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Proceedings of the Pacific Regional Peer Review on a Technical Review of the Fraser River Chinook Management Approach

July 9-10, 2019
Nanaimo, British Columbia

Chairperson: Mary Thiess
Editors: Mary Thiess & Erika Anderson

Fisheries and Oceans Canada
Science Branch
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Nanaimo, BC V9T 6N7

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Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

These proceedings summarize the relevant discussions and conclusions that resulted from a Fisheries and Oceans Canada, Canadian Science Advisory Regional Peer Review meeting on July 9-10, 2019 at the Pacific Biological Station in Nanaimo, B.C. A working paper titled “A technical review of the Fraser River Chinook Management Approach” was presented for peer review.

The major topics discussed were data sources and quality, fisheries-related incidental mortality, uncertainties related to marine survival, exploitation rates, genetic stock identification, and recreational fisheries data, biological properties and their link to management actions, and common terminology.

In-person and web-based participation included Fisheries and Oceans Canada (DFO), Indigenous organizations, recreational fishing industry representatives, Pacific Salmon Commission, Chinook Technical Committee, environmental non-governmental organizations and academia.

The Science Advisory Report, Research Document and Proceedings will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website and the recommendations arising from this review will inform future discussions of DFO’s management approach for stream-type Fraser River Chinook Salmon.

INTRODUCTION

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS), Regional Peer Review (RPR) meeting was held on July 9-10, 2019 at the Pacific Biological Station in Nanaimo, B.C. to evaluate a technical review of the Fraser River Chinook Management Approach.

The Terms of Reference (TOR) for the science review (Appendix A) were developed in response to a 2016 request for science advice from the Pacific Region Fisheries Management Branch of Fisheries and Oceans Canada. The working paper was informed by a Joint Technical Working Group (JTWG), a DFO and First Nations committee formed to review the data, assumptions, and theories used to assess fishery plans and management decisions. Notifications of the science review and conditions for participation were sent to representatives with relevant expertise from Fisheries and Oceans Canada, Indigenous organizations, recreational fishing industry representatives, Pacific Salmon Commission, Chinook Technical Committee (CTC), environmental non-governmental organizations and academia.

The following working paper was prepared and made available to meeting participants prior to the meeting:

> *Dobson, D., K. Holt, and B. Davis. 2019. A Technical Review of the Fraser River Chinook Management Approach. DFO. CSAP Working Paper. 2016SAL07.*

Participants also received copies of the Terms of Reference, Agenda (Appendix B), and written reviews (Appendices C and D) prior to the meeting.

Mary Thiess, the meeting chair, welcomed participants and reviewed the role of CSAS in the provision of peer-reviewed advice. The Chair discussed the role of participants and the definition and process around achieving consensus decisions and advice. In total, 31 people participated in the regional peer review (Appendix E). Erika Anderson was the rapporteur for the meeting.

WORKING PAPER

The authors, Diana Dobson, Kendra Holt and Brooke Davis, gave a comprehensive oral presentation of the working paper. Dobson began the presentation with a summary of background information and context regarding management of stream-type Chinook salmon. Davis followed with a description of the biological data including: management unit (MU) level escapement, conservation unit level escapement, length-at-age, age composition, and marine survival. Holt presented the estimates of harvest impacts, evaluation of management objectives, and sensitivity analyses. Dobson concluded with a summary of key results and recommended work. Participants asked clarification questions after each section; more detailed questions were delayed until after the presentation. The abstract of the working paper (CSAS process 2016SAL07) is provided in Appendix F.

PRESENTATION OF WRITTEN REVIEWS

MIKE HAWKSHAW

Please refer to Appendix D for a copy of the full written review. The main comments are listed below:

- The paper clearly presents available data and methods used to generate it.

- Literature review needs work, particularly citing run reconstruction modelling assumptions, and small sampling of rare individuals in mixed fisheries.
- Need to be consistent about presentation of ranges of values, confidence intervals, or other estimates of uncertainty. In particular, point estimates for marine survival need a measure of uncertainty.
- If no formal trend detection analysis is used, carefully review paper to be clear you are not saying there is a trend without testing for it.
- The careful discussion of sources of uncertainty (the sensitivity analysis) make this a good compilation of data. Additional detail includes comparison of run reconstruction and CWT generated results directly.
- A set of example figures was provided to compare methods (Figure 1).
- Suggestions for further group discussion include: impacts of uncertainty and bias on subsequent work, time lag associated with data collection, analysis, and management, and stronger recommendations and statements about errors and data gaps.

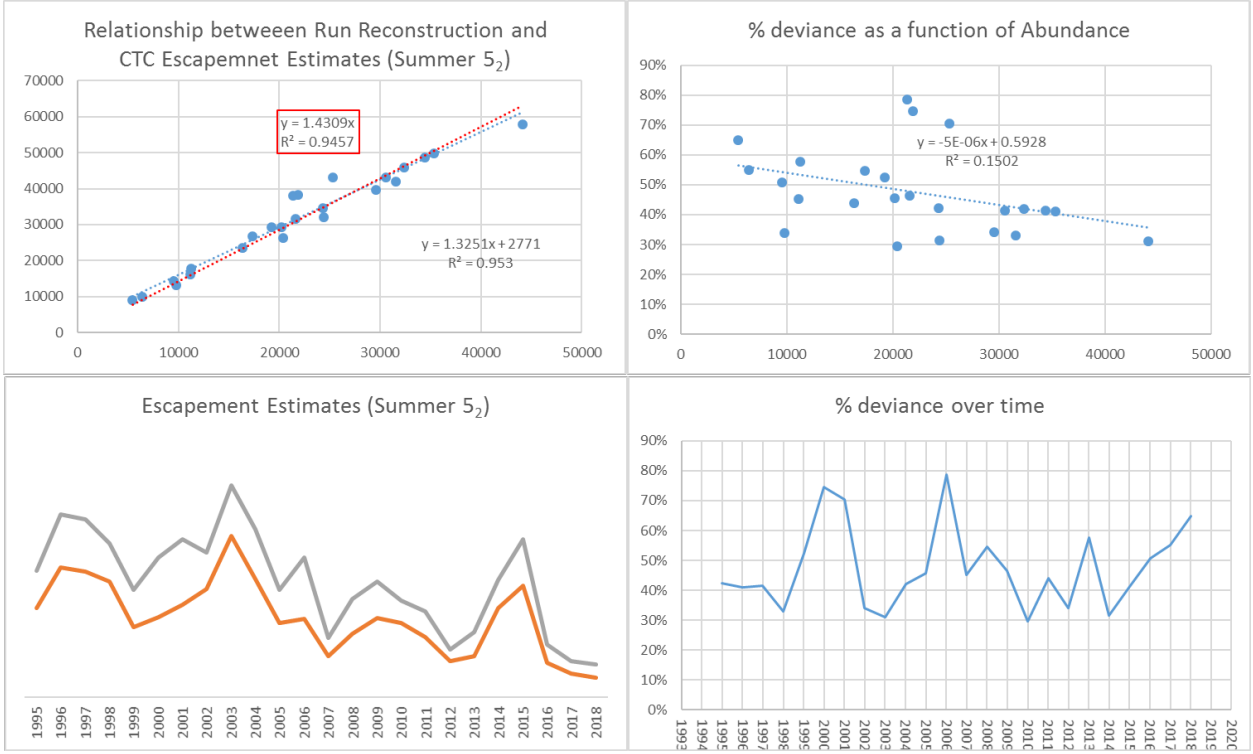

Figure 1: Example figures provided by reviewer on how to directly compare run reconstruction and Chinook Technical Committee escapement data.

AUTHORS RESPONSE TO MIKE HAWKSHAW

The authors thanked Hawkshaw for the example figures and agreed to incorporate this type of comparison into the research document. There was a discussion about how to estimate measurement error for marine survival and any available methods. Genetic stock identification (GSI) assignment error, low sampling rates for GSI, and use of microsatellites versus SnPs were discussed. The authors proposed both marine survival measurement error and GSI uncertainties be covered in future work section. A participant proposed that the time lag for new

indicator stock for Summer 52 Chinook may not be as significant as suggested, given recent coded wire tag (CWT) projects at Chilko.

ERIC HERTZ

Please refer to Appendix C for a copy of the full written review. The main comments presented are listed below:

- The authors and JTWG did a commendable job in this paper in synthesizing the disparate datasets on Fraser Chinook.
- The link between biological properties (i.e., changes in size and age) and the management outcomes should be strengthened.
- It is worthwhile to update and include versions of Table 5 and Figure 5 from the original Fraser River Chinook Run Reconstruction (English et al. 2007).
- Be more clear that the Dome CWT indicator stock is not a current indicator for Spring 5_2 stocks, and explain why the Dome CWT program was discontinued (data quality issues).
- The rationale for using the three-year window centred on 2010, rather than just 2010, is not well-articulated.
- Future work section is excellent and the background context for the controversy over sector allocation (First Nation Food, Social, and Ceremonial (FSC), Recreational, and Commercial Fisheries) is well explained.
- Great that fishery-related incidental mortality (FRIM) is included. Could the Patterson et al. 2017 approach be used with the data in hand? If the data are currently lacking to parameterize these values, then this should be stated.
- Table 10-16 is misleading. Is there any way to include a sense of the uncertainty associated with the realized change in exploitation rate indices (ERI) values?

AUTHORS RESPONSE TO ERIC HERTZ

Authors agreed to include a spawning area and river entry timing table for Fraser Chinook stocks, updated from Table 5 in English et al. (2007). The authors presented an average daily abundance figure for Spring 4_2, 5_2, and Summer 5_2 stocks, modelled after Figure 5 in English et al. (2007). Although the figure needed further edits, it was agreed that an updated version of mean spawning timing figure would be added to the paper. A participant later shared a similar figure using their own run reconstruction data for comparison. The authors presented additional summary statistics for the source of the escapement datasets, and amount of infilling. These additional tables will be added to the research paper. Holt suggested the R code for the run reconstruction model could be shared on GitHub. The authors agreed to several text modifications and other editorial changes: red status is not a lower benchmark, explanation of 3-year average for base year, and further explanation of Dome indicator stock. Nevertheless, the authors proposed that incorporating Patterson et al. (2017) methods to estimate FRIM is a large time commitment and should be considered future work.

GENERAL DISCUSSION

DATA

Reviewers and participants agreed that the authors assembled a large amount of data, however, the data was insufficient to answer all the objectives of the TOR. This was emphasized in the conclusions and future work section of the paper.

There were questions regarding the sources and years of data for specific analyses; therefore, the authors agreed to improve the text regarding data sources and year ranges in the table and figure captions.

In response to questions regarding infilling for escapement data, the authors presented a draft table summarizing infilled data used with the CTC and run reconstruction datasets. The authors agreed to include these completed tables in the research document.

The exclusion of US catch data from the working paper was discussed. It was determined that US harvest of the stocks should be acknowledged in the text, but the US catch is not required in the exploitation rate indices as the rates have been estimated to be relatively low.

The authors agreed to be more explicit about the assumptions underlying the run reconstruction model, specifically how salmon were treated in the marine environment. It was also noted that sublegal releases were not included in the exploitation rate (ER) indices. This will be clarified in the method section.

A participant proposed that Tables 9-3, 9-4 (or Table 10-3 and 10-4 depending on the version) are misleading as percentages. The authors agreed to redo the tables using presence and absence, without percentages. More detailed CWT recovery information will be included in an appendix.

Appendix I of the working paper containing the differences between estimated exploitation rates of the CWT indicator stocks from the CTC ERA analysis and the estimated CWT recoveries from the Mark Recovery Program (MRP) database. A participant pointed out that there are valid reasons for those differences. The authors countered that in-river net fisheries are fundamental to management of the Fraser River, and these tables highlight data issues.

Two participants offered to make a list of data quality issues to provide to authors to increase clarity in working paper. The authors agreed to review this list to address these concerns.

Other data issues mentioned during the meeting that the authors agreed to fix include: Area F catch in 2018 should be approximately 70 000 (not 40 000 in paper), and Table 9-16 (or Table 10-16 depending on version) and the associated text have inconsistent commercial exploitation rate (ER) values.

During the Science Advisory Report (SAR) development, the importance of data availability and accountability of the people responsible for the data was emphasized.

FISHERIES-RELATED INCIDENTAL MORTALITY

FRIM was discussed extensively throughout the two-day meeting.

The working paper incorporated release and drop-off mortality rates from a CTC report. There was some concern regarding the actual values used, and confusion regarding the definition of drop-off rates, which included depredation. As the values used in the working paper were not the most current CTC rates, the authors presented a table showing the differences between the mortality rates used in the working paper, recent CTC report, and Integrated Fisheries Management Plan (IFMP). The consensus was that the differences did not warrant a re-

analysis; however, work on mortality rates (both short and longer term) is strongly recommended for future work.

A participant provided a written review from a consultant, later shared with the group, which discussed possible impacts of incorporating FRIM. Given that the author of the written review was not present, and the methods were not peer-reviewed, the group focused on information provided by the associated participant and the published Patterson et al. (2017) report. The participant recommended that the analysis include cumulative impacts of release mortality, and total mortalities (catch plus FRIM). This change would likely increase the estimated exploitation rates in some fisheries.

There was a suggestion to incorporate a range of release mortality values into the sensitivity analysis. The authors said that could be done if the group proposed values to test. After discussion, participants agreed that it is a larger project that should be detailed in the recommended future work and include (but not limited to): age-selective mortality, mark-selective fisheries, cumulative impacts, and effects of water temperature on FRIM.

It was agreed that the CTC exploitation rate analysis (ERA) tables using CWT recoveries in mark selective fisheries be included as an appendix to inform future work on FRIM in mark selective fisheries.

The conclusion in the working paper stating that “Total ERs on both MUs likely averaged less than or equal to 30% in Zone 1 years”, should be qualified since higher FRIM would increase the uncertainty around this value.

UNCERTAINTIES

The reviewers and participants preferred that marine survival estimates from CWT recoveries and realized change in exploitation rates in Table 9-16 (or Table 10-16 depending on the version) be accompanied by measures of uncertainty. Although everyone agreed that confidence intervals are needed, methods to develop confidence intervals for marine survival are lacking, so this should be included as future work. Nevertheless, the level of uncertainty for the ER point values could be indicated in Table 9-16. A participant noted that the uncertainty associated with the FSC ER is misleading. FSC ER includes impacts from approximately 26 fisheries grouped together. The authors agreed to clarify this in the text.

There was agreement that the GSI was associated with several types of uncertainty: error associated with stock assignment, GSI sample rates are too low in some fisheries, GSI assumed to be the same in releases and kept catch (which is likely incorrect where selective fisheries occur), infilling when GSI samples are missing from a fishery, and difficulties with sampling rare stocks in mixed fisheries. Future investigations into GSI are recommended.

Specific uses of creel and iREC data were questioned. Authors confirmed that infilling was limited to creel survey periods, and early spring periods were not infilled using iREC data. iRec may not be suitable for assessment purposes. iREC data in Table 9-5 (or Table 10-5 depending on version) was provided to highlight potential data gaps in the analysis. The authors will clarify this in the table caption. The differences between creel and iREC data were discussed.

BIOLOGICAL PROPERTIES

There was discussion over whether the decreasing length-at-age could be described as a trend without statistical evidence. The authors explained that the JTWG had difficulty agreeing on a model to use during exploratory data analysis. Given the noisy data, the authors chose to display the biological data without analysis. Hawkshaw said the figures were acceptable, if the language regarding “trends” is removed from the paper.

Hertz requested more explanation regarding the link between biological properties and management actions. Participants recommended including future work on changing biological properties encompassing other basins and species, with an ecological perspective, as there may be common driving forces.

MISCELLANEOUS

The chair requested that editorial suggestions be emailed directly to the authors to incorporate into the research document.

It was agreed that the term “stream-type” Chinook would be used throughout the document, (including in the title), instead of “early-timed” Chinook as it is more accurate. In addition, SMU (stock management unit) will replace MU throughout the document.

The authors agreed to separate the background material discussing management under the Pacific Salmon Treaty into two periods for clarity: one during the data period and the other after the new Treaty agreement that influences future management decisions.

There are two parts to the sensitivity analysis in the working paper. The second part using Monte Carlo simulations will be separated out and called uncertainty analysis shows the influence of hypothesized variation, and not systematic bias.

A participant requested that the en-route mortality in section 4.6 Fraser River Run Reconstruction Model be rephrased: en-route mortality is “unknown”, which has a different meaning than “assumed to be zero”.

CONCLUSIONS AND RECOMMENDATIONS

The working paper was accepted with revisions.

While results from the Run Reconstruction analysis show that it is possible that overall reduction targets for exploitation rates on Spring 5_2 and Summer 5_2 Chinook were met, considerable uncertainty in the available data, including estimates of FRIM, precludes a definitive conclusion at this time. Similarly, fine-scale objectives related to sector-specific exploitation rates and the allocation of impacts among sectors identified in the 2012 RD Directive cannot be effectively evaluated at this time given the data systems in place.

Establishing clearly-defined and measurable stock and fishery objectives for stream-type Fraser Chinook Salmon that represent desired management outcomes (e.g., rebuild stock to a given level over a specified time period) rather than a desired management response (e.g., reduce exploitation rates) is recommended. These “rebuilding”-type performance objectives could help guide future management responses and allow for more transparent evaluation of management performance.

FUTURE WORK

While the objectives of this process were deemed to have been met (as stated in the Terms of Reference), several items were identified as future work to improve future analyses and are noted below. The cost of undertaking any of this future work should be weighed against the potential benefit to improving management objectives.

Closed-loop feedback simulations, possibly within the context of a First Nation and stakeholder supported Management Strategy Evaluation (MSE), could be used to support rebuilding efforts for the stream-type Fraser River Chinook Salmon SMUs by providing insights into the impacts of various harvest strategies on the probability of achieving rebuilding goals.

More robust evaluations of fishery-specific impacts from both marine and freshwater fisheries could be developed through the use of an integrated forward stock-depletion model that uses maximum likelihood estimation to fit multiple datasets from both in-river and marine fisheries.

It is recommended that plans to analyze GSI samples collected at the Albion test fishery be fully supported along with the incorporation of this information into the Fraser Run Reconstruction model to inform annual run timing. Further work to improve GSI baselines and stock identification to the SMU level will help support the utility of consistent, annual GSI sampling in fisheries impacting stream-type Fraser River Chinook Salmon SMUs.

It is recommended that efforts be coordinated across all fisheries sectors to improve sampling rates and representativeness of catch, release and effort data (i.e., to improve quality of information obtained from both CWT recoveries and GSI sampling). For example, it was recommended that efforts to improve recreational fisheries catch, release and effort estimates be supported, such as through increased creel surveys, and further development of logbook programs. Additionally, collecting GSI samples from both retained and released catch could help determine if management measures such as slot size are effective in limiting retention of stocks of concern in all relevant fisheries.

Estimates of released catch and fishery-specific rates of FRIM are highly uncertain for both marine and in-river fisheries. It is recommended that work be undertaken to apply the risk assessment approach developed by Patterson et al. (2017) to develop more detailed estimates of fishery-specific FRIM.

More comprehensive escapement monitoring, by surveying more stocks will improve confidence in escapement estimates, and resulting estimates of harvest impacts. For example, more survey data would reduce the need for infilling time series, increase the number of accurate estimates, and calibrate existing low precision time series. However, it is recommended that decisions about the level of effort afforded to increase escapement monitoring be made in the context of the level of precision needed to guide decision-making relative to management objectives.

The overall assessment and decision-making process for stream-type Fraser Chinook would benefit from improved documentation and transparency of data and assessment methods, as well as routine publication of this information in citable sources and retrievable databases (such as through the Government of Canada's Open Data Portal or the Pacific Salmon Foundation's Pacific Salmon Explorer). This work would also include well-defined responsibilities for data managers, as is intended through a regional data management strategy (currently in development).

It is recommended that a comprehensive review of available data be undertaken to identify priority areas for improvement within the decision-making context (i.e., to identify key data gaps and align them with the data needs of the management framework).

REVISIONS FOR WORKING PAPER

- Include direct comparisons of run reconstruction and CWT-generated results using suggested figures and methods.
- Update and include average spawning area timing and river entry timing for Fraser Chinook stocks. (Table 5) and average daily abundance of Chinook salmon entering the Fraser River (Figure 5) from English et al. (2007).
- Improve terminology and data sources: change early-timed Chinook to stream-type, use of SMU instead of MU, include years (2009 - 2018 in title and date ranges for analyses) and consistently cite data sources in tables, figures, and methods.

- Include summary statistics showing amount of infilling for CTC and run reconstruction escapement data.
- Modify tables with distribution of catch of marine-estimated CWT recoveries (Tables 9-3 and 9-4 or 10-3 and 10-4 depending on version) as presence and absence, without percentages. Include more detailed CWT recovery data in appendix.
- Include table showing the differences between the release and drop-off mortality rates used in the working paper, recent CTC report, and IFMP.
- Indicate the importance of FRIM and Patterson et al. (2017) methods in future work, including the effects of age-selective mortality, mark-selective fisheries, cumulative impacts, and water temperature.
- Include CTC ERA tables using CWT recoveries in mark-selective fisheries as an appendix to inform future work on FRIM in mark-selective fisheries.
- Marine survival and realized exploitation rate point estimates are lacking measures of uncertainty. Discuss this as future work for marine survival, and add indication of uncertainty within the change in ERI table (Table 9-16 or 10-16 depending on version).
- Highlight future work on GSI including the uncertainties: error associated with stock assignment, GSI sample rates too low in some fisheries, GSI assumed to be the same in releases as in catch, infilling when GSI missing from a fishery, and difficulties with sampling rare stocks in mixed fisheries.
- Adjust language regarding “trends” in biological properties, and improve explanation of why length-at-age is important for management actions.
- Review data quality and editorial issues provided by reviewers and participants directly.

ACKNOWLEDGEMENTS

The Chair thanks the authors (Diana Dobson, Kendra Holt and Brooke Davis) for delivering the working paper and revisions in a timely manner; Mike Hawkshaw and Eric Hertz for providing very thorough and thoughtful reviews; Erika Anderson for her support as rapporteur, both during the RPR and during the development of the proceedings; the Joint Technical Working Group for their contributions to the development of the working paper and all of the participants for the time they contributed to the RPR process. Finally, we thank the CSAS office (John Candy, Lisa Christensen, Ann Mariscak, and Kiran Dhesi) for their assistance in preparation for the meeting and in the production of the final documents.

REFERENCES CITED

English, K.K., Bailey, R.E., and Robichaud, D. 2007. Assessment of Chinook salmon returns to the Fraser River watershed using run reconstruction techniques, 1982-2004. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/020: vi + 76 p.

Patterson, D.A., Robinson, K.A., Raby, G.D., Bass, A.L., Houtman, R., Hinch, S.G., and Cooke, S.J. 2017. Guidance to derive and update fishing-related incidental mortality rates for Pacific Salmon. DFO Can. Sci. Advis. Sec. Res. Doc 2017/011: vii + 56.

APPENDIX A: TERMS OF REFERENCE

Technical Review of Fraser River Chinook Management Approach

Regional Peer Review – Pacific Region

July 9-10, 2019
Nanaimo, BC

Chairperson: Mary Thiess

Context

Early run-timed Fraser River Chinook Salmon management units (Spring 4_2, Spring 5_2 and Summer 5_2) contain 13 Wild Salmon Policy (WSP) Conservation Units (CUs), most of which are of conservation concern. A recent integrated biological status assessment of Southern British Columbia (BC) Chinook assigned seven of these 13 CUs to *red* status, one to *red/amber* status and one to *amber* status (MPO 2016). An additional three CUs were found to be *Data Deficient* and one is still *To Be Determined*. Further, broad-scale declines in productivity and size-at-age have been observed among several southern BC Chinook populations, including a number of the Fraser River populations identified here (MPO 2018).

Since 2008, Fisheries and Oceans Canada (DFO) implemented a series of fisheries closures and restrictions to protect Fraser Spring 4_2 Chinook stocks. Starting in 2012, closures and restrictions were expanded to confer additional protections to Fraser Spring 5_2 and Summer 5_2 Chinook stocks. A process was established in 2016 to conduct a review of the management approach implemented in 2012 given there were five years of data (i.e., equivalent to a full Chinook life cycle). The objective of the review is to determine whether the 2012 approach was achieving conservation and allocation objectives consistent with *An Allocation Policy for Pacific Salmon (1999),* including obligations to provide for constitutionally protected aboriginal and treaty fisheries after conservation objectives. This process (hereafter called the "Five-Year Review") will be conducted in two phases:

- **Phase 1**: Complete a technical review of the available information and analyses for Fraser Chinook Salmon that can be used to inform the second phase. This technical review will be subject to a CSAS peer reviewed advisory process.
- **Phase 2**: Discuss management implications of the technical review results and consider potential options for changes to DFO's management approach for Fraser River Chinook Salmon. These discussions will occur through DFO's existing consultation and advisory processes.

Under Phase 1 of the Five-Year Review, DFO Fisheries Management has requested that Science Branch provide a technical review of the data and methods available to assess fisheries impacts on Fraser River Spring 4_2, Spring 5_2 and Summer 5_2 Chinook for all fishing sectors (including catch and release mortalities). Additionally, the review should i) evaluate whether conservation objectives for these stocks outlined in the salmon Integrated Fisheries Management Plans (IFMP) were achieved; and, ii) evaluate the performance of the 'zoned' management approach for Spring 5_2 and Summer 5_2 Chinook outlined in 2012 letters from Rebecca Reid to First Nations and other fishery stakeholders. Additional management actions that were outlined in the 2012 letter specific to 'zone 1' abundance include:

- Reduce exploitation rates on Fraser River Spring 5_2 and Summer 5_2 Chinook by a minimum of 50% from the 50–60% exploitation rates in the early 2000's (resulting in an overall domestic exploitation rate of less than 30% for Fraser River Spring 5_2 Chinook).

- Distribute the exploitation rate reductions such that the recreational and commercial sectors have a greater overall reduction than First Nations. The proposed measures projected a reduction of 44% to the First Nations food, social, and ceremonial (FSC) exploitation rate (producing an exploitation rate of 20%), a reduction of 73% to the recreational sector (producing an exploitation rate of 4.3%), and a reduction of 77% to the commercial sector (producing an exploitation rate of 2.1%).
- First Nations fishing for FSC purposes will have priority over other uses and will be provided the majority of the available fishery exploitation.
- Increase the proportion of the Fraser River Spring 5_2 exploitation rate that is taken by the First Nations FSC fishery.

This review is also intended to identify key data gaps and uncertainties affecting the assessment of the Department's management approach and to provide advice on how to account for and/or resolve these gaps and uncertainties. Lack of recent data from coded wire tag indicator populations for Fraser River Spring 5_2 and Summer 5_2 management units will require the technical review to consider the use of DNA sample information from fisheries, information from the run reconstruction model used for Fraser River fisheries, and other tools or models used for fisheries planning.

The assessment, and advice arising from this Canadian Science Advisory Secretariat (CSAS) Regional Peer Review (RPR), will be used to inform discussion on DFO's management approach for Fraser River Chinook during Phase 2 of the Five-Year Review process.

Objectives

The following working paper will be reviewed and provide the basis for discussion and advice on the specific objectives outlined below.

Dobson, D., Holt, K., and Davis., B. Technical Review of Fraser River Chinook Management Approach. CSAP Working Paper 2016SAL07

The specific objectives of this review are to:

1. Summarize trends in spawner abundance, biological properties, and annual exploitation rates for Fraser River Spring 42, Spring 52, Summer 52 Chinook management units over the review period.
2. Estimate and present fishery mortalities (catch and release by First Nations, recreational, commercial), as well as the proportion of overall harvests attributable to each harvest sector. Where direct estimates are not available, use alternative methods to project fishery mortalities (e.g., using a run reconstruction approach or other method) to the extent possible.
3. To the extent possible, evaluate management outcomes relative to the stated management objectives, described above, for Fraser River Spring 42, Spring 52 and Summer 52 Chinook.
4. Examine and identify uncertainties in the data and methods. Use sensitivity analyses to identify which information gaps have the largest potential impact on estimated outcomes.
5. Document data sources, data treatments, models, key assumptions, uncertainties, and implications for results.

Expected Publications

- Science Advisory Report
- Proceedings

- Research Document

Expected Participation

- Fisheries and Oceans Canada (DFO): Ecosystems and Oceans Science, and Ecosystems and Fisheries Management sectors
- Indigenous communities and organizations
- Commercial and recreational fishing industries
- Pacific Salmon Commission Chinook Technical Committee

References

DFO. 2016. Integrated Biological Status of Southern British Columbia Chinook Salmon (*Oncorhynchus tshawytscha*) Under the Wild Salmon Policy. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/042.

DFO. 2018. Science information to support consultations on BC Chinook Salmon fishery management measures in 2018. DFO Can. Sci. Advis. Sec. Sci. Resp. 2018/035.

APPENDIX B: AGENDA

Canadian Science Advisory Secretariat

Centre for Science Advice Pacific

A Technical Review of the Fraser River Chinook Management Approach

July 9-10, 2019

Pacific Biological Station
Nanaimo, BC

Chair: Mary Thiess

Day 1: Tuesday July 9, 2019

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping CSAS Overview and Procedures	Mary Thiess
0915	Review Terms of Reference	Mary Thiess
0930	Presentation of Working Paper	Diana Dobson & team
1030	***Break***	
1050	Continue Working Paper presentation	Diana Dobson & team
1200	***Lunch***	
1300	Presentation of Written Reviews	Mike Hawkshaw Eric Hertz
1400	General Discussion • Data Issues (data sources, data treatments) • Analytic Issues (CWT vs. run reconstruction) • Conclusions and Recommendations	RPR Participants
1445	***Break***	
1500	General Discussion: • Uncertainties & Caveats • Review TOR objectives	RPR Participants
1645	Develop Plan for Day 2	Mary Thiess
1700	***Adjourn for the Day***	

Day 2 – Wednesday July 10, 2019

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping	Mary Thiess
0915	Review the Results of Day 1 Discussions	RPR Participants
0930	Continue General Discussions (topics TBD)	RPR Participants
1030	***Break***	
1045	Check-in: Consensus on Paper Acceptability & Review of Agreed-upon Revisions	RPR Participants
1100	SAR Development	RPR Participants
1200	***Lunch***	
1300	SAR Development (continued)	RPR Participants
1430	Next Steps & Concluding Remarks: – Timelines for document submissions – Other follow-up or commitments required – Summarize any other business arising from the review	Mary Thiess RPR Participants
1500	***Adjourn meeting***	

APPENDIX C: REVIEW BY MIKE HAWKSHAW

Date: 04/07/2019

Reviewer: Mike Hawkshaw, DFO, Program Head for the Fraser Sockeye and Pink Analytic Program

Chair CSAS Regional Peer Review,

As it stands in my opinion the paper does not meet all of the objectives laid out in the terms of reference. I have followed the recommended headings for review, below I list the key points of my review. In addition, I many several editorial suggestions that I have detailed in a marked up version of the PDF sent directly to the authors and chair.

Regards,

Mike Hawkshaw

Is the purpose of the working paper clearly stated?

Yes. The authors do a good job of clearly presenting the questions they will answer.

Are the data and methods adequate to support the conclusions?

In most cases the data and methods are sufficient to support the conclusions. There are several outstanding gaps. I've broken my comments down by objective:

Objective 1: Summarize trends in spawner abundance, biological properties, and annual exploitation rates for Fraser River Spring 42, Spring 52, Summer 52 Chinook management units over the review period.

- Trends in escapement are summarized, with caveats about in-filing. I have some suggestions about presentation of the different escapement time series, but these are editorial suggestions.
- Trends in biological properties are not summarized in sufficient detail. The data clearly exists and is collected in this paper but the paper doesn't use methods sufficient to support the conclusions they make this should be addressed before acceptance
- Trends in annual exploitation rates are presented with the major caveats that form the bulk of the work done in the paper.

Objective 2: Estimate and present fishery mortalities (catch and release by First Nations, recreational, commercial), as well as the proportion of overall harvests attributable to each harvest sector. Where direct estimates are not available, use alternative methods to project fishery mortalities (e.g., using a run reconstruction approach or other method) to the extent possible.

- This was well done in general. Methods used are clear, data and gaps are presented. The sensitivity analysis is a critical piece that was well done.
- There is are two clear gaps that still need to be addressed:
    - where multiple methods are used to estimate ER they are discussed together, but never directly compared (e.g. Spring 42 indicator stock).
    - The error associated with assignment of catch to stock/MU using GSI was not incorporated into the sensitivity work. It was discussed several times as a source of uncertainty, but it was not quantified. This should be corrected.

Objective 3: To the extent possible, evaluate management outcomes relative to the stated management objectives, described above, for Fraser River Spring 42, Spring 52 and Summer 52 Chinook.

- It was well done. Some editorial suggestions are made in the marked up PDF

Objective 4: Examine and identify uncertainties in the data and methods. Use sensitivity analyses to identify which information gaps have the largest potential impact on estimated outcomes.

- The scenarios seemed well thought out and well presented, the MCMC approach seems appropriate here.
- The work presented in the paper is a good start, with some revisions and additions I think you can meet this objective.
- The range of uncertainty used for the sensitivity analysis should be backed up with literature review, expert elicitation, or empirical study. I do not think this is not a show stopper IF the paper and subsequent advice are clear that these ranges of uncertainty (and bias) were chosen by fiat and clearly recommend an empirical or other approach to determine what to use in the future.
- Missing some critical literature review to discuss the implications of the sources of uncertainty
    - Sampling design for rare events is well studied but not cited (e.g. Monitoring to quantify Spring 4_2 by-catch in a mixed stock fishery requires a very different design than that required to estimate total catch in the same fishery)
    - There was some discussion of run reconstruction modelling issues, but there is a fairly extensive range of publications that detail the issues you describe.
    - This might be a result of the structure of the paper not having a clear “Introduction” section, or an oversight?
- The error associated with assignment of catch to stock/MU using GSI was not incorporated in the sensitivity work. It was discussed several times as a source of uncertainty, but not quantified. This should be corrected.
- Need to make stronger statements about what the scenarios say about key data gaps.

Objective 5: Document data sources, data treatments, models, key assumptions, uncertainties, and implications for results.

- Done well, I would like to see stronger (or differently organized) statements about what the scenarios say about key data gaps.

Are the data and methods explained in sufficient detail to properly evaluate the conclusions?

Yes. It is clear what data and methods were used. Replicating the analysis with the information presented seems plausible.

While it is nice to have the data in tables at the end of the document. It is cumbersome to read, It would be nice if the data referenced in the appendices were presented in a set of spreadsheets, a data base, or even some R objects. In several cases I wanted to check a plot, do small follow up analyses, or explore some other aspect of the data but because it was in a PDF it was a PAIN to get the data out. Given that the authors recommend:

“the overall assessment and decision-making process for early-timed Fraser chinook would benefit from improved documentation and transparency of data and assessment methods, as well as routine publication of this information in citable sources and retrievable databases. “

It would have been nice to get the data in a retrievable format. CSAS should consider implementing a process where submitting the data in a retrievable format is a pre-requisite to publication.

If the document presents advice to decision-makers, are the recommendations provided in a useable form, and does the advice reflect the uncertainty in the data, analysis or process?

Not sufficiently.

- The advice provided is generally of the form more study is required, that is a valid advice given the uncertainty discussed at length in the paper.
- I do not think that the paper is clear enough that in the absence of significant change in data collection, modelling and management framework there will be no improvement in the ability to detect changes in impacts to these stocks, nor any improvement in the ability to inform recovery plans.
- In several instances key sources of uncertainty were discussed or mentioned by not explicitly characterized.
    - “Marine Survival Estimates” based on coded wire tags are used extensively in this (and other papers), but are presented as a time series of point estimates. Given the importance these time series have in driving discussion of rebuilding, ecosystem response, marine conditions, habitat, etc… it is critical they be presented with estimates of uncertainty.
    - ER time series are generated using several methods that are well described in the paper. These methods are not directly compared to each other, this is a gap.
    - Escapement estimates are generated in two different ways that are well described in the paper. These methods are not directly compared to each other, this is a gap.
    - Size at age and age of return trends need to quantified. There are time series methods for doing this, you cannot say there is a trend without presenting the results of a statistical test.
- Presentation of ranges of values and uncertainty in estimates is inconsistent throughout the document this needs to be cleaned up. When a statement is made about uncertainty or an estimate is presented it needs to be referenced to a figure, table, or values presented with confidence intervals or other measure of uncertainty.

Can you suggest additional areas of research that are needed to improve our assessment abilities?

This paper establishes that our current management regime requires a level of scientific advice that is not matched to our data collection and ability to provide that advice. This results in the high uncertainties presented for ERI and other metrics generated in this paper.

- Like the authors the critical gap I see after reading this paper is a definition of measurable objectives for the stocks in question. This leads into the need to 1) design a strategy to meet those objectives and 2) feedback so that the strategy is evaluated, adjusted and reapplied in a timely manner.
- Clearly linking desired management tools to monitoring regimes is required so that there is no longer a discrepancy in the desired level of control and ability to describe outcomes.

In addition while doing a good job in conducting a sensitivity analysis this paper shows the shows the need for the establishment of best practices for conducting sensitivity analysis.

The highly uncertain outcomes presented here are often used as “data” in subsequent follow up analysis. After reading the extensive discussion of sources of uncertainty and bias it is clear that if you were to build stock recruitment or recovery planning models based on these outcomes (e.g. SMU specific ER and ESC time series) you would introduce severe errors-in-variable bias into your analysis. This is not a unique problem, but is worth highlighting as we will discuss error sand sensitivities in depth.

APPENDIX D: REVIEW BY ERIC HERTZ

Date: July 4, 2019

Reviewer: Eric Hertz

Overall Comments:

In this report, the authors assess the effectiveness of management measures introduced for early-timed Fraser Chinook salmon Management Units from 2008 through 2012. The purpose of these management measures was to reduce overall exploitation rates on early-timed Management Units (especially when salmon abundance was low). The distribution of these reductions was intended to be so that recreational and commercial fisheries would see the largest reductions in exploitation rates, while First Nations Food, Social and Ceremonial (FSC) fisheries would have a lower overall reduction in exploitation rate. Two approaches were used to assess whether the management outcomes with respect to exploitation rate indices: coded-wire tag programs based on an indicator stock, and the Fraser River Chinook Run Reconstruction Model using genetic stock identification. The authors found that the overall reduction targets for the Management Units were likely met, but that reduction in exploitation for FSC fisheries were larger than intended, while reductions in the commercial and recreational sectors were smaller than intended. However, the recreational and commercial sectors have relatively low impacts on these Management Units. Therefore, there is a great deal of uncertainty in the measurement of exploitation rate at these low values, making it much harder to detect whether intended management outcomes were achieved.

The authors and Joint Technical Working Group did a commendable job in this paper in synthesizing the disparate datasets on Fraser Chinook. This was a challenging task, since the management outcomes to be assessed in this paper were not supported by existing data and data systems. However, based on the available data, and a thorough sensitivity analysis, the authors have shown that conservation objectives for these Management Units were likely achieved. Overall, the management objectives/recommendations are excellent; in particular, the calls for improved monitoring and sampling rates would help track whether or not management objectives are being met in the future. Furthermore, the proposal to work with Fraser First Nations to improve CWT recovery and in situ dissection programs makes a lot of sense. Finally, the calls for improved documentation and transparency are necessary, and would be excellent to see moving forward. Below, I outline a number of points for the authors to consider:

- The link between biological properties (i.e. changes in size and age) and the management outcomes should be strengthened. While reporting on these is undoubtedly important, why exactly these parameters are being compiled and analysed isn't always clear. Perhaps a sentence or two could be added to section 4.2 explaining that, for example, changes in size and age are important because they can influence selectivity of fisheries and thus the effectiveness of management measures.
- It would be worthwhile to reproduce and update a few figures and tables from the English et al. 2007 report on the Fraser River Chinook Run Reconstruction. Table 5 in the report, in particular, would be useful to update and include in this CSAS document as a number of populations have been added to this table, and it would be useful to see the timing parameters associated with these populations. Also, if any of the values associated with the

populations in the original English et al. 2007 report have changed, this would be a useful place to document this. Secondarily, a version of Figure 5 in the English et al. 2007 report would be nice to reproduce to show the overlap in timing among run-timing groups.

- Section 2.1.5. Ecosystem Considerations: In the final bullet of the list, risks of disease transfer from salmon aquaculture are mentioned. However, neither of the studies look at *aquaculture* disease transfer; these are inappropriate citations.
- P7, Management Under the Pacific Salmon Treaty: While there is a lot of great information here, one salient point that is missed is whether or not there are SMU-specific management objectives for the three MUs of concern in this paper under the Pacific Salmon Treaty. This should be clarified.
- Page 9/10: states that there is no CWT indicator stock for both Spring 52s and Summer 52s. But on page 5 it states the Dome CWT indicator stock is for Spring 52s. Be more clear that, and why, this is not a CURRENT indicator stock for CWT data early on. Furthermore, there is no explanation of why the Dome CWT program was discontinued. This would be helpful context to add somewhere, for example, on P5, paragraph 3.
- P12: It would be useful here to add a paragraph discussing, in general terms, the magnitude of differences among the three separate Chinook escapement datasets
- P19: The run-timing parameters in the run reconstruction model are crucial for determining the allocation of harvest among different SMUs. Were these values updated from English et al. 2007 or assumed to be the same? Is there evidence that the run-timing of these SMUs is the same that it was in 2007, or have things shifted at all?
- P22, final paragraph: “as being at red status (i.e. below a lower benchmark)” For the CSAS integrated status assessment approach, I’m not sure that this is accurate. Biological status according to a number of different benchmarks are quantified, but then these status values are integrated with expert opinion to derive an overall status, correct? I don’t think there is a lower and upper benchmark defined for each CU where status flips, so I’m not sure that this statement is accurate.
- P29: The rationale for using the three-year window centred on 2010 rather than just 2010 is not well-articulated.
- P 37: The Future Work section is excellent and the steps outlined are essential to improving the management and assessment of early-timed Fraser Chinook salmon. As outlined in the introduction

  > “On the one hand, some Nations continued to assert that unless FSC needs are met, prioritizing constitutionally protected fisheries required exclusive First Nation access. On the other hand, the social and economic consequences of exclusive First Nation access are significant and egregious for recreational and commercial harvest groups whose impacts on early-timed Fraser Chinook are relatively low in mixed-stock fisheries targeting stronger non-Fraser stocks.”

  - Addressing the points in the future work would go a long way to addressing these concerns. In my opinion, this is especially true of the future work concerning setting objectives only if data and data systems are available to evaluate their performance, performing a Management Strategy Evaluation using a closed-loop simulation model, and improving data and information management for early-timed Fraser Chinook.
- P 40: FRIM: It’s great that this is incorporated for the first time, but could the Patterson et al. 2017b approach be used with the data in hand? These risk factors are well known and

should be taken into account. If the data are currently lacking to parameterize these values, then this should be stated.

- Table 10-16: I find this table to be a bit misleading. Is there any way to include a sense of the uncertainty associated with the realized change in ERI values? Presenting the point estimates for the FSC fishery might make sense, but the uncertainty associated with recreational and commercial fisheries is much larger.

Editorial Comments:

P1, paragraph 2: Should be Table I-3, I-4, not 1-3, 1-4

Page 2: 3rd bullet, should end in . not /

P4: 2.1.2 Stock Status: Here, it would be good to report the end date for the time series used in the integrated status assessment.

P5, paragraph 2 and 3: Reword to clarify that 'Fraser River' applies to both First Nation and Recreational Fisheries

Page 5: Summer 52s – statement about "landfall" further north and warmer waters seems like an incomplete thought. The rest of the section is about CWT data and exploitation rate; the data on Summer 52s is lacking but this statement seems speculative and out of context. I would suggest either adding a reference or removing altogether.

P5, Ecosystem Considerations section: seems like a bit of a random section. An extra sentence or two introducing the bulleted list might help

Page 8: Harvest control rules, add "Spring" to Fraser 42s. when discussing management measures for consistency.

P9, paragraph 2: Do harvest restrictions escalate or relax through zone 1 to 3?

P12, paragraph 1: It would be useful to report the range of infilled sites here by MU, both in terms of proportion of sites as well as proportion of abundance

Page 13, section 4.3.2: fisher interview(s) – suggest changing to plural.

Page 13: Table E-3 not E_3.

P14, section 4.3.3, paragraph 3: This paragraph is unclear. While all the data is tabulated, it is not very clear how the data gets translated from all stocks to only the ones of interest in this paper. Run timing?

Page 16: All bullets: format inconsistent (indents)

Page 16: 4th Sources of Uncertainty bullet: Voluntary, not voluntarily.

P19: It would be useful here to clarify what you mean when referring to stocks. Individual spawning populations, I think, but worth clarifying, and then checking for consistency throughout the paper (e.g. section 4.6).

P19: Just to clarify, GSI sampling in the WCVI rec and JDF rec fisheries is mandatory, while in the SoG it is voluntary? This section could be reworded to clarify why data from some regions was used while others was not.

Page 19: Sources of uncertainty: 3rd sub bullet. there is little information *on* either of these sources of mortality.

Page 19: Section 4.7. "statistical 'mixture models' not 'mixture models; (punctuation).

P19, final paragraph: This is a large assumption considering the size differences among MUs and the use of size limits as a management action. However, I believe that this assumption is adequately tested during the sensitivity analysis

Page 20: First bullet. “However, individual stock assignments were used *to* estimate….” Etc. Add “to” to the sentence.

Page 20, second bullet: estimates *of* stock composition… etc. Add “of” to sentence.

Page 21: Perhaps add a small explanation of English et al. infilling methods rather than just citing English et al. 2007…?

Page 23: Nicola Spring 42s… “between the late-1990’s *and* 2009.

Page 23, section 5.2.1. Patterson et al. 2017a – suggest “post-release mortality” which is the more typical phrasing rather than released mortality.

P24, final paragraph: Mostly an observation, but it is interesting that the SoG rec fishery had insufficient samples to include in the run reconstruction model, but there are still management measures being applied in the region to protect these Mus in this region.

Page 24, second last para: 11 types of fisheries, (1) should be Fraser River FSC not SC.

Page 25, section 5.2.2, 1995 to 1998 (add space).

P27, second-to-last paragraph: “The two approaches produced similar ERIs for the JDF recreational fishery in most years, with the exception of 2016 and 2018; however, there was poor alignment for other fisheries in recent years (e.g., WCVI recreational, NBC troll).” I’m not sure that I agree with this statement. The difference between 1 and 2%, using methods that have little ability to discriminate between these low values, does not suggest poor alignment to me.

P31: The number of fish returning to Bonaparte River is 8 in Table 17 and 5 here in the text.

P36, Section 6.2, second bullet: Values for commercial fisheries in the text diverge from table 10-16.

Page 40, last bullet line 1: Chinook (capitalized), typically.

Table 10-2: ‘Spring’ and ‘Summer’ and duplicated

Fig 1: It would be nice if this map also included the CU boundaries

Table 10-2: Hatchery releases – since these mainly (largely) come from Spius Creek, can the CU attribution be added to Table 10-2 rather than just the MU attribution? This would be useful, I think.

Table 10-2: Major Hatchery Facilities

Table 10-3: add year/time period for distribution data (seems like it’s for the entire time period, but the CWT data varies by management unit doesn’t it?).

Table 10-4: add year. (same comment as above). And, stipulate that the shaded/highlighted month is the greatest recovery period just for clarity.

Table 10-5: Are there independent datasets that overlap between IREC and creel survey data that could be compared? It would be interesting to see the differences among the kept and released values according to each approach. Probably not integral though, since the sensitivity analysis showed little impact of uncertainty in these fisheries on results

Tables 10-8 to 10-18: These tables should be revised so that they only show one decimal place. Otherwise, they are giving a false sense of precision.

Table 10-11: Zones, use consistent language (SRKW Actions in this table, but previous tables are just “SRKW”).

Table 10-17: Great list of assumptions to test!

Figure J1: It looks like these figures only go up to 2017, while the following table has data to 2018?

APPENDIX E: PARTICIPANTS

Last Name	First Name	Affiliation
Anderson	Erika	DFO Science
Brown	Gayle	DFO Science
Candy	John	DFO Science, Centre for Science Advice Pacific
Crowley	Sabrina	Nuu-chah-nulth
Davis	Brooke	DFO Science
Dobko	Ashley	DFO Resource Management Salmon
Dobson	Diana	DFO Science
Fisher	Aidan	Lower Fraser Fisheries Alliance
Fredrickson	Nicole	Inland Marine Aquatic Working Group (IMAWG)
Grout	Jeff	DFO Resource Management
Hawkshaw	Mike	DFO, Science Stock Assessment
Hertz	Eric	Pacific Salmon Foundation
Holt	Kendra	DFO Science
Jenewein	Brittany	DFO Resource Management
Kristianson	Gerry	Sport Fishery Advisory Board (SFAB)
Labelle	Marc	Consultant - Okanagan Nation Alliance
Luedke	Wilf	DFO, Science South Coast
Mahoney	Jason	DFO Salmon Enhancement Program
Maxwell	Marla	DFO Resource Management
McGreer	Madelaine	Frase River Aboriginal Fisheries Secretariat
Oldford	Greig	University of British Columbia
Paish	Martin	Sport Fishery Advisory Board (SFAB)
Ramshaw	Brock	DFO Science
Rusch	Bryan	DFO Resource Management
Staley	Mike	Fraser River Aboriginal Fisheries Secretariat
Taylor	Greg	Marine Conservation Caucus
Thiess	Mary	DFO Science
Trouton	Nicole	DFO Science Stock Assessment
Velez-Espinio	Antonio	DFO Science
Walsh	Michelle	Shuswap Nation Tribal Council
Whitney	Charlotte	Pacific Salmon Foundation
Winther	Ivan	DFO Science Stock Assessment

APPENDIX F: ABSTRACT OF WORKING PAPER

Starting in 2008, Fisheries and Oceans Canada (DFO) implemented a series of fisheries closures and restrictions to protect Fraser Spring 4_2 Chinook stocks. These restrictions were expanded in 2010 and again in 2012 to allow additional protections for Fraser Spring 5_2 and Summer 5_2 chinook stocks. The 2012 management approach was documented in a letter written by the Regional Director General (RDG) for DFO's Pacific Region to First Nations and stakeholder groups. An objective of the 2012 management approach was to ensure that First Nations fishing for food, social and ceremonial purposes had priority over other use. In this paper, we present a technical review of the available data and methods with which to evaluate recent management outcomes relative to the objectives laid out in the 2012 RDG Directive. We summarize trends in spawner abundance, biological properties, and annual exploitation rates for Fraser River Spring 4_2, Spring 5_2, Summer 5_2 Chinook management units. We then compare two alternative approaches for estimating fishery- and sector-specific exploitation rate indices using readily available data and assessment tools. The first of these approaches relies on the coded-wire-tag (CWT) mark and recovery program for the Spring 4_2 Nicola River CWT indicator stock while the second combines an existing Fraser River Chinook Run Reconstruction model with genetic stock identification (GSI) catch composition estimates from marine fisheries. We then use predicted exploitation rate indices from the Run Reconstruction approach to evaluate management outcomes relative the objectives stated in the 2012 RDG directive. Results show that all three early-timed Fraser Chinook stock management units show depressed escapement in recent years and consistent declines over the last four years. Time series of exploitation rate indices for the Spring 4_2 MU obtained using the Run Reconstruction approach showed similar patterns but with higher value than those obtained using CWT data. Results from the Run Reconstruction Model approach show that overall reduction targets for Spring and Summer 5_2 Chinook were likely met. However, reductions in from First Nations FSC fisheries were higher than those outlined in the 2012 RDG directive. In contrast, reductions in both recreational and commercial harvest impacts were smaller than intended. However, sensitivity analyses highlighted that measurement of sector-specific changes in exploitation rates such as these are highly uncertain, especially for recreational and commercial fisheries with relatively low impacts. The fact that we cannot detect reductions in lower impact fisheries with the available data, does not mean they did not occur. The management measures implemented in various fisheries, such as time and area closures during periods of peak early-timed Fraser Chinook migration, were reasonably expected to reduce impacts on early-timed Fraser Chinook. We make recommendations for future work to address key gaps in the management and assessment framework for early-timed Fraser Chinook.