To: AYK SSI Steering Committee

From: STC Sub-Committee: Milo Adkison, Daniel Schindler, Andrew Munro and John Sky Starkey (SC Rep.)

Date: May 22, 2016

Subject: Scope of Work for STC Recommended Project: Independent Peer Review Panel to Review Run Reconstruction & Spawner-Recruit Models for Chinook salmon in the Kuskokwim River

OVERVIEW:

At their April 15, 2016 meeting, the SC took two actions with regard to the STC proposed project "Independent Peer Review Panel to Review Run Reconstruction & Spawner-Recruit Models for Chinook salmon in the Kuskokwim River."

First, the SC asked Sky Starkey to serve as a SC rep. to the existing STC Subcommittee, which consists of Milo Adkison, Daniel Schindler and Eric Volk (now replaced by Andrew Munro from ADF&G). Second, the SC requested the Subcommittee to come back to them in 4-6 weeks with a draft project scope of work – presented below- addressing the follow two components:

> 1. Initial phase wherein an Independent Peer Review Panel would conduct a review and evaluation of the structure and performance of the drainage-wide run reconstruction and spawner-recruit models for generating estimates of stock status, trends, and productivity.

> 2. Second phase wherein the Independent Peer Review Panel would meet and collaborate with ADF&G's modeling team to discuss the findings of the panel's review and cooperatively explore approaches to integrating panel recommendations into future modeling efforts.

INTRODUCTION:

The run reconstruction model is the core stock assessment tool to estimate annual Chinook salmon run abundance in the Kuskokwim River. The model uses observed data from weirs, aerial surveys, harvest, and total abundance estimates based on a mark-recapture study to estimate a historical run abundance time series from 1976-2015. The model was developed by Brian Bue with input from ADF&G stock assessment scientists and was completed in 2012 (Bue et al. 2012). The original report can be accessed at: http://www.adfg.alaska.gov/FedAidpdfs/FDS12-49. There have been several minor changes to that model in 2014, as noted in a memorandum from Hamazaki and Liller (2015). Estimates of historic run abundance is critical component for spawner-recruit analysis and setting optimal biological escapement goals.

Effective conservation and management of salmon stocks in data-limited situations such as the AYK region require both: 1) reliable and transparent models for assessing stock status, trends, and productivity, and the associated uncertainties associated with these estimated parameters; and 2) a high degree of confidence in these models and their outputs by stakeholders and partner management agencies.

Stock assessment models informing management decisions that do not engender broad confidence inevitably generate conflict, which is costly to management agencies and stakeholders. Application of models to steeply declined stocks or stocks in rebuilding mode requires additional attention and vigilance to ensure unbiased model assessments of stock status.

Peer review is one of the foundations of science. By far the most widely accepted and robust approach to technical review and verification of stock assessment models informing management decisions – the gold standard for ensuring sound scientific advice – is use of independent expert peer review panels (NMFS 1999, NMFS 2001, NRC 1998, NRC 2002, NRC 2004). ADF&G routinely engages in other external reviews of technical analyses or stock assessments, as we are proposing here for Chinook salmon in the Kuskokwim River.

There are several reasons for proposing to conduct an independent peer review at this time:

1. Recent annual estimates of Kuskokwim River Chinook salmon run size were based on an analysis by Bue et al. (2012), who reconstructed historical sizes from several different sources of data collected from Kuskokwim River fisheries and a variety of escapement monitoring projects. This model was re-coded in 2014 to include some minor changes and was more recently re-coded in AD Model Builder with some important changes to the model structure (Martell 2016). In the process of developing this run reconstruction model – from initial development, subsequent revisions to identifying an escapement goal range (2013) for Alaska's largest Chinook salmon subsistence fishery – it has not received a formal, independent peer review.

2. The AYK SSI Chinook Salmon Action Plan states that: "The dominant influence of density-dependent factors on recruitment dynamics in Kuskokwim River Chinook salmon is anomalous when compared with the other stocks analyzed by Catalano (2012)." The apparently strong density-dependence suggests that escapement goals should be near the lower end of historically-observed spawning abundance, which is risky unless there is high confidence in the analysis. Within a precautionary framework, the combined presence of this anomalous spawner-recruit relationship with steep declines and on-going conservation concerns warrants formal external review. The STC Subcommittee is concerned that several recent analyses using a similar run reconstruction or escapement goal methodology have suggested escapement goals near or below the lowest historical escapement.

3. These models have implications for other salmon stocks. There are plans and initial efforts to apply a related model to Chinook salmon returning to the Canadian portion of the Yukon River. We can reasonably expect stakeholders in the Yukon River watershed to expect answers to these same questions regarding the structure and performance of the model. It would be desirable to complete a more comprehensive evaluation of the structure and performance of these run reconstructions prior to applying them to other data-limited cases in the AYK region and beyond.

4. These run reconstruction models have implications for management of other species – namely impacts on the total allowable catch of Bering Sea pollock – and are now inextricably linked to the NMFS and the NPFMC process via the "three river index" and the Proposed Rule for Chinook salmon bycatch. The NMFS has a robust external technical review for stock assessments conducted by the NPFMC BSAI and GOA Plan Teams and the Council's Scientific and Statistical Committee (SSC). In addition to the Martell (2016) technical comments to the NPFMC on behalf of the Pollock fishing industry, we can reasonably expect other stakeholders involved in the Council process to press for application of these same technical review standards to the Kuskokwim run reconstruction models.

5. It is critical to appropriately assess the nature and cost of uncertainty and risk in data-limited stock assessments (NRC 1998). Evaluation of the application of a Bayesian approach to an integrated run reconstruction – spawner-recruit analysis has a number of benefits including "an enhanced ability to incorporate auxiliary information, convenient and rigorous consideration of measurement error and missing data, and a more complete assessment of uncertainty" (Fleischman et al. 2013: 401).

6. The STC Subcommittee is concerned that current assessments of the relationship between spawning stock abundance and production do not appropriately account for errors (precision and bias) in data collection and in model analyses of these data. The current relationship between spawning stock abundance (i.e. escapement) and production is suspiciously precise given the vast region encompassed by the Kuskokwim watershed and the ability to effectively monitor basin scale escapement and harvest.

7. Lastly, the timing for beginning the peer review process (Fall 2016) is such that data from the final year of the three year Mark/Recapture project will be available by about the time the Panel would begin its work. We are aware of no significant additional data sources available for inclusion in the model.

PROJECT OBJECTIVE:

Conduct, via an independent panel of highly qualified stock assessment experts, a comprehensive evaluation of the structure and performance of Kuskokwim River Chinook salmon drainage-wide run reconstruction and spawner-recruit models for generating reliable estimates of stock status, trends, and productivity.

METHODS:

This section provides an overview of proposed approach to achieving the project objective and is summarized in Figure 1 below.
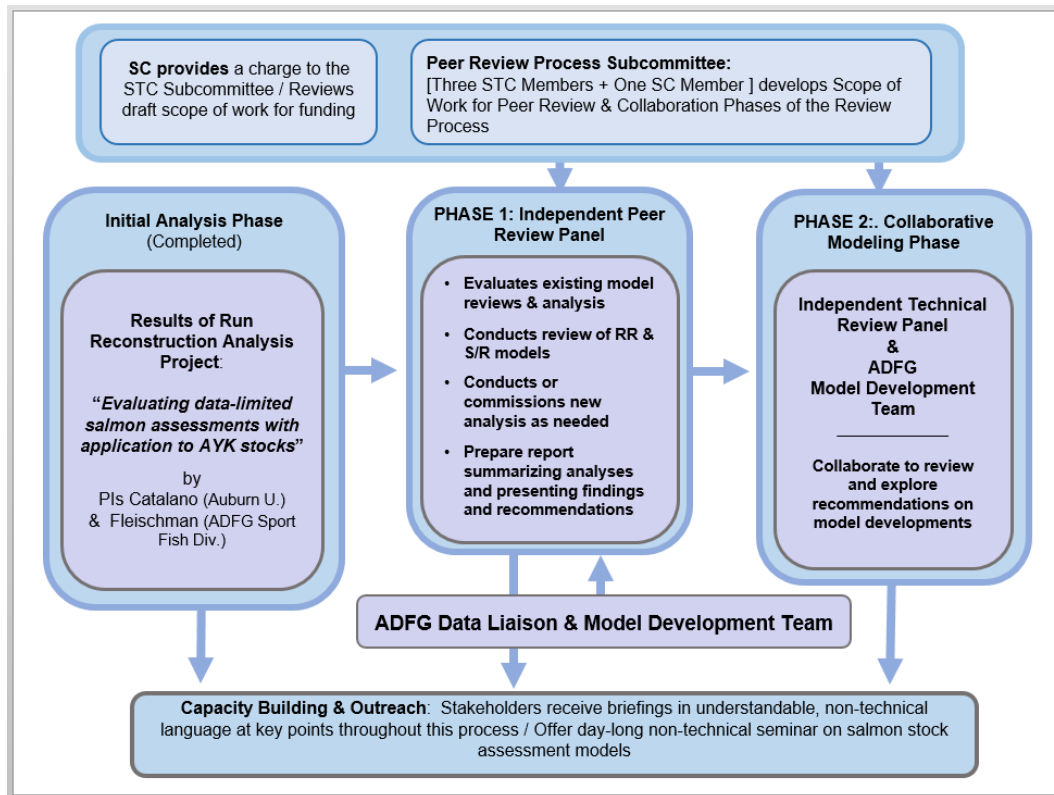

Figure 1: Overview of Independent Peer Review Process.

INITIAL ANAYSIS PHASE: (COMPLETED)**:**

An AYK SSI funded project "Evaluating data-limited salmon assessments with application to AYK stocks" by Catalano (Auburn University) and Fleischman (ADF&G) is a first step in contributing to this broader review process by conducting three sensitivity analyses to evaluate the structure and performance of these models (See project abstract and research question in Appendix #1).

> 1. The first set of analyses investigated the sensitivity of the 2014 version of the Bue et al. (2012) run reconstruction ("the R model") to five different data weighting assumptions. That report, titled "Description of the Kuskokwim River Chinook Salmon Run Reconstruction and an Investigation of Data Weighting" was prepared at the request of the KSMWG and was released summer 2015.

> 2. The second analysis involved challenging the Bue et al. (2012) model with simulated data as a means of exploring the sensitivity of escapement estimates to changes in simulated (i.e. specified) values of a set of stock assessment parameters. This analysis also explored a range of different data configurations that included varying the proportion of years that received a telemetric mark-recapture study, the relative proportions of aerial surveys and weirs, and the total number of escapement monitoring projects.

3. The third analysis assessed the sensitivity of the integrated run reconstruction spawner-recruit model to changes in structural assumptions of the run reconstruction model.

The latter two analyses will be available in their project final report to AYK SSI in late May, 2016

PHASE 1: INDEPENDENT PEER REVIEW PANEL PROCESS:

Appointment of Independent Peer Review Panel members: Four experts with a range of appropriate stock assessment modeling expertise will be appointed to the Independent Peer Review Panel by the non-conflicted members of the AYK STC. To maintain independence of the panel, and avoid conflicts of interest, panel members must agree to abide by the "Conflict of Interest Policy for AYK SSI Peer Reviewers" (Appendix #2). Academic and private sector members of the Panel will be compensated for their work on the panel.

The Independent Peer Review Panel will request ADF&G to identify a data and model liaison to work with the Panel (propose STC member Andrew Munro to serve in this capacity). As with other AYK SSI expert panel processes (e.g., The Escapement Goal and Chinook Action Plan Expert Panels) the AYK SSI staff Research Coordinator and Program Manager are available to assist the panel Chair and members in implementing this project.

The Panel will begin their review with thorough consultation with the ADF&G data liaison and the relevant modelers from ADF&G familiar with the data and development of the models in order to:

1. Access all relevant data, metadata, and model code.
2. Ensure a thorough understanding the data sources, their limitations, and structure of the models.
3. Ensure a thorough understanding of any anticipated revisions to the models.

Second, the Panel will review and consider the findings and sensitivity analyses presented in the Catalano & Fleischman project final report as discussed in the initial model review phase described above.

Third, building on the findings of existing model reviews, the Panel will identify and commission additional analyses, as needed, to further explore topics regarding model structure and performance as well as the limitations and uncertainties of historical stock assessment data, and new data that might become available under an expanded research program. The Panel would identify independent expert biometricians to conduct these analyses under their direction.

Potential Model Analyses / Review Topics:

The entire set of analyses and model review topics cannot be determined in advance of convening the Panel. However, we provide below a summary of some potential model analyses and review topics:

- The primary objective of the analyses will be to evaluate the reliability and sensitivity of the model outputs, given uncertainties in data and in model formulations, that most affect management. These include estimates of optimal escapement goal ranges and forecasts of next season's returns.

- The recommended approach is an evaluation similar to that employed by Catalano, Staton, and collaborators, who simulated stock dynamics, data collection, and data analysis to compare estimation outputs to the simulated true stock properties.

- The scenarios explored will be refined in the course of further meetings and examination of preliminary results. However, the STC expects the following types of scenarios to be investigated:

1. Assessment of relationships between escapement and production at the sub-basin scale where data are the high quality (i.e. tributaries with weirs), compared to basin-wide assessments of these relationships

2. Low contrast in historical escapements; either low escapements from historically high harvest rates, or high escapements due to historically low harvest rates

3. Alternative assessment model assumptions; examining varying degrees of asynchrony in substock components, both on a year-to-year basis or in longer-term trends

4. Regime shifts resulting in persistent change in stock productivity or escapement quality both at the river scale and at the sub-basin scale

5. Loss of or degradation in the quality or quantity of data of different types, as well as improvement in data quality or the addition of new types of data (e.g., new adult abundance estimates).

It is anticipated that during this phase, the Panel will regularly consult with the ADF&G modeling team regarding planned analysis and questions about model data sources.

Following completion of their analyses and review, the Panel will prepare a technical report presenting their findings and any recommendations for improvements. This will include an executive summary appropriate to non-technical audiences.

PHASE 2: COLLABORATIVE MODELING PHASE

Independent Peer Review Panel findings are not binding on ADF&G. However, they are intended to provide expert scientific advice about strengths of existing models, potential improvements to model performance in response to particular types of data or sources of uncertainty or insights about the best approaches to incorporate new data into run reconstruction and spawner-recruit models.

This "Collaborative Modeling Phase" is designed to provide time and resources to support meetings between Panel Members and the ADF&G modeling team to discuss findings and collaboratively explore and implement recommendations on model development or data collection that may be helpful to ADF&G. This phase may include a mix of more formal collaborative discussions and informal technical sessions where participants are working directly with data sets and model code to explore alternate approaches.

DELIVERABLE PRODUCTS:

1. Report and Recommendations from the Independent Peer Review Panel (Dec. 2017)

2. Capacity Building / Outreach Seminar (Fall 2017)

3. Summary of post-review collaborative model session with peer review panel members and ADF&G Modeling Team.

PEER REVIEW PANEL PROCESS TIMELINE:

TASKS	**2016** Jun-Dec	**2017** Jan-June	**2017** July-Dec	**2018** Jan- Jun
Appoint Independent Peer Review Panel	Peer Review Panel Appointed by Sept.1			
Access Code & Data	Work with ADF&G Data Liaison; initial consultation session with ADF&G modeling team.			
Conduct Analysis and Peer Review	Independent Peer Review Phase: Sept. 2016-Dec. 2017. Includes three in-person meetings during the course of this phase.			
Capacity Building Seminar	Periodic briefings in non-technical language at key points ruing this process.			Outreach / Capacity Building seminar: Jan. or Feb.2018
Final report			Draft Final report produced by Nov. 15th; finalized by Dec. 15th	
Collaborative Modeling Phase				Two in-person meetings / collaborative modeling sessions with Panel & ADFG modeling team (Jan & March 2018)

CAPACITY BUILDING:

- Stakeholders will receive periodic briefings in understandable, non-technical language at key points throughout this process.
- As the Peer Review Panel completes their work on Phase 1, we propose to present day-long non-technical seminar on salmon stock assessment models for interested stakeholders.

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