The Salmon Subcommittee of the Scientific and Statistical Committee (SSC), the Salmon Technical Team (STT), and the Model Evaluation Workgroup (MEW) met at the Pacific Fishery Management Council (Council) office in Portland, Oregon on October 5 and 6, 2009, to review the four salmon methodology issues identified by the Council at the September meeting:

- Characterization of bias in Chinook and Coho Fishery Regulation Assessment Models (FRAM) associated with multiple encounters in mark-selective fisheries.
- Forecasting impact rates in fall fisheries for Klamath River fall Chinook and Sacramento River fall Chinook.
- Assessment of the September 1 maturity boundary assumption for Klamath River fall Chinook.
- Conservation objective updates for Puget Sound coho.

A summary of each of the items discussed was given to the full SSC at the November meeting.

The reviews this year covered substantive issues that have been of interest to the Council for several years. In most cases materials were well documented, submitted on schedule, and had relevant management focus. The SSC commends the authors.

The SSC recommendations on each item are summarized below.

Characterization of Bias in the Chinook and Coho Fishery Regulation Assessment Models

In 2008, the SSC requested an analysis to estimate the level of bias in Fishery Regulation Assessment Model (FRAM)-estimated exploitation rates for unmarked fish in mark-selective fisheries. This bias was expected to occur primarily because FRAM cannot currently account for mortalities from multiple encounters of individual unmarked fish with the fishing gear. The result is that FRAM underestimates total mortalities of unmarked fish in mark-selective fisheries. In 2008 the SSC recommended interim measures to account for this bias, pending an analysis by the MEW. Mr. Andy Rankis of the MEW described the work that has been done over the past year to address this concern.

The MEW developed a Multiple Encounter Model (MEM) which provided results identical to those of FRAM given no multiple encounters. Two multiple encounter scenarios were then considered, with and without an increasing release-mortality rate with multiple releases. FRAM models summer fisheries with either a single time step (Chinook: July to September) or three time steps (coho: July, August, September). The MEM estimates higher unmarked mortality rates than FRAM in either case, with the difference between the two increasing exponentially as the marked exploitation rate increases. With multiple time steps the bias is reduced but not eliminated. The SSC agrees that the MEM better reflects the expected dynamics of mark-selective fisheries and provides a standard which can be compared to appropriate FRAM model output to estimate the bias in FRAM. However it would be impractical to incorporate the MEM computational framework into FRAM. A partial analytical solution was proposed for...
implementation in 2010, with further review and development anticipated for 2011. In particular, an option will be added within coho FRAM to include an analytical equation which accounts for multiple encounters within a time-step and area in mark-selective fisheries. This option should be completed and its performance evaluated by the MEW in time for use in the February 2010 coho FRAM runs. The SSC endorses the implementation of this adjustment in the coho FRAM. If this model change is to be used to model 2010 fisheries it will require one more stage of review prior to March 2010. Review material should include documentation of changes made to the coho FRAM and a demonstration that the revised model performance achieves the expected bias reduction. In order to allow time for review, material needs to be submitted to the Council office by 8 January 2010.

In the Chinook FRAM bias correction will be more difficult to implement because of the multiple age classes that are subject to harvest. The SSC recommends maintaining the guidelines proposed in 2008, limiting exploitation rates in each modeled selective fishery to 10 percent, with a maximum 30 percent overall exploitation rate. The SSC recommends developing bias correction methods for the Chinook FRAM for review in the fall of 2010.

Forecasting Impact Rates in Fall Fisheries for Klamath River Fall Chinook and Sacramento River Fall Chinook

Dr. Mike O'Farrell summarized his investigations into the problem of forecasting impacts of fall fisheries for Chinook salmon on Sacramento River Fall Chinook (SRFC) and Klamath River Fall Chinook (KFRC). The basic problem is that fall fisheries conducted south of Cape Falcon, Oregon occur after the model-assumed end of river entry (i.e., after the end of the model year $t$), but before the estimate of the year $t+1$ abundance is available. These fisheries are termed “credit card” fisheries because they borrow from the as yet unassessed stock abundance. Hence, any harvest is deducted from the next year's allocation.

An estimate of September 1 abundance in year $t$ is not currently available until February of year $t+1$ (i.e., after the fishery has occurred). Dr. O'Farrell examined whether existing modeling methods or historical data could provide the needed estimates of September 1 abundance in year $t$ for the year $t$ management planning cycle. He concluded that these forecasts would be of low quality and would not be useful for management purposes.

When planning fall fisheries, the degree to which these fisheries will constrain ocean fisheries in the following year is unknown. In the worst case these fisheries can affect the Council's ability to meet conservation objectives for SRFC and KRFC. Dr. O'Farrell recommended that future fall fishing opportunities not be increased above historical levels because the risk of fall fishing cannot be accurately estimated. He also recommended that the risk that fall fisheries pose to future fishing opportunity, if constrained by the California Coastal Chinook consultation standard, should be assessed by examination of historical estimates of the KRFC age-4 ocean harvest rate from fall fisheries.

The SSC endorses the conclusions and recommendations of this report. Specifically,

- Currently, there are no methods available which can reliably forecast the September 1 abundances of Sacramento River Fall Run Chinook and Klamath River Fall Run Chinook
in the fall of year $t$ at the time of PFMC fishery management planning process in the spring of that year.

- There are very few area, month, and fishery combinations for fall fisheries where the harvest of SRFC could reliably be expected to be low so time-area management to reduce the impacts of fall fisheries to the SRFC stock is currently not feasible.
- Fall fisheries harvest proportionally few KRFC in some ocean management areas. More northern areas usually harvest a higher and more variable proportion of KRFC in the fall. Time-area management to reduce the impacts of fall fisheries to the KRFC stock may be feasible.
- The risk that fall fisheries pose to future fishing opportunity, if constrained by the California Coastal Chinook consultation standard, should be assessed by examination of historical estimates of the KRFC age-4 ocean harvest rate from fall fisheries.

Assessment of the September 1 Maturity Boundary Assumption for Klamath River Fall Chinook

Dr. Mike O’Farrell and Ms. Melodie Palmer-Zwahlen presented their assessment and recommendations regarding the appropriateness of the September 1 river return date for Klamath River Fall Chinook (KRFC).

Choice of an appropriate river return date has implications for harvest allocation and estimation of fishery contact, harvest, and impact rates. KRFC ocean harvest after September 1 is credited against the following year’s fisheries, prior to the Council’s annual preseason forecasts. This has management implications for meeting Council conservation objectives and the NMFS ESA consultation standard for California Coastal Chinook.

The KRFC cohort analysis and Klamath Ocean Harvest Model (KOHM) both make a simplifying approximation that immediately prior to September 1, mature KRFC leave the ocean for the Klamath Basin and immature KRFC remaining in the ocean advance one year in age. If the proxy date is set too early the estimated ocean abundance would be negatively biased in the cohort reconstructions, and if the proxy date is set too late the estimated ocean abundance would be biased high. Any bias in estimated cohort ocean abundance propagates to bias in contact, harvest, and impact rates. To minimize bias in cohort abundance reconstruction, the proxy date should be the midpoint for the timing of escapement from ocean fisheries.

For KRFC there was a unique opportunity to evaluate the appropriateness of the September 1 proxy from catch timing data in the Yurok Tribal gillnet fishery in and near the Klamath River estuary. The assessment concluded that September 1 was an appropriate proxy for the mid-point river return date. In addition, most of the mature KRFC were estimated to have entered the Klamath River by September 15.

The SSC endorses the report recommendation that the current September 1 river return date approximation should be retained in KRFC fishery assessment models. The SSC agrees that the September 1 date is an appropriate average midpoint date for the timing of escapement from ocean fisheries. The SSC notes that, in the future, more accurately partitioning the harvest of mature and immature KRFC in August and September may be possible with the collection of additional biological data from ocean fishery sampling to identify KRFC catch proportions, age, and maturity.
The SSC notes that both of the previous discussion items have implications to the risk posed to the KRFC stock by fall ocean fisheries. The Council may want to consider an option to reduce the risk of harvesting mature KRFC in the September fisheries, the impacts of which apply toward the conservation objectives and consultation standards in the following year. The SSC concurs with the recommendation that the risk of harvesting mature KRFC that have not yet returned to the river could be reduced by limiting ocean fisheries between September 1 and September 15, particularly the commercial fisheries in the California Klamath (KC) and Central Oregon (CO) ocean management areas, while preventing compensatory expansion of fisheries in the Oregon Klamath (KO) management area.

Conservation Objective Updates for Puget Sound Coho

Mr. Pat Pattillo presented the conservation objectives for Puget Sound coho that are currently used in the U.S. v Washington annual management process to the SSC salmon subcommittee, the STT, and the MEW. These conservation objectives are exploitation rate (ER) targets based on forecast abundances with three categories (Normal, Low, Critical) separated by abundance forecast “breakpoints.” Exploitation rates and associated breakpoints were established through simulation modeling for three of five management units (MUs). For the other two MUs these values were based on views of maximum sustainable harvest (MSH) for the systems. Mr. Pattillo explained that the objectives were designed with ER objectives for MSH rather than escapement goals because, with the use of hatchery indicator stocks and CWT data, ERs could be measured more precisely than escapements. This system is also consistent with, and coordinated with, abundance-based management of Canadian stocks as negotiated through the Pacific Salmon Treaty.

Conceptually, target ERs and breakpoints are based on MSH under two survival conditions (low and high). Simulations were run by setting fixed escapement goals and searching for ERs that provided MSH given expected levels of survival variability and management error. The resulting values are chosen to be somewhat precautionary. The SSC was concerned with the knife-edged nature of the control rule, so that in principle a change in forecast abundance of one fish could lead to a 15-25 percent change in exploitation rate. Other systems either have smaller steps (e.g., Oregon Coastal Natural coho) or tie ERs to escapement level so that escapements are maintained by increasing ERs gradually with increasing abundance (e.g., Klamath River Fall Chinook).

The methods provided in the report were not sufficient for a thorough SSC review. Documentation was insufficient to evaluate the justification for the resulting ERs and breakpoints. The SSC supports the use of a Management Strategy Evaluation approach for analysis of alternative breakpoints, but was not provided with standard outputs on strategy performance to interpret the results and conclusions. These would include presentation of the variability in model outputs and model runs to show the likely performance of a range of control rule parameters. Performance should be evaluated in terms of likelihood of meeting specific targets under a variety of environmental conditions (marine survival), and resulting expected stock abundance, catch, and escapement. This management system has been in place since 2000. An analysis of the historical performance of abundance-based management in Puget Sound would provide an empirical basis for comparing management outcomes with model expectations.
It was unclear to the SSC how the U.S. v Washington conservation objectives for Puget Sound work within the Council FMP. Because of the negotiated agreements with Canada these stocks would likely merit an international exemption. It was, again, unclear whether the exemption would apply to Status Determination Criteria as well as Annual Catch Limits and Accountability Measures. Overfishing criteria should be related to the Critical threshold only, and not to MUs crossing between Normal and Low categories.

PFMC
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