SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON SALMON METHOOLOGY REVIEW

The Scientific and Statistical Committee (SSC) discussed the topics reviewed at a joint meeting of the Salmon Subcommittee of the Scientific and Statistical Committee, Salmon Technical Team (STT), and the Model Evaluation Workgroup (MEW) in Portland, Oregon on October 21-23, 2014. At that meeting proposed changes to salmon methodologies were reviewed for use in 2015 management.

Status Determination Criteria for Willapa Bay Natural Coho

Dr. Robert Kope (STT) gave a presentation on status determination criteria (SDC) for Willapa Bay natural coho (Agenda Item F.2.a. Attachment 1).

F_{MSY} and S_{MSY} were estimated based on a Ricker stock-recruit function fit to log-transformed data on recruits per spawner from 1996-2012, with appropriate back transformation. Spawner counts included both natural- and hatchery-origin fish, and recruits were reconstructed from spawners using run reconstruction based on terminal catch data and pre-terminal ocean exploitation rates of unmarked fish calculated using the fishery regulation assessment model (FRAM). The analyses are appropriate and the data used are the best available. Therefore the SSC supports F_{MSY}=0.74 and S_{MSY}=17,200 natural-area spawners.

Development of Escapement Goals for Grays Harbor fall Chinook Using Spawner-recruit Models

Dr. Pete McHugh and Dr. Kris Ryding presented the results of their recent stock-recruitment analyses for Grays Harbor fall Chinook, which produced a biologically-based spawner escapement goal to replace the current capacity-based escapement goal (Agenda Item F.2.a. Attachment 2). Escapement, terminal run reconstruction, and ocean abundance datasets were updated for this analysis. The two major populations of Grays Harbor fall Chinook, and Chehalis and Humptulips, were analyzed separately. This river system has been successfully managed to achieve an escapement goal, so there has been a narrow range of escapements over the 20 years of data and no observations of the very high or low escapements that would help define a spawner-recruit relationship. Although there was little evidence for a link between spawners and recruits over the observed range, the recommended S_{MSY} of 13,326 (S_{MSY} = 9,753 for the Chehalis and 3,573 for the Humptulips) is based on the best available science.

Standardized Method to Calculate Chinook Age 2 FRAM Stock Recruit Scalars, Based Upon the Age 3 Forecasts

Mr. Andy Rankis (MEW) gave a presentation on a new method of developing age-2 abundance inputs for Chinook FRAM (Agenda Item F.2.a. Attachment 3). Ms. Angelika Hagen-Breaux (MEW), Mr. Larrie LaVoy (MEW, STT), and Dr. Pete McHugh (WDFW) were also available to answer questions.

Currently, true age-2 forecasts based on full life cycle models or information specific to the cohort that will constitute age-2 fish in the upcoming year are not made for most stocks in Chinook

FRAM. Instead, age-2 inputs for Chinook FRAM are generated using different methods for different stocks, with a variety of assumptions.

Chinook FRAM has four model time steps, with time periods 1 and 4 spanning the same set of months in consecutive years, and assumes that fish "age up" between time steps 3 and 4. This means that the age 2 abundance in period 3 becomes the age 3 abundance (minus mortalities) in period 4. In Chinook FRAM's calculation of exploitation rates, fishing mortality is summed over time periods 2-4 while escapement is summed over time periods 1-3. Thus, the calculated exploitation rate is sensitive to the modeled number of age 3 fish in time step 4, which is driven not by the age-3 forecast inputs (which determines age-3 abundance at the start of time steps 1) but by the age-2 input.

The proposed method (specifically, equation 3 of F.2.a. Attachment 3) derives initial age-2 abundance in time period 1 such that it will project forward to an age-3 abundance in period 4 that matches the forecast abundance of age-3 in period 1. Using the current system of ad hoc age-2 inputs, modeled age-3 abundances in time periods 1 and 4 could be very different. In reality, age-3 fish in time period 1 and age-3 fish in time period 4 come from different cohorts (they were born one year apart) so the two abundances need not be equal. However, cohort strength tends to be autocorrelated: on average the two values should be close.

The SSC supports using this approach to generate age-2 inputs in Chinook FRAM in 2015. Exceptions should be stocks with age-2 forecasts shown to predict better than this default method. This will increase the accuracy of FRAM exploitation rate calculations but will not provide any new information on the strength of the actual age-2 cohort in the upcoming year.

A Method for Utilizing Recent Coded Wire Tag Recovery Data to Adjust FRAM Base Period Exploitation Rates

Dr. Galen Johnson gave a presentation on a method to adjust FRAM base period exploitation rates (BPERs) using recent coded wire tag (CWT) recoveries (Agenda Item F.2.a. Attachment 4). The recent FRAM-modeled Deep South Puget Sound Fall Fingerlings (SPS FF) catch in Hood Canal is much higher than the proportion of SPS FF CWT recoveries in the Hood Canal fishery. Adjusting BPERs using estimates from recent CWT recoveries was proposed as a short term solution specifically to reduce the modeled non-local catch of SPS FF in the Hood Canal fishery, however, it was noted that any stock in FRAM could be adjusted using this method.

The SSC agreed that a problem was identified; FRAM substantially over-estimates SPS FF catch in Hood Canal. The overestimate was quantified, and a sound solution proposed. If this adjustment is implemented, the FRAM output of SPS FF catch in Hood Canal would be reduced, and likely more realistic. However, concerns were voiced by several of the FRAM modelers about changing BPERs because reducing one BPER technically requires increasing all others slightly to maintain the model calibration. The larger problem is that arriving at a set of BPERs is a delicate balancing act. After a base period has been developed we inevitably identify areas where adjustments need to be made. The SSC recommends the development of standard procedures for identifying when adjustments are necessary and how the adjustments are implemented.

An Evaluation of the Effectiveness of the Cape Flattery Control Zone Closure at Reducing Non-treaty Troll Fishery Impacts on Puget Sound Chinook

Dr. Pete McHugh (WDFW) presented a series of analyses of the effectiveness of the Cape Flattery Control Zone closure in reducing impacts of the non-treaty troll fishery on three hatchery coded-wire tagged (CWT) indicator stocks that are believed to be closely aligned with the natural-origin Hood Canal, Mid- and South Puget Sound fall fingerling type Chinook salmon (Agenda Item F.2.a. Attachment 5).

The Cape Flattery Control Zone was closed to non-treaty trollers (NT) in 1999 but remained open to the Treaty Indian troll fleet (TI).

The analyses presented used CWT recovery data to estimate and quantify the statistical significance of:

1) The difference in exploitation rates (ER), normalized to catch in the NT fishery before and after the closure, to test whether the NT closure coincided with a reduction in ER,

2) The difference in ER in the TI fishery before and after the closure, to serve as a control, testing whether ER changed between the two time periods in a fishery expected to be largely unaffected by the NT closure, and

3) The difference in the ratio between ER of the NT and TI fisheries before and after the closure, with the expectation that NT ER would be reduced relative to TI if the closure reduced impacts of the NT.

Additionally, fishing mortalities estimated from CWT recovery data were compared to those calculated by Chinook FRAM, to determine an appropriate multiplier to apply to the Chinook FRAM-calculated NT fishing mortalities, which are driven by a base period prior to the closure.

The SSC finds the analyses technically sound and an appropriate use of the available data. The analyses show that ER in the NT fishery was lower, after the closure, although the difference is of marginal statistical significance, while ER in the TI fishery was very similar before and after the closure. Similarly, the NT:TI ER ratio became lower after the closure, but again statistical significance was marginal. Taken together, these results suggest that the closure was likely effective in reducing NT ER, although the magnitude of the reduction is uncertain. In addition, the size of reduction in ER may vary among individual stocks and across years.

The analysis found that the point estimate for the ratio of CWT-derived mortality estimates to FRAM mortality calculations was 0.56 (95% confidence interval of 0.25-0.86), or a 44% reduction. The SSC agrees that this is the best available point estimate. Using a value of 0.75, which was used last year, would be a precautionary policy decision. There was no risk assessment presented.

Conservation Objective for Southern Oregon Coastal Chinook

Todd Confer and Matt Falcy (ODFW) presented Conservation Objective for Southern Oregon Coastal Chinook (Agenda item F.2.a. Attachment 6). This document is based on the "Conservation Plan for Fall Chinook Salmon in the Rogue Species Management Unit" that was adopted by the Oregon Fish and Wildlife Commission in 2013. A version of this document submitted for

methodology review in 2013 was not reviewed. The present document addresses most of the major concerns from 2013.

The analysts objective was to update the current Status Determination Criteria (SDC) to measures compatible with the Salmon Fishery Management Plan (FMP) Amendment 16, and for the FMP SDCs and Oregon conservation objectives to be compatible. Rogue River fall Chinook are the escapement indicator stock for Southern Oregon Coastal Chinook (SOCC) which, in turn, are part of the Southern Oregon Northern California Chinook (SONCC) complex. Klamath fall Chinook are the ocean exploitation rate indicator stock for the SONCC. Ocean exploitation rates are not assessed for Rogue River fall Chinook.

Rogue escapements are calibrated to seine samples at one station (Huntley Park) and summer flows. Ocean exploitation rates are from Klamath fall Chinook as reported in Preseason Report I. A Ricker stock-recruitment function was fit to data from brood years 1972 through 2006. Point estimates from the analysis were: S_{MSY} = 34,992 and F_{MSY} = 0.54. Oregon chose to use the 75th percentile estimate of S_{MSY} as a conservation buffer, resulting in S_{MSY} = 36,880. MSST was calculated as 50% of the buffered S_{MSY}, or 18,440. Oregon also adopted an F_{MSY} of 0.78; the proxy for stocks without estimates of F_{MSY}, even though there is now an estimate (0.54) for this population.

The SSC found the point estimates to be the best available science and recommends that the Council adopt S_{MSY} = 34,992 and F_{MSY} = 0.54 for Rogue River fall Chinook. The choice of MSST is a policy decision as long as it is at least 50% of S_{MSY}.

Economic Impacts of Processing in Commercial Fisheries

The SSC Economics Subcommittee reported to the full SSC on their meeting in Spokane, Washington on September 10, 2014 where they compared the Fishery Economic Assessment Model (FEAM) and the Input-Output Model for Pacific Coast Fisheries (IO-PAC) models for analyzing economic impacts of processing in commercial salmon fisheries (subcommittee report attached). The SSC endorses the recommendations of the Economics Subcommittee.

The SSC recommends that IO-PAC apply its current dollar mark-up approach to estimate economic impacts for the 2015 Salmon SAFE. The 2015 Salmon SAFE should document the change from FEAM to IO-PAC and include a comparison of the economic impacts for the past few years using both models. The SSC supports supplementing the EDC with a salmon processor survey and shares the concern that a voluntary survey often has a low response rate.

SCIENTIFIC AND STATISTICAL COMMITTEE'S ECONOMICS SUBCOMMITTEE REPORT ON THE COMPARISON OF FEAM AND IO-PAC-TYPE MODELS FOR ANALYZING ECONOMIC IMPACTS OF PROCESSING IN COMMERCIAL SALMON FISHERIES

September 10, 2014
Spokane, Washington

IO-PAC, a model developed by the Northwest Fisheries Science Center (NWFSC) to estimate regional economic impacts, was reviewed by the SSC (most recently in April 2013) and determined to be the best available method of estimating economic impacts for the groundfish fishery. IO-PAC has gradually replaced the Fishery Economic Assessment Model (FEAM) as the source of economic impact estimates for groundfish regulatory analyses and Stock Assessment and Fishery Evaluation (SAFE) documents. Council staff is now working with the NWFSC on transitioning from FEAM to IO-PAC to estimate economic impacts that are routinely reported in the Salmon SAFE (the annual *Review of Ocean Salmon Fisheries*).

In April 2014, the SSC became aware of a difference between FEAM and IO-PAC that has implications for how economic impacts for the commercial salmon fishery are estimated from the two models. FEAM estimates non-fish input purchases by processors on the basis of weight of landings, while IO-PAC estimates these purchases on the basis of ex-vessel value. More specifically, FEAM relies on multiple processor production functions that vary by species (Chinook, coho, chum, sockeye) and gear type (troll, net, other), on the basis that different species and gears yield distinguishable products that require different combinations of non-fish processor inputs. IO-PAC estimates salmon processing costs by applying a markup to the processor cost of acquiring salmon (i.e., the ex-vessel value of salmon) that is the same for all salmon species. Because of this difference between the two models, IO-PAC yields higher estimates of processor impacts than FEAM at higher ex-vessel prices and lower estimates at lower ex-vessel prices.

The SSC Economics Subcommittee met on September 10, 2014 in Spokane, Washington to consider the extent to which existing processor data could be used to resolve the differences between FEAM and IO-PAC identified at the April 2014 meeting. The discussion focused largely on a document prepared for the meeting by Jerry Leonard (NWFSC), Marie Guldin (NWFSC) and Ed Waters (PFMC contractor) dated August 20, 2014 and entitled *Comparison of Weight-based and Cost-based Methods for Estimating processing Costs and Economic Impacts*. Mr. Leonard presented the co-authors' findings to the Subcommittee.

IO-PAC estimates of processor impacts for the salmon fishery are based on processor data collected in the Economic Data Collection (EDC) program – a mandatory economic data collection program that includes processors who have first-receiver site licenses to purchase IFQ groundfish. EDC includes not only groundfish processing data but also data for all other species (including salmon) processed by EDC respondents. Processors covered by the EDC program account for about 20% of Pacific coast salmon landings.

Regression methods were used to determine whether non-fish processor purchases are better explained by the weight-based approach (FEAM) or the dollar markup approach (IO-PAC), and

also whether processor operational costs vary by species. Because EDC processor data does not distinguish among individual salmon species, EDC data was combined with PacFIN landings receipt data to estimate the species composition of salmon processed by EDC respondents. Regression results from the merged 2012 EDC-PacFIN data are as follows:

- A statistically significant relationship was found between salmon processing costs and the weight of salmon landings, and the null hypothesis of equal coefficients for Chinook and other salmon landings was rejected – lending support to the weight-based (FEAM) approach.
- A statistically significant relationship was found between salmon processing costs and the ex-vessel value of salmon, and the null hypothesis of equal coefficients for Chinook and other salmon could not be rejected – lending support to the dollar markup (IO-PAC) approach.

Based on the r-squared, the weight-based approach appeared to fit the 2012 data better than the dollar markup approach and also supported differential treatment for Chinook versus other salmon species. However, similar regressions run with 2011 data yielded implausible results for the weight-based approach but plausible results for the dollar markup approach. *Although there appears to be merit to both approaches, based on the lack of consistency in regression results for the weight-based approach, the Economics Subcommittee recommends that IO-PAC apply its current dollar markup approach to estimate impacts for the Salmon SAFE.*

A comparison of income impacts of salmon processing using the weight-based and dollar markup approaches was provided for 14 port complexes on the Pacific coast, based on 2010 data. The two approaches yielded similar impact estimates except in ports where salmon prices paid by EDC processors differed substantially from the prices prevailing in that port. Price differences were most pronounced for Columbia River ports, which have an active salmon gillnet fishery. For these latter ports, the dollar markup approach (IO-PAC) yielded much lower impacts than the weight-based (FEAM) approach.

Given that the EDC program is constrained to collecting salmon data only from IFQ groundfish processors, it is not clear how well the EDC data represents salmon processing. One way to improve salmon coverage (particularly for under-represented ports or gillnet-caught salmon) would be to supplement the EDC with a voluntary salmon processor survey. However, it is not clear whether this would be feasible, given the typically low response rates to voluntary processor surveys.

Mr. Jim Seger indicated that an appendix will be added to the next Salmon SAFE that documents the change from FEAM to IO-PAC and includes tables that compare impact estimates for the past few years based on the two approaches. The Subcommittee agreed that this would be a useful way to alert managers and other users to the model change. These new comparisons will differ from the comparisons done for this Subcommittee review, as they will focus more broadly on how total income impacts (associated with both salmon harvesting and processing) would be represented in the SAFE using the two models.

The SSC Economics Subcommittee thanks the individuals who provided the analyses that clarified how the differences between FEAM and IO-PAC and how they affect the estimation of salmon

processor impacts. The SSC also thanks Council staff for their involvement in planning this review.