PACIFIC SALMON COMMISSION
JOINT CHINOOK TECHNICAL COMMITTEE REPORT

# 2017 Exploitation Rate Analysis and Model Calibration
# Volume Three: Documentation of circumstances and events regarding PSC model calibration 1503

TCCHINOOK (18)-01 V. 3

June 7, 2018

# Appendix M. Documentation of circumstances and events regarding PSC model calibration 1503

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## INTRODUCTION

On March 31, 2015, the AWG distributed PSC Chinook Model calibration 1503 for CTC review. Some members of the CTC raised concerns regarding calibration 1503 and the projected AIs and did not accept the calibration results. After deliberation, the CTC was unable to reach consensus regarding the use of calibration 1503 (CLB 1503) for the 2015 fishing season. Ultimately, the PSC decided to "*use the results from model calibration 1503, yielding abundance indices of 1.45 for SEAK, 1.23 for NBC, and 0.85 for WCVI to establish catch limits for the AABM fisheries*" (July 17, 2015 letter from Sue Farlinger and Ron Allen to the CTC). The PSC has recognized the need to prioritize CTC assignments and a process that provides more focus on: (1) the timeliness and adherence to the CTC guidelines and instructions for the preseason planning process (CTC Technical Note (96)-1: Protocol for Changing the Chinook Model) and (2) performance of the Chinook model.

Several analyses rely upon completion of the annual calibration process such as evaluation of catches in relation to the first post season abundance indices for 2014 AABM and ISBM fishery obligations. At the October 2015 executive session, the Commission agreed to use the output from the 2016 PSC Chinook Model calibration to set postseason abundance indices for 2014 and 2015.

The purpose of this technical note is to document the events that transpired after calibration 1503 was produced. A chronology of bilateral communications regarding calibration 1503 is provided as a record to document the progression of events. All bilateral communications are provided in appendices M1-M16.

## CHRONOLOGY OF EVENTS

| Appx # | Date | Type | From | To | Regarding |
|---|---|---|---|---|---|
| | March 16-20, 2015 | CTC-AWG in-person meeting | --- | --- | Model Calibration to determine 2015 AABM AIs; Clb 1503 completed by AWG March 28 |
| | 31-Mar-15 | Email following AWG conference call | CTC-AWG | CTC | Inputs and Outputs for PSC Chinook Model CLB 1503; Request feedback by April 3, 2015 otherwise proceed with drafting memo to PSC consistent with CLB 1503 Outputs for 2014 post-season AIs and 2015 pre-season AIs; CTC conference call scheduled for April 7 (due to national holidays for Canadian CTC members on Apr 3rd and 6th). |
| M 1 | 31-Mar-15 | Memo | John Carlile | CTC-AWG | CLB 1503 and SEAK AI Estimate |
| | 6-Apr-15 | Email | John Carlile on behalf of AK CTC members | CTC | Alaska does not accept the SEAK post-season AI estimate of 2.13 for 2014 or pre-season AI projection of 1.45 for 2015 from the PSC Chinook model calibration.<br><br>*"There have been wide fluctuations in preseason and postseason AIs for SEAK from the PSC Chinook model since 2012 (three fold larger, on average, than occurred from 1999-2011). This variability has been highly disruptive to SEAK fisheries. It has cast doubt on the validity of the current PSC Chinook Model to generate an accurate abundance index for the SEAK AABM fishery. Given recent anomalies in stock abundances, maturation rates, and environmental variables, a more thorough review of model calibration CLB1503 is warranted. The deadline of April 7th is insufficient to conduct a detailed review."* |
| | 7-Apr-15 | CTC Conference Call | --- | --- | Members state their intention to continue their review and provide a response by April 21; US members emphasize the need for conclusion of the PFMC fishery planning process |
| M 2 | 7-Apr-15 | Letter | CTC-Co-Chairs | PSC | Update on the status of the preseason AABM fishery Abundance Indices for 2015 and post-season Abundance Indices for 2014. |

| Appx # | Date | Type | From | To | Regarding |
|---|---|---|---|---|---|
| M 3 | 21-Apr-15 | Memo | AK members of CTC | CTC | Alaska members review of CLB1503 |
|  | April 27 - May 1, 2015 | CTC-AWG in-person meeting | --- | --- | Exchange of information concerning April 21, 2015 memo with webinar/conference call for those not attending (Apr 30).<br><br>Members request time to review -April 21, 2015 analyses with a response by May 19th. |
| M 4 | 19-May-15 | Memo | Southern US and Canada members of CTC | CTC | Review of CLB 1503 |
|  | 21-May-15 | CTC Webinar | CTC | CTC | Discussion regarding review of CLB 1503 without conclusion; members to respond by the next day (May 22) |
| M 5 | 21-May-15 | Memo | AK members of the CTC | CTC | Review of CLB 1503 |
| M 6 | 24-May-15 | Memo | CTC-Co-Chairs | PSC | Update on the status of the preseason AABM fishery Abundance Indices for 2015 and post-season AIs for 2014; request Commission to determine the 2015 catch levels for AABM fisheries |
| M 7 | 25-May-15 | Letter | Farlinger | Allen | Canadian concern regarding ongoing work of the CTC to establish abundance indices for 2015 pre-season allowable catches for AABM fisheries and PSC process |
| M 8 | 27-May-15 | Letter | Swanton | Farlinger | Clarification regarding SEAK king salmon sport fishing regulations based on AK domestic regulation timing |

| Appx # | Date | Type | From | To | Regarding |
|---|---|---|---|---|---|
| | June 1-5, 2015 | Full CTC in-person meeting | --- | --- | The CTC meeting to continue regular work plan tasks and to discuss how to proceed on a 2015 CLB&ER report if there is no final 2015 calibration. |
| M 9 | 19-Jun-15 | Letter | Allen | Farlinger | US section recommends that the three AABM fisheries employ indices consistent with the draft Model Calibration 1503 (CLB 1503). Request Canada's support to prioritize CTC assignments and process that focus on: (1) the timeliness and adherence to the CTC guidelines and instructions for the preseason planning process and (2) performance of the Chinook model. |
| M 10 | 24-Jun-15 | Letter | Farlinger | Allen | Confirms that Canada will apply Abundance Indices generated by CLB 1503 for the remainder of the season for NBC and WCVI AABM fisheries. Suggests that this is sufficient for joint endorsement of CLB1503 to configure fisheries.<br><br>Agreeable to have the CTC propose a prioritized list of high priority Model improvement tasks to the PSC. |
| M 11 | 17-Jul-15 | Letter | PSC | CTC | The Commission has agreed to use the results from model calibration 1503, yielding abundance indices of 1.45 for SEAK, 1.23 for NBC, and 0.85 for WCVI, to establish catch limits for the AABM fisheries. Authorities in each Party have agreed to structure their fisheries and regulatory regimes accordingly for 2015.<br><br>The Commissioners request the CTC to complete work on two memos by Sep 1 that will highlight issues for PSC attention. These memos will provide a) a review of CTC guidelines and instructions for the preseason planning process and recommend improvements to address timeliness and adherence to guidelines, and b) a list of recommended model improvement tasks that will need prioritization by the Commission relative to pre-2016 model calibration improvements. |

| Appx # | Date | Type | From | To | Regarding |
|---|---|---|---|---|---|
| M 12 | 4-Sep-15 | Memo | CTC | PSC | Reexamination of yearly Chinook Model calibration timeline |
| M 13 | 25-Sep-15 | Memo | CTC | PSC | CTC requests Commission guidance regarding inclusion of Calibration 1503 in CTC annual reports |
| M 14 | 29-Oct-15 | Memo | PSC | CTC | Commission responds to the CTC Calibration 1503 can be reported in three parts. Part 2 describes the current special report from the CTC to the PSC |
| M 15 | 29-Oct-15 | Memo | PSC | CTC | Re: Direction for CTC and AWG for model improvements and work products<br>1. The Commission is requesting that the AWG embark on investigating both the maturation rates and environmental variables to update and document the analyses performed in 2012 with the last two years of data. The objective is to provide for improved preseason and postseason abundance indices to be generated for the 2016 season and postseason AI's for both the 2014 and 2015 seasons.<br>2. Complete the Chapter 3 Performance Review.<br>3. AWG to complete Phase 2 of the CTC Model Base period calibration and an annual calibration using the new base period information. |
| M 16 | 9-Apr-16 | Memo | CTC | PSC | Preseason AABM fishery abundance indices for 2016 and post-season abundance indices for 2014 and 2015. |

## MEMORANDUM

**TO:** AWG
**FROM:** JOHN CARLILE
**SUBJECT:** CLB1503 - 2014 AND 2015 SEAK AI ESTIMATES
**DATE:** MARCH 31, 2015
**CC:**

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After reviewing the preliminary 2014 post-season AI estimate and the 2015 preseason AI projection from PSC Chinook model calibration CLB1503 I have a number of observations.

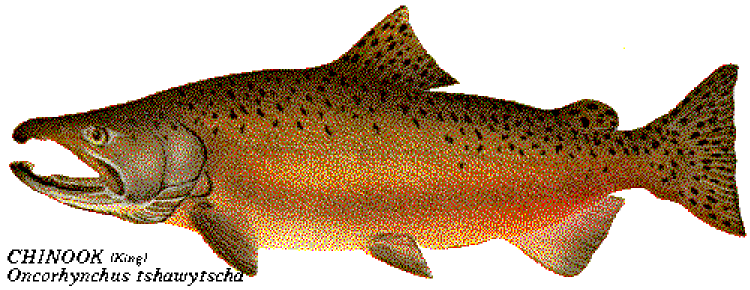
Regarding the 2014 post-season SEAK AI estimate of 2.13, this is lower than I would have predicted but high enough that it is in the realm of possibility. There was definitely a high abundance of Chinook last year and that was reflected in the SEAK troll fishery catch rates in both the winter and summer periods. The 2014 SEAK winter troll fishery CPUE (catch per day per permit) was one of the highest on record at 9.9 and was nearly three times as large as the 2013 winter CPUE of 3.6. The 2014 SEAK summer troll CPUE during the first opening in July was a record breaking 35.1; an average of 24,490 Chinook were being caught per day. This was nearly twice the 2013 SEAK summer troll (first opening) CPUE of 19.8, which was one of the largest seen up until that point.

This large abundance was also reflected in the high percentage of Chinook observed with an adipose clip but no CWT (no tags) in the 2014 SEAK winter troll fishery. At 55% no tags, this was the second highest observed since the start of the 2009 PST Agreement indicating that a large number of Columbia River Chinook were present. This high percentage of Columbia River Chinook was corroborated by both CWT contribution estimates and GSI estimates. GSI indicated that nearly 50% of the Chinook harvested in the 2014 SEAK troll fishery were upper Columbia River Summer/Fall fish (46%). The NBC GSI stock composition estimates showed a similar, though slightly higher proportion of Columbia River summers and brights. In summary, there was a high abundance of Chinook in Southeast Alaska last year and an extraordinarily large portion of them were from the Columbia River.

Regarding the 2015 preseason SEAK AI estimate of 1.45, this is far lower than I would have predicted and does not seem likely for the following reasons. Firstly, the 2015 SEAK winter troll CPUE of 10.0 is slightly higher than the 2014 winter troll CPUE of 9.9. Secondly, the percentage of no tags observed in the 2015 SEAK winter troll fishery is the same as last year (55%) indicating that there are a large number of Columbia River Chinook present again. Thirdly, the number of fall Chinook jacks observed at Bonneville Dam on the Columbia in 2014 (135,512) was even higher than the number of observed in 2013 (111,015). Fourthly, although the CWT contribution of upper Columbia River Fall Chinook in the 2015 SEAK winter troll fishery has gone down somewhat from the 2014 SEAK winter troll fishery (1,012 versus 2,371) the CWT contribution of Columbia River Summer Chinook appears to have increased substantially (2,600 versus 814). Finally, the fact that the Columbia River Chinook forecasts do not take any of these indicators or any ocean impacts into account leads me to believe that the 2015 abundance forecasts are likely biased low and that the abundance in the SEAK troll fishery in 2015 will likely be on par with what was seen in 2014. A summary of the statistics I referred to in this memo are presented in the table below.

SEAK Troll Fishery Statistics

| | Winter % AdClip w/ | CPUE (catch/boat/day) | | Winter CWT Contributions Upper Columbia | | | # of Fall Jacks at |
|---|---|---|---|---|---|---|---|
| Year | No-Tag | Winter | Summer | Falls | Summers | Total | Bonneville |
| 2009 | 27% | 6.2 | 9.9 | | | | 114,794 |
| 2010 | 48% | 7.7 | 11.9 | 350 | 613 | 963 | 64,394 |
| 2011 | 52% | 8.6 | 12.7 | 171 | 1,502 | 1,673 | 83,572 |
| 2012 | 61% | 7.4 | 8.7 | 510 | 276 | 786 | 124,115 |
| 2013 | 42% | 3.6 | 19.8 | 466 | 716 | 1,182 | 111,015 |
| 2014 | 55% | 9.9 | 35.1 | 2,371 | 814 | 3,185 | 135,512 |
| 2015 | 55% | 10.0 | | 1,012 | 2,600 | 3,612 | |




**PSC Chinook Technical Committee**

**TO:** Pacific Salmon Commission

**FROM:** John Carlile, Gayle Brown and Robert Kope

**DATE:** April 7, 2015

**SUBJECT:** Update on the Status of the Preseason AABM Fishery Abundance Indices for 2015 and Post-Season Abundance Indices for 2014

The Chinook Technical Committee (CTC) has not yet agreed to a final calibration of the Chinook Model for 2015. When completed the calibration will provide the Abundance Indices (AI) that are required for determining the 2015 preseason estimated allowable catches and the 2014 post-season allowable catches for the three Aggregate Abundance Based Management (AABM) fisheries: Southeast Alaska all gear (SEAK), Northern British Columbia troll and Queen Charlotte Island sport (NBC), and West Coast Vancouver Island troll and outside sport (WCVI). The current calibration of the Chinook model that is currently being reviewed by the CTC contains significant abundance reductions from last year's Chinook model calibration CLB1402 in all three AABM fisheries.

However, there are a number of indicators from the Southeast Alaska winter troll fishery that suggest that the 2015 Chinook abundance in Southeast Alaska will be as large or larger than the high abundance seen last year. This disparity between the Chinook model and other sources of information has troubled a number of CTC members and therefore more time is required to review the calibration and the auxiliary sources of information. A small group of Alaskan CTC members will be assembling analyses of the Chinook model calibration output and the auxiliary sources of information, and combining them into a report within the next two weeks. This report from the small group will be provided to the bilateral CTC for review. The information in the report will be reviewed on its' technical basis, and then the bilateral CTC will discuss how to proceed.

cc John Field
Alison Agness
Kate Ladell

**MEMORANDUM**

| | |
|---|---|
| To: | Chinook Technical Committee |
| From: | John Carlile, John H. Clark, Bob Clark, Brian Elliott, Dani Evenson, Gary Freitag, Andy Gray, Ed Jones, Scott McPherson, Randy Peterson, Bill Templin, and Eric Volk |
| Subject: | Review of CLB1503 |
| Date: | April 21, 2015 |
| cc: | |
| Attachments: | Appendices A–D |

Wide fluctuations in preseason and postseason AIs since 2012 have prompted concerns regarding the reliability of the current PSC Chinook Model to generate abundance indices for the AABM fisheries. While the PSC Chinook model is currently the tool we use to integrate observations from catches and escapements for coming year projections of abundance for implementation of PSC fishing regimes, the model was not designed for this purpose. Compounding this, the model is not designed to accommodate recent anomalies in stock abundances, maturation rates, and environmental variables. Additionally, the preliminary 2014 postseason and 2015 preseason AI estimates from model calibration CLB1503 do not comport with catch information from Southeast Alaska (SEAK) fisheries. Owing to these observations and in accordance with the 2009 PST Agreement Annex 4, Chapter 3, including paragraph 9 (e) and (f) and Appendix A paragraph 3 and 4, we reviewed CLB1503 with respect to model inputs and model assumptions. A summary of our findings below is accompanied by appendices that provide details of the analyses to support these findings.

There is substantial empirical evidence that the 2015 preseason AI is inaccurate (Appendix A). A review of recent PSC model performance indicates that the forecasting performance of the model has degraded in recent years. Deviations between pre and postseason estimates of the SEAK AABM AI since 1999 have approximately doubled since 2012. Moreover, two of the largest three forecast errors have occurred in the last three years in terms of absolute error and three out of three in terms of absolute percent error. These large deviations are putting undue burden on the stability of the SEAK fishery and do not comport with the MSY-based objectives of the Pacific Salmon Treaty.

There are four lines of evidence from SEAK troll fishery statistics that provide insights into the degraded performance of the PSC model and likely underestimation of the 2015 preseason AI:

1. SEAK winter troll catches through mid-March were the highest on record and the winter season that normally proceeds through the end of April had reached its Guideline Harvest

Range a full month earlier.

2. There is a very strong long term linear relationship between the Sitka Sound winter troll CPUE and postseason AI. The Sitka Sound winter troll CPUE was very high in 2015, indicating that abundance is high and will be much higher than forecast in CLB1503.
3. CWT contributions of major drivers of abundance in the SEAK fishery were above average in the 2015 winter fishery indicating that abundance of these stocks remains high. Columbia River Brights and Summers contributed double the 2010–2014 average to the 2015 SEAK winter fishery. Coded-wire tag recovery rates for these stock groupings were dominated by catches of age-5 fish, providing evidence that the BY2010 year class remains strong through 2015. These contributions of age-5 fish cannot be due to fishery recruitment rates alone as age-4 Chinook salmon are almost completely recruited to this fishery.
4. The continued high incidence of NO TAG fish in the SEAK winter fishery indicates continued strong year classes of the major mass marked stocks. Columbia River stocks provide the majority of these fish. While numbers of fish recovered that bear a CWT have remained relatively stable, the proportion of marked fish without CWTs (NO TAGS) in 2014 and 2015 are the highest ever observed in the SEAK winter fishery.

Two of the model assumptions need to be investigated: maturation rates and environmental variable (EV) scalars (Appendix B). We are concerned with model inputs, both irregularities in maturation rates and the significant reduction in EVs across stocks in CLB1503. We believe a careful review of these assumptions and how they affect the 2014 postseason AI and the 2015 projected AI is warranted. We note that changes with regard to these assumptions were made in 2013, which coincided with the large changes between preseason and 1st postseason AIs. While the intent of the change was admirable, the results of doing so are alarming; perhaps a reasonable first approach would be to revert to the pre-2013 methodology.

Stock-age abundance forecasts that are input into the model need to be evaluated (Appendix C). We have significant technical concerns with Columbia and WCVI forecasts. In the Columbia River case, there are issues with 5-year-old forecasts. Examining well established sibling relationships, we find that assumptions made about age 4/5 ratios do not comport with observed abundances of age-5 Columbia River fish on the SEAK fishing grounds. And, in the WCVI case, CLB1503 input for WCVI matches nothing we have been provided for review and in fact is outside of the range of any of the technical analyses provided. We recommend that forecasts and forecasting methods of these two important contributors to the SEAK fishery be reviewed and that revised forecasts be input into the model. In the longer term, we also recommend that previous efforts to establish bilaterally approved data and analytical standards for abundance forecasting methods be revisited.

The PSC Chinook model's ability to generate postseason AIs needs to be evaluated (Appendix D). We found that the Upper Columbia comprises a large proportion of the AI and the model has been chronically over-estimating Upper Columbia contribution to the AI. Therefore, the model and AIs are very sensitive to Columbia River forecasts, which are concerning particularly with regard to the lack of consistency of the Columbia River forecasts. We recommend that this issue be assessed and surmise that systematic over-representation may be due to the following causes: 1) yearly catch estimates in the model are influenced by the base period stock composition; 2) changes in stock distribution over time; and 3) the 30 model stocks do not adequately represent all production present.

Various data available to Alaska CTC members are being provided in an effort to help others understand our serious concerns with CLB1503. These data are direct observations, not model output based on a variety of assumptions and/or projections, and these observations simply do not comport with the output from CLB1503. While some of these data refute results from CLB1503, some may also be useful as an inseason adjustment to preseason projections such that management can be adjusted to more closely mimic the eventual 1st postseason AI.

The following list includes several specifics that we recommend be implemented as part of a new calibration for 2015 and/or be implemented in the future:

- Replace the recent 5-year average assumed maturation rates for URB age-2 with the last observed value as input to the PSC Chinook model or with another value that is consistent with existing observations. This could be done with other stocks as well.
- Research assumed maturation rates used for other driver stocks important to AABM fisheries and make appropriate changes to model input.
- Use a 2-year average EV which was shown to perform well in the 2012 analysis concerning the forecasting issue. Other options would be to revert to using the 5-year average EV values for incomplete broods, as was done in calibrations prior to 2013, or to update the 2012 forecasting analysis and identify a best option.
- Replace 2015 URB and MCB model inputs with those identified herein or alternate values that are consistent with statistically valid sibling relationships associated with these stocks. Provide plots of the sibling relationships used along with diagnostic statistics. Standard errors, and confidence or prediction intervals should be made available for these forecasts as measures of uncertainty.
- Investigate data inputs and methods of forecasting abundances for Columbia River stocks using run reconstructions that include harvests from ocean fisheries beyond the mouth of the Columbia River.
- Replace 2015 WCVI age-4 and age-5 model input to alternate inputs such as those identified herein or with alternate values that are consistent with statistically valid sibling relationships associated with the WCVI stock complex. Provide plots of the sibling relationship used along with diagnostic statistics. Standard errors and confidence or prediction intervals should be made available for these forecasts as measures of uncertainty.
- Research and review methodology associated with the age-3 WCVI 2015 forecast that is being used as model input; ensure the age-3 input is scientifically justified. The standard errors and confidence or prediction interval should be made available for this forecast as measures of uncertainty.

- Examine why the PSC Chinook model over-estimates the abundance of Upper Columbia River stocks relative to other PSC model stocks. The estimated stock composition from the PSC Chinook model may not represent the true stock composition for a number of reasons: 1) yearly catch estimates in the model are influenced by the base period stock composition; 2) changes in stock distribution over time; and 3) the 30 model stocks do not represent all production present. All three of these potential causes should be assessed.

Suggested long-term improvements to the model:

- Mandate use of scientifically defensible stock-age forecasts with measures of uncertainty.
- Develop bilaterally agreed to forecasting methods and data standards.
- Ensure maturation rates and EVs are consistent with existing data and that use of these assumed values do not introduce large errors into the model.
- Improve the timing of release of draft calibrations that will allow adequate CTC review within the needs of fishery management regimes.

## Appendix A– Empirical evidence that the 2015 preseason AI for SEAK is inaccurate

### A.1 Review of PSC Chinook model forecasting performance

The CTC has annually forecasted abundance indices for AABM fisheries since implementation of AABM fisheries in 1999. There have been wide fluctuations in preseason and postseason AIs since 2012 and the directionality of the bias, as measured by the difference between the postseason and preseason abundance indices (AI), has flip-flopped between over-forecasting (2012, 2014) and under-forecasting (2013) during the past three years (Figure A.1). The absolute difference between postseason and preseason AIs has ranged from a low of 0.03 in 1999 to highs of 0.43 (under-forecast) and 0.44 (over-forecast) in 2013 and 2014, respectively (Table A.1).

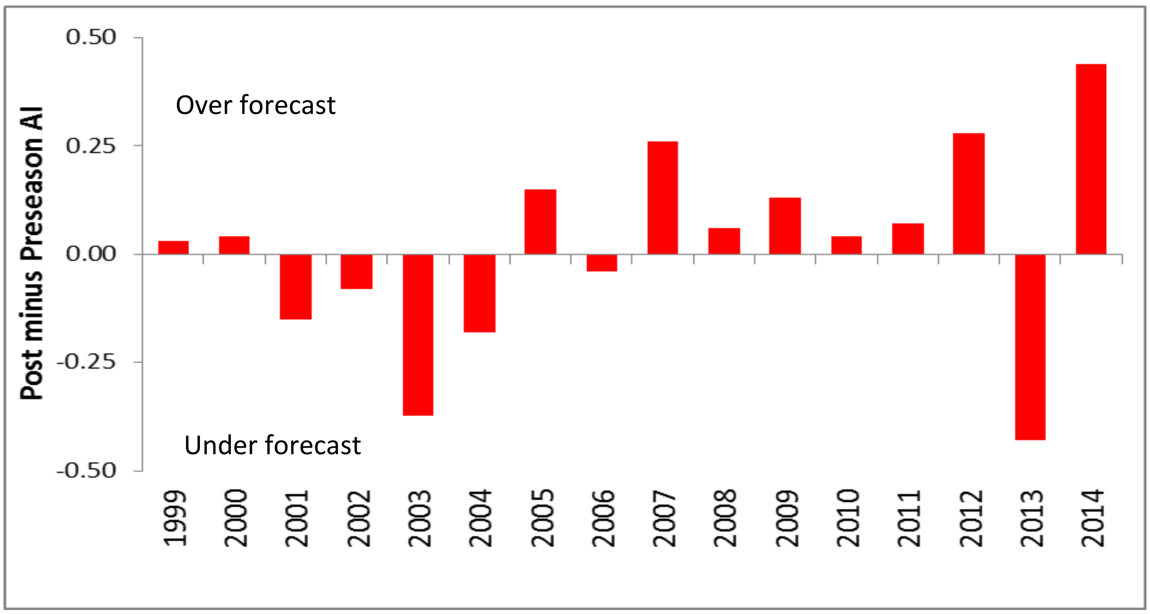



*Figure A.1.– Difference between pre- and postseason abundance indices (AIs) for the SEAK AABM fishery, 1999–2014.*

Substantive changes to the PSC Chinook model have been made over the years. Most recently, the model was altered in 2013 to incorporate observed variation in maturation rates and procedures for EV input were changed. Forecast accuracy, as measured by root mean squared error (RMSE) and mean absolute percentage error (MAPE), was evaluated for the entire time series and the recent three years (Table A.2).

Using the postseason AI from CLB1503, two of the largest three forecast errors have occurred in the last three years in terms of absolute error and three out of three in terms of absolute percent error. Forecast error, in terms of RMSE and MAPE over the last three years is twice that of the long-term average.

**Conclusions and Recommendations:**

1. *PSC Chinook model forecasting performance has degraded in recent years.*
2. *Review the 2015 PSC Chinook model inputs.*
3. *Examine the PSC Chinook model assumptions*

*Table A.1.– SEAK pre- and postseason abundance index (AI) time series.*

| Year | Pre Season CLB # | Post Season CLB # | Pre Season AI | Post Season AI | Error | % Error |
|---|---|---|---|---|---|---|
| 1999 | CLB 9902 | CLB 0021 | 1.15 | 1.12 | -0.03 | -2.68% |
| 2000 | CLB 0021 | CLB 0107 | 1.14 | 1.10 | -0.04 | -3.64% |
| 2001 | CLB 0107 | CLB 0206 | 1.14 | 1.29 | 0.15 | 11.63% |
| 2002 | CLB 0206 | CLB 0308 | 1.74 | 1.82 | 0.08 | 4.40% |
| 2003 | CLB 0308 | CLB 0404 | 1.79 | 2.17 | 0.38 | 17.51% |
| 2004 | CLB 0404 | CLB 0506 | 1.88 | 2.06 | 0.18 | 8.74% |
| 2005 | CLB 0506 | CLB 0604 | 2.05 | 1.90 | -0.15 | -7.89% |
| 2006 | CLB 0604 | CLB 0705 | 1.69 | 1.73 | 0.04 | 2.31% |
| 2007 | CLB 0705 | CLB 0807 | 1.60 | 1.34 | -0.26 | -19.40% |
| 2008 | CLB 0807 | CLB 0907 | 1.07 | 1.01 | -0.06 | -5.94% |
| 2009 | CLB 0907 | CLB 1007 | 1.33 | 1.20 | -0.13 | -10.83% |
| 2010 | CLB 1007 | CLB1106 | 1.35 | 1.31 | -0.04 | -3.05% |
| 2011 | CLB 1106 | CLB 1209 | 1.69 | 1.62 | -0.07 | -4.32% |
| 2012 | CLB 1209 | CLB 1309 | 1.52 | 1.24 | -0.28 | -22.58% |
| 2013 | CLB 1308 | CLB 1402 | 1.20 | 1.63 | 0.43 | 26.38% |
| 2014 | CLB 1402 | CLB 1503 | 2.57 | *2.13* | *-0.44* | *-20.66%* |
| 2015 | CLB 1503 | | *1.45* | | | |

*Table A.2.– SEAK pre- and postseason forecast accuracy.*

| Time Series | RMSE | CV(RMSE) | MAPE | SD |
|---|---|---|---|---|
| 1999–2014 | 0.22 | 14.35% | 10.75% | 8.03% |
| *2012–2014* | *0.39* | *23.42%* | *23.21%* | *2.91%* |

## A.2 Evaluation of SEAK winter troll fishery performance

By regulation, the SEAK winter troll fishery runs from October 1 through April 30, or until the guideline harvest range of 43,000 to 47,000 Treaty Chinook salmon (harvest less Alaska hatchery add-on) is reached. This year, record high harvests were observed through mid-March, prompting the closure of the fishery in statistical week (SW) 13 (March 25, 2015) with approximately 46,000 Treaty fish being harvested.

Since 2002, an average of 51% of the winter troll harvest has been caught after SW13 (Table A.3).

Hence, assuming similar conditions, if this fishery was kept open until April 30 (SW18 in 2015), more than 93,000 Chinook salmon would likely have been harvested. By comparison, in 2014 with a preseason AI of 2.57 and a preliminary postseason AI of 2.13, 51,647 were harvested through April 30 – one of the highest harvests on record for this fishery. Of the 2014 total, only 19,000 were harvested through SW13. Thus, the 2015 harvest through SW13 was more than double the amount harvested in 2014 during the same timeframe.

*Table A.3.–Southeast Alaska winter troll harvests, Sitka Sound (stat area 113-41) CPUE, and pre- and postseason abundance indices (AI), 2002–2015[1].*

| | SW41-13 | | | SW14-18 | | TOTAL | | Abundance Index | |
|---|---|---|---|---|---|---|---|---|---|
| AY | Harvest | 113-41 CPUE | p^ total harvest | Harvest | 113-41 CPUE | Harvest | 113-41 CPUE | Pre Season | Post Season |
| 2002 | 21,447 | 10.4 | 0.77 | 6,308 | 5.0 | 27,755 | 9.3 | 1.74 | 1.82 |
| 2003 | 32,390 | 12.7 | 0.71 | 13,390 | 18.3 | 45,780 | 13.9 | 1.79 | 2.17 |
| 2004 | 25,588 | 6.0 | 0.55 | 20,930 | 10.7 | 46,518 | 7.4 | 1.88 | 2.06 |
| 2005 | 32,040 | 7.1 | 0.69 | 14,498 | 17.3 | 46,538 | 8.8 | 2.05 | 1.9 |
| 2006 | 23,607 | 6.1 | 0.53 | 20,831 | 11.4 | 44,438 | 7.8 | 1.69 | 1.73 |
| 2007 | 13,332 | 3.7 | 0.31 | 30,044 | 14.9 | 43,376 | 9.8 | 1.6 | 1.34 |
| 2008 | 8,136 | 2.5 | 0.43 | 10,750 | 4.1 | 18,886 | 3.5 | 1.07 | 1.01 |
| 2009 | 6,822 | 3.0 | 0.32 | 14,463 | 7.6 | 21,285 | 6.2 | 1.33 | 1.2 |
| 2010 | 15,639 | 4.9 | 0.41 | 22,749 | 10.6 | 38,388 | 7.7 | 1.35 | 1.31 |
| 2011 | 18,857 | 5.4 | 0.41 | 26,916 | 12.3 | 45,773 | 8.6 | 1.69 | 1.62 |
| 2012 | 17,213 | 4.0 | 0.39 | 26,815 | 10.3 | 44,028 | 7.4 | 1.52 | 1.24 |
| 2013 | 12,791 | 3.3 | 0.54 | 10,898 | 3.9 | 23,689 | 3.6 | 1.2 | 1.63 |
| 2014 | 19,339 | 5.6 | 0.37 | 32,308 | 14.6 | 51,647 | 9.9 | 2.57 | 2.13[a] |
| 2015 | 46,257[2] | 10.0 | 0.49[3] | *no fishery* | | 93,472[4] | 10.0[4] | 1.45[5] | |

[1] Data for stat area 113-41 are not available prior to 2002 because the stat area was part of another stat area until 2002.

[2] Preliminary total harvest in 2015.

[3] Average proportion of the total catch observed through statistical week 13.

[4] Predicted harvest/CPUE using the relationship between total harvests through statistical week 13 and the end of the fishery using 2002 to 2014 data.

[5] Southeast Alaska preliminary 2014 postseason and 2015 preseason abundance indices.

There is a strong linear relationship between the SEAK post season AI and the winter troll harvests through SW13 ($R^2$=0.66; Figure A.2). This relationship degrades substantially when the 2015 preliminary preseason AI is added ($R^2$=0.25).

Sitka Sound comprises the majority of effort and harvest in the SEAK winter troll fishery (Table A.3). On average, 55% of the total effort and 61% of the total harvest occurs in this subdistrict during the winter troll fishery. There is a strong linear relationship between Sitka Sound winter troll fishery CPUE through SW13 and the SEAK postseason AI from 2002 to 2013 ($r^2$=0.635; Figure A.3). Using this linear relationship, the predicted postseason AI for 2015 is 1.99.

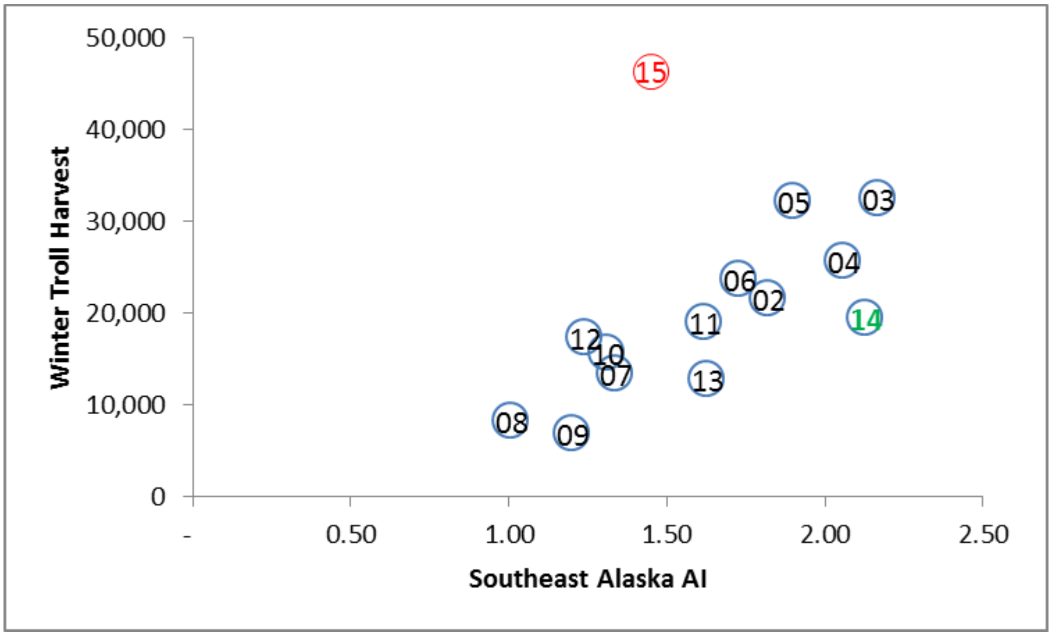



*Figure A.2.– Relationship between the Southeast Alaska postseason abundance index (AI) and harvests observed in the winter troll fishery through statistical week 13, 2002–2015. The 2014 data point (in green) uses preliminary postseason AI of 2.13 from CLB1503. The 2015 data point (in red) uses the preliminary preseason AI of 1.45 from CLB1503 and represents a harvest of approximately 46,000 fish.*

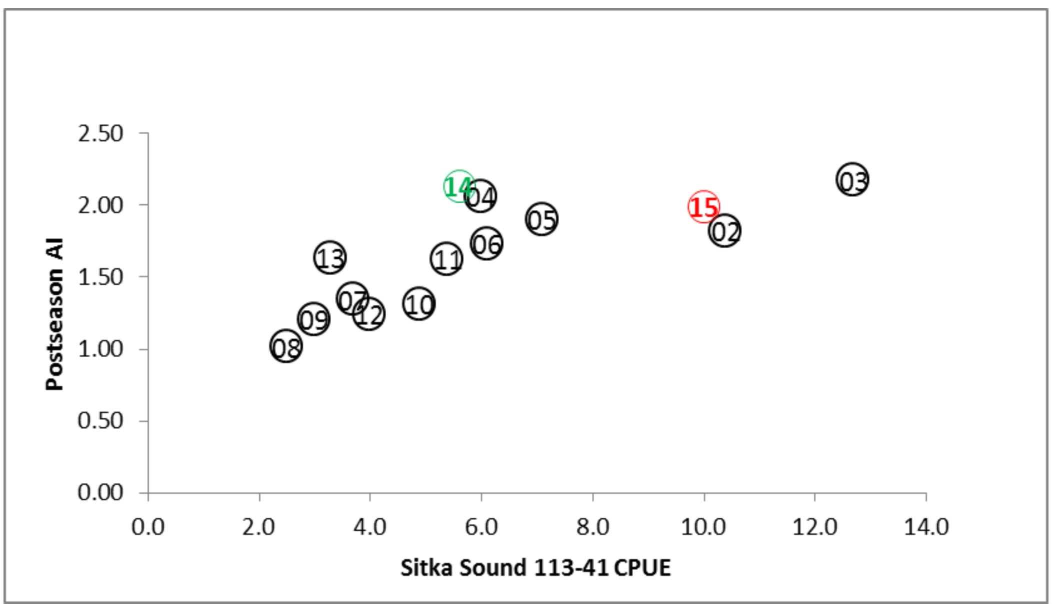



*Figure A.3.– Relationship between the Southeast Alaska postseason abundance index (AI) and CPUEs observed in the Sitka Sound winter troll fishery through statistical week 13, 2002–2014. The 2014 data (in green) uses the preliminary postseason AI of 2.13 from CLB1503; the 2015 datum (in red) is a forecast based on the linear relationship between Sitka Sound CPUE and postseason AI.*

**Conclusions and Recommendations:**

1. *There is a very strong long term linear relationship between the Sitka Sound winter troll CPUE and the postseason AI.*
2. *SEAK winter troll fishery performance indicates a larger 2015 preseason AI than the CLB1503 projection.*
3. *Evaluate the utility of using a relationship such as the Sitka Sound winter troll CPUE and postseason AI as an inseason adjustment to preseason projections.*

## A.3 Analysis of SEAK winter troll fishery CWT contributions

The contribution of Columbia River Brights (URBs + MCBs) in the 2015 SEAK winter troll fishery through SW13 was 1,287 fish, representing 12% of the harvest based on CWT recoveries (Table A.4). By comparison, the contribution of Brights in 2014 was 501 fish representing 10% of the harvest for the same period of time.

The contribution of Columbia River Summers in the 2015 SEAK winter troll fishery through SW13 was 2,819 fish representing 26% of the harvest based on CWT recoveries (Table A.4). In 2014, the contribution of summers was 700 fish representing 14% of the harvest for the same period of time.

The SEAK winter troll fishery in AY2015 harvested the highest number of Columbia River Brights (1,287) since 2000, and the highest number of Summers (2,822) since 2003. Both components of the harvest, when measured as a proportion of total known harvest from CWT expansion, comprise higher than average proportions of the total winter harvest in 2015, and the Summers proportion (0.26) is the highest since 1999 (Table A.4). These data indicate high abundance of these 2 stock groups (Figure A.4), and if the winter troll fishery continued through its normal timing window (April 30), the contribution of these two stock groups would likely have increased substantially.

The age 4/5 cohort ratio for the 2015 winter troll fishery is indicating a pronounced shift towards age-5 fish, once again representing strength of brood year 2010 for the Bright and Summer Columbia River stock groups (Table A.4.).

*Table A.4.– Age 4/5 ratio, winter troll harvest through SW13 and SW14-18, and summer troll harvest of Columbia River Bright and Summer stock groups, 1999–2015. Also included are age-4 and age-5 inriver abundance estimates for the Columbia River Bright stock group.*

| | Columbia River Bright | | | | | | | Columbia River Summer | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Age 4/5 Ratio | | Troll Harvest | | | | | Age 4/5 Ratio | | Troll Harvest | | | |
| AY | Winter Troll | Summer Troll | Winter SW 41-13 | p^ known harvest | Winter SW 14-18 | Summer | Age 4+5 URB+MCB | Winter Troll | Summer Troll | Winter SW 41-13 | p^ known harvest | Winter SW 14-18 | Summer |
| 1999 | 4.95 | 7.45 | 1,276 | 0.12 | 287 | 10,155 | 178,176 | 0.09 | 4.68 | 323 | 0.03 | 92 | 564 |
| 2000 | 0.23 | 0.83 | 3,448 | 0.14 | 903 | 7,625 | 169,013 | 0.18 | 2.12 | 597 | 0.02 | 337 | 940 |
| 2001 | 0.88 | 2.32 | 718 | 0.12 | 304 | 4,152 | 196,917 | 0.41 | 38.69 | 399 | 0.07 | 146 | 1,971 |
| 2002 | 5.88 | 6.28 | 714 | 0.08 | 282 | 12,333 | 296,511 | 0.04 | 2.37 | 1,891 | 0.22 | 665 | 4,174 |
| 2003 | 0.33 | 1.66 | 1,097 | 0.06 | 811 | 12,345 | 466,297 | 0.04 | 0.28 | 2,945 | 0.17 | 928 | 2,217 |
| 2004 | 0.02 | 0.66 | 392 | 0.03 | 234 | 10,618 | 351,724 | 0.28 | 1.95 | 473 | 0.03 | 458 | 2,274 |
| 2005 | 0.48 | 4.33 | 641 | 0.04 | 252 | 16,151 | 292,479 | 0.05 | 0.40 | 820 | 0.05 | 377 | 2,791 |
| 2006 | 0.52 | 0.36 | 544 | 0.06 | 317 | 7,669 | 253,150 | 0.10 | 2.62 | 341 | 0.03 | 384 | 981 |
| 2007 | 25.53 | 3.36 | 22 | 0.00 | 308 | 3,642 | 118,185 | 0.09 | 1.43 | 152 | 0.02 | 361 | 1,266 |
| 2008 | 0.01 | 3.60 | 25 | 0.01 | 250 | 4,556 | 145,971 | 0.29 | 6.28 | 83 | 0.03 | 151 | 1,608 |
| 2009 | 5.07 | 3.52 | 10 | 0.00 | 222 | 6,654 | 228,230 | 0.11 | 1.27 | 125 | 0.04 | 520 | 947 |
| 2010 | 1.18 | 0.76 | 140 | 0.02 | 212 | 2,461 | 221,590 | 0.47 | 7.68 | 367 | 0.06 | 432 | 1,504 |
| 2011 | 21.85 | 12.00 | 106 | 0.02 | 187 | 5,557 | 300,716 | 0.10 | 1.39 | 829 | 0.15 | 689 | 896 |
| 2012 | 1.20 | 1.75 | 421 | 0.07 | 504 | 4,611 | 171,663 | 0.33 | 14.09 | 199 | 0.03 | 492 | 3,492 |
| 2013 | 3.59 | 28.25 | 30 | 0.01 | 453 | 6,393 | 490,462 | 0.11 | 4.17 | 520 | 0.13 | 211 | 838 |
| 2014 | 1.84 | 5.39 | 501 | 0.10 | 2,306 | 20,921 | 756,900 | 0.19 | 5.54 | 700 | 0.14 | 594 | 2,197 |
| 2015 | 0.41 | | 1,287 | 0.12 | | | | 0.09 | | 2,822 | 0.26 | | |
| 1999-2014 average | 4.60 | 5.16 | 630 | 0.05 | 490 | 8,490 | 289,874 | 0.18 | 5.94 | 673 | 0.08 | 427 | 1,791 |

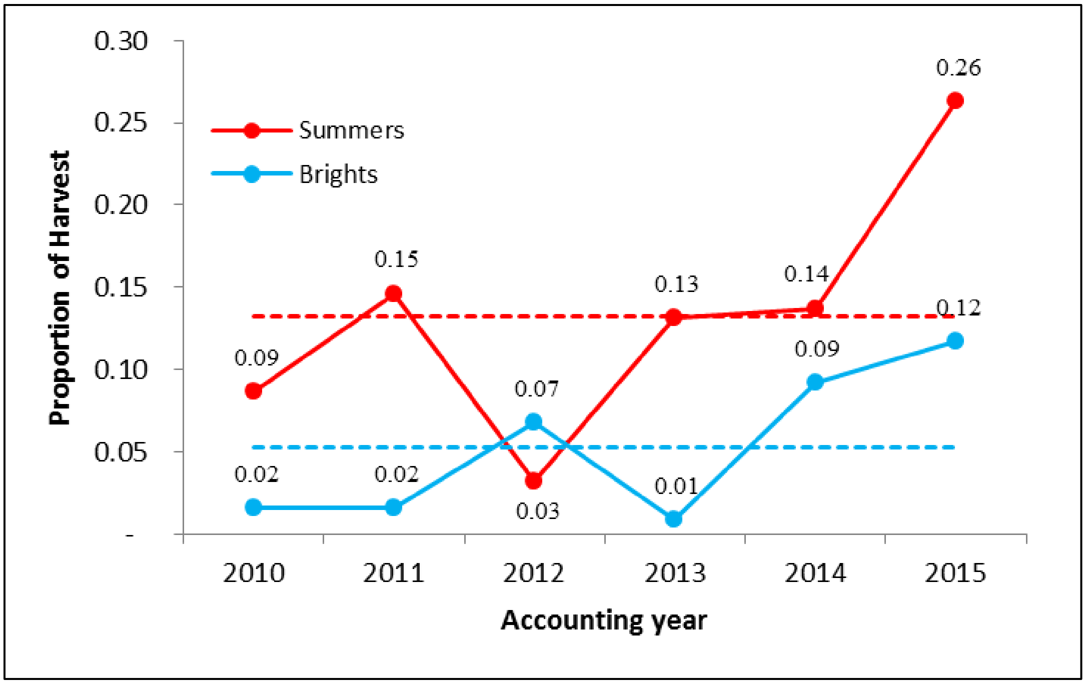



*Figure A.4.– Proportions of Columbia River Brights and Summers in the SEAK winter troll fishery for accounting years 2010 to 2015. Dashed lines represent 2010–2015 average proportions.*

The strength of Bright and Summer stock groups are also evidenced from CWT recovery rates for large tagged hatchery release groups within these stock groups (Table A.5). Brood year 2009 and particularly brood year 2010 are showing very high CWT recovery rates from the SEAK winter troll fishery. These data indicate high overall production from these two brood years from these Columbia River stock groups.

*Table A.5.– Coded-wire tag recovery rates (x 100,000) for principal Columbia River Bright and Summer stock groups from the SEAK winter troll fishery, through SW13 during AY2008-2015.*

| Release Group | Stock Group | BY 2005 | BY 2006 | BY 2007 | BY 2008 | BY 2009 | BY 2010 | BY 2011 |
|---|---|---|---|---|---|---|---|---|
| Priest Rapids Hatchery | Bright | | | 0.5 | 0.5 | 1.0 | 1.8 | 0.7 |
| (W) Hanford Reach Stock | Bright | 1.0 | 0.5 | 1.9 | 1.0 | 0.5 | 9.8 | |
| Klickitat Hatchery (YKFP) | Bright | 0.1 | 0.4 | 0.8 | 0.3 | 1.4 | 6.7 | 0.4 |
| Little White Salmon NFH | Bright | | | 0.9 | 0.0 | 1.0 | 2.3 | 0.0 |
| Lyons Ferry Hatchery | Bright | | | 0.9 | 0.0 | 1.5 | 7.7 | 3.0 |
| Chelan River | Summer | 0.0 | | 0.0 | 4.1 | 1.9 | 47.2 | 2.4 |
| Wells Hatchery | Summer | | | 4.9 | 1.5 | 4.3 | 12.5 | 6.9 |
| Entiat NFH | Summer | 0.0 | | | | 2.7 | 32.3 | 0.0 |
| Similkameen Hatchery | Summer | 5.9 | 10.2 | 4.6 | 7.9 | 11.5 | 34.8 | 0.3 |
| Dryden Pond | Summer | 6.3 | | 0.4 | 4.7 | 4.9 | 9.3 | 0.2 |

**Conclusions and Recommendations:**

1. *SEAK winter troll Fishery CWT contributions indicate a larger 2015 preseason AI.*
2. *Evaluate the potential of the SEAK winter troll CPUE as an inseason indicator of SEAK driver stock abundance.*
3. *Re-evaluate the robustness of model forecast inputs.*

## A.4 Evaluation SEAK troll fishery "NO TAG" percentage

Since 2010, the proportion of marked fish without coded-wire tags (NO TAGS) has increased substantially in the SEAK troll fishery, while the numbers of mass-marked fish released from hatcheries that contribute to the SEAK catch (Columbia, Washington Coast, Oregon Coast) have remained relatively constant since release year 2006 (SFEC 2015[1]) (FigureA.5). Overall, the most marked fish sampled was in the 2014 accounting year, which also had the largest number of tagged fish sampled since 2003.

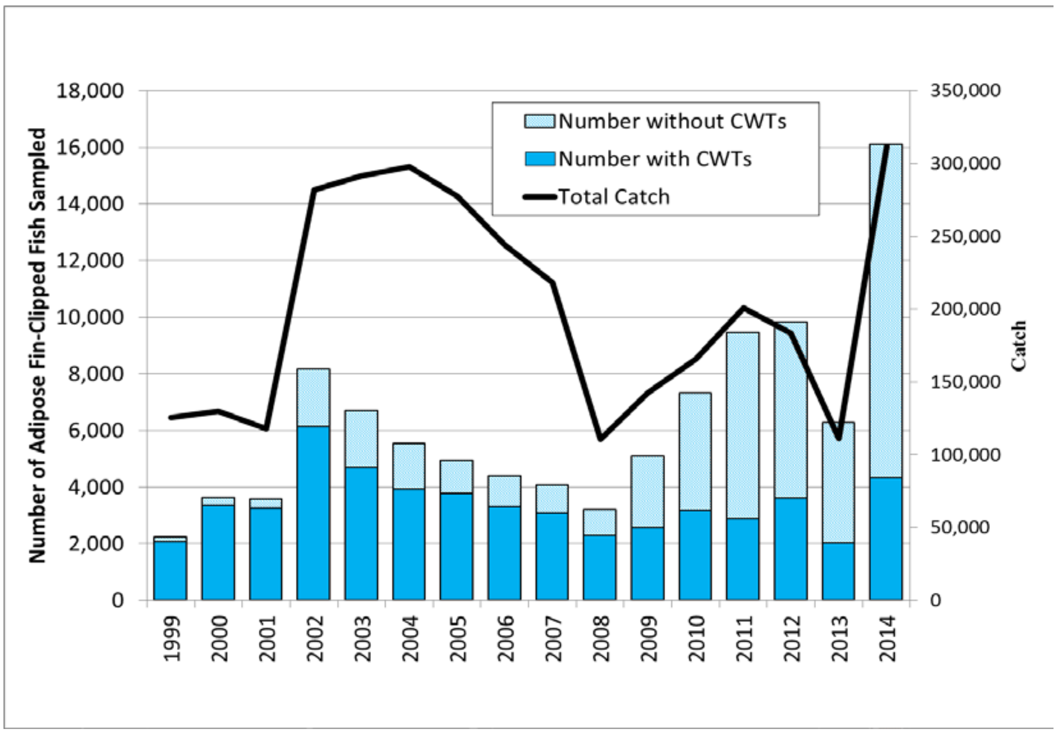



*Figure A.5.– Numbers of marked Chinook salmon processed from sampling catches in the SEAK troll fishery by untagged and tagged CWT status (y1 axis), with catch numbers (y2 axis), in catch accounting years 1995–2014.*

In both 2014 and 2015, approximately 55% of marked fish sampled in the SEAK winter troll fishery

[1] SFEC. 2015. Review of mass marking and mark-selective fishery activities proposed to occur in 2013. SFEC (15)-1, Vancouver, BC.

were NO TAGS (Figure A.6). Although, a 10-12% NO TAG rate in marked fish sampled from the SEAK fishery was common before the advent of mass-marking as a result of poor tag retention by hatcheries up and down the coast, 55% NO TAGS is an unusually large percentage. This is suggestive of good production and survival from mass-marked hatchery fish, and the Columbia River hatchery releases comprise the majority of the mass-marked releases contributing to the SEAK troll catch.

It is also noteworthy that that the largest percentage of marked fish were observed in winter 2015. It is a reasonable assumption that the NO TAGs originated from a similar suite of hatcheries as the CWT'ed fish recovered in the winter SEAK troll fishery, which indicates continued good production from the 2010 brood year from the Columbia River.

**Conclusions and Recommendations**

1. *The continued and increasing proportion of NO TAGS in the SEAK troll fishery through the winter of 2014-2015 is an indication that the Columbia River 2015 forecasts are too conservative.*
2. *Reevaluate PSC Chinook model assumptions and inputs that affect abundance of Columbia River stocks in the model.*

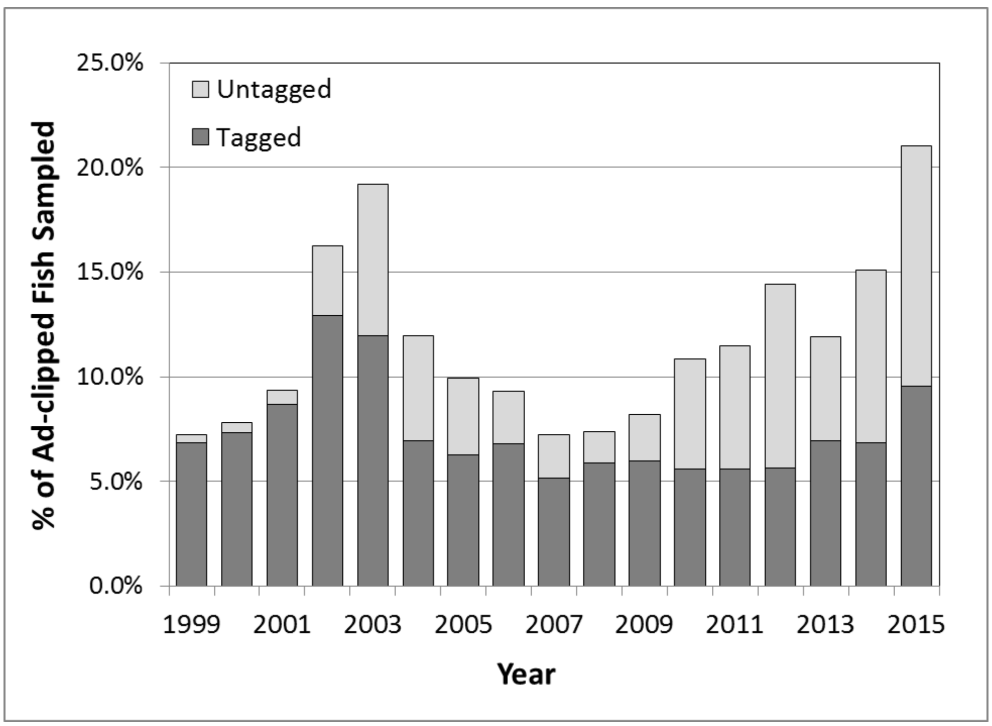



*Figure A.6.– Percentage of ad-clipped Chinook salmon sampled in the SEAK winter troll fishery by tagged and untagged status, 1999–2015.*

# Appendix B– Evaluation of model assumptions

## B.1 Examination of maturation rates

During the 1980s and early 1990s, the PSC Chinook model tended to display a lagging behavior in estimation of the AIs. As abundance increased, the PSC Chinook model tended to lag behind and under-forecast the AIs and as the abundance fell the model would lag behind and over-forecast the AIs. However, by the early 2000s, the PSC model started to display the curious behavior of consistently over-forecasting the AIs preseason regardless of whether abundance was rising or falling in the fisheries. Several years ago, an analysis was implemented to identify why the CTC model was biased and was chronically over-forecasting preseason AIs. Obviously the AWG and CTC could only address biases that resulted from model algorithms as opposed to errors introduced into the PSC model due to inaccurate or biased forecasts provided by the agencies. The analysis determined that there were two identified sources of bias in the model that resulted in over-forecasting of the AIs. The most significant source of bias was the use of age-specific long-term average maturation rates that were assumed as future maturation rates for incomplete broods for a number of stocks in the PSC model. The analysis revealed that maturation rates for a number of stocks were changing in recent years and that the age composition of the terminal runs for these stocks was shifting to younger ages at return. The effect of using long-term average maturation rates was to assume higher proportions of older fish that are more vulnerable to the fisheries in the current and projected years and that then led to the PSC model overestimations of the available abundance. The analysis conducted at the time, found that use of the recent 5-year average maturation rate was the most effective, of other options considered at the time, in reducing the bias in the projected AIs. The less significant source of bias was the use of 5-year average EVs (environment/survival scalars that scale the recruits in the model production functions). Based on the analysis, the CTC decided that a shorter average was a better assumption concerning the EVs and the CTC decided to just use the last available. In summary, the CTC decided to use recent 5-year average maturation rates and the most recent one-year EV as assumptions for input into the PSC Chinook model as a means of reducing bias in forecasting AIs instead of the assumption approaches used prior to the analysis.

However, the use of the recent 5-year average maturation rates, and the one-year EVs as assumptions in the PSC Chinook model, may be causing negative bias in the AIs from this year's calibration (CLB1503). Examination of the maturation rates from the ERA analysis that are currently being used as input to the PSC Chinook model for the Columbia Upriver Bright stock reveals the maturation rates by age provided in Table B.1.

Three of the five values (2007, 2008, and 2010) included in the most recent 5-year average are some of the highest maturation rates ever observed for age-2 URB Chinook salmon and these three high values are significantly raising the average value being used for the current and projected year. Such would not be a problem if the maturation rate was really staying that high.

However, there is scientific evidence from the existing data that they are not staying that high. The most recent 2011 age-2 value is 0.0444 (the blue shaded value) and we do have values from incomplete broods in the ERA analysis which are not used because they are missing two or three older ages. That said, they do provide compelling scientific evidence of what is happening with the age-2 maturation rates. The 2012 age 2 maturation rate from the ERA analysis is 0.0481 (BY 2010 which is missing age 5). Because this value is from an incomplete brood it is not completely accurate but it does provide evidence that the most recent maturation rates for age 2 are likely lower than the 5-year average of 0.0737 that is currently being used.

In an effort to examine what effect lowering the age 2 maturation rate would have on the calibration, the 5-year average maturation rates were replaced with the most recently available maturation rate for all stocks and ages in the MATAEQ file that is read into the model (for age 2 URBs this would be the value highlighted in blue in Table B.1). The effects on the calibration were dramatic. The 2014 postseason AI for SEAK rose from 2.13 to 2.26 and the 2015 preseason AI for SEAK rose from 1.45 to 1.60.

This rise in the AIs is most certainly the result of shifting the projected return toward older ages which is very likely given the existing scientific evidence of smaller age-2 maturation rate values, at least for URBs. This is likely part of the reason behind the counterintuitive AIs, given the high abundance and high catch rates that were observed in the 2015 SEAK winter troll fishery.

**Conclusions and Recommendations:**

1. *Calibration 1503 maturation rates for URBs are too high.*
2. *Replace URB age-2 assumed maturation rates with last observed value as input to the CTC model.*
3. *Research assumed maturation rates used for other driver stocks important to AABM fisheries and make appropriate changes to model input.*

*Table B.1. – Maturation rates used or assumed for the URB stock in calibration 1503 of the CTC model.*

*Note: Age-2 rates in the box for brood years 2007–2011 (within the box average 0.0737), the values listed for subsequent years highlighted in green. Age-2 maturation rates for the years 2007, 2008, and 2010 (highlighted in yellow) are among the largest values in the time series and the age-2 value of 0.0444 for the most recently measured value in 2012 (highlighted in blue) is about one half of the recent 5-year average.*

| | | Maturation Rates | | | |
|---|---|---|---|---|---|
| Year | Stock | Age 2 | Age 3 | Age 4 | Age 5 |
| 1979 | URB | 0.0563 | 0.0563 | 0.5304 | 1 |
| 1980 | URB | 0.0302 | 0.1877 | 0.3848 | 1 |
| 1981 | URB | 0.0496 | 0.2074 | 0.7690 | 1 |
| 1982 | URB | 0.0446 | 0.3678 | 0.8407 | 1 |
| 1983 | URB | 0.0171 | 0.1057 | 0.6021 | 1 |
| 1984 | URB | 0.0576 | 0.1862 | 0.4634 | 1 |
| 1985 | URB | 0.0776 | 0.1863 | 0.6507 | 1 |
| 1986 | URB | 0.0851 | 0.1606 | 0.6127 | 1 |
| 1987 | URB | 0.0119 | 0.1674 | 0.5753 | 1 |
| 1988 | URB | 0.0968 | 0.1135 | 0.6069 | 1 |
| 1989 | URB | 0.1300 | 0.1544 | 0.4022 | 1 |
| 1990 | URB | 0.0268 | 0.1355 | 0.5327 | 1 |
| 1991 | URB | 0.0414 | 0.1237 | 0.7526 | 1 |
| 1992 | URB | 0.0210 | 0.1414 | 0.4770 | 1 |
| 1993 | URB | 0.0338 | 0.0839 | 0.3757 | 1 |
| 1994 | URB | 0.0321 | 0.0402 | 0.5306 | 1 |
| 1995 | URB | 0.0377 | 0.2385 | 0.3829 | 1 |
| 1996 | URB | 0.0279 | 0.2507 | 0.6941 | 1 |
| 1997 | URB | 0.0125 | 0.2067 | 0.7146 | 1 |
| 1998 | URB | 0.0410 | 0.1356 | 0.5526 | 1 |
| 1999 | URB | 0.0196 | 0.2666 | 0.5853 | 1 |
| 2000 | URB | 0.0040 | 0.0664 | 0.7683 | 1 |
| 2001 | URB | 0.0229 | 0.1964 | 0.7781 | 1 |
| 2002 | URB | 0.0270 | 0.1460 | 0.5175 | 1 |
| 2003 | URB | 0.0113 | 0.1365 | 0.5680 | 1 |
| 2004 | URB | 0.0369 | 0.2160 | 0.4709 | 1 |
| 2005 | URB | 0.0296 | 0.2050 | 0.5451 | 1 |
| 2006 | URB | 0.0800 | 0.2723 | 0.8041 | 1 |
| 2007 | URB | 0.0708 | 0.1921 | 0.7480 | 1 |
| 2008 | URB | 0.1131 | 0.2882 | 0.7410 | 1 |
| 2009 | URB | 0.0429 | 0.1485 | 0.7705 | 1 |
| 2010 | URB | 0.0973 | 0.2741 | 0.5599 | 1 |
| 2011 | URB | 0.0444 | 0.4015 | 0.7889 | 1 |
| 2012 | URB | 0.0737 | 0.1826 | 0.8392 | 1 |
| 2013 | URB | 0.0737 | 0.259 | 0.7399 | 1 |
| 2014 | URB | 0.0737 | 0.259 | 0.7397 | 1 |
| 2015 | URB | 0.0737 | 0.259 | 0.7397 | 1 |
| 2016 | URB | 0.0737 | 0.259 | 0.7397 | 1 |

## B.2 Examination of stock and brood year specific environmental variable scalars

The PSC Chinook model calibration procedure fits the model estimated stock and brood-year-specific terminal-run sizes or escapements to the corresponding empirical estimates of terminal-run sizes or escapements that are external model inputs. This is accomplished through the use of stock- and brood-specific environmental variable (EV) scalars. EV scalars adjust the stock- and brood-specific age-1 abundances produced by the stock-specific spawner-recruit functions and can be thought of as survival scalars. However, EVs also adjust for biases resulting from errors in the data or assumptions used to estimate the stock-specific spawner-recruit parameters. Future EVs are estimated for incomplete broods using the EV from the most recent available incomplete brood that has available data. The most recent available incomplete brood year used in the 2015 model calibration is stock-specific and is either an EV from 2011 or 2012 depending on whether the max age for the associated stock is age-6 or age-5. The EV estimates for subsequent calibrations will remain in flux until broods are complete.

If the assumptions are met, EVs are designed to address year-to-year environmental variation and can be correlated with marine survival or alternate mortality related variables. However, large fluctuations in annual EVs from incomplete broods could indicate two problems: 1) the model maturation rates are incorrect and/or 2) the terminal run or escapement forecasts are incorrect. If the maturation rates are incorrect, the model will be allocating the stock-specific production across ages incorrectly and correspondingly result in an inappropriately large or small EV for a particular brood. If terminal run or escapement forecasts in the FCS file are incorrect, the EVs will be biased because the model treats these forecasts as observed data and calibrates to these values. Comparing the EVs from CLB1402 and CLB1503 shows large fluctuations in incomplete broods (Table B.2 and B.3).

The EV and maturation rate averages used in model projections were changed starting with the 2013 calibration to address concerns that the model was constantly over-forecasting. Since then, the largest deviations between pre- and postseason abundance indices have been observed. Due to this change in model inputs for maturation rates and EVs, the following recommendation was made in TCChinook (14)-01 (page 93): "*Given this departure from previous preseason calibrations, the AWG will continue to monitor the influence of EV and maturation assumptions on AI projections.*" The AWG has not performed extensive evaluations of the influence of EV and maturation rates on AI projections for calibrations 1402 and 1503. However, Excel workbooks showing relative deviations between brood-year specific EVs in each of the yearly calibrations have been produced to facilitate visual and quantitative comparisons of the EVs between calibrations. A comparison of EVs used in calibrations 1402 and 1503 is provided in this document.

In Table B.3, note that for 22 (73%) of the 30 model stocks, the EVs used for CLB 1503 decreased from the EVs used for CLB 1402 for brood year 2010 (5-year olds) and also decreased for 23 (77%) of the 30 model stocks for brood year 2011 (4-year olds). Several of the reductions are very large (>50% decrease). The predominantly negative drop in EVs significantly reduces abundance of Chinook salmon included in the model based on single year observations and is likely partially responsible for the large variations between preseason and postseason indices observed since

2013.

**Conclusions and Recommendations:**

1. *Use a 2-year average EVs for incomplete broods (5-year average EVs were used prior to 2013) instead of relying on the most recent incomplete brood; or*
2. *Revert back to the methods used prior to 2013; or*
3. *Update the 2013 analysis that led to the change in EV assumptions and select appropriate statistic.*

*Table B.2– Environmental variable (EV) scalars from PSC Chinook model calibrations CLB1503 and CLB1402.*

| | CLB1503 EVs | | | | | | | | CLB1402 EVs | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model Stock | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Alaska South SE | 1.1 | 1.2 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 1.0 | 0.8 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| North/Centr | 0.9 | 1.0 | 0.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 0.9 | 1.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Fraser Early | 0.6 | 0.7 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.6 | 0.7 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Fraser Late | 1.3 | 1.1 | 2.8 | 2.4 | 0.7 | 0.7 | 0.7 | 0.7 | 1.3 | 1.0 | 2.9 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| WCVI Hatchery | 0.3 | 0.4 | 0.8 | 0.1 | 0.6 | 0.6 | 0.6 | 0.6 | 0.3 | 0.4 | 1.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| WCVI Natural | 0.3 | 0.4 | 0.8 | 0.1 | 0.6 | 0.6 | 0.6 | 0.6 | 0.3 | 0.4 | 1.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Georgia St. Upper | 0.9 | 0.9 | 0.8 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.0 | 0.9 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| Georgia St. Lwr Nat | 0.5 | 0.3 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.4 | 0.3 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Georgia St. Lwr Hat | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Nooksack Fall | 0.7 | 0.7 | 0.6 | 0.7 | 0.9 | 0.9 | 0.9 | 0.9 | 0.7 | 0.7 | 0.7 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Pgt Sd Fing | 0.5 | 0.5 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Pgt Sd NatF | 0.3 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Pgt Sd Year | 0.5 | 0.5 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| Nooksack Spring | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Skagit Wild | 0.8 | 0.8 | 0.7 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| Stillaguamish Wild | 0.6 | 0.5 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.6 | 0.6 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Snohomish Wild | 0.2 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| WA Coastal Hat | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| UpRiver Brights | 2.8 | 7.4 | 15.6 | 4.9 | 7.4 | 7.4 | 7.4 | 7.4 | 2.8 | 8.4 | 17.4 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |
| Spring Creek Hat | 0.5 | 0.5 | 0.7 | 1.2 | 1.4 | 1.4 | 1.4 | 1.4 | 0.5 | 0.5 | 0.7 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lwr Bonneville Hat | 0.2 | 0.4 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Fall Cowlitz Hat | 2.4 | 3.0 | 3.9 | 2.5 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 3.0 | 4.1 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Lewis R Wild | 0.8 | 1.0 | 2.4 | 1.2 | 3.0 | 3.0 | 3.0 | 3.0 | 0.8 | 1.3 | 3.3 | 4.6 | 4.6 | 4.6 | 4.6 | 4.6 |
| Willamette R | 10.2 | 7.6 | 5.6 | 6.8 | 6.3 | 6.3 | 6.3 | 6.3 | 10.0 | 7.1 | 6.8 | 6.4 | 6.4 | 6.4 | 6.4 | 6.4 |
| Spr Cowlitz Hat | 0.3 | 0.8 | 0.4 | 0.7 | 0.9 | 0.9 | 0.9 | 0.9 | 0.3 | 0.8 | 0.4 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Col R Summer | 1.5 | 1.5 | 2.0 | 2.4 | 2.5 | 2.5 | 2.5 | 2.5 | 1.4 | 1.4 | 1.6 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| Oregon Coast | 0.8 | 1.0 | 0.9 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.9 | 1.1 | 0.7 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| WA Coastal Wild | 0.6 | 0.6 | 0.6 | 0.8 | 1.1 | 1.1 | 1.1 | 1.1 | 0.6 | 0.7 | 0.7 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Lyons Ferry | 4.7 | 5.8 | 5.6 | 5.4 | 5.4 | 5.4 | 5.4 | 5.4 | 3.3 | 4.8 | 6.8 | 10.2 | 10.2 | 10.2 | 10.2 | 10.2 |
| Mid Col R Brights | 0.2 | 0.8 | 1.4 | 0.4 | 0.5 | 0.5 | 0.5 | 0.5 | 0.2 | 0.8 | 2.3 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |

*Table B.3– Comparison, in terms of percent difference, of the environmental variable (EV) scalars from PSC Chinook model calibrations CLB1503 and CLB1402; positive values indicate the EV from CLB1503 is higher than the EV from CLB1402 and similarly negative values indicate the EV from CLB1402 is higher.*

| | $(EV_{CLB1503} – EV_{CLB1402})/EV_{CLB1503}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Model Stock | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Alaska South SE | 4.2% | 30.6% | 47.8% | 39.0% | 39.0% | 39.0% | 39.0% | 39.0% |
| North/Centr | 2.1% | -0.5% | -0.4% | 11.7% | 11.7% | 11.7% | 11.7% | 11.7% |
| Fraser Early | -0.8% | -0.4% | -9.5% | -2.3% | -2.3% | -2.3% | -2.3% | -2.3% |
| Fraser Late | 1.0% | 2.8% | -4.6% | -10.0% | -259.7% | -259.7% | -259.7% | -259.7% |
| WCVI Hatchery | 5.6% | -13.7% | -36.4% | -35.7% | 68.9% | 68.9% | 68.9% | 68.9% |
| WCVI Natural | 5.6% | -13.7% | -36.4% | -35.7% | 68.9% | 68.9% | 68.9% | 68.9% |
| Georgia St. Upper | -6.9% | -3.2% | -102.5% | -10.1% | -10.1% | -10.1% | -10.1% | -10.1% |
| Georgia St. Lwr Nat | 2.7% | 5.0% | -63.9% | -7.5% | -7.5% | -7.5% | -7.5% | -7.5% |
| Georgia St. Lwr Hat | 10.5% | 16.1% | 30.9% | 72.3% | 72.3% | 72.3% | 72.3% | 72.3% |
| Nooksack Fall | 1.0% | 1.2% | -22.6% | -44.0% | -9.2% | -9.2% | -9.2% | -9.2% |
| Pgt Sd Fing | -2.6% | -4.5% | -49.8% | -77.7% | -41.2% | -41.2% | -41.2% | -41.2% |
| Pgt Sd NatF | 7.5% | 26.8% | -0.2% | -43.2% | -38.6% | -38.6% | -38.6% | -38.6% |
| Pgt Sd Year | -2.6% | -4.5% | -49.8% | -77.7% | -41.2% | -41.2% | -41.2% | -41.2% |
| Nooksack Spring | 2.3% | 6.3% | 5.8% | -4.6% | 8.1% | 8.1% | 8.1% | 8.1% |
| Skagit Wild | 0.9% | -8.4% | -30.7% | -65.1% | -65.1% | -65.1% | -65.1% | -65.1% |
| Stillaguamish Wild | -0.3% | -22.2% | -70.5% | -76.4% | -70.0% | -70.0% | -70.0% | -70.0% |
| Snohomish Wild | 20.5% | 11.2% | -13.6% | -0.4% | 10.6% | 10.6% | 10.6% | 10.6% |
| WA Coastal Hat | 1.8% | 3.5% | -0.6% | -13.7% | -10.1% | -10.1% | -10.1% | -10.1% |
| UpRiver Brights | 2.0% | -13.6% | -11.8% | -33.2% | 12.6% | 12.6% | 12.6% | 12.6% |
| Spring Creek Hat | 1.0% | 2.3% | 6.2% | 19.3% | 26.6% | 26.6% | 26.6% | 26.6% |
| Lwr Bonneville Hat | 37.0% | 31.4% | 56.0% | 48.1% | 27.9% | 27.9% | 27.9% | 27.9% |
| Fall Cowlitz Hat | 1.1% | 2.3% | -5.9% | -7.8% | -9.6% | -9.6% | -9.6% | -9.6% |
| Lewis R Wild | 7.8% | -33.1% | -35.0% | -296.5% | -55.7% | -55.7% | -55.7% | -55.7% |
| Willamette R | 2.0% | 6.5% | -21.8% | 5.4% | -2.9% | -2.9% | -2.9% | -2.9% |
| Spr Cowlitz Hat | 0.9% | 0.7% | 3.1% | 22.7% | 40.2% | 40.2% | 40.2% | 40.2% |
| Col R Summer | 8.3% | 10.4% | 17.3% | -2.4% | 3.6% | 3.6% | 3.6% | 3.6% |
| Oregon Coast | -6.7% | -8.7% | 24.8% | 27.5% | -25.0% | -25.0% | -25.0% | -25.0% |
| WA Coastal Wild | 1.3% | -8.5% | -16.1% | -19.7% | 12.8% | 12.8% | 12.8% | 12.8% |
| Lyons Ferry | 28.5% | 17.1% | -21.1% | -90.5% | -90.5% | -90.5% | -90.5% | -90.5% |
| Mid Col R Brights | 4.6% | -5.9% | -65.0% | -205.3% | -135.6% | -135.6% | -135.6% | -135.6% |

# APPENDIX C–EVALUATION OF MODEL INPUTS

## C.1 Evaluation of 2015 forecasts of URBs and MCBs

The Brood Year (BY) Model uses sibling relationships to predict age-5 abundance from estimated return-at-age for age-2, age-3, and age-4 fish from the same BY[2]. Similarly, the BY Model predicts age-4 abundance from estimated return-at-age for age-2 and age-3 fish. This method takes advantage of overall BY strength instead of performing straight sibling regressions of one age to another, which are highly sensitive to maturation rates. Because maturation rates are showing higher variability in numerous stocks over the past decade, in particular, the BY Model is particularly appropriate because it reduces forecast error introduced from maturation rate variability.

The methodology includes using estimated returns from BY2010 age-2, age-3, and age-4 fish to predict age-5 returns in 2015. Total return for combined ages (2–4) is used to create a normal distribution based on the estimate and its standard error. This distribution is then sampled randomly with 1,000 replications to produce a set of total BY return values. This table of values is then applied to every combination of BY returns-at-age for the past 10 years, which produces a set of 100,000 possible age-5 estimates. These estimates are averaged and the standard error is calculated from the distribution to forecast the age-5 component of the return in 2015. Similar methods are used for the age-4 component as well as age-3 and age-6 components where appropriate.

Regarding the 2015 age-5 forecast of BY2010 Chinook salmon, variance in the combined age 2-4 return estimates will influence the amount of variance in the age-5 forecast, as the sample distribution is based on the amount of variance used as an input.

The BY Model utilizes the strength of BY2010, which has been above average for each age class at every return age. Using a 5-year average of age 4/5 ratios to forecast the age-5 URB abundance, for example (the TAC 2015 approach), does not take into account the overall strength of the age class. For a weaker age class, it would overestimate the strength of the age class; on the other hand, as with BY2010, the simple 5-year average would underestimate the strength of the age class. Recent age 4/5 ratios have been abnormally high and contrast sharply with the long term data series, which can create a large amount of forecasting error.

Forecasts made with the BY Model are higher than the TAC forecasts for all ages, with discrepancies the greatest for age-5 URBs (99% higher) and age-3 MCBs (64% higher; Table C.1). Overall forecast abundance of these two stock groups was 38% higher for the BY Model and much more in line with recent observations of a strong age-5 component of these stock groups in the SEAK winter troll fishery. The BY Model is a more appropriate choice of forecasting technique than those used by the TAC, especially when maturation rates and brood year strengths are variable over time.

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[2] Bernard, D. R., and E. L. Jones III. 2014. Forecasting annual run size of Chinook salmon to the Taku River of Alaska and Canada. Alaska Department of Fish and Game, Fishery Manuscript No. 14-08, Anchorage.

*Table C.1.–Columbia River URB and MCB stock groups: U.S. v Oregon TAC forecast vs BY Model.*

| | URB | | | MCB | | | URB+MCB | | |
|---|---|---|---|---|---|---|---|---|---|
| Age | TAC | BY Model | SE (BY) | TAC | BY Model | SE (BY) | TAC | BY Model | SE (BY) |
| 3 | 195.4 | 197.9 | 80.4 | 20.1 | 32.9 | 18.4 | 215.5 | 230.8 | 82.5 |
| 4 | 174.8 | 219.0 | 65.1 | 41.0 | 55.9 | 16.1 | 215.8 | 274.8 | 67.1 |
| 5 | 129.8 | 258.0 | 104.3 | 52.0 | 76.5 | 28.8 | 181.8 | 334.4 | 108.2 |
| 6 | 0.3 | 3.7 | 3.7 | 0.2 | 1.0 | 0.5 | 0.5 | 4.7 | 3.7 |
| Total | 500.3 | 678.6[1] | 131.0 | 113.3 | 166.2[2] | 32.9 | 613.6 | 844.8 | 135.1 |

[1] The BY Model URB forecast has a 0.91 probability of exceeding the TAC forecast

[2] The BY Model MCB forecast has a 0.95 probability of exceeding the TAC forecast

**Conclusions and Recommendations**

1. *2015 forecasts of URBs and MCBs are too low.*
2. *Replace 2015 URB and MCB model inputs with those identified herein or to alternate values that are consistent with statistically valid sibling relationships associated with this stock complex. Standard errors, and confidence or prediction intervals should be made available for these forecasts as measures of uncertainty.*
3. *Investigate data inputs and methods of forecasting abundances of these stocks using run reconstructions that include harvests from ocean fisheries beyond the mouth of the Columbia River.*

## C.2 Evaluation of 2015 forecast for WCVI

A review of CLB1503 of the PSC Chinook Model input revealed that the 2015 forecast for WCVI for age-4 fish is lower than expected (less than 13,000 fish) considering the age-3 production seen the year prior. Terminal run data by age for the WCVI stock since 1979 along with the 2015 WCVI forecast included in CLB1503 is provided in Table C.1.

The age-4 forecast of less than 13,000 fish seems low, given the apparent age-3 return from this brood year in 2014 that is defined in the PSC Chinook model as 17,546 fish. Figure C.1 provides a plot of age-3 through age-5 returns of WCVI Chinook salmon for brood years with data. On average, age-3 fish have represented 28% of the brood year return, age-4 fish have represented 52% of the brood year return, and age-5 fish have represented 20% of the brood year return. If the forecast is correct, the ratio of age -3 fish to age-4 fish for brood year 2011 would be 1.36. An examination of the ratios of age-3 to age-4 fish by brood year for the 35 years of complete data reveal that such a high ratio has never been observed; indeed, equal or less age-4 fish as compared to age-3 fish (or a ratio of age-3 to age-4 fish equal or greater than 1.0) has only occurred 4 times for these brood year returns of WCVI Chinook salmon.

*Table C.2.– Terminal runs of WCVI origin Chinook salmon by age per the CTC Model. Note: data listed for 2015 are a forecast and is highlighted in yellow.*

| Year | Age 3 | Age 4 | Age 5 | | Year | Age 3 | Age 4 | Age 5 |
|---|---|---|---|---|---|---|---|---|
| 1979 | 84,312 | 16,729 | 6,399 | | 1998 | 8,872 | 148,202 | 37,996 |
| 1980 | 27,138 | 61,633 | 2,291 | | 1999 | 7,293 | 32,481 | 65,628 |
| 1981 | 64,197 | 23,531 | 10,136 | | 2000 | 3,934 | 21,513 | 13,780 |
| 1982 | 67,414 | 72,313 | 10,815 | | 2001 | 59,400 | 19,019 | 10,790 |
| 1983 | 35,899 | 83,384 | 32,634 | | 2002 | 47,607 | 114,201 | 5,740 |
| 1984 | 29,041 | 100,567 | 26,193 | | 2003 | 43,887 | 135,766 | 38,009 |
| 1985 | 66,208 | 57,661 | 13,962 | | 2004 | 108,071 | 84,260 | 69,496 |
| 1986 | 4,076 | 61,190 | 11,135 | | 2005 | 29,385 | 107,578 | 20,943 |
| 1987 | 78,863 | 9,970 | 8,858 | | 2006 | 76,354 | 89,271 | 32,241 |
| 1988 | 32,630 | 102,842 | 10,706 | | 2007 | 7,337 | 98,207 | 15,688 |
| 1989 | 76,029 | 68,883 | 37,043 | | 2008 | 40,174 | 24.719 | 34,432 |
| 1990 | 78,636 | 108,625 | 33,096 | | 2009 | 25,075 | 53,736 | 14,133 |
| 1991 | 74,017 | 146,369 | 81,742 | | 2010 | 58,577 | 28,844 | 7,945 |
| 1992 | 70,990 | 140,936 | 76,824 | | 2011 | 16,073 | 139,226 | 7,793 |
| 1993 | 47,341 | 155,908 | 68,720 | | 2012 | 14,668 | 38,165 | 29,298 |
| 1994 | 5,904 | 110,360 | 64,372 | | 2013 | 83,046 | 74,962 | 23,130 |
| 1995 | 3,127 | 22,712 | 68,011 | | 2014 | 17,546 | 92,350 | 10,577 |
| 1996 | 58,827 | 22,681 | 24,266 | | | | | |
| 1997 | 54,497 | 86,191 | 6,609 | | 2015 | 43,624 | 12,921 | 48,458 |

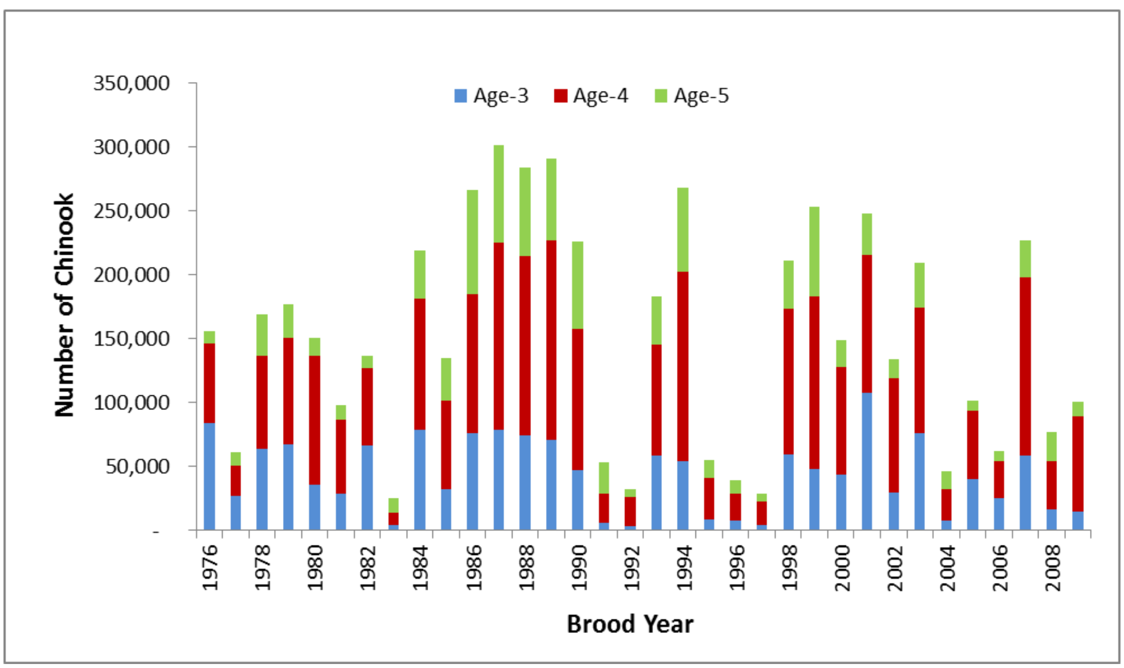


*Figure C.1.– Terminal returns by age for WCVI Chinook salmon for brood year returns 1976–2009.*

Because it seems unlikely that the age- 4 return of WCVI Chinook salmon would be outside of levels observed in 35 years of prior observations, given age-3 returns, sibling relationships using model data since 1979 were examined. Figures C.2 and C.3 provide plots of such relationships.

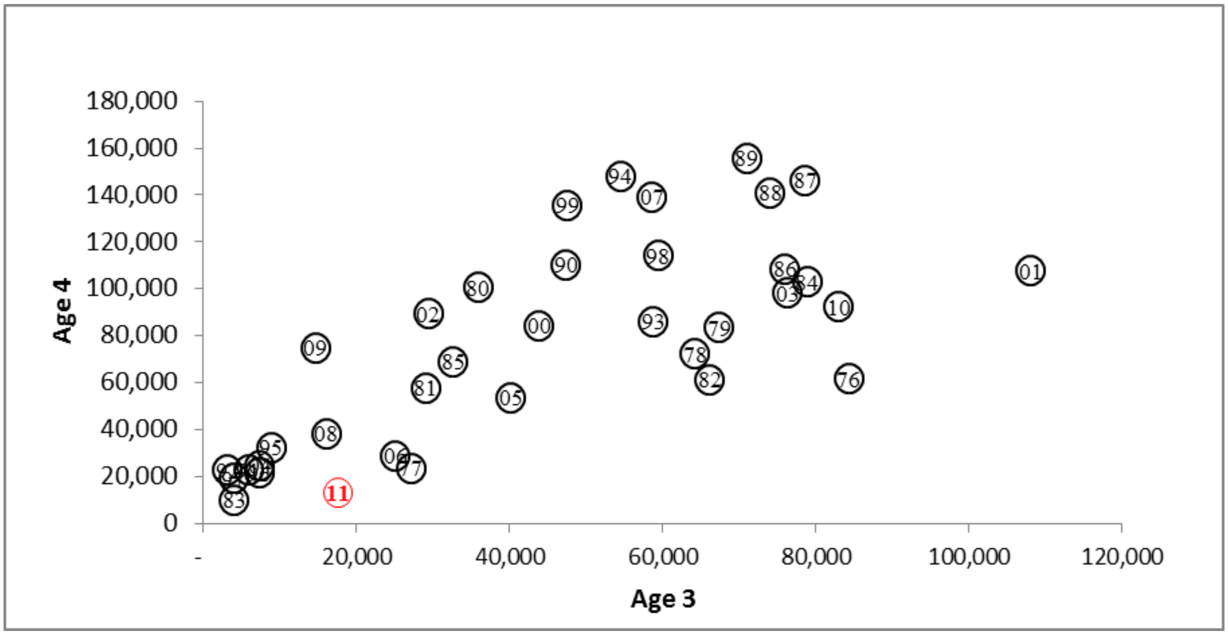


*Figure C.2.– WCVI Chinook salmon age-3 to age-4 sibling relationship. Calibration 1503 data for BY 2011 are shown in red.*

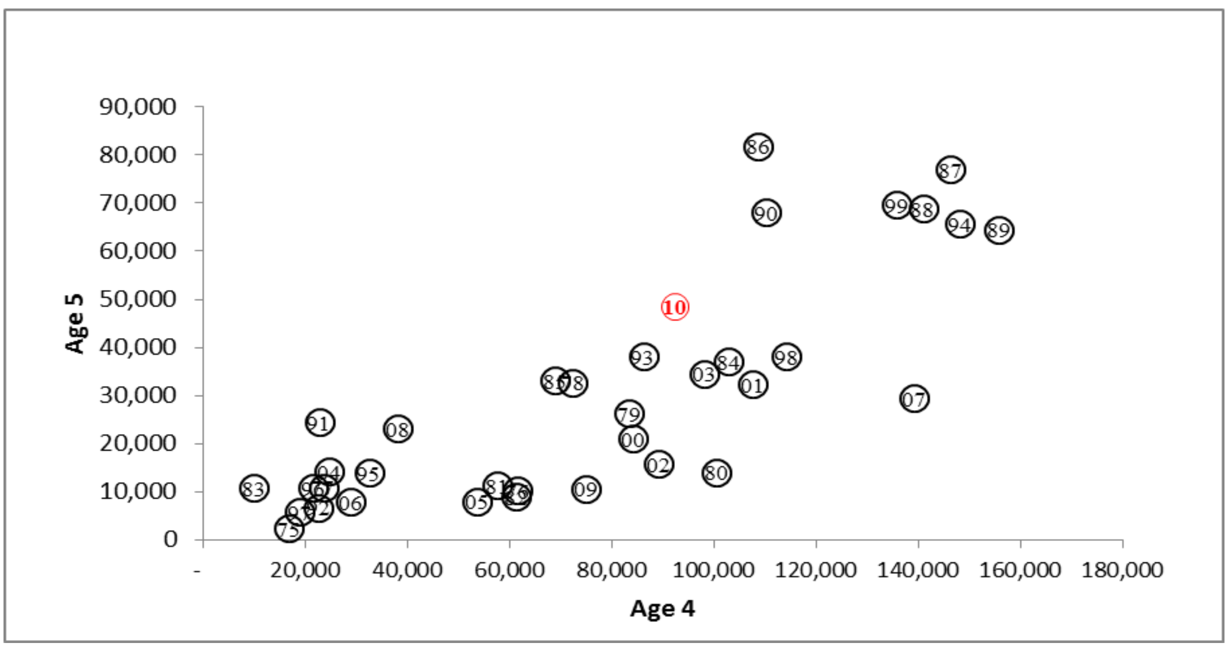


*Figure C.3.– WCVI Chinook salmon age-4 to age-5 sibling relationship. Calibration 1503 data for BY 2010 are shown in red.*

These two sibling relationships were analyzed with regression to determine if they might be useful for developing alternate forecasts of age-4 and age-5 WCVI Chinook salmon in 2015. Both relationships were very strong with the age-3 to age-4 sibling relationship having an $r^2$ of 53% and the age-4 to age-5 sibling relationship having an $r^2$ of 65%. Use of these relationships with the CLB 1503 values for age-3 and age-4 fish in 2014 provided forecasts for age-4 and age-5 fish of 48,011 and 36,218 Chinook salmon, respectively. A comparison of the WCVI 2015 forecast input to CLB1503 versus use of sibling relationships using model data is provided in Table C.3.

*Table C.3.– Comparison of WCVI forecast used as input to calibration 1503 versus use of the cohort data included in the PSC Chinook model to forecast the 2015 return using sibling relationships.*

| Age | Forecast Input into 1503 | Forecast Using Model Cohort Data | Difference (numbers) | Difference (percent) |
|---|---|---|---|---|
| Age-3 | 43,624 | 43,624 | - | - |
| Age-4 | 12,921 | 48,011 | 35,090 | 272% |
| Age-5 | 48,458 | 36,218 | (12,240) | -25% |
| Total | 105,003 | 127,852 | 22,849 | 22% |

Two alternate forecasts for WCVI Chinook salmon returns were produced using the newly developed AWG forecasting tool– the ARIMA and exponential smoothing modules of ForecastR. And, on April 17th, Diana Dobson provided four alternative WCVI forecasts. None of the six match the input used in CLB1503 (Table C.4).

*Table C.4.– Summary of various WCVI Chinook salmon forecasts by age for 2015.*

| WCVI Forecast | Basis | Age-3 | Age-4 | Age-5 | Total |
|---|---|---|---|---|---|
| Calibration 1503 | Unknown | 43,624 | 12,921 | 48,458 | 105,003 |
| Dobson A | Recent Maturation Rate | 52,381 | 13,120 | 26,933 | 92,435 |
| Dobson B | Alternate Maturation Rate | 68,053 | 14,910 | 26,933 | 109,897 |
| Dobson C | Stock Specific | 53,905 | 18,858 | 32,285 | 105,048 |
| Dobson D | Stock Specific with Landed Catch | 55,142 | 19,676 | 32,174 | 106,992 |
| ForecastR | ARIMA | 44,623 | 78,236 | 19,388 | 142,247 |
| ForecastR | Exponential Smoothing | 48,962 | 78,233 | 15,528 | 142,723 |
| Herein | Sibling Models | 43,624 | 48,011 | 36,218 | 127,853 |

A comparison of these various forecasts reveals that the age-3 forecast associated with CLB1503 is the lowest value (Table C.4). Any of the alternate age-3 values from Table C.4 substituted in for the age-3 value from CLB 1503 in the sibling approach developed above would increase the total WCVI forecast described in Table C.3. The age-4 forecast associated with CLB1503 is also the lowest value of any of the 2015 age-4 forecasts. Forecasts provided by Diana Dobson indicate anywhere from 1 to 7 thousand more age-4 fish are expected to return while the forecasts made with ForecastR indicate an additional 65,000 age-4 fish are expected to return. Lastly, the age-5 forecast associated with CLB1503 indicates a higher number than any of the other forecasts. In summary, all of the CLB1503 age-specific forecasts for WCVI in 2015 are outside the ranges associated with any of the alternate forecasts and it seems that more age-3 fish, more age-4 fish, and less age-5 fish are the likely end results for 2015 than is the case for the numbers used as input into the calibration.

**Conclusions and Recommendations:**

1. *2015 forecast for WCVI is too low and is inconsistent with available information*
2. *Replace 2015 WCVI age-4 and age-5 model input to alternate inputs such as those identified herein or to alternate values that are consistent with statistically valid sibling relationships associated with the WCVI stock complex. Provide plots of the sibling relationships used along with diagnostic statistics. Standard errors and confidence or prediction intervals should be made available for these forecasts as measures of uncertainty.*
3. *Research and review methodology associated with the age-3 WCVI 2015 forecast that is being used as model input; ensure the age-3 input is scientifically justified. Standard errors and confidence or prediction intervals should be made available for the age-3 forecasts as a measure of uncertainty.*

# APPENDIX D-VALIDATION OF POSTSEASON AI

## D.1 Comparison of PSC Chinook model and genetic stock composition of the SEAK troll fishery

As a means to validate the PSC Chinook Model, we compared the stock composition of the SEAK troll fishery based on genetic estimates from fishery sampling to the PSC Chinook model estimates for the same fishery (Figure D.1, Table D.1). Because both the genetics baseline and the PSC Chinook model both changed after 2009, the estimates provided herein are from fishery accounting years 2010 to 2014. Model estimates provided herein are from each year's postseason model calibration and the preseason model calibration for 2015 (CLB1106, CLB1209, CLB1309, CLB1402, CLB1503).

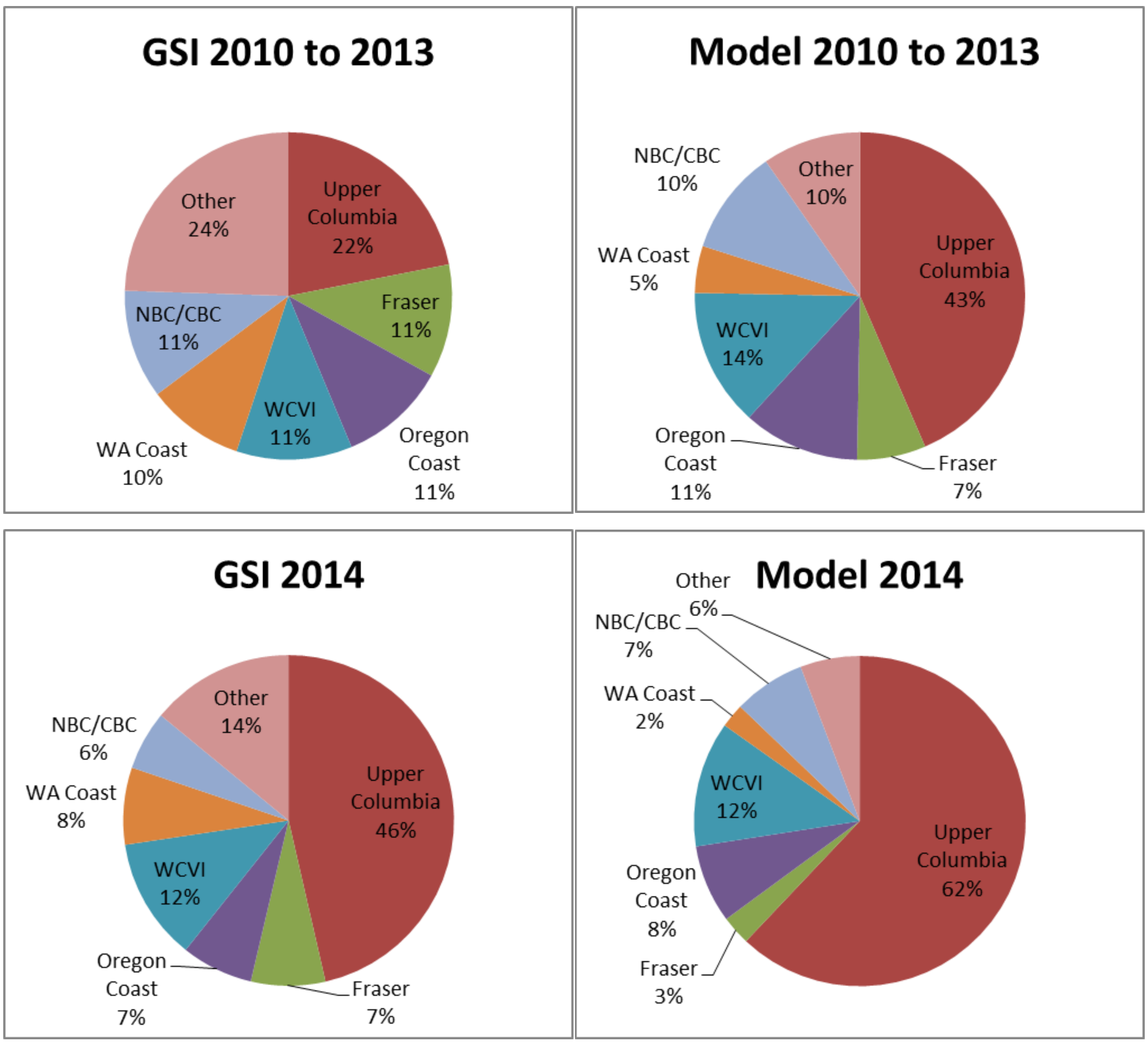


*Figure D.1.– Comparisons of model-generated and genetic analysis stock composition in the SEAK troll fishery, 2014 and the 2010–2013 average.*

Based on genetic stock composition estimates from direct sampling of the SEAK troll fishery, the proportion of Upper Columbia stocks have increased in recent years from 16.7% in 2010 to 46.4% in 2014 (Table D.1). For this analysis, the Upper Columbia stock group includes mid-Columbia Brights (MCBs), Upriver Brights (URBs), Summers, and Snake River Falls, with the URBs and MCBs making up the vast majority of this stock group. The large proportion of Upper Columbia fish in 2014, also evident in the NBC troll catch composition, is highly unusual. However, compared to the genetic stock composition estimates, the PSC Chinook Model has over-estimated the contribution of the Upper Columbia stock aggregate every year ranging from 15.6% in 2014 to 25.0% in 2010 with a recent 5-year average of 21%. Similarly, but not quite as pronounced, the model has comparatively underestimated Fraser stocks and "Other" stocks, with a recent 5-year average difference of -5.6% and -15.0%, respectively. The model also estimates lower contributions of WA Coast, with the recent 5-year average being half of the genetic estimates. This suggests that the PSC Chinook Model might be highly sensitive to forecasts of Upper Columbia stocks, particularly in SEAK and NBC where fish from the Upper Columbia comprise a large proportion of the model catch.

These differences between the stock composition from the model and the true stock composition from fishery sampling, especially with regards to Upper Columbia fish, indicate that the model is having problems that warrant a closer look at the model to explain this discrepancy.

**Conclusions and Recommendations:**

1. *The PSC Chinook model does not accurately portray SEAK troll fishery stock compositions.*
2. *The Upper Columbia comprises a large proportion of the AI and therefore the model and AIs are very sensitive to Columbia forecasts.*
3. *The model has been chronically over-estimating Upper Columbia contribution to the AI (compounding #2).*
4. *Examine why the PSC Chinook model over-estimates the abundance of Upper Columbia River stocks relative to other PSC model stocks. The estimated stock composition from PSC Chinook model may not represent the true stock composition for a number of reasons: 1) yearly catch estimates in the model are influenced by the base period stock composition; 2) changes in stock distribution over time; and 3) the 30 model stocks do not represent all production present. All three of these potential causes should be assessed.*

*Table D.1.– Comparison of stock composition from genetic analysis and PSC Chinook model for the SEAK troll fishery, 2010–2015.*[1]

| Stock | 2010[2] | | 2011[3] | | 2012[4] | | 2013[5] | | 2014[6] | | 2015[6] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Group | GSI | Model | GSI | Model | GSI | Model | GSI | Model | GSI | Model | Model |
| Upper Columbia | 16.7% | 40.4% | 16.7% | 41.7% | 21.2% | 40.0% | 27.8% | 52.1% | 46.4% | 62.0% | 57.4% |
| Fraser | 17.5% | 8.0% | 17.5% | 7.9% | 6.4% | 6.3% | 9.2% | 4.7% | 7.3% | 2.9% | 4.4% |
| Oregon Coast | 12.4% | 10.6% | 12.4% | 12.1% | 8.8% | 14.2% | 9.1% | 8.9% | 7.0% | 7.6% | 6.6% |
| WCVI | 9.4% | 10.2% | 9.4% | 16.4% | 10.9% | 14.8% | 11.9% | 12.9% | 12.0% | 12.3% | 8.1% |
| WA Coast | 10.2% | 4.5% | 10.2% | 4.7% | 11.8% | 5.7% | 4.9% | 3.7% | 7.5% | 2.3% | 3.9% |
| NBC/CBC | 8.3% | 13.2% | 8.3% | 9.1% | 10.8% | 9.6% | 13.2% | 9.7% | 5.8% | 7.0% | 9.7% |
| All Other | 25.6% | 13.2% | 25.6% | 8.0% | 30.0% | 9.3% | 24.0% | 8.1% | 14.0% | 5.8% | 9.9% |

[1]All model stock compositions are from postseason PSC Chinook Model calibrations except 2015 which is from a preseason projection.

[2]CLB1106

[3]CLB1209

[4]CLB1309

[5]CLB1402

[6]CLB1503

MEMORANDUM

| | |
|---|---|
| To: | Chinook Technical Committee |
| From: | Robert Kope, Gayle Brown, Ethan Clemons, Tim Dalton, Larrie LaVoy, Antonio Velez-Espino, Henry Yuen, Marianne McClure, Kristin Ryding, Chuck Parken, Rishi Sharma[1] Ivan Winther*, Teresa Ryan*, Dawn Lewis*, Sabrina Crowley*, Marianna Alexandersdottir* |
| Subject: | Review of CLB1503 |
| Date: | May 19, 2015 |
| cc: | |
| Attachments: | Appendix |

On April 21, the Alaskan members of the CTC presented the rest of the CTC with a memo detailing their concerns with Calibration #1503. These concerns stemmed from observations that in recent years there have been large discrepancies between the pre-season forecast AIs and the first post-season AIs in SEAK, and that the SEAK AI predicted for 2015 seemed low in light of observations from the 2014 SEAK fisheries, and in particular, the 2104-15 SEAK winter troll fishery. Four lines of evidence were presented to provide insight into the degraded performance and likely underestimation of the 2015 SEAK AI. We briefly address each of those lines of evidence, with supporting arguments and evidence presented in the appendix:

> *1. SEAK winter troll catches through mid-March were the highest on record and the winter season that normally extends through the end of April had reached its Guideline Harvest Range a full month earlier.*

We note that weather was particularly mild, and that effort in the fishery was also at a record high, which can explain both high catch rates and high catches. The unusually mild weather noted during the winter troll fishery coincided, and were undoubtedly associated with the exceptionally large scale ocean temperatures measured at well-above average levels throughout the North Pacific including the Gulf of Alaska.

> *2. There is strong long term linear relationship between the Sitka Sound winter troll CPUE and postseason AI. The Sitka Sound CPUE was very high in 2015, indicating that abundance is high and will be much higher than forecast in CLB1503.*

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[1] Denotes CTC members who support the recommendations but did not contribute substantively to the appendix.

While there is a significant correlation between the Sitka Sound winter troll CPUE and the post-season AI, many factors other than abundance affect CPUE. Such factors include, but are not limited to, fish availability, vulnerability to gear, weather, market conditions, regulations, fishing times and locations (e.g., seasonal - winter vs summer troll), the degree and nature of competition and cooperation among participants within and between sectors, and the composition and characteristics of the participating vessels, impacts of fleet rationalization/reduction on fisher skill levels, timing of fishery openings, sector allocations). Weather conditions were particularly mild in SEAK this past winter allowing fishermen more time on the water and access to locations they might have avoided in more extreme conditions. This would enable the ability to locate and to stay on concentrations of fish without having to spend much time searching.

> *3. CWT contributions of major drivers of abundance in the SEAK fishery were above average in the 2015 winter fishery indicating that the abundance of these stocks remains high. Columbia River Brights and Summers contributed double the 2010-2014 average to the 2015 SEAK winter troll fishery. Coded-wire tag recovery rates for these stock groupings were dominated by age-5 fish, providing evidence that the BY2010 year class remains strong through 2015. These contributions of age-5 fish cannot be due to fishery recruitment rates alone as age-4 Chinook salmon are almost completely recruited to this fishery.*

This is not surprising since Columbia River summer and bright fall stocks have been at record high abundance. The high abundance of summer Chinook CWTs is in part a result of the fact that much of the production is from hatcheries, and the hatchery fish are nearly all ad-clipped and CWTed. In the 2009 and 2010 broods more than 95% of the hatchery fish were tagged and a total of 7.5 million CWTs were released in the two years combined. We note that there is no correlation between the age-4/age-5 ratio on the SEAK winter troll fishery and the same ratio in the URB return to the river, and for Summer Chinook, the ratio is not meaningful because the run enters the river from mid-May to mid-July; the majority of age-5 Summer Chinook mature and spawn, and are no longer in SEAK by the time the summer fishery opens.

> *4. The continued high incidence of NO TAG fish in the SEAK winter fishery indicates continued strong year classes of the major mass marked stocks. Columbia River stocks provide the majority of these fish. While numbers of fish recovered that bear a CWT have remained relatively stable, the proportion of marked fish without CWTs (NO TAGS) in 2014 and 2015 are the highest ever observed in the SEAK winter fishery.*

The proportion of NO TAGS in the SEAK winter troll fishery appears to have remained relatively constant for the past 4 years, with the ratio in 2012 being higher than 2014 and 2015. This is consistent with continued high abundance of Columbia River bright fall stock which are forecast to have a return of 613.6 (URB and MCB combined) which would be the 3rd highest return ever observed, but does not argue for a high abundance of other stocks contributing to the SEAK winter troll fishery.

While the recent performance of the model and observations from the 2014-2015 SEAK winter troll fishery do indicate that investigation into model performance is warranted, such investigations should focus on exploring how modifications to the model would affect its overall performance, not on producing an outcome consistent with expectations in 2015. We do not believe that evidence presented warrants rejecting CLB1503, but support accepting CLB1503 and pursuing investigations into improving the model as time permits.

Appendix

Comments below are organized according to the Appendix and section of the Appendices to the Carlile, et. al. memo to the CTC dated April 21, 2015.

A. Empirical evidence that the 2015 preseason AI for SEAK is inaccurate

A.1. Review of PSC Chinook Model forecasting performance

Figure A-1 does not demonstrate any directional trend or bias, and shows that the SEAK AI has been overforecast in 7 of the last 10 years. We concur with (1), that there have been larger differences between pre-season and post-season AIs, and (3) this is worth investigating. The two largest differences occurred in the last two years, and this coincided with changes made to the calibration procedure (the use of 5 year average maturation rate and the most recent EV). However, this also coincided with some of the most extreme swings in abundance of driver stocks and environmental conditions, thus more erratic behavior of the model doesn't seem that surprising. The recommendations (2) to review 2015 model inputs and (3) to examine model assumptions do follow from the model's behavior, but it is not feasible to conduct those evaluations prior to this year's fisheries

A.2 Evaluation of SEAK winter troll fishery performance.

In order to use an alternative to the pre-season AI as an alternative indicator of abundance, or an in-season update to the AI, it must be demonstrated to be a better predictor of the post-season AI than the pre-season AI is. In Appendix A2 it is argued that CPUE is strongly correlated with post-season AI and could be used as an update or alternative to the model-generated pre-season AI. Appendix A2 reports $R^2$ values for linear regressions forced through the origin. This is an inappropriate statistic and is pretty much meaningless. A more appropriate measure of the fit for a zero-intercept linear regression is the square root of the mean squared error (RMSE). The RMSE of the zero intercept regression of post-season AI on Sitka Sound (Area 113-41) CPUE is 0.413, while the RMSE of the zero intercept regression of post-season AI on pre-season AI is 0.229. This indicates that the pre-season AI (Figure 1) has a stronger relationship with the post-season AI than does the Sitka Sound Winter troll CPUE. The weak correlation between the winter troll CPUE and preseason AI (Figure 2 does not support its use for updating or replacing the pre-season AI.

It is also argued that the 2015 preseason AI does not comport with Sitka Sound winter troll CPUE, and that inclusion of that data point degrades the relationship between Sitka Sound winter troll catch through statistical week 13 and the AI (Figure A.2 in the Alaska memo). However, in that figure, effort is not factored into the relationship, and coincidentally, the 2015 winter troll fishery had greater fishing effort through statistical week 13 than any other year shown in the figure. In Figure 2 the post-season 2014 AI is shown in green, and the 2015 preseason AI in red. The 2015 pre-season AI does not appear anomalous, and represents a smaller deviation from the relationship than the post-season 2014 AI.

Figure 3 shows the relationship between the first post-season SEAK AI and the Sitka Sound winter troll CPUE through statistical week 13 for the years 2002-2014. The $R^2$ is 0.528. Note that omission of the 2014 data point raises the $R^2$ to 0.635, which is slightly higher than the correlation between pre-and post-season AIs. However, whether or not the point is dropped, the regression produces an intercept greater than 1.0, implying that abundance could never be less than in the 1979-1982 base-period.

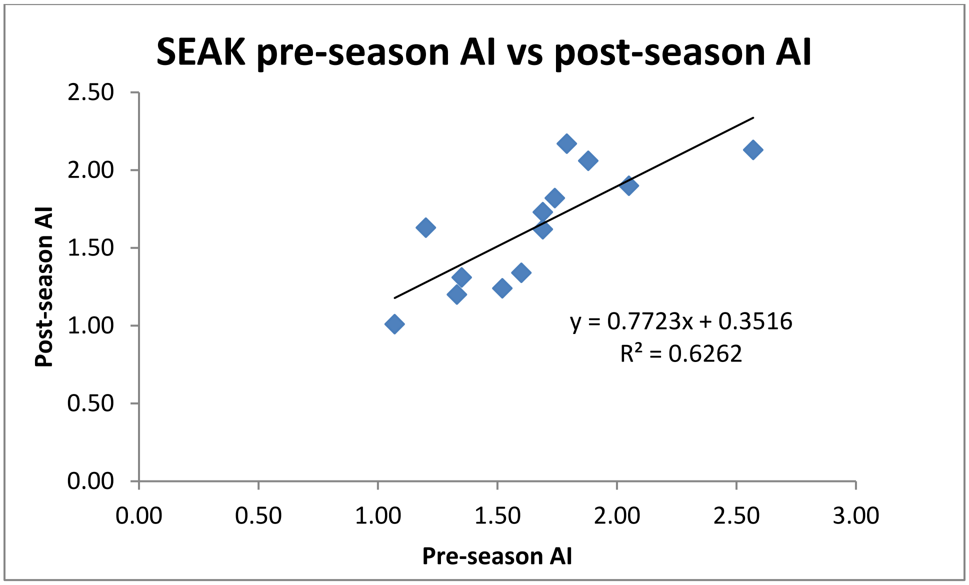



Figure 1. Relationship between SEAK pre-season AI and first post-season AI for the years 2002-2014.

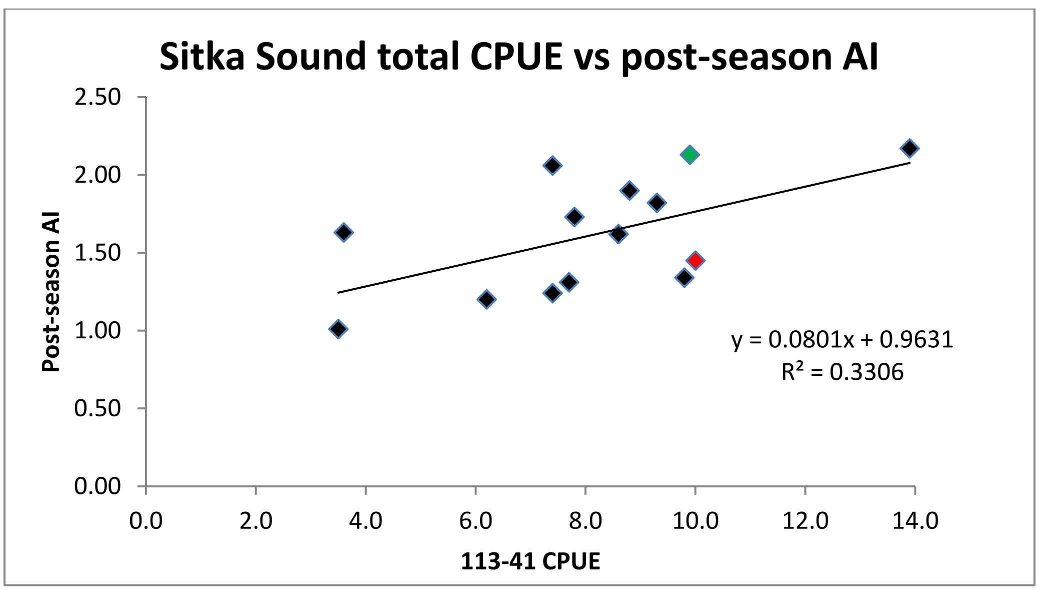



Figure 2. The relationship between SEAK AI and the Sitka Sound winter troll CPUE for years 2002-2015 (Figure A.3 in Alaska memo). Data are post season AIs except the red data point which is the 2015 pre-season AI from model calibration 1503. The 2014 data point is shown in green.

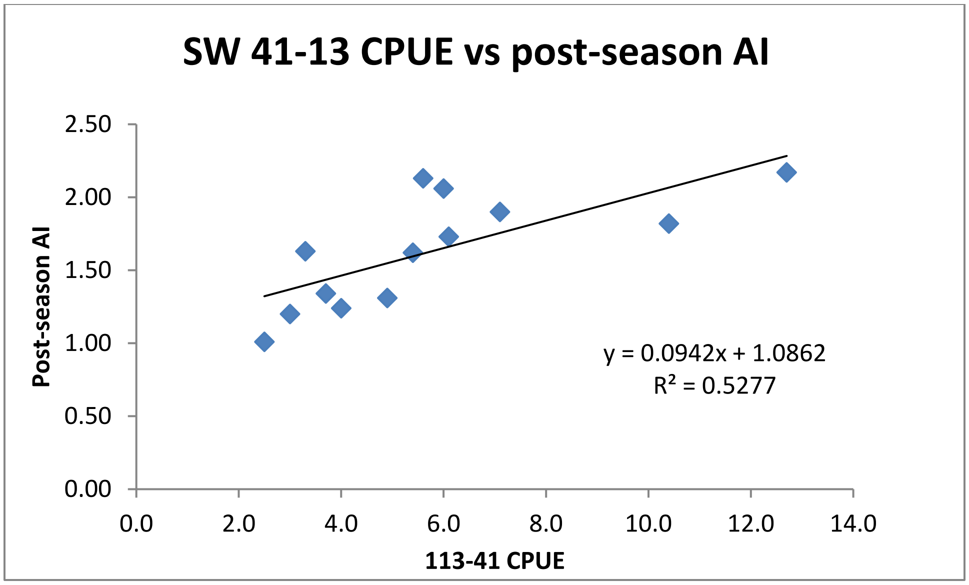
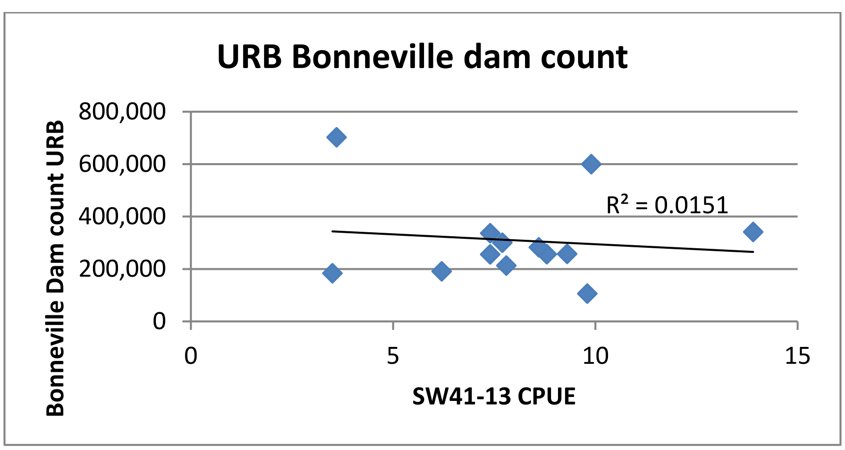



Figure 3. Relationship between post-season SEAK AI and Sitka Sound winter troll CPUE through statistical week 13 for the years 2002-2014.

The Alaska memo points out that the SEAK winter troll CPUE is strongly correlated with the post-season AI ($R^2$ = 0.66, omitting the 2014 data point) and concludes that a high SEAK winter CPUE indicates a larger 2015 preseason AI than the CLB1503 projection. However, the correlations between the post-season AI and the URB, SUM, and WVCI (RBH) forecast are less with $R^2$ = 0.21 (URB), 0.32 (SUM), and 0.56 (RBT). The correlation between the SEAK troll CPUE and the returns of URB, SUM, and WCVI (RBH) are even worse with $R^2$ = 0.01 (URB), 0.10 (SUM), and 0.08 (RBT). The correlation between the SEAK winter troll CPUE and the AI does not translate into a correlation between the SEAK winter troll CPUE and the abundance of Columbia River or WCVI stocks.



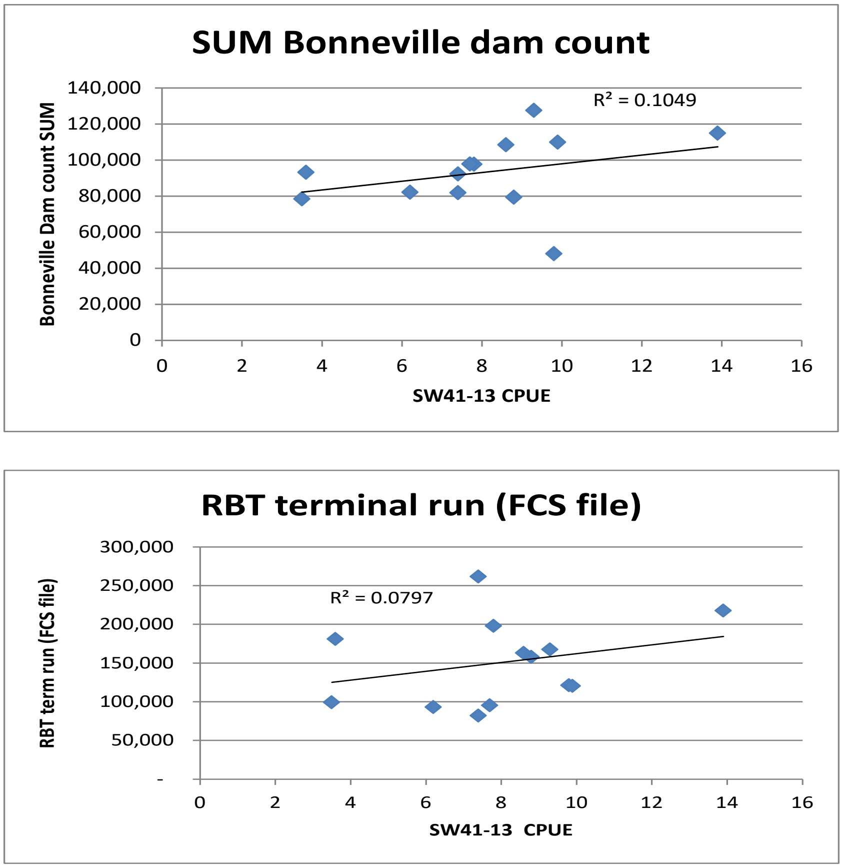



Figure 4. Correlations between SEAK winter troll CPUE and terminal runs of Columbia Upriver Bright, Summer, and Robertson Creek fall Chinook

The agency forecast is a better predictor of stock abundance that the SEAK winter troll CPUE

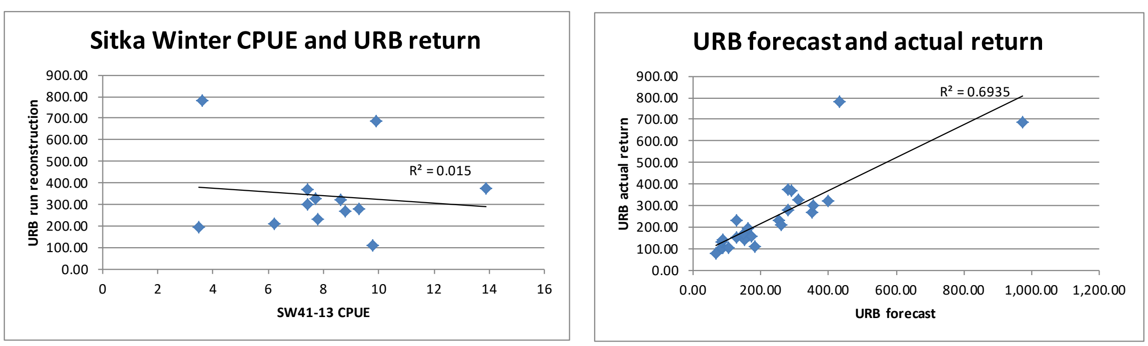



Figure 5. Comparison of the correlations between SEAK winter troll CPUE and the agency forecast, with actual return of URB.

Conclusions:

1. The 2015 SEAK AI from model calibration 1503 is not inconsistent with SEAK winter troll CPUE.

2. Evidence does not suggest that SEAK winter troll CPUE would be an improvement to the preseason SEAK AI or useful for making adjustments to agency forecasts.

A.3 SEAK winter Troll CWT recoveries

The contribution of Columbia River Summer Chinook to the total CWT recoveries in the SEAK winter troll fishery is substantially higher than usual. However, Columbia River summer Chinook include a large hatchery component which are nearly 100% ad-clipped and CWTed, so high numbers of CWT recoveries doesn't represent that many fish overall. Because the production of summer Chinook is a combination of yearling and fingerling releases, the 2009 and 2010 brood years would have contributed to the "4-yr-old" age class in 2014. In those two broods combined, over 7.5 million summer Chinook were released with CWTs. The contribution rate of URBs aligns with the observation that the 2010 brood was apparently the largest on record.

It is argued that the low ratio of age-4/age-5 CWTs in the catch is indicative of a continued high abundance of the age-5 year class for the summer troll of both URBs and summer Chinook in 2015. Statistically, there is little support for this assertion. For URBs, the correlation between the age 4/5 ratio in the SEAK winter troll fishery and the age 4/5 ratio in the terminal run has an $R^2$ of 0.008, and the correlation between the age 4/5 ratio in the winter troll and summer troll fisheries has an $R^2$ of 0.051. Comparison of the age 4/5 ratio for summer Chinook between the winter and summer fisheries reveals that the ratio is consistently much larger in the summer fishery than the winter fishery. This is not surprising since summer Chinook terminal run arrives from late-May through July, with the run peaking in mid-June. By the time the summer fishery starts, most of the age-5 fish have left SEAK on their spawning migration.

A.4 “No Tag” percentage

The proportion of ad-clipped fish with no tags in both the SEAK troll fishery (figure A.5) and the winter troll fishery (figure A.6) appears to be relatively stable and high over the last 4 years, (2011-14 in the summer and 2012-15 in the winter). This is consistent with a large contribution of Columbia River fish, and with the forecast for Columbia River Bright fall Chinook, which would be the third largest return on record, and with the ad-clipped, no-tag rate of Columbia River bright fall Chinook (Figure 6), It does not appear to be consistent with a large summer Chinook contribution, which are nearly 100% tagged, in the 2015 winter troll fishery.

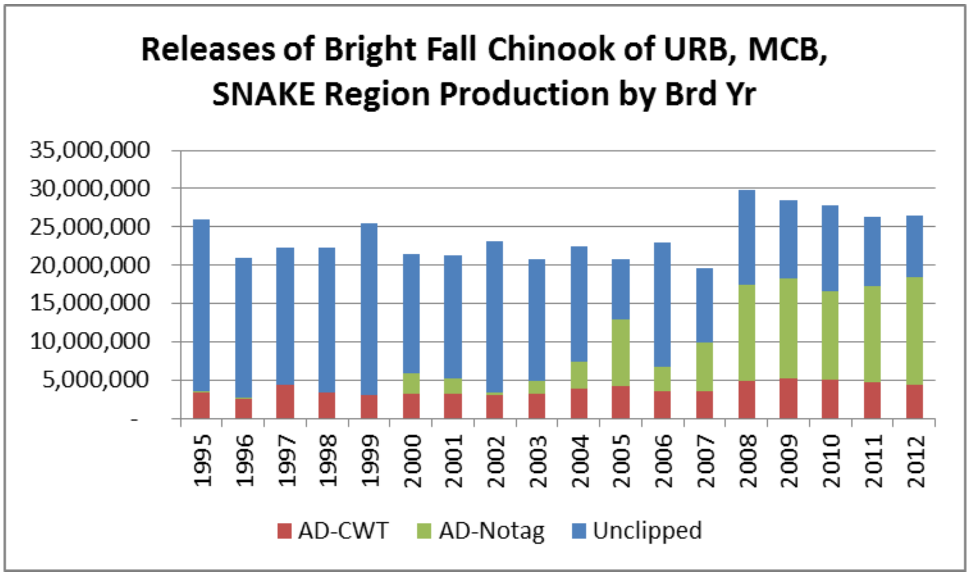



Figure 6. Total hatchery releases by brood year and mark/CWT status of bright fall Chinook to the Upper Columbia, mid-Columbia, and Snake Rivers combined. Data from RMIS database.

B. Evaluation of Model Assumptions

B.1 Examination of maturation rates

The argument is made that maturation rates have become more volatile and that the recent change to using 5-yr average maturity rates and most recent year EVs may be causing bias in calibration 1503. The recommendation is made to use the most recent year’s age-2 maturity rate.

Table 1 below shows the values used in Calibration 1503 along with the 5-yr running average used to predict it, and the previous year’s value. The mean absolute percent error using the previous year is substantially larger than the error from using the 5-yr running average, and the performance of using the prior year has been getting worse. During the five years used to forecast the age 2 maturity rate for the 2012 brood year (brood years 2007-2011) the correlation between the maturity rate in consecutive years is -0.826.

There is also an assertion made that evidence does not support age-2 maturation rates remaining high. However, the most recent incomplete brood (BY 2010) on which this assertion is based is lacking both age-4 and age-5 data. A high age-2 maturation rate corresponds to a ratio of age-2 to age-3 returns to the Columbia River within brood years. Figure 7 shows the within brood age 2/3 return ratio for URBs.

For the 2010 brood, this ratio reached a recent low point, corresponding to the under -forecast of age 3 abundance in 2013. However, that same ratio has returned to a very high level for the 2011 brood.

Conclusion: Use of the most recent URB age-2 maturity rate would substantially degrade the model performance and cause more erratic behavior.

Table 1. Age 2 maturity rates for URB stock used in the CTC model, with running average of the five previous years, and prior year, and the mean absolute percent error of each as a predictor.

| year | 1503 | 5-yr avg | prev yr |
|---|---|---|---|
| 2002 | 0.027 | 0.020 | 0.023 |
| 2003 | 0.011 | 0.023 | 0.027 |
| 2004 | 0.037 | 0.017 | 0.011 |
| 2005 | 0.030 | 0.020 | 0.037 |
| 2006 | 0.080 | 0.026 | 0.030 |
| 2007 | 0.071 | 0.037 | 0.080 |
| 2008 | 0.113 | 0.046 | 0.071 |
| 2009 | 0.043 | 0.066 | 0.113 |
| 2010 | 0.097 | 0.067 | 0.043 |
| 2011 | 0.044 | 0.081 | 0.097 |
| 2012 | 0.074 | 0.074 | 0.044 |
| MAPE (2002-2011) | | 0.556 | 0.700 |

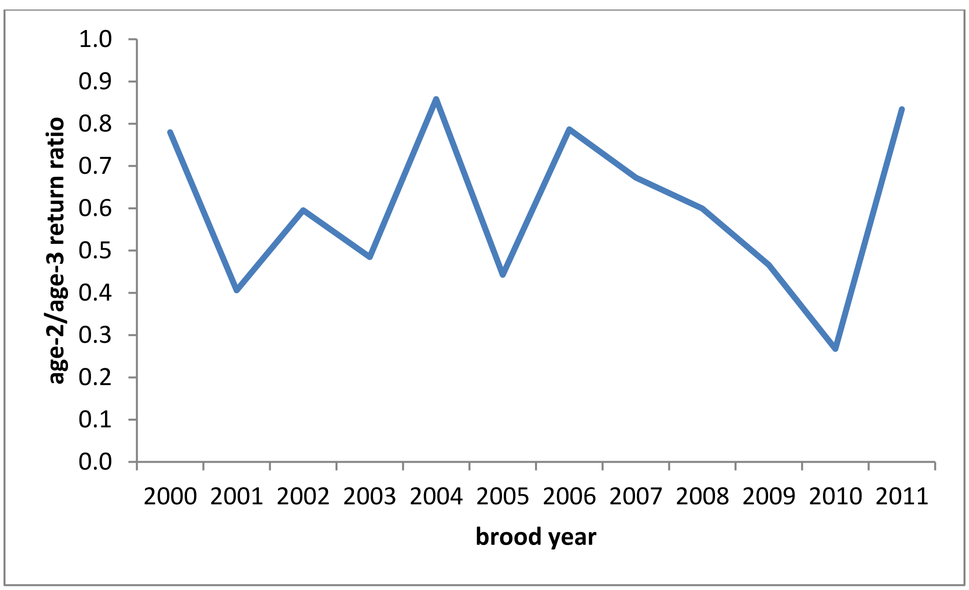



Figure 7. Ratio of river mouth return, by brood year, of Upriver Bright stock at age 2 to return at age 3.

B.2 Brood year and Stock EVs

There is a recommendation to use a 2-year average, or revert to a 5-yr average of EVs for incomplete broods. While it is true that using a single value is more volatile than a moving average, the CTC made this change just 2 years ago after reviewing the performance of alternatives. There is no information presented in the Alaskan memo that demonstrates a 2-yr or 5-yr moving average would be perform better, merely that it would result in a higher SEAK AI this year. This is purely an outcome-driven recommendation, and inappropriate as technical advice.

C. Evaluation of Model inputs

C.1. Columbia River URB and MCB forecasts.

Columbia River forecasts are made by the Columbia River Technical Advisory Committee (TAC ). Each year, for age classes that have substantial contributions to fisheries (ages 3 to 5), they compare the performance of a suite of forecast models that typically include sibling regressions and ratio estimators based on returns within cohorts in consecutive years, and for age classes that have returns from multiple years (age 4 and 5), total brood returns and multiple regression of returns at prior ages. They also compare the performance using data sets of different lengths. They evaluate the performance of these predictors and select the one with the best performance for each age class. In most cases this has been either a sibling regression, or a ratio estimator based on the return of the same brood in the previous year.

Performance of the forecasts over the past ten years for the Upriver Bright (URB) stock is shown in Table 2, and that of the mid-Columbia bright (MCB) stock is shown in Table 3. For both stocks , the tendency has been to over-predict the abundance of age-4 and age-5 fish. These are the two age classes that are the most vulnerable to northern fisheries. For age 3 fish, the forecasts for URBs have under-predicted by 10% and for MCBs they have over-predicted by 13%. Recent past performance of both forecasts does not suggest that a substantial under-prediction is likely in 2015.

Table 2. Age-specific forecasts for the Columbia River URB stock over the past ten years.

| | age 3 | | | age 4 | | | age 5 | | |
|---|---|---|---|---|---|---|---|---|---|
| year | pred | obs | error | pred | obs | error | pred | obs | error |
| 2005 | 47.2 | 58.4 | -19% | 231.8 | 154.2 | 50% | 66.5 | 57.3 | 16% |
| 2006 | 26.9 | 39.3 | -31% | 124.9 | 88.2 | 42% | 100.1 | 100.1 | 0% |
| 2007 | 41.3 | 27.3 | 51% | 77.4 | 52.2 | 48% | 59.6 | 32.1 | 85% |
| 2008 | 57.2 | 102.7 | -44% | 69.9 | 56.5 | 24% | 34.5 | 37.5 | -8% |
| 2009 | 53.0 | 45.4 | 17% | 168.0 | 137.6 | 22% | 37.7 | 28.3 | 33% |
| 2010 | 130.7 | 148.1 | -12% | 88.8 | 112.1 | -21% | 90.6 | 64.3 | 41% |
| 2011 | 74.1 | 93.1 | -20% | 249.2 | 195.4 | 28% | 72.6 | 33.2 | 119% |
| 2012 | 112.3 | 162.8 | -31% | 137.6 | 84.7 | 63% | 102.7 | 50.2 | 104% |
| 2013 | 187.5 | 427.6 | -56% | 200.1 | 329.7 | -39% | 44.3 | 20.4 | 117% |
| 2014 | 164.7 | 113.9 | 45% | 658.1 | 518.6 | 27% | 150.1 | 51.3 | 193% |
| average % error | | | -10% | | | 24% | | | 70% |

Table 3. Age specific forecasts for Columbia River MCB stock over the past ten years.

| | age 3 | | | age 4 | | | age 5 | | |
|---|---|---|---|---|---|---|---|---|---|
| year | pred | obs | error | pred | obs | error | pred | obs | error |
| 2005 | 13.2 | 18.3 | -28% | 57.5 | 53.0 | 8% | 18.7 | 26.8 | -30% |
| 2006 | 8.5 | 15.2 | -44% | 27.4 | 41.3 | -34% | 30.8 | 23.6 | 31% |
| 2007 | 16.3 | 13.1 | 24% | 36.7 | 23.1 | 59% | 15.0 | 10.7 | 40% |
| 2008 | 13.8 | 24.0 | -43% | 30.0 | 37.8 | -21% | 9.9 | 14.2 | -30% |
| 2009 | 21.5 | 10.5 | 104% | 54.6 | 47.7 | 14% | 18.1 | 14.6 | 24% |
| 2010 | 25.7 | 33.6 | -24% | 30.3 | 28.6 | 6% | 16.1 | 16.5 | -3% |
| 2011 | 15.9 | 14.7 | 8% | 70.5 | 64.4 | 9% | 13.4 | 7.7 | 75% |
| 2012 | 25.2 | 24.5 | 3% | 34.7 | 24.2 | 43% | 30.7 | 12.6 | 144% |
| 2013 | 41.2 | 108.9 | -62% | 53.0 | 124.6 | -57% | 11.0 | 15.8 | -30% |
| 2014 | 48.2 | 16.7 | 188% | 256.7 | 149.5 | 72% | 55.2 | 37.4 | 48% |
| average % error | | | 13% | | | 10% | | | 27% |

C.2. WCVI forecasts for 2015.The forecast for the WCVI aggregate comprised of hatchery and natural stocks was prepared by CDFO staff using the same procedures as in past years. The forecast procedure customarily incorporates age-specific exploitation rates and maturation rates from an up-to-date exploitation rate analysis completed for the RBT CWT indicator stock. For the 2015 forecast, results were incorporated from the cohort analysis procedure completed in March 2015 using complete recoveries to 2014 and brood CWT releases to 2012. Completion of the final step of the forecast procedure to obtain the estimates of terminal run by age requires assumed age-specific ocean exploitation rates for the forecast year. For 2015, the ocean ERs were assumed to be similar to those observed in 2014 (see Figure 8 based on a summary of data from the March 2015 mortality distribution table of total AEQ-adjusted mortality for RBT). This decision was made under the expectation that the continued strong abundance of the Columbia River Bright and Summer stocks would result in similar impacts in 2015 on the WCVI aggregate as indicated from the results of the cohort analysis for the RBT indicator in 2014. This assumption was described to the CTC-AWG during the March 2015 meeting to complete the annual ERA for CWT indicator stocks and Model calibration. A willingness to consider other ER assumptions was also identified at the same time but no specific debate or advice was forthcoming at the time.

CDFO acknowledges that the forecast procedure has an element of ‘co-dependency’ or ‘circularity’ with the Model calibration due to the requirement of maturation rate assumptions. The solution proposed to circumvent this aspect of the forecast for the WCVI stock aggregate is to modify the Model code so that age-specific ocean cohort abundances can be substituted in for the terminal run forecasts. While the CTC has agreed that this change to the Model code should occur, other Model improvements have taken priority to date. CDFO awaits the implementation of the capacity to provide forecasts of the cohort abundances for the annual Model calibration. Forecasts of cohort abundances would not require ER assumptions to derive the expected terminal run sizes at age.

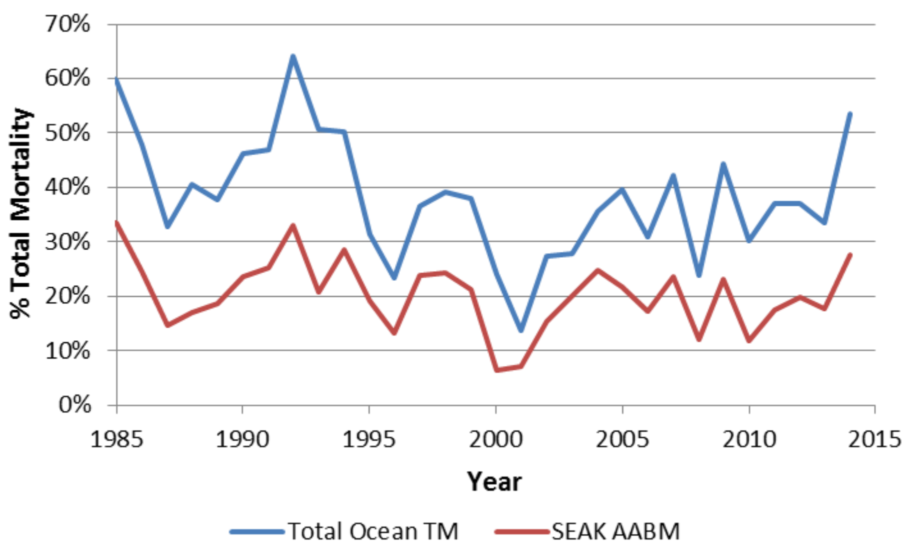



Figure 8. Percentage of the actual total AEQ-adjusted fishery mortality occurring in all preterminal (ocean) fisheries and in the SEAK AABM fisheries for the RBT CWT indicator stock in years 1985-2014. Data have been summarized from the current mortality distribution table based on total AEQ-adjusted estimated CWT mortalities across ages 2-5 within each calendar year.

Effects of the 2015 WCVI terminal run forecast at age on the Model calibration results was investigated through an experiment which involved removing the WCVI forecast from the Model’s forecast file and then re-running the calibration procedure to obtain new results (with all inputs except the WCVI forecast held constant). This particular experiment was conducted because the decision had been made by the CTC-AWG to exclude the WCVI forecast from the Model calibration in 2013 (Clb1308). With the 2015 WCVI forecast included as input to Calibration 1503 (total terminal run = 105,003), the Model generates an expected total terminal run of 71,970. Without the WCVI forecast included as input, the

Model generates a terminal run of 75,900 Chinook, ages 3-5. This forecast is smaller in magnitude but not drastically different when the Model must attempt to fit to the CDFO forecast.

An expanded sensitivity analysis was conducted by varying the forecast magnitudes of the three identified 'driver stocks' in SEAK troll. This sensitivity analysis revealed weak responses of 2015 Preseason AIs and 2014 Postseason AI to changes in total abundance of the 2015 agency forecast (while maintaining original age structures) or changes in age structures (while maintaining original total abundances) of three stocks: WCVI Hatchery and Natural (RBH+RBT), Columbia Upriver Brights (URB), and Mid-Columbia River Bright Hatchery (MCB). These stocks are important driver stocks for the SEAK AABM fishery and were highlighted in the April 21, 2015 memo from the Alaskan CTC members as requiring additional review. These stocks are also important contributors to the NBC (e.g., RBH+RBT and URB) and the WCVI (e.g., URB) AABM fisheries. The concerns expressed in that memo were not only about the quality of the forecasted 2015 total abundance but also about the corresponding age structures. The sensitivity of AIs was particularly weak to changes in age structures. In both types of sensitivity analyses, the response of 2014 Postseason AIs was markedly weaker than for the 2015 Preseason AIs. In addition, the results of these analyses showed that even in the presence of simultaneous changes to the total abundances of 2015 forecasts of RBH+RBT, URB, and MCB, increasing the total abundances of these stocks by as much as 60% produced a SEAK's 2015 Preseason AI of 1.652. A combination of increased total abundance with age structures characterized by proportion of age-4 fish greater than either age-3 or age-5 fish is expected to increase the SEAK's 2015 Preseason AI slightly more than in cases when only total abundance is increased. Hence, these results indicate that arguing potential underestimation of the 2015 Preseason AIs from CLB1503 as a result of errors in total abundances or age structures of the 2015 forecasts of driver stocks RBH+RBT, URB, and MCB is not substantiated.

Please note that the complete results of the above sensitivity analysis will be provided upon request to CDFO (Antonio Velez-Espino or Gayle Brown) but have not been included here in the interest of keeping this document to a reasonable size.

D. Contribution of Columbia River fish

GSI evidence is presented that the model overestimates the contribution of Columbia River stocks to SEAK fisheries. This is a potential topic that the Commissioners may want to discuss during renegotiation of the Chinook Chapter of the Treaty but is not germane to this year's model calibration or AI. The Treaty does not consider the local abundance or stock composition of Chinook salmon available to AABM fisheries, but clearly states [Chapter 3, paragraph 11(a)(i)] "…for AABM fisheries, performance will be evaluated and monitored using the first post-season CTC model calibration to compute the abundance index to determine, using Table 1, the allowable catch and total mortality;" The CTC model assumes that stocks have the same age-specific distributions and exploitation patterns as they did in 1979-1982. This produces a weighted average of the abundance of all stocks, using stock-specific and age-specific weights established under conditions that existed more than 30 years ago, and should not necessarily be expected to agree well with the composition of catches under current stock distributions and fishing patterns. No evidence is presented that elucidates whether the discrepancies between the model and genetic data are due to relative fish abundance or just distributional changes.

**MEMORANDUM**

| | |
|---|---|
| To: | Chinook Technical Committee |
| From: | John Carlile, John H. Clark, Bob Clark, Brian Elliott, Dani Evenson, Gary Freitag, Andy Gray, Ed Jones, Scott McPherson, Randy Peterson, Bill Templin, and Eric Volk |
| Subject: | Review of CLB1503 |
| Date: | May 21, 2015 |
| cc: | |
| Attachments: | |

We thank the select group of CTC members for their response memo dated May 19, 2015, and for consideration of the analyses tendered in our memo dated April 21, 2015.

The PSC Chinook model is currently the tool we use to integrate observed catches, terminal runs, escapements and other fishery information to project abundance in the AABM fisheries during the coming year for implementation of PSC fishing regimes. However the model was not designed for this purpose and has not been able to effectively handle recent anomalies in stock abundances, maturation rates, and environmental variables. Most notably, the annual errors associated with the three recent preseason AIs generated from the PSC Chinook model (2012–2014) all exceed the objective of the fishing regime described in Chapter 3 of the 2009 PST Agreement to annually achieve a 15% reduction in SEAK AABM fisheries from the 1999 Agreement levels.

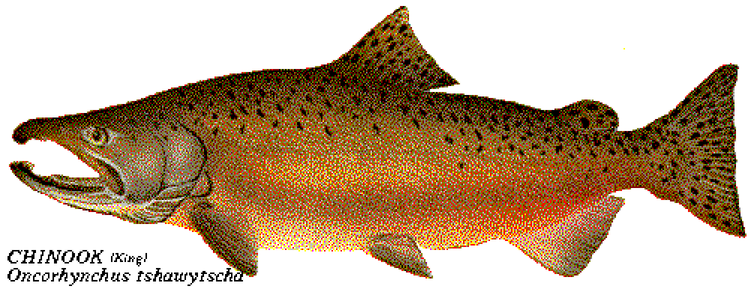
These concerns regarding the reliability of the current PSC Chinook Model to generate abundance indices for the AABM fisheries prompted us to undertake an expeditious review of the current model calibration. We maintain that the PSC Chinook model still warrants a more thorough review of model inputs and model assumptions.

In our memo dated April 21, 2015, we suggested improvements to the model including: use of scientifically defensible stock-age forecasts with measures of uncertainty, development of bilaterally agreed to forecasting methods and data standards, ensuring maturation rates and EVs are consistent with existing observed data and that use of these assumed values do not introduce large errors into the model, and improvement of the timing of draft model calibrations to allow adequate time for CTC non-trivial review but still within the needs of fishery management regimes.

Although the response memo dated May 19, 2015 from the select group of CTC members addressed many of the points in our original memo, overall it lacked information that directly refuted the assertions that we made. Instead, a myriad of possible complicating factors were presented that may or may not affect the conclusions that we reached in our original memo. The information presented in the May 19, 2015 memo was insufficient to convince us that the AI estimates from preliminary calibration CB1503 are reasonable given empirical information from the SEAK fishery. Further, no information was provided that spoke to the appropriateness of calibration 1503 for use in managing Canadian AABM fisheries.

In our view, there is a high likelihood that the 2015 SEAK pre- to post-season AI discrepancy generated by CLB1503 will follow the same trend that has existed since 2012 where the magnitude will exceed the 15% reduction objective of the 2009 PST Agreement for the SEAK AABM fishery. Forecast errors of this magnitude are unacceptable if we are to implement a U.S. PST abundance based management regime that achieves the goal of the Agreement. Therefore, we cannot accept PSC Chinook Model calibration CLB1503.

We believe that a serious and thorough review of model inputs, assumptions, and algorithms needs to be completed if the PSC Chinook Model is to continue to be used to forecast preseason abundance and estimate post-season abundance in the U.S. AABM fishery. Adequacy of its continued use for Canadian AABM fisheries remains an open question. Lastly, we disagree with putting off the review of the model, which is a primary task that was identified within the 2009 PST Agreement. The primary utility of the model at the current time is to set AABM limits which are fundamental components of the abundance-based management system. Improvement in model performance is a critical need and should be explored as soon as possible.




# PSC Chinook Technical Committee

**TO:** Pacific Salmon Commission

**FROM:** John Carlile, Gayle Brown and Robert Kope

**DATE:** May 24, 2015

**SUBJECT:** Update on the Status of the Preseason AABM Fishery Abundance Indices for 2015 and Post-Season Abundance Indices for 2014

We are writing to inform you that a majority of the bilateral members of the Chinook Technical Committee (CTC) participated in a conference call on Thursday May 21 to discuss the memo from the Alaskan members (dated Apr 21) and the response to it from a subgroup of the Southern US and Canadian members of the CTC (dated May 19). Discussion during the conference call did not resolve differences in views regarding the validity of the results of Model calibration 1503 nor identify an agreed course of action. We regret to inform you that the CTC has been unable to reach agreement on a final calibration of the Chinook Model for 2015 and resolution of the issue within the CTC does not appear likely in the immediate future. Expeditious resolution is needed given that the spring component of the WCVI AABM fishery has begun and the summer components of the SEAK and NBC AABM fisheries are scheduled to commence within the next month. We therefore request that the Pacific Salmon Commission determine the appropriate allowable 2015 catch levels for the three Aggregate Abundance Based Management (AABM) fisheries: Southeast Alaska all gear (SEAK), Northern British Columbia troll and Queen Charlotte Island sport (NBC), and West Coast Vancouver Island troll and outside sport (WCVI).

Details regarding the analyses and reviews of Model output and empirical data that were conducted are presented in the attached memos from subgroups of the CTC dated April 21, 2015 and May 19, 2015. A second memo (dated May 21) from Alaskan CTC members, distributed to the CTC soon after the conclusion of Thursday's CTC conference call, is also attached.

cc John Field
Alison Agness
Kate Ladell

Fisheries and Oceans Canada

Pêches et Océans Canada

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*Your file* *Votre référence*

*Our file* *Notre référence*
2015-506-00016

MAY 25 2015

Mr. W. Ron Allen
Vice-Chair, Pacific Salmon Commission
c/o Jamestown S'Kallam Tribe
1033 Old Blyn Highway
Sequim, WA 98382
U.S.A.
Email: < rallen@jamestowntribe.org >
c/o < alison.agness@noaa.gov >

Dear Mr. Allen:

I am writing to express Canada's concerns regarding the ongoing work of the bilateral Chinook Technical Committee (CTC) related to establishing abundance indices needed to determine the 2015 preseason allowable catches for the three Aggregate Abundance Based Management (AABM) areas.

As you know, in early April 2015, the CTC Co-Chairs informed the Pacific Salmon Commission that they had not yet agreed to a final calibration of the Chinook Model for 2015 (CLB1503) due to concerns raised by some CTC members. In particular, CTC members from Alaska noted a number of indicators from the Southeast Alaska winter troll fishery that suggest the 2015 Chinook abundance in Southeast Alaska will be as large or larger than the high abundance seen last year.

During this time I also learned that the Alaska Department of Fish and Game announced the 2015 sport fishing regulations for king salmon in Southeast Alaska and Yakutat. These regulations, which came into effect on May 1, 2015 specify possession and bag limits that are based on the 2014 preseason Chinook abundance estimates. I recognize the challenges associated with reconciling alternative sources of information and that Chinook Model improvements are needed. However, I am troubled by what appears to be one fisheries management agency conducting its own analysis and using it as the basis to take unilateral action.

While the discussion within the CTC is currently focused on the Southeast Alaska

.../2

AABM fishery, the manner in which this issue is addressed has broader implications. For example, if the Pacific Salmon Commission process is not used as the basis for determining the allowable Chinook catch in the Southeast Alaska AABM fishery then it would be appropriate to consider how the allowable catch of Chinook should be determined in the other AABM fisheries. Following the approach Alaska is currently taking suggests that Canada should conduct its own analysis of the Chinook abundance in the WCVI and northern BC AABM areas and use that as the basis for regulating Canadian fisheries.

It is my understanding that the CTC worked throughout April and May to try and reach agreement on a final calibration of the Chinook Model for 2015. This work involved, in part, attempting to determine to what extent the unusual ocean conditions of 2014 and early 2015 changed the distribution and availability of Chinook in Alaskan fisheries versus whether the Chinook Model under-forecasted the 2015 abundance of Chinook. I have just learned, unfortunately, that as of May 21st, the CTC has been unable to resolve the current impasse.

The Pacific Salmon Commission has committed a great deal of effort and resources to supporting an integrated fisheries management approach for Chinook salmon. Given the highly migratory nature of Chinook and the importance of Chinook to all of the participants in the Commission process, in my view, such an integrated process is essential. I remain committed to the PSC process and I would like to discuss with you potential actions that the PSC may wish to take given that the CTC has been unable to agree on a final calibration of the Chinook Model for 2015.

Yours sincerely,

Susan Farlinger
Regional Director General
Pacific Region

.../3

cc:
Phil Anderson, U.S. Commissioner
Robert Turner, U.S. Commissioner
Charles Swanton, U.S. Commissioner
Mike Clark, Alternate U.S. Commissioner
McCoy Oatman, Alternate U.S. Commissioner
Bill Auger, Alternate U.S. Commissioner
John McCulloch, Canadian Commissioner
Murray Ned, Canadian Commissioner
Bob Rezansoff, Canadian Commissioner
Brian Assu, Alternate Canadian Commissioner
Rebecca Reid, Alternate Canadian Commissioner
Brian Riddell, Alternate Canadian Commissioner
Paul Sprout, Alternate Canadian Commissioner
Gayle Brown, Canadian Co-Chair, Chinook Technical Committee
John Carlile, U.S. Co-Chair, Chinook Technical Committee
Robert Kope, U.S. Co-Chair, Chinook Technical Committee
Kate Ladell, Canadian Correspondent
Alison Agness, U.S. Correspondent
John Field, Executive Secretary, Pacific Salmon Commission

THE STATE of ALASKA

GOVERNOR BILL WALKER

**Department of Fish and Game**

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May 27, 2015

Ms. Susan Farlinger, Chair
Pacific Salmon Commission
Regional Director General, Pacific Region
401 Burrard Street, Suite 200
Vancouver, British Columbia V6C 3S4 Canada

Dear Ms. Farlinger:

I am writing as the Alaska Commissioner to the Pacific Salmon Commission (PSC) to clear up misconceptions you may have regarding the Southeast Alaska (SEAK) king salmon sport fishing regulations, discussed in your letter of May 25, 2015, to PSC Vice-Chair Ron Allen.

While it is correct to say that 2015 bag and possession limits for Southeast sport fishery were based on the preseason abundance index (AI) from the previous year, it is not true that this was a function of the Alaska Department of Fish and Game (ADF&G) "conducting its own analysis and using it as a basis to take unilateral action." The announcement of this year's sport bag and possession limits was instead predicated on the provisions of the Southeast Alaska King Salmon Management Plan, 5 Alaska Administrative Code 47.055. Subsection (a) of that plan specifies that "if the new preseason king salmon abundance index is not available by May 1, the bag and possession limits and other management measures for the remainder of the year will be based on the prior year's preseason abundance index, unless superseded by emergency order." Because the PSC Chinook Technical Committee (CTC) did not reach agreement on the AI for 2015 by May 1 (and in fact has just informed the PSC by memorandum dated May 24, 2015), that resolution of the 2015 model calibration "does not appear likely in the immediate future" – this provision of our management plan requires that possession and bag limits be established based on the previous year's AI. Several aspects of this situation warrant comment.

First, the management plan also states, in paragraph (b)(1), that the objective of the plan is to allow the sport fishery to attain an average percentage of the "annual harvest ceiling specified by the Pacific Salmon Commission." The harvest of Chinook salmon in the Southeast Alaska sport fishery is thus tied to the annual harvest limit set by the PSC for Southeast Alaska all gear fisheries, regardless of the bag and possession limits. Assuming that the PSC is able to agree on 2015 harvest levels for the three Aggregate Abundance Based Management (AABM) fisheries referenced in the CTC's memo, including SEAK, Alaska fully intends to comply with those harvest levels, regardless of how we allocate the harvest of those fish domestically.

Second, as indicated in the above-quoted provision of the management plan, the 2015 bag and possession limits for the fishery can be modified by emergency order. Depending on the final harvest levels agreed by the PSC for the AABM fisheries, including SEAK, we are fully prepared to modify those limits by emergency order as necessary to meet our obligations under Pacific Salmon Treaty and the provisions of Annex IV, Chapter 3.

Finally, the proposition that regulations from the prior year would carry over pending agreement on the ensuing year's regulations is common. For instance, the Pacific Coast Salmon Fishery Management Plan states, in Section 9, that "[u]ntil such time as the Council and Secretary can agree upon modifications to be made for the upcoming season, the previous year's regulations will remain in effect." The final rules published to implement that plan for 2015 indicate that they will remain in effect for 2016 fisheries that open earlier than May 1, 80 Federal Register 25611, 25615 (May 5, 2015). This is due to the timing of meetings of the Pacific Fishery Management Council, which makes it "impracticable" to recommend seasons for fisheries beginning before May 1.

Like you, I am committed to the management process for Chinook salmon that all of the parties have worked long and hard to develop, and I look forward to discussions with you and our fellow commissioners as we work toward resolving the issues that have arisen this year as a result of lack of agreement on the model calibration.

Respectfully,

Charles O. Swanton
Deputy Commissioner

cc: W. Ron Allen, Vice-Chair, Pacific Salmon Commission
Bill Auger, Alternate Commissioner, Alaska, Pacific Salmon Commission

U.S. Commissioners
W. Ron Allen
Phil Anderson
Charles Swanton
Robert Turner

**UNITED STATES SECTION**
**of the**
**PACIFIC SALMON COMMISSION**

Office of the
U.S. Section
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June 19, 2015

Ms. Susan Farlinger, Chair
Pacific Salmon Commission
Regional Director General, Pacific Region
401 Burrard Street, Suite 200
Vancouver, British Columbia V6C 3S4 Canada

Re: 2015 Chinook Season and CTC issues

Dear Ms. Farlinger:

The U.S. Commissioners would like to thank you and the rest of the Canadian Section for your patience while we worked to establish consensus on abundance indices needed to determine the 2015 preseason allowable catches for the three Aggregate Abundance Based Management (AABM) fisheries for 2015. In response to the CTC's memo dated May 24, 2015, the U.S. Section recommends abundance indices for the current year and seeks your concurrence. We agree with Canada's expressed concern from your May 25, 2015 letter regarding the absence of bilateral Chinook Technical Committee (CTC) concurrence to establish abundance indices this year. In order to address some of the issues that made arriving at a consensus challenging in 2015, we seek your support in recommending that the Pacific Salmon Commission (PSC) prioritize assignments of the CTC that would improve preseason planning and the performance of the Chinook model.

The U.S. Section recommends that the three AABM fisheries employ indices consistent with the draft Chinook Model calibration 1503 (CLB1503). Alaska will configure its 2015 summer troll fishery and the remainder of its king salmon sport fishery to abide by the abundance index of CLB1503 (1.45) for the Southeast Alaska AABM fisheries. Consistent with CLB 1503, the U.S. requests that Canada confirm the abundance indices that will be employed for the remainder of the Northern British Columbia troll and Queen Charlotte Islands sport and West Coast of Vancouver Island troll and outside sport AABM fisheries. Assuming the Parties are in agreement, we will endorse your communication to the PSC, as Chair, of our agreement and decision in response to the CTC's May 24th memo.

We seek Canada's support to prioritize CTC assignments and process that focus on: (1) the timeliness and adherence to the CTC guidelines and instructions for the preseason planning process and (2) performance of the Chinook model. We understand that the CTC has already discussed and is preparing to produce two memos responsive to the aforementioned topics to include specific recommendations specific to the timeliness and adherence to the CTC guidelines of the salmon forecasts and preseason planning process and specific topics of evaluation for additional model improvements. With that understanding, we want to bring to your attention our endorsement of the CTC's work on these topics, which we believe need to accompany date certain deliverables. We want to ensure that both topics are on the bilateral agenda in October, and anticipate that the CTC can produce the two memos by September 1, 2015 to ensure we have adequate time to discuss within our respective Sections before coming together at the October Executive Session.

Further, the U.S. Commissioners are concerned that the CTC, as one of our key technical bodies, is in the situation they are today. We would like to see as one of our priorities to identify what we can do to improve the functional operations for the CTC. In addition, we recommend that the PSC clarify the procedural direction for implementing the Chinook fishing regime and adopting abundance indices absent CTC concurrence to further ensure that the current events are not repeated.

It is our observation that the Technical Dispute Settlement Board is not a timely process, and therefore, is not a viable option for circumstances such as this one. This resolution process and guidelines may need to be reviewed as a useful option to address conflicts in the future.

We believe that our recommended course of action is essential to prevent the current events from recurring in future years, and stand ready to endorse with you through the PSC direction on the appropriate allowable 2015 catch levels for the three AABM fisheries responsive to the CTC's May 24, 2015 memo. Please let me know if you would like to discuss this letter or have any questions that may provide resolution for the 2015 AABM fisheries or address our proposed assignments to the CTC.

Sincerely,

W. Ron Allen

W. Ron Allen (PSC Vice-Chair)
Tribal Chairman
Jamestown S'Klallam Tribe
1033 Old Blyn Highway
Sequim, WA 98382

Cc: US Commissioners & Alternates

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*Your file* *Votre référence*

*Our file* *Notre référence*

JUN 2 4 2015

Mr. W. Ron Allen (Vice-Chair)
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Email: rallen@jamestowntribe.org
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Dear Mr. Allen:

Thank you for your June 19, 2015 letter informing us that the U.S. Section has established consensus and recommends that the three Aggregate Abundance Based Management (AABM) fisheries employ indices consistent with the Chinook Model calibration 1503 (CLB1503).

We anticipate that our Northern and Southern Salmon Integrated Fisheries Management Plans will be approved by our Minister within the next few weeks. However, I can confirm that, at present, we have planned our chinook fisheries on the basis of the provisions in Chapter 3. This includes an expectation that Abundance Indices generated by CLB1503 will be applied for the remainder of the Northern British Columbia troll and Queen Charlotte Islands sport and West Coast of Vancouver Island troll and outside sport AABM fisheries. I trust that this confirmation is sufficient for joint endorsement of CLB1503 and allows enough time for subsequent orders to be communicated regarding configurations of fisheries for the remainder of the season. We look forward to discussions in the fall confirming that harvests by both countries have been managed within the agreed upon abundance indices.

With respect to your request for Canada to support prioritization of CTC assignments and process as described in your letter, Canada would first like to better understand what documented guidelines currently exist regarding timeliness, timelines and instructions to the CTC regarding the preseason planning process, and whether these are clear and consistent with the annual CTC process for determining the final preseason Model calibration results.

The CTC work plan for 2014-15 directs the CTC to work on high priority Model improvement tasks such as the new base period calibration of the Chinook Model. As per the direction received from the Commission at the October 2014 session, the CTC has identified that Tasks 1 and 2 of this work is expected to be completed for presentation at the October session. The addition of new tasks for completion in advance of the October session could potentially interfere with completion of this challenging but essential work, and Canada recommends that this high priority work continue to conclusion. However, we are agreeable to having the CTC propose a prioritized list of high priority Model improvement tasks, including review of existing guidelines and instructions as suggested above, in the proposed 2015-16 CTC work plan at the October session. If the CTC is able to complete a review of existing CTC guidelines and instructions and produce the two memos by your suggested September 1st deadline without interfering with the ongoing Model improvement tasks, Canada is supportive.

With respect to the issue of CTC functioning and Commission policies on non-consensus, Canada is supportive of adding this item to the October 2015 Executive Session agenda.

We agree that it is essential to prevent the string of recent events from occurring in the future, and we believe that our suggested approach will enable both Parties to operate with better understanding of process and protocols while ensuring that existing tasks of the CTC are delivered by expected timelines.

Yours sincerely,

Susan Farlinger
Regional Director General
Pacific Region

cc:
Charles Swanton, U.S. Commissioner
Bill Auger, Alternate U.S. Commissioner
Phil Anderson, U.S. Commissioner
Robert Turner, U.S. Commissioner
Mike Clark, Alternate U.S. Commissioner
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Rebecca Reid, Alternate Canadian Commissioner
Brian Riddell, Alternate Canadian Commissioner
Paul Sprout, Alternate Canadian Commissioner

PACIFIC SALMON COMMISSION

ESTABLISHED BY TREATY BETWEEN CANADA
AND THE UNITED STATES OF AMERICA
MARCH 18, 1985

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TELEPHONE: (604) 684-8081
FAX: (604) 666-8707

TO: Chinook Technical Committee (CTC)

FROM: Susan Farlinger, Chair
W. Ron Allen, Vice-Chair

CC: Canadian and U.S. Commissioners

RE: 2015 AABM fisheries and tasks

DATE: July 17, 2015

This memorandum responds to your May 24, 2015 memo regarding appropriate allowable 2015 catch levels for the three Aggregate Abundance Based Management (AABM) fisheries: Southeast Alaska all gear (SEAK), Northern British Columbia troll and Queen Charlotte Island sport (NBC), and West Coast Vancouver Island troll and outside sport (WCVI). The Commission has reached a decision on this matter and we are writing to convey that with additional guidance for the CTC.

The Commission has agreed to use the results from model calibration 1503, yielding abundance indices of 1.45 for SEAK, 1.23 for NBC, and 0.85 for WCVI, to establish catch limits for the AABM fisheries noted above. Authorities in each Party have agreed to structure their fisheries and regulatory regimes accordingly for 2015.

In addition, we note that the CTC is working on two memos that will highlight issues for the Commission's attention. These memos will provide a) a review of CTC guidelines and instructions for the preseason planning process and recommend improvements to address timeliness and adherence to guidelines, and b) a list of recommended model improvement tasks that will need prioritization by the Commission relative to pre-2016 model calibration improvements. The Commission understands that Tasks 1 and 2 from the CTC 2014/2015 work plan remain the Committee's top priorities and expect that work on model improvement will be completed by October 15th. Further, the Commission understands that delivery of the aforementioned memos by September 1, 2015 will not impede the CTC's ability to complete Tasks 1 and 2 on schedule, and look forward to receipt by that date to inform Commission discussion in October and ensure the Commission can offer guidance for the efficient implementation of the Treaty in 2016 and beyond.

In the same spirit, the Commission will be discussing the CTC's annual workflow and functionality at its Fall Meeting this October. We will convey any outcomes of those discussions to the CTC as soon as they are complete.

We wish to express the Commission's appreciation for the CTC's ongoing and challenging work in support of the Treaty's management regime, without which the Parties could not adequately manage and conserve our shared stocks of Chinook salmon.

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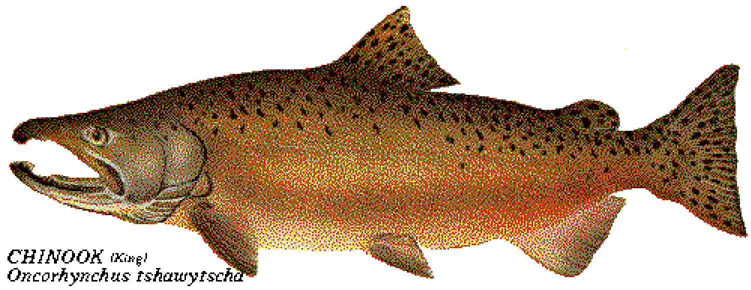



**PSC Chinook Technical Committee**

**TO:** PSC Commissioners

**FROM:** John Carlile, Robert Kope and Gayle Brown (CTC co-chairs)

**DATE:** September 4, 2015

**SUBJECT:** Reexamination of Yearly Chinook Model Calibration Timeline

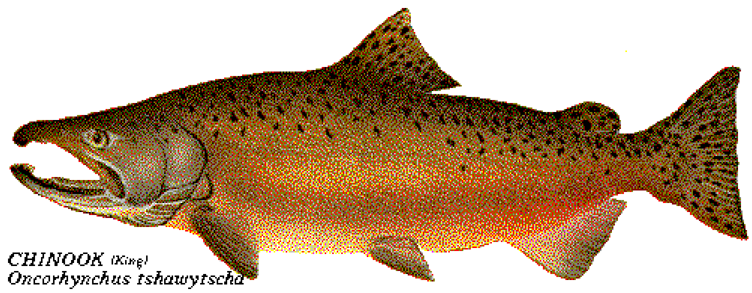
The Chinook Technical Committee strives each year to provide final results from the annual calibration of the PSC Coastwide Chinook Model by April 1st. This timeline was established at the request of the Southern US PSC Commissioners in order to make the Model calibration results available to the Pacific Fishery Management Council (PFMC) in time to facilitate the yearly preseason planning of Chinook fisheries under the jurisdiction of the PFMC. As part of the annual timeline, the CTC-Analytical Working Group also attempts to complete the Model calibration weeks in advance of April 1 to permit review of all data inputs, Model assumptions and results. Technical Note (96)-1 entitled "Protocol for Changing the Chinook Model" from the CTC to the PSC and distributed by the PSC secretariat on January 6, 1997 specifies that model calibrations will be subject to a two week review period by members of the AWG. While Technical Note (96)-1 also identifies that the AWG determines a final model calibration by consensus, it's been a customary CTC practice to strive to provide all CTC members with this period of time to review a calibration. Thus, when a calibration is produced and the AWG has completed its review, the calibration results are distributed to the bilateral CTC for a second period of review. As stated previously, a period of two weeks is the preferred time frame for this review.

Providing the final Model calibration results to the PSC by April 1st and meeting the preferred review period requires completion of the Model calibration in early March. This has not proven possible in most years for a number of logistical reasons. Foremost among these is that the annually required data elements (i.e., CWT data, catch and escapement data, stock forecasts) essential for the CWT-based exploitation rate analysis or the Model calibration are rarely complete or have had sufficient time for review by early March. In addition, fishery planning processes in which AWG members are also engaged typically pre-empt an early March model calibration meeting. And finally, in recent years, the AWG has worked to incorporate various improvements to analytical procedures but this work has required additional time for testing and validation of results. While the CTC has most often provided the PSC with finalized Model calibration results by April 1st, the review periods by the AWG and CTC have had to be curtailed in order to meet this deadline.

Following is a summary of the obligations and issues confronting the CTC:

1. The Southern U.S. North of Falcon (NOF) process needs close to final Abundance Indices (AIs) by the end of March for their Chinook fishery planning purposes.
2. The Southern U.S. PFMC process needs final AI numbers for their April meeting (this year April 9) to finalize their regulatory measures for the year.
3. Typically the CTC does not have sufficient time to adhere to its two week review policy of a proposed Model calibration by the full CTC.

The CTC respectfully requests that the PSC Commissioners consider whether a date later in April could be adopted for provision of finalized Model calibration results which would accommodate the logistical challenges faced by the CTC in completing the Model calibration in March and permit the preferred periods of review by the AWG and the CTC. The CTC also requests that the PSC Commissioners do what is possible to ensure timely provision of data and forecasts by contributing agencies.




**PSC Chinook Technical Committee**

**TO:** PSC Commissioners

**FROM:** John Carlile, Robert Kope and Gayle Brown (CTC co-chairs)

**DATE:** September 25, 2015

**SUBJECT:** Inclusion of Calibration 1503 in CTC annual reports

In the spring of this year, the CTC was unable to agree on a final PSC Coastwide Chinook Model calibration to set preseason Abundance Indices (AIs) for 2105 AABM fisheries and postseason AIs for 2014. Ultimately, the Commissioners agreed "to use the results from model calibration 1503 (CLB1503), yielding abundance indices of 1.45 for SEAK, 1.23 for NBC, and 0.85 for WCVI, to establish catch limits for the AABM fisheries" in 2015.

The CTC has been unable to reach a consensus on the inclusion of CLB1503 in our 2015 Model Calibration and Exploitation Rate Analysis (CLB&ER) report. We have agreed to include a timeline of events, detailing the chronology and rationale of the divergent views that resulted in the lack of agreement on a model calibration. However there is no consensus on inclusion of model calibration results in our report. Some CTC members argue that since the Commissioners agreed that the catch limits resulting from the CLB1503 AIs were to be used to manage fisheries in 2015, that other results from this calibration should be included in our annual report. The affected results comprise roughly half the CLB&ER report and are highlighted in the Appendix below. The opposing view is that the CTC was not able to reach agreement on a model calibration and that annual reports are consensus reports of the CTC, so there should be no presentation or discussion of the results of CLB1503 in our annual report.

The CTC co-chairs request specific direction from the Commission on whether the results from CLB1503 should be included in our 2015 CLB&ER report.

**APPENDIX**

Yellow Highlights Indicate Sections, Tables, Figures, and Appendices of 2014 CLB-ER Report (TCCHINOOK 15-1 v1) That Are Affected by CTC Model Calibration

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Memorandum October 29, 2015

To: CTC Co-Chairs
From: PSC Commissioners
Subject: Commission Response to CTC Re: Inclusion of Calibration 1503 in CTC Annual Reports

In the CTC's memo to PSC Commissioners, dated September 25, 2015, they identified the following need for Commission direction:

> "The CTC has been unable to reach a consensus on the inclusion of CLB1503 in our 2015 Model Calibration and Exploitation Rate Analysis (CLB&ER) report. We have agreed to include a timeline of events, detailing the chronology and rationale of the divergent views that resulted in the lack of agreement on a model calibration. However, there is no consensus on inclusion of model calibration results in our report. Some CTC members argue that since the Commissioners agreed that the catch limits resulting from CLB1503 AIs were to be used to manage fisheries in 2015, that other results from this calibration should be included in our annual report. The affected results comprise roughly half the CLB&ER report and are highlighted in the Appendix below. The opposing view is that the CTC was not able to reach agreement on a model calibration and that annual reports are consensus reports of the CTC, so there should be no presentation or discussion of the results of CLB 1503 in our annual report.
>
> The CTC co-chairs request specific direction from the Commission on whether the results from CLB1503 should be included in our 2015 CLB&ER report."

The Commission provides the following direction in response to the CTC's aforementioned request.

The CTC report in question be provided in three parts, described below:

Part 1 – Consensus Report: The consensus report of the CTC includes those Chapters where there are consensus and would reference to a separate stand-alone Chapter 3 and associated appendices. The Executive Summary would be refined to reflect these report components and the consensus report itself would include Part 2 , characterized below.

Part 2 – Catalogue Issues Regarding Model Calibration: The catalogue of issues regarding which model calibration to use includes characterizing the timeline of events, options evaluated, and ensuing responses. The catalogue would further include a description of agreements reached regarding CTC tasks that would ensure the Commission can offer guidance for the efficient implementation of the Treaty in 2016 and beyond.

Part 3 – Chapter 3: The Chapter 3 report and associated appendices would include the highlighted sections of the annual report outline and would be drafted by those CTC members who wish to author the report.

*M 15–PSC Memo to CTC, October 29, 2015*

October 29, 2015

To: Bilateral Chinook Technical Committee

From: Pacific Salmon Commission

RE: Direction for CTC and AWG for model improvements and work products

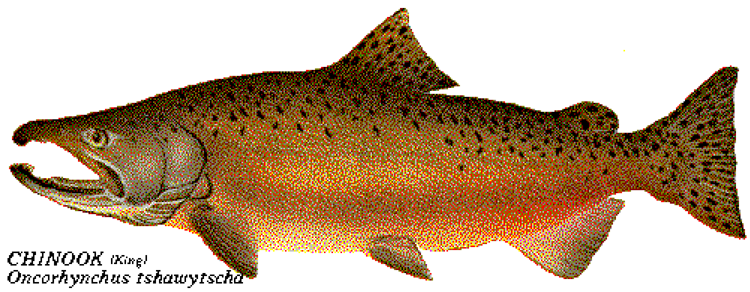
1. The PSC Chinook Model performance over the last several years has been highly variable based on the wide swings in estimated abundance as expressed within the model calibration abundance indices. The amount of technical debate that has ensued over the last 8 months has been cause for the CTC and AWG to request of the Commission instruction on several aspects of technical work moving forward (Memo to Commissioners from CTC dated September 4, 2015). There were two elements that were transmitted relative to the US Section meeting on June 10, 2015: one was timeliness of release of the preseason abundance index and the other was stability of the model calibration results. There are also several work products that are of immediate and longer term value for the Commission that we request you complete as best possible within the prescribed timelines as depicted below. We have heard discussion and received reasonable correspondence specific to the timing element; however the model stability element has not been adequately addressed.

   The Commission is requesting that the AWG embark on investigating both the maturation rates and environmental variables to update and document the analyses performed in 2012 with the last two years of data. The objective is to provide for improved preseason and postseason abundance indices to be generated for the 2016 season and postseason AI's for both the 2014 and 2015 seasons. We understand it is important to start this work soon to inform the current year calibration, and suggest the work completed by December 15, 2015 and no later than January 1, 2016 so that we can be assured that a preseason AI can be generated, evaluated and released for fishery planning purposes.

2. The second assignment is for the CTC to complete the Chapter 3 performance review. The Commission has determined to pursue Section 3.3 using a method that would project across the agreement period. In lieu of making yearly Chinook model calibrations from 2008 onward to make adjustments to escapements, forecasts and fishery catches to model what would have occurred if the 1999 Agreement were in effect during the 2009 Agreement period, the model will be run assuming the 1999 Agreement target harvest rates to forecast the expected catches, terminal runs and escapements for the entire 10-year period of the 2009 Agreement. Changes to the code of the current PSC Chinook model will be required to allow the multi-year forward simulations. The coding changes introduced in the PSC chinook model used in forward simulations to support the negotiation of the 1999 Pacific Salmon Treaty provide the recommended starting point. We think that a reasonable deadline for this work to be completed is by June 1, 2016.

3. The third assignment is for the AWG to complete Phase 2 of the CTC Model Base period calibration and an annual calibration using the new base period information. This work would commence following completion of item 1 from above and may require a hiatus mid-February so that annual work related to the postseason and annual meetings along with generating the 2016 Exploitation Rate Analysis and model calibration can be completed to inform the 2016 fishing regimes of the respective parties.

   This direction recognizes the need for sequencing the AWG's time and focus to first address task 1 followed by task 3, acknowledging a break for annual reporting work during February and March and further that the majority of task 2 and much of the annual reporting could be delegated to CTC members that are not on the AWG. As well, the direction provides "sideboards" or guidelines regarding deadlines and scope of work to help keep the workload manageable. We thank you for your attention to this matter and look forward to receiving the work products, as assigned.




# PSC Chinook Technical Committee

**TO:** Pacific Salmon Commission

**FROM:** John Carlile, Gayle Brown and Robert Kope

**DATE:** April 9, 2016

**SUBJECT:** Preseason AABM Fishery Abundance Indices for 2016 and Post-Season Abundance Indices for 2014 and 2015

It is the understanding of the Chinook Technical Committee (CTC) that the Commission has agreed to use a PSC Chinook Model calibration that includes all of the agency supplied forecasts to produce the preseason AIs for 2016 and post-season AIs for 2014 and 2015 in the AABM fisheries. Under this direction, the CTC has completed a final calibration (#1601) of the Chinook Model for 2016. The completed calibration provides the Abundance Indices (AI) that are required for determining the 2016 preseason and the 2014 and 2015 post-season allowable catches for the three Aggregate Abundance Based Management (AABM) fisheries: Southeast Alaska all gear (SEAK), Northern British Columbia troll and Queen Charlotte Island sport (NBC), and West Coast Vancouver Island troll and outside sport (WCVI).

Although the Commission has agreed to the forecast assumptions to be used in the 2016 calibration the CTC-AWG has not yet had the opportunity to perform a comprehensive review of the results of calibration #1601. This review is a standard phase in the completion of the annual calibration. If errors in model inputs or questionable model outputs are discovered the CTC will notify the Commission.

The 2016 preseason AIs and the associated allowable catches are shown in Table 1.

Table 1. Preseason Abundance indices and associated allowable catches for the 2016 AABM Fisheries.

| | SEAK | NBC | WCVI |
|---|---|---|---|
| Abundance Index | 2.06 | 1.70 | 0.89 |
| Allowable Catch | 355,600 | 248,000 | 133,300 |

The 2014 preseason and post-season AIs, associated allowable catches and the observed catches for the AABM fisheries are shown in Table 2.

Table 2. Preseason and post-season Abundance indices, associated allowable catches and the observed catches for the 2014 AABM fisheries.

| Preseason | | | |
|---|---|---|---|
| | SEAK | NBC | WCVI |
| Abundance Index | 2.57 | 1.99 | 1.20 |
| Allowable Catch | 439,400 | 290,300 | 205,400 |
| Actual | | | |
| Observed Catch | 435,166 | 216,901 | 188,374 |
| Post-Season | | | |
| Abundance Index | 2.20 | 1.80 | 1.12 |
| Allowable Catch | 378,600 | 262,600 | 191,700 |

The 2015 Post-season AIs, associated allowable catches and the observed catches for the AABM fisheries are shown in Table 3.

Table 3. Post-season Abundance indices, associated allowable catches and the observed catches for the 2015 AABM fisheries.

| Preseason | | | |
|---|---|---|---|
| | SEAK | NBC | WCVI |
| Abundance Index[1] | 1.45 | 1.23 | 0.85 |
| Allowable Catch | 237,000 | 160,400 | 127,300 |
| Actual | | | |
| Observed Catch | 337,794 | 158,903 | 113,293 |
| Post-Season | | | |
| Abundance Index | 1.95 | 1.69 | 1.05 |
| Allowable Catch | 337,500 | 246,600 | 179,700 |

[1] There was neither consensus within the CTC to use the 2015 preseason calibration CLB1503 nor agreement to use the AIs produced by the calibration. However, there was an agreement reached within the Commission to manage to the allowable catches that resulted from the AI values.

cc John Field
Alison Agness
Kirsten Ruecker