SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON SALMON METHODOLOGY REVIEW

Five topics recommended for review at the abbreviated Salmon Methodology Review were reviewed by the Scientific and Statistical Committee (SSC). SSC comments on each of the topics follow:

Technical revision to the Oregon Coastal Natural (OCN) coho work group harvest matrix

In November 2012 the Council approved using the wild coho salmon jack-to-smolt ratio from the Mill Creek (Yaquina) Life Cycle Monitoring site as a new predictor of marine survival for wild adult coho salmon for use in 2013 management. Approval was provisional, pending further analysis to address SSC recommendations regarding the new predictor and mitigate possible risks from reliance on a single site for predicting marine survival.

An ensemble mean forecast was developed using seven two-variable generalized additive models that incorporate additional biological and oceanographic indicators to predict marine survival. These models are very similar to the preseason models currently used to forecast OCN abundance. The ensemble mean forecast improved performance compared to the 2012 revision relying solely on the Mill Creek jack-to-smolt ratio. The proposed predictor is more robust to a change in any single indicator, and it appropriately limits impact rates when survival is expected to be low but allows harvest opportunity when it is expected to be high.

Three of the seven ensemble models rely on jack-to-smolt ratio data from the Mill Creek. To address concerns about alternative methods for predicting marine survival if there were a catastrophic failure at the Mill Creek site that prevented estimation of the jack-to-smolt ratio, a suite of three-variable environmental models was developed. An ensemble mean of six three-variable models was shown to perform nearly as well as the two-variable ensemble mean described above and was superior to the model relying on the Oregon Production Index Hatchery predictor.

The SSC recommends that the two-variable ensemble mean model be used to predict marine survival for use in the OCN coho salmon harvest matrix. In the event that jack-to-smolt ratio data from Mill Creek are unavailable, the three-variable ensemble mean model should be used. Every year the models should be refit incorporating the most recent data. Variable selection may change over time, and should be reviewed in five years, or when it becomes clear that some models are no longer well-supported statistically.

Lower Columbia Natural (LCN) Coho matrix control rule

Mr. Chris Kern (Oregon Department of Fish and Wildlife) made a presentation to the SSC which included two new analyses suggested at the subcommittee meeting (Addendum to C.2.a, Attachment 2). The primary purpose of the analysis was to incorporate new information from eight populations, in addition to the Clackamas and Sandy populations, into the framework for evaluating alternative harvest management matrices for LCN coho.

Spawner-recruit functions and full seeding levels were developed for all populations. Methods varied depending on available data, accounting for differences between the Washington and Oregon recovery plans. Relative risk and opportunity for a range of harvest strategies and harvest matrices was evaluated using a stochastic population viability analysis (PVA).

One strength of the proposed analysis framework is that it characterizes the relative risk from alternative harvest scenarios to the entire LCN coho evolutionarily significant unit, rather than simply the two healthiest populations (the Sandy and Clackamas). The SSC recommends using the shorter 1993 to 2009 data sets for the Sandy and Clackamas populations

The SSC evaluated the data reconstruction techniques used and technical aspects of the PVA. We did not evaluate any specific scenarios. The analysis framework is suitable for ranking the relative risk of various harvest scenarios. Numerical estimates of extinction risk from the model should be considered as index values only, and in no way represent actual probabilities of extinction. The analysis is complex, and the SSC identified several areas where alternative analytical techniques could be applied. However, the basic technique and application are sound, and relative rankings of scenarios are not likely to be greatly affected by the statistical refinements suggested. The populations used in the analysis do not exactly match those in the Fishery Regulation and Assessment Model (FRAM) model. These differences will need to be reconciled before a resulting harvest strategy can be applied.

Continued monitoring of LCN coho populations should help refine capacity and productivity estimates for Oregon populations and allow for empirical estimates for Washington populations. Investigation of alternative metrics to better represent marine survival of LCN coho, similar to approaches used for the OCN coho harvest matrix, should also be examined.

Incorporation of estimated legal and sublegal Chinook encounters into the Fishery Regulation and Assessment Model (FRAM)

Ms. Angelica Hagen-Breaux (Washington Department of Fish and Wildlife) presented this analysis to the SSC. Recent Chinook FRAM projections of total sublegal encounters for fisheries operating under minimum size limit regulations differ substantially from recent field observations for many fisheries. While the basis for differences is not understood, FRAM's current structure allows for *ad hoc* calibration of base period sublegal encounter rates through the use of a simple multiplicative adjustment factor, thereby providing users the ability to improve correspondence between model-projected sublegal encounters and sublegal encounter estimates based on data from sampled fisheries.

A comprehensive set of available sample-based estimates of sublegal Chinook encounters for a range of modeled fisheries was used to develop and test a set of simple computational algorithms to incorporate these data directly into FRAM modeling (i.e., to estimate the necessary adjustment factors for the model). The effect of the proposed changes on key model outputs (e.g., exploitation rates on stocks of conservation concern) was evaluated. Overall, recalibrating FRAM's current base period to produce fishery-level sublegal encounter totals consistent with recent data introduced minimal changes when assessed in terms of stock-specific impacts even though changes in sublegal encounter totals were substantial for some individual fisheries.

The proposed change to FRAM modeling of sublegal encounters: (1) improves fishery-level projections of total sublegal encounters; (2) strengthens the link between ongoing monitoring activities and fishery modeling; (3) minimally changes past assessments of stock-level impacts; and (4) establishes a foundation for improved size-limit modeling.

The SSC noted that the von Bertalanffy method currently used to estimate growth within a year may not be appropriate and may contribute to poor model performance in this area. Future model revisions could address this issue. Recent size-at-age data are most relevant to current fisheries. The SSC recommends that data be updated annually and older data that may not represent current conditions be dropped from the time series as appropriate.

The SSC recommends the incorporation of the revised sublegal encounter estimates in the FRAM model for 2014.

Modifications to Fishery Regulation and Assessment Model (FRAM) algorithms on sublegal and legal encounters and minimum size limits

Ms. Angelika Hagen-Breaux (Washington Department of Fish and Wildlife) gave a presentation to the SSC on a proposed change to Chinook FRAM which would allow evaluation of proposed size limit changes to FRAM fisheries. Chinook FRAM was originally designed to evaluate changes in fishery catches and stock impacts resulting from changes in minimum size limit regulations. Recent attempts to use this feature revealed the FRAM methodology and supporting data to be flawed.

At the 2012 Salmon Methodology Review, the Washington Department of Fish and Wildlife presented a method to address this size limit problem. Several issues were raised by the SSC at the 2012 review. The SSC recommended not to adopt the changes presented in 2012.

For the October 2013 Salmon Methodology Review, an improved method to estimate sublegal encounters in FRAM was suggested (see previous discussion item). Using updated sublegal encounter rates reduces the exploitation rate changes calculated for key stocks. Because encounters would be calibrated to recent-year observations under the proposed approach, those fisheries that experienced size limit changes since the base period would no longer need to be adjusted; only recent size limit changes would need to be modeled. In addition, the adjustment algorithm was modified to keep total encounters constant.

While this method addresses a known FRAM problem in evaluating proposed changes to fishery size limits, it does not address the problem of FRAM incorrectly allocating sublegal impacts to stocks and age groups. This problem would be addressed by the work currently being done to develop and implement a new Chinook FRAM base period including revisions to the model code dealing with growth.

The SSC recommends incorporating this method in FRAM modeling for 2014. This would be an interim measure until a new Chinook FRAM base period, model code revision, and model calibration allows incorporation of new growth and size limit algorithms.

Alternative forecast methodologies for the Sacramento Fall Chinook Index

Dr. Mike O'Farrell (National Marine Fisheries Service, Southwest Fishery Science Center) presented an analysis of alternative forecast methodologies for the Sacramento Fall Chinook Index (SI) to the SSC. The analysis compared the performance of a variety of potential forecast models for the SI. Models included simple averages, jack to SI regressions with multiple lags, time series models based on autocorrelated error or smooth changes in the jack relationship, and regressions including environmental variables. Models were fitted with data from 1983, in contrast to the shorter time series currently in use. Models were evaluated statistically, and examined for their ability to track recent trends in the SI that have proven challenging to forecast.

Most models out-performed the current model based on "leave one out" and "one year ahead" cross-validation techniques. Some environmental models performed well, but the environmental factors that contributed to the forecast tended to change over time, leading to the conclusion that variable selection in these models was inherently unstable. The authors identified a simple autoregressive error model relating jacks to SI as the most parsimonious and robust alternative. This model allowed for temporal changes in the expected ratio of the SI to the number of jacks the previous year through autocorrelation in residual errors. The performance gains compared with the current model are modest when error is calculated across all years, but the model structure should reduce the risk of extended periods of over- or under-predictions.

The SSC recommends use of the proposed "Model 8" for forecasting the SI in 2014.

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