

**2002 Yukon River Chinook Telemetry Surveys in
the Tr'ondek Hwech'in Traditional Territory**

CRE-02-02

Prepared By:

Jake Duncan

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Jake Duncan

Habitat Steward

Yukon Salmon Committee/DFO-HCSP
P.O. Box 844 Dawson City, YT Y0B 1G0
Ph (867) 993-6210 - Fx (867) 993-6093
jduncan@yknet.yk.ca

Prepared for:

Yukon River Commercial Fishing Association
P.O. Box 1375 Dawson City, YT Y0B 1G0

Tr'ondek Hwech'in
P.O. Box 599 Dawson City, YT Y0B 1G0

Yukon River Panel
P.O. Box 20973 Whitehorse, Yukon Y1A 6P4

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Photo 1. Panoramic view from the interior of project aircraft.

ABSTRACT

The overall goal of the basin-wide study conducted by the Alaska Department of Fish and Game (ADF&G) and the National Marine Fisheries Service (NMFS) study, "Run Characteristics of Chinook Salmon in the Yukon River Basin 2002", was to gain knowledge of the migratory characteristics and distribution of Yukon River chinook salmon in the Yukon River watershed. A total of 768 Radio tags were applied to chinook salmon near the Alaskan villages of Marshal and Russian Mission; 748 of these fish moved upriver (97.4%). The upriver movements were monitored through a network of remote tracking stations, aerial surveys, and, through recaptures in various fisheries.

This project (CRE-02-02) was initiated to detect the locations of radio tagged fish that were tagged as part of the basin-wide study (748) and was intended to contribute to the understanding of salmon spawning distributions within the Tr'ondek Hwech'in traditional territory. In total, 215 radio tags crossed the CAN/US border and 181 migrated upstream without being recaptured in a local fishery. In total, 38 individual radio tags that were not captured in fishery or deemed to be in transit (migrating) were tracked within the Tr'ondek Hwech'in Traditional Territory. Eight of these radio tags were determined to be terminal in this area, with 6 tags recovered on the Klondike (5) and North Klondike Rivers (1), 1 on the Chandindu River, and 1 on Coal Creek. One radio tag location was recovered on the lower White River and 30 on the Yukon River Mainstem; radio tags that were likely in transit to upper terminal areas.

Although some rivers in this area, such as the Klondike River, have previous documentation of chinook salmon utilizing them, other streams in the area such as Coal Creek have not benefited from documentation. Through this study, Coal Creek now has documentation of adult chinook salmon utilizing this stream and the overall goal of understanding the distribution of chinook salmon within the area has benefited.

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INTRODUCTION

General

In 2002, the United States National Marine Fisheries Service (NMFS), and the Alaska Department of Fish and Game (ADF&G), and the Yukon River Panel's Restoration and Enhancement Fund (YRP R&E) initiated a large-scale radio telemetry study on the run characteristics of chinook salmon (*Oncorhynchus tshawytscha*) in the Yukon River basin (Spencer et al. in prep.). The study's intent was to tag and release up to 1,000 migrating adult chinook salmon captured throughout the run in the vicinity of the Alaskan villages of Marshall and Russian Mission. These radio tagged fish were to be tracked throughout the Yukon River drainage, both in Alaska and Canada, through the use of remote tracking stations (RTS) and aerial tracking (Eiler 1995). The RTS's were situated near the mouths of principle tributaries and at four sites on the mainstem Yukon River. The RTS's that were located within the survey area of this project included the Yukon River near the confluence of the Fourtymile River, the mouth of the Stewart River, and the Yukon River at the mouth of the White River. The aerial telemetry surveys conducted during this project were intended to obtain high resolution information on the migration and distribution of radio tags between these sites and in terminal areas.

As a result of consultations with John Eiler (NMFS) and exposure to the basin-wide chinook study, it became clear that there was both an opportunity to collect data within the Tr'ondek Hwech'in traditional territory and a need to locate these fish to compliment the basin-wide study. Information gathered during this project is considered valuable for the purposes of planning, specifically; gaining a better understanding of chinook distribution within the study area, sub-basin restoration and enhancement planning, and priority setting. Increased understanding of the distribution of chinook salmon within the Yukon River North Mainstem Sub-basin and Tr'ondek Hwech'in traditional territory as a result of this study is intended to

compliment previously completed physical, archival, and, traditional and local knowledge study (Cox, et al. 1997). The information gathered as a result of this study is intended to contribute to overall area sub-basin planning.

Objectives

The objectives of this project were to:

1. Obtain precise information on the number of radio-tagged chinook salmon in streams within the Upper Yukon River North Mainstem, Canadian Sub-Basin.
2. Obtain precise information on the location of radio-tagged chinook salmon in streams within the Upper Yukon River North Mainstem Canadian Sub-Basin.
3. Locate and document previously undocumented spawning areas within the Upper Yukon River North Mainstem Canadian Sub-Basin.
4. Gather information as it relates to the assessment of the relative distribution of radio-tagged chinook salmon within the Upper Yukon River North Mainstem Canadian Sub-Basin.
5. Provide data to the larger, more comprehensive study being carried-out concurrently by ADF&G, NMFS, and the Yukon River Panel.R&E Fund.

Study Area

The Yukon River North Mainstem sub-basin is one of 8 sub-basins that, when combined, form the Canadian portion of the Yukon River drainage basin (Figure 1). The sub-basin is primarily located within the traditional lands of the Tr'ondek Hwech'in First Nation (Figure 2). Larger rivers that flow into the Yukon River in the survey area include: the Klondike River; the Chandindu River (Twelvemile);

the Fifteenmile River; Coal Creek; the Fortymile River; the Sixtymile River; the White River; the Stewart River; the McQuesten River; the Indian River; and, the upper Tatonduk River. Populations of spawning chinook have been documented in many of these streams (Cox et al. 1997).

The Upper Yukon River watershed in Canada drains 262,600 km². Annual mean flows measured by the United States Geological Service at Eagle Alaska are 2,381m³/s with peaks of 15,433m³/s (June 12, 1964) for the 52 years of record (USGS, 2003). The estimated average mid-channel depth is approximately 4.5m during high water, but is as deep as 20m (Cliff Creek) and as shallow as 1.8-2.5m in sections of the study area. Average channel width (for the purposes of navigation) is approximately 180m, but narrows to approximately 90m (Cliff Creek) and widens to approximately 360m in some areas. The Klondike River, a tributary to the Yukon River within the study area with a gauge station, has annual mean discharges averaging 64.3m³/s with instantaneous peak discharges of 700m³/s (426 m³/s average), for the 39 years on record (Water Survey of Canada, 2003).

Background

Aquatic resources residing in the study area include: Freshwater fish -- Arctic Lamprey, Inconnu, Humpback Whitefish, Broad Whitefish, Least Cisco, Round Whitefish, Pygmy Whitefish, Arctic Grayling, Lake Trout, Dolly Varden/Bull Trout, Rainbow Trout, Northern Pike, Lake Chub, Longnose Sucker, Burbot, and Slimy Sculpin; Salmon species include -- Chum salmon, Chinook salmon and some evidence of Coho salmon in the Upper Yukon River (Al von Finster, pers. comm.). The use of aquatic resources includes native subsistence use of most freshwater species and all salmon species (by their constitutionally protected right, as defined in Chapter 16 of the Umbrella Final Agreement and individual

First Nation Final Agreements) and commercial, domestic, and recreational use of salmon species.

Many streams with spawning populations of chinook salmon have been identified within the Tr'ondek Hwech'in traditional territory in archival and traditional knowledge studies (Cox, et al. 1997). As a result of these earlier studies, the rivers of primary interest to the Tr'ondek Hwech'in (TH) First Nation and the Yukon River Commercial Fishing Association (YRCFA) for salmon restoration purposes include, but are not limited to, the Klondike River, the Chandindu River, the Fifteenmile River and Coal Creek. However, little is known regarding the distribution and abundance of these sub-populations of chinook salmon, as well as salmon resources from other streams in the area.

Assessments of salmon habitats and stocks within the TH Traditional Territory and the Yukon River North Mainstem Sub-Basin have been conducted by many organizations including: the Tr'ondek Hwech'in First Nation, the Government of Canada (DFO), consultants retained by various industries or natural resource agencies of government, the Yukon River Commercial Fishing Association, other non-governmental organizations, and by the Dawson District Renewable Resources Council (DDRRC).

Additional details regarding the basin-wide telemetry study, such as tagging sites and methodologies have been reported (Eiler 1995, Eiler and Holder 2000, Spencer et al. in prep.). Preliminary data from the 2002 basin-wide chinook radio tagging project is presently available (at time of writing), however a detailed report of findings is in progress.

METHODS AND MATERIALS

Prior to conducting aerial radio-telemetry surveys in the region, the project aircraft, a Piper J-3 Cub, was retrofitted with two 4-element Yagi antennas and wired for the Advanced Telemetry Systems (ATS) 4500 receivers. A global positioning system (GPS) antenna was also fixed to the plane and utilized by the ATS receiver. A workshop on radio telemetry techniques and the basin-wide telemetry study was conducted by John Eiler from the National Marine Fisheries Service on July 15th. Training flights were also conducted in the area with Sifton Air's Cessna 206 using H-type antennas on July 16th. A total of 6 people from Dawson and Old Crow¹ participated in the workshop. Finally, a test flight was conducted with the project aircraft (Piper J-3 Cub) on July 16th. Antenna, mounts, ATS receivers and the GPS were tested on this flight using reference tags to ensure proper operation.

The project aircraft was supplied and flown by Gerry Couture on a volunteer basis (Photo 2). The light, 2-place aircraft has a gross weight of 1,250 lbs/567kgs and a maximum cruising airspeed of 60 knots, or approximately 70 miles/112km per hour. Brackets were constructed to hold the antennas on the plane's struts and were made from 90 degree steel angle brackets that were bolted together and held to the strut with 6-inch diameter stainless steel pipe clamps (Photos 3, 4, and 5). The aluminum pipe was fastened perpendicular to each wing of the aircraft by bolting to the angle brackets and the antennas were mounted by inserting the stem of the antenna into the aluminum pipe and cross-bolting them through pre-drilled holes to maintain their connection. All connections were checked and all coaxial wire was fastened to the wing-struts with electrical tape. The antennas were mounted vertically for best reception through water (Photo 2).

Prior to conducting surveys, flight planning was conducted. It was determined that some flights such as the Chandindu and Fifteenmile surveys could be combined for efficiency, while other surveys like those on the Klondike River

would be done on their own. Coordination with John Eiler took place to best determine the timing of the surveys. The initial surveys were conducted between July 26th and August 4th to correspond with the first general pulse of radio tagged fish crossing the border. The second round of surveys was conducted between August 19th and the 29th, to correspond generally with a second pulse of radio-tagged fish crossing the border.

The ATS receivers were pre-programmed to scan 12 frequencies ranging from 150.684 MHz to 151.033 MHz for 2-second intervals and to record GPS waypoints each time the receivers locked on to individual pulse-coded radio tags. Many tags that were later identified as being captured in a fishery were recorded during the surveys, especially in the Dawson City area. Post-season data analysis included: sorting tags that were captured in a fishery vs. migrating; sorting individual radio tags per survey; and designating tags as Terminal to those with a final location within the survey area (final spawning location).

It is important to note that the GPS waypoints recorded by the ATS receivers, once the units have detected an individual tag code, are the positions of the receiver and the aircraft, and not the exact position of the radio-tag. Tag locations (by survey) were determined by averaging the recorded latitudes and longitudes at the highest signal strength recorded (Appendix A). The points that are plotted (Figures 3 through 6) are the mean latitude and longitude coordinates of the aircraft while recording tag codes at the highest signal strength.

Although there is a possibility that radio tagged fish with positions recorded on the Yukon River Mainstem may be spawning or have died and were detected while drifting downstream, for the purposes of this study these fish were considered to be in transit. Radio tagged fish with their last known locations detected on the Klondike River, the Chandindu River and on Coal Creek were determined to be Terminal. The determination of "Terminal" (or radio tags with final migratory locations in presumed spawning areas) to "Non-Terminal" tags

was done by determining individual tags by tag code and recording each of their last known positions.



Photo 2. Project aircraft – Piper J-3 Cub with 4-element Yagi antennas mounted.



Photo 3. Antenna bracket mounted on the wing strut of the project aircraft – from above.



Photo 4. Antenna bracket mounted on the wing strut of the project aircraft – side view.



Photo 5. Yagi type (4-element) antenna mounted in the "Upright" position on project aircraft.

RESULTS AND DISCUSSION

Between July 16th and August 29th flights were performed on 13 days for a total of 34.9 hours spent in the air (Table 1). Four flights were made on the Klondike system. All other rivers were surveyed twice: once earlier in run timing; and once later after peak migration had occurred. Survey timing was coordinated with tag migration information from the remote tracking stations (Eiler 1995, Yukon River Joint Technical Committee 2002). The Chandindu River, Fifteenmile River, Coal Creek, Fortymile River (from the mouth to the US Border), Sixtymile River, White River (from the mouth to approximately Eighteenmile Creek), Indian River, Swede Creek, Rock Creek and Flat Creek were surveyed (Table 2, Figures 3, 4-6).

Of the four surveys conducted on the Klondike River, only three were recorded by the ATS receiver. The survey conducted on August 19th was completed with inexperienced personnel and the tag positions were not recorded.

A total of 38 radio tags were identified in the survey area. These were individual fish that were not removed in fisheries in the survey area and were considered escapement. Of the 38 tags identified, 5 were located in the Klondike River (3% of the total tags into Canada) and 1 was located in the North Klondike (0.5% of the total tags into Canada). One tag was identified in the Chandindu River and one on Coal Creek (0.5% of the total tags into Canada each). Tags located in these tributaries were considered to be Terminal. Of the remaining 30 tags identified, 29 were located on the mainstem Yukon River downstream of Thistle Creek and one was located on the lower White River in Eighteenmile Creek. These fish were considered to be in-transit through the survey area and not in terminal spawning areas.

In-season data was forwarded to John Eiler (NMFS) for incorporation into the larger basin-wide database. This information will be used in the determination of

overall distribution of chinook salmon and in verifying data gathered from telemetry towers. Results from this study are not currently available (Spencer et al. in prep.).

It should be noted that, during the 2002 Radio Tag Recovery effort, water levels were much lower than average which may have contributed to the relative ease of distinguishing frequencies and tag codes encountered in the 2002 field surveys (Figure 7).

The preseason workshop and training flights were extremely valuable to those involved with this project and other similar projects being conducted in 2002. The ability to train additional people from Old Crow was considered to be valuable and contributed to the success of the 2002 project on rivers in the Porcupine system (Anderton 2002, in prep.). Pre-season preparations, training flights (July 11 Sifton Air, and July 16 via project aircraft), retrofitting of project aircraft with antennas, and flight planning preparations went well, and, telemetry flights commenced on July 26th. All preparations were conducted in consultation with John Eiler of the National Marine Fisheries Service, Clive Osborne of Haldane Environmental Services, and, Patrick Milligan of DFO. Their input and expertise contributed greatly to this project's success.

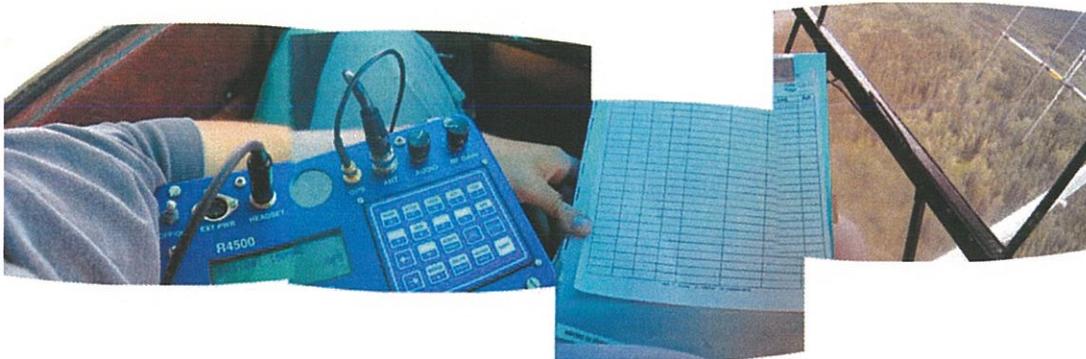


Photo 6, Panoramic photo of interior of aircraft with ATS receiver and antenna.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, a number of radio tags were located in the area during the surveys and much training occurred during the course of this project thanks to the involvement of John Eiler and Clive Osborne. The capacity for conducting this type of work in the area has greatly increased. Future telemetry studies will benefit from this training.

Although many of the radio tags were found on the Yukon River and were likely in transit, the Klondike River (6, 3%), the Chandindu River (1, 0.5%) and Coal Creek (1, 0.5%) had fish with radio tags that were located in terminal spawning areas. This was not a surprise in the case of the Klondike and Chandindu Rivers, as these rivers have documentation of the presence spawning chinook, but Coal Creek has little documentation and will therefore benefit from this study.

The surveys conducted on the Fortymile River were limited as the surveys only covered the distance between its mouth and the CAN/US border. Given this distance and the known daily migration rates of Yukon River chinook salmon, this section of river would have to be flown daily to detect a radio-tag should one migrate through this area. If surveys were to continue in subsequent years, efforts to survey the entire Fortymile River drainage should be explored.

Surveys conducted on the White River were also limited and, for the same reasons noted above, could be increased in number and length to assist in the determination of tag locations on this system. The larger basin-wide study has a network of fixed remote tracking stations to identify tags migrating to larger streams off the Yukon River. However this network does not include stations on the White river system due to technical difficulties encountered with their placement and effective coverage. The larger study would greatly benefit from a tower to determine the radio tags migrating to the White River system. Failing the

ability to locate a technically appropriate location for a remote station, telemetry flights on the entire White River system would be recommended.

As the information gathered from 2002 is from only one year of study and interannual fluctuations in results would be expected, future work is desirable. If the Yukon River basin-wide study continues in 2003, it is highly recommended that surveys in the Tr'ondek Hwech'in traditional territory continue. The study of spawning areas within the Tr'ondek Hwech'in traditional territory would benefit from future work of this kind. Post-season data analysis would be greatly assisted by recording flight paths, which could be done inexpensively via newer GPS units such the Garmin Etrex and related software.

Finally, this study would benefit from a better in-season, locally based (Dawson City), system to collect radio-tags captured in fisheries. Having in-season data from these captured tags during the season would assist surveyors in testing equipment, tracking individual tags, and sorting out post-season data. A new system could include an education component that would have positive results in the overall management of the resource. The Dawson District Renewable Resources Council or the Tr'ondek Hwech'in are groups that could assist with this new system to collect radio tags.

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- Appendix A Summary of Radio-Telemetry Records

Table 1. Summary of Radio Telemetry Flights Conducted in 2002

Date	Flight_ID	Description of Flight/Survey	Log Book Flight Time
16-Jul-02	Local - TEST	Test Flight over the Yukon and Klondike Rivers	1.4
26-Jul-02	Klondike1	Hunker Ck. to Hamilton Ck., Flat ck., N.Klondike to END SURVEY point	2.7
27-Jul-02	Chandindu	Chandindu River, Fifteenmile River	2.3
29-Jul-02	Fifteenmile	Fifteenmile River	2.4
2-Aug-02	Coal/Fortymile	Fortymile River (to US border only) and Coal Creek	3.1
3-Aug-02	Swede/Sixtymile/Indian	Sixtymile and Indian Rivers	3.1
4-Aug-02	Klondike2	Klondike and N.Klondike	3.7
19-Aug-02	Klondike3	Klondike and N.Klondike	2.1
24-Aug-02	Klondike4	Klondike and N.Klondike	1.8
25-Aug-02	Chandindu/Fifteenmile/Coal Ck.	Chandindu River, Fifteenmile River and Coal Creek	2.8
26-Aug-02	Indian/Sixtymile/Swede	Indian and Sixtymile Rivers	3.0
28-Aug-02	Yukon River/Fortymile	Fortymile River (to US border only), Yukon River (US border to Klondike)	3.3
29-Aug-02	Yukon River/White/Stewart	Mouth of White and Stewards Rivers, Yukon River (from Thistle Creek to Dawson City)	3.2

34.9

Table 2. 2002 Radio Telemetry Survey Waypoints

2002 TELEMETRY SURVEY POINTS	North	West
CHANDINDU RIVER BOTTOM SURVEY	64° 15.191'	-139° 42.895'
CHANDINDU RIVER TOP SURVEY	64° 41.133'	-138° 57.75'
COAL CREEK BOTTOM SURVEY	64° 28.739'	-140° 25.577'
COAL CREEK TOP SURVEY	64° 36.796'	-139° 52.935'
DAWSON AIRPORT YDA	64° 2.516'	-139° 7.864'
FIFTEENMILE RIVER BOTTOM SURVEY	64° 17.037'	-139° 48.834'
FIFTEENMILE RIVER TOP SURVEY	64° 37.679'	-139° 35.421'
FLAT CREEK BOTTOM SURVEY	63° 56.768'	-138° 37.478'
FLAT CREEK TOP SURVEY	63° 51.225'	-138° 9.499'
FORTYMILE RIVER BOTTOM SURVEY	64° 25.588'	-140° 31.955'
FORMILE RIVER TOP SURVEY	64° 18.795'	-141° 0.167'
INDIAN RIVER BOTTOM SURVEY	63° 46.937'	-139° 43.665'
INDIAN RIVER TOP SURVEY	63° 44.549'	-138° 31.625'
KLONDIKE BOTTOM SURVEY	64° 2.167'	-139° 10.692'
KLONDIKE TOP SURVEY	64° 4.78'	-137° 26.935'
N. KLONDIKE BOTTOM SURVEY	63° 57.713'	-138° 41.531'
N. KLONDIKE TOP SURVEY	64° 26.786'	-138° 13.585'
ROCK CREEK BOTTOM SURVEY	64° 3.736'	-139° 5.466'
ROCK CREEK TOP SURVEY	64° 13.219'	-138° 58.991'
SIXTYMILE BOTTOM SURVEY	63° 33.83'	-139° 45.71'
SIXTYMILE TOP SURVEY	64° 1.694'	-140° 21.796'
STEWART RIVER BOTTOM SURVEY	63° 17.495'	-139° 24.968'
STEWART RIVER TOP SURVEY	63° 10.855'	-138° 59.245'
SWEDE CREEK BOTTOM SURVEY	64° 1.374'	-139° 33.995'
SWEDE CREEK TOP SURVEY	64° 11.761'	-140° 13.768'
WHITE RIVER BOTTOM SURVEY	63° 11.008'	-139° 35.774'
WHITE RIVER TOP SURVEY	63° 12.236'	-140° 8.541'
YUKON RIVER BOTTOM SURVEY	64° 40.907'	-141° 0.024'
YUKON RIVER TOP SURVEY	63° 3.587'	-139° 30.714'

Table 3-11 records of Radio Tagged Fish by the Flight and Rer System

DATE	FLIGHT_ID	Radio Tag/River System	FREQ	CODE	COUNT	AVG LAT	MAX LAT	MIN LAT	AVG LONG	MAX LONG	MIN LONG
26-Jul	Klondike1	Klondike River	742	330	19	63.974	63.976	63.972	-138.403	-138.398	-138.409
26-Jul	Klondike1	Klondike River	842	290	29	63.986	63.986	63.986	-138.329	-138.281	-138.348
26-Jul	Klondike1	N. Klondike River	842	310	21	64.044	64.047	64.041	-138.536	-138.529	-138.542
26-Jul	Klondike1	Klondike River	902	790	21	64.064	64.065	64.063	-138.980	-138.969	-138.990
26-Jul	Klondike1	Klondike River	942	360	5	63.989	63.989	63.988	-138.240	-138.236	-138.251
27-Jul	Chandindu	Yukon River (in-migration)	684	190	10	64.270	64.271	64.269	-139.791	-139.786	-139.795
27-Jul	Chandindu	Klondike River	722	320	6	64.064	64.062	64.062	-139.104	-139.103	-139.106
27-Jul	Chandindu	Yukon River (in-migration)	783	890	17	64.265	64.276	64.256	-139.767	-139.738	-139.800
27-Jul	Chandindu	Chandindu River	881	440	15	64.291	64.293	64.290	-139.318	-139.250	-139.336
27-Jul	Chandindu	Yukon River (in-migration)	922	230	8	64.146	64.148	64.144	-139.506	-139.502	-139.509
27-Jul	Chandindu	Yukon River (in-migration)	942	420	10	64.248	64.248	64.248	-139.653	-139.647	-139.659
29-Jul	Fifteenmile	Yukon River (in-migration)	684	350	2	64.093	64.093	64.093	-139.451	-139.451	-139.451
29-Jul	Fifteenmile	Yukon River (in-migration)	684	800	13	64.111	64.124	64.091	-139.470	-139.450	-139.483
29-Jul	Fifteenmile	Yukon River (in-migration)	702	910	21	64.256	64.260	64.248	-139.738	-139.678	-139.761
29-Jul	Fifteenmile	Yukon River (in-migration)	722	900	12	64.215	64.220	64.204	-139.598	-139.595	-139.601
29-Jul	Fifteenmile	Yukon River (in-migration)	902	170	8	64.109	64.110	64.108	-139.466	-139.465	-139.468
29-Jul	Fifteenmile	Yukon River (in-migration)	922	10	22	64.257	64.270	64.265	-139.782	-139.777	-139.789
29-Jul	Fifteenmile	Klondike River	922	820	40	64.038	64.043	64.029	-139.323	-139.186	-139.425
29-Jul	Fifteenmile	Yukon River (in-migration)	942	480	15	64.249	64.250	64.247	-139.670	-139.612	-139.704
29-Jul	Fifteenmile	Yukon River (in-migration)	982	10	5	64.190	64.191	64.189	-139.558	-139.554	-139.560
29-Jul	Fifteenmile	Yukon River (in-migration)	982	210	22	64.287	64.295	64.282	-139.808	-139.786	-139.828
2-Aug	Coal/Fortymile	Yukon River (in-migration)	702	900	8	64.248	64.249	64.248	-139.697	-139.688	-139.705
2-Aug	Coal/Fortymile	Yukon River (in-migration)	742	210	11	64.165	64.179	64.154	-139.532	-139.523	-139.542
2-Aug	Coal/Fortymile	Yukon River (in-migration)	842	620	15	64.237	64.242	64.233	-139.587	-139.586	-139.591
2-Aug	Coal/Fortymile	Chandindu River	881	440	18	64.270	64.283	64.263	-139.389	-139.377	-139.415
2-Aug	Coal/Fortymile	Yukon River (in-migration)	922	120	21	64.370	64.371	64.369	-140.379	-140.367	-140.394
2-Aug	Coal/Fortymile	Coal Creek	922	370	56	64.482	64.500	64.464	-140.237	-140.182	-140.318
2-Aug	Coal/Fortymile	Klondike River	922	820	8	64.060	64.063	64.048	-139.115	-139.103	-139.157
2-Aug	Coal/Fortymile	Yukon River (in-migration)	942	930	4	64.061	64.061	64.060	-139.444	-139.443	-139.444
3-Aug	Swede/Sixtymile/Indian	Yukon River (in-migration)	702	860	27	63.766	63.791	63.741	-139.732	-139.707	-139.746
3-Aug	Swede/Sixtymile/Indian	Yukon River (in-migration)	742	210	8	63.800	63.801	63.799	-139.745	-139.745	-139.745
3-Aug	Swede/Sixtymile/Indian	Yukon River (in-migration)	842	340	15	63.758	63.783	63.718	-139.726	-139.698	-139.744
3-Aug	Swede/Sixtymile/Indian	Yukon River (in-migration)	881	860	10	63.717	63.727	63.681	-139.704	-139.698	-139.725
3-Aug	Swede/Sixtymile/Indian	Yukon River (in-migration)	922	840	1	63.563	63.563	63.563	-139.743	-139.743	-139.743
3-Aug	Swede/Sixtymile/Indian	Yukon River (in-migration)	942	930	5	63.732	63.734	63.731	-139.700	-139.700	-139.701
4-Aug	Klondike2	Klondike River	742	330	49	63.962	63.960	63.952	-138.555	-138.381	-138.666
4-Aug	Klondike2	Klondike River	842	290	48	63.979	63.991	63.972	-138.380	-138.249	-138.440
4-Aug	Klondike2	N. Klondike River	842	310	39	64.058	64.067	64.040	-138.522	-138.512	-138.548
4-Aug	Klondike2	Yukon River (in-migration)	842	600	6	64.027	64.032	64.022	-139.497	-139.487	-139.508
4-Aug	Klondike2	Klondike River	902	790	8	63.954	63.957	63.952	-138.625	-138.609	-138.648
4-Aug	Klondike2	Klondike River	922	820	64	64.059	64.065	64.037	-139.011	-138.831	-139.123
4-Aug	Klondike2	Klondike River	942	360	18	63.983	63.978	63.978	-138.355	-138.328	-138.401
4-Aug	Klondike2	Yukon River (in-migration)	942	560	10	64.012	64.020	63.981	-139.599	-139.571	-139.659
24-Aug	Klondike4	Klondike River	722	320	6	64.038	64.038	64.038	-139.250	-139.249	-139.255
24-Aug	Klondike4	Klondike River	842	290	21	63.982	63.986	63.971	-138.376	-138.332	-138.447
24-Aug	Klondike4	Klondike River	842	310	22	64.047	64.056	64.031	-138.538	-138.514	-138.568
24-Aug	Klondike4	Klondike River	902	790	19	63.952	63.952	63.952	-138.624	-138.616	-138.629
24-Aug	Klondike4	Klondike River	922	820	45	64.054	64.055	64.000	-139.019	-138.600	-139.131
24-Aug	Klondike4	Klondike River	942	360	18	63.972	63.978	63.959	-138.697	-138.650	-138.737
25-Aug	Chandindu/Fifteenmile/C	Chandindu River	881	440	61	64.297	64.313	64.290	-139.302	-139.143	-139.500
25-Aug	Chandindu/Fifteenmile/C	Coal Creek	922	370	1	64.473	64.473	64.473	-140.383	-140.383	-140.383
26-Aug	Indian/Sixtymile/Swede	Yukon River (in-migration)	842	320	82	63.767	63.773	63.733	-139.708	-139.642	-139.767
26-Aug	Yukon River/Fortymile	Klondike River	722	320	9	64.048	64.048	64.048	-139.387	-139.385	-139.389
29-Aug	Yukon River/White/Slew	Yukon River (in-migration)	742	930	53	63.244	63.312	63.244	-139.451	-139.435	-139.514
29-Aug	Yukon River/White/Slew	White River	742	800	4	63.201	63.202	63.201	-139.825	-139.824	-139.828
29-Aug	Yukon River/White/Slew	Yukon River (in-migration)	842	340	52	63.804	63.832	63.767	-139.746	-139.729	-139.751

Table 4. Summary of Terminal Radio Tagged fish to Total Radio Tagged Fish in Migration and Percentages

	#	%
Radio Tags in migration on the Yukon River, Canada (crossing CAN/US border - not captured in fishery):	181	100.0%
Radio tagged fish recovered in the Klondike River system	6	3.3%
Radio tagged fish recovered in the Chandindu River system	1	0.6%
Radio tagged fish recovered in Coal Creek system	1	0.6%
Total radio tagged fish recovered in area:	8	4.4%
Radio tagged fish remaining in migration on the Yukon River, Canada:	173	95.6%

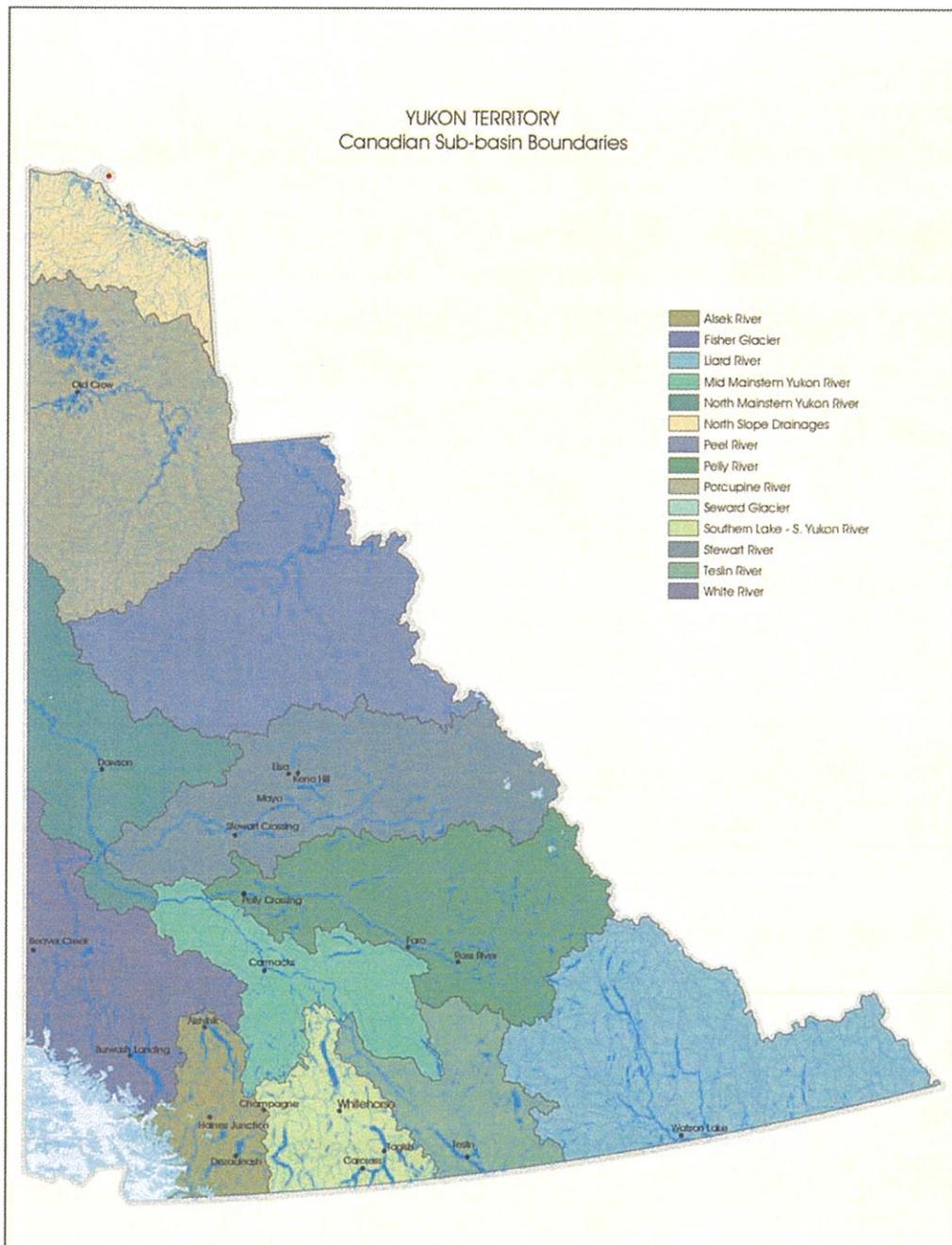


Figure 1. Map of Canadian Sub-basin boundaries

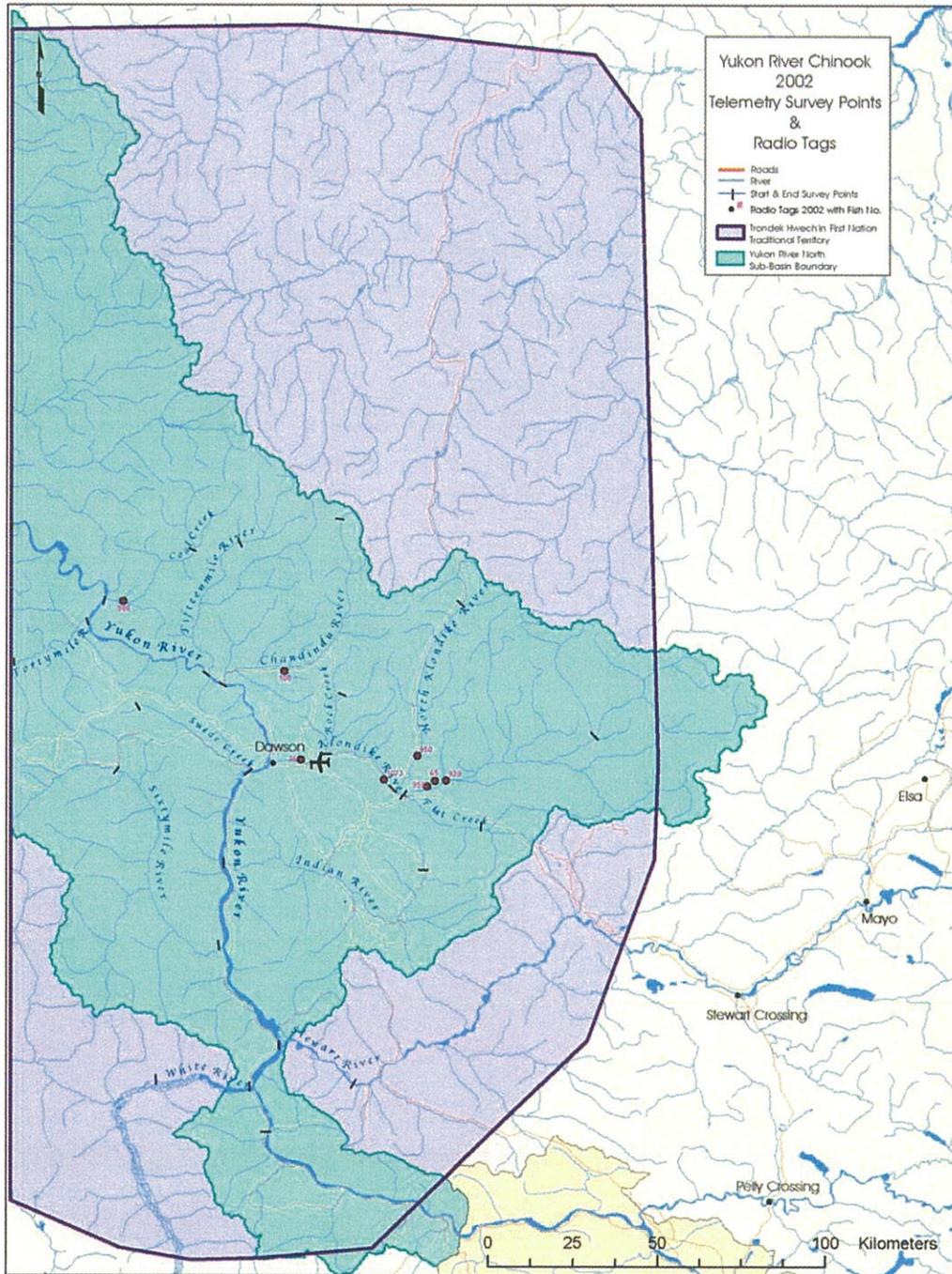


Figure 3. Map of the Yukon River North Mainstem Sub-basin, the Tr'ondek Hwech'in Traditional Territory and 2002 Radio Telemetry Survey Points

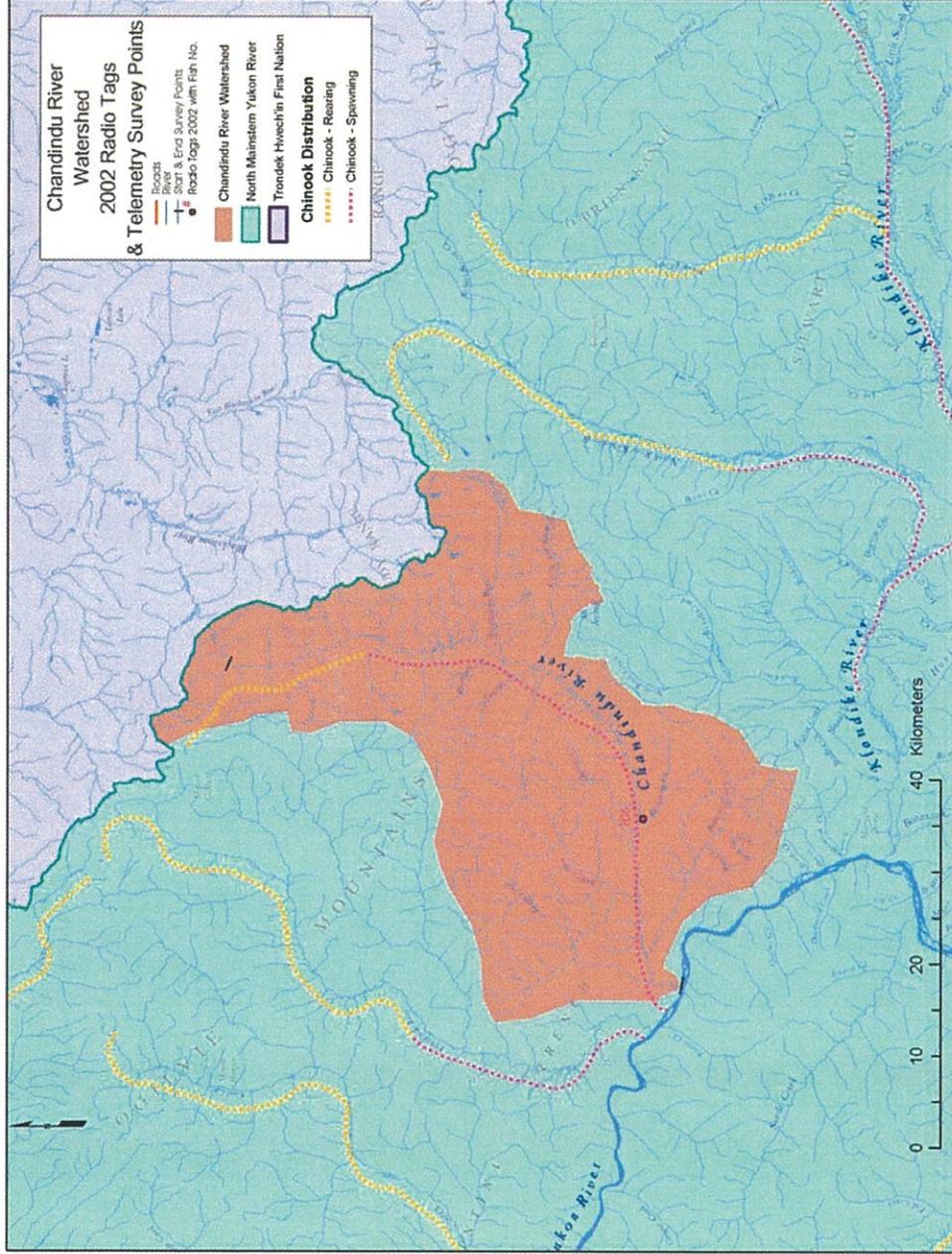


Figure 5. Map of the Chandindu River Watershed, with 2002 Radio Telemetry Survey Points.

Figure 7. Yukon River Flows (m³/s), USGS 15356000 at Eagle AK.

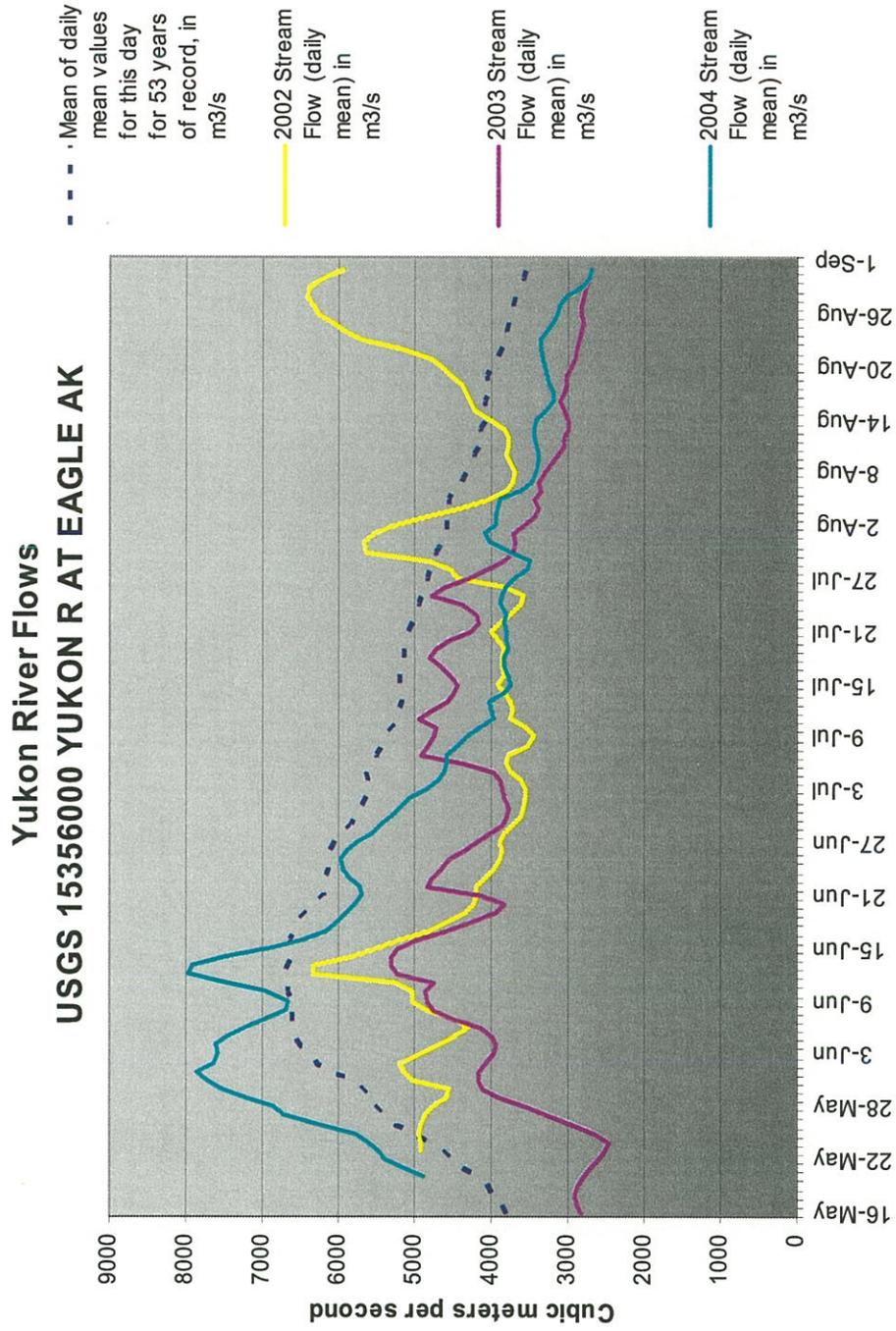
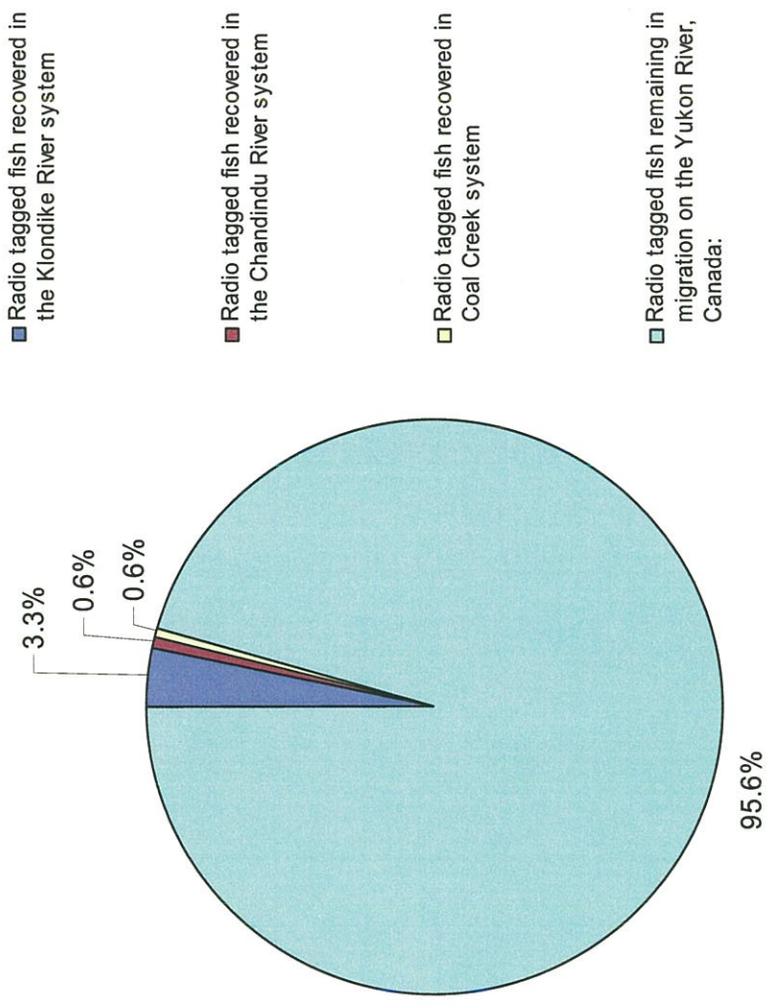


Figure 8. Comparison of terminal radio tag recoveries in the Tr'ondek Hwech'in traditional territory to the total number of radio tags migrating on the Yukon River in Canada



Appendix A

Radio Tag/River System	FLIGHT_ID	FREQ	CODE	AVG LAT	AVG LONG
Chandindu River	Chandindu	881	440	64.291	-139.318
	Chandindu/Fifteenmile/Coal	881	440	64.297	-139.302
	Coal/Fortymile	881	440	64.270	-139.389
Coal Creek	Chandindu/Fifteenmile/Coal	922	370	64.473	-140.383
	Coal/Fortymile	922	370	64.482	-140.237
Klondike River	Chandindu	722	320	64.064	-139.104
	Coal/Fortymile	922	820	64.060	-139.115
	Fifteenmile	922	820	64.038	-139.323
	Klondike1	742	330	63.974	-138.403
		842	290	63.986	-138.329
		902	790	64.064	-138.980
		942	360	63.989	-138.240
	Klondike2	742	330	63.962	-138.555
		842	290	63.979	-138.380
		902	790	63.954	-138.625
		922	820	64.059	-139.011
	Klondike4	942	360	63.983	-138.355
		722	320	64.038	-139.250
		842	290	63.982	-138.376
		842	310	64.047	-138.538
		902	790	63.952	-138.624
	Yukon River/Fortymile	922	820	64.054	-139.019
		942	360	63.972	-138.697
		722	320	64.048	-139.387
		842	310	64.044	-138.536
842		310	64.058	-138.522	
N. Klondike River	Yukon River/White/Stewart	742	800	63.201	-139.825
White River	Chandindu	684	190	64.270	-139.791
		783	890	64.265	-139.767
		922	230	64.146	-139.506
Yukon River (in-migration)	Coal/Fortymile	942	420	64.248	-139.653
		702	900	64.248	-139.697
		742	210	64.165	-139.532
		842	620	64.237	-139.587
	Fifteenmile	922	120	64.370	-140.379
		942	930	64.061	-139.444
		684	350	64.093	-139.451
		684	800	64.111	-139.470
		702	910	64.256	-139.738
		722	900	64.215	-139.598
		902	170	64.109	-139.466
		922	10	64.267	-139.782
		942	480	64.249	-139.670
		982	10	64.190	-139.558
	982	210	64.287	-139.808	
	Indian/Sixtymile/Swede	842	340	63.767	-139.708
	Klondike2	842	600	64.027	-139.497
		942	560	64.012	-139.599
	Swede/Sixtymile/Indian	702	860	63.766	-139.732
		742	210	63.800	-139.745
		842	340	63.758	-139.726
		881	860	63.717	-139.704
		922	840	63.563	-139.743
	Yukon River/White/Stewart	942	930	63.732	-139.700
		722	930	63.285	-139.451
		842	340	63.804	-139.746