2007 CHINOOK SALMON SONAR ENUMERATION ON THE BIG SALMON RIVER

CRE-41-07

Prepared For: The Yukon River Panel
Restoration and Enhancement Fund

Prepared By: B. Mercer and J.K. Wilson

J. Wilson & Associates
Box 20263
Whitehorse, Yukon
Y1A 7A2

January, 2008

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES ii

ABSTRACT iii

INTRODUCTION 1

- Study Area 2
- Objectives 2

METHODS 4

- Site selection 4
- Camp and Sonar Station setup 4
- Sonar and computer software configuration 6
- Sonar data collection 8
- Carcass Pitch 9

RESULTS 9

- Chinook Salmon Counts and Run Timing 9
- Diel Migration 10
- Carcass Pitch 11

DISCUSSION 11

- Recommendations: 14

REFERENCES 15

ACKNOWLEDGEMENTS 16

LIST OF FIGURES AND TABLES

Figure 1. Big Salmon River Watershed and location of the 2007 Big Salmon sonar station. 3
Figure 2. Partial weirs and 34 m opening for fish passage viewed from the south bank. . 5
Figure 3. Aerial view of sonar station camp and partial weirs. 6
Figure 4. Sonar transducer unit and mounting stand. 7
Figure 5. Sonar transducer unit and mounting stand in position. 7
Figure 6. Schematic diagram of river profile and sonar and weir configuration. 8
Figure 7. Daily counts of Chinook salmon passing the Big Salmon River sonar station in 2005, 2006, and 2007. 10
Figure 8. Cumulative counts of Chinook salmon passing the Big Salmon River sonar station in 2005, 2006, and 2007. 10
Figure 9. Total hourly counts of Chinook salmon passing the Big Salmon River sonar station in 2005, 2006 and 2007. 11
Table 1. Size and age structure of Big Salmon River Chinook salmon carcasses sampled in 2007. 12

LIST OF APPENDICES

Appendix 1. 2007 Big Salmon River Sonar Chinook Salmon Counts and Water Conditions. 17
Appendix 2. 2007 Big Salmon River Chinook Salmon Carcass Pitch Sampling Results. 18
Appendix 3. Daily and cumulative Big Salmon River Chinook sonar counts in 2005 and 2006. 21

ABSTRACT

In 2007, a long range dual frequency identification sonar (DIDSON-LR) was used to enumerate the Chinook salmon escapement to the Big Salmon River. In addition, associated run timing and diel migration patterns were determined. This was the third consecutive year the DIDSON sonar was operational at this site. The sonar was sited on the Big Salmon River at the same location used in 2005 and 2006; approximately 1.5 km upstream of the confluence with the Yukon River. Partial weirs were again placed on both sides of the river to restrict fish passage through a 34 m opening. The sonar was configured to provide a 29º conical ensonified field, 40 m wide that covered the water column within the fish passage opening.

A total of 4,450 targets identified as Chinook salmon was counted past the sonar station between July 16 and August 26, 2007. The peak daily migration of 435 fish occurred on August 1, and 90% of the run had passed the station by August 14. The cumulative daily run pattern exhibited a normal distribution and the 2007 run timing was similar to that observed in 2005 and 2006.

As in the previous years, the DIDSON-LR sonar unit produced observable images of fish swimming through the ensonified field at distances up to 40 m. At ranges greater than 25 m the lower resolution of target images did not allow for the quantitative determination of fish size. However, the relative size of the targets beyond 25 m could be determined qualitatively and the identification of migrating Chinook salmon was considered to be accurate. The results indicated that migrating Chinook salmon were readily distinguishable from resident fish species by the relative size of the image and difference in swimming behaviour. The 2007 Chinook count and run timing correlated well with previous Chinook salmon passage data from the Big Salmon River and were concordant with the 2007 DFO upper Yukon River Chinook genetic stock identification (GSI) proportional escapement estimates.

A carcass pitch was conducted over the total length of the Big Salmon River that yielded 150 Chinook carcasses. Each carcass was sampled for age, sex, length (ASL data) and DNA tissue. Of the 234 fish sampled, 110 (73%) were female and 40 (27%) were male. The mean fork length of females and males sampled was 835 mm and 774 mm, respectively. Age data was determined from 122 fish sampled. Age 1.4 (European)[1] was the dominant age class representing 93% of the sample while age 1.3 represented 24% of the sample. Age 1.2 and 1.5 represented 4% and 1% of the fish sampled, respectively. No spaghetti tags were observed or recovered from the sampled fish. A total of 74 DNA (axillary appendage) samples were collected.

[1] With European age format the first numeral denotes years spent in freshwater after hatching of fry (broodyear +1), and the second numeral denotes years spent in the ocean including spawning year of return. All age notations in this report are in European format

INTRODUCTION

Development of the DIDSON (**D**ual frequency **ID**entification **SON**ar) sonar technology occurred at the Applied Physics Laboratory at the University of Washington. It was initially developed for U.S. military applications and first utilised in 2002. It quickly became apparent that the DIDSON technology was suited for many applications including the detection of migrating salmon. Subsequently, researchers have found the DIDSON apparatus to be superior to other sonar systems for many applications involving the enumeration of migrating salmon (Galbreath and Barber 2005, Holmes et al. 2005, Maxwell et al. 2004). In general, the DIDSON units have been found to be reliable, require a minimum of operator training, and provide accurate counts of migrating salmon (Holmes et al. 2006, Mercer & Wilson 2005, 2006).

Data from the 2005 and 2006 Big Salmon River sonar project as well as other studies (Mercer Wilson 2006) indicate the Big Salmon River is a significant contributor to upper Yukon River Chinook salmon production. Telemetry studies from 2002 through 2004 indicated the system accounted for 9.2%, 10.4 % and 16.4% of the radio tags located in the upper Yukon River drainage[2] (Mercer 2005, Mercer and Eiler 2004, Osborne et al. 2003). Spawning escapement estimates into the Big Salmon River drainage, based on the three consecutive years of telemetry results, were 2,014, 13,126, and 4,224. In 2005 and 2006, the Big Salmon River sonar counts were 5,618 and 7,308. These counts represented approximately 18% and 20% of the total upper Yukon River spawning escapement point estimate in 2005 and 2006 (JTC 2006).

The Yukon River Joint Technical Committee (JTC) has indicated that obtaining accurate estimates of spawning escapements is required for the proper management of the Yukon River Chinook stocks. In the 2007 Yukon River Panel (YRP) Framework, determination of escapement estimates is ranked as a high priority as there is strong public and JTC interest in knowing the quantity and quality (ASL data) of escapements. This information is required for the construction of brood year tables, which are the bases for the establishment of scientifically based escapement objectives. The JTC's escapement recommendations address both escapement numbers and ASL data (Yukon River Panel 2007). The Big Salmon River stock contributes a significant share of the total upper Yukon River Chinook escapement and accurate counts of Chinook entering the drainage can provide a valuable index for the estimation of the total annual upper Yukon River Chinook escapement.

Traditional salmon weirs provide accurate counts but these are not suitable in larger rivers and streams. Due to high flow rates, First Nation concerns, and wilderness recreational use in the Big Salmon River, the use of traditional salmon weir techniques on this river is not feasible. For these reasons the DIDSON sonar was considered as a relatively low impact, non-intrusive method of enumerating annual Chinook escapements to the Big Salmon River system. The use of sonar allows for enumeration of migrating

---

[2] This is the proportional distribution of radio tags entering the Big Salmon River that had passed the telemetry stations at the Canada/U.S. border. In this report the upper Yukon River refers to the portion of the Yukon River drainage within Canada, excluding the Porcupine River system.

Chinook salmon while minimizing negative impacts on fish behaviour and providing un-restricted recreational use of the river.

A proposal to install and operate a DIDSON sonar station as well as conduct a Chinook carcass pitch on the Big Salmon River was submitted by J. Wilson and Associates to the Yukon River Panel Restoration and Enhancement (R&E) fund in January 2007. The proposal was accepted and financial support received from the R&E fund.

Study Area

The Big Salmon River flows in a north-westerly direction from its headwaters at the Quiet and Big Salmon lakes chain to its confluence with the Yukon River (Figure 1). The river and its tributaries drain an area of approximately 6,760 km^2, predominantly from the Big Salmon Range of the Pelly Mountains. Major tributaries of the Big Salmon River include the North Big Salmon River and the South Big Salmon River. The Big Salmon River can be accessed by boat from Quiet Lake along the Canol Road, from the Yukon River on the Robert Campbell and Klondike Highways, or from Lake Laberge via the 30 Mile and Yukon rivers.

Objectives

The objectives of the 2007 Big Salmon River sonar project were:

1. To re-establish a field camp on the Big Salmon River at the location used in 2005 and 2006.
2. To construct two partial weirs to constrict the passage of migrating Chinook to a 30 m opening.
3. To set up a DIDSON-LR sonar unit to enumerate Chinook salmon migrating upstream through the opening and obtain information on run timing and diel migration patterns.
4. To conduct a Chinook salmon carcass sampling pitch throughout the Big Salmon River system to obtain information on the age, sex and length structure of the run, retrieve spaghetti tags and obtain tissue samples for DNA analysis

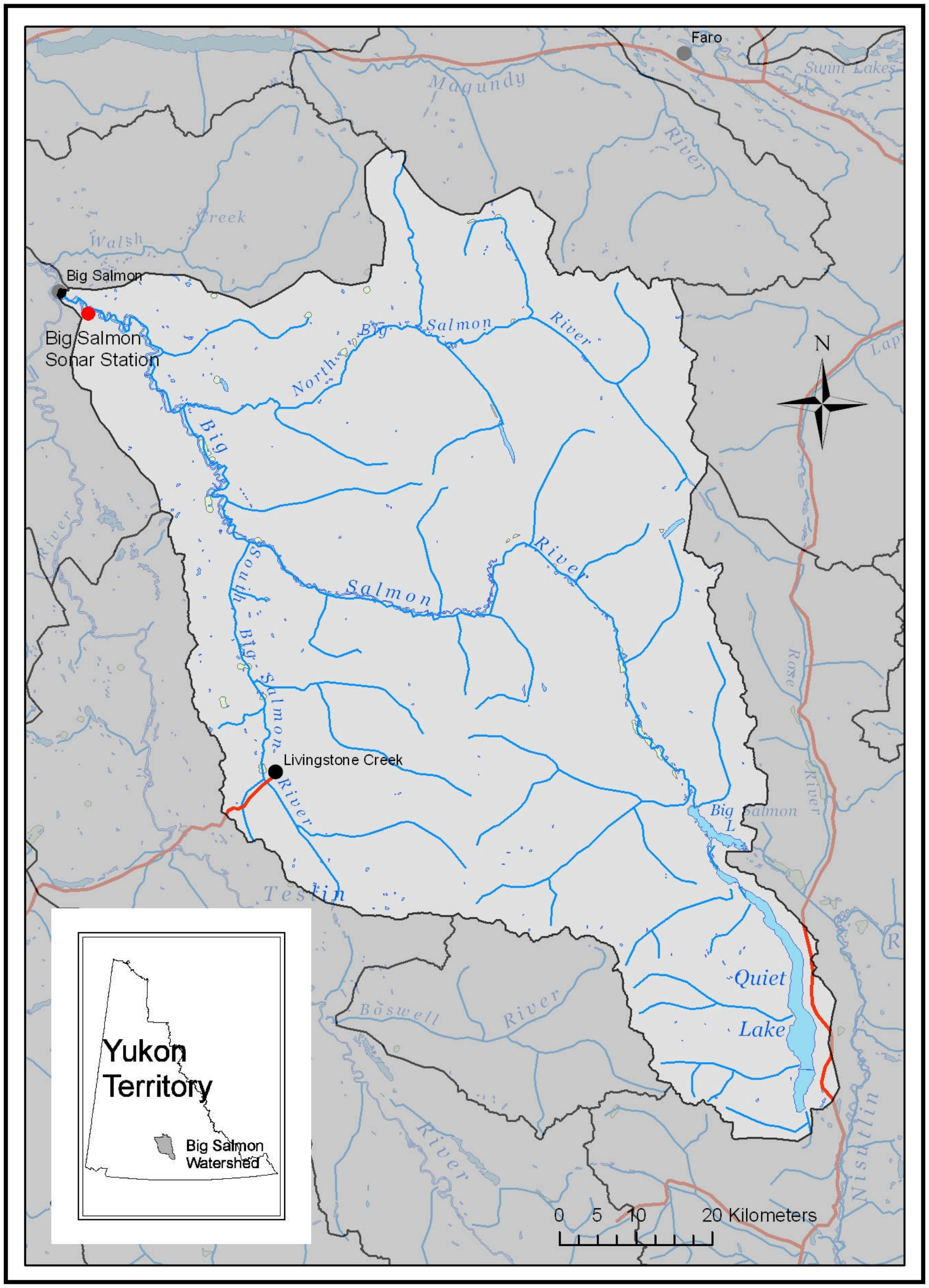

Figure 1. Big Salmon River Watershed and location of the 2007 Big Salmon sonar station.

METHODS

Site selection

The sonar station site used in 2005 and 2006 was considered to be the optimal location for the sonar station in 2007. This site, located approximately 1.5 km upstream from the confluence with the Yukon River (Figure 1), was retained for the following reasons:

- It was a sufficient distance upstream of the mouth to avoid straying UpperYukon/Teslin River Chinook salmon.
- The site was in a relatively straight section of the river and far enough downstream from any bends in the river so that recreational boaters using the river would have a clear view of the in-stream structures.
- The river flow was laminar and swift enough to preclude milling or 'holding' behaviour by migrating fish.
- Bottom substrates consisted of gravel and cobble evenly distributed along the width of the river.
- The stream bottom profile would allow for complete ensonification of the water column.
- There was the existing campsite located on the south bank where wall tent frames were already constructed within close proximity to the sonar set-up.
- The site was accessible by boat and floatplane.

Camp and Sonar Station setup

An application was submitted to Yukon Energy, Mines & Resources, Lands Branch, for a land use permit to establish the sonar camp on the lower Big Salmon River in 2005. A permit was granted for use in 2005 and 2006 with the option of renewal for one more year. This option was exercised in 2007. If the project continues into 2008 at this site a permanent lease may be required. Approval was also granted by the Whitehorse District Forestry office to cut and remove timber on Territorial lands for the purposes of clearing and the use of fuel wood.

An application was submitted to Transport Canada (Marine Branch), Navigable Waters Protection for approval to install partial fish diversion fences in a navigable waterway in 2005. Approval was granted for ongoing annual sonar operations as described in the original application.

Construction of the camp and sonar station was initiated on July 12. Materials for the camp, equipment, sonar apparatus, and additions to the existing diversion fence were transported from Whitehorse to Carmacks. These were then transported to the sonar site by riverboat and floatplane. Subsequent camp access, crew changes, and delivery of supplies was also accomplished via riverboat and supplemented by floatplane from Whitehorse.

As in previous years, the camp was comprised of two wall tents: one to house a kitchen/eating area and computer station and another for sleeping quarters. The kitchen and computer station was located 6 m from the south bank of the river and constructed using a 5m x 5m “weatherall” free standing wall tent placed on a plywood platform. The sleeping quarters was situated 70 m from the shore and constructed using a 14’ X 16’ canvas wall tent placed on a plywood platform and wooden frame (Figure 3).

Two diversion weirs were constructed on opposite sides of the river to divert shoreline migrating Chinook salmon through the ensonified area (Figure’s 2 and 3). The diversion fences were constructed using prefabricated panels of electrical conduit. Tripods and stringers from the 2006 project were re-used and additional tripods were constructed on-site using locally cut poles. The diversion fence on the north bank was extended into the shallower reaches using “vexar” plastic mesh that was anchored with rebar driven into the stream bottom. The upper margin of the “vexar” was fastened to 2-inch PVC pipe to provide flotation and create a fence that self adjusted to fluctuating water levels. The south bank fence extended approximately 7 m from the bank and the north bank fence approximately 25 m from the bank providing a 34 m opening for fish passage. Light activated flashing beacon lights were secured to each diversion fence to mark the in-stream extent of weirs. A warning sign was also posted 200 m upstream of the station to alert boaters of the partial obstruction ahead in accordance with Transport Canada, Navigable Waters Protection requirements.

Figure 2. Partial weirs and 34 m opening for fish passage viewed from the south bank.

Figure 3. Aerial view of sonar station camp and partial weirs.

Sonar and computer software configuration

The configuration of the DIDSON sonar unit was similar to that used in 2005 and 2006. The unit was mounted on an adjustable stand constructed of 2-inch steel galvanized pipe similar in design to those used at other DIDSON sonar projects (Galbreath and Barber 2005). The stand consisted of two T-shaped legs 120 cm in height connected by a 90 cm crossbar (Figure 4). The sonar unit was bolted to a steel plate suspended from the cross bar that was connected to the stand with adjustable fittings (Kee Klamps™). The adjustable clamps allowed the sonar unit to be raised or lowered according to fluctuating water levels as well as rotation of the transducer lens to adjust the beam angle.

The mounted sonar unit and stand was placed next to the south bank immediately upstream of the diversion fence in approximately 1.0 m of water (Figure 5). The “feet” of the stand were secured to the stream bottom using sandbags. A 6 mm stainless steel safety cable was affixed to the sonar unit and fastened to a buried anchor onshore.

The DIDSON transducer lens was positioned to a depth of approximately 12 cm below the surface of the river. The angle of the sonar beam was set at approximately -4° which resulted in the entire length of the upper edge of the ensonified cone of water remaining parallel to the surface of the river (Figure 6). If the transducer angle was set higher, reflections from surface turbulence would produce interference in the sonar recordings.

Figure 4. Sonar transducer unit and mounting stand.

Figure 5. Sonar transducer unit and mounting stand in position.

Once the sonar was in place and properly positioned, the primary sonar unit settings and software were configured. These settings included the window start length, the ensonified window length, and the frame rate.   The receiver gain was set at –40 dB, the window start at 5.86 m, window length at 40 m, and auto frequency enabled for the duration of the project. Threshold settings were set at 3 dB and intensity at 40 dB. The recording frame rate was typically set at 4 frames per second, which was the highest frame rate the computers could process with a window length setting of 40 m. Two Toshiba laptop computers were used for the project, one recording the DIDSON files and one for reviewing the files.

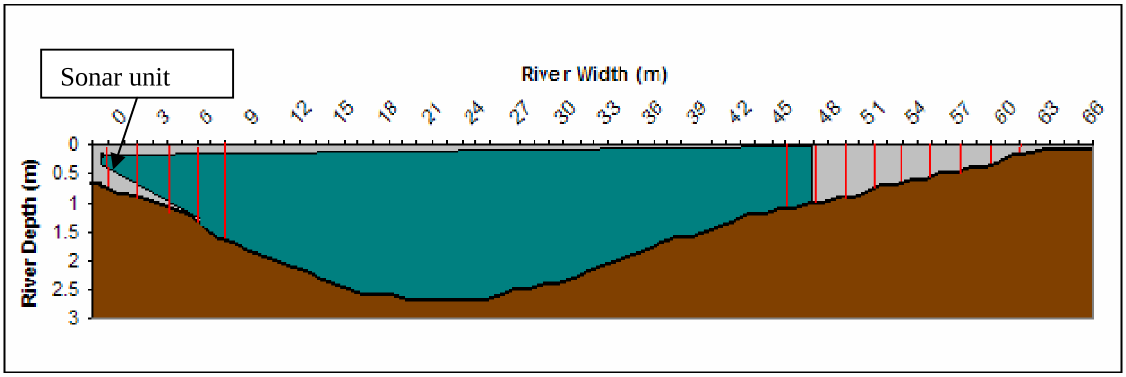

Figure 6. Schematic diagram of river profile and sonar and weir configuration.
Red bars denote weir structures and blue the ensonified portion of the water column.
Note: Vertical scale is exaggerated.

The sonar system was powered by two sets of 6 gel cell batteries connected in two parallel circuits to create a 12 volt power source. The battery banks were charged by 6 solar panels and a backup 2.4 kw generator. An 800 watt inverter was used to obtain 110 volt AC from the batteries to supply power for the computers and the sonar unit. The battery banks, solar panels and tower components used for the project were retrieved from a DFO telemetry tower located near Hootalinqua on the 30 Mile River and a U.S. National Marine Fisheries Service telemetry site on the Big Salmon River, approximately 10 km upstream of the sonar station. Two additional solar panels that were surplus from past telemetry projects were obtained from DFO Whitehorse.

After completing the setup of the apparatus on July 14, the range of the sonar as well as the target identification capability was tested by dragging objects beneath a boat across the ensonified portion of the river.

Sonar data collection

The sonar data was collected continuously and stored automatically in pre-programmed 20 minute files each specifying time and date. This resulted in an accumulation of 72 files over a 24 hour period. These files were subsequently reviewed the following morning and stored on the active PC as well as backed up on an external hard drive. All files collected from the project were archived on external hard drives.

To optimize target detection during file review, the background subtraction feature was used to remove static images such as the river bottom and weir structures. The intensity (brightness) was set at 40 dB and threshold (sensitivity) at 3dB. The playback speed depended on the preference and experience of the observer, but was generally set between 30 and 40 frames per second, approximately 8 to 10 times the recording rate.

This allowed observers to quickly review files, particularly during long periods when no targets were observed. When necessary, the recording was stopped when a fish was observed and replayed at a slower rate for positive identification. The target measurement feature of the DIDSON software was used to estimate the size of the observed fish. The minimum size used to identify Chinook salmon was approximately 50 cm, although there was some subjective interpretation regarding identification and categorization of the smaller fish observed. Review of the data files indicate that less than 1% of the observed Chinook salmon was in the 50 cm size range. Chinook salmon images were visually counted using a hand counter and the total count from each file was entered into an excel spreadsheet. Fish identified as Chinook salmon moving downstream were subtracted from the file total. A record of each 20 minute file count as well as hourly, daily and cumulative counts was maintained throughout the run.

Carcass Pitch

Chinook salmon carcass sampling was conducted throughout the total length of the Big Salmon River from the sonar station to Big Salmon Lake over the period August 21 through September 1, 2007. Access to the system was gained using a 5.5 m skiff powered by a 60 hp outboard jet motor. Each carcass sampling trip took approximately 3 days to complete. The North Big Salmon River was not surveyed for carcasses this year due to the low water levels experienced in late August.

In addition to dead Chinook salmon found on the stream banks and in back eddies, post-spawn moribund fish were collected using a barbed spear on a 3m extension pole. Carcass sampling consisted of collecting five scales per fish placed in prescribed scale cards, noting presence of spaghetti tags and recording sex and post-orbital hypural and mid-eye-fork lengths (to the nearest 0.5cm). Axillary appendage tissue samples were also obtained from each carcass and preserved in 95% ethanol for DNA analysis.

RESULTS

Chinook Salmon Counts and Run Timing

Scheduled 24 hr recording began on July 15 at 12:00. The first Chinook salmon was observed on July 16 at 14:00. A total of 4,450 targets identified as Chinook salmon was counted past the sonar station from July 16 through to August 26 (Appendix 1). Since the sonar was removed before the run was entirely complete, daily counts after the sonar was removed were extrapolated. The extrapolated count was estimated using a logarithmic regression ($y = -33.22Ln(x) + 105.39$) based on the previous 15 daily counts. Based on the extrapolation, the run would have continued until September 1 with an additional 54 fish, bringing the season total to 4,504.

The peak daily count of 435 fish occurred on August 1 at which time 46% of the run had passed the sonar station. By August 14, 90% of the run had passed. The cumulative daily run pattern exhibited the same normal distribution as occurred in 2005 and 2006.

The 2007 run timing was approximately 5 days earlier than 2006 but similar to that of 2005 (Figures 7 and 8).

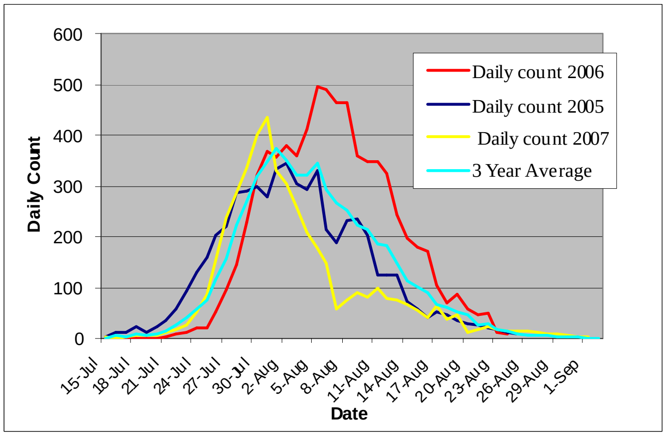

Figure 7. Daily counts of Chinook salmon passing the Big Salmon River sonar station in 2005, 2006, and 2007.

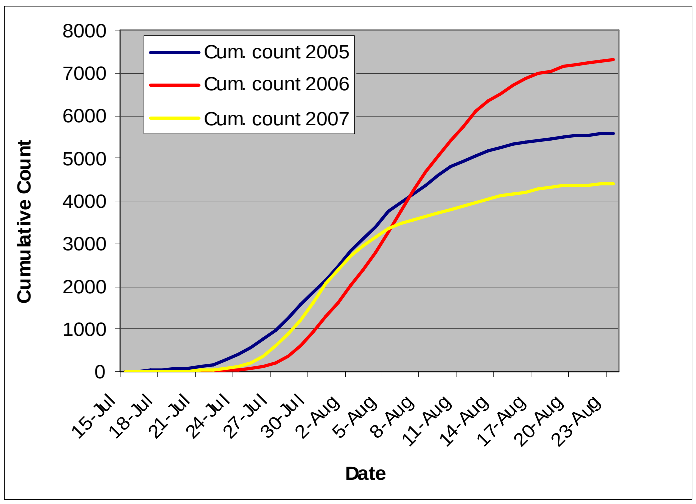

Figure 8. Cumulative counts of Chinook salmon passing the Big Salmon River sonar station in 2005, 2006, and 2007.

Diel Migration

As occurred in 2005 and 2006, there was no significant diel migration pattern observed in the Chinook salmon migration in the Big Salmon River (Single factor ANOVA, tested for homogeneity of variance: df=23, F=0.40, α=0.05, p=0.99). Yukon River Chinook salmon have some of the highest daily migration rates recorded for this species (Spencer et al. 2002). The lack of diel migration patterns by Yukon River Chinook salmon may be due to the long distances traveled and high daily travel rates. It may require several years of data to determine if diel patterns are present.

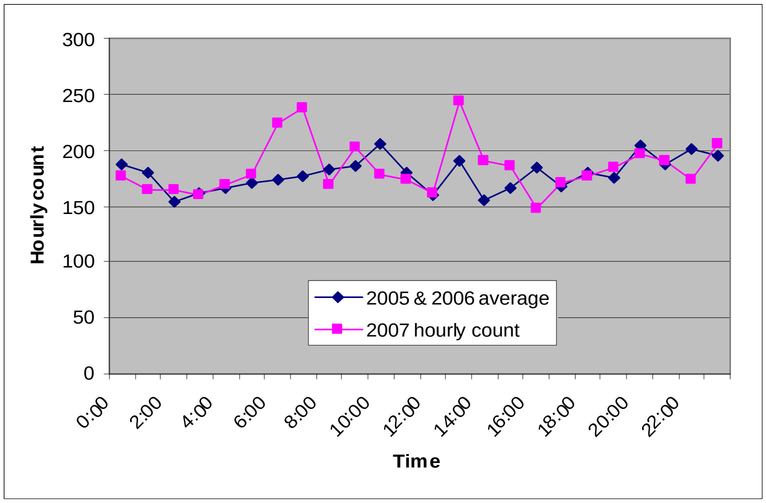

Figure 9. Total hourly counts of Chinook salmon passing the Big Salmon River sonar station in 2005, 2006 and 2007.

Carcass Pitch

A total of 150 Chinook salmon carcasses was retrieved and sampled on the Big Salmon River during the period August 21 through September 1, 2007. The results of the carcass sampling are detailed in Appendix 2.

Of the 150 fish sampled, 110 (73%) were female and 40 (27%) were male. The mean fork length of females and males sampled was 835 mm and 774 mm, respectively. Age was determined from 122 samples. , age 1.4 (European) were the dominant age class (93%) and age 1.3 made up 24% of the carcasses sampled (Table 1). Age 1.2 and 1.5 represented 4% and 1% of the fish sampled, respectively. No spaghetti tags were observed or recovered from the sampled fish. A total of 74 DNA (axillary appendage) samples was collected.

DISCUSSION

The 2007 Eagle sonar project on the Yukon River produced a border[3] escapement estimate of 41,200 Chinook salmon (P. Milligan, DFO Whitehorse, stock assessment biologist, per. comm.). Based on proportional GSI analysis, the Big Salmon River escapement count of 4,450 represented 10.6% (SE 2.5%) of the total above border escapement. Expansion of the Big Salmon River escapement yields a 2007 point estimate of 41,981 (95%CI 33,500 – 51,151) for the total Canada/U.S. Chinook salmon spawning escapement. The above border point estimate based on GSI expansion, plus the Canadian Chinook catch of 5,617 would yield a total above border point estimate of

[3] Border escapement is the number of fish estimated to have entered the Upper Yukon River drainage in Canada. The Eagle sonar estimate has not been adjusted (reduced) for the subsistence catch which occurs near the community of Eagle, Alaska.

Table 1. Size and age structure of Big Salmon River Chinook salmon carcasses sampled in 2007.
Note: 122 samples were successfully aged; 38 samples were un-aged samples due to resorbed or regenerated scales.

Sex	Age	Data	Total	% of Total
Female	1.3	Average of MEF (mm)	735	
		Count of AGE	9	7%
	1.4	Average of MEF (mm)	846.8	
		Count of AGE	77	63%
	1.5	Average of MEF (mm)	710	
		Count of AGE	1	1%
Female Average of MEF (mm)			834	
Female Count of AGE			87	71%
Male	1.2	Average of MEF (mm)	596.3	
		Count of AGE	4	3%
	1.3	Average of MEF (mm)	778.3	
		Count of AGE	15	12%
	1.4	Average of MEF (mm)	835.6	
		Count of AGE	16	13%
Male Average of MEF (mm)			784	
Male Count of AGE			35	29%

47,590. The proportional contribution of the Big Salmon River stock to above border Chinook escapements in 2007 is relatively consistent with the proportional contributions in 2005 and 2006 of 10.8% and 9.7%, respectively. These proportions are also consistent with those derived from previous radio telemetry studies that ranged from 9.2% to 16.4% (Osborne et al. 2003, Mercer and Eiler 2004, Mercer 2005). With the development of a more complete baseline GSI database of upper Yukon River Chinook stocks, proportional GSI based escapement estimates will likely become a relatively accurate technique for determining Chinook salmon escapement.

As occurred in the 2005 and 2006 project results, there was a high degree of concordance between the 2007 Big Salmon River Chinook salmon sonar counts and the aggregate 2002 – 2004 passage of radio tagged Chinook salmon past the Big Salmon telemetry tower[4] (Mercer and Wilson 2006). Based on the radio tag passage during these years, the first and last tags passed the telemetry tower on July 19 and August 27, respectively. The peak passage was on July 31, and 90% of the radio tags had passed the tower by August 12. The 2007 Chinook run was essentially the same as the aggregate radio tag timing

[4] The Big Salmon telemetry tower was located approximately 10 km upstream of the sonar station.

with the peak of the run on August 1, and 90% having passed the sonar station by August 12.

The accuracy of the Big Salmon sonar counts has been discussed in detail in previous Big Salmon River sonar reports (Mercer and Wilson 2005, 2006). Unlike the 2006 season, there were no Chinook spawning near the ensonified water column in 2007. This year, however, a sudden high water event in which levels rose 44 cm in a 24 hour period resulted in the collapse of the north bank weir on August 8. Weir materials were recovered and the weir re-installed on August 11after water levels had dropped (Appendix 1). Although the sonar continued to operate and detect fish throughout this period, daily counts of fish passing the sonar declined. Except for the sudden decline in Chinook counts the day the weir washed out, subsequent daily counts before the weir was replaced were not inconsistent with daily counts after the weir was re-installed, suggesting the decline in daily fish passage was a result of the high water event.

For reasons outlined in a previous report (Mercer and Wilson 2006), the project staff and managers continue to have confidence the Big Salmon River sonar counts accurately reflect the number of Chinook salmon migrating past the station. Results from both the 2005 and 2006 Big Salmon River sonar operations have shown a high concordance between observer counts. This was demonstrated by a random review of 20 sonar files from both the 2005 and 2006 Big Salmon River sonar operations. The independent blind counts demonstrated a 99% concordance with counts in the archived files.

In 2005 and 2006, it was recommended that efforts should be made to reduce the ensonified window length to 20 m in future projects at this site. When operated at high frequency (HF) the maximum window length setting is 20 m. The window start length can be set at 13 m, which would allow high resolution viewing out to 33 m. Operating at HF would result in increased precision in estimating the size of the targets, and theoretically increase the precision and confidence of the total Chinook counts, particularly with regard to the smaller size classes. However, in order to reduce the window length to 20 m this year, the diversion weir would need to have been extended a further 15 m in-stream. The water levels encountered when the diversion fences were installed were too high to consider extending the fence on the south bank a further 15 m. The fence was extended approximately 3 m using additional fence materials transported to the site in 2006. Because of the river depth and velocity in the mid-section of the river, specialized fish weir structures (such as a resistance board weir) would have to be used and installed during low water conditions in May in order to extend the diversion fences beyond their current limit. Since there appears to be little ambiguity regarding species identification, the additional expense associated with installing a resistance board weir is likely not warranted. However, for the 2008 project it is expected that weir materials will be used from a past R&E project. The materials consist of metal tripods and cross pieces. The use of these materials along with the existing weir material (panels) currently on site should provide a more robust structure that is unlikely to shift during periods of high water.

The Big Salmon sonar project in 2007, as in the previous two years, demonstrated that the DIDSON sonar unit produced total Chinook salmon counts that correlated well with past fish passage data, the Eagle sonar project, and the 2007 upper Yukon River Chinook salmon escapement estimates. The DIDSON sonar is a low impact, non-intrusive method of enumerating the Big Salmon River system Chinook salmon escapement while allowing unhindered passage for boaters and canoeists traveling the river.

Recommendations:

It is recommended for the 2008 sonar project that:

1. Some weir materials from the now defunct Chandindu weir project be transported to the Big Salmon sonar site before startup of the project on July 14. The weir materials required would be seven metal tripods and associated crosspieces.

2. Evidence from the 2006 and 2007 carcass pitch on the Big Salmon River indicates that peak post-spawn mortality likely occurs around August 25. ASL information is considered by the Yukon River Joint Technical Committee) (JTC) to be important data for run reconstruction and sibling forecasts. It is recommended that a carcass pitch be conducted in 2008 from August 20 through August 30.

REFERENCES

Galbreath, P.F. and P.E. Barber. Validation of Long-Range Dual Frequency Identification Sonar for Fish Passage Enumeration in the Methow River. Unpublished report for the PSC Southern Fund project. 2005.

Holmes, J. A., Cronkite, G. M. W., Enzenhofer, H. J., and Mulligan, T. J. 2006. Accuracy and precision of fish-count data from a ‘‘dual-frequency identification sonar’’ (DIDSON) imaging system. ICES Journal of Marine Science, 63: 543e555.

Holmes, J.A., G.M.W. Cronkite, H.J. Enzenhofer, and T.J. Mulligan. Accuracy and Precision of Fish Count Data from a Dual Frequency Identification Sonar (DIDSON) Imaging System. 2005. Unpublished report for the PSC Southern Boundary Restoration and Enhancement Fund. 2005.

Maxwell, S., D. Burwen, and C. Pfisterer. Testing the Range Limitations of the Long Range and Standard Versions of the Dual Frequency Identification Sonar (DIDSON). Draft report. Regional Information Report No. 2A04-XX April 2004.

Mercer, B. 2005. Distribution and Abundance of Radio Tagged Chinook Salmon in the Canadian Portion of the Yukon River Watershed as Determined by 2004 Aerial Telemetry Surveys. CRE project 77-04, Yukon River Panel.

Mercer, B. and J Eiler, 2004. Distribution and Abundance of Radio Tagged Chinook Salmon in the Canadian Portion of the Yukon River Watershed as Determined by 2003 Aerial Telemetry Surveys. CRE project 77-03, Yukon River Panel.

Mercer B. and J. Wilson, 2006. 2005 Chinook Salmon Sonar Enumeration on the Big Salmon River. Unpublished report for Yukon River Panel CRE project 41-05.

Mercer B. and J. Wilson, 2007. 2006 Chinook Salmon Sonar Enumeration on the Big Salmon River. Unpublished report for Yukon River Panel CRE project 41-06.

Osborne, C.T., B. Mercer, and J.H. Eiler, 2003. Radio Telemetry Tracking of Chinook Salmon in the Canadian Portion of the Yukon River Watershed – 2002. CRE project 78-02, Yukon River Panel.

Spencer, T.R., R.S. Chappel, J.H. Eiler, and T. Hamazaki. Estimation of Abundance and Distribution of Chinook Salmon in the Yukon River Using Mark-Recapture and Radio Telemetry in 2000 and 2001. ADF&G (Alaska Department of Fish and Game), 2002. Regional Information Report No. 3A02-37.

ACKNOWLEDGEMENTS

Several people contributed to the operational success of the 2007 Big Salmon River sonar project. Robert Gransden, Marcus Leijon and Jim Mercer worked as technicians on the project and played an especially valuable role during camp construction and demobilization and freighting of materials. Henri Schildnicht assisted with the carcass pitch sampling. Special acknowledgement is again due to Dawn and Don Marino of Carmacks for their support and storage of equipment.

Appendix 1. 2007 Big Salmon River Sonar Chinook Salmon Counts and Water Conditions.

Note: Shaded values were obtained through extrapolation of counts from the previous 15 days.

Date	Daily Count	Cumulative Count	Time	Air Temp.	Water Temp.	Water Level (cm)	Comments
			900	13	12.5	51	cloudy with showers all day
16-Jul	2	2	830	11	11.5	50	sunny
17-Jul	0	0	930	14	13	54	partly cloudy
18-Jul	2	2	905	12.5	12.5	51	clouding over
19-Jul	5	7	940	17	14	47	partly cloudy
20-Jul	5	12	1015	15.5	14	47	cloudy in AM, sunny PM
21-Jul	7	19	915	14	14	47	cloudy in AM, sunny PM
22-Jul	11	30	920	15.5	14	47	sunny
23-Jul	18	48	1000	12	14	51	cloudy with showers
24-Jul	26	74	920	13	13	46	sunny
25-Jul	52	126	1110	17	13.5	42	sunny, clouding over later in day
26-Jul	88	214	1045	15	13.5	40	rain previous night, sun and cloud mixed
27-Jul	153	367	1020	14	13	42	sun and cloud mixed, thundershowers in afternoon
28-Jul	237	604	930	13.5	13	41	overcast with showers, clearing in the afternoon
29-Jul	287	891	945	14	13.5	40	sun and cloud mixed, thundershowers in afternoon
30-Jul	337	1228	930	13	13.5	40	sun in morning, clouding over to heavy thundershowers
31-Jul	400	1628	940	15	14	40	sun and cloud mixed. Thundershowers developing late in day
1-Aug	435	2063	1014	14	14	45	mostly sunny, scattered showers in afternoon
2-Aug	331	2394	915	12	13	43	Sun and cloud mixed
3-Aug	304	2698	930	12	13	40	Sun and cloud mixed
4-Aug	258	2956	1030	17	14	38	Overcast, light shower in AM
5-Aug	210	3166	915	14	14	36	Overcast, showers and rain all day
6-Aug	178	3344	913	13	12	44	Overcast, clearing by evening. Water rising to 88 cm. at 0430
7-Aug	147	3491	900	7	10	88	Overcast, clearing to mostly sunny in afternoon
8-Aug	59	3550	925	7	9.5	78	Clear and sunny
9-Aug	74	3624	945	10	10	66	Clear and sunny
10-Aug	90	3714	945	12	10	59	Clear, sunny and windy all day
11-Aug	82	3796	930	5	9	53	Clear and sunny
12-Aug	98	3894	945	7	9.5	50	Cloudy, with showers all day
13-Aug	77	3971	945	13	9.5	49	Cloudy clearing in late morning to mostly sunny
14-Aug	74	4045	940	14	11	72	Sunny
15-Aug	66	4111	940	11	11	64	Sunny
16-Aug	56	4167	940	13	12	56	Sunny
17-Aug	40	4207	930	12	12	51	Sunny again
18-Aug	64	4271	933	15	12.5	48	Clouding over late
19-Aug	37	4308	940	11	12.5	45	Light rain
20-Aug	47	4355	940	12	11	43	Cloudy showers at night
21-Aug	11	4366	1010	13	11	41	Sun and cloud mixed with occasional showers
22-Aug	16	4382	1040	9	10.5	40	Sun and cloud mixed with occasional showers
23-Aug	23	4405	1045	11	10.5	39	Mostly cloudy, clear and cold overnight
24-Aug	17	4422	1140	11	10	37	Sun and cloud mixed
25-Aug	14	4436	1120	9	9.5	35	Sun and cloud mixed, fog in morning
26-Aug	14	4450					
27-Aug	13	4463					
28-Aug	11	4474					
29-Aug	9	4484					
30-Aug	8	4491					
31-Aug	6	4497					
1-Sep	4	4501					
2-Sep	3	4504					

Appendix 2. 2007 Big Salmon River Chinook Salmon Carcass Pitch Sampling Results.

Note: RG = regenerate scale (center is missing from scale)
RS = resorbed scale (growth from margin is missing)

FISH #	SEX	MEF (mm)	POHL (mm)	AGE	Code
1	M	780	605	13	
2	F	880	785	14	
3	F	890	795	14	
4	F	785	715	14	
5	F	780	695		RG
6	F	835	760	14	
7	F	790	715	14	
8	M	715	625	13	
9	F	760	685	14	
10	F	830	750	M4	RG
11	F	765	690	14	
12	F	705	645	13	
13	F	925	840	13	
14	F	710	635	15	
15	F	755	680	1F	RS
16	M	930	830	1F	RS
17	F	820	760	13	
18	F	755	690	14	
19	M	520	460	14	
20	M	665	605	12	
21	M	665	605	13	
22	F	755	680	13	
23	M	810	725	14	
24	F	920	845	14	
25	F	885	800	14	
26	M	905	810	14	
27	F	865	780	14	
28	F	885	770	14	
29	F	910	830	M4	RG
30	M	820	795	14	
31	F	740	670	14	
32	F	810	725	14	
33	F	880	810	14	
34	F	795	725	14	
35	F	740	665	14	
36	F	885	795	14	
37	F	740	660	M3	RG
38	F	700	630		RG
39	F	700	625	13	
40	F	800	735	14	
41	F	825	720	14	
42	F	655	575	14	
43	M	520	480		RS
44	F	700	595	13	
45	F	845	745	14	
46	F	665	595	13	
47	F	880	785	14	
48	F	835	765	14	
49	F	875	800	14	
50	F	890	800	M4	RG

Appendix 2 cont'd.

FISH #	SEX	MEF (mm)	POHL (mm)	AGE	Code
51	F	850	770	M4	RG
52	F	975	880	14	
53	M	985	890	13	
54	F	870	775	14	
55	F	835	725	14	
56	F	805	720	14	
57	F	901	820	14	
58	F	745	660	14	
59	M	855	750	14	
60	M	850	835	14	
61	F	865	785	M4	RG
62	F	810	730	14	
63	M	550	485	12	
64	F	795	710	14	
65	F	790	710	14	
66	M	890	795	13	
67	M	635	560	M3	RG
68	F	860	765	14	
69	F	835	735	14	
70	F	875	770	14	
71	F	780	700	14	
72	F	855	765	M4	RG
73	F	825	740	14	
74	F	650	585	13	
75	F	835	750	M4	RG
76	F	820	745	14	
77	F	880	795	M4	RG
78	F	910	825	14	
79	M	855	770	14	
80	F	820	730	14	
81	F	885	800	14	
82	F	900	825	M4	RG
83	M	880	775	13	
84	M	885	780	13	RG
85	M	720	650	13	
86	F	845	765	14	
87	M	680	600	14	
88	F	695	620	13	
89	F	870	765	14	
90	F	850	765	1F	RS
91	F	810	730	14	
92	F	850	770		RG
93	F	765	680	14	
94	M	655	585	13	
95	F	730	645	M2	RG
96	M	645	570	14	
97	F	845	740	14	
98	F	760	670	14	
99	F	800	705	14	
100	F	880	790	14	

Appendix 2 cont'd.

FISH #	SEX	MEF (mm)	POHL (mm)	AGE	Code
101	F	900	825	14	
102	F	810	740	14	
103	F	825	750		RG
104	M	535	465	12	
105	F	825	740	14	
106	M	680	600		RS
107	F	870	765	14	
108	F	830	750	14	
109	M	770	685	13	
110	F	870	790	14	
111	F	850	780	14	
112	M	800	700	13	
113	M	635	560	12	
114	M	740	655	13	
115	F	830	755	14	
116	F	830	750	14	
117	F	895	810	14	
118	F	805	720	M4	RG
119	M	755	660	13	
120	M	920	815	14	
121	F	845	765	M4	RG
122	F	920	835	14	
123	M	650	575	13	
124	M	910	795	14	
125	F	860	780	M4	RG
126	F	835	750	14	
127	M	780	685	M4	RG
128	M	950	750	14	
129	M	1075	830	14	
130	F	995	825	14	
131	M	870	775	14	
132	F	910	735	14	
133	F	895	720	14	
134	F	995	810	M4	RG
135	F	895	735	14	
136	F	865	700	14	
137	F	900	730	M4	RG
138	F	945	765	14	
139	F	835	700	14	
140	F	945	775	14	
141	F	935	770	14	
142	M	785	605	13	
143	F	945	780	14	
144	F	870	730	14	
145	F	910	745		RG
146	F	880	720	14	
147	F	880	725	14	
148	F	850	700	14	
149	M	930	720	14	
150	M	775	620	14	

Appendix 3. Daily and cumulative Big Salmon River Chinook sonar counts in 2005 and 2006.

Date	2006 Daily	2006 Cumulative	2005 Daily	2005 Cumulative
15-Jul	1	1	2	2
16-Jul	0	1	12	14
17-Jul	1	2	13	27
18-Jul	0	2	23	50
19-Jul	0	2	13	63
20-Jul	1	3	23	86
21-Jul	3	6	36	122
22-Jul	8	14	58	180
23-Jul	11	25	92	272
24-Jul	21	46	130	402
25-Jul	20	66	158	560
26-Jul	53	119	204	764
27-Jul	95	214	219	983
28-Jul	146	360	287	1270
29-Jul	230	590	290	1560
30-Jul	321	911	299	1859
31-Jul	368	1279	279	2138
1-Aug	357	1636	333	2471
2-Aug	379	2015	346	2817
3-Aug	358	2373	303	3120
4-Aug	413	2786	292	3412
5-Aug	496	3282	331	3743
6-Aug	490	3772	214	3957
7-Aug	464	4236	188	4145
8-Aug	464	4700	232	4377
9-Aug	360	5060	234	4611
10-Aug	349	5409	203	4814
11-Aug	348	5757	124	4938
12-Aug	324	6081	126	5064
13-Aug	243	6324	125	5189
14-Aug	196	6520	72	5261
15-Aug	180	6700	57	5318
16-Aug	172	6872	40	5358
17-Aug	104	6976	53	5411
18-Aug	69	7045	47	5458
19-Aug	87	7132	35	5493
20-Aug	59	7191	29	5522
21-Aug	45	7236	26	5548
22-Aug	50	7286	19	5567
23-Aug	12	7298	17	5584
24-Aug	10	7308	13	5597
25-Aug			9	5606
26-Aug			6	5612
27-Aug			4	5616
28-Aug			2	5618

Note: Shaded cells denote extrapolated counts.