

2015 Teslin River Chinook Sonar Project

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Restoration and Enhancement Fund

Prepared By: Brian Mercer
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Metla Environmental Inc.

Box 20046

Whitehorse, Yukon

Y1A 7A2

metla.ca

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ABSTRACT

Multiple beam high resolution sonars were used to enumerate the 2015 Chinook salmon (*Onchorynchus tshawytscha*) escapement to the Teslin River system. This was the fourth year the project was conducted at this site. The sonars were operated on the mainstem Teslin River at a site 12 km upstream of the confluence of the Teslin and Yukon Rivers at Hootalinqua. Sonar operation began on July 16 and operated continuously through to August 31. A total of 20,402 targets identified as Chinook salmon was counted during the period of operation. Of this total, the north bank sonar counted 14,792 (67%) and the south bank 6,695 (33%) of the passing Chinook. Daily 24 hour counts ranged from 3 to 868 with a mean of 443. The peak daily count occurred on August 15 at which time 76% of the run had passed the sonar station. 2015 genetic stock identification (GSI) sampling indicated the Teslin stock group comprised 25.4% (SD = 2.4%) of upper Yukon River Chinook escapement. A carcass pitch was conducted over approximately 120 km of the mainstem Teslin River over the period September 3 through September 13. This yielded 556 Chinook sampled for age, length and sex. Of these, 377 (68%) were female and 179 (32%) were male. The mean fork length of females and males sampled was 838 mm and 733 mm, respectively. Full age data was obtained from 535 of the Chinook sampled. Age 1.4 (48%) was the dominant age class, followed by age 1.3 fish (37%). Age 1.2 and 1.5 fish each represented 8% and 6% respectively.

TABLE OF CONTENTS

1. INTRODUCTION	1
Background	1
Multiple Beam Sonar	2
Teslin River System and Study Area	2
2. OBJECTIVES	5
3. METHODS	5
Site Selection.....	5
Regulatory Submissions and Permits.....	5
Mobilization and Personnel	6
Sonar Deployment and Operation.....	6
Data Collection and Chinook Enumeration	9
Cross Section Profile.....	10
Target Identification.....	11
Precision of Counts	11
Carcass Pitch.....	12
Hydrometric Data and Weather	13
Communication.....	13
4. RESULTS	13
Chinook Counts.....	13
Chinook Spawning Escapement Estimates generated from GSI data and sonar counts	19
5. DISCUSSION AND RECOMMENDATIONS.....	20
6. REFERENCES	23
7. ACKNOWLEDGEMENTS	25

LIST OF TABLES

Table 1. 2015 Daily counts of Teslin River Chinook salmon.....	15
Table 2. Initial and reviewed files and calculated difference between counts.....	17
Table 3. Mainstem Teslin Chinook age, sex and length data, 2015.	19

LIST OF FIGURES

Figure 1. Mainstem Teslin River and sonar site.	3
Figure 2. Daily minimum, maximum and mean discharge rates for mainstem Teslin River at station 09AF001 from December 1955 through January 1973.	4
Figure 3. Aerial view of sonar site depicting the camp, sonar locations and schematic representation of ensonified portions of the river (2012 photo).	7
Figure 4. NB sonar unit mounted on tripod stand with diversion weir downstream of the sonar.	8
Figure 5. NB diversion weir in place (2013 photo).	8
Figure 6. SB sonar unit mounted on stand with diversion fence downstream (2014 photo).	9
Figure 7 (a). Cross section profile of Teslin River at location of North bank sonar.....	11
Figure 7 (b). Cross section profile of Teslin River at location of South bank sonar.	11
Figure 8. Daily Counts of Chinook at Teslin River sonar station 2015, and mean daily counts 2013 and 2014.	14
Figure 9. Cross section distribution of migrating Chinook, Teslin sonar site, 2013-2015.	14
Figure 10. 2015 daily counts of NB and SB sonars.	16
Figure 11. Linear regression between original and reviewed sonar file data that has been analysed by two different readers.	17
Figure 12. Length Frequency histogram of sampled Teslin River Chinook, 2015.....	18

LIST OF APPENDICES

Appendix 1. Location of radio tagged Chinook during peak spawning in the Teslin River drainage in 2003.....	26
Appendix 2. Daily aggregate of reviewed and corresponding original files from North Bank Teslin River sonar, 2015.....	27
Appendix 3 (a). 2015 Mainstem Teslin River carcass pitch data.	28
Appendix 3 (b) Principal spawning areas on Mainstem Teslin River based on sample site locations,	41
2015.....	41
Appendix 4. Hydrometric data and weather observations, Teslin sonar site 2015.	42
Appendix 5. Referenced water levels at Teslin sonar site 2012 through 2015.	43

1. INTRODUCTION

Background

The Yukon River system encompasses a drainage area of approximately 854,000 km² and contributes to important aboriginal, subsistence and commercial fisheries in the U.S. and Canada. Approximately 50% of Chinook salmon entering the Yukon River from the Bering Sea is typically destined for spawning grounds in Canada (Eiler et al. 2004, 2006). Chinook salmon that spawn in Canada have contributed up to 67% of the total U.S. commercial and subsistence fisheries in the Yukon River system (Templin et al. 2005; cited in Daum and Flannery 2009) .

Canadian and U.S. fishery managers of the Yukon River Joint Technical Committee (JTC) as well as members of the Yukon River Panel (YRP) recognize that obtaining accurate estimates of abundance is required for the management of Yukon River Chinook stocks. Quantified Chinook escapements along with biological information are important for post-season run reconstruction, pre-season run forecasts and the establishment of biologically based escapement goals. In addition, the accurate enumeration of genetically distinct stocks, coupled with a representative genetic stock identification (GSI) sampling program can be used to obtain independent above border as well as stock specific Chinook escapement estimates¹.

The Teslin River system has been identified as a potential Conservation Unit under the Fisheries and Oceans Canada (DFO) Wild Salmon Policy (DFO 2007). One of the long term goals of the Wild Salmon Policy is the establishment of biologically based escapement goals for all species of salmon within designated conservation units. A sufficiently long time series data set of salmon escapements coupled with stock recruitment modelling is the primary method for the establishment of biologically based escapement goals. Currently, there is no other in-season monitoring specific to Teslin River Chinook. Based on current data the Teslin system is the largest single tributary contributor to upper Yukon River Chinook production.

Teslin River origin Chinook have been an important contributor to aboriginal fisheries in the upper Yukon watershed and are of particular importance to the Teslin Tlingit First Nation. Monitoring of Teslin River Chinook will assist in achieving long term management and escapement objectives for the Teslin Tlingit Council (TTC). Of the five species of salmon entering the Yukon River, adult Chinook salmon travel the farthest upstream and have been documented at the furthest headwaters of the Teslin system in the McNeil River, 3,300 km from the river mouth (Mercer & Eiler 2004).

¹ For the purposes of this report border escapement is defined as the number of Chinook salmon estimated to have crossed the Canada/U.S. border into the Upper Yukon River drainage minus the total Canadian harvest. Representative GSI sampling of upper Yukon River Chinook stocks occurs at the Eagle sonar site near the Canada/U.S. border in Alaska.

Multiple Beam Sonar

Fixed-location, side-view sonar techniques are presently the primary means of obtaining abundance estimates for anadromous fish stocks migrating in rivers that are either: a) too wide for conventional weir structures; b) too turbid for visual observations or; c) where weir emplacements would be a navigational impediment. Since 2002, multiple beam sonar has been used for enumeration of several species of salmon in a broad range of environments (Galbreath and Barber 2005, Holmes et al. 2006, Maxwell et al. 2004, Enzenhofer et al., 2010). Sound Metrics Corporation manufactures the DIDSON® and ARIS® sonar units that have been used on the Teslin sonar project. They are currently the primary manufacturers of multi-beam sonars employed for enumerating migrating salmon in riverine environments. In general, these sonar units have been found to be reliable and provide accurate counts of migrating salmon. Detecting and counting migrating salmon using correctly positioned imaging sonar can be as accurate as visual counts of fish migrating through an enumeration fence (Holmes et al., 2006). In the upper Yukon River drainage imaging sonar has been used on the Big Salmon River (Mercer & Wilson, 2005-2015), the Klondike River (Mercer, 2009-2011) and the Porcupine River (EDI, 2015) to enumerate annual Chinook salmon escapements into these systems. The 2015 Teslin sonar project used two multiple beam ARIS (Adaptive Resolution Imaging Sonar) sonars.

The deployment configuration of the sonar is dependent on the characteristics of the particular site, species involved, and project objectives. The ARIS sonar produces an ensonified field 29° wide in the horizontal plane and, depending on the transducer lens configuration, from 1° to 12° deep in the vertical plane. It is our experience that the maximum ensonified distance the ARIS sonar (with an 8° lens) can detect and identify migrating Chinook is approximately 50 m. With a horizontally aligned 8° transducer lens the maximum ensonifiable depth is 5.6 m at a 40 m window length. For the accurate enumeration of fish it is essential that the sonar is aimed so the beams completely ensonify the entire area through which fish are migrating. In addition, the bathymetric profile must preclude the presence of acoustic shadows or turbulence (air entrained water) that could mask fish targets. Species identification and/or apportionment should also be unambiguous.

Unlike split beam sonar the multiple beam sonar produces a real time image of the target. This imaging capability can allow for the identification of the species based on size, form and swimming characteristics. When mounted in a horizontal configuration the sonar provides information on the distance the target is from the sonar but not the depth of the target within the water column.

Teslin River System and Study Area

The Teslin River system has a drainage area of 36,500 km² that overlaps the Yukon and B.C. border (Figure 1, Appendix 1). Teslin Lake is the largest water body in the system

with a surface area of approximately 354 km². Teslin Lake is fed by several drainages in the upper system and discharges at its outlet into the mainstem Teslin River. The lower mainstem Teslin River has a mean annual discharge volume of 869 m³/sec (range 1080 – 643 m³/sec; Water survey of Canada, Station 09AF001; Figure 2).

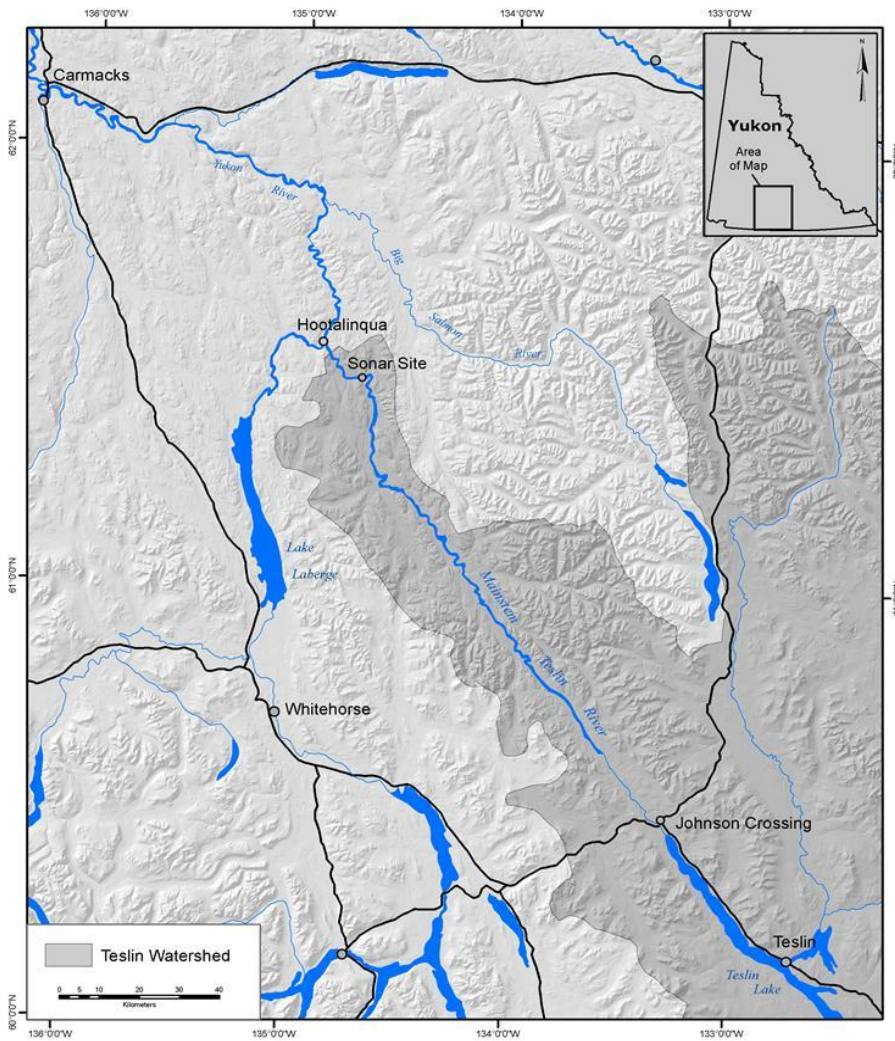


Figure 1. Mainstem Teslin River and sonar site.

Digital map data source: Yukon Government spatial data collection. www.geomaticsyukon.ca.

The lower mainstem Teslin River area is remote with no road access. Access to the area is by riverboat from Lake Laberge or Johnson's Crossing (approximately 100 and 145 river km respectively) or by floatplane with a direct distance of 95 km from Whitehorse, Yukon.

Fish species documented in the mainstem Teslin River system include, but are likely not limited to, Chinook and Chum salmon (*Oncorhynchus tshawytscha* and *O. keta*),

Grayling (*Thymallus thymallus*), Burbot (*Lota lota*), Inconnu (*Stenodus leucichthys*), Round Whitefish (*Prosopium cylindraceum*), slimy sculpin (*Cottus cognatus*) and longnose sucker (*Catostomus catostomus*) (DFO FISS database).

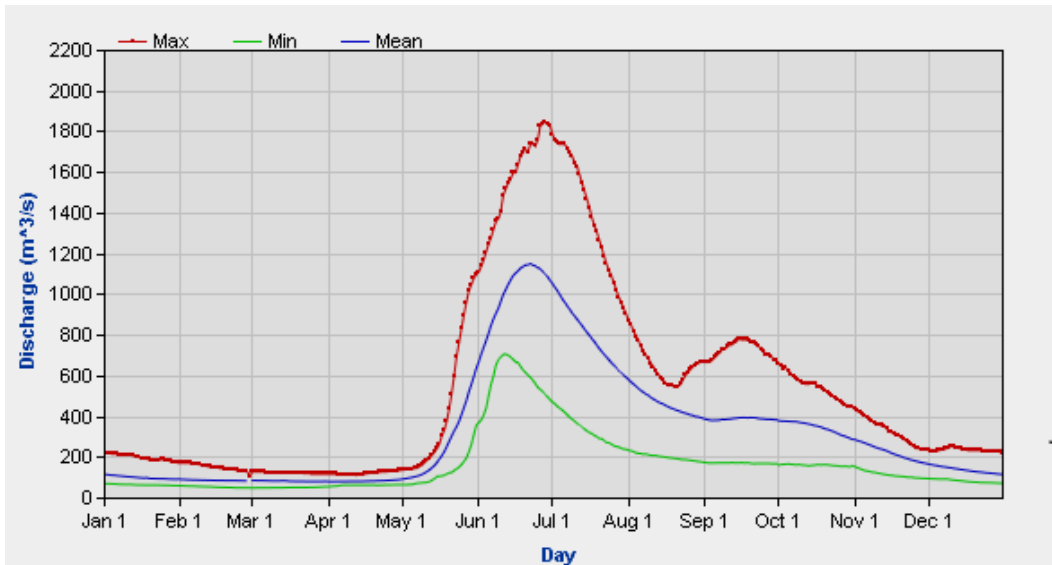


Figure 2. Daily minimum, maximum and mean discharge rates for mainstem Teslin River at station 09AF001² from December 1955 through January 1973. Source: Water Survey Board of Canada.

A three year radio telemetry study conducted on Yukon River Chinook from 2002 through 2004 indicated that the Teslin River system received on average 19.6% (range 18.1% - 20.8%) of the total Canadian origin Chinook in the Yukon River watershed (Mercer et al. 2004, 2005; Osborne et al. 2003; Appendix 6). Based on this radio telemetry data, approximately 70% of the radio tagged Chinook entering the Teslin system returned to and spawned in the mainstem Teslin River (Appendix 1). The remaining 30% were located throughout several headwater systems draining into Teslin Lake. This proportional distribution within the Teslin system was consistent over the three years of the study. The Chinook stock proportions in other upper Yukon River tributaries, as indicated by the telemetry results, have been corroborated by subsequent sonar enumeration projects on the Big Salmon and Klondike rivers (Mercer and Wilson 2005-2014). Based on Genetic stock identification (GSI) data collected at the Eagle sonar site from 2008 through 2014, the Teslin system stocks contributed an average of 27.4% (Range 16.4% - 37.8%) to the total upper Yukon Chinook production (Unpublished data, DFO Whitehorse; Appendix 6). The telemetry, GSI and the 2013 through 2015 Teslin sonar data indicate the Teslin system is the largest single tributary contributor to upper Yukon River Chinook production.

² This station, decommissioned in 1973, was located 300 m downstream of the sonar site.

2. OBJECTIVES

The objectives of the 2015 Teslin River sonar project were to:

1. Enumerate the Teslin River Chinook salmon escapement and obtain information on run timing and diel migration patterns.
2. To conduct a carcass pitch on the mainstem Teslin River to obtain age-sex-length (ASL) data from as many post-spawned Chinook as possible with a target goal of 500 samples. In addition, document egg retention in female spawners and the principal recovery locations of spawned out fish.

3. METHODS

Site Selection

The sonar site used in 2015 was the same site used for the 2012 – 2015 projects (Mercer 2014). This site, located approximately 12 km upstream from the confluence with the Yukon River (Figure 1), was selected for the following reasons:

- The river width is sufficiently narrow to allow for complete ensonification of the migration corridor using two sonar units.
- It is a sufficient distance upstream of the mouth to avoid straying or milling Chinook salmon destined for other headwater spawning sites.
- The site is 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 have a clear view of the in-stream structures.
- The river flow is laminar and swift enough to preclude milling or ‘holding’ behaviour by migrating Chinook.
- The stream bottom profile and river width allows for complete ensonification of the water column by two sonars.
- The site is accessible by boat and floatplane.

It should be noted that this site is the only location on the system that meets the selection criteria outlined above.

Regulatory Submissions and Permits

In 2015 a licence of occupation was granted by the Yukon Territorial Government (YTG) Lands Branch for the sonar camp on the mainstem Teslin River. Approval was granted from Transport Canada (Marine Branch), Navigable Waters Protection to install partial fish diversion fences in a navigable waterway for the 2015 project.

Mobilization and Personnel

Construction of the camp infrastructure began on July 10 with the transport of materials, construction personnel and project manager to the site via river boat and aircraft. Some of the project equipment was stored at the Big Salmon sonar site and was transported by aircraft to the project.

The sonar crew consisted of the project supervisor who was on site continually for the duration of the project and one technician. Technicians were employed on the project on a rotational basis. The project manager was on-site for 10 days during the construction and start-up phase and again at three separate periods over the course of the project.

Sonar Deployment and Operation

The 2015 operational plan was to place a sonar unit on each side of the river. The sonars were configured to aim across the river enabling ensonification of the entire migration corridor (Figure 3). Two ARIS model 1800 sonar units were deployed over the duration of the project.

Power for the sonar units, computer apparatus, and wireless transceivers was obtained from 12 volt battery banks located on each side of the river. The 12 volt battery current was converted to 120 volt AC using 1000 watt inverters. The north bank batteries were charged using 4 solar panels as well as a commercial grade battery charger powered by a 2000 watt Honda® generator. The south bank sonar location was in perpetual shade precluding the use of solar panels. These batteries were charged with a second Honda® generator and commercial grade battery charger.

The sonar stands used during the 2014 project were again used in 2015 (Figures 4 and 5). This apparatus is described in a previous report (Mercer 2014).

The sonar transducer lenses were positioned to a depth of approximately 12 cm below the surface of the river and angled downward approximately 3° from horizontal. This resulted in the upper edge of the ensonified field of view remaining parallel to the surface of the river. The sonars have a compass and inclinometer that displayed the tilt and azimuth of the sonar beams on the computer display.

After placement of the sonars a diversion fence was positioned 3 m downstream of each sonar unit to deflect migrating Chinook into the ensonified area of the river. The north bank (NB) weir was constructed of metal tripods with horizontally connected wooden “stringers”. Prefabricated panels of electrical conduit were placed on the tripod structures to create the diversion fence (Figures 4 and 5). The fence for the south bank (SB) sonar consisted of a log boom extending approximately 8 meters out from the shore perpendicular to the current. For the 2015 project four additional fence panels were fabricated for use on the SB deflection weir. These pre-fabricated panels measured 1.5 m

x 4 m and consisted of a 2.5 cm steel box metal frame with 10 cm page wire in-fill. These panels were placed on the outer 4 m of the extended boom. The standard welded conduit panels that were used the previous years were placed along the in-shore portion of the boom. The page wire panels permitted extension of the SB diversion fence which reduced the required SB sonar window length. The new panels created an effective fish tight deflection fence with a minimal resistance to the current.

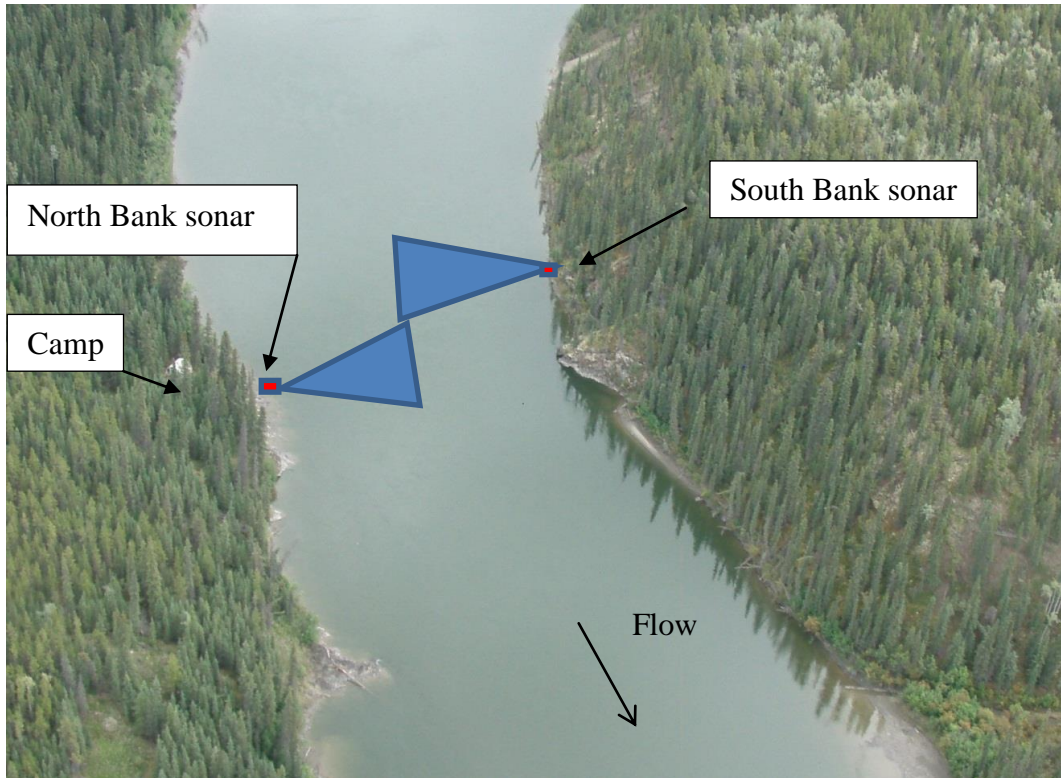


Figure 3. Aerial view of sonar site depicting the camp, sonar locations and schematic representation of ensonified portions of the river (2012 photo).

The same sonar settings were used for both the NB and SB ARIS sonars. The start and end ranges were 5.0 m and 50 m. The sonar settings were the default frequency of 1.1 Mhz. and receiver gain of 23 dB. The recording frame rate was set at 4 frames per second.



Figure 4. NB sonar unit mounted on tripod stand with diversion weir downstream of the sonar.



Figure 5. NB diversion weir in place (2013 photo).
Note: Photo taken in late August at lower water levels than photo in Figure 4.



Figure 6. SB sonar unit mounted on stand with diversion fence downstream (2014 photo).

Data Collection and Chinook Enumeration

The sonar data was collected continuously and stored automatically in pre-programmed, 20 minute date stamped files. This resulted in an accumulation of 72 files over a 24 hour period for each sonar unit. Review of the files typically occurred the following day. The files were stored on the laptop as well as a 3 TB external hard drive. It is MEI policy to maintain the files on the external hard drive for a minimum of 3 years after the project is completed.

The sonars were operated over the course of the project with minor planned and larger unplanned stoppages varying in duration from 2 minutes to 8.3 hours. All stoppages were recorded and potentially missed fish were added to the counts by extrapolation based on the mean number of fish per hour counted 12 hours before and after the outage. When complete files were missed the Chinook passage was estimated by interpolation of the average file count over the 12 hour period before and after the missing sample event as follows:

$$P_m = \frac{X_a + X_b}{2}$$

Where m is m th missing value, X_a is the mean file count prior to the missing sample event and X_b is the mean file count of the sample after the missing file(s).

The recorded files were examined using a combination of the sonar view platform and echograms of each file. The echogram feature of the ARISfish® software was typically used to examine all the files. However, if an examiner was uncertain about a particular target both views could be used for positive identification. To optimize target detection

in sonar view, the background subtraction feature was used to remove the static images such as the river bottom and weir structures. The playback speed depended on the preference and experience of the observer, but was generally set between 40 and 50 frames per second, approximately 10 - 12 times the recording rate. When necessary, the file review was stopped when a target was observed and replayed at a slower rate to aid in identifying passing fish.

All targets identified as Chinook were marked using ARISfish® software. The program enters applicable data such as time, size and position into a .csv format file that is exported into an excel spreadsheet. The position of each Chinook observed within the cross section profile of the river was recorded within 5m increments. This provided information on the spatial pattern of migrating Chinook within the ensonified area of the river. A spreadsheet record was maintained for each 20 minute file count as well as hourly, daily and cumulative counts. The count data from each sonar was combined and entered daily into a master spreadsheet.

Cross Section Profile

Cross section profiles of the river bottom were obtained to determine if the profiles have remained unchanged since the feasibility study in 2011. An accurate bottom profile will verify the site allows for complete ensonification of the water column by two sonars without acoustic shadows. These profiles will be collected each year the project operates at this site. A boat mounted Biosonics DTX split beam sonar, aimed 90° down from the surface, was used to obtain a cross section profile of the river bottom at the sonar site. Data was collected from two north bank to south bank transects of the river. These transects were located at each sonar deployment site.

The cross section profile at each sonar deployment location is presented in Figures 6 (a) and 6 (b). The profiles indicate that with proper sonar deployment it is possible to ensonify the entire area through which the Chinook migrate past the station. It appears the cross section profile of the river bottom at the site has remained relatively unchanged since the project started in 2011.

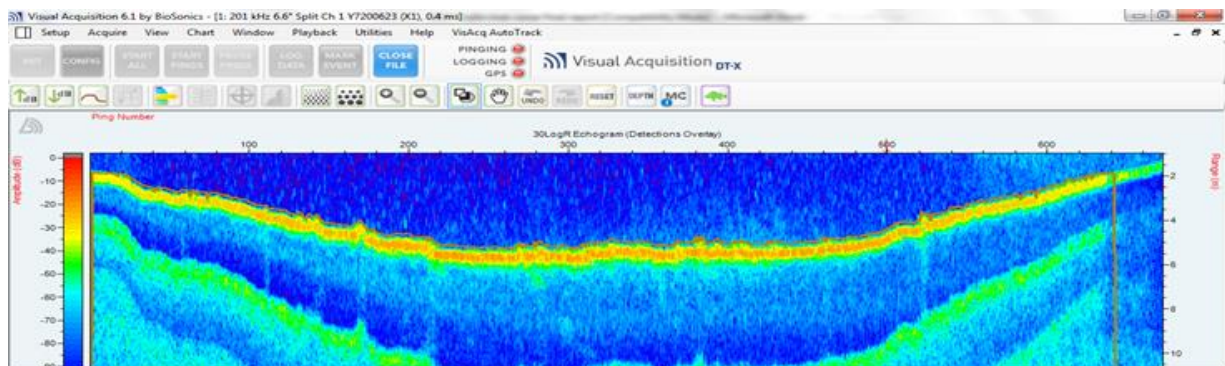


Figure 7 (a). Cross section profile of Teslin River at location of North bank sonar.
Note: North bank on left side of figure. Bottom is orange-yellow line; thalweg at 4.8m.

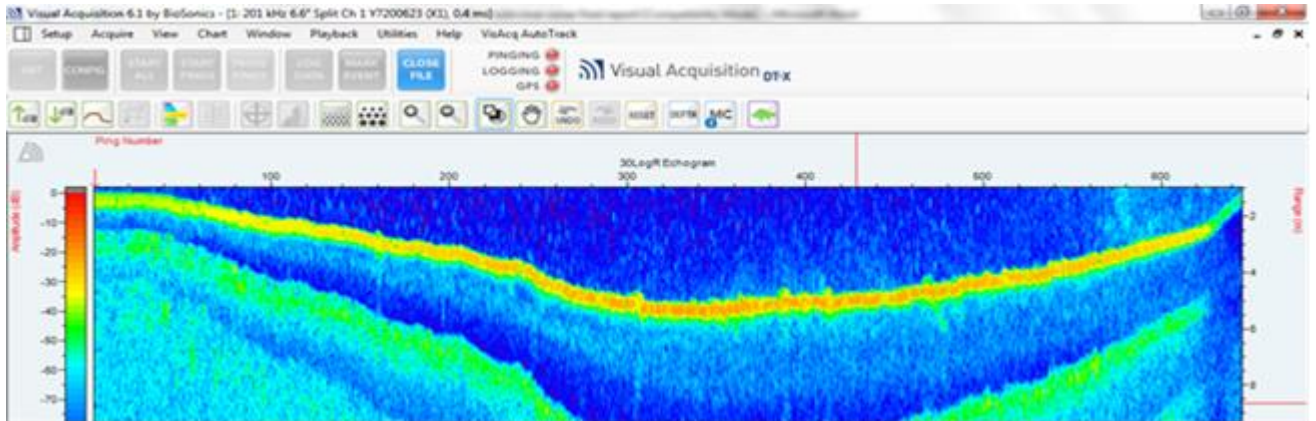


Figure 7 (b). Cross section profile of Teslin River at location of South bank sonar.
Note: South bank on right side of profile. Bottom is orange-yellow line; thalweg at 4.5m.

Target Identification

Fish identification was based on the size, form and swimming behaviour of detected sonar targets. The target measurement feature of the sonar software was used to estimate the size of the observed fish when required. The minimum size used to classify Chinook salmon for the project was 50 cm. It has been demonstrated that with adequate training the sonar operators are able to differentiate, with a high degree of accuracy, between resident fish species and migrating salmon (Enzenhofer et al. 2010). Blind trials comparing both visual and DIDSON sonar counts of Chinook on the Klondike River demonstrated that trained sonar operators detected and correctly identified 100% of the visually observed (n=106) Chinook passing the Station (Mercer 2010).

It is possible that co-migrating Chum salmon could be incorrectly identified as migrating Chinook due to similar form, swimming behaviour and overlapping size classes. Fall Chum salmon are documented spawning in the mainstem Teslin River (DFO FISS database). However, data from the Eagle sonar project and other evidence indicates it is unlikely a temporal overlap of migrating fall Chum and Chinook occurs in the Teslin system. This is discussed in detail in a previous report (Mercer 2014).

Precision of Counts

Some salmon enumeration sonar projects, particularly those with relatively high passage rates, review a sub-set of recorded data and apply an expansion factor to obtain an estimate of total fish passage. The variance associated with this expansion method can be quantified and incorporated into the total fish passage estimate (Enzenhofer et al., 2010, Crane and Dunbar (2007, 2010). However, all the recorded files for the Teslin sonar

project were reviewed in their entirety. Because of this, there is no variance associated with the expansion of a sub-set of data. Therefore the counts are considered to accurately reflect the actual Chinook passage at the station.

The precision of the file counts was measured by double reviewing a sub-set of all the files recorded. Precision in this context refers to the repeatability of a count between different individuals for the same data file. Approximately 12 (8%) of the 144 files recorded were double checked each day by a second reader. The re-count from each file was recorded for comparison with the original.

Sonar projects with high fish passage rates may use the the average percent error (APE) method to quantify the repeatability (precision) of counts (Enzenhofer *et. al*, 2010). This formula is expressed as:

$$APE = \frac{1}{N} \sum_{j=1}^N \left[\frac{1}{R} \sum_{i=1}^R \frac{|X_{ij} - \bar{X}_j|}{\bar{X}_j} \right] \times 100$$

where N is the number of events counted by R observers, X_{ij} is the i th count of the j th event and \bar{X}_j is the average count of the j th event.

However, because of the relatively low number of fish per hour in most of the Teslin sonar files the average percent error could be over-estimated. For example, if the first counter observed two upstream fish and the second counter missed one, the APE would be as high as 33 %. This is because of the leverage that small numerical differences in low counts have on the overall calculation of APE. It should be noted that the magnitude of this error is high when individual file counts are low but because these numbers are also relatively low it has little influence on the overall count. Because of this potential bias, the average percent error for the 2015 Teslin project was calculated using a daily aggregate of the reviewed counts and the corresponding original counts. As well, comparisons were only made using those files with daily aggregate counts ≥ 5 fish.

As well as calculating APE a sample variance estimator based on the absolute difference between readers was used to quantify and illustrate the precision of the counts and the net variability between readers.

Carcass Pitch

The carcass pitch on the upper mainstem Teslin River was conducted by a crew of two technicians. Access to Chinook spawning areas was by a river boat powered by a 60 hp outboard jet. The crew made two trips over a 12 day period from September 3 – 13. The river was accessed at the Johnson's Crossing boat ramp, located approximately 4 km downstream from the outlet of Teslin Lake (Figure 1). Carcass pitch efforts extended downstream approximately 110 km from Johnson's Crossing. Only dead or moribund post-spawn fish were collected. Collection was by hand or by using an extendable spear.

Collection of ASL data involved recording the sex, mid-eye-fork and post-orbital hypural lengths (to the nearest 5 mm). As well, the post spawn egg retention, based on subjective examination by the samplers, was determined for all females sampled. The GPS coordinates of the principal spawning locations (based on densities of dead and moribund fish) were also documented. Scale cards and an electronic copy of the ASL and other recovery data were submitted to DFO Whitehorse on completion of the project.

Hydrometric Data and Weather

Air and water temperatures and water levels were recorded daily at the sonar site. A referenced water gauge was established so that relative water levels could be recorded in subsequent years. Anecdotal weather observations were also recorded.

Communication

For safety purposes a satellite phone was present in the camp at all times as well as carried by the crew during extended boat trips. In addition, a satellite internet system was installed at the site. The satellite internet system facilitated communications between the field personnel, project manager and technical support team from Sound Metrics. Tri-weekly sonar counts were passed on by email to DFO Whitehorse, the TTC Department of Lands and Resources and other interested parties. The satellite internet also allowed direct real time communication and file sharing with technical staff at Sound Metrics.

4. RESULTS

Chinook Counts

A total of 20,402 targets identified as Chinook salmon was counted during the period July 16 through August 31. Of this total, the north bank sonar counted 14,792 (68%) and the south bank 6,977 (32%) of the passing Chinook. The sonars were removed from the river before the Chinook run was fully complete. An estimate of Chinook passage after the removal of the sonars was calculated through extrapolating the last 5 days of the sonar counts using the logarithmic regression formula: $y = -49.36\ln(x) + 113.86$. This yields an estimated 61 additional Chinook bringing the total count to 20,463.

The first Chinook salmon was recorded on July 16, the first day the sonar was operational. A peak daily count of 868 fish occurred on August 15, at which time 71% of the run had passed the sonar station. Approximately 90% of the run had passed the station by August 23, 36 days after the first Chinook was observed. Daily and cumulative counts are presented in Table 1 and illustrated in Figure 7.

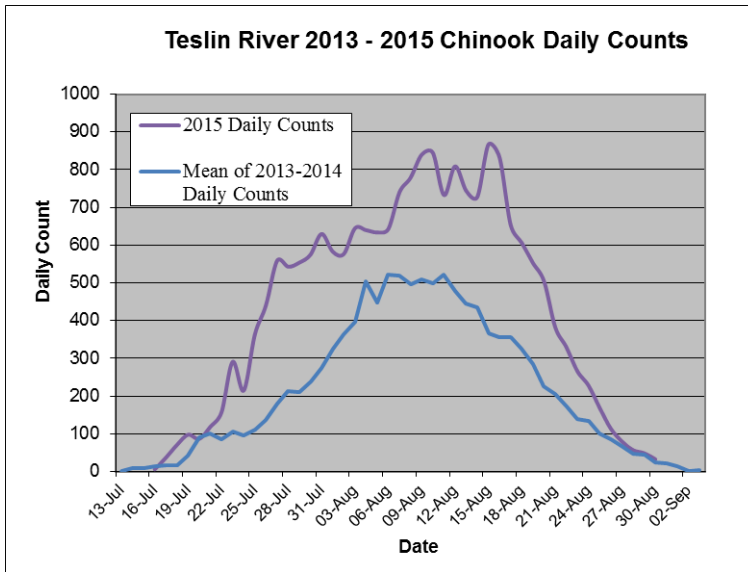


Figure 8. Daily Counts of Chinook at Teslin River sonar station 2015, and mean daily counts 2013 and 2014.

The cross sectional distribution pattern of the migrating Chinook is presented in Figure 9. Over the years 2013 through 2015 a majority of the Chinook passing the station were detected by the NB sonar (Figures 9 and 10).³ The temporal and spatial distribution pattern of migrating Chinook past the sonar station is discussed in Section 5.

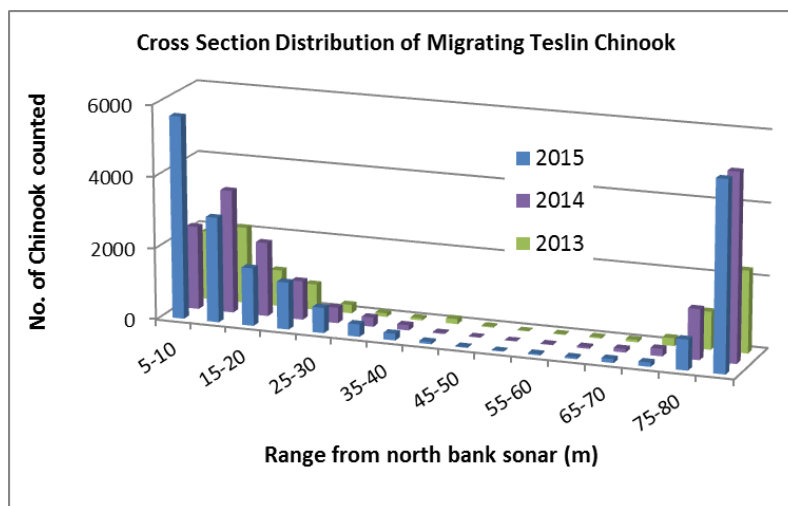


Figure 9. Cross section distribution of migrating Chinook, Teslin sonar site, 2013-2015.

³ The deflection fences were absent during the 2011 feasibility study and likely were not completely impervious to fish passage during the 2012 project. Therefore distribution of fish in the migration corridor would be mis-represented by the sonar results.

Table 1. 2015 Daily counts of Teslin River Chinook salmon.

Date	North	South	Daily Total	Cumulative
16-Jul	3	3	6	6
17-Jul	18	19	37	43
18-Jul	35	36	71	114
19-Jul	48	50	98	212
20-Jul	43	44	87	299
21-Jul	61	58	119	418
22-Jul	96	61	157	575
23-Jul	203	88	291	866
24-Jul	124	91	215	1081
25-Jul	245	118	363	1444
26-Jul	289	152	441	1885
27-Jul	365	194	559	2444
28-Jul	366	177	543	2987
29-Jul	355	201	556	3543
30-Jul	376	199	575	4118
31-Jul	439	191	630	4748
01-Aug	368	214	582	5330
02-Aug	405	171	576	5906
03-Aug	325	320	645	6551
04-Aug	335	305	640	7191
05-Aug	351	281	632	7823
06-Aug	445	197	642	8465
07-Aug	539	201	740	9205
08-Aug	507	270	777	9982
09-Aug	549	291	840	10822
10-Aug	629	216	845	11667
11-Aug	505	226	731	12398
12-Aug	598	211	809	13207
13-Aug	548	197	745	13952
14-Aug	470	258	728	14680
15-Aug	592	276	868	15548
16-Aug	622	210	832	16380
17-Aug	488	165	653	17033
18-Aug	431	174	605	17638
19-Aug	434	119	553	18191
20-Aug	355	149	504	18695
21-Aug	266	117	383	19078
22-Aug	208	122	330	19408
23-Aug	184	82	266	19674
24-Aug	159	69	228	19902
25-Aug	101	66	167	20069
26-Aug	72	42	114	20183
27-Aug	57	23	80	20263
28-Aug	42	15	57	20320
29-Aug	32	17	49	20369
30-Aug	24	9	33	20402
31-Aug			25	20427
01-Sep			18	20445
02-Sep			11	20456
03-Sep			5	20462
04-Sep			1	20463

Note: Shaded cells denote extrapolated daily counts

Precision of Counts

Of the 6,925 sonar files recorded and analysed, a total of 605 (8.7%) was reviewed by a second observer. Of the 605 files reviewed, a total of 63 files (10.4%) exhibited a discrepancy between readers. A positive difference was observed in 39 (6.4%) of double reviewed files and a negative difference in 24 (3.9%) of the files. Of the files that exhibited inconsistencies between readers, 44 additional fish were observed by the reviewer and 27 fish missed by the reviewer. The total number of fish counted in the original file set was 2,196. The total number of fish counted in the reviewed file set was 2,213. The net difference between the sums of the original and double reviewed files was +17 fish; 0.74% of the total fish counted in the reviewed files. Applying this expansion factor of 0.0074 to the total count (20,402) would result in a total of 149 Chinook that may not have been observed and counted over the course of the project. The sum of daily

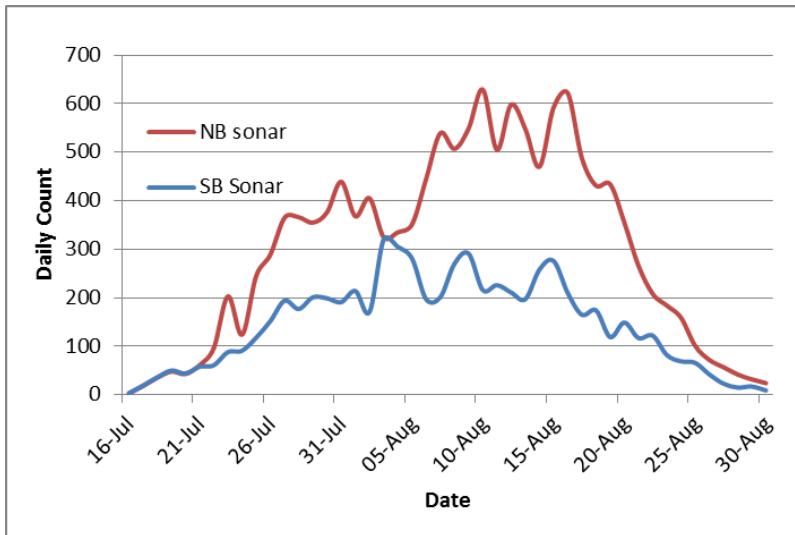


Figure 10. 2015 daily counts of NB and SB sonars.

counts of reviewed files showed variation between the readers. However, the overall correlation of counts is high ($R^2 = 0.99$). Figure 11 illustrates the relationship between counts of two different file readers comparing the daily pooled original and corresponding reviewed files. The precision of the counts is discussed in section 5 below.

The average percent error between readers was calculated by using the daily aggregate of reviewed and corresponding original files that had total counts ≥ 5 fish. These figures are listed in Appendix 2. The average percent error between the original and reviewed aggregate files was 0.3%.

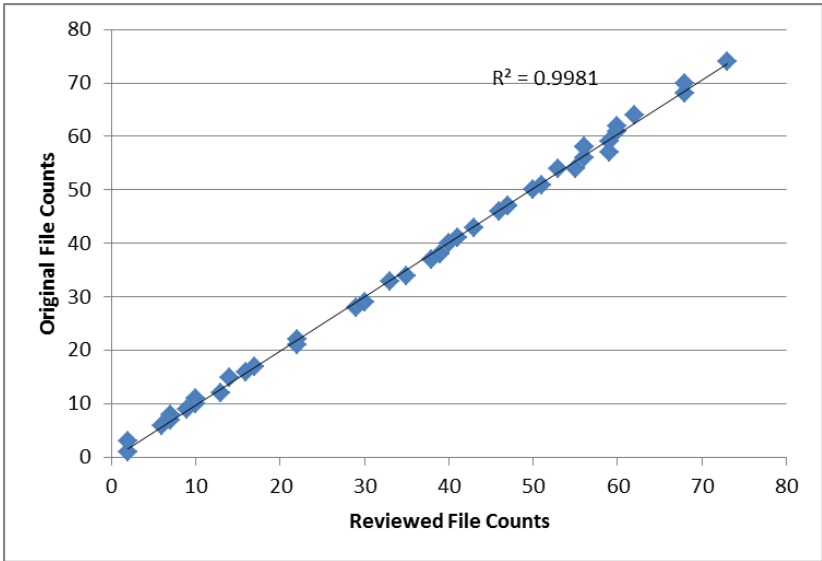


Figure 11. Linear regression between original and reviewed sonar file data that has been analysed by two different readers.

Note: Data points are NB sonar counts representing daily pooled original and reviewed Chinook counts.

Table 2. Initial and reviewed files and calculated difference between counts.

	Count	%
Total files recorded during project	6925	
Total files double reviewed	605	8.7%
Total Fish counted in first tally	2196	
Total fish counted in reviewed files	2213	
Total files with + discrepancy	39	6.4%
Total files with - discrepancy	24	3.9%
Total files with discrepancy	63	10.4%
Total plus fish	39	1.7%
Total minus fish	24	-1.1%
Net difference	17	0.7%

Carcass Pitch

A total of 556 dead or moribund mainstem Teslin Chinook was recovered and sampled during the carcass pitch. Of the fish collected, 377 (68%) were female and 179 (32%) were male. A mid-eye fork (MEF) length-frequency histogram of the sampled Chinook is

illustrated in Figure 11. The mean mid-eye fork length of females and males sampled was 838 mm and 733 mm respectively.

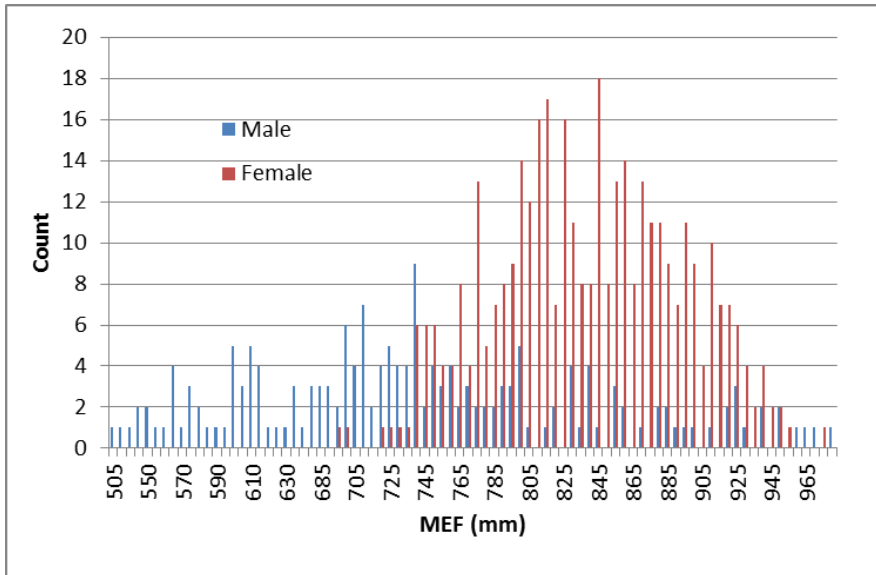


Figure 12. Length Frequency histogram of sampled Teslin River Chinook, 2015.

Complete age data⁴ was determined from 535 of the Chinook sampled; the remaining 31 samples were not aged due to regenerate scales. Age 1.4⁵ (48%) was the dominant age class, followed by age 1.3 fish (37%). Age 1.2 and 1.5 fish each represented 8% and 6% respectively. The ASL data for the 535 sampled fish for which complete age data is available is presented in Table 3.

Egg retention of the sampled dead and moribund female Chinook was low. Of the 347 females examined where a determination could be made, 10 (2.8%) were considered not to have fully spawned. Of these 10 fish, it was estimated that 8 had released > 50% of their eggs. Two of the 347 examined females had 100% egg retention. Complete age, length and sex data as well as egg retention and principal recovery locations are presented in Appendix 3.

⁴ Scale age analysis was conducted for DFO Whitehorse by the Pacific Biological Station sclerochronology lab in Nanaimo, British Columbia. All sampled fish except one were 1 year freshwater so for those analyzed with marine ages only it was assumed they were 1 year freshwater as well.

⁵ European age format; e.g. 1.3 denotes a 5 year old fish with 1+ years freshwater residence and 3 years marine residence.

Table 3. Mainstem Teslin Chinook age, sex and length data, 2015.

SEX	AGE *	Data	Total	%
Female	12	Average of MEF (mm)	853	
		Count	3	1%
	13	Average of MEF (mm)	793	
		Count	98	18%
	14	Average of MEF (mm)	852	
		Count	210	39%
	15	Average of MEF (mm)	889	
		Count	53	10%
	23	Average of MEF (mm)	830	
		Count of AGE *	1	0%
Female Average MEF (mm)			838	
Female Count			365	68%
Male	11	Average of MEF (mm)	575	
		Count	1	0%
	12	Average of MEF (mm)	617	
		Count	39	7%
	13	Average of MEF (mm)	746	
		Count	86	16%
	14	Average of MEF (mm)	803	
		Count	36	7%
	15	Average of MEF (mm)	750	
		Count	7	1%
	16	Average of MEF (mm)	1010	
		Count	1	0%
Male Average MEF (mm)			732	
Male Count			170	32%
Total Sampled for age			535	

Note: Above ASL data is for the 535 fish of the 556 sampled for which complete age data was available.
 *European age classification.

Chinook Spawning Escapement Estimates generated from GSI data and sonar counts

The 2015 Eagle sonar project on the Yukon River downstream of the Canada/U.S. border yielded a Chinook passage estimate of 84,031 and a spawning escapement⁶ estimate of 82,674 Chinook salmon (DFO Whitehorse unpublished data 2015). Genetic stock identification (GSI) samples were also obtained at the Eagle sonar site using drift nets. The GSI data provides information on the proportional contribution of identified stocks to the total above border Chinook escapement. The 2015 proportional contribution of the

⁶ Spawning escapement is the Eagle sonar count minus the catches in the U.S. above the sonar station and in the Canadian fisheries.

regional Teslin River stock to the Chinook border escapement based on un-weighted analysis of the GSI samples was 25.4% (SD 2.4), (DFO Whitehorse unpublished data). Expansion of the 2015 Teslin sonar count (20,463) using the proportion of Teslin origin stock derived from the Eagle GSI sampling results in a 2015 Chinook border escapement estimate of 80,563 (95% CI, 73,608 – 88,969).

It is also possible to obtain a Chinook border escapement by using the sum of the sonar counts from both the Big Salmon and Teslin projects and the aggregate of the GSI proportions from these two stocks. The combined 2015 Teslin and Big Salmon sonar counts totalled 30,541 Chinook. The un-weighted aggregate Big Salmon and Teslin GSI stock proportion based on the 2015 Eagle sampling is 35.1% (SD = 3.1) (Unpublished data, DFO – PBS Nanaimo genetics lab). Using the aggregate GSI stock proportions and the total of the two sonar counts yields an expanded 2015 Chinook border escapement estimate of 87,071 (95% CI = 79,950 – 95,441).

The Eagle Chinook sonar counts and GSI stock proportions can also be used to determine an estimate of the Teslin Chinook stock. Using this technique yields a Teslin escapement estimate of 21,004 (95% CI, 18,997 – 23,012). The use of Yukon River Chinook sonar counts and GSI stock proportion to determine proxy escapements is discussed below.

5. DISCUSSION AND RECOMMENDATIONS

The 2015 Teslin River sonar project was conducted successfully and as planned over the course of the Chinook run into the system. The relatively low water levels and reduced flows encountered in 2015 contributed to easier installation and maintenance of the deflection fences. In general the sonars and related equipment functioned well, however as occurred in 2014, the down time for the SB sonar was greater than expected. The difficulties associated with the SB sonar again were related to random network disconnections between the sonar and computer receiving the file data. This issue was more prevalent at the beginning and diminished over the course of the project. Sonar downtime is more problematic during periods when the technicians may not be present to monitor the recording status of the sonar. To rectify this situation the technicians set up an audible alarm system that alerted the crew when the data connection between the sonar and computer was disrupted.

The run timing of the 2015 Teslin Chinook was similar to previous years, although the peak of the run was later than was experienced in 2013 or 2014. As in previous years, more Chinook were observed passing in the north side of the river. It was observed in preceding years that no Chinook were observed by the SB sonar at the beginning of the run. This may have been a result of orientation of migrating fish to the north side of the river until water level/flows receded to the point when swimming energetics were conducive to migration along the south side of the river. In 2015, perhaps due to the low water levels, Chinook were observed on both sides of the river at the beginning of the run.

For the 2015 project the average percent error between readers of the 605 reviewed files was relatively low at 0.3%. These values are similar to those in 2013 and 2014 (Mercer 2015). The linear regression between readers of the daily pooled file counts indicate the correlation of counts between readers is high ($R^2 = 0.99$). The variability between the original and reviewed counts is due to missed fish rather than misidentified fish. This statement is based on the knowledge that only one species of salmon is being counted and the migrating Chinook are readily distinguishable from resident fish and other non-fish targets. As occurred in 2013 and 2014, files examined a second time produced a net gain of fish over the first count. The sum net gain of Chinook in all reviewed files was 1.5% in 2013, 1.7% in 2014 and 0.7% in 2015. It is postulated that the gain may be due to greater diligence by the second reader; wanting to be certain they do not miss fish observed by the first reader. This suggests the overall sonar count could be biased low. However the evidence indicates the bias in 2015 was minimal, < 1% of the total count.

In 2015 there was a high level of concordance between the Teslin Chinook escapement proxy estimates based on GSI data and actual sonar counts. Both the Teslin and above border proxy escapement estimates were within the 95% C.I. range predicted by the GSI data. The relatively large GSI sample sizes obtained at Eagle in 2015 may have contributed to the congruity. It is outside the scope of the Teslin sonar project and this report to analyze and comment on the upper Yukon River Chinook GSI stock compositions, related sonar counts and the precision of the resultant escapement estimates. However, examination of this data does underscore the value of obtaining independent⁷ escapement estimates of upper Yukon Chinook. The value of accurate escapement data is increased if it can be correlated with accurate stock composition information. An accurate count of a Chinook stock or aggregate stocks coupled with accurate GSI stock proportions has the capability of generating independent upper Yukon Chinook escapement estimates that are within defined statistical parameters.

As was evidenced in 2014, the carcass pitch demonstrated there are areas of relatively high densities of spawning Chinook in the mainstem Teslin River. The 2015 carcass pitch on the mainstem Teslin was extended to occur over the whole of the peak die off period. This, coupled with the relatively large escapement into the system, resulted in a sample size larger than the target of 500 fish. Dead pitch sampling bias has been documented in other systems (Mears and Dubois 2009; Zou 2002) and has been discussed in previous Teslin sonar reports (Mercer 2014 and 2015). Extending the sampling period over the whole die off period may reduce this bias. However, it was likely still present in the 2015 Teslin dead pitch as evidenced by the significantly larger proportion of females in the sample set.

The Teslin sonar project is challenging due to the size of the river, swift flow and the strong bank orientation of the migrating Chinook. The low water levels in 2015 made the installation and maintenance of the deflection weirs easier than it has been in the past. The placement of effective and robust deflection weirs is essential for conducting a

⁷ Using data separate from the Eagle or Pilot Station sonar projects.

successful sonar project at this site. High water conditions and associated strong currents could prevent the installation and maintenance of fish tight deflection fences, particularly during the beginning of the project when water levels are at their highest. If the Teslin sonar program continues in 2016 it is recommended that continued refinements be made to the design and construction of the deflection fences.

The solar powered battery bank used to power the NB sonar and computer equipment was obtained in a used condition at the beginning of the program in 2012. The 6 batteries have reached the end of their service life and should be replaced if the project occurs again in 2016.

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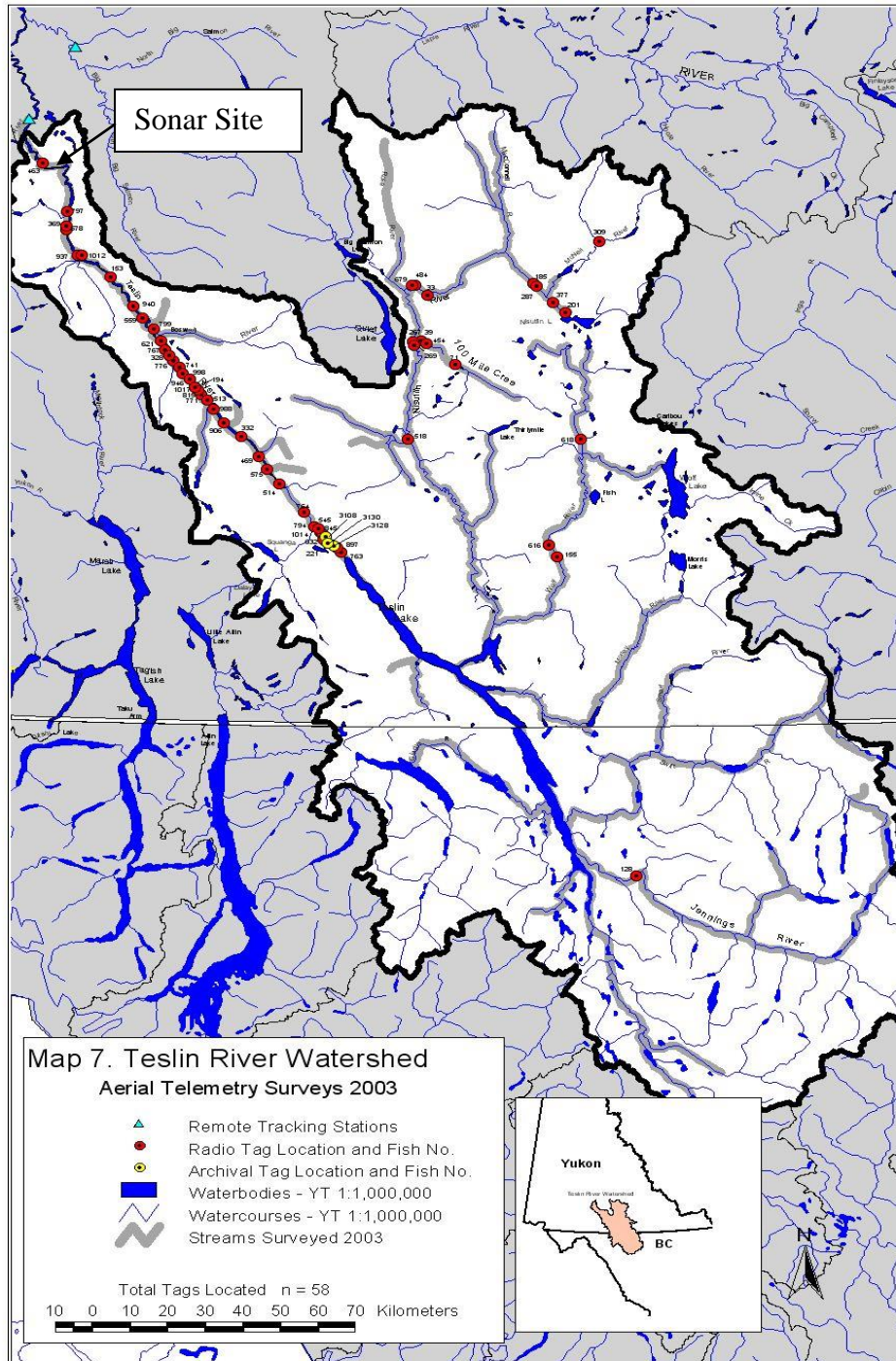
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7. ACKNOWLEDGEMENTS

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Appendix 1. Location of radio tagged Chinook during peak spawning in the Teslin River drainage in 2003.
 Source: Mercer and Eiler, 2004.



Appendix 2. Daily aggregate of reviewed and corresponding original files from North Bank Teslin River sonar, 2015.

Date	Daily Aggregate of Reviewed Counts	Daily Aggregate of Original Counts	Difference
22-Jul	10	11	-1
23-Jul	17	17	0
24-Jul	13	12	1
25-Jul	22	21	1
26-Jul	35	34	1
27-Jul	55	54	1
28-Jul	40	40	0
29-Jul	41	41	0
30-Jul	43	43	0
31-Jul	50	50	0
01-Aug	46	46	0
02-Aug	47	47	0
03-Aug	33	33	0
04-Aug	51	51	0
05-Aug	39	38	1
06-Aug	56	58	-2
07-Aug	47	47	0
08-Aug	38	37	1
09-Aug	59	59	0
10-Aug	73	74	-1
11-Aug	60	62	-2
12-Aug	62	64	-2
13-Aug	60	61	-1
14-Aug	56	56	0
15-Aug	53	54	-1
16-Aug	59	57	2
17-Aug	68	68	0
18-Aug	56	58	-2
19-Aug	68	70	-2
20-Aug	29	28	1
21-Aug	22	22	0
22-Aug	30	29	1
23-Aug	16	16	0
24-Aug	14	15	-1
25-Aug	10	10	0
26-Aug	9	9	0
27-Aug	7	8	-1
28-Aug	6	6	0
29-Aug	7	7	0
30-Aug	2	1	1
31-Aug	2	3	-1
Grand Total	1511	1517	

Note: Only aggregate counts ≥ 5 fish were used to calculate average percent error.

Appendix 3 (a). 2015 Mainstem Teslin River carcass pitch data.

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
3-Sep	1	F	100	885	810	730	14	815	1	1-41	1
3-Sep	2	F	100	850	775	695	13	815	1	2-42	1
3-Sep	3	F	100	810	745	660		815	1	3-43	1
3-Sep	4	F	0	845	775	700	13	815	1	4-44	1
3-Sep	5	F	100	855	780	715	14	815	1	5-45	1
3-Sep	6	F	100	890	820	725	14	815	1	6-46	1
3-Sep	7	F	100	965	875	785	14	815	1	7-47	1
3-Sep	8	F	NA	875	800	725	13	815	1	8-48	1
3-Sep	9	F	100	920	855	780	14	815	1	9-49	1
3-Sep	10	F	100	970	875	780	13	815	1	10-50	1
3-Sep	11	F	100	955	865	770	14	816	2	1-41	1
3-Sep	12	F	100	885	810	735	15	816	2	2-42	1
3-Sep	13	F	NA	820	745	670	13	816	2	3-43	1
3-Sep	14	F	100	815	730	650	13	816	2	4-44	1
3-Sep	15	F	100	935	845	770	14	816	2	5-45	1
3-Sep	16	M		920	820	720	13	816	2	6-46	1
3-Sep	17	F	100	1030	945	850	14	816	2	7-47	1
3-Sep	18	F	100	895	820	740	15	816	2	8-48	1
3-Sep	19	F	100	975	890	795	14	816	2	9-49	1
3-Sep	20	F	100	890	805	705	14	816	2	10-50	1
3-Sep	21	M		830	740	655	13	817	3	1-41	1
3-Sep	22	F	NA	835	755	680	13	817	3	2-42	1
3-Sep	23	M		890	780	675	13	817	3	3-43	1
3-Sep	24	F	100	830	760	675	13	817	3	4-44	1
3-Sep	25	F	NA	880	800	730	13	817	3	5-45	1
3-Sep	26	F	100	1000	900	805	14	817	3	6-46	1
3-Sep	27	F	100	970	895	795	15	817	3	7-47	1
3-Sep	28	F	100	935	855	760	14	817	3	8-48	1
3-Sep	29	F	100	815	745	660	13	817	3	9-49	1
3-Sep	30	F	NA	890	815	730	14	817	3	10-50	1
3-Sep	31	M		1025	930	810	13	818	4	1-41	1
3-Sep	32	F	100	890	815	715	13	818	4	2-42	1
3-Sep	33	F	100	825	755	680	M4	818	4	3-43	1
3-Sep	34	M		970	860	755	14	818	4	4-44	2
3-Sep	35	F	100	995	910	820	14	818	4	5-45	2
3-Sep	36	F	100	820	750	670	13	818	4	6-46	2
3-Sep	37	F	100	975	900	805	M4	818	4	7-47	2
3-Sep	38	F	100	995	915	835	14	818	4	8-48	2
3-Sep	39	M		790	700	615	M3	818	4	9-49	2
3-Sep	40	M		835	755	675		818	4	10-50	2
3-Sep	41	F	100	770	700	620	13	819	5	1-41	2
3-Sep	42	F	100	1025	930	845	14	819	5	2-42	2

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
3-Sep	43	F	100	840	770	680	13	819	5	3-43	2
3-Sep	44	F	100	890	810	725	14	819	5	4-44	2
3-Sep	45	F	100	790	720	645	14	819	5	5-45	2
3-Sep	46	F	100	855	785	700	14	819	5	6-46	2
3-Sep	47	F	100	915	845	750	15	819	5	7-47	2
3-Sep	48	M		1040	920	815	14	819	5	8-48	2
3-Sep	49	F	NA	910	845	735	13	819	5	9-49	2
3-Sep	50	F	100	950	860	770	14	819	5	10-50	2
3-Sep	51	F	100	915	840	740	14	820	6	1-41	2
3-Sep	52	F	100	985	890	790	14	820	6	2-42	2
3-Sep	53	F	100	975	895	805	14	820	6	3-43	2
3-Sep	54	F	50	890	805	705	14	820	6	4-44	2
3-Sep	55	F	100	830	750	670	13	820	6	5-45	2
4-Sep	56	F	100	990	915	815	14	820	6	6-46	2
4-Sep	57	F	100	880	800	710	14	820	6	7-47	2
4-Sep	58	F	100	1015	935	830	15	820	6	8-48	2
4-Sep	59	M		900	800	695	13	820	6	9-49	2
4-Sep	60	F	100	915	835	745	1F	820	6	10-50	2
4-Sep	61	F	100	850	770	695	13	821	7	1-41	2
4-Sep	62	F	100	890	800	705	13	821	7	2-42	2
4-Sep	63	M		875	775	685	13	821	7	3-43	2
4-Sep	64	F	100	960	860	775	15	821	7	4-44	2
4-Sep	65	F	100	990	920	820	15	821	7	5-45	2
4-Sep	66	F	100	1000	910	805	14	821	7	6-46	2
4-Sep	67	F	100	965	885	775	15	821	7	7-47	2
4-Sep	68	M		945	845	750	14	821	7	8-48	2
4-Sep	69	F	100	910	825	745	14	821	7	9-49	2
4-Sep	70	F	100	895	810	725	13	821	7	10-50	2
4-Sep	71	F	100	875	795	710	13	822	8	1-41	2
4-Sep	72	M		895	785	695	14	822	8	2-42	2
4-Sep	73	F	100	865	790	710	14	822	8	3-43	2
4-Sep	74	F	100	930	845	760	15	822	8	4-44	2
4-Sep	75	F	100	890	805	720	14	822	8	5-45	2
4-Sep	76	F	100	940	855	770	14	822	8	6-46	2
4-Sep	77	F	75	905	810	725	13	822	8	7-47	2
4-Sep	78	F	100	810	735	660	13	822	8	8-48	2
4-Sep	79	F	100	1040	950	845	15	822	8	9-49	2
4-Sep	80	M		770	690	605	13	822	8	10-50	2
4-Sep	81	F	100	885	810	725	14	823	9	1-41	2
4-Sep	82	M		765	680	600	13	823	9	2-42	2
4-Sep	83	M		675	600	525	M2	823	9	3-43	2
4-Sep	84	F	100	965	880	785	14	823	9	4-44	2
4-Sep	85	F	100	940	870	785	14	823	9	5-45	2
4-Sep	86	M		960	840	740	14	823	9	6-46	2

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
4-Sep	87	F	NA	895	810	740	14	823	9	7-47	2
4-Sep	88	M		605	545	475	M2	823	9	8-48	2
4-Sep	89	M		970	855	755	14	823	9	9-49	2
4-Sep	90	F	100	905	825	745	14	823	9	10-50	2
4-Sep	91	M		750	680	605	13	824	10	1-41	2
4-Sep	92	M		765	700	610	13	824	10	2-42	2
4-Sep	93	F	100	920	825	740	14	824	10	3-43	2
4-Sep	94	F	100	890	815	735	14	824	10	4-44	2
4-Sep	95	M		940	820	715	13	824	10	5-45	2
4-Sep	96	M		760	675	600	M3	824	10	6-46	2
4-Sep	97	F	100	955	870	775		824	10	7-47	1
4-Sep	98	F	100	1010	925	820	M4	824	10	8-48	1
4-Sep	99	F	100	970	875	785	13	824	10	9-49	1
4-Sep	100	M		620	555	495	12	824	10	10-50	1
4-Sep	101	F	100	850	775	705	14	825	11	1-41	1
4-Sep	102	M		805	725	640	13	825	11	2-42	1
4-Sep	103	F	100	835	760	680	13	825	11	3-43	1
4-Sep	104	F	100	920	830	755	M3	825	11	4-44	1
4-Sep	105	F	100	995	910	805	15	825	11	5-45	1
4-Sep	106	M		840	750	665	13	825	11	6-46	1
4-Sep	107	F	100	1005	920	820	15	825	11	7-47	1
4-Sep	108	F	100	980	895	795	14	825	11	8-48	1
4-Sep	109	F	100	910	825	740	14	825	11	9-49	1
4-Sep	110	F	100	925	840	745	14	825	11	10-50	1
4-Sep	111	F	100	820	745	670	13	826	12	1-41	1
4-Sep	112	F	100	955	870	775	14	826	12	2-42	1
4-Sep	113	F	NA	930	845	755	14	826	12	3-43	1
4-Sep	114	F	100	895	825	730	M4	826	12	4-44	1
4-Sep	115	F	100	960	870	790	14	826	12	5-45	1
4-Sep	116	F	100	820	740	665	13	826	12	6-46	1
4-Sep	117	F	100	945	860	765	13	826	12	7-47	1
4-Sep	118	F	100	1020	925	820	14	826	12	8-48	1
4-Sep	119	M		935	835	730	14	826	12	9-49	1
4-Sep	120	M		865	770	680	13	826	12	10-50	1
4-Sep	121	F	NA	895	825	745	14	827	13	1-41	1
4-Sep	122	F	NA	935	865	775	14	827	13	2-42	1
4-Sep	123	F	NA	860	805	715	14	827	13	3-43	1
5-Sep	124	F	100	930	845	755	14	827	13	4-44	3
5-Sep	125	F	NA	880	815	730	13	827	13	5-45	3
5-Sep	126	F	100	890	805	720		827	13	6-46	3
5-Sep	127	M		835	740	650	13	827	13	7-47	3
5-Sep	128	M		875	770	680	13	827	13	8-48	3
5-Sep	129	M		885	790	690	M4	827	13	9-49	3
5-Sep	130	F	100	945	865	790	14	827	13	10-50	3

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
5-Sep	131	F	100	960	870	785	14	828	14	1-41	3
5-Sep	132	F	100	835	765	680	13	828	14	2-42	3
5-Sep	133	F	100	960	880	785	15	828	14	3-43	3
5-Sep	134	F	100	960	880	785	14	828	14	4-44	3
5-Sep	135	M		855	750	670	13	828	14	5-45	3
5-Sep	136	F	100	840	765	685	13	828	14	6-46	3
5-Sep	137	M		590	535	470	12	828	14	7-47	4
5-Sep	138	M		670	610	560	12	828	14	8-48	4
5-Sep	139	M		680	610	550	12	828	14	9-49	4
5-Sep	140	M		715	640	560	12	828	14	10-50	4
5-Sep	141	M		895	795	705	13	829	15	1-41	4
5-Sep	142	M		690	615	560	12	829	15	2-42	4
5-Sep	143	F	100	815	750	670	13	829	15	3-43	4
5-Sep	144	M		790	705	625	13	829	15	4-44	4
5-Sep	145	F	100	1020	925	830	14	829	15	5-45	4
5-Sep	146	M		1015	895	780	14	829	15	6-46	4
5-Sep	147	M		855	760	665	13	829	15	7-47	4
5-Sep	148	F	100	940	850	760	14	829	15	8-48	4
5-Sep	149	M		945	840	750	13	829	15	9-49	4
5-Sep	150	M		695	625	550	12	829	15	10-50	4
5-Sep	151	M		820	730	635	13	830	16	1-41	4
5-Sep	152	M		775	690	615	13	830	16	2-42	4
5-Sep	153	M		910	800	700	12	830	16	3-43	4
5-Sep	154	M		775	700	625	13	830	16	4-44	4
5-Sep	155	M		800	715	630	13	830	16	5-45	4
5-Sep	156	F	100	1010	925	880	15	830	16	6-46	3
5-Sep	157	M		800	710	630	13	830	16	7-47	3
5-Sep	158	M		840	755	665	13	830	16	8-48	3
5-Sep	159	F	100	970	875	790	14	830	16	9-49	3
5-Sep	160	M		595	550	480	12	830	16	10-50	3
5-Sep	161	M		750	680	590	12	831	17	1-41	3
5-Sep	162	M		815	730	645	13	831	17	2-42	3
5-Sep	163	M		835	745	650	13	831	17	3-43	3
5-Sep	164	M		890	780	685	13	831	17	4-44	3
5-Sep	165	M		825	730	640	13	831	17	5-45	3
5-Sep	166	M		665	600	530	12	831	17	6-46	3
5-Sep	167	M		660	610	545	12	831	17	7-47	3
5-Sep	168	M		680	605	550	13	831	17	8-48	3
5-Sep	169	M		790	720	635	13	831	17	9-49	3
5-Sep	170	M		810	730	640	13	831	17	10-50	1
6-Sep	171	F	100	1000	900	810	14	832	18	1-41	1
6-Sep	172	M		955	855	755	13	832	18	2-42	1
6-Sep	173	F	100	960	860	775	15	832	18	3-43	1
6-Sep	174	F	100	965	880	790	14	832	18	4-44	1

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
6-Sep	175	F	100	870	780	700	13	832	18	5-45	1
6-Sep	176	F	100	910	825	725	14	832	18	6-46	1
6-Sep	177	F	100	910	825	745	14	832	18	7-47	1
6-Sep	178	F	50	795	725	645	M3	832	18	8-48	1
6-Sep	179	F	100	950	870	780		832	18	9-49	1
6-Sep	180	F	100	865	790	705	14	832	18	10-50	1
6-Sep	181	F	100	945	860	770	13	833	19	1-41	1
6-Sep	182	M		935	840	740	M2	833	19	2-42	1
6-Sep	183	M		1060	925	800	M4	833	19	3-43	1
6-Sep	184	F	100	875	800	925	14	833	19	4-44	1
6-Sep	185	F	100	825	750	665	13	833	19	5-45	1
6-Sep	186	F	100	920	835	760	14	833	19	6-46	1
6-Sep	187	F	50	765	695	625	13	833	19	7-47	1
6-Sep	188	F	100	830	760	685	M4	833	19	8-48	1
6-Sep	189	F	100	890	820	730		833	19	9-49	1
6-Sep	190	F	100	915	830	745	14	833	19	10-50	1
6-Sep	191	M		1045	920	795	13	834	20	1-41	1
6-Sep	192	F	100	890	815	730	13	834	20	2-42	1
6-Sep	193	F	100	840	775	690	14	834	20	3-43	1
6-Sep	194	F	100	870	795	720	M4	834	20	4-44	1
6-Sep	195	F	100	920	830	740	15	834	20	5-45	1
6-Sep	196	F	100	980	885	795	14	834	20	6-46	1
6-Sep	197	F	100	980	895	790	14	834	20	7-47	1
6-Sep	198	F	100	960	880	785	M4	834	20	8-48	1
6-Sep	199	F	100	855	775	690	13	834	20	9-49	1
6-Sep	200	F	100	925	835	755	M4	834	20	10-50	1
6-Sep	201	F	100	895	815	740	14	835	21	1-41	5
6-Sep	202	F	100	880	810	715	13	835	21	2-42	5
6-Sep	203	F	NA	1005	905	810	14	835	21	3-43	5
6-Sep	204	M		890	795	700	13	835	21	4-44	5
8-Sep	205	F	100	910	830	745	14	836	22	1-41	1
8-Sep	206	F	100	945	870	790	14	836	22	2-42	1
8-Sep	207	F	100	985	905	815	14	836	22	3-43	1
8-Sep	208	F	100	935	860	775	14	836	22	4-44	1
8-Sep	209	F	100	945	860	775	14	836	22	5-45	1
8-Sep	210	F	100	880	790	705	13	836	22	6-46	1
8-Sep	211	F	100	945	865	760	M3	836	22	7-47	1
8-Sep	212	F	100	985	895	805	M3	836	22	8-48	1
8-Sep	213	F	NA	865	795	725	14	836	22	9-49	1
8-Sep	214	F	100	1030	940	855	14	836	22	10-50	1
8-Sep	215	F	100	930	855	765	14	837	23	1-41	1
8-Sep	216	F	100	875	790	710	14	837	23	2-42	1
8-Sep	217	M		1010	885	775	14	837	23	3-43	1
8-Sep	218	F	100	885	815	725	14	837	23	4-44	1

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
8-Sep	219	F	100	865	785	705	14	837	23	5-45	1
8-Sep	220	F	100	895	820	730	14	837	23	6-46	1
8-Sep	221	F	100	1015	920	820		837	23	7-47	1
8-Sep	222	F	100	915	835	755	14	837	23	8-48	1
8-Sep	223	F	100	910	820	740	14	837	23	9-49	1
8-Sep	224	F	NA	870	805	730	13	837	23	10-50	1
8-Sep	225	F	100	875	810	725	13	838	24	1-41	1
8-Sep	226	F	100	995	915	810	14	838	24	2-42	1
8-Sep	227	F	100	910	830	740	14	838	24	3-43	1
8-Sep	228	F	100	950	865	770	14	838	24	4-44	1
8-Sep	229	F	100	885	815	720	13	838	24	5-45	1
8-Sep	230	F	100	980	895	795	15	838	24	6-46	1
8-Sep	231	F	100	980	900	825	15	838	24	7-47	1
8-Sep	232	F	100	870	790	705		838	24	8-48	1
8-Sep	233	F	100	1020	925	850	13	838	24	9-49	1
8-Sep	234	F	100	1000	910	815	14	838	24	10-50	1
8-Sep	235	F	100	850	780	700	13	839	25	1-41	1
8-Sep	236	F	100	955	875	780	14	839	25	2-42	1
8-Sep	237	F	NA	945	860	775	14	839	25	3-43	1
8-Sep	238	F	100	960	875	785	14	839	25	4-44	1
8-Sep	239	F	100	850	785	705	14	839	25	5-45	1
8-Sep	240	F	100	880	800	710	1F	839	25	6-46	1
8-Sep	241	F	100	875	805	710	14	839	25	7-47	1
8-Sep	242	F	100	880	805	730	14	839	25	8-48	1
8-Sep	243	F	100	835	755	665	13	839	25	9-49	1
8-Sep	244	F	100	960	875	790	15	839	25	10-50	1
8-Sep	245	F	100	940	855	765	14	840	26	1-41	1
8-Sep	246	F	100	920	845	755	14	840	26	2-42	1
9-Sep	247	F	100	845	765	680	M4	840	26	3-43	2
9-Sep	248	M		675	615	540	12	840	26	4-44	2
9-Sep	249	M		900	800	700	13	840	26	5-45	2
9-Sep	250	F	100	820	740	660	13	840	26	6-46	2
9-Sep	251	F	100	1010	920	815	14	840	26	7-47	2
9-Sep	252	F	100	925	850	765	M4	840	26	8-48	2
9-Sep	253	F	100	1010	915	795	14	840	26	9-49	2
9-Sep	254	F	100	890	795	720	13	840	26	10-50	2
9-Sep	255	F	100	865	780	700	14	841	27	1-41	2
9-Sep	256	F	100	875	805	715	14	841	27	2-42	2
9-Sep	257	F	100	940	845	760	14	841	27	3-43	2
9-Sep	258	F	100	1035	940	830	14	841	27	4-44	2
9-Sep	259	F	100	855	765	685	13	841	27	5-45	2
9-Sep	260	F	100	890	810	735	14	841	27	6-46	2
9-Sep	261	F	100	930	835	745	14	841	27	7-47	2
9-Sep	262	M		1095	965	830	1F	841	27	8-48	2

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
9-Sep	263	F	NA	965	855	770	14	841	27	9-49	2
9-Sep	264	F	100	910	825	745	14	841	27	10-50	2
9-Sep	265	F	100	880	795	720	13	842	28	1-41	2
9-Sep	266	F	100	960	870	795	M3	842	28	2-42	2
9-Sep	267	F	100	875	790	705	M4	842	28	3-43	2
9-Sep	268	F	100	890	810	725	14	842	28	4-44	2
9-Sep	269	F	100	905	835	750	14	842	28	5-45	2
9-Sep	270	M		810	725	635	13	842	28	6-46	5
9-Sep	271	M		830	735	645	14	842	28	7-47	5
9-Sep	272	M		810	735	645	13	842	28	8-48	5
9-Sep	273	M		680	610	535	12	842	28	9-49	5
9-Sep	274	F	100	910	840	745	M4	842	28	10-50	5
9-Sep	275	M		650	590	510	12	843	29	1-41	5
9-Sep	276	M		880	795	695	14	843	29	2-42	5
9-Sep	277	M		835	740	650	13	843	29	3-43	5
9-Sep	278	M		565	505	440	12	843	29	4-44	5
9-Sep	279	F	100	980	890	805	14	843	29	5-45	5
9-Sep	280	F	NA	930	850	765	M4	843	29	6-46	5
9-Sep	281	M		820	735	650	M3	843	29	7-47	5
9-Sep	282	F	100	820	740	650	M3	843	29	8-48	5
9-Sep	283	F	90	895	815	740	13	843	29	9-49	5
9-Sep	284	F	100	1005	910	815	15	843	29	10-50	5
9-Sep	285	F	100	880	805	715	14	844	30	1-41	5
9-Sep	286	M		970	855	755	14	844	30	2-42	5
9-Sep	287	M		1075	950	830	14	844	30	3-43	5
9-Sep	288	M		1085	960	830	1F	844	30	4-44	5
9-Sep	289	M		840	760	660	14	844	30	5-45	5
9-Sep	290	M		930	840	735	14	844	30	6-46	5
9-Sep	291	F	100	850	770	695	14	844	30	7-47	5
9-Sep	292	M		685	630	560	13	844	30	8-48	5
9-Sep	293	F	100	920	840	760	14	844	30	9-49	5
9-Sep	294	F	100	810	740	655	14	844	30	10-50	5
9-Sep	295	F	NA	850	775	685	13	845	31	1-41	1
9-Sep	296	F	100	890	810	705	13	845	31	2-42	1
9-Sep	297	F	100	965	875	790	M3	845	31	3-43	1
9-Sep	298	F	100	995	895	800	14	845	31	4-44	1
9-Sep	299	F	100	1045	945	830	M4	845	31	5-45	1
9-Sep	300	F	100	885	810	720		845	31	6-46	1
9-Sep	301	M		820	725	635	14	845	31	7-47	1
9-Sep	302	F	100	925	845	750	13	845	31	8-48	1
9-Sep	303	F	100	960	870	770	14	845	31	9-49	1
9-Sep	304	F	70	820	745	665	14	845	31	10-50	1
9-Sep	305	F	100	945	855	765	14	846	32	1-41	1
9-Sep	306	M		845	750	665	15	846	32	2-42	1

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
9-Sep	307	F	NA	895	830	755	23	846	32	3-43	1
9-Sep	308	F	100	860	785	715	14	846	32	4-44	1
9-Sep	309	F	100	1000	915	815	M4	846	32	5-45	1
9-Sep	310	F	100	970	880	785	M4	846	32	6-46	1
9-Sep	311	F	100	1005	915	815	M4	846	32	7-47	1
9-Sep	312	F	100	915	825	740	14	846	32	8-48	1
9-Sep	313	F	100	895	815	720	13	846	32	9-49	1
9-Sep	314	F	100	950	860	760	14	846	32	10-50	1
9-Sep	315	M		670	600	530	12	847	33	1-41	1
9-Sep	316	M		950	830	740	13	847	33	2-42	1
9-Sep	317	F	100	965	880	785	14	847	33	3-43	1
9-Sep	318	F	NA	850	775	680	13	847	33	4-44	1
9-Sep	319	M		1050	925	825	M4	847	33	5-45	1
10-Sep	320	F	100	930	845	760	14	847	33	6-46	3
10-Sep	321	M		870	790	695	13	847	33	7-47	3
10-Sep	322	M		820	740	645	13	847	33	8-48	3
10-Sep	323	M		790	710	630	13	847	33	9-49	3
10-Sep	324	M		820	725	655	13	847	33	10-50	3
10-Sep	325	M		785	710	630	13	848	34	1-41	3
10-Sep	326	M		780	705	635	13	848	34	2-42	3
10-Sep	327	M		835	740	675	14	848	34	3-43	3
10-Sep	328	M		780	695	620	13	848	34	4-44	3
10-Sep	329	M		890	800	705	13	848	34	5-45	3
10-Sep	330	F	100	930	845	755	14	848	34	6-46	3
10-Sep	331	M		1045	910	805	M4	848	34	7-47	3
10-Sep	332	F	100	1000	910	830	15	848	34	8-48	3
10-Sep	333	F	100	910	825	745	14	848	34	9-49	3
10-Sep	334	M		825	740	650	13	848	34	10-50	3
10-Sep	335	M		835	740	665	12	849	35	1-41	3
10-Sep	336	F	100	880	800	720	14	849	35	2-42	3
10-Sep	337	F	100	970	880	800	14	849	35	3-43	3
10-Sep	338	M		650	580	515	12	849	35	4-44	3
10-Sep	339	F	100	840	765	690	13	849	35	5-45	3
10-Sep	340	M		810	720	635	12	849	35	6-46	3
10-Sep	341	F	100	930	835	750	14	849	35	7-47	3
10-Sep	342	M		845	750	660	13	849	35	8-48	3
10-Sep	343	F	100	875	805	730	14	849	35	9-49	3
10-Sep	344	M		855	755	675	12	849	35	10-50	6
10-Sep	345	M		690	620	545	M2	850	36	1-41	6
10-Sep	346	M		670	595	515	12	850	36	2-42	6
10-Sep	347	M		745	760	595	12	850	36	3-43	6
10-Sep	348	M		830	740	640	13	850	36	4-44	6
10-Sep	349	M		835	745	645	13	850	36	5-45	6
10-Sep	350	M		880	785	685	13	850	36	6-46	6

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
10-Sep	351	F	100	980	905	810	14	850	36	7-47	6
10-Sep	352	F	100	1050	950	870	M4	850	36	8-48	6
10-Sep	353	F	NA	990	900	830		850	36	9-49	6
10-Sep	354	M		630	565	495	12	850	36	10-50	6
10-Sep	355	M		860	770	670	13	82304	37	1-41	6
10-Sep	356	M		930	815	715	14	82304	37	2-42	6
10-Sep	357	M		900	790	685	1F	82304	37	3-43	6
10-Sep	358	F	NA	950	860	770	14	82304	37	4-44	6
10-Sep	359	M		620	565	505	12	82304	37	5-45	6
10-Sep	360	F	100	950	865	770	13	82304	37	6-46	6
10-Sep	361	F	100	950	870	775	14	82304	37	7-47	6
10-Sep	362	M		600	540	480	12	82304	37	8-48	6
11-Sep	363	F	100	880	805	730	13	82304	37	9-49	7
11-Sep	364	F	100	980	885	790	14	82304	37	10-50	7
11-Sep	365	F	100	965	875	805	13	82309	38	1-41	7
11-Sep	366	F	100	935	865	770	14	82309	38	2-42	7
11-Sep	367	F	100	940	855	770	13	82309	38	3-43	7
11-Sep	368	F	100	870	795	720	15	82309	38	4-44	7
11-Sep	369	F	100	1025	940	845	14	82309	38	5-45	7
11-Sep	370	M		765	685	615	12	82309	38	6-46	7
11-Sep	371	M		795	710	640	14	82309	38	7-47	7
11-Sep	372	F	100	900	815	725	13	82309	38	8-48	7
11-Sep	373	F	100	820	750	565	13	82309	38	9-49	7
11-Sep	374	F	100	850	775	695	12	82309	38	10-50	7
11-Sep	375	M		630	565	500	13	82308	39	1-41	7
11-Sep	376	M		800	725	640	12	82308	39	2-42	7
11-Sep	377	F	100	930	845	760	14	82308	39	3-43	7
11-Sep	378	F	100	985	905	815	14	82308	39	4-44	7
11-Sep	379	F	50	910	825	735	15	82308	39	5-45	7
11-Sep	380	F	75	870	790	710	13	82308	39	6-46	7
11-Sep	381	F	100	955	880	785	M1	82308	39	7-47	7
11-Sep	382	M		675	615	530	14	82308	39	8-48	7
11-Sep	383	F	100	995	900	815	13	82308	39	9-49	7
11-Sep	384	F	100	890	810	720	13	82308	39	10-50	7
11-Sep	385	M		635	575	510	11	82307	40	1-41	7
11-Sep	386	M		660	600	540	12	82307	40	2-42	7
11-Sep	387	F	100	1000	910	825	14	82307	40	3-43	7
11-Sep	388	F	100	940	850	755	14	82307	40	4-44	7
11-Sep	389	F	100	850	775	695	13	82307	40	5-45	7
11-Sep	390	M		625	565	495	12	82307	40	6-46	7
11-Sep	391	F	100	900	830	745	14	82307	40	7-47	7
11-Sep	392	F	100	1000	920	825	14	82307	40	8-48	7
11-Sep	393	M		615	560	490	12	82307	40	9-49	7
11-Sep	394	M		670	605	525	12	82307	40	10-50	7

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
11-Sep	395	M		775	695	620	12	82306	41	1-41	7
11-Sep	396	M		670	600	535	1F	82306	41	2-42	7
11-Sep	397	F	100	970	885	795	14	82306	41	3-43	7
11-Sep	398	F	100	975	890	795	14	82306	41	4-44	7
11-Sep	399	F	100	1005	910	820	14	82306	41	5-45	7
11-Sep	400	M		950	830	730	13	82306	41	6-46	7
11-Sep	401	M		620	550	485	14	82306	41	7-47	7
11-Sep	402	F	100	1010	930	840	12	82306	41	8-48	7
11-Sep	403	M		780	700	630	14	82306	41	9-49	7
11-Sep	404	M		780	710	630	M3	82306	41	10-50	7
11-Sep	405	M		710	640	565	14	82305	42	1-41	7
11-Sep	406	M		935	830	735	14	82305	42	2-42	7
11-Sep	407	M		795	705	615	14	82305	42	3-43	7
11-Sep	408	F	100	990	895	795	14	82305	42	4-44	7
11-Sep	409	F	100	975	890	815	14	82305	42	5-45	7
11-Sep	410	M		640	575	505	13	82305	42	6-46	7
11-Sep	411	M		1070	940	810	13	82305	42	7-47	7
11-Sep	412	F	100	900	830	725	13	82305	42	8-48	7
11-Sep	413	M		685	610	540	13	82305	42	9-49	7
11-Sep	414	M		690	615	540	13	82305	42	10-50	7
11-Sep	415	F	100	965	870	780	14	82310	43	1-41	7
11-Sep	416	F	100	930	855	750	14	82310	43	2-42	7
11-Sep	417	F	100	935	845	735	14	82310	43	3-43	7
11-Sep	418	F	100	875	795	715	13	82310	43	4-44	7
11-Sep	419	F	100	1050	955	830	15	82310	43	5-45	7
11-Sep	420	M		905	800	705	1F	82310	43	6-46	7
11-Sep	421	F	100	1040	930	830	14	82310	43	7-47	7
11-Sep	422	F	100	925	845	750	M4	82310	43	8-48	7
11-Sep	423	F	100	855	785	700	13	82310	43	9-49	7
11-Sep	424	M		1000	880	765	13	82310	43	10-50	7
11-Sep	425	F	100	940	860	765	14	82311	44	1-41	7
11-Sep	426	M		715	640	570	13	82311	44	2-42	7
11-Sep	427	M		865	775	670	14	82311	44	3-43	7
11-Sep	428	M		640	580	510	12	82311	44	4-44	7
11-Sep	429	F	100	900	815	720	13	82311	44	5-45	7
11-Sep	430	F	100	940	855	770	14	82311	44	6-46	7
11-Sep	431	F	100	985	885	790	14	82311	44	7-47	7
11-Sep	432	M		650	585	500	12	82311	44	8-48	7
11-Sep	433	M		605	545	485	12	82311	44	9-49	7
11-Sep	434	M		640	575	500	12	82311	44	10-50	7
11-Sep	435	F	100	990	910	815	14	82312	45	1-41	7
11-Sep	436	M		890	805	710	14	82312	45	2-42	7
11-Sep	437	M		830	740	650	13	82312	45	3-43	7
11-Sep	438	M		795	715	630	13	82312	45	4-44	7

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
11-Sep	439	M		790	705	620	13	82312	45	5-45	7
11-Sep	440	M		925	830	725	14	82312	45	6-46	7
11-Sep	441	F	100	865	775	705	13	82312	45	7-47	7
11-Sep	442	F	NA	910	830	755	14	82312	45	8-48	7
11-Sep	443	M		945	880	790	13	82312	45	9-49	8
11-Sep	444	M		780	710	645	13	82312	45	10-50	8
11-Sep	445	M		1110	980	880	14	82313	46	1-41	8
11-Sep	446	M		750	685	620	13	82313	46	2-42	8
11-Sep	447	F	100	980	900	805	14	82313	46	3-43	8
11-Sep	448	F	100	815	740	665	13	82313	46	4-44	8
11-Sep	449	M		670	605	535	12	82313	46	5-45	8
11-Sep	450	M		995	885	765		82313	46	6-46	8
11-Sep	451	F	100	920	840	745	M4	82313	46	7-47	8
11-Sep	452	M		850	765	685	13	82313	46	8-48	8
11-Sep	453	M		990	860	760	13	82313	46	9-49	8
11-Sep	454	M		800	710	625	13	82313	46	10-50	8
11-Sep	455	F	100	980	885	790	1F	82314	47	1-41	8
11-Sep	456	M		785	700	615	13	82314	47	2-42	8
11-Sep	457	F	100	850	775	695	13	82314	47	3-43	8
11-Sep	458	M		790	700	615	M3	82314	47	4-44	8
11-Sep	459	F	100	1015	915	820	14	82314	47	5-45	8
11-Sep	460	M		975	870	755	13	82314	47	6-46	8
12-Sep	461	F	100	975	885	790	14	82314	47	7-47	1
12-Sep	462	F	100	890	800	720	13	82314	47	8-48	1
12-Sep	463	F	100	930	840	765	14	82314	47	9-49	1
12-Sep	464	F	100	905	825	730	13	82314	47	10-50	1
12-Sep	465	F	NA	910	830	735	13	82315	48	1-41	1
12-Sep	466	F	100	1020	930	830	15	82315	48	2-42	1
12-Sep	467	F	100	875	800	720	14	82315	48	3-43	1
12-Sep	468	F	100	845	770	695	14	82315	48	4-44	1
12-Sep	469	F	100	910	820	745	14	82315	48	5-45	1
12-Sep	470	F	100	965	880	805	M4	82315	48	6-46	1
12-Sep	471	F	100	885	810	715	13	82315	48	7-47	1
12-Sep	472	F	100	850	775	695	13	82315	48	8-48	1
12-Sep	473	F	100	940	850	765	14	82315	48	9-49	1
12-Sep	474	F	100	970	890	795	14	82315	48	10-50	1
12-Sep	475	F	100	815	745	670	M3	82316	49	1-41	1
12-Sep	476	F	100	875	800	700	13	82316	49	2-42	1
12-Sep	477	F	100	840	765	685	13	82316	49	3-43	1
12-Sep	478	F	100	890	810	735	14	82316	49	4-44	1
12-Sep	479	F	100	980	895	810	14	82316	49	5-45	1
12-Sep	480	F	100	975	885	795	14	82316	49	6-46	1
12-Sep	481	F	100	950	855	760	13	82316	49	7-47	1
12-Sep	482	F	100	845	765	690	13	82316	49	8-48	1

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
12-Sep	483	F	100	895	815	725	14	82316	49	9-49	1
12-Sep	484	F	100	935	850	745	14	82316	49	10-50	1
12-Sep	485	F	100	965	875	780	14	82317	50	1-41	1
12-Sep	486	F	NA	945	855	760	14	82317	50	2-42	1
12-Sep	487	F	NA	1025	935	840	14	82317	50	3-43	1
12-Sep	488	F	100	950	860	760	14	82317	50	4-44	1
12-Sep	489	F	100	845	765	680	13	82317	50	5-45	1
12-Sep	490	F	100	825	750	680	13	82317	50	6-46	1
12-Sep	491	F	100	950	855	750	14	82317	50	7-47	1
12-Sep	492	F	100	975	875	785	14	82317	50	8-48	1
12-Sep	493	F	100	980	815	720	14	82317	50	9-49	1
12-Sep	494	F	100	855	785	705	13	82317	50	10-50	1
12-Sep	495	F	100	950	860	775	14	82318	51	1-41	1
12-Sep	496	F	100	880	800	715	14	82318	51	2-42	1
12-Sep	497	M		1060	940	825	14	82318	51	3-43	1
12-Sep	498	F	100	1095	1000	890	15	82318	51	4-44	1
12-Sep	499	F	100	980	895	795	14	82318	51	5-45	1
12-Sep	500	F	100	900	825	735	13	82318	51	6-46	1
12-Sep	501	F	100	910	825	740	13	82318	51	7-47	1
12-Sep	502	F	100	1010	925	825	14	82318	51	8-48	1
12-Sep	503	F	NA	920	815	710	14	82318	51	9-49	1
12-Sep	504	F	100	870	795	720	13	82318	51	10-50	2
12-Sep	505	F	100	845	775	695	13	82319	52	1-41	2
12-Sep	506	F	100	825	740	680	13	82319	52	2-42	2
12-Sep	507	F	100	870	800	725	13	82319	52	3-43	2
12-Sep	508	F	100	915	840	750	13	82319	52	4-44	2
12-Sep	509	F	100	960	870	795	14	82319	52	5-45	2
12-Sep	510	F	100	990	910	815	M4	82319	52	6-46	2
12-Sep	511	F	100	930	840	760	14	82319	52	7-47	2
12-Sep	512	F	100	895	820	730	14	82319	52	8-48	2
12-Sep	513	F	100	875	795	710	M4	82319	52	9-49	2
12-Sep	514	F	100	955	870	785	14	82319	52	10-50	2
12-Sep	515	M		1060	950	825		82320	53	1-41	2
12-Sep	516	M		990	890	765	14	82320	53	2-42	2
12-Sep	517	M		1140	1010	900	M5	82320	53	3-43	2
12-Sep	518	F	100	970	880	785	14	82320	53	4-44	2
12-Sep	519	M		840	735	645	13	82320	53	5-45	2
12-Sep	520	F	100	950	860	765	14	82320	53	6-46	2
12-Sep	521	F	100	900	825	735	14	82320	53	7-47	2
12-Sep	522	F	100	990	900	805	14	82320	53	8-48	2
12-Sep	523	F	100	820	755	670	13	82320	53	9-49	2
12-Sep	524	F	100	920	845	755	13	82320	53	10-50	2
12-Sep	525	F	100	840	760	680	13	82321	54	1-41	2
12-Sep	526	M		1005	900	780	M4	82321	54	2-42	2

DATE	FISH #	SEX	% SPAWNED	FL (mm)	MEF (mm)	POHL (mm)	AGE *	SCALE BOOK#	BOOK #	SCALE #	LOCATION
12-Sep	527	M		805	720	645	13	82321	54	3-43	2
12-Sep	528	M		800	720	645	13	82321	54	4-44	2
12-Sep	529	M		630	570	500	12	82321	54	5-45	2
12-Sep	530	M		1045	925	845	M4	82321	54	6-46	2
12-Sep	531	M		860	760	655	13	82321	54	7-47	2
12-Sep	532	M		850	765	675	13	82321	54	8-48	2
12-Sep	533	F	100	905	830	745	14	82321	54	9-49	2
12-Sep	534	M		760	685	605	13	82321	54	10-50	2
12-Sep	535	F	100	850	780	710	14	82322	55	1-41	2
13-Sep	536	F	0	945	850	750	14	82322	55	2-42	1
13-Sep	537	F	100	1000	895	790	14	82322	55	3-43	1
13-Sep	538	F	100	885	800	710	14	82322	55	4-44	1
13-Sep	539	F	100	930	845	740	14	82322	55	5-45	1
13-Sep	540	F	100	995	900	805	14	82322	55	6-46	1
13-Sep	541	F	100	1025	920	825	14	82322	55	7-47	1
13-Sep	542	F	100	975	890	800	M4	82322	55	8-48	1
13-Sep	543	F	NA	885	800	720	14	82322	55	9-49	1
13-Sep	544	F	100	950	865	760	14	82322	55	10-50	1
13-Sep	545	F	100	865	790	700	13	82323	56	1-41	1
13-Sep	546	F	100	915	815	725	13	82323	56	2-42	1
13-Sep	547	F	100	980	885	780	14	82323	56	3-43	1
13-Sep	548	F	100	930	845	765	14	82323	56	4-44	1
13-Sep	549	M		770	690	610	1F	82323	56	5-45	1
13-Sep	550	F	100	860	785	705	13	82323	56	6-46	1
13-Sep	551	F	NA	1010	920	825	15	82323	56	7-47	1
13-Sep	552	F	100	935	850	755	14	82323	56	8-48	1
13-Sep	553	F	100	890	815	740	14	82323	56	9-49	1
13-Sep	554	F	100	930	845	755	15	82323	56	10-50	1
13-Sep	555	F	100	1020	940	850	15	82324	57	1-41	1
13-Sep	556	F	100	920	835	765	14	82324	57	2-42	1

Appendix 3 (b) Principal spawning areas on Mainstem Teslin River based on sample site locations, 2015.

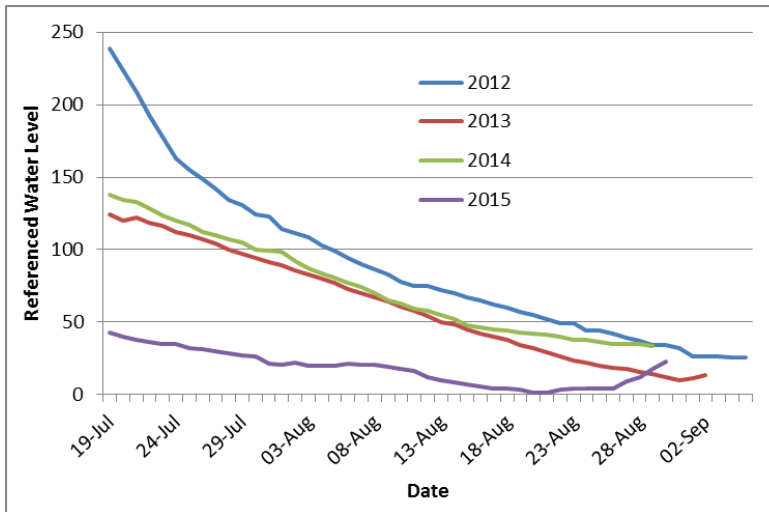
Sample Site	GPS Coordinates
1	N 60 30.635' W 133 21.914'
2	N 60 31.843' W 133 23.175'
3	N 60 45.985' W 133 44.212'
4	N 60 50.488' W 133 53.614'
5	N 60 34.404' W 133 26.810'
6	N 60 47.647' W 133 49.580'
7	N 60 54.122' W 133 59.467'
8	N 60 52.824' W 133 58.138'

Appendix 4. Hydrometric data and weather observations, Teslin sonar site 2015.

Date	Air Temp	Water Temp	Water Level
20-Jul	16.0	42.9	42.9
21-Jul	15.0	40.0	40.0
22-Jul	15.0	37.5	37.5
23-Jul	15.0	36.2	36.2
24-Jul	14.0	34.9	34.9
25-Jul	13.0	34.9	34.9
26-Jul	15.0	32.4	32.4
27-Jul	15.0	31.1	31.1
28-Jul	15.0	29.8	29.8
29-Jul	14.0	28.6	28.6
30-Jul	14.0	27.3	27.3
31-Jul	14.0	26.0	26.0
01-Aug	15.0	21.6	21.6
02-Aug	15.0	21.0	21.0
03-Aug	14.0	22.2	22.2
04-Aug	15.0	19.7	19.7
05-Aug	16.0	19.7	19.7
06-Aug	15.0	19.7	19.7
07-Aug	15.0	21.6	21.6
08-Aug	14.0	21.0	21.0
09-Aug	15.0	20.3	20.3
10-Aug	14.0	19.1	19.1
11-Aug	14.0	17.8	17.8
12-Aug	15.0	16.5	16.5
13-Aug	13.0	12.1	12.1
14-Aug	14.0	9.5	9.5
15-Aug	14.0	8.3	8.3
16-Aug	14.0	7.0	7.0
17-Aug	14.0	5.7	5.7
18-Aug	14.0	4.4	4.4
19-Aug	14.0	4.4	4.4
20-Aug	14.0	3.2	3.2
21-Aug	13.0	1.3	1.3
22-Aug	13.0	1.3	1.3
23-Aug	13.0	3.2	3.2
24-Aug	13.0	3.8	3.8
25-Aug	13.0	4.4	4.4
26-Aug	13.0	4.4	4.4
27-Aug	13.0	4.4	4.4
28-Aug	12.0	8.9	8.9
29-Aug	12.0	12.1	12.1
30-Aug	11.0	17.8	17.8

Note: Temperatures and water levels observed at 0:900 daily.

Appendix 5. Referenced water levels at Teslin sonar site 2012 through 2015.



Appendix 6. Estimated proportions of Big Salmon River and Teslin River Chinook in upper Yukon River Chinook escapements, 2002 through 2015.

Year	Method	Big Salmon River Estimated % proportion of border escapement based on telemetry or GSI sampling () = sd	Teslin River Estimated % proportion of border escapement based on telemetry or GSI sampling () = sd
2002	Telemetry	9.2	19.8
2003	Telemetry	15.1	18.1
2004	Telemetry	10.0	20.8
2006	Fishwheel GSI Sampling	10.7 (3.2)	14.2 (2.4)
2007	Fishwheel GSI Sampling	10.6 (2.5)	9.6 (1.6)
2008	Fishwheel GSI Sampling	9.3 (6.0)	16.4(3.4)
2009	Eagle Gillnet GSI Sampling	16.9 (3.6)	25.6(3.3)
2010	Eagle Gillnet GSI Sampling	11.7 (2.4)	33.0(4.6)
2011	Eagle Gillnet GSI Sampling	8.0 (2.4)	25.3(3.3)
2012	Eagle Gillnet GSI Sampling	6.7 (2.8)	37.8 (4.6)
2013	Eagle Gillnet GSI Sampling	6.6 (2.7)	25.6 (5.2)
2014	Eagle Gillnet GSI Sampling	2.7 (2.0)	28.2 (3.3)
2015	Eagle Gillnet GSI Sampling	9.7 (1.9)	25.4 (2.4)
Mean		9.8	23.1
Std. Dev.		3.7	8.0

Data source: DFO unpublished data, Osborne et al. 2003, Mercer and Eiler 2004, Mercer 2005.