Biological and Habitat Data for Fish Collected During Stream Surveys in the Sahtu Settlement Region, Northwest Territories, 2006

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BIOLOGICAL AND HABITAT DATA FOR FISH COLLECTED DURING STREAM SURVEYS IN THE SAHTU SETTLEMENT REGION, NORTHWEST TERRITORIES, 2006

by

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ABSTRACT

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Stream surveys were conducted in selected reaches of 15 streams in the Sahtu Settlement Area during 2006. Habitat availability and use were recorded in seven of these streams. A total of 908 fish representing nine different species were captured. Slimy sculpin (*Cottus cognatus*) was the most abundant species in this area representing 67.5 % of the total catch followed by Arctic grayling (*Thymallus arcticus*) (27.5 %), lake chub (*Couesius plumbeus*) (2.1 %), bull trout (*Salvelinus confluentus*) (1.0 %), and Dolly Varden (*Salvelinus malma*) (1.3 %). Brook stickleback (*Culaea inconstans*), northern pike (*Esox lucius*), mountain whitefish (*Prosopium williamsoni*), and white sucker (*Catostomus commersoni*) accounted for only 0.6 % of the catch. Arctic grayling was the most widespread species found in this area as it was present in all but one location where fish were caught. Mean depths ranged from 7.1 cm to 42.5 cm; mean velocities ranged from 0.04 $m \cdot s^{-1}$ to 0.34 $m \cdot s^{-1}$; mean temperatures ranged between 6.7 °C and 17.7 °C; and cobble was the dominant substrate and cover observed.

Key Words: Northwest Territories; stream surveys; Mackenzie Gas Pipeline; fish habitat; Arctic grayling; bull trout; Dolly Varden; Sahtu Settlement Area.

RÉSUMÉ

Mochnacz, N. J et J. D. Reist. 2007. Données sur la biologie et l'habitat des poissons pris lors du recensement des cours d'eau dans la région de Sahtu, Territoires du Nord-Ouest, 2006. *Can. Data Rep. Fish. Aquat. Sci*. 1189: vii + 40 p.

Le recensement des cours d'eau a été réalisé dans des passages sélectionnés de 15 cours d'eau dans la région de Sahtu en 2006. La disponibilité et l'utilisation de l'habitat ont été enregistrées dans sept de ces cours d'eau. Un total de 908 poissons représentant neuf espèces différentes ont été capturés. Le chabot visqueux (*Cottus cognatus*) était l'espèce la plus abondante dans la région, représentant 67,5 % de la prise totale, suivi par l'ombre de l'Arctique (*Thymallus arcticus*) (27,5 %), le méné de lac (*Couesius plumbeus*) (2,1 %), l'omble à tête plate (*Salvelinus confluentus*) (1,0 %), et l'omble du Pacifique (*Salvelinus malma*) (1,3 %). L'épinoche à cinq épines (*Culaea inconstans*), le grand brochet (*Esox lucius*), le ménomini de montagnes (*Prosopium williamsoni*) et le meunier noir (*Catostomus commersoni*) représentaient seulement 0,6 % de la prise. L'ombre de l'Arctique était l'espèce la plus répandue dans cette région, puisqu'elle se trouvait dans tous les emplacements de prise des poissons, à l'exception d'un seul. Les profondeurs moyennes se situaient entre 7,1 cm et 42,5 cm; les vitesses moyennes se situaient entre 0,04 $m \cdot s^{-1}$ et 0,34 $m \cdot s^{-1}$; les températures moyennes se situaient entre 6,7 °C et 17,7 °C; et le substrat dominant et la couverture observée étaient formés de galets.

Mots-clés : Territoires du Nord-Ouest; recensement des cours d'eau; gazoduc du Mackenzie; habitat du poisson; ombre de l'Arctique; omble à tête plate; omble du Pacifique; zone d'installation de Sahtu.

INTRODUCTION

The Mackenzie River originates in northeastern British Columbia and flows north approximately 4,000 km to the Beaufort Sea. The Mackenzie Delta is a combination of channels, lakes (~ 24,000), and delta plains, encompassing an area of approximately 13,000 km^2 (Mackenzie River Basin Board 2003). The higher elevation areas (i.e., delta plains) are within the river's floodplain but are capable of supporting flood tolerant plant species such as mature spruce forests (Hirst et al. 1987). Freshwater and anadromous fish use the Mackenzie River and associated tributaries at different times of the year (Dryden et al. 1973). The main stem of the river is used by fish for short- and long-range migrations, feeding, and as winter habitat. Some fish species may spend much of the year in the Mackenzie River; however, most species, especially anadromous ones, use the river as a migration corridor to spawning and feeding areas. Tributaries of the river are used by fish for spawning in the spring or fall and occasionally during the winter (Hatfield et al. 1972; Dryden et al. 1973).

The proposed Mackenzie Gas Pipeline (MGP) will intersect 495 watercourses along the Mackenzie River Valley from Inuvik, NT to northwestern Alberta (Imperial Oil Resources Ventures Limited 2004). These watercourses range from intermittent swales, which provide seasonal fish habitat, to much larger tributaries such as Great Bear River, which provide year-round fish habitat. In anticipation of increased activities related to pipeline construction and operation, studies were initiated in 2004 by Fisheries and Oceans Canada (DFO) to fill data gaps and update existing baseline data on fisheries resources along the Mackenzie River Valley. Although fish species found within the entire valley could be affected by environmental disturbance, this research focused primarily on the east side of the Mackenzie River. Research was conducted on fisheries resources along the Mackenzie Valley in the late 1970's (e.g., Hatfield et al. 1972; Dryden et al. 1973) and during the 1980's as part of the Northern Oil and Gas Action Program (e.g., Chang-Kue and Jessop 1991). However, filling data gaps and collecting up-to-date baseline information is important to establish pre-development reference conditions. Such information can be used for post-development monitoring to detect changes in the future.

The Mackenzie River supports 34 known species of freshwater and/or anadromous fish. These fish communities exhibit primarily riverine life histories, and are part of a larger dynamic ecosystem. Negative impacts on habitat from hydrocarbon development coupled with other ongoing activities such as commercial, sport, and subsistence fisheries, could compromise some of these species. Several of the riverine fish species found along the proposed MGP route are sensitive – possessing a lower tolerance to withstand over harvesting and habitat degradation – and as such are more susceptible to negative effects on habitat associated with pipeline development. Riverine species are most at risk to habitat degradation since the proposed MGP route will cross numerous tributaries flowing into the

Mackenzie River which are used primarily for spawning or as access to spawning sites. Eleven species from this area are important to subsistence and sport fisheries and are considered to be vulnerable to environmental disturbance: Arctic grayling (*Thymallus arcticus*), bull trout (*Salvelinus confluentus*), Dolly Varden (*Salvelinus malma*), Arctic cisco (*Coregonus autumnalis*), least cisco (*Coregonus sardinella*), inconnu (*Stenodus leucichthys*), walleye (*Sander vitreus*), broad whitefish (*Coregonus nasus*), lake whitefish (*Coregonus clupeaformis*), round whitefish (*Prosopium cylindraceum*), and burbot (*Lota lota*) (Stein et al. 1973). Pearl dace (*Margariscus margarita*) and brook stickleback (*Culaea inconstans*) are also important components of the ecosystem as they are consumed by many of the species identified above (Stein et al. 1973).

To minimize impacts of anticipated hydrocarbon development, it is important to understand differential habitat use and distribution of fish species, and their life history types and stages. At community workshops in 2003, it was established that this information was lacking for many streams along the proposed pipeline route (Gartner Lee Ltd. 2003; Gartner Lee Ltd. 2004). The objectives of this study are to improve our understanding of biodiversity below the species level (e.g., life history types), geographic distribution, and habitat associations for different life history and life stages of each sensitive fish species. Small streams with seasonal flow will be the focus since it is not explicitly clear how these streams function to maintain fish populations and the extent of their contribution to the larger Mackenzie River system. The project will run for a minimum of two years to obtain pre-development baseline information for comparative post-development monitoring.

MATERIALS AND METHODS

STUDY AREA

The Sahtu Settlement Area (SSA) reaches from just south of Great Bear Lake, extending north along the Mackenzie River Valley and ends approximately 150 km from the Mackenzie River Delta (Fig. 1). Colville Lake, Deline, Fort Good Hope, Norman Wells, and Tulita are the five communities established in this area. The Mackenzie River flows north approximately 520 km across the SSA where it receives freshwater input from tributaries ranging in size from seasonal swales to large rivers (Fig. 1).

The tributaries found along the east side of the Mackenzie River in the Sahtu Settlement Area originate in the Franklin Mountains and those found on the west side originate in the Mackenzie Mountains. Streams running into the Mackenzie River flow either year round or seasonally and peak discharge occurs after the spring freshet. River levels and flows are lowest in the late summer/early fall and some streams run dry by mid to late summer; however, some fish species may still use these streams seasonally for spawning, rearing, and feeding. The tributaries found in this area are high-gradient, mountain streams that run clear after the spring freshet. Stream discharge is governed primarily by snow melt and precipitation during the open water season but in many streams groundwater also influences flows during the year. Most of the smaller tributaries (i.e., < 3 m) typically freeze completely to the bottom during winter; however, large tributaries with sufficient depth and flow do not. The larger rivers (i.e., 20 to 30 m wide) in this area, such as the Keele and Mountain rivers (Fig. 1), carry a relatively high sediment load after the spring freshet and for much of the open water season. Turbidity levels in these rivers are influenced by precipitation in the mountains throughout the open water season. Groundwater is prevalent in this area and provides summer and winter refuges for many fish species.

BIOLOGICAL DATA COLLECTION

Field work was conducted in mid summer from July 25 to July 30, and in late summer from August 28 to September 3, 2006. Streams were selected based on knowledge gaps identified by DFO as well as requests by local communities to gain a better understanding of the fish species using streams along the proposed MGP corridor. Site selection was also driven by our understanding of the distribution of sensitive species in the area. Surveys were conducted at 15 different streams in the Sahtu Settlement Region (Fig. 1). Fish were captured using a backpack electro-fisher (Smith-Root Type VII POW) and angling gear in larger tributaries where depth and flow prevented wading. Set lines were also deployed in selected streams. Streams were stratified into lower, middle and upper sections, and randomly selected stations ranging in length from 40 m to 280 m were fished in these sections. Co-ordinates were taken at the central point of each station or shoreline that was fished (North American Datum 1983, Canada) with a Garmin (GPSMAP 60C) hand-held global positioning system (GPS). In some situations streams were only sampled in one or two sections due to logistical constraints.

To minimize research impacts on populations, a combination of live- and dead-sampling was conducted.

LIVE SAMPLING

All fish captured were identified to species where possible. A total count of individuals and the range (i.e., minimum and maximum) of fork lengths (FL) were taken for smaller forage fish (e.g., cyprinids), which were not considered sensitive species but were abundant in the catch. Fish were placed in a holding bag which was anchored in slow moving water providing a well-oxygenated recovery environment before and after field processing. Biological data, which included fork length (nearest mm), weight (nearest g), sex, and maturity (Table 1; McGowan 1992) were documented for all sensitive species where possible. Life history type and life stages were assigned based on external characteristics, such as size, color, and presence of unique marks (e.g., parr marks). Fish with fork lengths > 200 mm were fitted with a uniquely numbered T-bar tag inserted at the base of the dorsal fin between the posterior basal pterygiophores. A portion of the adipose fin was removed from all tagged fish, as well as a random sub-sample of smaller fish from various locations, for genetic analysis and as a secondary marking method. Once biological data were recorded, fish were released at the same location where they were originally captured.

DEAD SAMPLING

A limited number of fish were sacrificed for confirmation of species identity and to acquire additional biological information. Large fish (FL = 400 – 800 mm) were frozen whole, and all other fish were placed in 10% buffered formalin for 1-2 weeks, soaked twice in freshwater for 24 hours, and then transferred into 70% ethanol. Preserved fish were shipped to DFO (Winnipeg, MB) for subsequent analysis. All fish were identified to species (McPhail and Lindsey 1970; Scott and Crossman 1973) and fork lengths (nearest mm) and weight (nearest 0.1 g) were recorded. Additionally sex, maturity, and gonad weight (nearest 0.1 g) were recorded where possible for Arctic grayling, burbot, chars, and mountain whitefishes. Sexual maturity was determined by internal examination of gonads and each fish was assigned a maturity code (Table 1). The liver from each burbot was photographed, and weighed. Stomachs and livers were also preserved in 70% ethanol for subsequent analysis.

Morphometric measurements and meristic counts were taken for all dead-sampled Dolly Varden and bull trout. Morphometric measurements were recorded to the nearest 0.1 mm and included: pre-orbital, orbital and postorbital lengths; interorbital width; trunk, dorsal, lumbar, anal and caudal peduncle lengths; head, body and caudal peduncle depths; maxillary length and width; pectoral, pelvic and adipose fin lengths; middle gill raker length, and lower arch length. Meristic variables that were counted included: dorsal, anal, pectoral, and pelvic principal fin rays; total branchiostegal rays; upper and lower gill rakers; and pyloric caecae (Reist et al. 1997).

Fish ages were determined using the whole (Secor et al. 1992), sectioned (Secor et al. 1992), or break-and-burn (Chilton and Beamish 1982) otolith methods.

CHAR IDENTIFICATION

Chars were identified to species by comparison to known qualitative morphological criteria described in the literature (Cavender 1978; Haas and McPhail 1991; Nelson and Paetz 1992; Reist et al. 2002), and applying a linear discriminant function (LDF) (Haas and McPhail 1991) proven to be 100% effective in distinguishing Dolly Varden from bull trout. The LDF is based on four variables: total branchiostegal ray number, total anal ray number, and the ratio of total upper jaw length to standard length. The upper jaw length was measured from the tip of the snout to the posterior end of the maxilla. These variables are used in the following equation to determine LDF scores for individuals:

$$LDF = 0.629N_b + 0.178N_a + 37.310\ L_j/L_s - 21.8$$

Where:

LDF	=	Linear Discriminant Function score
N_b	=	Total number of branchiostegal rays
N_a	=	Total number of anal fin rays
L_j	=	Total length of upper jaw
L_s	=	Standard length of fish

All fish with LDF scores > 0 are bull trout and those with scores < 0 are Dolly Varden.

Ribosomal DNA (rDNA) (Baxter et al. 1997), mitochondrial DNA (mtDNA), and growth hormone DNA (GH DNA) analyses (Taylor et al. 2001) were conducted on 17 tissue samples from chars collected. The final identifications were deemed conclusive if two or more of the analyses (i.e., morphological, LDF, DNA analyses) were in agreement.

HABITAT DATA COLLECTION

Habitat information was collected from seven streams to describe the type of habitat available for fish and determine how selected sensitive species use this habitat. Habitat use was quantified at the macrohabitat and microhabitat level in randomly selected stations from seven streams. Macrohabitat represents general physical features (e.g., depth, velocity, substrate, wetted width) of a stream. Microhabitat represents the physical features of the stream at specific positions where fish are captured within the stream (Goetz 1997).

MACROHABITAT DATA COLLECTION

Macrohabitat was measured along transects in randomly selected reaches (stations) of each stream. One station was randomly selected from the lower, middle, and upper sections of each stream. Stations ranged in length from 40 m to 280 m. The stations selected in each section were 40 mean stream widths (MSW) in length and 13–20 transects were sampled within each station. The MSW was based on 5-10 preliminary measurements (nearest 0.5 m) of the wetted stream width taken at the downstream end of each station. Simonson et al. (1994) show that a minimum of 13 transects with four data points across each transect should be sampled in a station to obtain an accurate representation of the habitat present. Habitat was not measured in all three sections of some streams because of logistical constraints (e.g., no safe landing areas).

Transects were spaced two MSW apart and placed perpendicular to water flow. This systematic placement of transects ensured that a maximum of 20 transects could be sampled within a station. At four equidistant points across each transect water depth, water velocity, substrate and cover types, and water temperature were measured. Depth was measured with a meter stick (nearest 0.5 cm), and velocity was measured at 60% of the water depth using a Marsh-McBirney flow meter (accurate to 0.01 $m \cdot s^{-1}$). Dominant substrate was estimated visually in the surrounding 5 cm for each point using a modified Wentworth scale (Table 2) and cover was estimated visually according to a ranked classification scale (Table 3). Temperature was recorded at the bottom of the river bed within the substrate using a hand-held DigiSense Thermister Thermometer™ attached to a metal probe. The metal probe was armored in a steel sheath and driven as far into the river bottom as possible. Ambient river temperature was also recorded at one minute intervals halfway down the water column, while on site with Stowaway Tidbit Temperature Loggers™. The mean depth and water velocity were determined for each station, and the mode was determined for substrate and cover types.

MICROHABITAT DATA COLLECTION

Microhabitat was quantified at specific positions in the stream where Arctic grayling, mountain whitefish, and burbot were captured during electrofishing surveys. Most of the habitat use data are for Arctic grayling as this was the sensitive species encountered most often during field work. A two-person crew electrofished randomly selected stations in each stream. Each time one of these species was captured a weighted orange or yellow marker, representing either juvenile or adult fish, was placed in the habitat unit for later identification. Arctic grayling with fork lengths greater than 300 mm were considered adults and those less than 300 mm were considered juveniles. Water depth, water velocity, dominant substrate and cover were recorded at the point where the marker was dropped as well as four points approximately 10 cm around the central point in a clockwise direction at 0°, 90°, 180°, and 270°.

RESULTS

Common and scientific names with corresponding species codes for all species captured are presented in Table 4. Table 5 shows capture location information, method, effort expended to capture fish, number of fish tagged and released, number of fish dead-sampled, and catch-per-unit-effort. A total of 908 fish representing nine different species were captured. Slimy sculpin (*Cottus cognatus*) was the most abundant species in this area representing 67.5 % of the total catch followed by Arctic grayling (27.5 %), lake chub (*Couesius plumbeus*) (2.1 %), bull trout (1.0 %), and Dolly Varden (1.3 %). Brook stickleback, northern pike (*Esox lucius*), mountain whitefish (*Prosopium williamsoni*), and white sucker (*Catostomus commersoni*) accounted for only 0.6 % of the catch. Arctic grayling was the most widespread species found in this area as it was present in all but one location where fish were caught. Table 6 summarizes biological data obtained from brook stickleback, lake chub, northern pike, slimy sculpin, and white sucker. Similar biological data are presented in Table 7 for sensitive species captured. Genetic analyses, LDF analyses, and comparison of key morphological traits to those of known species confirmed that nine bull trout and twelve Dolly Varden were captured during the study (Tables 7 and 8). Habitat data showed that the mean depths ranged from 7.1 cm to 42.5 cm; mean velocities ranged from 0.04 $m \cdot s^{-1}$ to 0.34 $m \cdot s^{-1}$; mean temperatures ranged between 6.7 °C and 17.7 °C; and cobble was the dominant substrate and cover observed (Table 9).

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Table 1. Sexual maturity codes assigned to fish captured during the study (McGowan 1992).

Maturity State	Male – 1	Female – 2
Immature	06 – testes long and thin, tubular and scalloped shape, up to full body length, putty-like firmness	01 – ovaries granular, hard and triangular, up to full length of body cavity, membrane full, eggs distinguishable
Mature	07 – current year spawner, testes large and lobate, white to purplish in color, centres may be fluid, milt not expelled by pressure	02 – current year spawner, ovary fills body cavity, eggs near full size but not loose and not expelled by pressure
Ripe	08 – testes full size, white and lobate, milt expelled by slight pressure	03 – ovaries greatly extended and fill body cavity, eggs full size and transparent, expelled by slight pressure
Spent	09 – spawning complete, testes flaccid with some milt, blood vessels obvious, testes violet-pink in colour	04 – spawning complete, ovaries ruptured and flaccid, developing oocytes visible, some eggs retained in body cavity
Resting	10 – testes tubular, less lobate, healed from spawning, no fluid in center, usually full length of body, mottled and purplish in colour	05 – ovary 40 – 50% of body cavity volume, membrane thin and semi-transparent, healed from spawning, developing oocytes apparent with few atretic eggs, some eggs may be retained in body cavity
Unknown (virgin)	00 – cannot be sexed, gonads long or short and thin, transparent or translucent	
Unknown (non-virgin)	11 – resting fish, has spawned but gonads regenerated, or sexing not possible	

Table 2. Modified Wentworth classification of substrate types by size used for stream surveys in the Sahtu Settlement Area (Cummins 1962).

Code	Particle size range (mm)	Substrate definition
5	> 256	Boulder
4	64 - 255	Cobble
3	16 - 63	Pebble
2	2 - 15	Gravel
1	0.06 - 1	Sand
0	< 0.059	Silt

Table 3. Cover classification defining types for stream surveys conducted in the Sahtu Settlement Area (Sexauer and James 1997).

Code	Type or size range	Cover definition
1	aquatic vegetation	Submerged vegetation
2	riparian vegetation	Overhanging vegetation
3	water column depth	Depth
4	water turbulence	Turbulence
5	65 - 255 mm	Cobble
6	256+ mm	Boulder
7	> 30 cm diameter	Large wood
8	< 30 cm diameter	Small wood
9	stable bank, undercut	Undercut bank
10	none of the above are applicable	No cover

Table 4. Fish species captured during stream surveys in the Sahtu Settlement Area during summer, 2006.

Common Name	**Scientific Name**	**Species Code**
Arctic grayling	*Thymallus arcticus*	ARGR
Bull trout	*Salvelinus confluentus*	BLTR
Brook stickleback	*Culaea inconstans*	BRST
Dolly Varden	*Salvelinus malma*	DVCH
Lake chub	*Couesius plumbeus*	LKCH
Mountain whitefish	*Prosopium williamsoni*	MTWH
Northern pike	*Esox lucius*	NRPK
Slimy sculpin	*Cottus cognatus*	SLSC
White sucker	*Catostomus commersoni*	WHSC

Table 5. Fish inventory data for all species captured from streams and rivers in the Sahtu Settlement Area during summer, 2006. ANG = angling, EF = electrofishing, SL = set line.

Capture location	Site No.	Date M/D/Y	Method	Effort (s)	Species	No. of fish	No. of fish released	No. of fish dead-sampled	CPUE fish/100 s
Norman Range									
Canyon Creek Reach 1	1	07/28/06	EF	3050	ARGR	4	1	3	0.1
65° 13.649' N, 126° 31.240' W					LKCH	9	1	8	0.3
					SLSC	101	75	26	3.3
Total						**114**	**77**	**37**	**3.7**
Canyon Creek Reach 2	2	07/29/06	EF	2009	ARGR	20	13	7	1.0
65° 15.199' N, 126° 28.354' W					SLSC	18	18	0	0.9
Total						**38**	**31**	**7**	**1.9**
Canyon Creek Reach 3	3	07/29/06	EF	2791	ARGR	3	1	2	0.1
65° 13.347' N, 126° 31.660' W					LKCH	1	0	1	0.0
					SLSC	78	58	20	2.8
Total						**82**	**59**	**23**	**2.9**
Canyon Creek Reach 4	4	08/29/06	EF	1615	ARGR	29	17	12	1.8
65° 15.220' N, 126° 28.269' W					SLSC	36	23	13	2.2
Total						**65**	**40**	**25**	**4.0**
Canyon Creek Reach 5	5	08/31/06	EF	1678	ARGR	44	29	15	2.6
65° 14.984' N, 126° 28.922' W					SLSC	23	23	0	1.4
Total						**67**	**52**	**15**	**4.0**

Capture location	Site No.	Date M/D/Y	Method	Effort (s)	Species	No. of fish	No. of fish released	No. of fish dead-sampled	CPUE fish/100 s
Chick Creek	6	08/26/06	EF	1685	ARGR	78	28	49	4.6
65° 50.979' N, 128° 08.137' W									
Total						**78**	**28**	**49**	**4.6**
Elliot Creek	7	08/30/06	EF	1126	ARGR	1	0	1	0.1
65° 31.753' N, 127° 32.309' W					LKCH	1	0	1	0.1
					SLSC	62	31	31	5.5
Total						**64**	**31**	**33**	**5.7**
Fire Break Reach 1	8	08/30/06	EF	521	ARGR	3	0	3	0.6
65° 15.543' N, 126° 39.620' W									
Total						**3**	**0**	**3**	**0.6**
Francis Creek Reach 1	9	07/26/06	EF	1332	ARGR	15	7	8	1.1
65° 12.228' N, 126° 27.698' W					SLSC	188	145	43	14.1
Total						**203**	**152**	**51**	**15.2**
Francis Creek Reach 2	10	07/26/06	EF	1465	ARGR	1	0	1	0.1
65° 13.001' N, 126° 25.917' W					SLSC	24	24	0	1.6
Total						**25**	**24**	**1**	**1.7**
Francis Creek Reach 3	11	08/31/06	EF	1047	-	0	0	0	0.0
65° 14.441' N, 126° 23.584' W									
Total						**0**	**0**	**0**	**0.0**

Capture location	Site No.	Date M/D/Y	Method	Effort (s)	Species	No. of fish	No. of fish released	No. of fish dead-sampled	CPUE fish/100 s
Gibson Creek Reach 1	12	07/26/06	EF	1350	ARGR	3	1	2	0.2
65° 42.600' N, 127° 53.420' W					SLSC	13	13	0	1.0
					MTWH	1	0	1	0.1
Total						**17**	**14**	**3**	**1.3**
Gibson Creek Reach 2	13	08/30/06	EF	1248	ARGR	8	5	3	0.6
65° 42.509' N, 127° 53.343' W					LKCH	1	1	0	0.1
					NRPK	1	1	0	0.1
					SLSC	36	36	0	2.9
Total						**46**	**43**	**3**	**3.7**
Helava Creek Reach 1	14	07/26/06	EF	1338	ARGR	4	2	2	0.3
65° 11.476' N, 126° 25.263' W					SLSC	9	5	4	0.7
Total						**13**	**7**	**6**	**1.0**
Helava Creek Reach 2	15	07/27/06	EF	730	ARGR	2	1	1	0.3
65° 12.105' N, 126° 23.924' W					BRST	1	0	1	0.1
					LKCH	2	0	2	0.3
					SLSC	13	12	1	1.8
Total						**18**	**13**	**5**	**2.5**
Jungle Ridge Creek	16	07/27/06	EF	1570	ARGR	17	10	7	1.1
65° 03.683' N, 126° 03.688' W					LKCH	1	0	1	0.1
					NRPK	1	1	0	0.1
					SLSC	3	2	1	0.2

Capture location	Site No.	Date M/D/Y	Method	Effort (s)	Species	No. of fish	No. of fish released	No. of fish dead-sampled	CPUE fish/100 s
Jungle Ridge Creek (Continued).					WHSC	1	1	0	0.1
Total						**23**	**14**	**9**	**1.5**
RPR 332 Reach 1	17	07/28/06	EF	480	ARGR	1	0	1	0.2
64° 54.181' N, 125° 16.767' W					SLSC	2	0	2	0.4
					LKCB	4	0	4	0.8
Total						**7**	**0**	**7**	**1.5**
RPR 332 Reach 2	18	07/28/06	EF	125	-	0	0	0	0.0
64° 54.181' N, 125° 16.767' W									
Total						**0**	**0**	**0**	**0.0**
RPR 314		07/30/06	EF	671	-	0	0	0	0.0
65° 08.686' N, 126° 16.828' W	19								
Total						**0**	**0**	**0**	**0.0**
Seagrams Creek	20	07/25/06	EF	3250	ARGR	11	5	6	0.3
64° 22.472' N, 124° 38.742' W					SLSC	7	5	2	0.2
Total						**18**	**10**	**8**	**0.6**
Mackenzie Mountains									
Carcajou River Reach 1	21	7/15/06	ANG	21 600	BLTR	1	0	1	0.005
65° 07.412' N, 127° 20.911' W									
Total						**1**	0	1	0.005

Capture location	Site No.	Date M/D/Y	Method	Effort (s)	Species	No. of fish	No. of fish released	No. of fish dead-sampled	CPUE fish/100 s
Carcajou River Reach 2	22	7/15/06	ANG	1800	BLTR	1	0	1	0.056
64° 57.000' N, 127° 10.000' W									
Total						**1**	0	1	0.056
Doris Lake	23	09/03/06	SL	18 000	BLTR	1	0	1	0.01
65° 10.888' N, 128° 19.162' W									
Total						**1**	**0**	**1**	**0.01**
Gayna River Reach 1	24	09/03/06	ANG	5400	ARGR	2	2	0	0.0
65° 17.453' N, 129° 21.445' W					DVCH	12	4	8	0.2
Total						**14**	**6**	**8**	**0.3**
Gayna River Reach 2	25	09/03/06	ANG	7200	ARGR	4	4	0	0.1
65° 17.892' N, 129° 21.340' W					BLTR	6	0	6	0.1
Total						**10**	**4**	**6**	**0.1**
Mountain River	26	09/03/06	SL	14 400	-	0	0	0	0.0
65° 13.579' N, 128° 34.076' W									
Total						**0**	**0**	**0**	**0.0**

Table 6. Biological data for both live- and dead-sampled brook stickleback, lake chub, northern pike, slimy sculpin, and white sucker captured in streams from the Sahtu Settlement Region during summer, 2006. DS = dead sampled, LR = live release.

Location	Site No.	Date M/D/Y	No.	Species	FL (mm)	Wt (g)	Fish fate
Canyon Cr. Reach 1	1	07/28/06	1	LKCH	87	10.0	DS
65° 13.649' N, 126° 31.240' W			2	LKCH	55	2.4	DS
			3	LKCH	65	3.4	DS
			4	LKCH	62	34.0	DS
			5	LKCH	55	2.0	DS
			6	LKCH	72	5.1	DS
			7	LKCH	61	3.1	DS
			8	LKCH	56	2.2	DS
			9	LKCH	-	-	DS
			10	SLSC	63	2.5	DS
			11	SLSC	45	0.6	DS
			12	SLSC	46	0.8	DS
			13	SLSC	76	-	LR
			14	SLSC	78	-	LR
			15	SLSC	81	-	LR
			16	SLSC	46	-	LR
			17	SLSC	54	-	LR
			18	SLSC	75	-	LR
			19	SLSC	35	-	LR
			20	SLSC	67	-	LR
			21	SLSC	51	-	LR
			22	SLSC	75	4.5	DS
			23	SLSC	49	1.2	DS
			24	SLSC	61	3.1	DS
			25	SLSC	66	3.4	DS
			26	SLSC	59	2.1	DS
			27	SLSC	35	0.5	DS
			28	SLSC	34	0.4	DS
			29	SLSC	42	0.8	DS
			30	SLSC	37	0.6	DS
			31	SLSC	43	0.9	DS
			32	SLSC	36	0.4	DS
			33	SLSC	40	0.7	DS
			34	SLSC	67	3.2	DS
			35	SLSC	38	0.8	DS
			36	SLSC	56	2.3	DS
			37	SLSC	31	0.4	DS
			38	SLSC	41	0.8	DS
			39	SLSC	35	0.5	DS
			40	SLSC	36	0.5	DS

Location	Site No.	Date M/D/Y	No.	Species	FL (mm)	Wt (g)	Fish fate
Canyon Cr. Reach 1			41	SLSC	37	0.7	DS
(Continued).			42	SLSC	34	0.4	DS
			43	SLSC	33	0.2	DS
			44	SLSC	41	0.7	DS
Canyon Cr. Reach 3	3	07/29/06	45	LKCH	59	2.3	DS
65° 13.347' N, 126° 31.660' W			46	SLSC	45	0.8	DS
			47	SLSC	37	0.5	DS
			48	SLSC	32	0.4	DS
			49	SLSC	33	0.4	DS
			50	SLSC	36	0.4	DS
			51	SLSC	62	2.1	DS
			52	SLSC	35	0.4	DS
			53	SLSC	51	1.1	DS
			54	SLSC	56	1.6	DS
			55	SLSC	48	1.1	DS
			56	SLSC	55	1.5	DS
			57	SLSC	65	2.7	DS
			58	SLSC	67	3.0	DS
			59	SLSC	48	1.0	DS
			60	SLSC	37	0.6	DS
			61	SLSC	36	0.4	DS
			62	SLSC	46	1.1	DS
			63	SLSC	37	0.5	DS
			64	SLSC	40	0.7	DS
			65	SLSC	36	0.4	DS
Canyon Cr. Reach 4	4	08/29/06	66	SLSC	61	2.6	DS
65° 15.220' N, 126° 28.269' W			67	SLSC	64	3.0	DS
			68	SLSC	67	3.8	DS
			69	SLSC	69	3.6	DS
			70	SLSC	57	2.4	DS
			71	SLSC	67	3.1	DS
			72	SLSC	62	2.5	DS
			73	SLSC	68	3.6	DS
			74	SLSC	64	3.3	DS
			75	SLSC	58	2.1	DS
			76	SLSC	54	1.6	DS
			77	SLSC	60	2.5	DS
			78	SLSC	60	2.6	DS

Location	Site No.	Date M/D/Y	No.	Species	FL (mm)	Wt (g)	Fish fate
Elliot Cr.	7	08/30/06	79	LKCH	63	4.0	DS
65° 31.753' N, 127° 32.309' W			80	SLSC	84	6.8	DS
			81	SLSC	82	6.2	DS
			82	SLSC	78	5.4	DS
			83	SLSC	46	1.1	DS
			84	SLSC	55	2.1	DS
			85	SLSC	57	1.8	DS
			86	SLSC	50	1.3	DS
			87	SLSC	50	1.2	DS
			88	SLSC	44	0.8	DS
			89	SLSC	35	0.5	DS
			90	SLSC	46	1.2	DS
			91	SLSC	53	1.3	DS
			92	SLSC	56	1.8	DS
			93	SLSC	56	1.7	DS
			94	SLSC	86	7.1	DS
			95	SLSC	47	0.9	DS
			96	SLSC	52	1.2	DS
			97	SLSC	51	1.2	DS
			98	SLSC	47	1.0	DS
			99	SLSC	56	1.9	DS
			100	SLSC	37	0.4	DS
			101	SLSC	43	0.9	DS
			102	SLSC	40	0.6	DS
			103	SLSC	34	0.4	DS
			104	SLSC	42	0.8	DS
			105	SLSC	37	0.5	DS
			106	SLSC	43	0.7	DS
			107	SLSC	48	1.1	DS
			108	SLSC	47	1.0	DS
			109	SLSC	73	4.2	DS
			110	SLSC	86	7.4	DS
Francis Cr. Reach 1	9	07/26/06	111	SLSC	70	2.9	DS
65° 12.228' N, 126° 27.698' W			112	SLSC	58	1.9	DS
			113	SLSC	57	1.6	DS
			114	SLSC	43	0.8	DS
			115	SLSC	45	0.7	DS
			116	SLSC	63	2.7	DS
			117	SLSC	66	2.4	DS
			118	SLSC	54	2.1	DS
			119	SLSC	64	2.7	DS
			120	SLSC	63	2.4	DS

Location	Site No.	Date M/D/Y	No.	Species	FL (mm)	Wt (g)	Fish fate
Francis Cr. Reach 1			121	SLSC	68	3.0	DS
(Continued).			122	SLSC	50	1.4	DS
			123	SLSC	64	2.9	DS
			124	SLSC	57	1.9	DS
			125	SLSC	56	1.8	DS
			126	SLSC	37	0.7	DS
			127	SLSC	55	1.7	DS
			128	SLSC	44	0.8	DS
			129	SLSC	50	1.3	DS
			130	SLSC	45	1.0	DS
			131	SLSC	45	0.9	DS
			132	SLSC	40	0.6	DS
			133	SLSC	48	1.0	DS
			134	SLSC	40	0.7	DS
			135	SLSC	33	0.4	DS
			136	SLSC	35	0.4	DS
			137	SLSC	45	0.9	DS
			138	SLSC	36	0.5	DS
			139	SLSC	37	0.6	DS
			140	SLSC	40	0.7	DS
			141	SLSC	48	1.1	DS
			142	SLSC	36	0.6	DS
			143	SLSC	39	0.8	DS
			144	SLSC	35	0.4	DS
			145	SLSC	44	0.9	DS
			146	SLSC	44	0.9	DS
			147	SLSC	22	0.1	DS
			148	SLSC	61	2.4	DS
			149	SLSC	57	1.4	DS
			150	SLSC	75	3.3	DS
			151	SLSC	51	1.1	DS
			152	SLSC	71	2.7	DS
			153	SLSC	35	0.2	DS
			154	SLSC	36	0.4	DS
			155	SLSC	79	-	LR
			156	SLSC	38	-	LR
			157	SLSC	51	-	LR
			158	SLSC	62	-	LR
			159	SLSC	36	-	LR
			160	SLSC	73	-	LR
			161	SLSC	45	-	LR
			162	SLSC	45	-	LR
			163	SLSC	45	-	LR
			164	SLSC	59	-	LR

Location	Site No.	Date M/D/Y	No.	Species	FL (mm)	Wt (g)	Fish fate
Francis Cr. Reach 1			165	SLSC	65	-	LR
(Continued).			166	SLSC	71	-	LR
			167	SLSC	84	-	LR
			168	SLSC	43	-	LR
			169	SLSC	46	-	LR
			170	SLSC	41	-	LR
			171	SLSC	87	-	LR
			172	SLSC	65	-	LR
			173	SLSC	29	-	LR
			174	SLSC	73	-	LR
			175	SLSC	74	-	LR
			176	SLSC	80	-	LR
			177	SLSC	72	-	LR
			178	SLSC	46	-	LR
Gibson Cr. Reach 1	12	07/26/06	179	SLSC	71	-	LR
65° 42.600' N, 127° 53.420' W			180	SLSC	69	-	LR
			181	SLSC	57	-	LR
Gibson Cr. Reach 2	13	08/30/06	182	LKCH	56	1.7	DS
65° 42.509' N, 127° 53.343' W			183	NRPK	209	-	LR
Helava Cr. Reach 1	14	07/26/06	184	SLSC	77	5.9	DS
65° 11.476' N, 126° 25.263' W			185	SLSC	62	1.3	DS
			186	SLSC	67	3.1	DS
			187	SLSC	71	3.9	DS
Helava Cr. Reach 2	15	07/27/06	188	BRST	66	1.6	DS
65° 12.105' N, 126° 23.924' W			189	LKCH	62	2.9	DS
			190	LKCH	54	1.6	DS
			191	SLSC	77	5.0	DS
Jungle Ridge Cr.	16	07/27/06	192	LKCH	77	4.4	DS
65° 03.683' N, 126° 03.688' W			193	NRPK	99	-	LR
			194	SLSC	33	0.3	DS
			195	SLSC	74	-	LR
			196	SLSC	70	-	LR
			197	WHSC	90	-	LR

Location	Site No.	Date M/D/Y	No.	Species	FL (mm)	Wt (g)	Fish fate
RPR 332 Reach 1	17	07/27/06	198	LKCH	44	0.9	DS
64° 54.181' N, 125° 16.767' W			199	LKCH	43	0.9	DS
			200	LKCH	47	1.1	DS
			201	LKCH	42	0.7	DS
			202	LKCH	40	0.8	DS
			203	LKCH	45	0.9	DS
			204	SLSC	67	3.4	DS
			205	SLSC	54	1.8	DS
Seagrams Cr.	20	07/25/06	206	SLSC	14	-	DS
64° 22.472' N, 124° 38.742' W			207	SLSC	61	2.8	DS
			208	SLSC	106	-	LR
			209	SLSC	72	-	LR
			210	SLSC	65	-	LR
			211	SLSC	65	-	LR
			212	SLSC	68	-	LR

Table 7. Biological data collected for live - and dead-sampled Arctic grayling, bull trout, Dolly Varden, and mountain whitefish captured in streams from the Sahtu Settlement region during summer, 2006. 1. MC### and FT### = T-bar tag codes, ## F/C = genetic sample codes of fin clips (F/C), five digit codes (e.g., 51023) are DFO (Winnipeg) archival numbers; 2. see Table 1 for sex and maturity codes; 3. A = adult, J = Juvenile, YOY = young-of-the-year; 4. DS = dead-sampled, RNT = release no tag, T = live release with tag.

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Canyon Cr. Reach 1	1	07/28/06	1	51039	ARGR	102	8.8	-	00	-	1	J	DS
65° 13.649' N, 126° 31.240' W			2	51049	ARGR	110	15.6	-	00	-	1	J	DS
			3	51048	ARGR	102	10.6		00	-	1	J	DS
			4	-	ARGR	-	-	-	-	-	-	-	RNT
Canyon Cr. Reach 2	2	07/29/06	5	51051	ARGR	101	10.9		00	-	1	J	DS
65° 15.199' N, 126° 28.354' W			6	51050	ARGR	85	6.6	1	00	-	1	J	DS
			7	51052	ARGR	98	9.0	1	00	-	1	J	DS
			8	51053	ARGR	109	12.9	1	00	-	1	J	DS
			9	51054	ARGR	111	15.9	1	00	-	2	J	DS
			10	51055	ARGR	139	30.3	1	00	-	2	J	DS
			11	51056	ARGR	138	26.4	2	00	-	2	J	DS
			12	-	ARGR	112	-	-	-	-	-	J	RNT
			13	-	ARGR	119	-	-	-	-	-	J	RNT
			14	-	ARGR	106	-	-	-	-	-	J	RNT
			15	-	ARGR	109	-	-	-	-	-	J	RNT
			16	-	ARGR	104	-	-	-	-	-	J	RNT
			17	-	ARGR	127	-	-	-	-	-	J	RNT
			18	-	ARGR	98	-	-	-	-	-	J	RNT
			19	-	ARGR	105	-	-	-	-	-	J	RNT
			20	-	ARGR	146	-	-	-	-	-	J	RNT
			21	-	ARGR	132	-	-	-	-	-	J	RNT

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Canyon Cr. Reach 2			22	-	ARGR	110	-	-	-	-	-	J	RNT
(Continued).			23	-	ARGR	119	-	-	-	-	-	J	RNT
			24	-	ARGR	102	-	-	-	-	-	J	RNT
Canyon Cr. Reach 3	3	07/29/06	25	51058	ARGR	121	19.2	-	00	-	2	J	DS
65° 13.347' N, 126° 31.660' W			26	-	ARGR	-	-	-	-	-	-	-	RNT
			27	51057	ARGR	94	8.8	1	06	-	1	J	DS
Canyon Cr. Reach 4	4	08/29/06	28	51059	ARGR	157	41.4	-	00	-	2	J	DS
65° 15.220' N, 126° 28.269' W			29	51060	ARGR	115	14.2	-	00	-	3	J	DS
			30	51061	ARGR	107	12.8	-	00	-	1	J	DS
			31	51062	ARGR	122	17.7	-	00	-	1	J	DS
			32	51063	ARGR	129	22.9	-	00	-	2	J	DS
			33	51064	ARGR	101	10.2	-	00	-	2	J	DS
			34	51065	ARGR	103	11.7	-	00	-	1	J	DS
			35	51066	ARGR	123	20.2	-	00	-	2	J	DS
			36	51067	ARGR	100	10.9	-	00	-	1	J	DS
			37	51068	ARGR	89	7.9	-	00	-	1	J	DS
			38	51069	ARGR	83	6.3	-	00	-	1	J	DS
			39	51070	ARGR	66	3.2	-	00	-	0	YOY	DS
			40	-	ARGR	128	-	-	-	-	-	J	RNT
			41	-	ARGR	155	-	-	-	-	-	J	RNT
			42	-	ARGR	153	-	-	-	-	-	J	RNT
			43	-	ARGR	119	-	-	-	-	-	J	RNT
			44	-	ARGR	125	-	-	-	-	-	J	RNT
			45	-	ARGR	117	-	-	-	-	-	J	RNT
			46	-	ARGR	87		-	-	-	-	-	RNT

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Canyon Cr. Reach 4			47	-	ARGR	151	30.0	-	-	-	-	J	RNT
(Continued).			48	-	ARGR	137	-	-	-	-	-	J	RNT
			49	-	ARGR	150	-	-	-	-	-	J	RNT
			50	-	ARGR	123	-	-	-	-	-	J	RNT
			51	-	ARGR	105	-	-	-	-	-	J	RNT
			52	-	ARGR	106	-	-	-	-	-	J	RNT
			53	-	ARGR	128	-	-	-	-	-	J	RNT
			54	-	ARGR	116	-	-	-	-	-	J	RNT
			55	-	ARGR	106	-	-	-	-	-	J	RNT
			56	-	ARGR	106	-	-	-	-	-	J	RNT
Canyon Cr. Reach 5	5	08/31/06	57	01 F/C	ARGR	165	44.0	-	-	-	-	J	RNT
65° 14.984' N, 126° 28.922' W			58	51127	ARGR	205	98.0	1	06	-	3	J	DS
			59	51134	ARGR	102	9.9	-	00	-	1	J	DS
			60	02 F/C	ARGR	128	-	-	-	-	-	J	RNT
			61	51128	ARGR	153	38.9	2	01	-	2	J	DS
			62	51129	ARGR	143	30.6	2	01	-	2	J	DS
			63	51130	ARGR	152	36.9	-	00	-	2	J	DS
			64	51131	ARGR	135	28.6	2	01	-	2	J	DS
			65	51132	ARGR	124	20.5	2	01	-	1	J	DS
			66	51133	ARGR	115	17.0	2	01	-	1	J	DS
			67	51135	ARGR	121	19.4	2	01	-	1	J	DS
			68	51136	ARGR	114	13.3	2	01	-	2	J	DS
			69	51137	ARGR	100	10.5	2	01	-	1	J	DS
			70	51138	ARGR	96	9.4	2	01	-	1	J	DS
			71	51139	ARGR	101	11.0	-	-	-	1	J	DS
			72	51140	ARGR	97	9.7	2	01	-	1	J	DS
			73	51141	ARGR	74	4.5	2	01	-	0	YOY	DS

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Canyon Cr. Reach 5			74	03 F/C	ARGR	112	-	-	-	-	-	J	RNT
(Continued).			75	04 F/C	ARGR	120	-	-	-	-	-	J	RNT
			76	05 F/C	ARGR	85	-	-	-	-	-	-	RNT
			77	06 F/C	ARGR	110	-	-	-	-	-	J	RNT
			78	07 F/C	ARGR	80	-	-	-	-	-	-	RNT
			79	08 F/C	ARGR	85	-	-	-	-	-	-	RNT
			80	11 F/C	ARGR	103	-	-	-	-	-	J	RNT
			81	12 F/C	ARGR	119	-	-	-	-	-	J	RNT
			82	13 F/C	ARGR	130	20.0	-	-	-	-	J	RNT
			83	16 F/C	ARGR	151	-	-	-	-	-	J	RNT
			84	19 F/C	ARGR	108	-	-	-	-	-	J	RNT
			85	22 F/C	ARGR	118	-	-	-	-	-	J	RNT
			86	23 F/C	ARGR	107	-	-	-	-	-	J	RNT
			87	24 F/C	ARGR	118	-	-	-	-	-	J	RNT
			88	26 F/C	ARGR	114	-	-	-	-	-	J	RNT
			89	27 F/C	ARGR	116	13.0	-	-	-	-	J	RNT
			90	28 F/C	ARGR	175	50.0	-	-	-	-	J	RNT
			91	30 F/C	ARGR	156	38.0	-	-	-	-	J	RNT
			92	31 F/C	ARGR	137	22.0	-	-	-	-	J	RNT
			93	32 F/C	ARGR	161	44.0	-	-	-	-	J	RNT
			94	37 F/C	ARGR	123	-	-	-	-	-	J	RNT
			95	38 F/C	ARGR	115	-	-	-	-	-	J	RNT
			96	39 F/C	ARGR	128	19.0	-	-	-	-	J	RNT
			97	40 F/C	ARGR	119	-	-	-	-	-	J	RNT
			98	42 F/C	ARGR	99	7.0	-	-	-	-	J	RNT
			99	43 F/C	ARGR	117	-	-	-	-	-	J	RNT
			100	-	ARGR	162	-	-	-	-	-	J	RNT

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Carcajou River Reach 1	21	07/15/06	101	51158	BLTR	662	2805.0	2	05	27.2	13	A	DS
65° 19.000' N, 127° 30.000' W													
Carcajou River Reach 2	22	07/15/06	102	51159	BLTR	593	1877.0	2	05	16.8	12	A	DS
65° 00.000' N, 127° 30.000' W													
Chick Cr.	6	08/28/06	103	51083	ARGR	49	1.2	-	00	-	0	YOY	DS
65° 50.979' N, 128° 08.137' W			104	51074	ARGR	56	1.9	-	00	-	0	YOY	DS
			105	51075	ARGR	57	1.9	-	00	-	0	YOY	DS
			106	51076	ARGR	52	1.3	-	00	-	0	YOY	DS
			107	51077	ARGR	111	13.1	-	00	-	1	J	DS
			108	51078	ARGR	65	3.1	-	00	-	0	YOY	DS
			109	51079	ARGR	41	0.6	-	00	-	0	YOY	DS
			110	51080	ARGR	51	1.3	-	00	-	0	YOY	DS
			111	51081	ARGR	59	2.0	-	00	-	0	YOY	DS
			112	51082	ARGR	53	1.6	-	00	-	0	YOY	DS
			113	51084	ARGR	44	0.8	-	00	-	0	YOY	DS
			114	51085	ARGR	52	1.6	-	00	-	0	YOY	DS
			115	51086	ARGR	62	2.6	-	00	-	0	YOY	DS
			116	51087	ARGR	54	1.5	-	00	-	0	YOY	DS
			117	51088	ARGR	40	0.7	-	00	-	0	YOY	DS
			118	51089	ARGR	47	1.1	-	00	-	-	YOY	DS
			119	51090	ARGR	52	1.4	-	00	-	0	YOY	DS
			120	51091	ARGR	56	1.8	-	00	-	0	YOY	DS
			121	51092	ARGR	52	1.4	-	00	-	0	YOY	DS
			122	51093	ARGR	50	1.3	-	00	-	0	YOY	DS
			123	51094	ARGR	46	0.9	-	00	-	0	YOY	DS

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Chick Cr.			124	51095	ARGR	49	1.3	-	00	-	0	YOY	DS
(Continued).			125	51096	ARGR	63	2.5	-	00	-	0	YOY	DS
			126	51097	ARGR	45	0.9	-	00	-	0	YOY	DS
			127	51098	ARGR	46	0.8	-	00	-	0	YOY	DS
			128	51099	ARGR	51	1.2	-	00	-	0	YOY	DS
			129	51100	ARGR	40	0.6	-	00	-	0	YOY	DS
			130	51101	ARGR	45	0.9	-	00	-	0	YOY	DS
			131	51102	ARGR	45	1.0	-	00	-	0	YOY	DS
			132	51103	ARGR	58	2.1	-	00	-	0	YOY	DS
			133	51104	ARGR	56	2.0	-	00	-	0	YOY	DS
			134	51105	ARGR	57	2.0	-	00	-	0	YOY	DS
			135	51106	ARGR	58	2.2	-	00	-	0	YOY	DS
			136	51107	ARGR	49	1.2	-	00	-	0	YOY	DS
			137	51108	ARGR	44	0.9	-	00	-	0	YOY	DS
			138	51109	ARGR	55	1.8	-	00	-	0	YOY	DS
			139	51110	ARGR	53	1.4	-	00	-	0	YOY	DS
			140	51111	ARGR	43	0.7	-	00	-	0	YOY	DS
			141	51112	ARGR	46	1.0	-	00	-	0	YOY	DS
			142	51113	ARGR	45	1.0	-	00	-	0	YOY	DS
			143	51114	ARGR	49	1.0	-	00	-	0	YOY	DS
			144	51115	ARGR	53	1.6	-	00	-	0	YOY	DS
			145	51116	ARGR	51	1.3	-	00	-	0	YOY	DS
			146	51117	ARGR	53	1.6	-	00	-	0	YOY	DS
			147	51118	ARGR	54	1.7	-	00	-	0	YOY	DS
			148	51119	ARGR	56	2.0	-	00	-	0	YOY	DS
			149	51120	ARGR	50	1.2	-	00	-	0	YOY	DS
			150	51121	ARGR	52	1.6	-	00	-	0	YOY	DS
			151	51122	ARGR	54	1.4	-	00	-	0	YOY	DS
			152	-	ARGR	57	-	-	-	-	-	YOY	RNT

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Chick Cr.			153	-	ARGR	59	-	-	-	-	-	YOY	RNT
(Continued).			154	-	ARGR	64	-	-	-	-	-	YOY	RNT
			155	-	ARGR	69	-	-	-	-	-	YOY	RNT
			156	-	ARGR	65	-	-	-	-	-	YOY	RNT
			157	-	ARGR	60	-	-	-	-	-	YOY	RNT
			158	-	ARGR	54	-	-	-	-	-	YOY	RNT
			159	-	ARGR	57	-	-	-	-	-	YOY	RNT
			160	-	ARGR	50	-	-	-	-	-	YOY	RNT
			161	-	ARGR	62	-	-	-	-	-	YOY	RNT
			162	-	ARGR	60	-	-	-	-	-	YOY	RNT
			163	-	ARGR	54	-	-	-	-	-	YOY	RNT
			164	-	ARGR	60	-	-	-	-	-	YOY	RNT
			165	-	ARGR	63	-	-	-	-	-	YOY	RNT
			166	-	ARGR	54	-	-	-	-	-	YOY	RNT
			167	-	ARGR	59	-	-	-	-	-	YOY	RNT
			168	-	ARGR	56	-	-	-	-	-	YOY	RNT
			169	-	ARGR	51	-	-	-	-	-	YOY	RNT
			170	-	ARGR	49	-	-	-	-	-	YOY	RNT
			171	-	ARGR	57	-	-	-	-	-	YOY	RNT
			172	-	ARGR	55	-	-	-	-	-	YOY	RNT
			173	-	ARGR	56	-	-	-	-	-	YOY	RNT
			174	-	ARGR	52	-	-	-	-	-	YOY	RNT
			175	-	ARGR	53	-	-	-	-	-	YOY	RNT
			176	-	ARGR	50	-	-	-	-	-	YOY	RNT
			177	-	ARGR	59	1.9	-	-	-	-	YOY	RNT
			178	-	ARGR	57	-	-	-	-	-	YOY	RNT
			179	-	ARGR	56	-	-	-	-	-	YOY	RNT
			180	51160	ARGR	295	335.0	1	07	4	6	A	DS

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Doris Lake	23	09/03/06	181	51148	BLTR	487	1135.0	1	06	1.0	9	J	DS
65° 10.888' N, 128° 19.162' W													
Elliot Cr.	7	08/30/06	182	51126	ARGR	178	65.7	2	01	0.05	4	J	DS
65° 31.753' N, 127° 32.309' W													
Fire Break Reach 1	8	08/30/06	183	51072	ARGR	136	24.9	-	01	-	2	J	DS
65° 15.543' N, 126° 39.620' W			184	51071	ARGR	170	49.8	2	01	-	2	J	DS
			185	51073	ARGR	123	16.9	-	01	-	2	J	DS
Francis Cr. Reach 1	9	07/26/06	186	51026	ARGR	57	2.1	-	01	-	0	YOY	DS
65° 12.228' N, 126° 27.698' W			187	51025	ARGR	56	1.7	-	01	-	0	YOY	DS
			188	-	ARGR	117	-	-	-	-	-	J	RNT
			189	51024	ARGR	108	13.1	-	00	-	1	J	DS
			190	51027	ARGR	65	2.9	-	00	-	0	YOY	DS
			191	51029	ARGR	57	1.9	-	00	-	0	YOY	DS
			192	51030	ARGR	55	1.6	-	00	-	0	YOY	DS
			193	51031	ARGR	85	6.7	2	01	-	1	J	DS
			194	51028	ARGR	59	2.3		00	-	0	YOY	DS
			195	-	ARGR	47	~1	-	-	-	-	YOY	RNT
			196	-	ARGR	57	-	-	-	-	-	YOY	RNT
			197	-	ARGR	86	-	-	-	-	-	J	RNT
			198	-	ARGR	84	-	-	-	-	-	J	RNT
			199	-	ARGR	60	-	-	-	-	-	YOY	RNT
			200	-	ARGR	58	~1	-	-	-	-	YOY	RNT

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Francis Cr. Reach 2	10	07/26/06	201	51032	ARGR	90	6.1	-	-	-	1	J	DS
65° 13.001' N, 126° 25.917' W													
Gayna River Reach 1	24	09/03/06	202	FT0874	ARGR	277	-	-	-	-	-	J	T
65° 17.453' N, 129° 21.445' W			203	FT0875	ARGR	395	-	-	-	-	-	A	T
			204	51149	DVCH	305	254.0	1	07	4.5	8	A	DS
			205	51150	DVCH	236	148.0	2	03	17.9	7	A	DS
			206	51152	DVCH	277	190.0	2	05	2.0	8	A	DS
			207	51153	DVCH	293	256.0	1	07	4.7	8	A	DS
			208	51154	DVCH	265	193.0	2	03	20.5	8	A	DS
			209	51155	DVCH	267	205.0	2	03	25.3	6	A	DS
			210	51156	DVCH	245	130.0	1	06	0.5	5	J	DS
			211	51157	DVCH	281	203.0	2	05	2.2	10	A	DS
			212	FT0871	DVCH	275	190.0	-	-	-	-	-	T
			213	FT0872	DVCH	267	-	-	-	-	-	-	T
			214	FT0873	DVCH	248	-	-	-	-	-	-	T
			215	MC0049	DVCH	304	-	-	-	-	-	-	T
Gayna River Reach 2	25	09/03/06	216	MC0048	ARGR	207	-	-	-	-	-	-	T
65° 17.892' N, 129° 21.340' W			217	-	ARGR	163	-	-	-	-	-	-	RNT
			218	-	ARGR	~300	-	-	-	-	-	-	RNT
			219	MC0047	ARGR	336	-	-	-	-	-	-	T
			220	51142	BLTR	634	2502.0	2	02	16.7	16	A	DS
			221	51143	BLTR	468	1103.0	2	02	5.4	9	A	DS
			222	51144	BLTR	555	1892.0	1	06	1.0	11		DS
			223	51145	BLTR	647	2649.0	1	06	1.8	16		DS
			224	51146	BLTR	685	3385.0	2	02	24.7	18	A	DS

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Gayna River Reach 2 (Continued).			225	51147	BLTR	730	3420.0	1	06	1.4	16		DS
Gibson Cr. Reach 1	12	07/26/06	226	51034	ARGR	178	67.4	1	07	-	4	4	DS
65° 42.600' N, 127° 53.420' W			227	51033	ARGR	169	57.5	2	02	-	3	3	DS
			228	-	ARGR	186	-	-	-	-	-	J	RNT
		07/26/06	229	51035	MTWH	144	26.1	1	-	-	2	2	DS
Gibson Cr. Reach 2	13	08/30/06	230	51123	ARGR	186	71.7	2	-	0.3	4	J	DS
65° 42.509' N, 127° 53.343' W			231	51124	ARGR	166	56.6	2	-	0.2	3	J	DS
			232	-	ARGR	67	-	-	00	-	-	YOY	RNT
			233	51125	ARGR	69	3.5	-	00	-	0	YOY	DS
			234	-	ARGR	72	-	-	00	-	-	YOY	RNT
			235	-	ARGR	162	36.0	-	00	-	-	J	RNT
			236	-	ARGR	188	64.0	-	00	-	-	J	RNT
			237	-	ARGR	153	-	-	00	-	-	J	RNT
Helava Cr. Reach 1	14	07/26/06	238	51037	ARGR	96	8.3	-	00	-	1	J	DS
65° 11.476' N, 126° 25.263' W			239	51038	ARGR	128	21.9	-	00	-	1	J	DS
			240	-	ARGR	118	-	-	00	-	-	J	RNT
			241	-	ARGR	120	-	-	00	-	-	J	RNT
Helava Cr. Reach 2	15	07/27/06	242	51036	ARGR	94	7.3	2	06	-	1	J	DS
65° 12.105' N, 126° 23.924' W			243	-	ARGR	101	-	-	-	-	-	J	RNT

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Jungle Ridge Cr.	16	07/27/06	244	51040	ARGR	49	1.1	-	00	-	0	YOY	DS
65° 03.683' N, 126° 03.688' W			245	51041	ARGR	50	1.2	-	00	-	0	YOY	DS
			246	51042	ARGR	53	1.5	-	00	-	0	YOY	DS
			247	51043	ARGR	50	1.5	-	00	-	0	YOY	DS
			248	51044	ARGR	57	1.9	-	00	-	0	YOY	DS
			249	51045	ARGR	56	2.0	-	00	-	0	YOY	DS
			250	51046	ARGR	58	1.9	-	00	-	0	YOY	DS
			251	-	ARGR	65	-	-	00	-	-	YOY	RNT
			252	-	ARGR	59	-	-	00	-	-	YOY	RNT
			253	-	ARGR	61	-	-	00	-	-	YOY	RNT
			254	-	ARGR	56	-	-	00	-	-	YOY	RNT
			255	-	ARGR	57	-	-	00	-	-	YOY	RNT
			256	-	ARGR	65	-	-	00	-	-	YOY	RNT
			257	-	ARGR	55	-	-	00	-	-	YOY	RNT
			258	-	ARGR	54	-	-	00	-	-	YOY	RNT
			259	-	ARGR	58	-	-	00	-	-	YOY	RNT
			260	-	ARGR	59	-	-	00	-	-	YOY	RNT
RPR 332 Reach 1	17	07/27/06	261	51047	ARGR	61	2.2	-	00	-	0	YOY	DS
64° 54.181' N, 125° 16.767' W													
Seagrams Cr.	20	07/25/06	262	51020	ARGR	39	0.4	-	00	-	-	YOY	DS
64° 22.472' N, 124° 38.742' W			263	51021	ARGR	45	0.8	-	00	-	0	YOY	DS
			264	51018	ARGR	52	1.3	-	00	-	0	YOY	DS
			265	51019	ARGR	51	1.1	-	00	-	0	YOY	DS
			266	51022	ARGR	50	1.1	-	00	-	0	YOY	DS
			267	51023	ARGR	47	0.9	-	00	-	0	YOY	DS

Location	Site No.	Date M/D/Y	No.	Fish ID[1]	Species	FL (mm)	Wt (g)	Sex	Mat[2]	Gonad Wt (g)	Age (yr+)	Life Stage[3]	Fish fate[4]
Seagrams Cr.			268	-	ARGR	57	1.0	-	-	-	-	YOY	RNT
(Continued).			269	-	ARGR	47	1.0	-	-	-	-	YOY	RNT
			270	-	ARGR	55	1.0	-	-	-	-	YOY	RNT
			271	-	ARGR	49	1.0	-	-	-	-	YOY	RNT
			272	-	ARGR	48	1.0	-	-	-	-	YOY	RNT

Table 8. Qualitative, quantitative, and genetic identification of char dead-sampled from the Sahtu Settlement Area in 2006.

Fish ID code	Location	Standard length (mm)	Upper jaw length (mm)	Anal Ray Count	Branchio-stegal Ray Count	LDF score	Age (yr+)	Qualitative ID	mt DNA ID	GH DNA ID	rDNA ID	Final ID
51142	Gayna R. Reach 2	565.0	86.0	9	27	2.4640	16	BLTR	-	-	-	BLTR
51143	Gayna R. Reach 2	417.0	57.0	10	26	1.4339	9	BLTR	BLTR	BLTR	BLTR	BLTR
51144	Gayna R. Reach 2	496.0	73.0	9	24	0.3892	11	BLTR	BLTR	BLTR	BLTR	BLTR
51145	Gayna R. Reach 2	575.0	83.0	9	27	2.1706	16	BLTR	BLTR	BLTR	BLTR	BLTR
51146	Gayna R. Reach 2	611.0	86.0	9	27	2.0365	18	BLTR	BLTR	BLTR	BLTR	BLTR
51147	Gayna R. Reach 2	656.0	97.0	10	29	3.7379	16	BLTR	BLTR	BLTR	-	BLTR
51148	Doris Lake	433.0	64.0	10	28	3.1066	9	BLTR	BLTR	BLTR	BLTR	BLTR
51149	Gayna R. Reach 1	271.0	38.0	10	23	-0.3213	8	DVCH	DVCH	DVCH	DVCH	DVCH
51150	Gayna R. Reach 1	210.0	22.0	9	22	-2.4513	7	DVCH	DVCH	DVCH	DVCH	DVCH
51152	Gayna R. Reach 1	247.0	26.0	9	20	-3.6906	8	DVCH	DVCH	DVCH	DVCH	DVCH
51153	Gayna R. Reach 1	260.0	35.0	10	22	-1.1595	8	DVCH	DVCH	DVCH	DVCH	DVCH
51154	Gayna R. Reach 1	236.0	26.0	10	20	-3.3296	8	DVCH	DVCH	DVCH	DVCH	DVCH
51155	Gayna R. Reach 1	235.0	24.0	9	23	-1.9206	6	DVCH	DVCH	DVCH	DVCH	DVCH
51156	Gayna R. Reach 1	220.0	25.0	9	23	-1.4912	5	DVCH	DVCH	DVCH	DVCH	DVCH
51157	Gayna R. Reach 1	251.0	26.0	11	21	-2.7682	10	DVCH	DVCH	DVCH	DVCH	DVCH
51158	Carcajou River Reach 1	596.0	87.0	10	29	3.6673	13	BLTR	BLTR	BLTR	BLTR	BLTR
51159	Carcajou River Reach 2	528.0	80.0	9	29	3.6960	12	BLTR	BLTR	BLTR	BLTR	BLTR

Table 9. Summary of macrohabitat data collected from streams in the Sahtu Settlement Area during summer, 2006. Stream order is based on the Strahler system (Gallagher 1999).

Location	Site No.	Latitude (N)	Longitude (W)	Stream order (map scale 1:50 000)	Mean wetted width (m)	Mean temp (°C)	Month	Elevation (m) (map scale 1:50 000)	Mean Depth (range) cm	Mean Velocity (range) m·s^{-1}	Dominant substrate	Dominant cover
Helava Creek	14	65° 11.476'	126° 25.263'	2	4	14.4	July	200	11.5(3-48)	0.16(0.01-0.64)	3	5
	15	65° 12.105'	126° 23.924'	2	3	-	July	300	7.1(93-26.5)	0.14(0.01-0.47)	3	5
Francis Creek	9	65° 12.228'	126° 27.698'	2	3	15.3	July	200	9.7(2-31)	0.17(0.01-0.72)	2	10
	10	65° 13.001'	126° 25.917'	2	3	14.0	July	450	7.6(2-20.5)	0.29(0.01-0.88)	3	5
	11	65° 14.441'	126° 23.584'	2	4	7.3	Aug	1200	7.4(2-21)	0.18(0.01-0.56)	3	5
Jungle Ridge Creek	16	65° 03.688'	126° 03.683'	2	4	16.6	July	350	42.5(8-1.09)	0.17(0.01-0.88)	4	1
Canyon Creek	1	65° 13.649'	126° 31.240'	4	7	17.0	July	250	12.1(2-28)	0.31(0.02-0.80)	3	5
	2	65° 15.199'	126° 28.354'	3	4	7.1	July	700	12.7(2-40)	0.34(0.01-0.75)	3	5
	3	65° 13.347	126° 31.660'	4	5	17.7	July	200	16.6(2-29)	0.34(0.04-0.90)	3	5
	4	65° 15.220'	126° 28.269'	3	4	5.9	Aug	750	13.0(1-29)	0.33(0.01-1.08)	4	5
	5	65° 14.984'	126° 28.922'	3	4	8.7	Aug	700	11.9(2-28)	0.31(0.01-1.03)	3	5
Chick Creek	6	65° 50.979'	128° 08.137'	3	3	9.1	Aug	450	14.3(2-74)	0.04(0.01-0.31)	3	5
Gibson Creek	13	65° 42.509'	127° 53.343'	2	3	6.7	Aug	300	14.1(6-98)	0.08(0.01-0.37)	1	8
Elliot Creek	7	65° 31.753'	127° 32.309'	3	3	8.8	Aug	350	25.4(2-70)	0.10(0.01-.39)	2	5

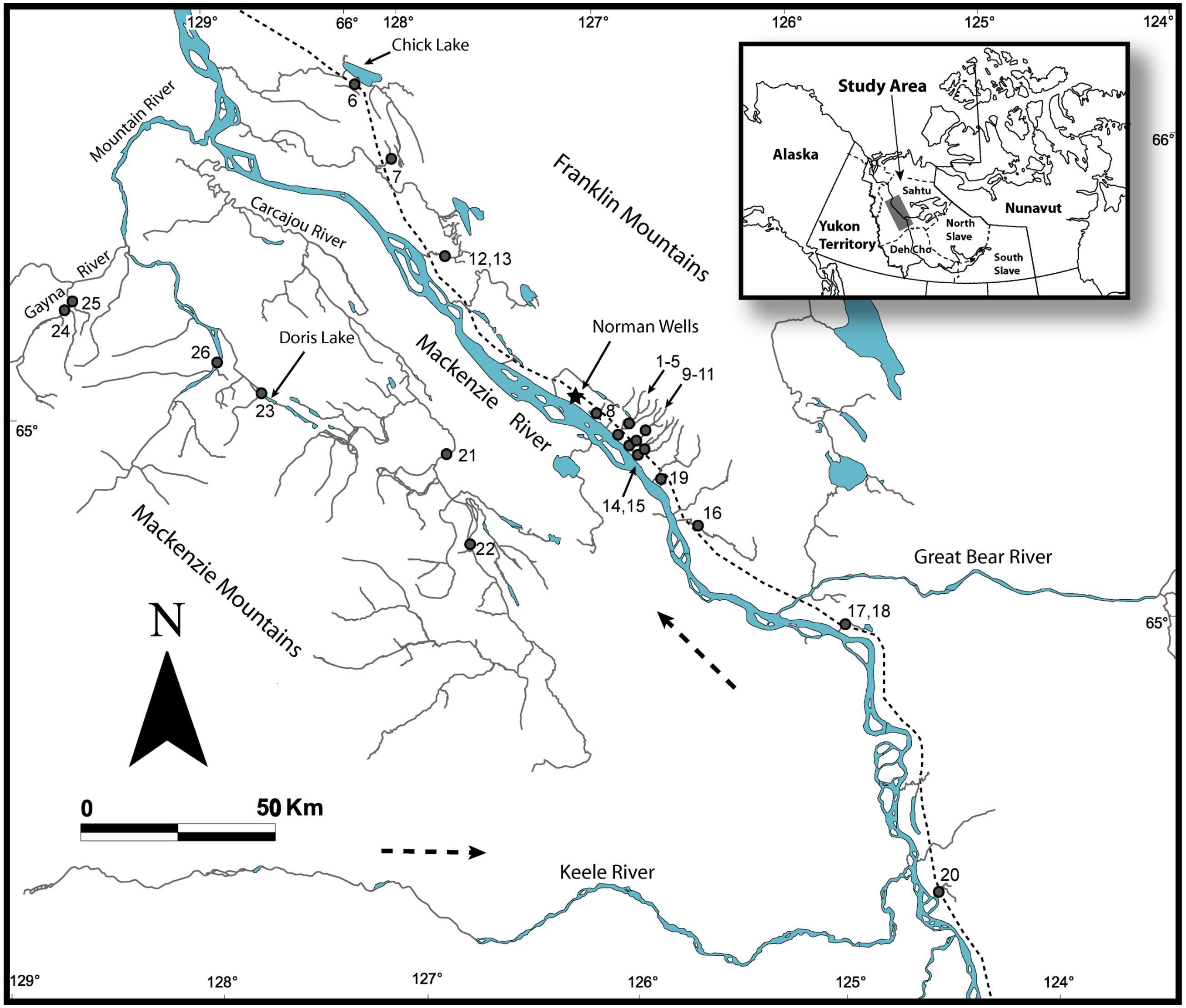

Figure 1. Sampling locations (dots) where stream surveys were completed in the Sahtu Settlement Area, 2006. The dotted line shows the proposed Mackenzie Gas Pipeline route, dashed arrows indicate flow direction, and not all drainages are shown.