SALMON TECHNICAL TEAM REPORT ON FINAL METHODOLOGY REVIEW

The Salmon Technical Team (STT), the Model Evaluation Workgroup (MEW), and the Scientific and Statistical Committee Salmon Subcommittee (SSC-SS) met remotely on October 11, 2023, to discuss the following Salmon Methodology Review topics:

1. Consider technical modifications to the Sacramento River winter Chinook (SRWC) abundance forecast by examining whether an egg-to-fry covariate can improve forecast performance,
2. Explore alternative forecast approaches for the Oregon Production Index hatchery (OPI-H) coho forecast, and
3. Review and consider improvement to methods used to model South of Falcon fisheries in the Chinook Fishery Regulation Model (FRAM).

In addition to these three Methodology Review topics, the participants received a progress report on recent updates to the FRAM documentation website, focused primarily on documentation of the Chinook base period.

1. SRWC abundance forecast

Tanya Rogers (Southwest Fishery Science Center) presented the report "A re-evaluation of preseason abundance forecasts for Sacramento River winter Chinook salmon" at the Methodology Review meeting. The report evaluated the forecast performance of the status quo method (*BASE*) and a method similar to the *BASE* model, with the exception that it allowed for the juvenile survival rate (from fry to age-2 in the ocean) to be modeled as a function of the egg-to-fry survival rate. This model was referred to as the *ETF* model. In addition to evaluating the performance of the *BASE* and *ETF* models, a suite of Gaussian Process (*GP*) models were also considered. GP models relate covariates to postseason estimates of abundance using a flexible function with few assumptions about mechanism. Covariates considered were the number of spawners, hatchery releases, ETF survival rates, and a freshwater temperature covariate. The report concluded with a recommendation to adopt the GP-2 model for future SRWC abundance forecasts.

Following the Methodology Review meeting, the SSC-SC requested additional information on forecasts performance for the suite of models considered. The analysts produced a supplemental report titled "Supplement to a re-evaluation of preseason abundance forecasts for Sacramento River winter Chinook salmon" in response to this request. The first part of the supplemental report was focused on evaluating forecast performance based on control rule outputs (the allowable age-3 impact rate south of Point Arena). The analysts note that the relative performance of *Base, ETF*, and the *GP* models remain largely unchanged, except that the GP-1 model outperformed the *GP-2* model for some performance measures. However, it is likely that other GP model formulations outside of the *GP-1* and *GP-2* models could have better performance.

The second part of the supplemental report was focused on re-evaluating forecast model performance when the postseason estimate of abundance was computed using year-specific age structure values rather than mean age structure (which was used in the original report). The analysts note that "The relative

performance of the *Base*, *ETF*, and *GP* models remains largely unchanged, except that the *GP-1* model outperforms the *GP-2* model in metrics of accuracy."

Overall, the GP models clearly outperform the *BASE* and *ETF* approaches. The best performing GP models vary depending on how the analysis is conducted, and the choice of performance measures. The STT agrees with the recommendation in the initial report to adopt the *GP-2* model for future SRWC forecasts while acknowledging that the *GP-1* model performs better by some measures and evaluation scenarios.

2. Exploration of alternative forecasting approaches for OPI-H coho salmon

Cassie Leeman (STT, MEW, Oregon Department of Fish and Wildlife), Thomas Buehrens, Shannon Conley, and Mark Sorel (Washington Department of Fish and Wildlife [WDFW]) presented an overview of the evaluation of alternative forecast approaches for OPI-H coho at the Methodology Review Meeting. The approach utilized an autoregressive integrated moving average (ARIMA) model structure that included smolt release and jack returns metrics in addition to a variety of environmental covariates as model predictors. The forecast performance assessed one-year-ahead projections of the most recent 15 years with a variety of summary performance metrics. Results demonstrate the mean absolute percentage error weighted (MAPE weighted) ensemble forecast was the best preforming model considered and reduced absolute forecast error by approximately 40 percent compared to the current methodology. The data and code used to generate the forecasts is publicly available on a WDFW-managed GitHub repository, as detailed in agenda item D.3, Attachment 1. Also, the Oregon Production Index Technical Team (OPITT) stated that the MAPE-weighted ensemble approach is ready to be used for the 2024 preseason planning process.

The STT was impressed by the approach, particularly because of the reduction in forecast error compared to the current method, and recommends using the MAPE weighted ensemble approach for the OPI-H forecast beginning in 2024. The STT also recommends that the OPITT continue to investigate additional ways to refine the forecast approach, including: (1) evaluating the ideal level of model complexity (i.e., could complexity be reduced without a loss in performance?), and (2) evaluating whether performance could be improved by forecasting individual stock components rather than the total OPI-H aggregate abundance.

The ARIMA model uses different error structures among combinations of autoregression, moving average, and trend. The STT recommends including information on the error structure when documenting the model selected each year in Preseason Report I.

3. Consider improvement to methods used to model South of Falcon fisheries in Chinook FRAM.

Jon Carey (STT, National Marine Fishery Service) presented an overview of the current approach used to develop inputs for fisheries south of Cape Falcon in Chinook FRAM, in addition to two recommended updates to this approach, as detailed in agenda item D.3, Attachment 1. The STT agrees that these updates should lead to improved model performance and recommends implementing them beginning with the 2024 preseason planning process.

PFMC
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