSC-SSC and STT were unable to attend the review.

[Council Operating Procedure 15](#) (COP 15) governs the conduct of Salmon Methodology Reviews, and currently makes a distinction between methodology changes and data range changes. Both of the items for review demonstrate that this distinction is not always clear, and that data changes can have implications that merit scientific review. The SSC-SSC recommends an appraisal of the type of changes that merit scientific review in the salmon process, which might aid in clarification of COP 15.

Oregon Production Index Hatchery Forecast Modification

The SSC-SSC received a presentation from Cassie Leeman and Thomas Buehrens on a proposed modification to the approach for forecasting Oregon Production Index-Hatchery (OPI-H) Coho abundance approved by the Council in 2023 and applied in 2024. The Oregon Production Index Technical Team (OPITT) annually produces a forecast of natural origin Coho salmon from the Columbia River Basin and hatchery Coho salmon from Leadbetter Point, WA, to the California/Mexico border, and this aggregate is referred to as the OPI-H. Jack returns, delayed smolt releases, and nine environmental covariates were considered for use in a multi-model approach to forecasting. The authors explored alternate forecast models and recommended a modification in the previously approved approach ([Agenda Item D.3.a, Supplemental SSC Report 1, November 2023](#)) using MAPE (mean absolute percent error)-weighted ARIMA-based (autoregressive integrated moving average) ensemble forecast.

The 2025 projections were a source of concern to the analysts given the divergence between Pacific Decadal Oscillation (PDO) and sea surface temperatures, the record low predicted jack to adult ratio, and the record low predicted hatchery to natural origin adult ratio. Further, they hypothesized that model performance 15 years ago may be less relevant relative to performance in more recent years. To address these concerns, a model decay weighting approach was explored that emphasizes recent conditions while maintaining some connection to historical conditions.

The new methods proceed with the same steps as the [approach endorsed by the SSC and Council in 2023](#), but input years are given weights equal to $(1-\alpha)^t$ relative to the most recent year included in fitting the model, with $\alpha=0.25$ as the proposed modification. That is, if the most recent year is given a weight of 1.0, the second most recent year is given weight 0.75, the third most recent year is given a weight of 0.5625 (0.75^2), and so on. Under this approach, an older year has less than half the influence of the most recent year after three years, less than a quarter the influence after five years, and less than a tenth the influence after nine years.

A performance evaluation of using a range of different α values for weighting was conducted to identify an optimal value to reduce the MAPE. Down-weighting was optimized using a weighted MAPE with an alpha term of 0.25 to down-weight older years. This change resulted in improving forecast accuracy from 39% to 33% across the most recent 15 years. For weighted data sets, an “effective sample size” can be calculated by dividing the squared sum of the weights by the sum of the squared weights (Kish 1992). In this case, using $\alpha=0.25$, the effective sample size cannot exceed 7.0 regardless of how many total years are considered. While this proposed methodology continues to use 15 years of data, the effective sample size is less than half of the previously adopted methodology. SSC-SSC notes that large reductions in the amount of data informing a model may be concerning, and it may be worthwhile to revisit the definition of a data range change under COP 15.

The SSC reviewed the performance of the forecast for the OPI-H, but this aggregate is divided into stocks for use in the Coho Fishery Regulation Assessment Model (FRAM) and smaller aggregates for Preseason Report 1. The performance of the stock-specific abundance forecasts (or the stock-specific “forecasts” implied by disaggregating the OPI-H based on additional models) is likely to be worse than performance for the aggregate, though the results for the aggregate were a modest improvement over the current method. The analysts operated under the assumption that improvements to the aggregate mean there are improvements to all of the components, but did not take the step to test that assumption. The SSC-SSC strongly recommends exploring forecasts of the individual hatchery and natural origin Coho stocks used for management.

The SSC-SSC finds that the revised MAPE-weighted ARIMA-based ensemble forecast model is an improvement over the current methodology for the aggregate of stocks, but finds the information provided insufficient to assess its performance at the stock level used in the Council process. The SSC-SSC endorses the use of the modification for 2026, but for subsequent years the SSC-SSC recommends that performance be measured for the same natural and hatchery components used by FRAM during the preseason process.

References

Kish, L. 1992. Weighting for Unequal Pi . Journal of Official Statistics 8:183-200.

Oregon Coastal Natural Coho Marine Survival

The annual allowable exploitation rate of Oregon Coastal Natural (OCN) Coho Salmon is set using a two-dimensional matrix with observed parental returns as one axis and forecasted marine survival as the other axis. Currently the marine survival axis is a marine survival index (MSI) of forecasted OCN smolt-to-adult returns. Observed OCN MSI from five life cycle monitoring (LCM) sites is used along with biological and environmental predictor variables to fit an ensemble of generalized additive models each year, and this model ensemble is used to predict the MSI. Previously, there were six LCM sites but the northern-most site was dropped in 2017. A decision has been made now to close the two southern-most LCM sites, Winchester and WF Smith, going forward so a new method is needed to predict the MSI. Four approaches were investigated:

1. Continue to refit the forecast models annually, calculating the MSI using a multivariate state space model to interpolate missing LCM sites from past data and new information from the remaining sites (interpolation method).
2. Continue to refit the forecast models annually using the three remaining sites (reduced method).
3. Use the most recent (2025) model to forecast MSI into the future (fixed method).
4. Return to the OPI hatchery/smolt indicator used for this process prior to 2013 (OPI-H method).

For the analysis, interpolated data was produced using the MARSS R package and a reduced data set was produced using a weighted average of the remaining sites, with the Mill Creek (Yaquina) site given a weighting of 1/6 due to rearing conditions conducive to larger smolts, and thus improved marine survival, relative to the other sites. The MSI data sets produced by the interpolation and reduced methods were compared to the current MSI by iteratively removing three to eight years of data from the WF Smith and Winchester sites and evaluating the mean absolute error (MAE) and mean absolute percentage error (MAPE). The MSIs calculated with the interpolation method had lower MAE and MAPE than the reduced method for the removal of

three to eight years of data when compared to the observed values for the five-site method. As more data was removed, the difference between the interpolation and reduced methods decreased.

Next, the model ensemble was fit using the MSIs from the interpolated and reduced methods for years 2021 to present. For the fixed method, the model ensemble was fit using data from 1998-2019 and used to forecast for 2020 to 2025. Finally, marine survival categories were determined for the current (five-site) method, interpolated method, reduced method and fixed method using the current matrix and marine survival categories were determined for the OPI-H method using the categories in use prior to 2013. All forecasted marine survival categories were the same except for the OPI-H method in 2021, which was predicted to be high rather than medium. The analysts should update Table 3 and Figure 4 to include the observed categories and marine survival for 2021-2024, as was done in the 2017 report. It is important to understand how overall model performance changes as well as any associated changes in category designation.

The analysts concluded that though all MSI alternatives forecast marine survival in the same category for the five years evaluated as the current five-site method, the interpolated method had the best fit and provides flexibility if the defunded LCM sites come back into use.

The SSC-SSC agreed with the analysts' conclusion and supports the use of the interpolated method going forward, and strongly recommends that the method be re-examined after several years of use. The SSC-SSC recognizes this work was on a tight timeline because of the immediate need to address the closing of the two LCM sites, however, environmental changes that seem to be affecting the performance of the OPI-H forecast models strongly suggest it is worth revisiting the model ensemble used for forecasting OCN Coho salmon. The SSC-SSC noted that of the six original LCM sites, the northernmost and the two southernmost are now no longer in use. This limits the ability to detect regional signals that may impact marine survival, although for now it appears that marine survival of OCN coho is driven by larger scale processes, though that should not be the default assumption as both habitat restoration and environmental degradation simultaneously act to alter relationships.

Appendix A.

SSC Salmon Subcommittee Members in Attendance

John Budrick, California Department of Fish and Wildlife, San Carlos, CA

Tim Copeland, Idaho Department of Fish and Game

Galen Johnson, (SSC Salmon Subcommittee Chair), Northwest Indian Fisheries Commission

Jason Schaffler (SSC Chair), Muckleshoot Indian Tribe, Auburn, WA

Carly Somerset (Alternate), Idaho Department of Fish and Game

Tien-Shui Tsou, Washington Department of Fish and Wildlife, Olympia, WA