2014 Teslin River Chinook Sonar Project

CRE-01N-14

Prepared For: The Yukon River Panel
Restoration and Enhancement Fund

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March, 2015

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ABSTRACT

Multiple beam high resolution sonars were used to enumerate the 2014 Chinook salmon (*Onchorynchus tshawytscha)* escapement to the Teslin River system. This was the second year the project was conducted at this site. The sonars were operated on the mainstem Teslin River at the site identified during the 2011 feasibility study; approximately 12 km upstream of the confluence of the Teslin and Yukon Rivers at Hootalinqua. Sonar operation began on July 13 and operated continuously through to August 28. A total of 17,507 targets identified as Chinook salmon was counted during the period of operation. Of this total, the north bank sonar counted 9,841 (56%) and the south bank 7,666 (44%) of the passing Chinook. Daily 24 hour counts ranged from 0 to 796 with a mean of 372. The peak daily count occurred on August 6 at which time 54% of the run had passed the sonar station. 2014 genetic stock identification (GSI) sampling indicated the Teslin stock group comprised 28.2% (SD = 3.3%) of upper Yukon River Chinook escapement.

A carcass pitch was conducted over approximately 120 km of the mainstem Teslin River over the period September 1-5. This yielded 504 Chinook sampled for age, length and sex. Of these, 304 (60%) were female and 200 (40%) were male. The mean fork length of females and males sampled was 847 mm and 741 mm, respectively. The DFO scale lab determined full ages from 443 Chinook sampled. Age 1.4 (63%) was the dominant age class, followed by age 1.3 fish (28%). Age 1.2 and 1.5 fish each represented 6% and 1% of the sample.

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1. INTRODUCTION

Background

The Yukon River system encompasses a drainage area of approximately 854,000 km^2 and contributes to important aboriginal, subsistence and commercial fisheries in the U.S. and Canada. 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). 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). Canadian origin fish contribute approximately 47% to 67% of the total U.S. commercial and subsistence fisheries (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 and biological information is important for post-season run reconstruction, pre-season run forecasts and the establishment of biologically based escapement goals. The accurate enumeration of genetically distinct stocks, coupled with a representative genetic stock identification (GSI) sampling program can also be used to obtain independent above border as well as stock specific Chinook escapement estimates[1].

The Teslin River system has been identified as a potential discrete 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 evidence, the Teslin system is the largest single tributary contributor to upper Yukon River Chinook production.

Teslin River origin Chinook are also 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).

[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 high resolution 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 is as accurate as visual counts of fish migrating through an enumeration fence in a clear water river (Holmes et al., 2006). In the upper Yukon drainage DIDSON sonar has been used on the Big Salmon River (Mercer & Wilson, 2005-2012) and the Klondike River (Mercer, 2009-2011) to enumerate annual Chinook salmon escapements into these systems. The 2014 Teslin sonar project deployed 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. Both sonar models produce 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 45 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 km^2 that over laps 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 km^2. 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 m^3/sec (range 1080 – 643 m^3/sec; Water survey of Canada, Station 09AF001; Figure 2).

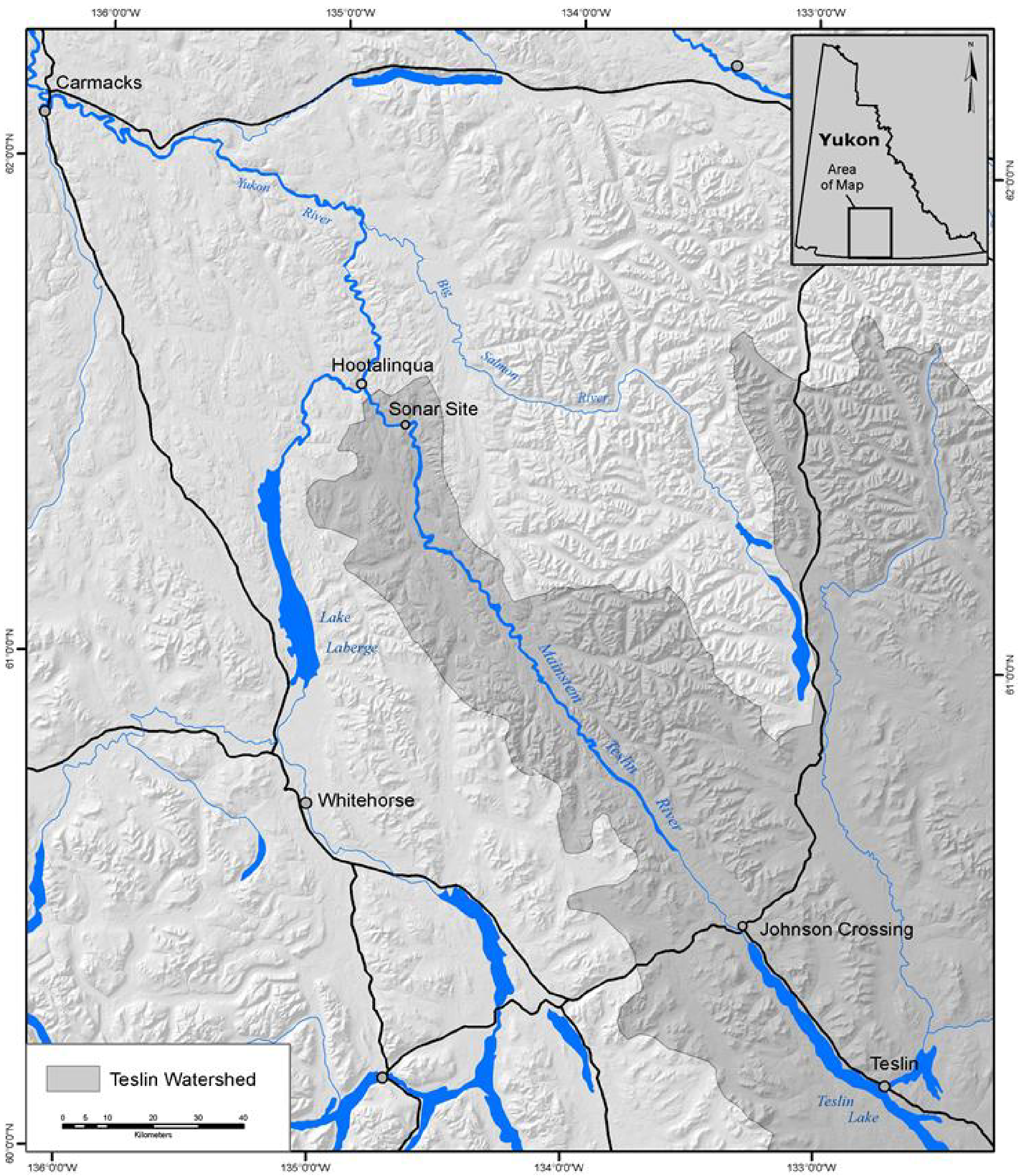

Figure 1. Mainstem Teslin River and sonar site.
Digital map data source: Yukon Government spatial data collection. www.geomaticsyukon.ca.

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 approximately 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).

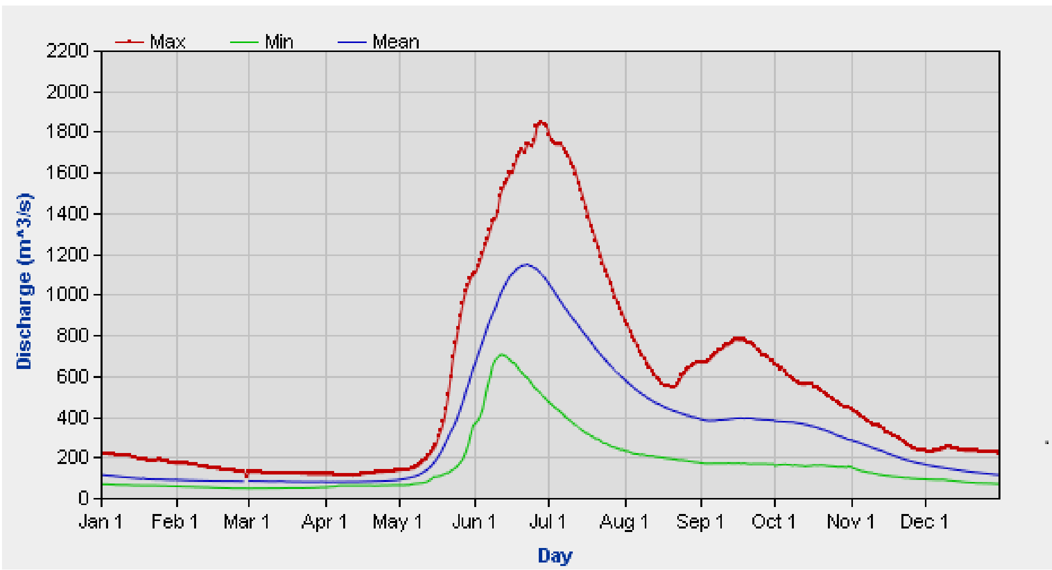

Figure 2. Daily minimum, maximum and mean discharge rates for mainstem Teslin River at station 09AF001[2] from December 1955 through January 1973.
Source: Water Survey Board of Canada.

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 (mean 70%, SD = 2). The Chinook stock proportions in other upper Yukon River basin as indicated by the telemetry results have been corroborated by subsequent sonar enumeration projects on the Big Salmon River (Mercer and Wilson 2005-2014). Based on Genetic stock identification (GSI) data collected at the Eagle

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

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 2012 through 2014 Teslin sonar data indicate the Teslin system is the largest single tributary contributor to upper Yukon River Chinook production.

2. OBJECTIVES

The objectives of the 2014 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. Conduct spawning ground sampling for age-sex-length data and genetic tissue samples from post-spawn fish.

3. METHODS

Site Selection

The sonar site used in 2014 was the same site selected during the 2011 feasibility study (Mercer 2012). This site, located approximately 12 km upstream from the confluence with the Yukon River (Figure 1), was initially selected for the following reasons:

- 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 fish.
- 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.

Regulatory Submissions and Permits

A three year land use permit 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 2014 project.

Mobilization and Personnel

Construction of the camp infrastructure began on July 8 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 project supervisor was on site continually for the duration of the project. Two BMA 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 2014 operational plan was to place a sonar unit on each side of the river. The sonar units were configured to aim across the river enabling ensonification of the entire migration corridor (Figure 3). Two ARIS model 1800 sonar units were deployed for the entire duration of the project.

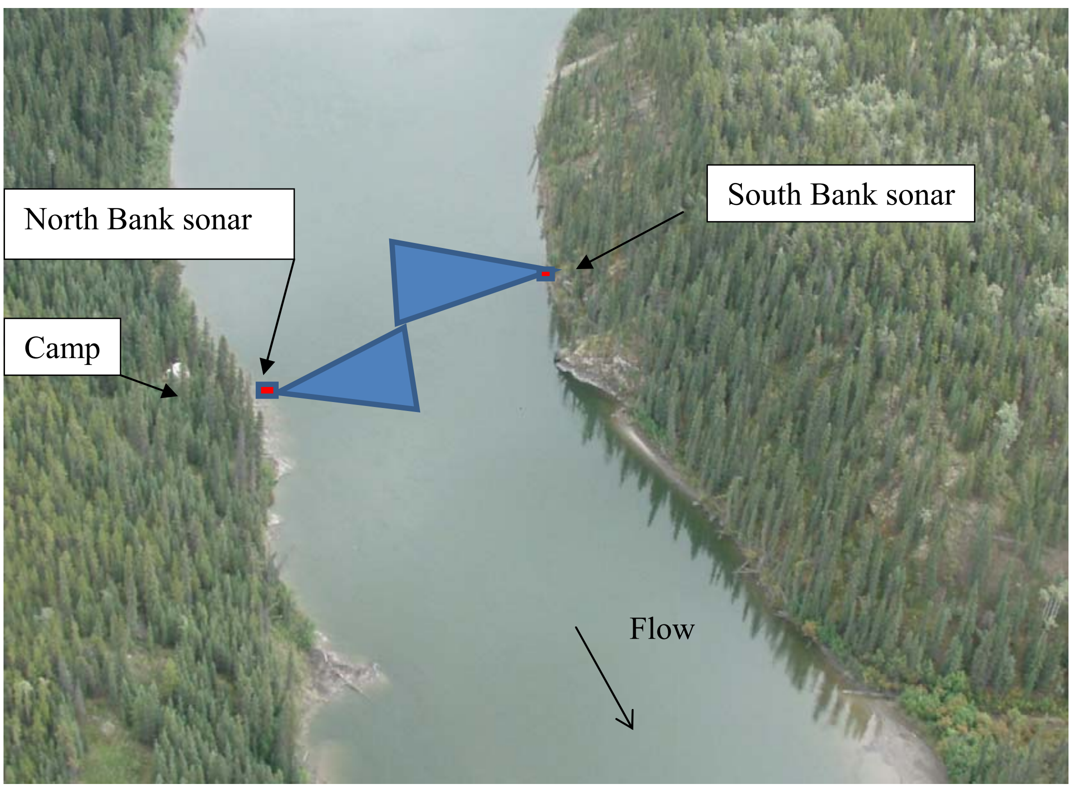

Figure 3. Aerial view of sonar site depicting the camp, sonar locations and schematic representation of ensonified portions of the river (2012 photo).

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 using an Ampair® model UW100 in-stream water turbine, as well as a second Honda® generator and battery charger.

The sonar stands used during the 2013 project were again used in 2014 (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 3º 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 shows 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 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 SB sonar consisted of a log boom extending approximately 6 meters out from the shore perpendicular to the current, Prefabricated panels of electrical conduit were placed against the boom. A 6 m x 2m length of page wire fencing was attached to the inner length of the boom. The bottom margin of the fencing was weighted with rocks so the wire would hang perpendicular to the surface.

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..

The same sonar settings were used for both the NB and SB ARIS sonars. The start and end ranges were 5.0m and 45m. 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.

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 unit. These files were subsequently reviewed the following day and backed up on an external hard drive.

The sonars were operated over the course of the project with minor planned and larger unplanned stoppages varying in duration from 2 minutes to 16 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 mth 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 either the sonar view platform or echograms of each file. The echogram feature of the ARISfish® software was typically used to examine 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 visually counted and entered 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 record was maintained of 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 enables complete ensonification of the water column by two sonars with no 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.

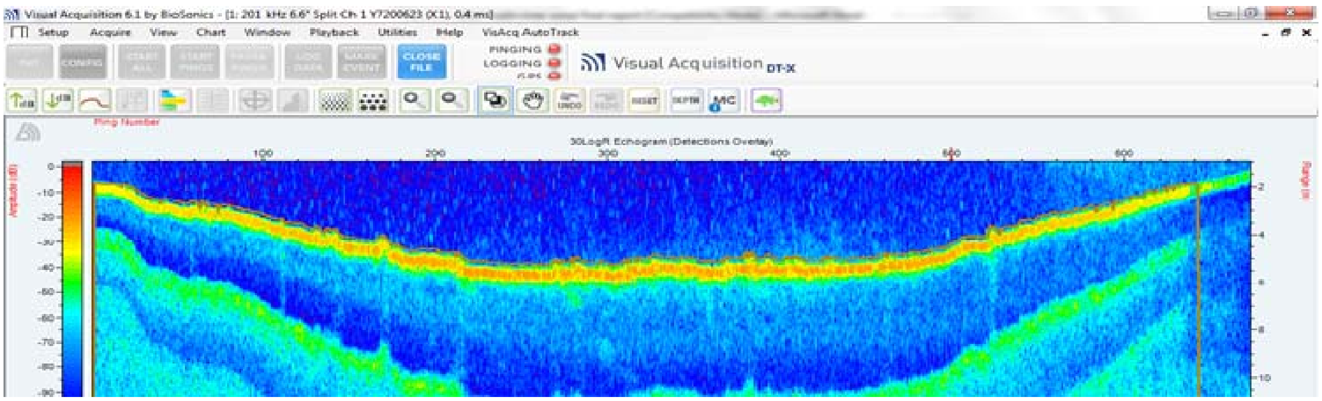

Figure 7 (a). Cross section profile of Teslin River at location of North bank sonar.
Note: North bank on left side of figure. Bottom is orange-yellow line; thalweg at 4.8m.

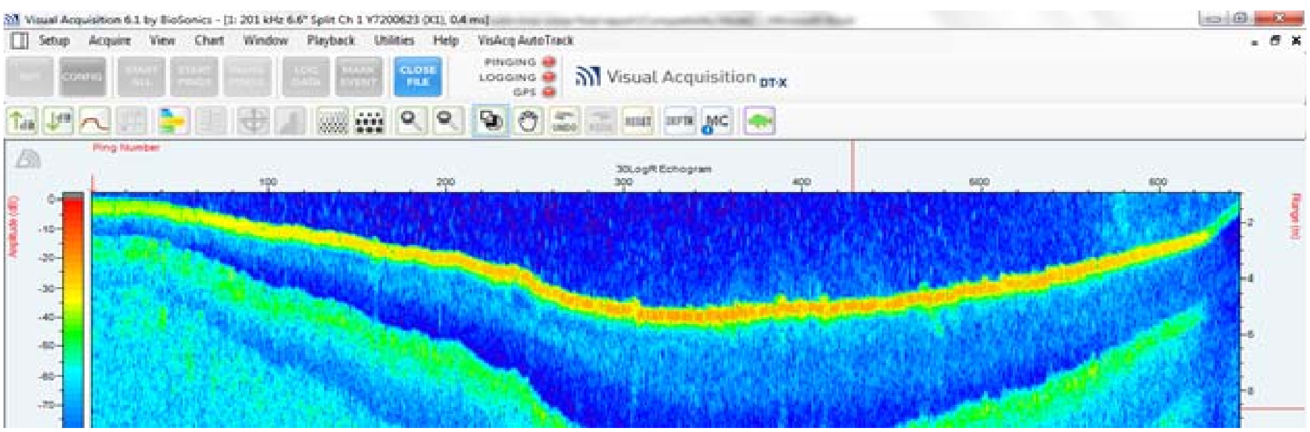

Figure 7 (b). Cross section profile of Teslin River at location of South bank sonar.
Note: South bank on right side of profile. Bottom is orange-yellow line; thalweg at 4.5m.

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, it is unlikely a temporal overlap of migrating fall Chum and Chinook occurs in the Teslin system. This was 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 a file data. Therefore the counts are deemed 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 refers to the repeatability of a count between different individuals for the same data file. Approximately 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:

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

where N is the number of events counted by R observers, Xij is the ith count of the jth event and Xj is the average count of the jth 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 2014 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 one trip over a 5 day period from September 1 – 5. 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 can 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. Bi-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 allowed direct real time communication and file sharing with technical staff at Sound Metrics.

4. **RESULTS**

Chinook Counts

A total of 17,507 targets identified as Chinook salmon was counted during the period July 13 through August 28. Of this total, the north bank sonar counted 9,841 (56%) and the south bank 7,666 (44%) of the passing Chinook. The first Chinook salmon was recorded on July 13, the first day the sonar was operational. A peak daily count of 796 fish occurred on August 6, at which time 54% of the run had passed the sonar station. Approximately 90% of the run had passed the station by August 17, 34 days after the first Chinook was observed. Daily and cumulative counts are presented in Table 1 and illustrated in Figure 7.

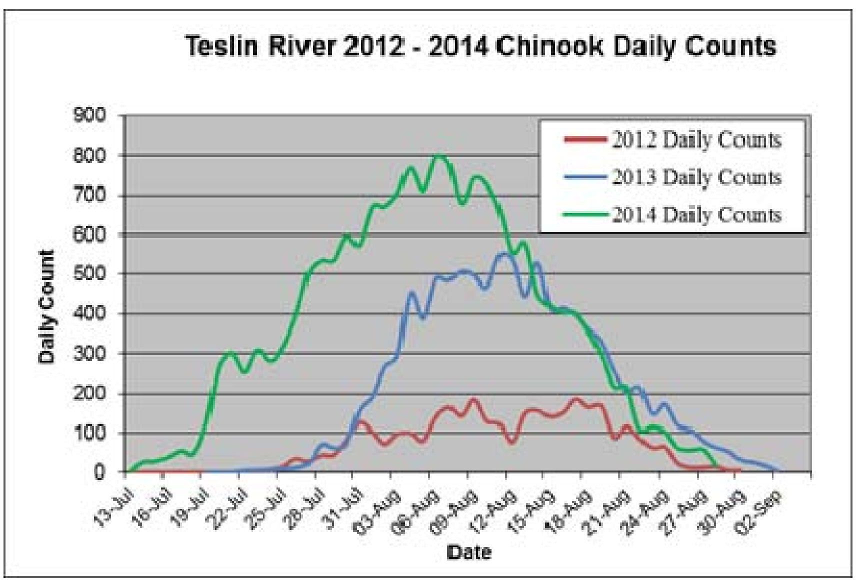

Figure 7. Daily Counts of Chinook at Teslin River sonar station 2012 - 2014.

Table 1. 2014 Daily counts of Teslin River Chinook salmon.

Date	North	South	Daily Total	Cumulative
12-Jul	0	0	0	0
13-Jul	3	0	3	3
14-Jul	25	0	25	28
15-Jul	27	0	27	55
16-Jul	39	0	39	94
17-Jul	54	0	54	148
18-Jul	48	0	48	196
19-Jul	95	32	127	323
20-Jul	156	114	270	593
21-Jul	207	94	301	894
22-Jul	178	74	252	1146
23-Jul	217	90	307	1453
24-Jul	236	44	280	1733
25-Jul	230	87	317	2050
26-Jul	289	106	395	2445
27-Jul	290	212	502	2947
28-Jul	346	188	534	3481
29-Jul	360	175	535	4016
30-Jul	366	229	595	4611
31-Jul	267	308	575	5186
01-Aug	379	291	670	5856
02-Aug	371	300	671	6527
03-Aug	372	333	705	7232
04-Aug	409	359	768	8000
05-Aug	366	346	712	8712
06-Aug	420	376	796	9508
07-Aug	385	396	781	10289
08-Aug	278	401	679	10968
09-Aug	421	321	742	11710
10-Aug	462	265	727	12437
11-Aug	321	341	662	13099
12-Aug	223	331	554	13653
13-Aug	277	301	578	14231
14-Aug	233	217	450	14681
15-Aug	191	229	420	15101
16-Aug	220	183	403	15504
17-Aug	200	202	402	15906
18-Aug	224	131	355	16261
19-Aug	177	118	295	16556
20-Aug	123	93	216	16772
21-Aug	91	125	216	16988
22-Aug	56	54	110	17098
23-Aug	64	51	115	17213
24-Aug	56	46	102	17315
25-Aug	32	32	64	17379
26-Aug	26	30	56	17435
27-Aug	27	30	57	17492
28-Aug	3	12	15	17507

The cross sectional distribution pattern of the migrating Chinook is presented in Figure 8. In 2011 and 2012, the distribution of Chinook passing the station was skewed to the north side of the river with few Chinook (3% and 0% respectively) detected by the SB sonar. However, in 2013 and 2014 a significant proportion of the run (37% and 44% respectively) was detected by the SB sonar (Figures 8 and 9).[3] As occurred in 2013, Chinook were detected in the north side of the river 6 days before the first Chinook was observed on the south side. The temporal and spatial distribution pattern of migrating Chinook past the sonar station is discussed in section 5.

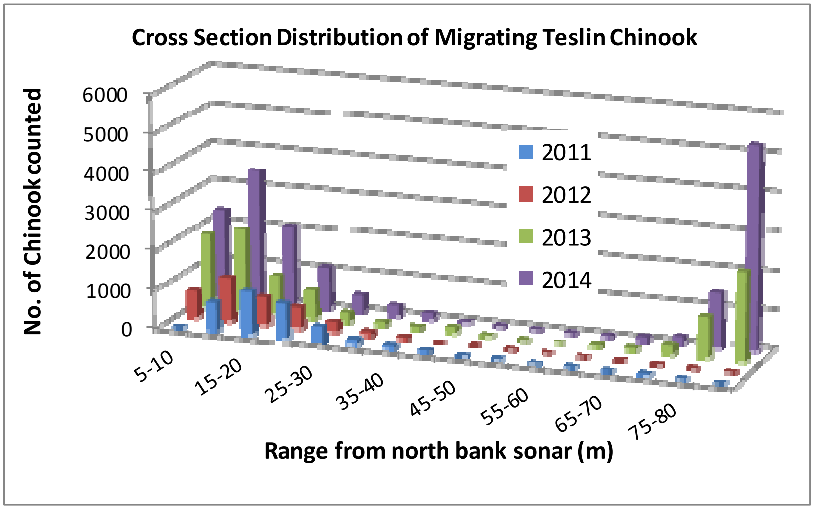

Figure 8. Cross section distribution of migrating Chinook, Teslin sonar site, 2011-2014.

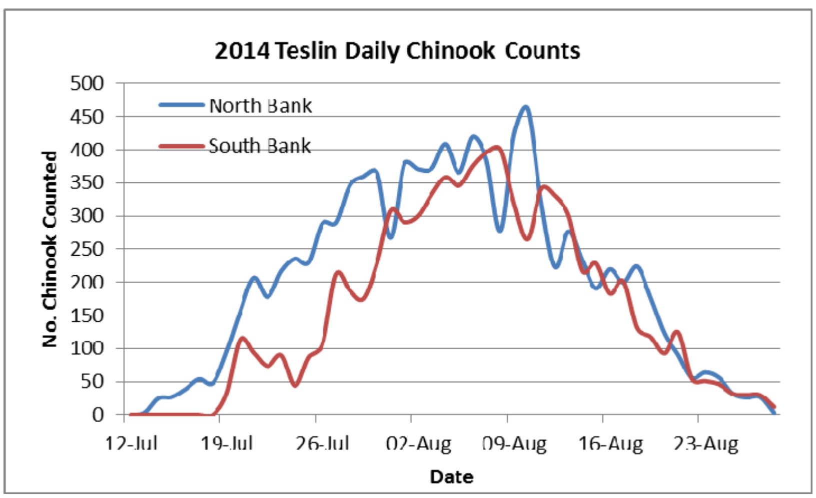

Figure 9. 2014 daily counts of NB and SB sonars.

[3] It should be noted in respect to Figure 8 that the deflection fences were absent during the 2011 feasibility study and therefore fish within the near field of the sonar (<5m) would have been missed.

Precision of Counts

Of the 6,064 sonar files recorded and analysed, a total of 473 (7.8%) was reviewed by a second observer. Of the 473 files reviewed, a total of 93 files (19.6%) exhibited a discrepancy between readers. A positive difference was observed in 58 (12.2%) of double reviewed files and a negative difference in 35 (7.3%) of the files. Of the files that exhibited inconsistencies between readers, 58 additional fish were observed by the reviewer and 35 fish missed by the reviewer. This would represent a net gain of 23 fish for the 473 files that were reviewed. The total number of fish counted in the original file set was 1,351. The total number of fish counted in the reviewed file set was 1,374. The net difference between the sums of the original and double reviewed files was +23 fish; 1.7% of the total fish counted in the reviewed files. Applying this expansion factor of 0.017 to the total count (17,507) would result in a total of 298 Chinook that may not have been observed and counted. This figure was not added to the total. The precision of the counts is discussed in section 5.

Linear regression between readers showed variation between counts but overall the correlation is high (R^2= 0.99). Figure 10 illustrates the relationship between counts of two different file readers comparing the daily pooled original and corresponding reviewed files.

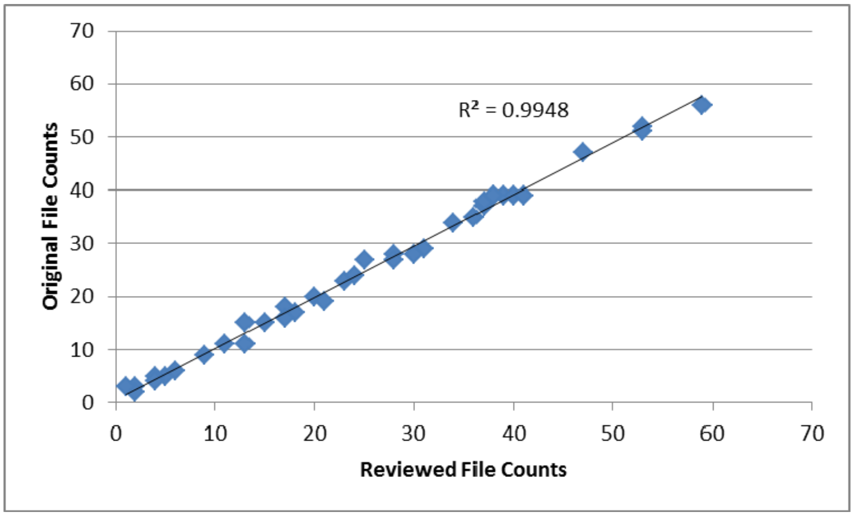

Figure 10. Linear regression between original and reviewed sonar file data that has been analysed by two different readers.
Note: Data points are NB sonar counts representing daily pooled original and reviewed file data.

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 2.6%.

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

	Count	%
Total files recorded during project	6064	
Total files double reviewed	473	7.8%
Total Fish counted in first tally	1351	
Total fish counted in reviewed files	1374	
Total files with + discrepancy	58	12.3%
Total files with - discrepancy	35	7.4%
Total files with discrepancy	93	19.7%
Total plus fish	58	4.3%
Total minus fish	35	-2.6%
Net difference	23	1.7%

Carcass Pitch

A total of 504 dead or moribund mainstem Teslin Chinook was recovered and sampled during the carcass pitch. Of the fish collected, 304 (60%) were female and 200 (40%) were male. A length-frequency histogram of the sampled Chinook is illustrated in Figure 11. The mean mid-eye fork length of females and males sampled was 847 mm and 741 mm, respectively.

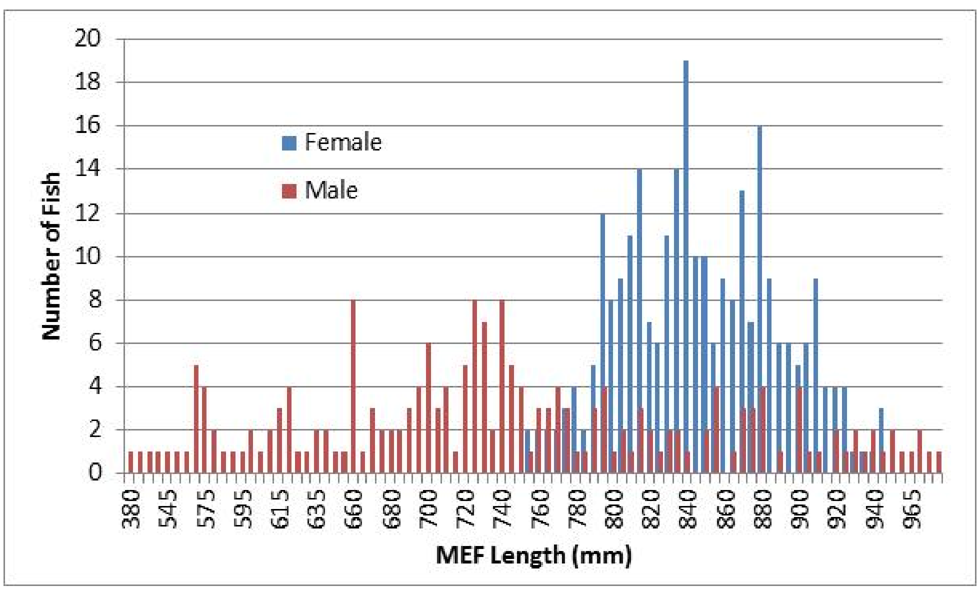

Figure 11. Length Frequency histogram of sampled Teslin River Chinook, 2014.

Complete age data[4] was determined from 443 of the Chinook sampled; the remaining 61 samples yielded partial ages or no ages due to regenerate scales. Complete age, length and sex data are presented in Appendix 3. Age 1.4[5] (63%) was the dominant age class, followed by age 1.3 fish (28%). Age 1.2 and 1.5 fish each represented 6% of the sample. The ASL data for the 443 sampled fish for which complete age data is available, is presented in Table 3.

Table 3. Mainstem Teslin Chinook age, sex and length data, 2014.

SEX	AGE*	Data	Total	%
Female	12	Count of Age	7	1.6%
		Average of MEF (mm)	853	
	13	Count of Age	51	11.5%
		Average of MEF (mm)	839	
	14	Count of Age	205	46.3%
		Average of MEF (mm)	848	
	15	Count of Age	5	1.1%
		Average of MEF (mm)	889	
Female Count of Age			268	60.5%
Female Average of MEF (mm)			847	
Male	11	Count of Age	2	0.5%
		Average of MEF (mm)	690	
	12	Count of Age	21	4.7%
		Average of MEF (mm)	657	
	13	Count of Age	75	16.9%
		Average of MEF (mm)	735	
	14	Count of Age	76	17.2%
		Average of MEF (mm)	763	
	15	Count of Age	1	0.2%
		Average of MEF (mm)	660	
Male Count of Age *			175	39.5%
Male Average of MEF (mm)			737	
Total Count of Age			443	
Total Average of MEF (mm)			801	

Note: Above ASL data is for the 443 fish of the 504 sampled for which complete age data was available.
*European age classification.

Egg retention of the sampled dead and moribund female Chinook was low. Of the 304 females sampled, 12 (3.9%) were considered not to have fully spawned. Of these 12 fish, it was estimated that 9 had released > 50% of their eggs. Two of the 304 examined

[4] Scale age analysis was conducted for DFO Whitehorse by the Pacific Biological Station, fish ageing lab in Nanaimo, British Columbia.
[5] European age format; e.g. 1.3 denotes a 5 year old fish with 1+ years freshwater residence and 3 years marine residence.

females were fully un-spawned. Complete age, length and sex data as well as egg retention and principal recovery locations are presented in Appendix 3.

Chinook Spawning Escapement Estimates generated from GSI data and sonar counts

The 2014 Eagle sonar project on the Yukon River downstream of the Canada/U.S. border yielded a Chinook passage estimate of 63,431 and a spawning escapement[6] estimate of 69,331 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 2014 proportional contribution of the regional Teslin River stock to the Chinook border escapement based on un-weighted analysis of the GSI samples was 28.2% (SD 3.3), (DFO Whitehorse unpublished data). Expansion of the 2014 Teslin sonar count (17,507) using the proportion of Teslin origin stock derived from the Eagle GSI sampling results in a 2014 Chinook border escapement estimate of 62,070 (95% CI, 50,589 – 80,663).

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 2014 Teslin and Big Salmon sonar counts totalled 23,828 Chinook. The un-weighted aggregate Big Salmon and Teslin GSI stock proportion based on the 2014 Eagle sampling is 31.0% (SD = 3.7) (Unpublished data, DFO – PBS Nanaimo genetics lab). Using the aggregate GSI stock proportions and the total of the two sonar counts yields an expanded 2014 Chinook border escapement estimate of 76,864 (95% CI = 63,376 – 100,540). These above border escapement estimates are discussed below.

5. DISCUSSION AND RECOMMENDATIONS

The 2014 Teslin River sonar project was conducted successfully and as planned throughout the course of the Chinook run. The contractor is confident the sonar count accurately reflects the Chinook escapement into the Teslin system. In general the sonars and related equipment functioned well, however the down time for the SB sonar was higher than expected and considerably higher than experienced in 2013. The difficulties associated with the SB sonar were related to random network disconnections between the sonar and computer receiving the file data. This appeared to be due to issues with the ARIS 1.0 software running the SB sonar. The software on this ARIS unit has since been upgraded by Sound Metrics and should not be an issue in the future. In a project of this nature it is to be expected there may be brief periods of down time due to equipment adjustments, maintenance and unplanned technical difficulties.

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

The time of arrival and peak migration of the 2014 Teslin River Chinook run occurred approximately 7 days earlier than was observed in 2013. In-season assessments in the lower Yukon River indicated the run timing was earlier than average and consequently mobilization for the project began one week earlier than scheduled. The first Chinook was observed passing the Teslin sonar site in 2014 on July 13. Chinook were observed on the first file recorded at 23:00 on July 13 so it is probable some Chinook passed the site prior to the start of the project. However, based on the past run pattern at this site and the few Chinook observed the following day it is assumed this number is relatively low (< 30). The final total was not adjusted for any fish missed prior to project start up.

The significantly higher proportion of Chinook observed migrating on the south side of the river in 2013 and 2014 compared to the two previous years may be due to the lower water levels. It is worth noting that, as occurred in 2013, no Chinook were observed by the SB sonar until 7 days after Chinook were first recorded by the NB sonar (Figure 9). This lag may have been a result of orientation of migrating fish to the north side of the river until water levels receded to the point when swimming energetics were conducive to migration along the south side of the river.

The average percent error between readers calculated for the 473 reviewed files was 2.6%. The net difference between the sums of the original and reviewed files was +23 fish; 1.7% of the total 1,351 fish originally counted. These values are similar to those in 2013 (Mercer 2014). The linear regression between readers of the daily pooled file counts indicate the correlation is high (R^2= 0.99). The variability between the original and reviewed counts appears to be due to missed fish rather than mis-identified 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 the 2013, the 2014 reviewed files produced a net gain of fish over the first count. This net gain was approximately 1.5% in 2013 and 1.7% in 2014. It is postulated that this may be due to greater diligence by the second reader; wanting to be certain they do not miss fish observed by the first reader. Consequently, this suggests the sonar count could be biased low by approximately 1.5% of the final abundance estimate. No adjustments were made to the final count to compensate for this possible bias.

The 2014 above border escapement point estimate (62,070) based on expansion of the Teslin sonar count and the Teslin regional GSI stock proportion was very close to the 2014 Eagle sonar estimate of 63,331.

However, using the aggregate of both the Teslin and Big Salmon sonar and GSI data yields a point estimate of 76,864; considerably higher than the Eagle sonar estimate. The 2014 Big Salmon GSI based stock proportion is considerably lower than has been observed in the past (Appendix 6). This low 2014 Big Salmon stock proportion results in a significantly higher point estimate. This, coupled with the above average 2014 Big Salmon escapement (6,321) suggests the 2014 Big Salmon GSI stock proportion is biased low. The reasons for this are not known. It is outside the scope of the Teslin sonar project and this report to analyze in detail 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 independent[7] 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. The lack of congruency among the escapement estimates also highlights that the use of GSI stock proportions for Yukon Chinook stock assessment is a process still in the early stages of development.

The 2014 carcass pitch on the mainstem Teslin was conducted during the peak die off period. This, coupled with the relatively large escapement into the system, resulted in achieving the sample target of 500 fish. The carcass pitch demonstrated there are areas of relatively high densities of spawning Chinook in the mainstem Teslin River.

It is recognized that potential biases can occur with carcass sampling, just as biases can and do occur with all salmon sampling methods currently employed other than those that sample the whole population. Chinook dead pitch sampling bias has been examined (Mears and Dubois 2009; Zou 2002). As a generalization, age and sex compositions from survey samples underestimated the ages of small fish and males while overestimating those of large fish and females. Carcass pitch sampling is bias toward females because of their overall larger size and their propensity to live longer and stay on redds until they expire. The Mears study indicated males were underrepresented in the carcass survey by 14% and females were overrepresented by 20%. Zou (2002) found in a multi-year study that males were under represented by 8% and females over represented by 12%. However, indications were that the population age class structures typically are representative of the population. In summary, the carcass survey data may be able to provide an adequate estimate of age class structure for each sex, but the numbers of individuals per sex may deviate from the whole population. It is worth noting those age classes that contribute the highest productive potential (age 5 and age 6) have the lowest probability of exhibiting age class sampling bias. Carcass pitch sampling biases can be influenced by environmental factors (turbidity, flows), timing of data collection in relation to the die off period, inter-annual variation in age and sex structure of the population, sample size and sampling location. It is our opinion that the experience and equipment used by the samplers may significantly influence sampling bias. An experienced sampler who knows the likeliest locations for dead and moribund fish and uses a jet boat to access those areas has a far greater likelihood of obtaining a representative sample of the population (reducing size selective bias) than someone with less experience passively floating by in a canoe or raft. The length frequency data of fish collected in 2014 (Figure 11) is not suggestive of significant size selective bias.

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

The Teslin sonar project is challenging due to the size of the river and the strong bank orientation of the migrating Chinook, particularly along the north bank. It is important that the diversion fences are able to deflect all passing Chinook into the ensonified areas of the river. 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 project continues in 2015 it is recommended additional weir materials be moved to the site to provide a more robust weir structure for the SB sonar.

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7. ACKNOWLEDGEMENTS

Several individuals contributed to the success of the 2014 Teslin River sonar project. David Macdonald was the on-site project supervisor for the duration of the project. He assisted with the camp setup and ably conducted the sonar operations. Robert Gransden, Lucas Wheeler, and Mitch McMann all worked on the sonar operation and assisted with the carcass pitch. Jane Wilson assisted with logistics and expediting and provided editorial support for this report. Trix Tanner of DFO Whitehorse coordinated the provision of GSI and ASL data as well as other technical input. Funding for this project was provided by the Yukon River Panel Restoration and Enhancement Fund.

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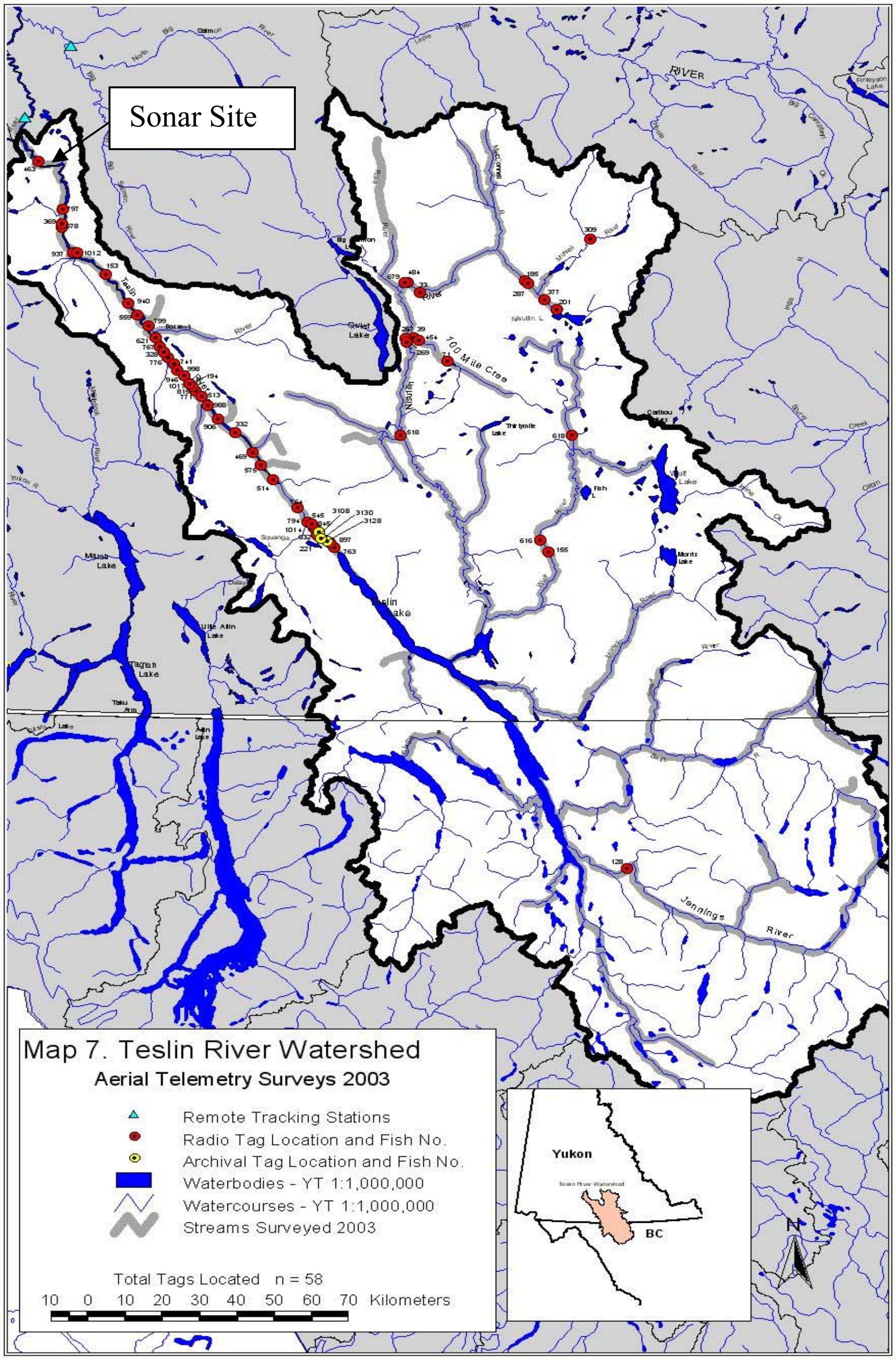
Appendix 1. Location of radio tagged Chinook during peak spawning in the Teslin River drainage in 2003.
Source: Mercer and Eiler, 2004.



Appendix 2. Daily aggregate of reviewed and corresponding original files from North Bank sonar.

Date	Daily Aggregate of Reviewed Counts	Daily Aggregate of Original Counts	Difference
15-Jul	2	3	-1
16-Jul	5	5	0
17-Jul	2	2	0
18-Jul	1	3	-2
19-Jul	15	15	0
20-Jul	17	18	-1
21-Jul	24	24	0
22-Jul	18	17	1
23-Jul	17	16	1
25-Jul	28	27	1
26-Jul	30	28	2
27-Jul	36	35	1
28-Jul	41	39	2
29-Jul	37	38	-1
30-Jul	38	39	-1
31-Jul	25	27	-2
01-Aug	39	39	0
02-Aug	37	37	0
03-Aug	28	28	0
04-Aug	53	52	1
05-Aug	34	34	0
07-Aug	40	39	1
08-Aug	47	47	0
09-Aug	59	56	3
10-Aug	53	51	2
13-Aug	38	39	-1
14-Aug	31	29	2
15-Aug	20	20	0
16-Aug	21	19	2
17-Aug	11	11	0
18-Aug	23	23	0
19-Aug	13	15	-2
20-Aug	13	11	2
21-Aug	6	6	0
22-Aug	4	5	-1
23-Aug	9	9	0
24-Aug	4	4	0
Grand Total	919	910	9

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

Appendix 3 (a). 2014 Mainstem Teslin River carcass pitch data.

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
1-Sep	1	F	100	855	755	13	95356	1	1-41	1
1-Sep	2	F	100	845	740	14	95356	1	2-42	1
1-Sep	3	F	100	865	775	14	95356	1	3-43	1
1-Sep	4	F	100	830	745	14	95356	1	4-44	1
1-Sep	5	F	100	805	700	14	95356	1	5-45	1
1-Sep	6	F	100	925	820	14	95356	1	6-46	1
1-Sep	7	F	100	815	715	14	95356	1	7-47	1
1-Sep	8	F	100	945	855	14	95356	1	8-48	1
1-Sep	9	F	100	905	795	14	95356	1	9-49	1
1-Sep	10	F	50	810	715	14	95356	1	10-50	1
1-Sep	11	F	50	825	735	14	95357	2	1-41	1
1-Sep	12	M		720	630	14	95357	2	2-42	1
1-Sep	13	F	100	N/A	760	14	95357	2	3-43	1
1-Sep	14	F	100	N/A	780	M4	95357	2	4-44	1
1-Sep	15	F	100	850	750	14	95357	2	5-45	1
1-Sep	16	F	100	840	735	M4	95357	2	6-46	1
1-Sep	17	F	100	N/A	695	14	95357	2	7-47	1
1-Sep	18	F	100	845	745	14	95357	2	8-48	1
1-Sep	19	F	100	805	705	14	95357	2	9-49	1
1-Sep	20	F	100	755	660	M3	95357	2	10-50	1
1-Sep	21	F	100	890	795	14	95358	3	1-41	1
1-Sep	22	F	100	N/A	705	14	95358	3	2-42	1
1-Sep	23	M		765	655	14	95358	3	3-43	1
1-Sep	24	F	100	880	775	14	95358	3	4-44	1
1-Sep	25	F	100	885	785	14	95358	3	5-45	1
1-Sep	26	F	100	890	790	M3	95358	3	6-46	1
1-Sep	27	F	100	825	715	14	95358	3	7-47	1
1-Sep	28	F	100	885	770	13	95358	3	8-48	1
1-Sep	29	F	100	860	755	14	95358	3	9-49	1
1-Sep	30	F	100	800	710	14	95358	3	10-50	1
1-Sep	31	F	80	870	765	14	95366	4	1-41	1
1-Sep	32	F	100	860	760	14	95366	4	2-42	1
1-Sep	33	F	100	840	745	14	95366	4	3-43	1
1-Sep	34	F	100	825	725	14	95366	4	4-44	1
1-Sep	35	F	100	N/A	825	14	95366	4	5-45	1
1-Sep	36	F	100	835	740	14	95366	4	6-46	1
1-Sep	37	F	100	880	800	14	95366	4	7-47	1
1-Sep	38	F	100	880	785	14	95366	4	8-48	1
1-Sep	39	F	100	810	720	14	95366	4	9-49	1
1-Sep	40	F	100	830	730	M4	95366	4	10-50	1
1-Sep	41	F	100	840	755	14	95367	5	1-41	1
1-Sep	42	F	100	865	780	13	95367	5	2-42	1

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
1-Sep	43	F	100	760	670	13	95367	5	3-43	1
1-Sep	44	F	100	855	780	13	95367	5	4-44	1
1-Sep	45	F	100	845	755	14	95367	5	5-45	1
1-Sep	46	F	100	910	810	14	95367	5	6-46	1
1-Sep	47	F	100	840	755	14	95367	5	7-47	1
1-Sep	48	F	100	830	735	1F	95367	5	8-48	1
1-Sep	49	F	100	870	775	14	95367	5	9-49	1
1-Sep	50	F	100	800	720	14	95367	5	10-50	1
1-Sep	51	F	100	805	715	13	95368	6	1-41	1
1-Sep	52	F	100	905	800	14	95368	6	2-42	1
1-Sep	53	F	100	820	725	14	95368	6	3-43	1
1-Sep	54	F	100	775	690	14	95368	6	4-44	1
1-Sep	55	M		925	785	14	95368	6	5-45	1
1-Sep	56	F	100	815	725	14	95368	6	6-46	1
1-Sep	57	M		795	690	13	95368	6	7-47	1
1-Sep	58	F	100	865	790	14	95368	6	8-48	1
1-Sep	59	F	100	775	700	14	95368	6	9-49	1
1-Sep	60	F	100	795	705	14	95368	6	10-50	1
2-Sep	61	F	100	885	785	14	95369	7	1-41	2
2-Sep	62	F	100	900	790	14	95369	7	2-42	2
2-Sep	63	F	100	895	785	14	95369	7	3-43	2
2-Sep	64	F	100	780	680	14	95369	7	4-44	2
2-Sep	65	F	100	850	760	14	95369	7	5-45	2
2-Sep	66	F	100	880	780	14	95369	7	6-46	2
2-Sep	67	F	100	830	735	14	95369	7	7-47	2
2-Sep	68	F	100	860	760	15	95369	7	8-48	2
2-Sep	69	F	100	835	730	14	95369	7	9-49	2
2-Sep	70	F	100	890	780	M4	95369	7	10-50	2
2-Sep	71	M		750	660	M4	95370	8	1-41	2
2-Sep	72	M		950	820	14	95370	8	2-42	2
2-Sep	73	M		700	605	13	95370	8	3-43	2
2-Sep	74	F	100	805	710	13	95370	8	4-44	2
2-Sep	75	F	100	815	720	14	95370	8	5-45	2
2-Sep	76	F	100	875	780	M4	95370	8	6-46	2
2-Sep	77	F	50	850	755	14	95370	8	7-47	2
2-Sep	78	F	100	880	780	14	95370	8	8-48	2
2-Sep	79	M		575	505	12	95370	8	9-49	2
2-Sep	80	F	100	890	770	14	95370	8	10-50	2
2-Sep	81	F	100	800	720	13	95371	9	1-41	2
2-Sep	82	M		725	645	14	95371	9	2-42	2
2-Sep	83	M		570	495	12	95371	9	3-43	2
2-Sep	84	F	100	755	670	13	95371	9	4-44	2
2-Sep	85	F	100	810	725	14	95371	9	5-45	3
2-Sep	86	F	100	830	740	14	95371	9	6-46	3

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
2-Sep	87	F	100	900	805	14	95371	9	7-47	3
2-Sep	88	F	100	810	720	1F	95371	9	8-48	3
2-Sep	89	M		720	630	12	95371	9	9-49	3
2-Sep	90	F	100	760	685	14	95371	9	10-50	3
2-Sep	91	M		725	640	12	95372	10	1-41	3
2-Sep	92	F	100	885	790	14	95372	10	2-42	3
2-Sep	93	F	100	880	790	M4	95372	10	3-43	3
2-Sep	94	F	100	835	750	14	95372	10	4-44	3
2-Sep	95	M		950	835	14	95372	10	5-45	3
2-Sep	96	F	100	845	750	14	95372	10	6-46	3
2-Sep	97	F	100	835	740	14	95372	10	7-47	3
2-Sep	98	M		710	615	12	95372	10	8-48	3
2-Sep	99	F	100	910	800	14	95372	10	9-49	3
2-Sep	100	F	100	845	750	13	95372	10	10-50	3
2-Sep	101	M		855	755	13	95373	11	1-41	3
2-Sep	102	F	100	815	730	14	95373	11	2-42	3
2-Sep	103	M		830	730	1F	95373	11	3-43	3
2-Sep	104	F	100	880	795	14	95373	11	4-44	3
2-Sep	105	F	100	770	685	13	95373	11	5-45	3
2-Sep	106	F	100	815	720	13	95373	11	6-46	4
2-Sep	107	F	100	870	770		95373	11	7-47	4
2-Sep	108	F	100	825	730	14	95373	11	8-48	4
2-Sep	109	F	100	770	680	14	95373	11	9-49	4
2-Sep	110	F	100	905	790	14	95373	11	10-50	4
2-Sep	111	F	100	845	740	14	95374	12	1-41	4
2-Sep	112	M		865	755	1F	95374	12	2-42	4
2-Sep	113	F	100	N/A	715	14	95374	12	3-43	4
2-Sep	114	F	100	865	775		95374	12	4-44	4
2-Sep	115	F	100	840	755	14	95374	12	5-45	4
2-Sep	116	F	100	840	740	13	95374	12	6-46	4
2-Sep	117	F	100	820	720	13	95374	12	7-47	4
2-Sep	118	M		980	860	M4	95374	12	8-48	4
2-Sep	119	F	100	N/A	760	14	95374	12	9-49	4
2-Sep	120	F	100	865	770	14	95374	12	10-50	4
2-Sep	121	F	100	905	810	13	95375	13	1-41	4
2-Sep	122	F	100	795	710	14	95375	13	2-42	4
2-Sep	123	M		620	540	12	95375	13	3-43	4
2-Sep	124	F	75	840	745	14	95375	13	4-44	4
2-Sep	125	F	100	815	720	14	95375	13	5-45	4
2-Sep	126	F	100	835	745	14	95375	13	6-46	4
2-Sep	127	F	100	N/A	720	14	95375	13	7-47	4
2-Sep	128	F	100	840	745	14	95375	13	8-48	4
2-Sep	129	F	100	780	695	14	95375	13	9-49	4
2-Sep	130	F	100	850	750	14	95375	13	10-50	4

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
2-Sep	131	F	100	865	760	14	95376	14	1-41	4
2-Sep	132	M		585	510	13	95376	14	2-42	4
2-Sep	133	F	100	815	720	14	95376	14	3-43	4
2-Sep	134	F	100	850	745	14	95376	14	4-44	4
2-Sep	135	F	100	910	815	14	95376	14	5-45	1
2-Sep	136	F	100	875	785	M4	95376	14	6-46	1
2-Sep	137	M		700	605	13	95376	14	7-47	1
2-Sep	138	F	100	840	750	14	95376	14	8-48	1
2-Sep	139	F	100	835	745	14	95376	14	9-49	1
2-Sep	140	F	100	845	760	14	95376	14	10-50	1
2-Sep	141	F	100	880	790	14	95377	15	1-41	1
2-Sep	142	F	0	865	765	13	95377	15	2-42	1
2-Sep	143	F	0	930	820	14	95377	15	3-43	1
2-Sep	144	F	100	N/A	830	13	95377	15	4-44	1
2-Sep	145	F	100	810	720	14	95377	15	5-45	1
2-Sep	146	F	100	925	825	13	95377	15	6-46	1
2-Sep	147	F	50	835	725	13	95377	15	7-47	1
2-Sep	148	F	100	885	795	14	95377	15	8-48	1
2-Sep	149	M		965	850	14	95377	15	9-49	1
2-Sep	150	F	100	870	780	13	95377	15	10-50	1
2-Sep	151	F	100	795	705	13	95378	16	1-41	1
2-Sep	152	F	100	N/A	785	14	95378	16	2-42	1
2-Sep	153	F	100	915	820	13	95378	16	3-43	1
2-Sep	154	F	100	800	715	14	95378	16	4-44	1
2-Sep	155	M		960	835	14	95378	16	5-45	1
2-Sep	156	F	100	785	700	13	95378	16	6-46	1
2-Sep	157	F	100	800	715	14	95378	16	7-47	1
2-Sep	158	F	100	800	705	14	95378	16	8-48	1
2-Sep	159	F	100	900	800	14	95378	16	9-49	1
2-Sep	160	F	100	905	800	13	95378	16	10-50	1
2-Sep	161	F	100	945	840	14	95379	17	1-41	1
2-Sep	162	M		820	720	14	95379	17	2-42	1
2-Sep	163	F	100	870	790	14	95379	17	3-43	1
2-Sep	164	M		650	580	13	95379	17	4-44	1
2-Sep	165	M		610	535	12	95379	17	5-45	1
2-Sep	166	M		770	675	13	95379	17	6-46	1
2-Sep	167	F	100	880	780	14	95379	17	7-47	1
2-Sep	168	F	100	840	740	14	95379	17	8-48	1
2-Sep	169	F	100	795	710	14	95379	17	9-49	1
2-Sep	170	F	100	880	780	14	95379	17	10-50	1
2-Sep	171	F	100	920	820	14	95380	18	1-41	1
2-Sep	172	F	100	920	820	14	95380	18	2-42	1
2-Sep	173	F	100	N/A	840	1F	95380	18	3-43	1
2-Sep	174	F	100	800	720	14	95380	18	4-44	1

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
2-Sep	175	F	50	840	745	14	95380	18	5-45	1
2-Sep	176	F	100	885	795		95380	18	6-46	1
2-Sep	177	F	100	850	755	14	95380	18	7-47	1
2-Sep	178	F	100	845	745	14	95380	18	8-48	1
2-Sep	179	F	100	895	795	14	95380	18	9-49	1
2-Sep	180	F	50	920	820	14	95380	18	10-50	1
2-Sep	181	F	100	N/A	665	13	95381	19	1-41	1
2-Sep	182	F	100	N/A	665	M3	95381	19	2-42	1
2-Sep	183	M		625	550	12	95381	19	3-43	1
3-Sep	184	M		825	720	13	95381	19	4-44	5
3-Sep	185	M		855	740	14	95381	19	5-45	5
3-Sep	186	M		920	805	13	95381	19	6-46	5
3-Sep	187	M		775	690	14	95381	19	7-47	5
3-Sep	188	F	100	860	770	14	95381	19	8-48	5
3-Sep	189	M		695	600	13	95381	19	9-49	5
3-Sep	190	F	100	835	755	M4	95381	19	10-50	5
3-Sep	191	F	100	825	730	13	95386	20	1-41	5
3-Sep	192	M		765	670	14	95386	20	2-42	5
3-Sep	193	M		900	785	13	95386	20	3-43	5
3-Sep	194	F	100	840	750	13	95386	20	4-44	5
3-Sep	195	F	100	880	775	13	95386	20	5-45	5
3-Sep	196	F	100	875	785	13	95386	20	6-46	5
3-Sep	197	M		750	655	14	95386	20	7-47	5
3-Sep	198	M		600	530	M4	95386	20	8-48	5
3-Sep	199	F	100	875	780	14	95386	20	9-49	5
3-Sep	200	F	100	860	755	13	95386	20	10-50	5
3-Sep	201	M		730	640	14	95383	21	1-41	5
3-Sep	202	F	100	845	755	M3	95383	21	2-42	5
3-Sep	203	F	100	835	740	13	95383	21	3-43	5
3-Sep	204	M		720	640	13	95383	21	4-44	5
3-Sep	205	M		735	650	14	95383	21	5-45	5
3-Sep	206	M		660	585	14	95383	21	6-46	5
3-Sep	207	F	100	N/A	870	14	95383	21	7-47	5
3-Sep	208	M		700	605	14	95383	21	8-48	6
3-Sep	209	M		695	595	13	95383	21	9-49	6
3-Sep	210	F	100	870	775	13	95383	21	10-50	6
3-Sep	211	M		835	730	13	95384	22	1-41	6
3-Sep	212	M		805	705	13	95384	22	2-42	6
3-Sep	213	M		870	760	14	95384	22	3-43	6
3-Sep	214	F	100	860	755	13	95384	22	4-44	6
3-Sep	215	M		705	615	12	95384	22	5-45	6
3-Sep	216	F	100	815	720	14	95384	22	6-46	6
3-Sep	217	M		880	785	13	95384	22	7-47	6
3-Sep	218	F	100	875	770	15	95384	22	8-48	6

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
3-Sep	219	M		1015	880	M4	95384	22	9-49	6
3-Sep	220	M		775	670	14	95384	22	10-50	6
3-Sep	221	F	100	920	805	13	95385	23	1-41	6
3-Sep	222	F	100	810	720	14	95385	23	2-42	6
3-Sep	223	M		700	605	14	95385	23	3-43	6
3-Sep	224	F	100	880	765	14	95385	23	4-44	6
3-Sep	225	M		990	860	13	95385	23	5-45	6
3-Sep	226	F	100	830	735	13	95385	23	6-46	6
3-Sep	227	M		775	675	13	95385	23	7-47	6
3-Sep	228	M		785	680	14	95385	23	8-48	6
3-Sep	229	F	100	795	705		95385	23	9-49	7
3-Sep	230	F	100	795	700	14	95385	23	10-50	7
3-Sep	231	F	100	N/A	700	13	95382	24	1-41	7
3-Sep	232	M		660	580	M4	95382	24	2-42	7
3-Sep	233	F	100	945	840	14	95382	24	3-43	7
3-Sep	234	M		795	695	M4	95382	24	4-44	7
3-Sep	235	M		525	460	13	95382	24	5-45	7
3-Sep	236	F	100	915	820	14	95382	24	6-46	7
3-Sep	237	F	100	775	695	14	95382	24	7-47	7
3-Sep	238	F	100	855	760	14	95382	24	8-48	7
3-Sep	239	F	100	915	825	15	95382	24	9-49	7
3-Sep	240	F	100	905	810	M2	95382	24	10-50	7
3-Sep	241	M		660	590	14	75960	25	1-41	7
3-Sep	242	F	100	870	775	14	75960	25	2-42	7
3-Sep	243	M		690	600	13	75960	25	3-43	8
3-Sep	244	M		700	610		75960	25	4-44	8
3-Sep	245	M		730	680	14	75960	25	5-45	8
3-Sep	246	M		640	580		75960	25	6-46	8
3-Sep	247	F	100	820	730	13	75960	25	7-47	8
3-Sep	248	M		855	760	13	75960	25	8-48	8
3-Sep	249	F	100	815	740	14	75960	25	9-49	8
3-Sep	250	M		720	635	14	75960	25	10-50	8
3-Sep	251	M		635	565	14	75961	26	1-41	8
3-Sep	252	M		685	595	M4	75961	26	2-42	8
3-Sep	253	M		720	655	14	75961	26	3-43	8
3-Sep	254	F	100	780	700	M4	75961	26	4-44	8
3-Sep	255	F	100	N/A	665	M4	75961	26	5-45	8
3-Sep	256	F	100	795	715	14	75961	26	6-46	8
3-Sep	257	F	100	N/A	780	13	75961	26	7-47	8
3-Sep	258	F	100	900	805	12	75961	26	8-48	8
3-Sep	259	M		760	670	14	75961	26	9-49	8
3-Sep	260	F	100	860	770	14	75961	26	10-50	8
3-Sep	261	F	100	835	745	M4	75962	27	1-41	8
3-Sep	262	M		550	490	14	75962	27	2-42	8

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
3-Sep	263	M		945	830	14	75962	27	3-43	8
3-Sep	264	M		910	790	14	75962	27	4-44	8
3-Sep	265	M		710	620	12	75962	27	5-45	8
3-Sep	266	M		670	585	12	75962	27	6-46	8
3-Sep	267	M		580	505	13	75962	27	7-47	8
3-Sep	268	M		830	740	14	75962	27	8-48	8
4-Sep	269	M		795	695	14	75962	27	9-49	9
4-Sep	270	M		575	500	14	75962	27	10-50	9
4-Sep	271	F	100	815	720	14	75963	28	1-41	9
4-Sep	272	F	100	N/A	760	14	75963	28	2-42	9
4-Sep	273	F	100	870	770	14	75963	28	3-43	9
4-Sep	274	M		920	810	12	75963	28	4-44	9
4-Sep	275	M		695	605	14	75963	28	5-45	9
4-Sep	276	M		880	775	14	75963	28	6-46	9
4-Sep	277	M		705	620	13	75963	28	7-47	9
4-Sep	278	M		770	675	13	75963	28	8-48	9
4-Sep	279	M		790	705	14	75963	28	9-49	9
4-Sep	280	F	100	940	850	14	75963	28	10-50	9
4-Sep	281	M		660	590	15	75964	29	1-41	9
4-Sep	282	M		740	645	1F	75964	29	2-42	9
4-Sep	283	M		880	795	13	75964	29	3-43	9
4-Sep	284	M		565	500	13	75964	29	4-44	9
4-Sep	285	M		670	590		75964	29	5-45	9
4-Sep	286	F	100	815	725	M3	75964	29	6-46	9
4-Sep	287	F	100	805	720	14	75964	29	7-47	9
4-Sep	288	M		590	510	14	75964	29	8-48	10
4-Sep	289	M		740	650	M3	75964	29	9-49	10
4-Sep	290	M		570	500	14	75964	29	10-50	10
4-Sep	291	M		N/A	570	13	75965	30	1-41	10
4-Sep	292	M		690	600	14	75965	30	2-42	10
4-Sep	293	M		930	825	14	75965	30	3-43	10
4-Sep	294	M		750	665	14	75965	30	4-44	10
4-Sep	295	M		630	540	14	75965	30	5-45	10
4-Sep	296	M		660	570	12	75965	30	6-46	10
4-Sep	297	M		575	505	14	75965	30	7-47	10
4-Sep	298	M		695	610	14	75965	30	8-48	10
4-Sep	299	M		710	635	M3	75965	30	9-49	10
4-Sep	300	M		725	640		75965	30	10-50	10
4-Sep	301	F	100	850	755	14	75966	31	1-41	10
4-Sep	302	M		380	330	12	75966	31	2-42	10
4-Sep	303	M		730	640	14	75966	31	3-43	10
4-Sep	304	M		730	645	14	75966	31	4-44	10
4-Sep	305	F	100	830	735	13	75966	31	5-45	10
4-Sep	306	M		940	815	13	75966	31	6-46	10

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
4-Sep	307	M		740	655	12	75966	31	7-47	10
4-Sep	308	F	100	795	710	14	75966	31	8-48	10
4-Sep	309	F	100	845	745	14	75966	31	9-49	10
4-Sep	310	M		745	655	11	75966	31	10-50	10
4-Sep	311	F	100	830	735	14	75967	32	1-41	10
4-Sep	312	M		710	620	13	75967	32	2-42	10
4-Sep	313	M		660	580	14	75967	32	3-43	10
4-Sep	314	F	100	890	790	14	75967	32	4-44	10
4-Sep	315	M		615	540	13	75967	32	5-45	10
4-Sep	316	M		675	595	14	75967	32	6-46	10
4-Sep	317	F	100	830	735	12	75967	32	7-47	10
4-Sep	318	M		605	530	13	75967	32	8-48	11
4-Sep	319	M		740	655	13	75967	32	9-49	11
4-Sep	320	M		610	555	14	75967	32	10-50	11
4-Sep	321	M		570	500	13	75968	33	1-41	11
4-Sep	322	M		645	575	13	75968	33	2-42	11
4-Sep	323	M		815	710	13	75968	33	3-43	11
4-Sep	324	M		810	710	12	75968	33	4-44	11
4-Sep	325	M		725	635	13	75968	33	5-45	11
4-Sep	326	M		660	575	M4	75968	33	6-46	11
4-Sep	327	M		800	695	13	75968	33	7-47	11
4-Sep	328	F	100	865	780	12	75968	33	8-48	11
4-Sep	329	M		745	670	13	75968	33	9-49	11
4-Sep	330	M		530	475	12	75968	33	10-50	11
4-Sep	331	M		745	645	13	75969	34	1-41	11
4-Sep	332	M		620	545	12	75969	34	2-42	11
4-Sep	333	M		900	785	14	75969	34	3-43	11
4-Sep	334	M		665	580	13	75969	34	4-44	11
4-Sep	335	F	100	925	815	12	75969	34	5-45	11
4-Sep	336	M		820	725	13	75969	34	6-46	11
4-Sep	337	F	100	810	725	12	75969	34	7-47	11
4-Sep	338	M		835	730	13	75969	34	8-48	11
4-Sep	339	M		595	520	13	75969	34	9-49	11
4-Sep	340	M		815	710	14	75969	34	10-50	11
4-Sep	341	M		570	500	14	75970	35	1-41	11
4-Sep	342	M		635	560	11	75970	35	2-42	11
4-Sep	343	F	100	805	730	13	75970	35	3-43	11
4-Sep	344	M		735	635		75970	35	4-44	11
4-Sep	345	M		760	670	14	75970	35	5-45	11
4-Sep	346	M		750	660	13	75970	35	6-46	11
4-Sep	347	M		575	510	13	75970	35	7-47	11
4-Sep	348	M		740	645	14	75970	35	8-48	11
4-Sep	349	M		760	660	M4	75970	35	9-49	11
4-Sep	350	M		725	640	13	75970	35	10-50	11

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
4-Sep	351	F	100	790	705	14	10913	36	1-41	12
4-Sep	352	M		685	610	13	10913	36	2-42	12
4-Sep	353	M		730	635	13	10913	36	3-43	12
4-Sep	354	M		905	800	14	10913	36	4-44	12
4-Sep	355	M		570	490	13	10913	36	5-45	12
4-Sep	356	M		670	595	14	10913	36	6-46	12
4-Sep	357	M		780	690	14	10913	36	7-47	12
4-Sep	358	F	100	850	755	12	10913	36	8-48	12
4-Sep	359	M		740	665	13	10913	36	9-49	12
4-Sep	360	M		875	765	13	10913	36	10-50	12
4-Sep	361	M		730	640	13	10914	37	1-41	12
4-Sep	362	M		875	765	1F	10914	37	2-42	12
4-Sep	363	M		790	695		10914	37	3-43	12
4-Sep	364	M		615	540	14	10914	37	4-44	12
4-Sep	365	M		660	575	14	10914	37	5-45	12
4-Sep	366	M		875	775	M3	10914	37	6-46	12
4-Sep	367	M		715	620	13	10914	37	7-47	12
4-Sep	368	M		620	550	14	10914	37	8-48	12
4-Sep	369	M		725	640	14	10914	37	9-49	12
4-Sep	370	F	100	790	710	12	10914	37	10-50	12
4-Sep	371	M		935	820	13	10915	38	1-41	12
4-Sep	372	M		740	650	13	10915	38	2-42	12
4-Sep	373	M		620	550	13	10915	38	3-43	12
5-Sep	374	M		880	765	13	10915	38	4-44	13
5-Sep	375	M		740	650	14	10915	38	5-45	13
5-Sep	376	M		840	735	13	10915	38	6-46	13
5-Sep	377	F	100	895	815	14	10915	38	7-47	13
5-Sep	378	F	100	825	730	1F	10915	38	8-48	13
5-Sep	379	M		705	615	13	10915	38	9-49	13
5-Sep	380	M		755	665	14	10915	38	10-50	13
5-Sep	381	M		580	515	13	10916	39	1-41	13
5-Sep	382	F	100	810	730	13	10916	39	2-42	13
5-Sep	383	M		855	755	14	10916	39	3-43	13
5-Sep	384	F	100	885	790	M3	10916	39	4-44	13
5-Sep	385	F	100	815	730		10916	39	5-45	13
5-Sep	386	M		680	595	13	10916	39	6-46	13
5-Sep	387	F	100	790	705	13	10916	39	7-47	13
5-Sep	388	M		900	790	M3	10916	39	8-48	13
5-Sep	389	M		675	585	14	10916	39	9-49	13
5-Sep	390	F	100	910	810	M4	10916	39	10-50	13
5-Sep	391	M		850	735	14	10917	40	1-41	13
5-Sep	392	M		640	565	13	10917	40	2-42	13
5-Sep	393	M		730	635	13	10917	40	3-43	13
5-Sep	394	F	100	N/A	865	13	10917	40	4-44	13

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
5-Sep	395	M		615	545	13	10917	40	5-45	13
5-Sep	396	F	100	910	800	14	10917	40	6-46	13
5-Sep	397	F	100	910	800	M4	10917	40	7-47	4
5-Sep	398	F	100	900	800	14	10917	40	8-48	4
5-Sep	399	M		700	620	13	10917	40	9-49	4
5-Sep	400	F	50	830	735	14	10917	40	10-50	4
5-Sep	401	F	100	840	745	14	10918	41	1-41	4
5-Sep	402	F	100	870	760	13	10918	41	2-42	4
5-Sep	403	M		980	850	1F	10918	41	3-43	4
5-Sep	404	F	100	890	780	14	10918	41	4-44	4
5-Sep	405	F	100	N/A	705	14	10918	41	5-45	4
5-Sep	406	M		770	675	14	10918	41	6-46	4
5-Sep	407	F	100	910	815	15	10918	41	7-47	4
5-Sep	408	F	100	895	790	14	10918	41	8-48	4
5-Sep	409	F	100	880	780	M4	10918	41	9-49	4
5-Sep	410	F	100	860	770	14	10918	41	10-50	4
5-Sep	411	M		900	780	14	10919	42	1-41	4
5-Sep	412	M		815	740	14	10919	42	2-42	4
5-Sep	413	M		N/A	505	M3	10919	42	3-43	4
5-Sep	414	M		940	845	14	10919	42	4-44	4
5-Sep	415	M		600	520	12	10919	42	5-45	4
5-Sep	416	F	100	790	705	14	10919	42	6-46	4
5-Sep	417	F	100	830	740	14	10919	42	7-47	4
5-Sep	418	M		870	775	14	10919	42	8-48	4
5-Sep	419	F	100	N/A	815	14	10919	42	9-49	4
5-Sep	420	F	25	935	825	14	10919	42	10-50	4
5-Sep	421	M		745	660	12	10920	43	1-41	4
5-Sep	422	F	100	885	780	15	10920	43	2-42	1
5-Sep	423	F	100	925	830	14	10920	43	3-43	1
5-Sep	424	F	100	840	745	14	10920	43	4-44	1
5-Sep	425	F	100	835	730	14	10920	43	5-45	1
5-Sep	426	F	100	790	705	14	10920	43	6-46	1
5-Sep	427	F	100	875	780	M4	10920	43	7-47	1
5-Sep	428	M		725	625	13	10920	43	8-48	1
5-Sep	429	F	100	N/A	670	M3	10920	43	9-49	1
5-Sep	430	F	100	810	720	14	10920	43	10-50	1
5-Sep	431	M		930	805	14	10921	44	1-41	1
5-Sep	432	M		795	700	13	10921	44	2-42	1
5-Sep	433	F	100	N/A	845	14	10921	44	3-43	1
5-Sep	434	F	100	870	765	14	10921	44	4-44	1
5-Sep	435	M		725	635	13	10921	44	5-45	1
5-Sep	436	F	100	795	715	13	10921	44	6-46	1
5-Sep	437	F	100	840	755	14	10921	44	7-47	1
5-Sep	438	M		545	475	12	10921	44	8-48	1

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
5-Sep	439	F	100	915	820	M4	10921	44	9-49	1
5-Sep	440	M		745	650	13	10921	44	10-50	1
5-Sep	441	M		770	680	14	10922	45	1-41	1
5-Sep	442	F	100	895	800	14	10922	45	2-42	1
5-Sep	443	F	100	840	755	14	10922	45	3-43	1
5-Sep	444	F	100	765	685	14	10922	45	4-44	1
5-Sep	445	F	100	N/A	825	14	10922	45	5-45	1
5-Sep	446	F	100	895	795	13	10922	45	6-46	1
5-Sep	447	M		850	745	13	10922	45	7-47	1
5-Sep	448	F	100	805	910	14	10922	45	8-48	1
5-Sep	449	M		805	705	13	10922	45	9-49	1
5-Sep	450	F	100	785	705	14	10922	45	10-50	1
5-Sep	451	F	100	815	730	13	10923	46	1-41	1
5-Sep	452	F	100	875	785	14	10923	46	2-42	1
5-Sep	453	F	100	795	720		10923	46	3-43	1
5-Sep	454	F	100	870	780	14	10923	46	4-44	1
5-Sep	455	F	100	795	705	14	10923	46	5-45	1
5-Sep	456	M		890	780	14	10923	46	6-46	1
5-Sep	457	F	100	855	770	14	10923	46	7-47	1
5-Sep	458	F	100	765	690	13	10923	46	8-48	1
5-Sep	459	F	100	880	785	14	10923	46	9-49	1
5-Sep	460	F	100	840	750	14	10923	46	10-50	1
5-Sep	461	M		680	600	14	10924	47	1-41	1
5-Sep	462	F	100	835	745	14	10924	47	2-42	1
5-Sep	463	F	100	835	740	13	10924	47	3-43	1
5-Sep	464	F	100	820	730	14	10924	47	4-44	1
5-Sep	465	M		765	670	13	10924	47	5-45	1
5-Sep	466	M		790	690	13	10924	47	6-46	1
5-Sep	467	M		690	605	13	10924	47	7-47	1
5-Sep	468	M		870	775	14	10924	47	8-48	1
5-Sep	469	F	100	870	765	14	10924	47	9-49	1
5-Sep	470	F	100	910	800	14	10924	47	10-50	1
5-Sep	471	F	100	810	710	14	10925	48	1-41	1
5-Sep	472	F	100	840	755	14	10925	48	2-42	1
5-Sep	473	F	100	N/A	740	14	10925	48	3-43	1
5-Sep	474	F	100	855	765	14	10925	48	4-44	1
5-Sep	475	F	100	885	765	14	10925	48	5-45	1
5-Sep	476	F	100	N/A	735	14	10925	48	6-46	1
5-Sep	477	F	100	N/A	750	14	10925	48	7-47	1
5-Sep	478	F	100	850	755	14	10925	48	8-48	1
5-Sep	479	F	100	805	710	14	10925	48	9-49	1
5-Sep	480	F	100	N/A	720	14	10925	48	10-50	1
5-Sep	481	F	100	850	750	14	82301	49	1-41	1
5-Sep	482	F	100	835	740	14	82301	49	2-42	1

DATE	FISH #	SEX	% SPAWNED	MEF (mm)	POHL (mm)	AGE	SCALE BOOK#	BOOK #	SCALE #	LOCATION
5-Sep	483	F	100	N/A	820	14	82301	49	3-43	1
5-Sep	484	F	100	N/A	755	14	82301	49	4-44	1
5-Sep	485	F	100	800	700	14	82301	49	5-45	1
5-Sep	486	F	100	910	815	14	82301	49	6-46	1
5-Sep	487	F	100	820	730	14	82301	49	7-47	1
5-Sep	488	F	100	840	750	14	82301	49	8-48	1
5-Sep	489	F	100	880	775	14	82301	49	9-49	1
5-Sep	490	F	100	N/A	690	14	82301	49	10-50	1
5-Sep	491	F	100	820	715	14	82302	50	1-41	1
5-Sep	492	F	100	870	775	13	82302	50	2-42	1
5-Sep	493	F	100	805	710	14	82302	50	3-43	1
5-Sep	494	F	100	N/A	840	13	82302	50	4-44	1
5-Sep	495	F	100	820	730	14	82302	50	5-45	1
5-Sep	496	F	100	860	770	14	82302	50	6-46	1
5-Sep	497	F	100	815	720	14	82302	50	7-47	1
5-Sep	498	F	100	780	685	M3	82302	50	8-48	1
5-Sep	499	M		540	465	13	82302	50	9-49	1
5-Sep	500	F	100	N/A	760	14	82302	50	10-50	1
5-Sep	501	F	100	795	710	14	82303	51	1-41	1
5-Sep	502	F	100	880	770	M3	82303	51	2-42	1
5-Sep	503	F	100	855	755	14	82303	51	3-43	1
5-Sep	504	F	100	810	725	14	82303	51	4-44	1

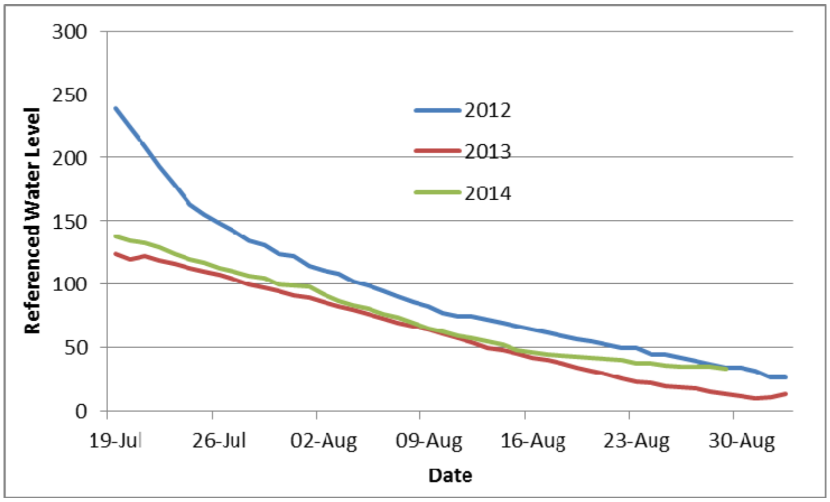
Appendix 3 (b) Principal spawning areas based on sample site locations.

Sample Site	* GPS Coordinates
1	N 60 30.639' W 133 21.925'
2	N 60 31.865 W 133 23.643
3	N 60 31.292 W 133 22.694
4	N 60 31.062' W 133 21.899'
5	N 60 33.995' W 133 26.245'
6	N 60 35.958' W 133 30.038'
7	N 60 43.866' W 133 41.592'
8	N 60 45.953' W 133 44.045'
9	N 60 47.080' W 133 48.188'
10	N 60 50.463' W 133 53.633'
11	N 60 47.686' W 133 49.587'
12	N 60 46.766' W 133 46.204'
13	N 60 32.663' W 133 25.378'

Appendix 4. Hydrometric data and weather observations, Teslin sonar site 2014.

Date	Time	Air Temp. C	Water Temp. C	Water Level cm
13-Jul				147.955
14-Jul	0800h		14	
15-Jul	0800h		14	
16-Jul	0800h		14	144.145
17-Jul	0800h	13.0	15	140.335
18-Jul	0800h		15	137.795
19-Jul	0725h	10.0	14	133.985
20-Jul	0820h	15.0	13	132.715
21-Jul	0917h	14.0	13	128.905
22-Jul	0900h	13.0	14	123.825
23-Jul	0800h		14	
24-Jul	1000h		14	117.475
25-Jul	0835h	12.0	14	112.395
26-Jul	0900h	16.0	14	109.855
27-Jul			14	
28-Jul	0900h	13.5	14	104.775
29-Jul	0924h	13.5	15	99.695
30-Jul	0742h	10.0	15	
31-Jul	0800h	10.0	14	98.425
01-Aug	0730h	7.0	14	92.075
02-Aug	0842h	15.0	15	86.995
03-Aug	0600h	8.0	15	83.185
04-Aug	0800h	17.0	16	80.645
05-Aug	0820h	10.0	16	76.835
06-Aug			16	
07-Aug			16	
08-Aug			15	
09-Aug	1100h	15.0	14	62.865
10-Aug	0927h	15.0	14	59.055
11-Aug	0800h	17.0	15	57.785
12-Aug			15	
13-Aug			15	
14-Aug			14	
15-Aug	0800h		15	46.355
16-Aug			14	
17-Aug			14	
18-Aug			13	
19-Aug			13	
20-Aug	0800h		14	41.275
21-Aug			14	
22-Aug	0800h		14	37.465
23-Aug	0800h		14	37.465
24-Aug			14	
25-Aug			13	
26-Aug			13	
27-Aug	0700h	8.0	13	34.925
28-Aug	0900h	8.0	13	33.655

Appendix 5. Referenced water levels at Teslin sonar site 2012, 2013 and 2014.



Appendix 6. Estimated proportions of Big Salmon River and Teslin River Chinook in upper Yukon River Chinook escapements, 2002 through 2014.

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)
Mean 2002-2014		9.8	22.9
Std. Dev.		3.7	8.0

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