

## SALMON TECHNICAL TEAM REPORT ON FINAL METHODOLOGY REVIEW

The Salmon Technical Team (STT) met remotely with the Model Evaluation Workgroup (MEW) and the Scientific and Statistical Committee Salmon Subcommittee (SSCSC) on October 20-21, 2021, to discuss the following four Methodology Review topics:

1. Documentation of the Fishery Regulation Assessment Model (FRAM),
2. Evaluate post-season metrics of FRAM performance,
3. Documentation of the abundance forecast approach used for Willapa Bay natural coho,
4. Review the Oregon Production Index Hatchery coho (OPIH) forecast methodology.

In addition, an optional FRAM tutorial was presented by Angelika Hagen-Breaux on the first day of the Methodology Review, which further covered much of the material included in item one above.

### Documentation of the FRAM program, including algorithms and the User Manual

Jeremiah Shrovnal [Washington Department of Fish and Wildlife (WDFW)] presented a new FRAM documentation website, including newly-added technical documentation. The documentation is housed in a publically-accessible GitHub repository which also hosts (1) the previously presented “User Manual”, (2) a placeholder site for future base period documentation, and (3) the new technical overview. The overview contains separate documentation for Chinook and coho FRAM and describes model history, model structure, data, algorithms, and special procedures. The documentation was a collaborative effort between the tribal and state comanagers and MEW members. The STT found the FRAM documentation to be readily accessible, comprehensive, and easily modifiable as changes to the FRAM are made. The STT commends the efforts of tribal and state comanagers to produce this documentation in time for the Methodology Review and looks forward to future updates to this website, specifically those that include documentation of the Chinook FRAM base period.

### Evaluate post-season metrics of FRAM performance

Jon Carey [National Marine Fisheries Service (NMFS), STT, MEW] presented a comparison of FRAM exploitation and maturation rates to corresponding rates estimated by the Pacific Salmon Commission’s Chinook Technical Committee through their annual Exploitation Rate Analysis (ERA). The analysis included the development of a framework to provide for rapid future comparative analyses. FRAM and ERA-derived exploitation rates were compared graphically for stocks represented by similar coded-wire-tag codes. For many cases, there was generally good coherence between FRAM and ERA-derived exploitation rates. There were some cases where discrepancies were larger and initial work to explore the causes of discrepancies was described. For some stocks there were differences in stock and fishery mapping, which made comparisons difficult. Future work will focus on the influence of sampling and catch reporting, and incorporating feedback provided at the Methodology Review.

### Willapa Bay natural coho forecast

WDFW staff presented an analysis of new forecasting approaches for Willapa Bay natural coho. These included a Spatio-Temporal Integrated Population Model (STIPM), a lag-1 autoregressive model (AR1), and use of 3-year means of abundance calculated at various lags. The analysts also noted that alternative forecasting procedures that included model selection, model averaging, and the potential use of environmental covariates could be possible with the models described at this Methodology Review. The data and code used to generate the forecasts is publicly available on a GitHub repository.

Forecast performance, assessed using one-year-ahead projections and a variety of summary performance metrics, was similar between the STIPM and AR1 models. Both the STIPM and AR1 models had improved forecast performance relative to the status quo approach(es), though the improvements were modest. No forecast skill results were provided under scenarios that included model selection, model averaging, or inclusion of environmental covariates.

After discussion with the WDFW analysts and the SSCSC, the STT recommends that future Willapa Bay natural coho forecasts be generated with both the STIPM and AR1 models. The forecast used for management could be either (1) the forecast generated from the STIPM model, (2) the forecast generated by the AR1 model, or (3) a model-averaged forecast from the STIPM and AR1 models. Model (or forecast) selection would be guided by forecast performance statistics.

#### Oregon Production Index Hatchery forecast

Erik Suring (Oregon Department of Fish and Wildlife) provided a description of the OPIH forecast approach, and described the annual forecasting process conducted by the Oregon Production Index Technical Team (OPITT). Documentation of the forecasting approach included the basic method, evaluation of model fit over time, and assessment of forecast performance. The data and code used to make the forecast is publicly available on a GitHub repository.

There was no alternative OPIH forecast model proposed and this topic was focused on further documentation and analysis of the existing approach that went beyond what is documented annually in Preseason Report I.

The STT notes that the current forecast model fits the data well, yet goodness of fit has declined over time. Nonetheless, forecast performance ranks relatively high when compared to other coho stocks that make substantial contributions to Council area fisheries. Given this, the STT recommends that OPITT continue to use the status quo OPIH forecasting approach for 2022 and beyond.

#### Workload planning

The STT and SSCSC held discussions on three “workload planning” topics. The discussion surrounding these topics is briefly described here.

##### *Clarify the definition of “major stocks”*

Council Operating Procedure (COP) 15 establishes the procedure for the review and Council approval of salmon estimation methodologies, utilizing the Scientific and Statistical Committee (SSC), the STT, and the MEW. Within COP 15, it is stated that:

*During the March and April meetings or at other appropriate times, the SSC, in conjunction with the STT and MEW, will identify methodology issues which need documentation and/or merit a full review. The SSC is responsible for reviewing new*

*or changed methodology as opposed to specific applications of the methodology. Examples of issues that could merit a full review include new model algorithms, methods for incorporating base data into models, forecasting methods for major PFMC stocks, experimental design of proposed experimental fisheries, and technical changes to stock complexes or conservation objectives.*

Members of the SSCSC have pointed out that there is no explicit definition of “major PFMC stocks”, for which forecasting methods could warrant a full review, and that a definition of major stocks should be developed. The STT acknowledges that development of a definition for “major PFMC stocks” would likely require a change to COP 15, at a minimum. If the Council wishes to pursue the development of such a definition, the STT would like to be involved in discussions with the other salmon advisory bodies.

#### *Development of an abundance forecast database*

The SSCSC has requested the development of a database that tracks salmon abundance forecast methods, documents when those methods have changed, and the review those changes were subject to. Annually, the Preseason Report 1 presents forecasts for 42 Chinook salmon and 36 coho salmon stock groups along with descriptions of the forecasting methodology used for each and the management entities responsible for those forecasts. Past Preseason 1 reports are available on the Council website going back to 2011. In discussion with the SSCSC, it was acknowledged that it may be difficult or impossible to retrospectively chronicle all changes in forecast methodologies, and the review of those changes, for all forecasted stocks in the Fishery Management Plan (FMP). A potential path forward could be to track forecast modifications, and reviews, from the present time into the future. However, such an endeavor would be time-consuming and it would require new efforts towards database design, data entry, and database maintenance. The STT would look to guidance from the Council on the level of priority that should be given to this proposed task.

#### *Review of reference points and conservation objectives*

Current FMP language and COPs 10 and 15 discuss the process for making changes to reference points and conservation objectives, but the COPs are not prescriptive. The FMP states that “The Council considers established conservation objectives to be stable and a technical review of biological data must provide substantial evidence that a modification is necessary” and that “...periodic review and revision of established objectives is anticipated as additional data become available for a stock or stock complex.”

The SSCSC has recommended compiling all documentation relevant to the development of conservation objectives, and documentation of any review that occurred for these conservation objectives, in a repository. While citations for documents that contributed to the various conservation objectives are provided in the FMP, and other Council reports, it is acknowledged that some of these documents are old, in the gray literature, and can be difficult to locate. The STT would look to guidance from the Council on the level of priority that should be given to this proposed task.

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