NECHAKO FISHERIES CONSERVATION PROGRAM

A Joint Program of the Government of Canada, Rio Tinto Alcan and the Province of British Columbia

STEERING COMMITTEE MEETING (2014/15-1)

DATE: March 31, 2015

Members:

Steering Committee	**Technical Committee**
Mike Long (Rio Tinto Alcan)	Justus Benckhuysen (Rio Tinto Alcan)
Ted Zimmerman (Provincial Crown)	Ray Pillipow (Provincial Crown)
Jason Hwang (Federal Crown)	Byron Nutton (Fed Crown)
	David Levy (Independent Member)

Decision Record

In Year 23 (2010-2011) a decision was taken (SC Decision Record 2010/11-2) to "close-off" the accounting for monitoring projects up to and including Year 22 which were considered balanced in accordance with the cost-sharing provisions of the 1987 Settlement Agreement. In consideration of the fry/juvenile work ($372,000) that was financed by RTA in 2010, it was agreed that DFO would fund the majority of the enumeration and carcass recovery projects delivered between 2011 through 2015. The actual expenditures by RTA and DFO for NFCP monitoring activities from 2010 up to and including 2014/15 (Year 27) are shown in the Table below.

	Rio Tinto Alcan	Fisheries & Oceans	Total	**Imbalance**
Year 23	$374,600	$90,700	$465,300	**$283,900**
Year 24	$2,500	$90,700	$93,200	**$195,700**
Year 25	-	$61,000	$61,000	**$134,700**
Year 26	-	$61,000	$61,000	**$73,700**
Year 27	-	$70,700	$70,700	**$3,000**
Total	$377,100	$374,100	$751,200	**$3,000**

This book-keeping indicates that the imbalance has been effectively retired with RTA having expended $3,000 more than DFO over the 5-year financing period.

P.O. Box 2551, Vanderhoof, B.C. V0J 3A0

Jason Hwang, Fisheries and Oceans Canada

Ted Zimmerman
BC Ministry of Forests, Lands and Natural Resource Operations

Mike Long
Rio Tinto Alcan

STEERING COMMITTEE MEETING (2014/15-2)

DATE: March 31, 2015

Members:

Steering Committee	**Technical Committee**
Mike Long (Rio Tinto Alcan)	Justus Benckhuysen (Rio Tinto Alcan)
Ted Zimmerman (Provincial Crown)	Ray Pillipow (Provincial Crown)
Jason Hwang (Federal Crown)	Byron Nutton (Fed Crown)
	David Levy (Independent Member)

Decision Record

Re: Termination of NFCP Chinook Monitoring in the Nechako River

The NFCP has monitored Chinook salmon escapements to the Nechako River annually since 1988. The program has evolved substantially since the cancellation of the Kemano Completion Project in 1995 and the preparation of program evaluations in a Technical Data Review (TDR) in 2005 and 2 Five Year Plans covering 2007-2012 and 2012-2017.

Following the accumulation of multiyear data sets the Technical Committee produced a comprehensive TDR to summarize monitoring information spanning the years 1988 - 2002. Following thorough review, the TDR concluded that :

> *"... it is the opinion of the [NFCP] Technical Committee that the current in-river conditions examined by the committee are sufficient to sustain a population of Chinook salmon that fluctuates generally within the "target population" range identified by the Conservation Goal."*

and

> *"... the Nechako Fisheries Conservation Program Technical Committee concludes that the spirit and intent of the Conservation Goal has been met."*

Following 2005 the Nechako Environmental Enhancement Fund evaluated the feasibility of constructing a Kenney Dam Cold Water Release Facility (CWRF) that would have potentially altered the flow hydrograph in the Nechako River. Consequently the parties to the NFCP agreed that continuation of the Chinook monitoring program beyond 2005 would be desirable. With the decision not to proceed with a CWRF and now that 26 years of Chinook escapement monitoring have elapsed it is timely to evaluate the monitoring results in relation to the original program objectives.

Analyses by the Technical Committee have shown that Nechako Chinook escapements between 2003 - 2014 have increased on average by 61% compared to the earlier period considered during the TDR (1988 - 2002) thus supporting the earlier conclusions contained in the TDR . Over the period 2003-2014 the average escapement was 3967, very close to the upper range of the target population (4000 spawners) of the Conservation Goal. The Technical Committee report, attached to this Decision Record, that documents these findings is titled:

Trends in Adult Chinook Salmon Escapements in the Nechako River: Results from 26 Years of NFCP Monitoring

The Chinook escapement monitoring program, previously undertaken between the last week of August and throughout September, will be taken over by the Stock Assessment Division of DFO as part of the province-wide escapement monitoring of large Chinook rivers in BC. Other NFCP water management functions, including the Annual Water Allocation (AWA) and the Summer Temperature Management Program (STMP), will continue to be operated as set out in the *1987 Settlement Agreement*.

Jason Hwang, Fisheries and Oceans Canada

Ted Zimmerman
BC Ministry of Forests, Lands and Natural Resource Operations

Mike Long
Rio Tinto Alcan

Trends in Adult Chinook Salmon Escapements in the Nechako River:

Results from 26 Years of NFCP Monitoring

Prepared by:

Nechako Fisheries Conservation Program Technical Committee

March, 2015

Executive Summary

The NFCP has monitored Chinook salmon escapements to the Nechako River annually since 1988. The program has evolved substantially since the cancellation of the Kemano Completion Project in 1995 and the preparation of program evaluations in a Technical Data Review (TDR 2005) and 2 Five Year Plans covering 2007-2012 and 2012 - 2017. Now that 26 years of Chinook escapement monitoring have elapsed it is timely to evaluate the monitoring results in relation to the original program objectives.

Chinook salmon utilize the Nechako River year round for adult migration, spawning, egg incubation, alevin development, juvenile rearing and juvenile migration. Juveniles outmigrate from the river either as fry, fingerlings or smolts. The population is thus dependent upon the integrity of Nechako River habitats. Escapement monitoring provides a means to integrate the effects of flow regulation coupled with survival in downstream habitats, the ocean and harvesting of Nechako Chinook in commercial, recreational and aboriginal fisheries.

Escapement measurement methodology has evolved over time and presently involves Area-under-the-Curve and Maximum Likelihood Analysis procedures. The method relies upon sequential helicopter overflights and an estimate of the residence time of female Chinook in the vicinity of spawning redds. The present evaluation considered 2 monitoring periods: 1) 1988 - 2002, covering the data set analysed during the 2005 TDR, and 2) 2003 - 2014. The intention was to determine whether the conclusions in the TDR remain valid by comparing the respective escapements in the 2 periods. Results showed that Chinook escapements in the recent period have increased on average by 61% compared to the earlier period, thus supporting the earlier conclusions contained in the TDR . Over the period 2003-2014 the average escapement was 3967, very close to the upper range of the target population (4000 spawners) of the Conservation Goal.

Contents

1. Introduction

The NFCP was created by a 1987 legal agreement between the Canadian Federal Government (Department of Fisheries and Oceans), the British Columbian Provincial Government (Ministry of Environment and Parks), and Alcan Inc. to ensure the conservation of the Nechako River salmon. The NFCP Technical Committee is comprised of individuals representing these three agencies and one independent member who chairs the Committee. The 1987 agreement provided a mandate for the NFCP to ensure the conservation of Nechako salmon during the planned Kemano Completion Project (KCP) which would have further reduced flows in the Nechako River.

Between 1987 - 1994, NFCP initiated a scientific program that anticipated a future KCP flow reduction. Among other activities, data bases and indices were developed to detect changes in Nechako Chinook abundance. A set of 'remedial measures' was evaluated in the event they were required following implementation of the lower KCP flows.

These arrangements were altered in January 1995 after the KCP was rejected by the Government of BC. There was then an uncertain period between 1995 - 1997 when outstanding legal issues were resolved. Finally, in 1997 there was a BC-Alcan Agreement signed which eliminated the prospect for lower flows to the Nechako River. The Agreement also specified that the NFCP would continue to operate according to the *status quo* in effect since 1988.

The *1987 Settlement Agreement* sets out a “Conservation Goal,” defined as: *… the conservation on a sustained basis of the target population of Nechako River Chinook salmon including both the spawning escapement and the harvest as referred to in paragraph 3.1 of the Summary Report.*

Paragraph 3.1 of the *Summary Report*, appended to the Agreement, states that:

> *"The total population of Chinook to be conserved is that represented by the average escapement to the river plus the average harvest during the period 1980-1986. Department of Fisheries and Oceans escapement records during this period averaged 1,550 with a range of 850-2,000. In view of the known inaccuracies in spawner count data the working group recognizes that the*

estimated escapement is on average 3,100 spawning Chinook, but ranges from 1,700 to 4,000. This number is referred to as the target population."

After multiyear data sets began to accumulate the Technical Committee produced a comprehensive Technical Data Review (TDR 2005) to summarize monitoring information spanning the years 1988 - 2002. Following thorough review, the TDR concluded that :

"… it is the opinion of the [NFCP] Technical Committee that the current in-river conditions examined by the committee are sufficient to sustain a population of Chinook salmon that fluctuates generally within the "target population" range identified by the Conservation Goal."

and

"… the Nechako Fisheries Conservation Program Technical Committee concludes that the spirit and intent of the Conservation Goal has been met."

In view of these previous conclusions, in 2007 the NFCP prepared a Five-Year plan that significantly revised adult Chinook estimation procedures based on systematic evaluation of the need for, and consequences of, alterations to the frequency and scheduling of monitoring activities. Specific changes included reductions in helicopter overflight frequency during annual abundance surveys, adoption of the long term average residency time for scaling adult Chinook numbers, and reduced frequency of fry emergence and juvenile outmigration surveys. These modifications were extended into the second NFCP Five-Year plan covering 2012-2017.

In view of the long duration of NFCP monitoring (26 years) it is timely to examine whether the conclusions of the TDR remain valid and to assess the need for continued NFCP Chinook monitoring on a long-term basis. This report has been prepared to evaluate the trends in Chinook escapements in the Nechako, and to serve as a basis for a future Chinook monitoring program re-evaluation. Other annual NFCP activities, e.g. Summer Temperature Management Program (STMP) and the Annual Water Allocation (AWA) are outside the scope of the review and will remain in effect independently of the results of a future Chinook escapement monitoring re-evaluation.

2. Nechako Chinook Life History

To evaluate the sensitivity of the Chinook population to flow regulation it is important to understand Nechako Chinook life history. The NFCP monitoring program was initially designed to comprehensively monitor all life history stages in all years. Over time, this approach has been streamlined, based on experience and empirical evaluation, to create efficiencies in program delivery. This section provides a brief review of Nechako Chinook life history to provide context for NFCP monitoring activities

A comprehensive summary of Chinook life history (Healey 1991) provides general biological information on Chinook salmon across their geographical range. Chinook are divided into 2 different races: "ocean-type" and "stream-type" depending on whether they emigrate to the ocean as fry or as yearling smolts. Nechako Chinook are stream-type animals (Bradford 1994) and have juveniles that reside in the Nechako during their first year or in the Fraser River mainstem (Levings and Lauzier 1991), or in non-natal streams (Murray and Rosenau 1989) before outmigrating to the ocean. Following hatching the juvenile Chinook outmigrate either as fry in March - May, as fingerlings later in April - July or as yearling smolts in the following spring.

Chinook spawn in the mainstem of the Nechako River between Vanderhoof and Cheslatta Falls typically between the end of August and early October. Chinook spawning locations are fairly evenly distributed, with highest numbers in the Upper Nechako about 20 km downstream of Kenney Dam. The eggs hatch in about December but the newly hatched alevin remain in the gravel until March of the following year. Juvenile Chinook emerge as free-swimming fry from March to May. During NFCP juvenile assessments, separate programs are run to sample emergent fry in mid-March through mid-May using Inclined Plane Traps and migrating fingerlings between mid-April through mid-July utilizing Rotary Screw Traps and electrofishing (see Appendix 1).

Sampling of Chinook carcasses has been conducted annually by the NFCP to collect biological data on age, size, life history, sex and egg retention. The following data are routinely collected.

- sex
- condition
- post-orbital hypural length
- egg retention and fecundity
- scale samples for aging purposes

Over 99% of Nechako Chinooks spend their first summer and winter in freshwater before going to sea in their second year of life. 5-year olds are the dominant age class, followed by four-year olds. In some years e.g. 2014, 4_2 Chinook predominate. Small numbers of 3-year old, 6-year old and 7-year old fish also occur in the Nechako population.

The sex ratio of Chinook (number of female carcasses to male carcasses) has averaged 1.37. The higher frequency of females is thought to be related to a number of possible causes including male:female variations in residence time and sex-based catchability. Egg retention data can provide some insight into habitat conditions during migration, particularly high water temperature which can cause salmon to die before spawning.

The TDR (2005) compared the life history characteristics of Nechako and upper Fraser River Chinook, including Stuart River Chinook, and came to the following conclusions. There were no notable differences in adult characteristics between the Chinook from the Nechako River and those from the unregulated streams of the Upper Fraser River basin. The age structure of Nechako Chinook closely resembled the age structure found in the unregulated Stuart River and was not markedly different from the age structure of combined Fraser River basin stream-type Chinook. The sex ratios of the Nechako and Stuart River Chinook populations were skewed towards females, but that was possibly the result of a bias towards sampling female carcasses, compounded by sex-related differences in age at sexual maturation. The fact that the Nechako River and Stuart River populations have a similar range of sex ratios and age structure indicated that the observed ratios in the Nechako River were not related to flow regulation. The fecundity of the Nechako River population appeared to follow the same general trend for body length observed for other Fraser River basin Chinook stocks. Egg retention was low, indicating most females had the opportunity to release their eggs.

In summary, Chinook are present in the Nechako River throughout the year and utilize river habitats for adult migration, spawning, egg incubation, alevin development, juvenile rearing and juvenile migration. They are potentially sensitive to flow regulation at all of these different life history stages. Section 3 evaluates temporal trends in Chinook escapements as a means to integrate impacts of water regulation across the different life history stages.

3. Chinook Escapement Estimates

Nechako River Chinook have been monitored annually in relation to the Conservation Goal. Spawner abundance estimation has been carried out using Area-under-the-Curve methodology since 1988; prior to then, spawner counts were obtained by DFO Fishery Officers using less rigorous methods (Jaremovic and Rowland 1988).

The Area-under-the-Curve (AUC) method uses both periodic helicopter counts of spawner numbers during fall Chinook spawning and estimates of the time female spawners spend on the redd (residence time) in the calculation of the spawner population size. Detailed sampling procedures are described in the TDR (2005).

There is no absolute ground truth of the number of spawning Chinook in the Nechako, such as a fence count. The accuracy of applicable survey methods, including the Area-under-the-Curve method, is only partially understood[1]. In contrast, the precision of the estimates can be estimated by means of repeated measurements (i.e. replicate helicopter surveys within single days), but these are largely impractical. In general, higher sampling frequencies result in more precise measurements. These relationships are illustrated in Figure 1.

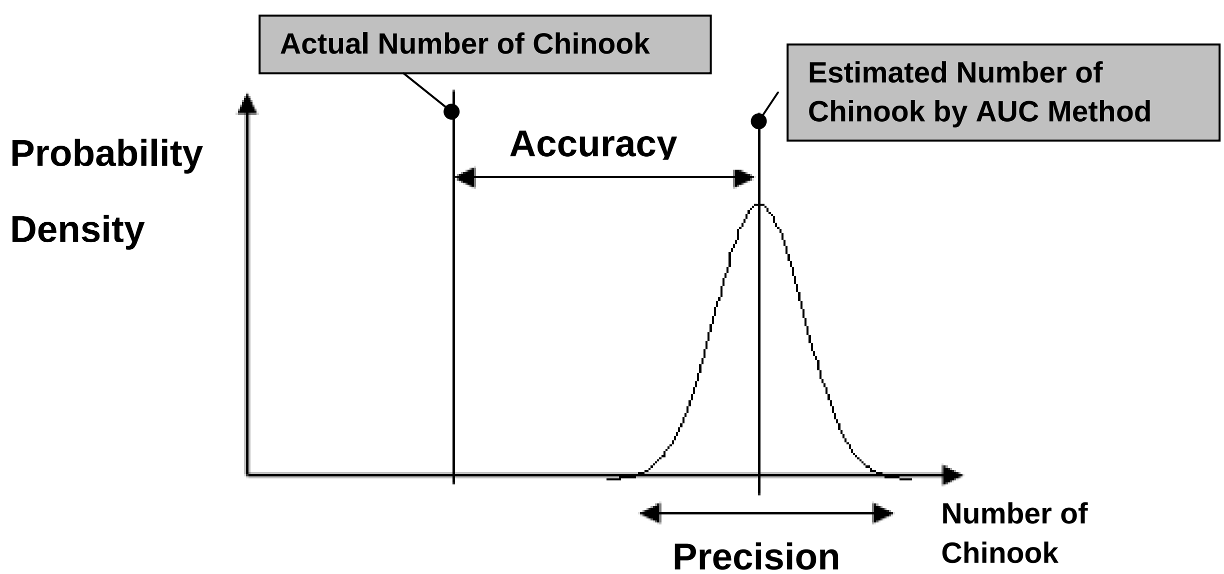


Figure 1. Graphic to illustrate the concepts of accuracy and precision, as they pertain to Chinook abundance estimation in the Nechako River.

[1] For example, there is no correction for observer sighting efficiency of chinook during aerial counts

DFO have analyzed the loss in spawner abundance estimation precision associated with reductions in the overflight frequency. The method integrates abundance over time and either uses a trapezoidal approach (i.e. “connect the dots”) or more recently a maximum likelihood analysis (MLA) to fit a normal curve to the data. Figure 2 shows the 1989 aerial overflight observations relative to the fitted normal curve.

The MLA has better statistical properties than the trapezoidal approach, thus providing a better estimate of the true Chinook population size. From 1988 to 2005 the NFCP used the trapezoidal method as the basis for the annual population estimate. In 2006, the NFCP adopted the MLA based on analyses conducted by DFO. Table 1 indicates that the use of the MLA has limited the departure from escapement counts generated by the trapezoidal method and also provides adequate precision at lower flight frequencies.

DFO reviewed the sensitivity of the precision of the spawner estimate to the frequency of the spawner flights and concluded that the use of five weekly flights (occurring throughout the first 4 weeks in September and first week of October) achieved the best balance between survey frequency, accuracy of resultant escapement estimates, and ability to produce reliable inferences for stock status. This result is similar to the conclusions of Hill (1997). Table 1 compares the results with the entire data series (6-9 overflights/year) with the MLA using all data; this analysis shows that the reduced flight frequency had a mean percent error of 1.3% (95% CI is ±0.6%).

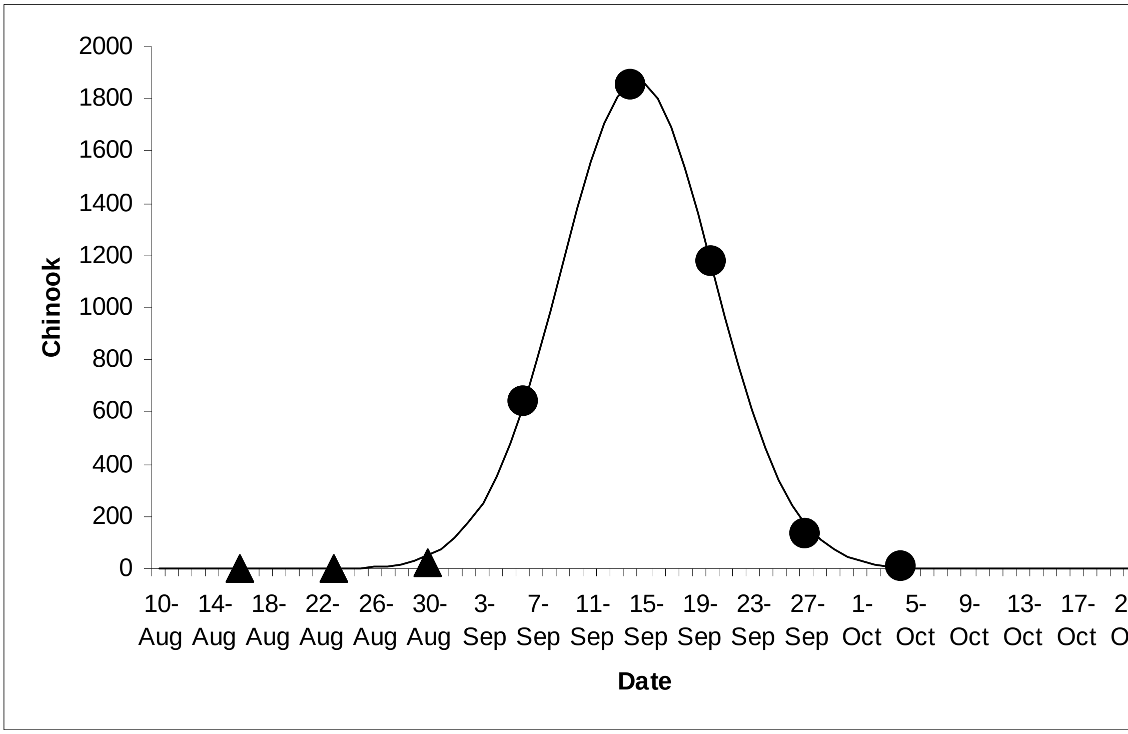


Figure 2. Maximum Likelihood fit of the normal curve to estimates of adult Chinook in the Nechako River, 1989. Round circles indicate the five observations that fall within a September/first week of October timing window; triangles are observations that fall outside the recommended sampling window.

Table 1. DFO sensitivity analysis of Nechako flight frequency for estimating Chinook spawner population abundance. ML = maximum likelihood, AUC = area-under-the-curve. Source: DFO, Kamloops.

Option	Description	Mean Absolute Percent Error	95% CI
1: ML AUC – 5 flights	5 of the original weekly flights thru the first 4 weeks of Sept. and first week of Oct.	1.3%	±0.6%
2: ML AUC – 5 flights	5 of the original weekly flights thru the last week in Aug. and the first 4 weeks of Sept.	2.8%	±2.5%
3: ML AUC – 4 flights	4 of the original weekly flights thru the first 4 weeks of Sept.	3.9%	±3.5%
4: ML AUC – 4 flights	1 flight from the last week in Aug. and the first 3 weeks in Sept.	17.4%	±12.9%
5:Trapezoidal – AUC	All original flights	3.3%	±2.8%
6: Peak count	Original flight with highest count and 1.56 expansion factor (assumes 65% of population is observed)	14.2%	±4.8%
7: Peak count	Original flight with highest count and 1.68 expansion factor (assumes 61% of population is observed)	12.2%	±6.5%

These observations are consistent with a threshold mechanism between flight frequency and measurement precision of Chinook escapements. Additional flights above the threshold will not greatly improve precision. In contrast, a reduced number of flights below the threshold will lead to rapid degradation of the precision of the escapement estimates.

Parameters affecting the accuracy and precision of the Chinook spawner population estimate were evaluated by Triton (1997). There was no significant impact on population estimates when mean residency times were pooled for sampling sites (upper river vs. lower river) and spawning times (early spawners vs. late spawners). This implies that a single monitoring site located in the upper river can suffice for measurements of residency time. Consequently, since 2007, NFCP has relied upon a single site in the Upper Nechako for estimating residence time on a 5-year measurement interval.

Additional sensitivity analyses have been reported in the NFCP 5-year plan covering 2007-2012 (NFCP 2007). Mean female residency time on redds has varied between 8.9 days in 1994 to 12.5 days in 2004. The use of a mean residence time of 10.6 days in comparison with an annual frequency of measurement results generally in a relatively small loss of measurement precision. The magnitude of difference in the annual population estimate introduced by using the mean residency time varied between 0 to ±18 % between the period 1989 – 2005. Deviations greater than 10 % occurred in 7 out of 17 years. This reduction in measurement precision (from using the mean residency time) over the course of the program would not have altered any conclusions regarding the achievement of the Conservation Goal.

The Technical Committee concluded in 2007, based on the results of this analysis shown in the 2007-2012 Five Year Plan, that use of the mean residence time (10.6 days) in future AUC calculations would provide a sufficiently precise estimate of the spawner population. However, if the population were to approach the minimum level (1700) included in the 1987 Settlement Agreement, the Technical Committee would re-evaluate the necessity to revert to annual estimates of residence time.

The performance goal for Chinook monitoring is defined as a range of 1700-4000 animals with an average of 3100, based on “the average escapement to the river plus the average harvest during the period 1980-1986.” A significant challenge is the inability to estimate the harvest component for the stock. Coded-wire tagging data from an Upper Fraser chinook hatchery would be required to derive catch estimates but no such data are available over the life of the NFCP monitoring program.

In 1988 and subsequently, the NFCP monitored Stuart River Chinook using mark-recapture methods so as to measure and compare the population trends in an adjacent unregulated river system. During the 2005 Technical Data Review preparation, DFO Science Branch and Stock Assessment personnel advised the Technical Committee that they believed the technique used to enumerate the Stuart River Chinook escapement, both in theory and in practice, was highly variable and that its value in identifying future trends in the escapement would be limited. In response the Technical Committee decided to discontinue the annual project.

NFCP has explored alternate means to identify whether variations in year-to-year Chinook returns to the Nechako are a result of independent variation in the productivity of this stock or whether these variations are synchronous in other stocks. The latter would reflect extrinsic events taking place outside of the Nechako River.

This was done by first assessing trends from other stocks in geographical proximity (i.e. Stuart River) and comparing escapement per escapement[2] of non-Nechako vs. Nechako stocks and, second, by examining aggregates of DFO Chinook Technical Committee (CTC) index stocks.

[2] synonymous with recruits-per-spawner

Chinook escapement data from other Fraser stocks were compared to Nechako returns to assess whether there was another stock(s) that correlated with Nechako returns over the period of record. No individual stock correlated with Nechako returns over the periods 1980 to 2003 and 1988 to 2003 (after NFCP monitoring began). Comparisons were also undertaken by comparing CTC Spring and Summer index stocks (aggregates) with trends in Nechako Chinook returns. Both Summer 5_2 Chinook (Chilko, Quesnel, Nechako[3], Stellako, Stuart, Clearwater, Mahood, Raft, Portage, N.Thompson, Seton and Portage stocks) and mid Fraser stocks (Maria Slough, Upper Pitt, Birkenhead, Bridge, Portage, Seton, Chilcotin, Chilko, Cottonwood, Horsefly, Quesnel and Westroad) were compared.

The results from the comparison of escapement per escapement (EPE) suggested that the Summer 5_2 and mid-Fraser stocks are strongly coherent. However neither the Stuart nor the aggregates (CTC Summer or mid Fraser) provided a suitable reference for the Nechako population (NFCP 2007).

NFCP looks at trends in other populations to better understand the overall context of salmon stock dynamics, however the main focus is to ensure that Nechako specific data supports the Conservation Goal. Nechako Chinook can be analyzed in relation to 2 separate time periods (Table 2) corresponding to different phases of NFCP monitoring: prior to and after the TDR evaluation.

Table 2. Comparison of Chinook escapements over the period 1988 - 2014.

Time Period	Description	Mean Escapement
1988 - 2002	start-up of NFCP monitoring until end of TDR analysis	2460
2003 - 2013	recent period incorporating modifications described in 5 year Plan for 2007-2012 and 2012 - 2017	3967

The escapement time trends for the 2 periods are shown in Figure 3 together with the corresponding mean escapements.

[3] excluded from aggregate value

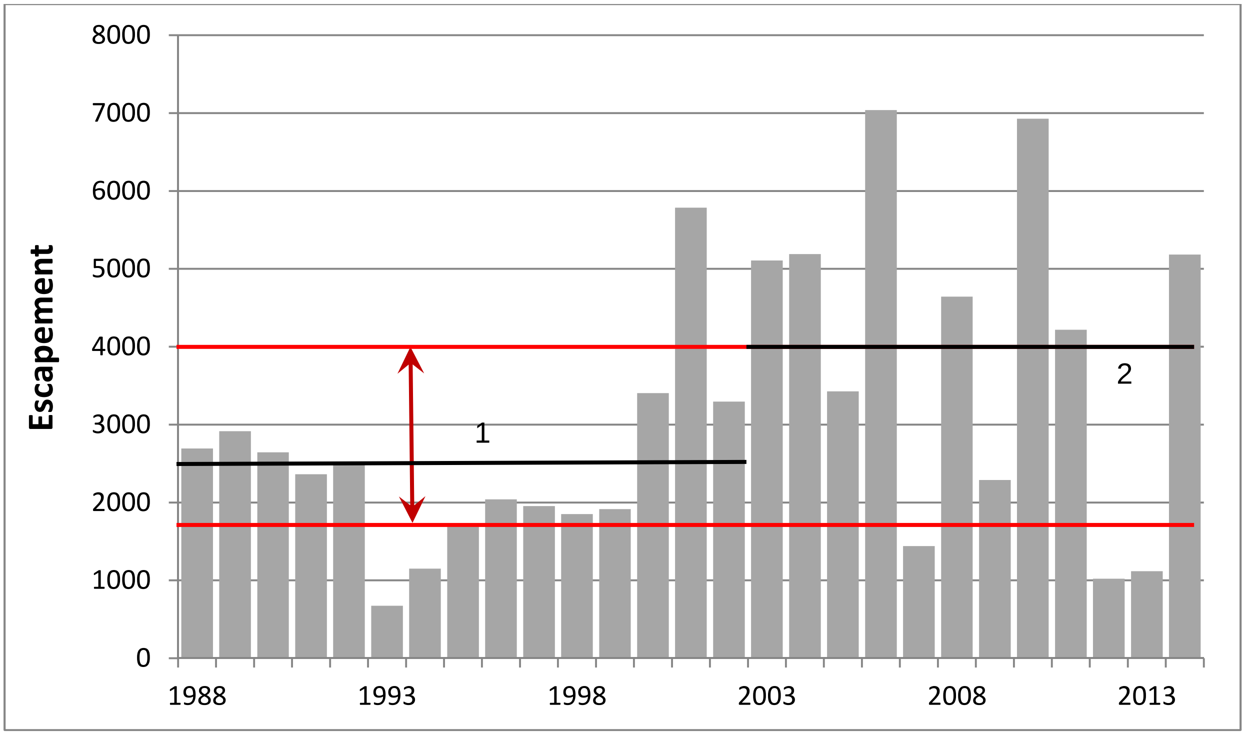


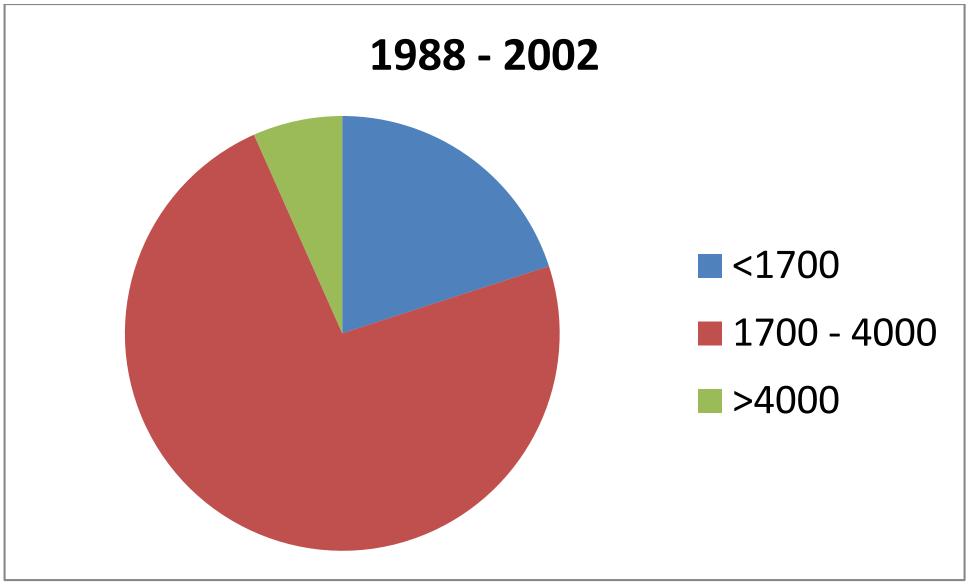
Figure 3. Comparison of Nechako Chinook escapements during 2 different time periods - 1: 1988 - 2002, and 2: 2003-2014. Mean values are depicted by the black horizontal lines and red lines show the Conservation Goal.

The escapements were significantly higher in time period 2 (2003-2014) as determined by a one-tailed T-test (p=0.014).

The escapement time series was further analysed by summing the number and percentage of years when escapements were below, within, or above the target escapements that define the Conservation Goal. The distributions are shown in Table 3 and Figure 4.

Table 3. Frequency analysis of escapements in 2 time periods. Percentage values shown in brackets.

	Less than 1700	Between 1700 - 4000	Greater than 4000
1988 - 2002	3 (20%)	11 (73%)	1 (7%)
2003 - 2013	3 (25%)	2 (17%)	7(58%)



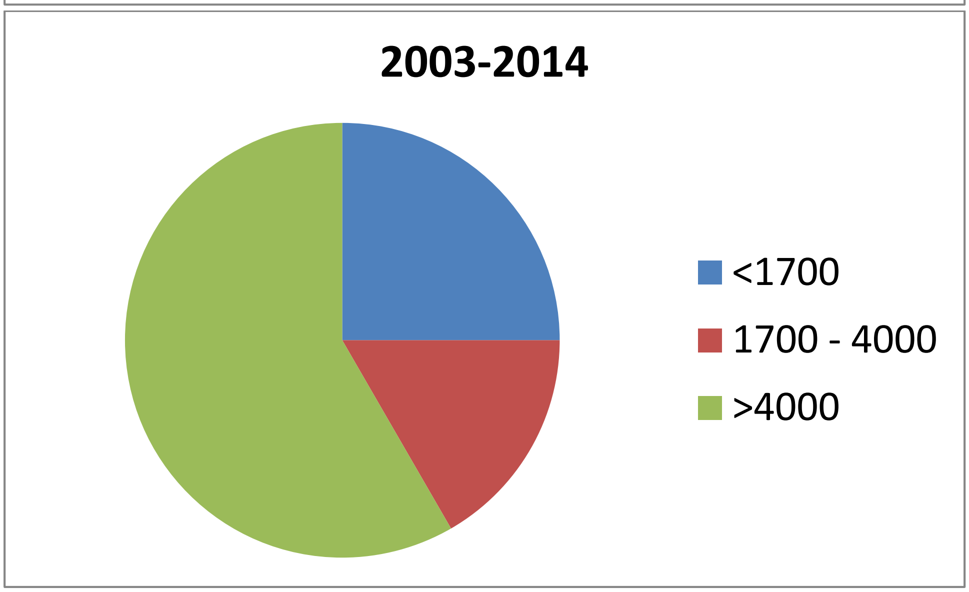


Figure 4. Pie charts depicting the distribution of Nechako Chinook escapements in relation to the target population of the Conservation Goal.

During 2003 - 2013 there was a higher percentage of escapement-years below the 1700 target population (27% vs. 20%) as well as a higher percentage of escapement-years above the 4000 target population (55% vs. 7%). This suggests higher variability in Chinook escapements during the 2003-2013 monitoring period compared to 1988-2002.

Over the entire escapement time series, when escapements were less than the 1700 target population, low escapements did not persist over time. For example, between 1993-1999 there was a series of relatively low escapements below or only slightly above the 1700 target population (Figure 3). Thereafter, a period of relatively high escapements persisted until 2007 which was again followed by an increase starting in

2008. Following 2012 and 2013 when escapements were below the 1700 target there was an increase to 5183 spawners in 2014.

Taken together, the data indicate an increasing trend in Nechako Chinook escapements over the 26 year observation period (Figure 5). The trend line needs to be interpreted cautiously since the correlation coefficient is low (R = 0.36). The overall trend is weakly positive.

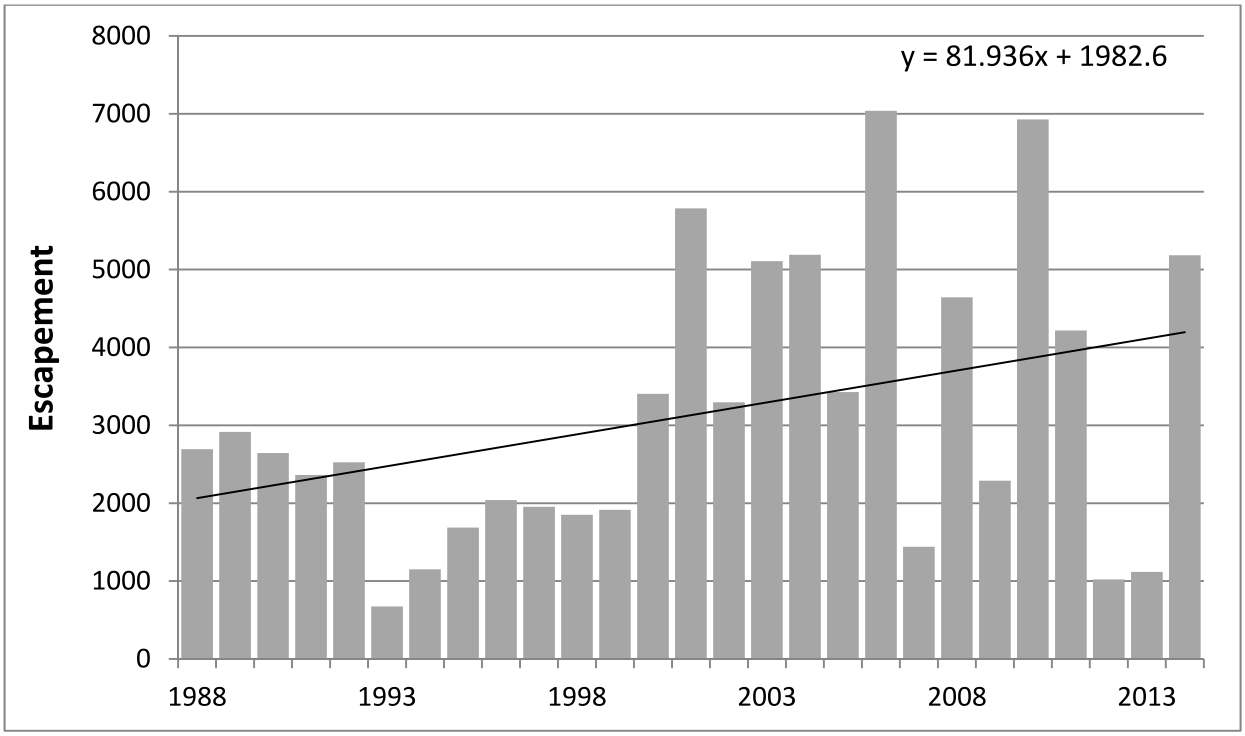


Figure 5. Nechako Chinook escapements showing linear trend line.

4. Discussion and Conclusions

The motivation for undertaking the present analysis was to evaluate the stability of Chinook escapements in the Nechako River and to determine whether recent escapements were similar, lower or higher than those which preceded the 2005 Technical Data Review. Escapement values obtained between 2003 - 2013 were on average 61% higher than those measured between 1988 - 2002. While the underlying reasons for the measured increase in escapements are not understood the results suggest that habitat conditions in the Nechako have remained suitable to support a Chinook population that generally fluctuates within the Conservation Goal.

Escapement estimation procedures were streamlined after 2005, by reducing helicopter overflight frequency during annual abundance surveys (from 7-9 overflights down to 5 after 2006), adopting the long term average residency time for scaling adult Chinook numbers (10.6 days), and reducing the frequency of fry emergence and juvenile outmigration surveys. Adult carcass surveys were continued between 2006-2014 to provide biological supporting data for the Chinook population counts and to provide a linkage to the historic data set. The impact of these changes was critically evaluated during the preparation of the 2007-2012 Five-Year Plan and it was determined that that the modified procedures only resulted in a minor loss of measurement accuracy and precision (NFCP 2007). Therefore it is unlikely that the increasing trends evident in the Nechako spawning escapement time series are strongly related to reduced sampling effort.

Previously, Bradford (1994) evaluated the trends in Nechako Chinook abundance during the 1970's and 1980's and demonstrated that over this time period, Nechako Chinook survived poorly in relation to other Upper Fraser Chinook stocks. He concluded that the divergence was due to the poor survival of broods using the Upper River where the relative degree of water removal was the greatest. This was surmised to be due to early emergence of fry caused by elevated fall and winter water temperatures or to higher rates of predation on juveniles and loss of rearing habitat caused by the elimination of the spring freshet. There may be value in revisiting Bradford's conclusions since over the period that the NFCP has monitored Nechako Chinook (1988 - present) the population has increased during a time period when other Upper and Middle Fraser Chinook stocks have declined (Riddell et al. 2013).

The present analysis confirms that the conclusions derived in the NFCP Technical Data Review (2005) remain valid, namely 1) "*that the current in-river conditions examined by the committee are sufficient to sustain a population of Chinook salmon that fluctuates generally within the “target population” range identified by the Conservation Goal”* and 2) *“that the spirit and intent of the Conservation Goal has been met.”*

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Appendix 1: Related NFCP Chinook Monitoring Activities

Fry Emergence and Juvenile Outmigration Surveys

Juvenile life history data indicate several strong correlations between number of Chinook spawners in the river and corresponding juvenile production indices. The indices developed by NFCP include:

- Fry emergence index
- Juvenile outmigration index

During 2010, Triton Environmental Consultants Ltd. undertook the most recent fry emergence and juvenile outmigration assessments on behalf of the NFCP Technical Committee. Results are shown in Figures 6 and 7 respectively.

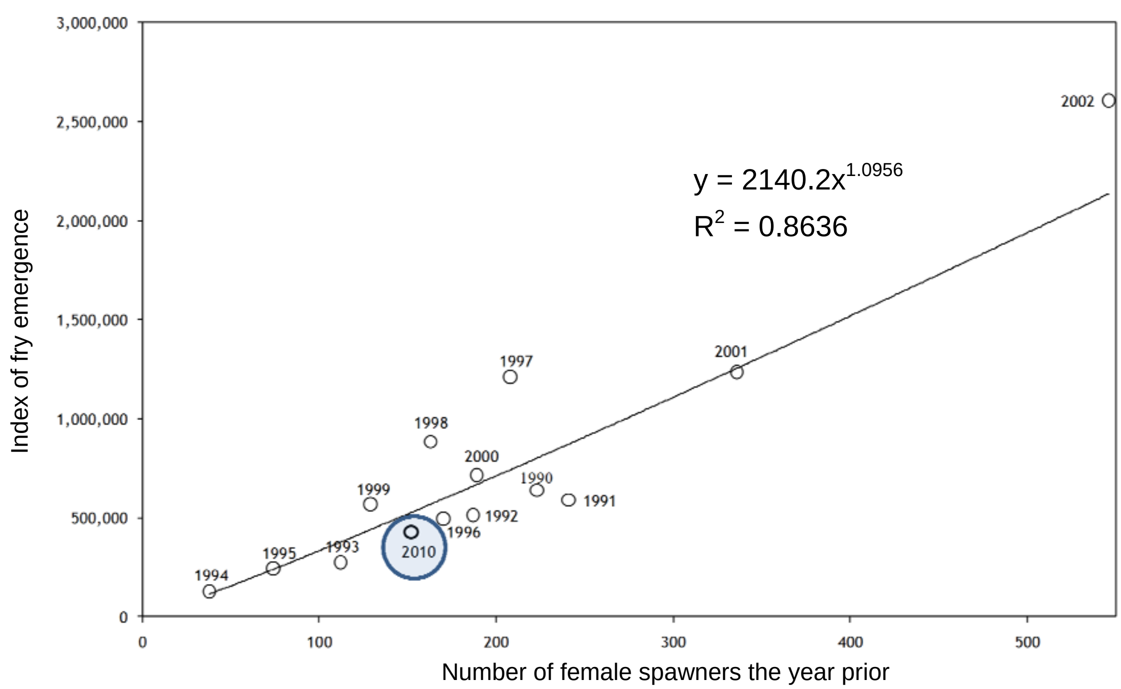

Figure 6. Index of fry emergence vs. spawner escapement during the previous year above Bert Irvine's, km 19 of the Nechako River, 1991- 2002, 2010 (circled data point).

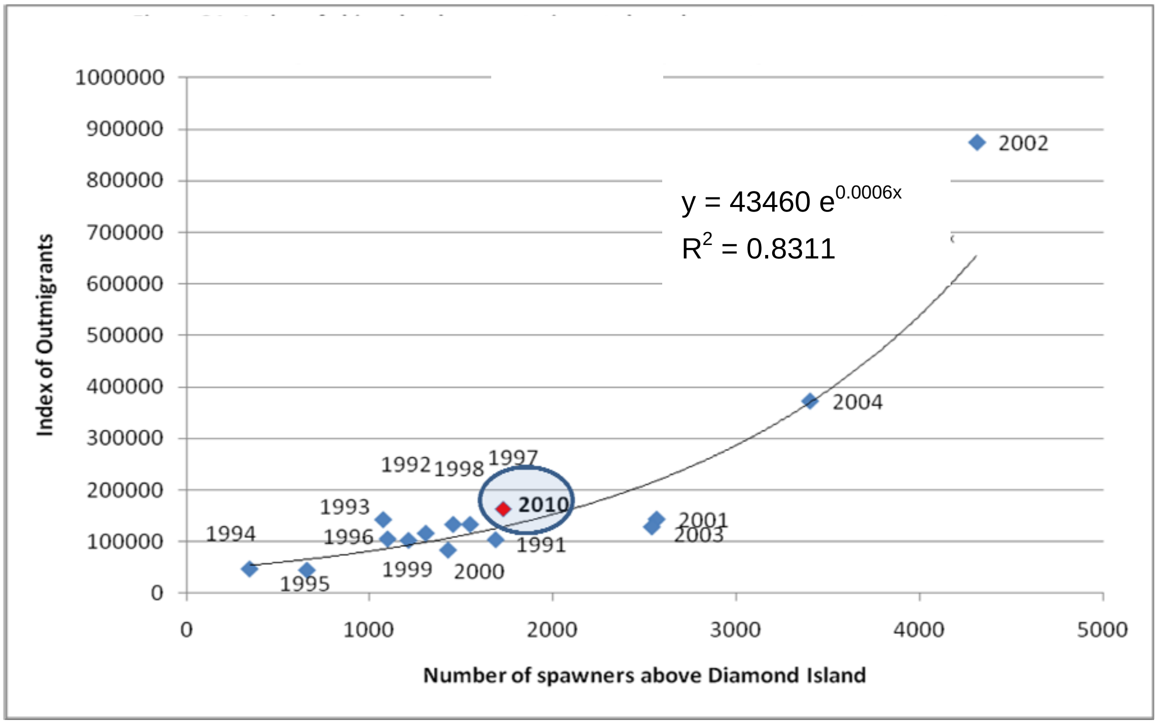

Figure 7. Index of Chinook salmon outmigrants based on rotary screw captures vs. the number of spawners above Diamond Island the previous year, Nechako River 1992-2004, 2010 (circled data point).

The regressions, including the 2010 data points, indicate a stable riverine environment over the period of record. In addition the relationships provide the opportunity to identify the percent departure for each of the project years. Based on the data on record and corresponding adult returns, the ranges in index values reflect conditions that are consistent with the achievement of the Conservation Goal.

Formerly, NFCP undertook fry and juvenile surveys on an annual basis. Based on the strength of the statistical relationships and the apparent stability of in-river habitat conditions, it was recommended in the 2007-2012 Five Year Plan that fry and juvenile surveys be carried out once every five years. It was further recommended that measurements of adult residence time be scheduled for the year prior to fry and juvenile surveys so as to optimize the accuracy of fry per spawner and juvenile outmigrants per spawner estimates. These recommendations were implemented and the results (Figures 6-7) confirm previous conclusions that the Nechako River provides a stable incubation and rearing habitat for the Chinook salmon population.

NECHAKO FISHERIES CONSERVATION PROGRAM

A Joint Program of the Government of Canada, Rio Tinto Alcan and the Province of British Columbia

STEERING COMMITTEE MEETING (2014/15-3)

DATE: March 31, 2015

Members:

Steering Committee	**Technical Committee**
Mike Long (Rio Tinto Alcan)	Justus Benckhuysen (Rio Tinto Alcan)
Ted Zimmerman (Provincial Crown)	Ray Pillipow (Provincial Crown)
Jason Hwang (Federal Crown)	Byron Nutton/Mark Potyrala (Fed Crown)
	David Levy (Independent Member)

Decision Record

The Steering Committee approves the 2015-2016 program as set out in the attached table.

Jason Hwang, Fisheries and Oceans Canada

Ted Zimmerman
BC Ministry of Environment

Mike Long
Rio Tinto Alcan

Table 1. NFCP: Proposed 2015/2016 Program.

REMEDIAL MEASURES	DAYS	DISBURSEMENTS*	RESPONSIBLE
Summer Temp Management	$54,750	$15,910	RTA
Flow Control	$11,250	$3,410	RTA
Flow Discrepancy Project	$4,500	$10,000	RTA
TOTAL	$70,500	$29,320	**$99,820**
COMMITTEE OPERATIONS**	***	$50,000	

*Includes contracts
**Includes Independent Member, Annual Meeting and Report, Technical Report Production, and Committee Meetings
***As required by each party