2015 Porcupine River Chinook Salmon Telemetry

Prepared For

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EXECUTIVE SUMMARY

In 2014, the Vuntut Gwitchin Government (VGG) initiated a program to radio tag Chinook salmon in the Canadian portion of the Porcupine River, to determine the locations and extent of utilization of spawning habitats in the upper portion of the watershed. A VGG program to enumerate of Porcupine River Chinook salmon via sonar at a site in the near vicinity of Old Crow also began operation in 2014. The Vuntut Gwitchin First Nation relies on Chinook salmon as a traditional food source and the subsistence harvest of salmon on the Porcupine River is an important component in the traditional lifestyle of Old Crow residents. These two programs were intended to increase the level of scientific knowledge of Porcupine River Chinook; prior to 2014 such information was limited for Porcupine River Chinook.

The 2014 program underestimated the amount of sampling effort that was required to tag Chinook salmon in the Porcupine River, and was discontinued prior to tracking flights. Revisions to projects method and sampling were made, and a second year of radio tagging and tracking was conducted successfully by VGG in 2015. Esophageal implant radio tags were applied to 51 Chinook salmon during late August and September near the confluence of the Porcupine River and Caribou Bar Creek, approximately 70 km downstream of Old Crow. Age, sex and length data was collected from captured Chinook salmon and genetic sampling (clipping of axillary processes) was conducted for radio tagged Chinook. Genetic samples were thus tied to specific radio tags, allowing for the genetic sample data to be tied to specific spawning locations in the upper Porcupine River when tags were relocated.

Radio tagged Chinook salmon were relocated via aerial telemetry tracking flights and by radio telemetry receivers that installed in two stationary towers prior to the start of the tagging program. One such tower was installed approximately 14 km downstream of the tagging site and was intended to detect tagged Chinook that migrated back downstream after tagging. The second stationary tower was installed on the Miner River, near its confluence with the Porcupine River and was intended to detect Chinook salmon that entered the Fishing Branch and Miner Rivers, two key headwater spawning tributaries of the Porcupine River. Combined data from aerial surveys conducted from August 13 to 15 and from September 2 to 5 and from the stationary radio towers allowed for the relocation of 94% (48 of 51) of tagged Chinook salmon.

The total number of relocated tagged Chinook salmon was adjusted to remove the tags that were found near Old Crow (4 tags; assumed harvested and not recovered), those tagged Chinook that migrated downstream or were presumed to have died near the tagging site (8 tags) those tags that were not relocated (3 tags) and one tagged Chinook that was captured at the sonar site. The remaining 35 tagged Chinook were relocated at presumed spawning locations, with the largest proportion in the Miner River (9 tags), followed by the Bell River watershed and upper Porcupine River mainstem (7 tags each).

This project provided 2 weeks of fisheries related field work and capacity building for two local VGFN citizens and demonstrated the viability of radio tagging Chinook salmon on the Porcupine River. In addition, this project provided the first scientific evidence of Chinook salmon spawning in the Bell River watershed.

ACKNOWLEDGEMENTS

Funding for this project was provided by the Yukon River Salmon Restoration and Enhancement Fund. The Department of Fisheries and Oceans provided logistical support, and allowed field staff to use the field camp established for the 2015 Porcupine River chum salmon sonar program. William Josie, Erica Tizya and David Frost, of the Vuntut Gwitchin Government Natural Resources Department provided general project direction and assistance with logistics, and collected tags recovered in the local fishery.

AUTHORSHIP

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Members of the field crew for this project included Joel MacFabe, Lee Hawkings and Jake Duncan of EDI. Local VGFN technicians Dennis Frost and Keith Rispin assisted with radio tag applications and provided the practical input to ensure the project's success.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND AND OBJECTIVES

Salmon migrating up the Porcupine River through the Traditional Territory of the Vuntut Gwitchin Government (VGG) are culturally important to VGG citizens. Old Crow, the only Canadian community on the Porcupine River, relies on the salmon fishery as a traditional food source and the subsistence harvest of salmon on the Porcupine River is an important component in the traditional lifestyle of Old Crow residents.

The Yukon River Panel was established to manage "transboundary" salmon stocks, which move through waters subject to both U.S. and Canadian fisheries management processes, in a cooperative forum. Three salmon species spawn in the Canadian portion of the Porcupine River: Chinook (*Oncorhynchus tshawytscha*), chum (*Oncorhynchus keta*) and coho (*Oncorhynchus kisutch*). Chinook and chum salmon are managed jointly through the Yukon River Panel's Joint Technical Committee (JTC) process; however, there is currently no joint management process for coho salmon in the Porcupine River.

In 2014, VGG initiated a project to radio tag Chinook salmon in order to help determine the current extent of Chinook salmon spawning location in the upper Porcupine River watershed (upstream of Old Crow). A VGG program to enumerate of Porcupine River Chinook salmon via sonar at a site in the near vicinity of Old Crow also began operation in 2014. Due to challenges in capturing a sufficient sample size of Chinook salmon in 2014, radio tagging/tracking was not successfully completed in 2014 (EDI 2015). Revision to the project methods were developed in response to the challenges that were encountered in 2014, and VGG initiated a second year of radio telemetry in 2015. The plan for the 2015 program included an increased amount of sampling effort, incorporation of an experienced local fisher into the field crew and changes to gill netting equipment in order to maximize the ability to capture Chinook salmon for radio tag applications. Additionally, two radio telemetry receivers were installed in stationary towers at locations upstream and downstream of the tag application site (one tower at each location). These towers were intended to quantify the proportion of tags that migrate downstream after tagging (possibly due to tagging stress) and the number of Chinook salmon that entered the upper Porcupine River tributaries (Miner and Fishing Branch rivers).

The primary goal of the 2015 project was to tag Chinook salmon in the Porcupine River (downstream of Old Crow) and to track the tags throughout the Porcupine River watershed, thereby increasing the level of understanding of Chinook salmon spawning areas in VGG's Traditional Territory. A secondary goal of this project was to help increase the resolution of the Chinook salmon genetic stock identification baseline dataset for the Porcupine River and its tributaries. The specific objectives of this project were to:

- Tag 50 Chinook salmon with esophageal implant radio tags in the Porcupine River mainstem downstream of Old Crow;
- Refine the capture methods used in 2014 to increase the number of Chinook that can be captured and radio tagged;
- Collect 50 genetic samples from radio tagged adult Chinook salmon during the radio tagging process which may be identified to priority areas using radio tag relocations; and,
- Provide local capacity building, including technical training and employment for two local community members for approximately 2 weeks.

1.2 STUDY AREA

The Porcupine River is one of the largest tributaries in the Yukon River watershed, much of which is located within the Traditional Territory of the Vuntut Gwitchin First Nation. It has a number of large tributaries within Canada, including the Whitestone, Miner, and Fishing Branch rivers (Map 1). The only substantial Canadian settlement within the Porcupine River watershed is the community of Old Crow, located approximately 80 kilometres east of the Canada/U.S. border at the confluence of the Old Crow and Porcupine rivers. Old Crow has a population of approximately 300 people, mainly VGG citizens.

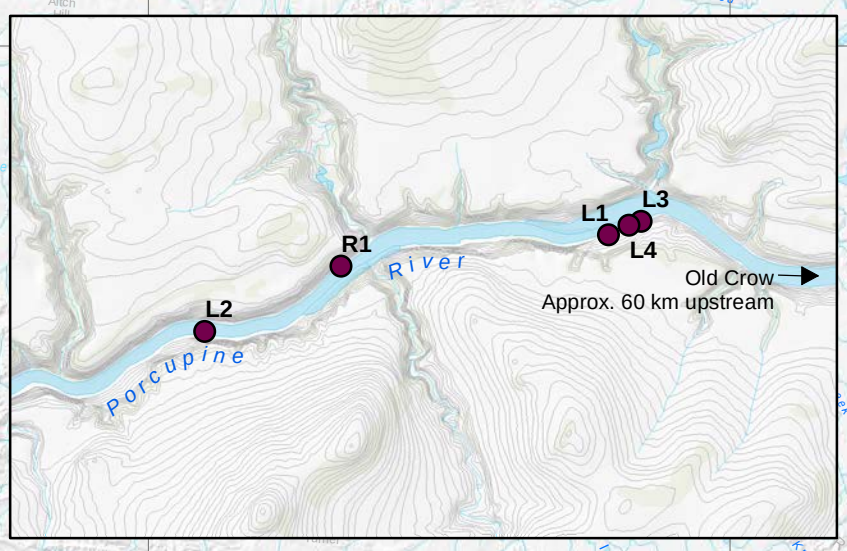
Overview of 2015 Porcupine River Tag Application Sites and Tracking Locations

Tagging Locations (Inset Below)

Old Crow

Fishing Branch Weir

PORCUPINE RIVER



Legend

- Fishing Branch River Weir - Inactive
- Radio Tag Application Site
- Stationary Radio Telemetry Tower Site
- Extent of 2015 Aerial Telemetry Surveys

Data Sources
1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Natural Resources Canada. All Rights Reserved.

1:1,000,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2015) was obtained using Garmin GPS technology.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

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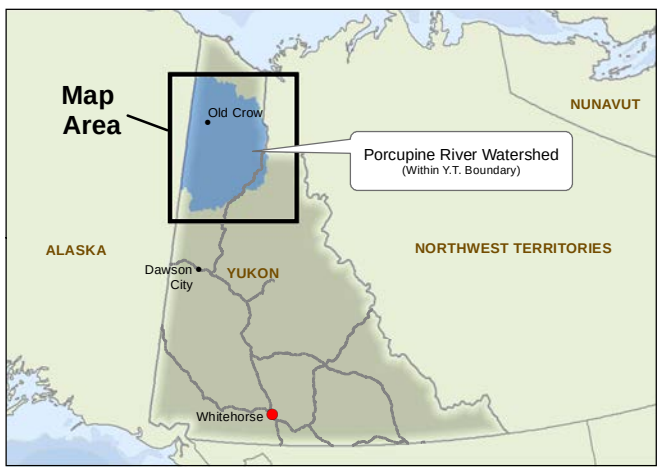
Kilometres

Map Scale 1:1,300,000 (printed on 11 x 17)
Map Projection: North American Datum 1983 CSRS Yukon Albers



Drawn:	Checked:	Date:	MAP 1
MP	BSn/BSc	16/12/2015	

Vuntut Gwitchin First Nation

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2 METHODS

2.1 CHINOOK SALMON RADIO TAGGING

The capture and tagging of Porcupine River Chinook salmon was conducted between July 7 and 22, 2015, in the vicinity of the confluence of Caribou Bar Creek, approximately 70 km downstream of Old Crow. Tag applications were conducted by an EDI biological technician and two local VFGN technicians, with support from EDI biologists based in Whitehorse.

Chinook salmon were captured for radio tagging using gill nets. Mesh sizes that were used included 6.0, 7.5 and 8.25 inches (15.24, 19.05 and 20.95 cm); all nets were 100 feet in length with a net depth of approximately 15 feet. Nets were set at various sites near Caribou Bar Creek (on both banks) as determined by water levels and capture success. Set nets were constantly monitored and checked regularly to minimize the time that fish remained caught within the net. Additionally, all nets were constructed using twine mesh to minimize the potential for injury and stress to captured fish (relative to more abrasive mono-filament netting). Nets were hung at a relatively loose hanging ratio of 3:1.

Captured fish were removed from the net and placed in a water filled tote to recover. Fish were observed for any signs of injury (e.g. lacerations, bleeding from gills), and healthy Chinook salmon were selected for tagging. Scale samples were collected from all captured Chinook (three scale per individual) and delivered to DFO for processing; any injured Chinook salmon were sexed, measured, sampled (genetics and scale samples) and released untagged. Any other captured fish were identified to species, measured and released. Genetic samples were collected from radio tagged Chinook salmon by clipping the paired axillary processes from each fish. Axillary processes were then immersed in ethanol filled vials in the field in order to preserve them. A separate vial was used for each sampled Chinook salmon, and the tag frequency and code of the implanted radio was recorded on the sample vial for each individual. Sample vials were delivered to DFO for analysis and processing at the completion of the field program.

Chinook salmon that were selected for radio tagging were fitted with an ATS (Advanced Telemetry Systems) model F1845B esophageal implant tag. In addition to the radio tag, a secondary numbered orange floy tag was applied to each radio tagged Chinook (Photo 1). These tags were each had a unique number, and were meant to make radio tagged fish more visible to local fishers; tags were brightly colored and fishers were accustomed to looking for tags due to previous salmon research programs on the Porcupine River. Following each successful tag application, fish were allowed to recover and were inspected for any signs of injury or unusual stress prior to release. Radio tags were removed from Chinook that showed signs of injury or abnormal behaviour after tagging, and were reapplied to a different individual.

Photo 1. **A field crew member holding a Chinook salmon tagged with an esophageal implant tag (tag antenna protruding from mouth) and posterior secondary orange floy tag; July 18, 2015.**

A total of 51 radio tags (one more tag than initially planned) on three different frequencies were utilized for this project, as shown in Table 1. One additional tag was retained as a tester tag to allow for the testing of the radio receiver and antennas prior to tracking flights. Each tag was coded by the manufacturer with a unique identifier; a full list of tag frequency and unique tag identifiers is provided in Appendix A. Tags were also encoded with a mortality sensor, to help determine whether tracked Chinook had reached their terminal spawning destinations. Mortality sensors were pre-set to activate if no movement was registered by the tag for 24 hours or more.

Table 1. **Frequencies of radio tags applied to Chinook salmon at the Porcupine River sonar site in 2015.**

Tag frequency	Number of tags
149.294	19
149.374	24
150.583	8

2.2 TRACKING OF RADIO TAGGED CHINOOK SALMON

2.2.1 AERIAL TRACKING

Aerial tracking of radio tagged Chinook salmon was conducted from August 13 to 15 and September 2 to 5, 2015. Tracking was attempted on September 4, but could not be conducted due to poor weather conditions. The areas that were surveyed on each date are detailed in Table 2. All major spawning tributaries with the Canadian portion of the Porcupine River were surveyed. Suspected key spawning areas (e.g. the Miner River) were surveyed during both tracking periods in order to maximize survey time in these areas and ensure that no tags were missed.

Table 2. Summary of Chinook salmon aerial tracking surveys conducted in the Porcupine River watershed in 2015.

Date of Tracking Flight	Survey Locations
August 13, 2015	• Miner River, including lower portion of Fishing Creek • Fishing Branch River, including North Fork • Whitestone River, including east and west forks, as well as lower portions of Chance and McParlon Creeks
August 14, 2015	• Lower Miner River • Porcupine River mainstem, from Miner River confluence to Canada/U.S. border • Bluefish River • Lower Bell River to Eagle River confluence • Eagle River • Crow River, including Timber, Thomas, Blackfox, Johnson, Schaefer and Suprise Creeks
August 15, 2015	• Driftwood River • David Lord Creek • Johnson and Pine Creeks (tributaries to Porcupine River mainstem) • Upper Bell River, above Eagle River Confluence • Rock River
September 2, 2015	• Upper Miner River, to Fishing Creek confluence • Fishing Branch River, including North Fork • Cody Creek • Whitestone River, including east, west and middle forks
September 3, 2015	• Lower Miner River, downstream of Fishing Creek confluence • Porcupine River mainstem from Miner River confluence to Canada/U.S. border • Crow River including Black Fox, Timber, Thomas and upper Johnson Creeks • Lower Bell River to Eagle River confluence • Rock River
September 5, 2015	• Berry Creek, tributary to the Porcupine River • Waters River • Little Bell River

Aerial tracking was conducted by an EDI biologist/biological technician, using a Cessna 172 chartered from Whitehorse. Radio antennas were mounted to each wing strut of the plane, to allow for optimal detection of tags on either side of the plane's flight path. Tracking was completed using an ATS model R4520C GPS

equipped receiver; the same receiver unit was used on all flights. The frequencies of applied tags were input into the receiver, and the receiver was set to cycle through each frequency at a scan rate of 3 seconds per channel. While tracking, the plane was flown as low as possible (300 to 500 feet), at speeds ranging from 100 to 130 km/h (the slowest possible speed, dependent on wind conditions). When a tag tone was heard by, the frequency was locked using the receiver's "hold" function, the tag was decoded and GPS coordinates were recorded automatically by the receiver. When required, the pilot was asked to fly a loop to allow the receiver sufficient time to detect and decode the tag.

2.2.2 STATIONARY TOWER TRACKING

In order to gain a better understanding the migration patterns of radio tagged Chinook salmon, two stationary (fixed) telemetry towers were installed in 2015 prior to the commencement of radio tagging. The first tower was located approximately 14 km downstream of the tagging location (Map 1) and was installed in order to determine if any radio tagged Chinook salmon were migrating downstream after being tagged. The second stationary tower was installed on the Miner River, near the confluence with Porcupine River (approximately 384 km upstream of the tag application site; Map 1). This tower was also located downstream of the confluence of the Miner and Fishing Branch rivers. Both the Miner and the Fishing Branch rivers are known to be important salmon spawning tributaries to the upper Porcupine River and the stationary radio tower was meant to quantify the number of radio tagged Chinook salmon that entered these two rivers. Additionally, tag detection data from this tower was used to determine rates of travel of Chinook salmon between the tagging site and the tower location.

Each stationary tower was equipped with a solar panel and powered with a 12 volt deep cycle battery. In order to determine the direction of travel of a radio tag that passed by the tower, two antennas were installed on each tower, one pointing upstream, the other downstream. Each tower used a R4520C ATS telemetry receiver (the same model used for aerial tracking) and was equipped with an antenna switch to allow for differentiation of tag detections from both antennas. The receivers used in the stationary tower deployments were set to stationary scan mode and continuously scanned through all three possible tag frequencies. The stationary scan recorded the date, time and signal strength of detected radio tags that migrated past the tower in either direction (upstream or downstream).

The tower downstream of the tagging site was deployed on July 6th 2015, at the beginning of the radio tag application program. Data from this tower was set to be backed up on the receiver's internal memory and periodic checks of this tower and receiver were made by field staff during the tag application period (July 7 to 22) to ensure it was functioning properly. The tower was removed on August 18, 2015 after the completion of tag application. Leaving the tower in place until August 18 maximized the opportunity to detect any fish that had migrated downstream after tagging. Collected telemetry data was downloaded from the internal storage on the tower's receiver for analysis.

The stationary tower on Miner River was installed on June 29, 2015, several weeks before the first radio tag applications. This tower was configured in the same manner as the tower that was installed downstream of the tagging site; however, it also contained an ATS Remote Data Platform (RDP). The RDP is a satellite

data modem that provides automatic, hourly data uploads of radio tag detection data as well as status of the tower's power system (via the Iridium satellite network). A test radio tag was also deployed near this tower, which was meant to be detected by the tower once per hour. The detection of this tag could be viewed on the regular data transfers via the Iridium network, and allowed EDI biologists to ensure that all tower components were functional. In order to avoid confusion with detection from radio tagged chum salmon, the test tag that was used was on frequency that was different from all three tag frequencies that were used to radio tag Chinook salmon in 2015. Retrieval of the tower at the Miner River confluence occurred on August 24, 2015, at which time it was moved to the Fishing Branch River (weir site) to be used during the subsequent chum telemetry program.

2.3 DETERMINING LOCATIONS AND MORTALITY OF RADIO TAGGED CHINOOK SALMON

The locations of radio tagged Chinook salmon were determined using the telemetry data collected during radio tracking flights as well as data from the two stationary radio towers. During tracking flights, the R4520C radio receiver recorded the date, time, frequency, tag identifier, signal strength and GPS coordinates (UTMs) of each tag that was decoded. After each survey, this data was downloaded from the receiver and exported to Microsoft Excel for further analysis. Telemetry data collected by the fixed towers was analyzed in a similar manner, to determine passage dates of radio tagged Chinook salmon at the Miner and Porcupine rivers confluence, tag movement direction, and the potential for downstream migration of Chinook salmon after tagging.

Each radio tag was set to continually broadcast its data, and therefore several tag detection records were collected for most tags. To determine the final position of each tagged Chinook salmon, all radio tag tracking data (including aerial surveys and stationary radio tower detections) was sorted by frequency, tag identifier and signal strength. The tag detection record with the highest signal strength was then taken as the best approximation of the fish's location. Where a tag was detected by a stationary tower and on the spawning ground during aerial tracking, the highest signal strength from the aerial survey detections was used to identify the tags location even.

To determine the status of a tag's mortality sensor, an average of recorded mortality codes were taken for each radio tagged Chinook salmon that was located during tracking. The radio tag mortality sensor outputs one of three possible numerical codes, based on the motion of a tagged fish:

0 = tagged fish in constant motion;

1 = intermittent motion of tagged fish; or,

2 = no motion of tagged fish

Since the mortality sensor value can change from "on" to "off" over time, if a tagged Chinook salmon was detected on multiple survey dates, only the data from the final detection date was analyzed. Taking the average of the mortality codes enabled comparison between tag detection records that had variable mortality

readings. When averages were taken, every individual with a mean mort code of less than one was assumed to be "alive", while averages greater than one are assumed "dead". Individuals with a mean mort code of one were categorized as "unclear".

In most cases, the mortality sensors provide a good indication of whether a tagged fish is alive or dead; however, false positive are possible. For example, a Chinook carcass that is caught on large woody debris in an area of high current could be moving enough to maintain the mortality sensor in the "alive" position, erroneously indicating this fish was still alive. For this purposes of this project, the status of the mortality sensors on tagged Chinook salmon were taken as indicator of the vitality of each tagged Chinook, but were not taken as definitive proof that a particular Chinook salmon was alive or dead.

3 RESULTS

3.1 CHINOOK SALMON TAGGING

3.1.1 FISH CAPTURE DATA

Weekly fish capture data during the tag application period of this program is summarized in Table 3; daily catch data is detailed in Appendix B. A total of 73 Chinook salmon were captured in 158.9 hours of set netting in the vicinity of Caribou Bar Creek between July 7 and 22, 2015 (Table 3). Fifty-one of these Chinook were selected for radio tagging. Aside from Chinook salmon, only one inconnu (*Stenodus leucichthys*) and three broad whitefish (*Coregonus nasus*) were captured. No other salmon species were captured.

Table 3. Summary of 2015 weekly drift and set netting fish captures at the Porcupine River sonar site.

Tagging Program Week	Total Set Netting Effort (Hours)	Number of Chinook salmon Captured	Number of Other Fish Species Captured	Total Fish Captured	Chinook Proportion (%)
July 7-14	87.3	30	2	32	94%
July 15-22	71.6	43	2	45	96%
Total	**158.9**	**73**	**4**	**77**	**95%**

3.1.2 CHINOOK AGE, SEX AND LENGTH DATA

Sex ratios and fork lengths of Chinook salmon that were captured between July 7 and 22, 2015 are summarized in Table 4; sex and length data for individual Chinook are included in Appendix B. Seven captured Chinook escaped from the net during retrieval, and their sex could not be verified. These fish were not included in sex/length ratio calculations. The mean fork lengths of captured Chinook salmon were 81.5 cm for males and 88.4 cm for females. Male Chinook accounted for a higher percentage of the catch (65.8%) than females (34.2%; Table 4). At the time that this report was written, analysis of scale samples taken from captured Chinook salmon was not yet completed by DFO.

Table 4. Weekly summary of sex and fork length data from Chinook salmon captured during the Porcupine River radio telemetry program, from July 7 to July 22, 2015.

Tagging Program Week	Male			Female		
	Weekly Total Chinook Sampled	% of Weekly Total	Mean Length (cm)	Weekly Total Chinook Sampled	% of Weekly Total	Mean Length (cm)
July 7-14	19	70%	81.7	8	30%	85.6
July 15-22	23	59%	81.4	16	41%	89.8
Total	**42**	-	-	**24**	-	-
Program Mean	-	**63.6**	**81.5**	-	**36.4**	**88.4**

3.1.3 RADIO TAG APPLICATIONS

A summary of daily radio tag applications rates are shown in Table 5; more detailed radio tag application data is included in Appendix B. In response to the difficulty in capturing an adequate number of Chinook salmon in 2014, radio tag applications focused on a two week period during the peak of the run. This decision was meant to maximize the amount of Chinook salmon that could be captured with a reasonable amount of sampling effort. As shown in Table 5, tag applications were spaced throughout the application period. While the intent was to distribute tags evenly, low capture rates on certain days and a high water event on July 12 meant that application rates deviated slightly from this plan. Only a single confirmed recapture of a radio tagged Chinook salmon occurred in 2015, during test netting conducted as part of the 2015 Chinook salmon sonar program. This tag was reapplied to different fish later during the tagging period.

Table 5. Summary of weekly Chinook salmon radio tag deployments on the Porcupine River 2015

Tag Application Date	Number of Radio Tagged Chinook salmon	Proportion of Total Tags Applied (%)
07-Jul-15	1	2.0%
08-Jul-15	3	5.9%
09-Jul-15	3	5.9%
10-Jul-15	3	5.9%
11-Jul-15	3	5.9%
12-Jul-15	0[a]	0.0%[a]
13-Jul-15	6	11.8%
14-Jul-15	4	7.8%
15-Jul-15	6	11.8%
16-Jul-15	4	7.8%
17-Jul-15	5	9.8%
18-Jul-15	3	5.9%
19-Jul-15	3	5.9%
20-Jul-15	3	5.9%
21-Jul-15	2	3.9%
22-Jul-15	2	3.9%
Total	**51**	**100%**

[a]A high water event on July 12 prevented set netting from being conducted, as such, no tags were deployed.

3.1.4 GENETIC SAMPLE COLLECTION

Genetic samples were collected from all radio tagged Chinook salmon, and delivered to DFO for further analysis. The tag frequency, unique identifier and final destination of each tagged Chinook is included in Appendix C. This data can be used to tie genetic samples to specific spawning tributaries; however, at the time that this report was written, analysis of genetic samples from captured Chinook salmon was not yet completed by DFO.

3.2 RADIO TRACKING TELEMETRY DATA

Data from both the aerial tracking surveys and the two stationary radio towers was used to determine the final location of each tagged Chinook salmon. The locations of all tags are displayed on Maps 2, 3 and 4 and are summarized in Section 3.2.1. A more detailed breakdown of the location of each tag is included in Appendix C. The 2015 program was the first season that stationary towers were used to assist in the tracking of radio tagged Chinook salmon on the Porcupine River; tag detection data from the towers is further detailed in Section 3.2.2.

3.2.1 LOCATIONS OF RADIO TAGGED CHINOOK SALMON

Radio telemetry tracking (including aerial and stationary radio tower tracking) located 48 of the 51 Chinook salmon that were radio tagged by this project in 2015. The locations of all tags are summarized in Table 6; specific coordinates for individual tags can be found in Appendix C. The Miner River constituted the primary spawning destination for the tagged Chinook, and accounted for 22% of the relocated Chinook salmon (11 of 51 tags; Table 6). A substantial number of radio tagged Chinook salmon were also relocated in the upper Porcupine River mainstem (18% of all tags) and the Bell River watershed (14% of all tags). The presence of this number of radio tags in the Bell River watershed is notable given that this provides the first scientific confirmation of Chinook spawning in this watershed. Of the seven radio tagged Chinook salmon that were found in the Bell watershed included, five were in the Rock River, one was in the Waters River and one was in the upper Bell River (above the Little Bell River confluence). Two tags were located in the lower Crow River mainstem, but were not thought to represent a specific spawning site due to a lack of suitable spawning habitat in this portion of the Crow River.

Table 6. Summary of Chinook salmon radio tag detection in the Porcupine River watershed in August and early September 2015 (combined aerial and stationary tower data).

Radio Tag Location	Number of Tags Detected
Miner River (upstream of Fishing Branch River confluence)	9
Miner River (between confluence of Fishing Branch and Whitestone rivers)	4
Fishing Branch River	4
Upper Porcupine River (from Whitestone River confluence downstream to Pine Creek confluence)	7
Porcupine River mainstem (Pine Creek confluence to Old Crow, including mouth of David Lord Creek)	2
Bell River watershed (including the Rock, Waters and upper Bell rivers)	7
Crow River mainstem, presumed non-spawning	2
Old Crow and vicinity, presumed mortalities	4
Porcupine River downstream of stationary tower below tagging site	5
Presumed mortalities near the tagging site	3
Captured at the sonar test netting site (mortality)	1
Not relocated	3
TOTAL	**51**

3.2.2 STATIONARY TOWER RADIO TELEMETRY DATA

The two stationary radio towers used in this project detected a total of 26 tagged Chinook salmon, with one individual being detected at both towers (Table 7). The radio tower downstream of the tagging site detected ten tagged Chinook salmon, while the tower upstream of the tagging site on the Miner River detected 16 radio tagged Chinook salmon. Both towers worked as intended, and no technical issues were experienced during their period of operation.

Tagged Chinook salmon that were detected by the tower downstream of the radio tagging site had variable migrations rates. A number of tagged Chinook were detected by this tower very soon after tagging, and were only heard briefly (travel time of less than a day to 1 day; Table 7). Several other radio tagged Chinook appeared to have migrated upstream for several days before changing direction and heading back downstream (travel times of 6 to 17 days). Two tagged Chinook exhibited markedly distinct and different behavior patterns; one individual was detected moving downstream of the tower but was then detected moving upstream of the tower approximately one week later (15 days after it was tagged; Table 7). The second individual was detected migrating downstream, and then changed directions and migrated upstream past both radio towers. Two of the radio tagged Chinook salmon that were detected by the lower radio tower showed very little movement for a period of several consecutive days, and were presumed to be post-tagging mortalities.

At the tower on the Miner River, all radio tagged Chinook were detected moving upstream past the tower. No tags were detected moving downstream past the tower. The travel time of the tagged Chinook salmon from the tagging site to the tower ranged from 6 to 9 days, with an average calculated travel time of 7 days. It should be noted that the one tagged Chinook that first travelled downstream of the tagging site tower was not included in the calculated of the average travel time, as the behavior of this fish appeared to be inconsistent with that of the other tagged fish detected by the Miner River tower. The distance between the tagging site and the tower on the Miner River was approximately 384 km; dividing this distance by the travel time of radio tagged Chinook salmon indicates that migration rates between the two sites ranged from 42 to 64 km/day, with an approximate average travel time of 55 km/day.

The travel time of Chinook salmon has previously been calculated between a test fish near Rampart Rapids and the Eagle Sonar Program located near the Canada/U.S. border (a distance of approximately 793 km; Zuray 2015). This data is of interest as it includes a large sample size of Chinook salmon in a different part of the Yukon River watershed; in 2014 the calculated average travel rate of Chinook salmon between the Ramport Rapids site and the Eagle Sonar site was approximately 53/km day. This rate is similar to the observed rate of travel of Chinook salmon that were radio tagged in this project. If additional Chinook salmon radio tracking studies are completed on the Porcupine River, future comparisons of Chinook salmon travel rates using similar data could help inform on Chinook salmon run timing in greater detail.

Table 7 Chinook salmon radio tag detections by stationary towers in the Porcupine River watershed in July and August 2015. Where tags were detected on multiple dates, the date specified is the first tag detection.

Date of Tag Application	Radio Tag Frequency	Unique Tag Identifier Code	Date Detected by Tower Downstream of Tagging Site	Date Detected by Miner River Tower	Travel Time from Tagging Site (Days)	Direction of Tag Movement	Final Status of Tagged Fish
7-Jul-15	149.374	1	12-Jul-15	-	5	No movement	Mortality
8-Jul-15	149.294	22	9-Jul-15	-	1	Downstream	Downstream of tower
11-Jul-15	149.374	13	12-Jul-15	-	1	Downstream	Downstream of tower
14-Jul-15	149.374	18	15-Jul-15	-	1	No movement	Mortality
15-Jul-15	149.294	9	15-Jul-15	-	0	Downstream	Downstream of tower
15-Jul-15	149.374	12	30-Jul-15	-	15	Upstream[1]	Upstream of tower[1]
16-Jul-15	149.294	26	24-Jul-15	-	8	Downstream	Downstream of tower
16-Jul-15	149.294	6	2-Aug-15	-	17	Downstream	Downstream of tower
19-Jul-15	149.294	18	25-Jul-15	-	6	Downstream	Downstream of tower
8-Jul-15	149.294	13	-	17-Jul-15	9	Upstream	Upstream of tower
9-Jul-15	149.374	11	-	17-Jul-15	8	Upstream	Upstream of tower
10-Jul-15	149.374	20	-	18-Jul-15	8	Upstream	Upstream of tower
10-Jul-15	149.374	4	-	17-Jul-15	7	Upstream	Upstream of tower
13-Jul-15	149.374	17	-	19-Jul-15	6	Upstream	Upstream of tower
13-Jul-15	149.374	15	-	20-Jul-15	7	Upstream	Upstream of tower
13-Jul-15	149.374	3	16-Jul-15	21-Jul-15	8	Upstream[2]	Upstream of tower[2]
14-Jul-15	149.374	26	-	23-Jul-15	9	Upstream	Upstream of tower
15-Jul-15	149.374	22	-	22-Jul-15	7	Upstream	Upstream of tower
15-Jul-15	149.294	23	-	21-Jul-15	6	Upstream	Upstream of tower
15-Jul-15	149.294	8	-	22-Jul-15	7	Upstream	Upstream of tower
17-Jul-15	149.294	19	-	23-Jul-15	6	Upstream	Upstream of tower
17-Jul-15	149.294	15	-	23-Jul-15	6	Upstream	Upstream of tower
18-Jul-15	149.294	75	-	25-Jul-15	7	Upstream	Upstream of tower
18-Jul-15	149.294	12	-	25-Jul-15	7	Upstream	Upstream of tower
18-Jul-15	149.294	17	-	24-Jul-15	6	Upstream	Upstream of tower
22-Jul-15	150.583	2	-	29-Jul-15	7	Upstream	Upstream of tower

[1]Tag was first detected moving downstream past the tower, then later detected moving upstream past the tower.

[2]Tag first migrated downstream of the tower below the tagging site, then migrated upstream past both towers.

200000
250000
1400000
1350000
1300000
N
Pine
Creek
Cody
Creek
Schaeffer
Creek
PORCUPINE RIVER
Fishing
Branch
Weir
Fishing Branch River
Chance
Creek
Miner River
Fishing Branch River
Miner River

Legend

- Fishing Branch River Weir - Inactive
- Extent of 2015 Telemetry Surveys
- Stationary Radio Telemetry Tower Site

Location of Radio Tagged Chinook Salmon (Sex/Status)

- Female - Live
- Female - Dead
- Male - Live
- Male - Dead
- Male - Status Unclear

Locations of radio tagged Chinook salmon in the southern portion of the Porcupine River Survey Area (2015)

Data Sources

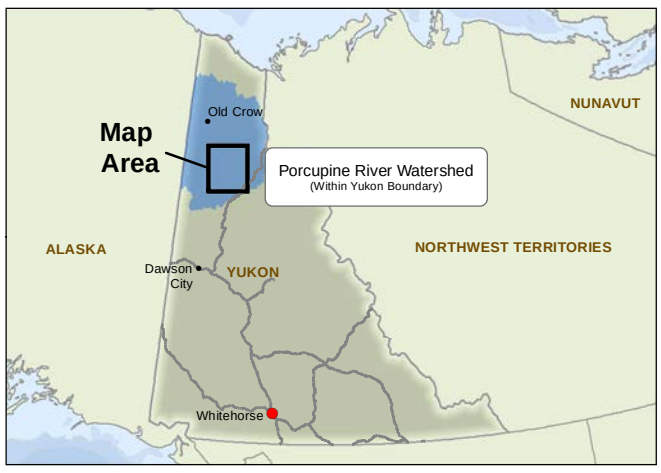
National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2015) was obtained using Garmin GPS technology.

0 1 2 3 4
Kilometres

Reference Scale: 1:400,000 (printed on 11"x17")
Coordinate System: NAD 1983 CSRS Yukon Albers

Drawn:	Checked:	**Date:**	**MAP 2**
MP	BSn/BSc	**02/02/2016**	



Vuntut Gwitchin First Nation

EDI

Path: J:\Yukon\Projects\2015\15Y0169_PorcupineChinook\TelemMapping\FinalMaps\Map2_SouthPorcupine.mxd

250000 300000 350000

1450000 1400000

N

Berry

Waters River

Bell River

La Chute

PORCUPINE RIVER

Eagle

Rock River

Schaeffer Creek

NORTHWEST TERRITORIES
YUKON TERRITORY

Legend

Extent of 2015 Telemetry Surveys

Location of Radio Tagged Chinook Salmon (Sex/Status)

- Female - Live
- Female - Dead
- Male - Live
- Male - Dead
- Male - Status Unclear

Locations of radio tagged Chinook salmon in the eastern portion of the Porcupine River Survey Area (2015)

Data Sources

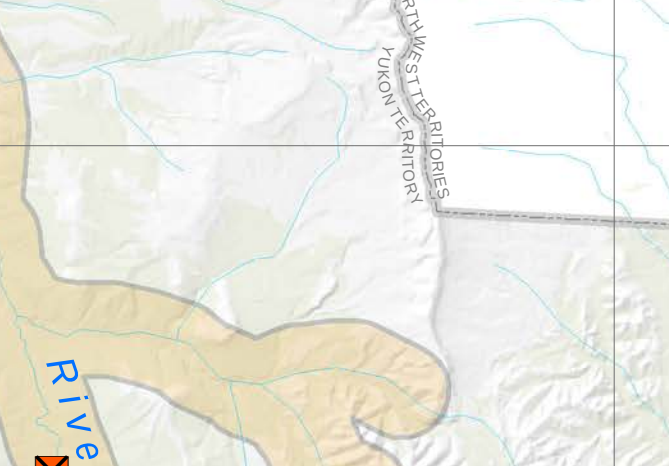
National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2015) was obtained using Garmin GPS technology.

0 5 10 15 20
Kilometres

Reference Scale: 1:400,000 (printed on 11"x17")
Coordinate System: NAD 1983 CSRS Yukon Albers

Drawn: MP	Checked: BSn/BSc	**Date: 02/02/2016**	**MAP 3**



Vuntut Gwitchin First Nation

EDI

Path: J:\Yukon\Projects\2015\15Y0169_PorcupineChinook\Telem\Mapping\Final\Maps\Map3_EastPorcupine.mxd

150000
200000
1500000
1450000
N
Schaffer
Ck
Johnson
ALASKA (UNITED STATES OF AMERICA)
YUKON TERRITORY
Bar
Ck
Caribou
Crow River
Old Crow
PORCUPINE RIVER
Creek
River
Bluefish
David Lord

Legend

- Extent of 2015 Aerial Telemetry Surveys
- Stationary Radio Tower Site

Location of Radio Tagged Chinook Salmon (Sex/Status)

- Female - Live
- Female - Dead
- Male - Live
- Male - Dead
- Male - Status Unclear

Locations of radio tagged Chinook salmon in the northern portion of the Porcupine River Survey Area (2015)

Data Sources

National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

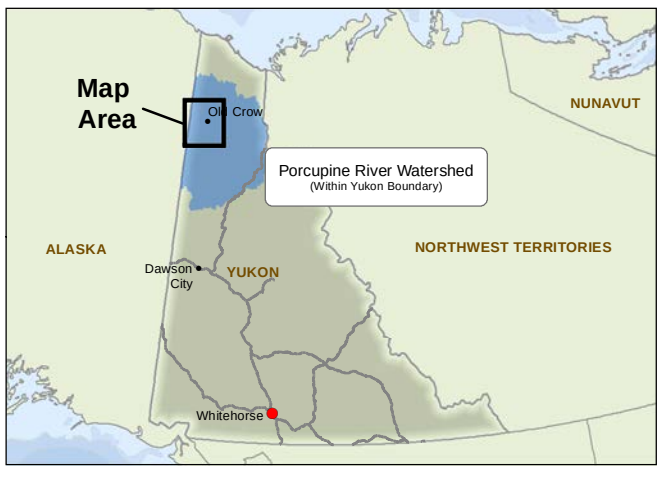
Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2015) was obtained using Garmin GPS technology.

0 5 10 15 20

Kilometres

Reference Scale: 1:400,000 (printed on 11"x17")
Coordinate System: NAD 1983 CSRS Yukon Albers

Drawn:	Checked:	**Date:**	**MAP 4**
MP	BSn/BSc	**02/02/2016**	



Vuntut Gwitchin First Nation

EDI

Path: J:\Yukon\Projects\2015\15Y0169_PorcupineChinook Telem\Mapping\Final Maps\Map 4_NorthPorcupine.mxd

3.2.3 MORTALITY SENSOR STATUS

The status of the mortality sensors for the detected Chinook salmon tags that were presumed to have migrated to spawning sites is summarized in Table 8. Those tags which were found in the vicinity of Old Crow, located in the lower Crow River mainstem, recaptured in the local fisheries, migrated downstream, not relocated or were assumed to be a post-tagging mortality and were removed from the analysis of mortality sensor status. The majority of tagged Chinook salmon that were detected on the spawning grounds were found with their mortality sensors 'on' (Table 7), meaning that no movement had occurred in over 24 hours and indicating the these Chinook were likely dead. Several tags in the Bell and and one tag in the upper Porcupine River were detected with their mortality sensor 'off', indicating that the tags in these fish were still registering movement. The mortality sensor readings were unclear for a small number of tags in the Miner and Fishing Branch rivers. Given the period of time between tagging and the first aerial tracking survey (a minimum of 22 days), these tagged Chinook should have had ample time to reach their spawning destinations. These tag detections are still presumed to be indicative of spawning areas, even though the mortality sensors suggest that these fish were 'alive'. The most likely explanation for the tags giving off the "alive" signal is carcass and/or tag drift in the river.

Table 8. Summary of mortality sensor status for radio tagged Chinook salmon detected in spawning area of the Porcupine River in 2015

Location	Number of Tags with Mortality Status 'Dead'	Number of Tags with Mortality Status 'Alive'	Number of Tags with Mortality Status 'Unclear'	Percentage of 'Dead' Tags (%)
Miner River (upstream of Fishing Branch River confluence)	7	0	2	78%
Miner River (between confluence of Fishing Branch and Whitestone rivers)	3	0	1	75%
Fishing Branch River	3	0	1	75%
Upper Porcupine River (from Whitestone River confluence downstream to Schaeffer Creek confluence)	6	1	0	86%
Porcupine River mainstem (Schaeffer Creek confluence to Old Crow, including mouth of David Lord Creek)	2	0	0	100%
Bell River watershed (including the Rock, Waters and upper Bell rivers)	4	3	0	57%
Program Average	-	-	-	**75%**

4 DISCUSSION

4.1 Development of Local Capacity

An important goal of the 2015 Chinook salmon radio tagging program was to continue to develop local capacity to conduct fisheries work within the community of Old Crow. While a number of past programs (e.g., mark-recapture, CPUE index and sonar programs) have helped to develop fisheries technical capacity within the community, this particular program provides several important advantages:

- The program offered approximately 2 weeks of fisheries related work to two individuals when combined with the concurrent sonar program;
- The skills needed to apply the radio tags and conduct set netting provided new learning opportunities for local technicians; and,
- The program provides a means to employ skilled fisheries technicians in the community, while also providing experience to younger community members in fisheries related work.

Two local field technicians were trained and participated in this program in 2015. Field technicians conducted a portion of the tagging work independently from the biologists, and were essential to safe and successful drift netting. The knowledge of the theory and rationale of radio tagging fish is a specialized skill and there is a considerable amount of interest within the community of Old Crow to pursue further stock assessment programs, especially for the Porcupine River Chinook salmon. If additional radio tagging studies are conducted in the Porcupine River watershed, there is an existing technical understanding of radio tag application techniques that can be leveraged to support such projects.

4.2 Adjusted Total Radio Tag Numbers

The results of the Chinook salmon radio tag tracking confirm that the Miner River was a notable spawning destination for Porcupine River Chinook salmon in 2015. Of the 51 radio tags that were applied during the 2015 program, 13 tags were found in the Miner River. This finding concurs with the finding from previous Miner River Chinook salmon aerial counts that were conducted from 2009 to 2013, which suggest that the Miner River is a key spawning areas for Chinook salmon in the Porcupine River watershed (EDI 2014).

The 2015 aerial tracking also detected the majority of the tagged Chinook salmon with their mortality sensors 'on', indicating that the fish were likely dead. This finding indicates that fish that were found in the upper Porcupine River and its tributaries were most likely spawning in those locations, and it supports the conclusion that the period of 22 days between the 2015 radio tag applications and the first aerial telemetry flights was sufficient to ensure that all tagged Chinook salmon had sufficient time to reach their spawning grounds.

If the total number of tagged Chinook salmon is adjusted to remove the tags that were found near Old Crow (4 tags; assumed harvested and not recovered), the tags that were located in a presumed non-spawning site in the Crow River (2 tags), those tagged Chinook that migrated downstream or were presumed to have died near the tagging site (8 tags), those tags that were not relocated (3 tags) and the one tagged Chinook that was captured at the sonar site, an adjusted total of 33 tagged Chinook salmon remain. The proportions of this adjusted total number of tagged Chinook salmon that were located in the various spawning areas upstream of the tagging site are shown in Table 9. Based on the adjusted tag numbers, the Miner River was the spawning destination for 27.3% of all Chinook salmon that were tagged in 2015. Interestingly, both the upper Porcupine River mainstem and the Bell River watershed also appeared to be important spawning destinations for Chinook salmon in 2015 (21.2% of the adjusted tag total was found in each of these two areas; Table 9).

The total Chinook salmon passage estimate at the Porcupine River sonar site in 2015 was 4,851. The Chinook salmon that were tagged in 2015 were captured downstream of the sonar site and over a shorter period that the sonar operated for; nonetheless, a preliminary comparison of the total sonar passage estimate to the adjusted proportions of radio tags can be made from the two data sources. Based on the adjusted proportion of tags that were found in the Miner, upper Porcupine and Bell River, each of these areas may support a spawning population of several hundred Chinook. Additional radio telemetry and sonar data could provide greater insights into extent of spawning in future years.

Table 9. Summary of Chinook salmon radio tags located in spawning destinations of the Porcupine River in 2015. Tags that were not located or were found in areas where spawning habitat was not apparent (i.e. Crow River and mainstem Porcupine River downstream of tagging site) are not included.

Radio Tag Location	Number of Tags Detected	Proportion of adjusted total (%)
Miner River (upstream of Fishing Branch River confluence)	9	27.3%
Miner River (between confluence of Fishing Branch and Whitestone rivers)	4	12.1%
Fishing Branch River	4	12.1%
Upper Porcupine River (from Whitestone River confluence downstream to Pine Creek confluence)	7	21.2%
Porcupine River mainstem (Pine Creek confluence to Old Crow, including mouth of David Lord Creek)	2	6.1%
Bell River watershed (including the Rock, Waters and upper Bell rivers)	7	21.2%
TOTAL	**33**	**100%**

4.3 Fates of Missing Radio Tags

The 2015 radio telemetry tracking successfully located 94% of all tags (48 of 51) that were applied to Chinook salmon in 2015. The use of a stationary radio tower downstream of the tagging location detected five Chinook salmon that migrated downstream after tagging, and would have otherwise not been accounted for. The locations of the remaining three tags are unknown; however, there are several possible theories that may explain the fates of these three tags.

Tag failure could account for a portion of the missing tags. Hardware failures on VHF radio tags of the type used in the 2015 program are rare; according to manufacturer data, the failure rate is approximately 2% (Adsem pers. comm. 2013). Although it is understood to be a very infrequent occurrence, a 2% tag failure rate could account for one or more of the missing tags that were applied in 2015. Another possibility is that damage to tags could also have occurred from predators consuming tagged salmon on the spawning grounds; however, this is occurrence is thought to be unlikely.

Given the very extensive aerial telemetry flights conducted during 2015, it is very unlikely that tags were missed within the portion of the watershed that was surveyed. The radio receiver that was used during the aerial tracking often detected tags a considerable distance (5-10 km) away from the actual tag location. Areas with a high number of tags (e.g. the Miner River) were also flown a number of times to ensure that all tags were detected.

A more likely possibility is that some of these tags may have been incidental captures in upriver subsistence nets and not turned in, or that a small number of tagged Chinook salmon may have migrated upstream into un-surveyed areas of the Porcupine River watershed. The Porcupine River watershed drains a vast portion of the northern Yukon, and despite the extensive aerial surveys conducted in 2015, it is conceivable that tagged Chinook salmon migrated to remote areas of the watershed that were not surveyed in 2015.

5 CONCLUSIONS

The 2015 Porcupine River Chinook salmon telemetry program provided new and valuable insights into Chinook salmon spawning areas in the watershed. This project substantially improved on the methods of the 2014 project, and successfully relocated nearly all tagged Chinook salmon (94%). The location of radio tagged Chinook salmon in 2015 highlighted the importance of the Miner River as a notable spawning destination for tagged Chinook salmon in the Porcupine River watershed. Also noteworthy was the presence of a considerable number of tags that were found in the Bell River watershed, which represents the first confirmed spawning of Chinook salmon in this watershed. The project also provided new information on extent of known Chinook salmon spawning in the upper Porcupine River watershed and its tributaries.

The incorporation of two stationary towers during the 2015 Chinook telemetry program assisted greatly in determining the fates of radio tags that may not otherwise have been found. The tower downstream of the tagging site provided key data on the downstream migration of Chinook salmon after tagging. The second tower (on the Miner River) provided new data on travel rates of tagged Chinook salmon, which will inform future studies about the timing for post-tagging aerial flights.

6 REFERENCE CITED

EDI 2008. Porcupine River Coho Radio Tagging/Telemetry Project. Prepared by EDI Environmental Dynamics for the Vuntut Gwitchin Government and the Yukon River Panel.

EDI 2015. Re: Radio Tracking of Chinook Salmon and Genetic Sampling in the Porcupine River – Final Report. Letter report prepared by EDI Environmental Dynamics for the Vuntut Gwitchin Government and the Yukon River Panel.

EDI 2014. 2013 Miner River Aerial Index Survey. Prepared by EDI Environmental Dynamics for the Vuntut Gwitchin Government and the Polar Continental Shelf Program.

Zuray, S. 2015. Rampart Rapids Full Season Video Monitoring, 2014 - Using a Fish Wheel on the Yukon River, Alaska. Annual report to the Yukon River Panel, Anchorage, Alaska.

6.1 PERSONAL COMMUNICATIONS

Adsem, J. Advanced Telemetry Systems Territory Manager & Project Consultant. Phone call to the author. January 7, 2014.

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APPENDIX A. TAG FREQUENCY LIST PROVIDED BY ADVANCED TELEMETRY SYSTEMS

ATS
ADVANCED TELEMETRY SYSTEMS
470 FIRST AVE N - ISANTI, MN 55040-7123
763-444-9267 - 763-444-9284 fax
sales@atstrack.com - www.atstrack.com

Transmitter Data Sheet

Job #: 36515
Ship Date: 6/4/2015

Customer Info

Environmental Dynamics Inc
Attn: Ben Schonewille
2195 - 2nd Ave

Whitehorse YT Y1A1X8
CANADA

Serial #	Quantity	Model#	Description	Species
01	10	F1845B	Implant Transmitter	Chinook
		ProgDesc:	Mortality: 24 hr, Duty Cycle: On 180 days then Off Forever, DC>Mort	

Pulse Rate:	45.8 ppm	Pulse Width:	30 ms	Weight:	26 gr	Warranty Life:	81 days	Battery Cap Life:	162 days

150.583	150.583	150.583	150.583
A-1/850/55	A-11/1080/155	A-12/1000/125	A-2/890/65
150.583	150.583	150.583	150.583
A-3/910/75	A-4/920/85	A-5/940/95	A-6/970/105
150.583	150.583		
A-8/1070/165	A-9/1010/135		

ATS
ADVANCED TELEMETRY SYSTEMS
470 FIRST AVE N • ISANTI, MN 55040-7123
763-444-9267 • 763-444-9384 fax
email:sales@atstrack.com • www.atstrack.com

Transmitter Data Sheet

Job #: 81902

Ship Date: 5/28/2014

Customer Info

Edynamics
Attn: Ben Snow
2195 Second Ave.

Whitehorse YT Y1A 3T8
CANADA

Serial #	Quantity	Model#	Description	Species
)3	50	F1845B	Implant Transmitter	Chinook
		ProgDesc:	Mortality: 24 hr	

Pulse Rate: 45.8 ppm **Pulse Width:** 30 ms **Weight:** 26 gr **Warranty Life:** 81 days **Battery Cap Life:** 162 days

149.294 A-0/830/45	149.294 A-1/850/55	149.294 A-11/1060/155	149.294 A-12/1000/125
149.294 A-13/1090/175	149.294 A-14/1130/185	149.294 A-15/1140/195	149.294 A-16/1160/205
149.294 A-17/1180/215	149.294 A-18/1190/225	149.294 A-19/1220/235	149.294 A-2/890/65
149.294 A-20/1240/245	149.294 A-21/1270/255	149.294 A-22/1290/265	149.294 A-23/1300/275
149.294 A-24/1310/285	149.294 A-26/990/115	149.294 A-3/910/75	149.294 A-4/920/85
149.294 A-5/940/95	149.294 A-6/970/105	149.294 A-75/1030/145	149.294 A-8/1070/165
149.294 A-9/1010/135	149.374 A-0/830/45	149.374 A-1/850/55	149.374 A-11/1060/155
149.374 A-12/1000/125	149.374 A-13/1090/175	149.374 A-14/1130/185	149.374 A-15/1140/195
149.374 A-16/1160/205	149.374 A-17/1180/215	149.374 A-18/1190/225	149.374 A-19/1220/235
149.374 A-2/890/65	149.374 A-20/1240/245	149.374 A-21/1270/255	149.374 A-22/1290/265
149.374 A-23/1300/275	149.374 A-24/1310/285	149.374 A-26/990/115	149.374 A-3/910/75
149.374 A-4/920/85	149.374 A-5/940/95	149.374 A-6/970/105	149.374 A-75/1030/145
149.374 A-8/1070/165	149.374 A-9/1010/135		

APPENDIX B. FISHING EFFORT & CAPTURE DATA

Table B1. Summary of set netting effort near the confluence of Caribou Bar Creek during the 2015 Porcupine River Chinook salmon radio telemetry project.

Net Set Number	Set Date	Set Time	Pull Time	Set Duration (Hours)	Net Mesh Size (in)	Latitude	Longitude
1	6-Jul-15	11:15	20:50	9.58	7.5	67.4635	-140.6655
2	7-Jul-15	8:45	20:50	12.08	7.5	67.4635	-140.6655
3	7-Jul-15	11:08	16:30	5.37	8.25	67.4458	-140.6658
4	8-Jul-15	9:03	17:50	8.78	6	67.4635	-140.6655
5	9-Jul-15	8:12	13:10	4.97	6	67.4635	-140.6655
6	9-Jul-15	8:26	13:28	5.03	5.75	67.4657	-140.6655
7	10-Jul-15	8:30	17:20	8.83	6	67.4634	-140.5847
8	10-Jul-15	13:05	20:15	7.17	7.5	67.4634	-140.5847
9	11-Jul-15	8:45	11:20	2.58	7.5	67.4634	-140.5847
10	12-Jul-15	21:30	23:05	1.58	6	67.4648	-140.5847
11	13-Jul-15	9:00	18:30	9.33	6	67.4648	-140.5847
12	13-Jul-15	9:45	12:40	2.92	7.5	67.4634	-140.5847
13	13-Jul-15	13:00	19:00	6.00	7.5	67.4554	-140.5849
14	14-Jul-15	8:15	11:23	3.13	7.5	67.4554	-140.5849
15	15-Jul-15	8:40	20:50	12.17	7.5	67.4556	-140.6656
16	16-Jul-15	8:55	22:50	13.92	7.5	67.4635	-140.6655
17	16-Jul-15	9:10	17:55	8.75	6	67.4554	-140.5849
18	17-Jul-15	8:28	11:45	3.28	7.5	67.4634	-140.5847
19	17-Jul-15	8:35	11:10	2.58	6	67.4554	-140.5849
20	18-Jul-15	8:00	20:06	12.10	7.5	67.4634	-140.5847
21	19-Jul-15	8:45	16:05	7.33	7.5	67.4634	-140.5847
22	20-Jul-15	7:50	14:05	6.25	7.5	67.4635	-140.6655
23	21-Jul-15	8:30	11:45	3.25	7.5	67.4635	-140.6655
24	22-Jul-15	8:05	10:05	2.00	7.5	67.4635	-140.6655

Table B2. Summary of set netting fish capture data near the confluence of Caribou Bar Creek during the 2015 Porcupine River Chinook salmon radio telemetry project.

Date Captured	Species	Sex	Length (cm)	Scale Card #	Scale Column Number	Floy Tag Number	Radio Tag Frequency (Mhz)	Radio Tag Unique Identifier
6-Jul-15	CH	Female	85	-	-	-	-	
7-Jul-15	CH	Female	97.5	95633	10	4287	149.374	1
8-Jul-15	CH	Male	103	95633	9	4405	149.294	13
8-Jul-15	CH	Male	93	95633	8	3198	149.294	22
8-Jul-15	BW	-	-	-	-	-	-	-
8-Jul-15	BW	-	-	-	-	-	-	-
8-Jul-15	CH	Male	71	95633	7	3049	149.374	24
8-Jul-15	CH				Escaped from net, not sampled			
9-Jul-15	CH	Female	84	95633	6	3543	149.374	8
9-Jul-15	CH	Female	77	95633	5	3262	149.374	21
9-Jul-15	CH	Male	87	95633	4	3718	149.374	11
10-Jul-15	CH				Escaped from net, not sampled			
10-Jul-15	CH	Female	88	95633	3	4522	149.374	9
10-Jul-15	CH	Male	65	95633	2	4637	149.374	20
10-Jul-15	CH	Female	72	95633	1	4032	149.374	4
11-Jul-15	CH	Male	92.5	95627	10	3200	149.374	6
11-Jul-15	CH	Male	95	95627	9	3263	149.374	13
11-Jul-15	CH	Male	100.5	95627	8	3467	149.374	14
13-Jul-15	CH	Male	68	95627	4	4245	149.374	17
13-Jul-15	CH	Male	67	95627	3	4247	149.374	75
13-Jul-15	CH	Male	65	95627	2	4409	149.374	15
13-Jul-15	CH				Escaped from net, not sampled			
13-Jul-15	CH	Male	75	95627	7	4631	149.374	23
13-Jul-15	CH	Male	86	95627	5	4511	149.374	3
13-Jul-15	CH	Female	85	95627	6	3050	149.374	19
13-Jul-15	CH	Female	97			Escaped from net, not sampled		
13-Jul-15	CH	Male	107			Escaped from net, not sampled		
14-Jul-15	CH	Male	87	95636	10	3469	149.374	18
14-Jul-15	CH	Male	58	95636	9	3810	149.374	26
14-Jul-15	CH	Male			Escaped from net, not sampled			
14-Jul-15	CH	Male	88	95636	8	2183	149.374	5
14-Jul-15	CH	Male	63	95636	7	3545	149.374	16
15-Jul-15	CH	Male	86	95636	6	4403	149.294	9
15-Jul-15	CH	Male	68	95636	5	4406	149.374	22
15-Jul-15	CH	Female	-	-	-	-	-	-
15-Jul-15	IN		-	-	-	-	-	-
15-Jul-15	CH	Female	96	-	-	-	-	-
15-Jul-15	CH	Male	86	95636	4	3391	149.294	23
15-Jul-15	CH	Female	90	95636	2	3720	149.374	0

Date Captured	Species	Sex	Length (cm)	Scale Card #	Scale Column Number	Floy Tag Number	Radio Tag Frequency (Mhz)	Radio Tag Unique Identifier
15-Jul-15	CH	Male	102	95636	1	4888	149.294	8
15-Jul-15	CH	Male	62	95637	10	3721	149.374	12
16-Jul-15	CH	-	-	-	-	-	-	-
16-Jul-15	CH	Male	90	95637	8	3201	149.294	26
16-Jul-15	CH	Female	89	95637	7	3199	149.294	21
16-Jul-15	CH	Male	81	-	-	-	-	-
16-Jul-15	CH	Female	95	-	-	-	-	-
16-Jul-15	CH	Female	104	-	-	-	-	-
16-Jul-15	BW	-	51	-	-	-	-	-
16-Jul-15	CH	-	88.5	-	-	-	-	-
16-Jul-15	CH	Male	79.5	95637	6	3809	149.294	6
16-Jul-15	CH	Male	74	95637	5	3326	149.294	16
17-Jul-15	CH	Male	60	95637	1	3620	149.294	19
17-Jul-15	CH	Male	88.5	95631	7	4288	149.294	15
17-Jul-15	CH	Female	82	95631	10	3806	149.294	11
17-Jul-15	CH	Male	65	95631	9	4404	149.294	14
17-Jul-15	CH	Male	61	95631	8	3807	149.294	20
17-Jul-15	CH	Male	84	-	-	-	-	-
17-Jul-15	CH	Male	102	-	-	-	-	-
17-Jul-15	CH	Male	72	-	-	-	-	-
18-Jul-15	CH	Female	87	95631	3	4246	149.294	75
18-Jul-15	CH	Female	83	95631	2	4248	149.294	12
18-Jul-15	CH	Male	104	95628	10	3202	149.294	17
18-Jul-15	CH	Male	89	-	-	-	-	-
19-Jul-15	CH	Male	80	95628	9	4250	150.583	6
19-Jul-15	CH	Female	83	95628	8	3052	149.294	18
19-Jul-15	CH	Female	97.5	95628	7	3389	149.294	24
20-Jul-15	CH	Female	87.5	95628	6	3051	150.583	3
20-Jul-15	CH	Female	82	95628	4	3544	150.583	4
20-Jul-15	CH	Male	82	95628	3	3468	150.583	5
20-Jul-15	CH	Male	88	-	-	-	-	-
20-Jul-15	CH				Escaped from net, not sampled			
20-Jul-15	CH				Escaped from net, not sampled			
21-Jul-15	CH	Male	77	95628	2	3148	150.583	1
21-Jul-15	CH	Female	87	95628	1	3618	150.583	11
21-Jul-15	CH	Female	97.5	-	-	-	-	-
22-Jul-15	CH	Female	87	95630	9	2185	150.583	2
22-Jul-15	CH	Male	93	95630	8	4408	150.583	12

CH = Chinook Salmon, BW = Broad Whitefish, IN = Inconnu

APPENDIX C. LOCATION OF RADIO TAGGED CHINOOK SALMON DETECTED BY AERIAL SURVEYS AND STATIONARY RADIO TOWERS

Table C1. Location of radio tagged Chinook Salmon in the Porcupine River watershed in 2015, as determined by aerial surveys and stationary radio towers. Coordinates are provided only for those tags detected at potential spawning areas.

Radio Tag Frequency	Radio Tag ID	Location	Latitude	Longitude
149.294	6	Downstream migrant past lower tower	-	-
149.294	8	Upper Porcupine River mainstem	66.6515	-138.1944
149.294	9	Downstream migrant past lower tower	-	-
149.294	11	Lower Porcupine River	67.5582	-139.0781
149.294	12	Fishing Branch River	66.4529	-138.6371
149.294	13	Miner River	66.3813	-138.6975
149.294	14	Bell River Mainstem	67.8765	-136.8952
149.294	15	Miner River	66.4956	-138.4842
149.294	16	Rock River	67.2378	-137.0717
149.294	17	Fishing Branch River	66.4530	-138.6324
149.294	18	Downstream migrant past lower tower	-	-
149.294	19	Miner River	66.3482	-138.7173
149.294	20	Upper Porcupine River mainstem	66.8333	-137.8701
149.294	21	Old Crow vicinity, presumed mortality	-	-
149.294	22	Downstream migrant past lower tower	-	-
149.294	23	Fishing Branch River	66.4396	-138.6859
149.294	24	Lower Porcupine River	66.9732	-137.6221
149.294	26	Downstream migrant past lower tower	-	-
149.294	75	Fishing Branch River	66.5195	-139.2064
149.374	0	Not found	-	-
149.374	1	Tagging Site vicinity, presumed mortality	-	-
149.374	3	Miner River	66.4270	-138.6268
149.374	4	Miner River	66.1239	-138.8931
149.374	5	Recaptured at sonar site (mortality)	-	-
149.374	6	Old Crow vicinity, presumed mortality	-	-
149.374	8	Upper Porcupine River mainstem	66.7294	-137.9268
149.374	9	Upper Porcupine River mainstem	66.6807	-138.0285
149.374	11	Miner River	66.2251	-138.8029
149.374	12	Rock River	66.8651	-136.6055
149.374	13	Tagging Site vicinity, presumed mortality	-	-
149.374	14	Upper Porcupine River mainstem	66.8676	-137.8276
149.374	15	Miner River	66.1827	-138.8115
149.374	16	Old Crow vicinity, presumed mortality	-	-
149.374	17	Miner River	66.2251	-138.8029
149.374	18	Tagging Site vicinity, presumed mortality	-	-
149.374	19	Upper Porcupine River mainstem	66.8752	-137.7659
149.374	20	Miner River	66.4225	-138.6356
149.374	21	Upper Porcupine River mainstem	66.6152	-138.2453
149.374	22	Miner River	66.4862	-138.5089
149.374	23	Rock River	67.1848	-137.0196
149.374	24	Miner River	66.1833	-138.8106
149.374	26	Miner River	66.4560	-138.5738
149.374	75	Rock River	67.0737	-136.7959
150.583	1	Crow River, presumed non spawning	67.7171	-139.8715
150.583	2	Miner River	66.5043	-138.4459
150.583	3	Crow River, presumed non spawning	67.8275	-139.8642
150.583	4	Not found	-	-
150.583	5	Rock River	66.9990	-136.7334
150.583	6	Old Crow vicinity, presumed mortality	-	-
150.583	11	Not found	-	-
150.583	12	Waters River	67.3975	-137.0392