SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON 2008 METHODOLOGY REVIEW

The Salmon Subcommittee of the Scientific and Statistical Committee (SSC), the Salmon Technical Team (STT), and the Model Evaluation Workgroup (MEW) met at the Marriott Courtyard Portland Airport on October 15, 2008, to review the three salmon methodology items identified by the Council at the September meeting:

- Development of a new stock abundance forecast for Sacramento River fall Chinook.
- Harvest forecast model for Sacramento River fall Chinook.
- Sensitivity analysis of Chinook and Coho Fishery Regulation Assessment Models (FRAM) to major assumptions including sensitivity to parameters related to mark-selective fisheries.

Presentations on each of the items were given to the full SSC at the November meeting.

Development of a New Stock Abundance Forecast for Sacramento River Fall Chinook

Dr. Michael O'Farrell presented a review of the updated Sacramento River fall Chinook (SRFC) abundance forecast data and methods using a new Sacramento Index (SI) methodology. The SI was initially developed for the 2008 preseason management process in response to the decline of the SRFC stock and to address management limitations of the Central Valley Index (CVI) used in previous seasons. Dr. O'Farrell noted the updated SI now includes a more complete accounting of SRFC adult ocean abundance and a straightforward accounting of river harvest and escapement of SRFC, resulting in an advance in the extent, resolution, and specificity of the SRFC assessment framework

The SSC agrees that the SI is a more appropriate index than the CVI for representing the status of the SRFC stock. The updated SI represents a substantial improvement over the CVI and the SI used in 2008. The SSC recommends that the updated SI be reported in place of the CVI in future Council salmon reports to represent the status of the SRFC stock.

Bias in the estimate of the potential escapement of SRFC is possible because of: (1) the simplifying assumptions when accounting for ocean harvest, (2) not accounting for natural mortality between the time of harvest and escapement, and (3) drop-off mortality. The SSC agrees with the working group that bias from these factors is likely small under recent Council management. A simple length cutoff for separating jacks from adults in returns to Sacramento River Basin hatcheries has probably introduced errors in jack counts and could reduce the accuracy of forecasts of SRFC adult abundance from jack returns; the SSC understands from the discussion that coded-wire-tag (CWT) marking has been recently initiated at these hatcheries, in part to correct this deficiency. Further work on the age composition of hatchery returns will be useful in reducing forecast error.

Harvest Forecast Model for Sacramento River Fall Chinook

Dr. Michael O'Farrell presented a review of the Sacramento Harvest Model (SHM). The SHM was developed in 2008 in concert with the Sacramento Index (SI) in response to the need to model Sacramento River Fall Chinook (SRFC) distinct from the Central Valley combined stocks. In particular, the Sacramento Index (SI) directly accounts for harvest north of Point Arena and river harvest. Using the SHM it is now possible to evaluate the effect of variation in management measures. The SHM is not age structured, because adequate age data are not available.

The SHM considers harvest during a "biological year" (September 1 – August 31), rather than the calendar year of the CVI model. September – December harvest is estimated from fishery data using the same method used for calculating the SI. January - August harvest is projected using harvest rates predicted from expected effort by area and month using the Klamath Ocean Harvest Model and the expected numbers of adult SRFC in the ocean. River harvest is modeled as well, which was not done in the Central Valley modeling.

The SSC considers the SHM an improvement in modeling the harvest of SRFC, and endorses it for Council use. The SSC compliments the authors presenting the SI methodology and SHM for providing thorough and comprehensive documentation for review which greatly facilitated the review process.

Sensitivity Analysis of Chinook and Coho Fishery Regulation Assessment Models

Mr. Andy Rankis presented "Three tests of a potential method for development of a FRAM sensitivity analysis". The methodology incorporates a "complete factorial design" to examine a model's sensitivity to manipulation of selected parameters and to guage interaction among those parameters. For Chinook FRAM, the sensitivity analysis examined the model function in regard to manipulating the release mortality rates for: drop-off/out, legal size Chinook, and sub-legal size Chinook. Two Chinook analyses included the doubling of these parameters for all FRAM fisheries; the first analysis had no mark selective fisheries, the second analysis was based upon a relatively large Puget Sound sport fishery converted into a selective fishery. A third analysis tested the coho FRAM selective fishery parameters of: mark misidentification rate, unmark misidentification rate, and drop-off mortality rate. By running the model with the Council-adopted rates and double these rates they were able to characterize the relative importance of these factors and show how the factors interacted in the model.

The first Chinook analysis demonstrated that the model seems to be working correctly (for the three selected parameters) and is not overly sensitive to the key mortality rate parameters that largely determine the non-landed portion of total fishery related mortality; and in combination, the second Chinook analysis demonstrates that the model continued to function in a consistent manner when a relatively large selective fishery replaced a previously non-selective fishery. The third analysis showed that in the relatively low-intensity coho selective fisheries that were modeled, the interaction effects of the three selective fishery parameters are explainable and minor.

The SSC agrees that the proposed approach is useful and encourages the MEW to conduct a thorough sensitivity analysis with the framework that has been proposed. Because of the large number of parameters to be examined, the SSC recommends a partial factorial design instead of a full factorial for future sensitivity analyses. Also, future analyses should examine three levels of the parameters being examined: the nominal level, something less than the nominal level, and something greater than the nominal level. This will allow analysts to determine if the effects of some of the parameters are non-linear. Finally, future sensitivity analyses should define the objective of the analyses presented. For example, (1) model performance, (2) identification of key parameters that affect key model outputs used for management, and (3) how uncertainty in key model inputs affects key model outputs used for management.

Chinook Selective FRAM

At the September meeting the Council expressed renewed interest in obtaining SSC approval of Chinook selective FRAM as a management tool for use in Council fisheries.

The selective fishery version of the Chinook FRAM was first presented to the SSC in 2002. At that time the SSC could not evaluate the suitability of the model because it was poorly documented and lacked validation. Based on the complex Chinook life cycle (compared with the relatively simpler life cycle of coho salmon) and concern that errors could become very large, the SSC concluded, in part, that:

"2. ...the SSC cannot support the use of the modified Chinook FRAM to evaluate mark-selective fishery proposals in 2003.

3. If the Council chooses to use the modified Chinook FRAM to evaluate mark-selective fishery proposals in 2003, the SSC supports the STT recommendation to establish buffers for management targets to compensate for the increased bias and uncertainty of model estimates..." (Exhibit C.4.b, Supplemental SSC Report, November 2002).

Subsequently, an attempt to compare model predictions with fisheries-based field studies in 2003 -2004 in Washington Marine Catch Areas 5 and 6 in the Strait of Juan de Fuca was reviewed by the SSC. After that review the SSC concluded:

"Overall results indicated that FRAM produced reasonably good predictions for encounter rates. However, the fisheries were too small and the data too variable to reach any firm conclusions about stock-specific predictions of impacts. Also, it is not possible to assess model predictions of non-landed mortalities with this comparison. The SSC is no closer to being able to recommend adoption of the mark-selective version of Chinook FRAM for use in evaluating Council fisheries than it was two years ago." (Agenda Item D.2.b. Supplemental SSC Report, November 2004).

As a result of SSC recommendations in 2002, the MEW was formed. The first task of the MEW was to produce documentation for the FRAM models. This task has been substantially completed and reviewed by the SSC. Documentation includes: (1) an Overview, (2) a User Manual, (3) Technical Documentation, (4) a Programmers Guide, and (5,6) Base Period documentation for Chinook and Coho FRAMs. After reviewing the documentation the SSC now

has a better understanding of the modeling framework in general and Chinook selective FRAM in particular.

Based upon increased understanding of Chinook selective FRAM during the last several years due to the new documentation and additional analyses (such as the preliminary sensitivity analysis), the SSC concluded that the Chinook selective FRAM is suitable for modeling mark-selective fisheries of low intensity, with "low intensity" provisionally defined as those fisheries with fishery-specific exploitation rates on marked stocks of less than 10 percent and overall selective fishery exploitation rates of less than 30 percent. However, the Salmon Technical Team should further valuate the appropriateness of the 10 percent/30 percent provisional guidelines and make recommendations to the Council.

The values of 10 percent and 30 percent are not arbitrary – they are based on precautionary application of modeling results presented by Lawson and Sampson (1996) for coho salmon. These results are based on simulations that show that selective fisheries do not harvest all stocks at an equal rate, but remove marked fish from a population more rapidly, thereby changing the stock composition and progressively increasing encounters (and consequent mortalities) on unmarked fish. As a result, unmarked fish mortalities increase exponentially, rather than linearly with exploitation rate and the effect can be quantified. This effect is negligible at low harvest rates, which makes the current linear models adequate to model low intensity fisheries, but exploitation rates for higher intensity fisheries will be biased low.

Similar results are likely to apply to Chinook given that the same fishery dynamics apply. Chinook cohort sizes are re-estimated annually similarly to coho, so modeling errors are unlikely to propagate from year to year. Because the intensity of mark-selective fisheries on marked hatchery stocks will be used to determine if a fishery is low intensity, the exploitation rate on marked hatchery stocks will now need to be monitored during the management process.

Lawson, Peter W. and David B. Sampson. 1996. Gear related mortality in selective fisheries for ocean salmon. North American Journal of Fisheries Management 16:512-520.

PFMC
11/02/08