

CHINOOK SALMON ASSESSMENT OF THE OLLIE LAKES DRAINAGE IN THE
UPPER STEWART RIVER WATERSHED.

CRE- 39-02

Prepared for:

The Yukon River Panel
Restoration & Enhancement Fund

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March, 2010

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ABSTRACT

This report presents the results of a field study conducted in August 2002 of the Ollie Lakes drainage, a Chinook salmon spawning area in the Upper Stewart River Watershed. The primary purpose of the study was to determine the current status of the Chinook run and provide preliminary data on the habitat characteristics. The headwaters of the drainage are a chain of lakes, locally referred to as the 'Ollie Lakes', situated approximately 150 km northeast of the community of Ross River. The outlet stream (Ollie Creek) flows for about 32 km from its headwaters northwesterly to its confluence with an unnamed tributary of the Hess River. A total of 34 live and 3 dead Chinook spawners was observed in a 2 km section of Ollie Creek immediately below the lower lake during ground surveys between August 17 and August 19, 2002. Juvenile Chinook salmon were captured in Ollie Creek and in the stream connecting the two lower lakes. The average length of the 52 jcs captured was 72 mm and the mass 4.2 g. An aerial survey conducted on August 25, 2002 of the Ollie Lakes drainage resulted in a total count of 21 spawners. These were observed in the upper 6 km of Ollie Creek. Fish observed at this time were mostly unpaired and a number of redds were uninhabited suggesting peak spawning was over. Stream habitat characteristics including water quality and benthics are described for four reaches of Ollie Creek below the outlet lake and the lower 250 meters of the inlet stream of the lower lake. The Ollie Creek drainage remains unaffected by human activity at this time and supports a small but important Chinook spawning population in the Upper Stewart River Watershed.

INTRODUCTION

The Ross River Dena Council (RRDC) in cooperation with federal and other agencies has undertaken a number of projects within their traditional territory in recent years to collect data on Chinook salmon (*Onchorynchus tshawytscha*) populations and their habitats with the goal to protect and rebuild existing Chinook salmon stocks. The traditional territory of the RRDC encompasses Chinook salmon spawning and rearing streams in the Pelly River and Upper Stewart River drainages. Most of the current information on salmon utilisation in their traditional territory has been obtained from studies conducted on the Pelly River system, primarily in locations that are accessible by boat or road. Conducting studies on salmon utilisation in the Upper Stewart River drainage has been more difficult, however, because of its remoteness. The drainage is a considerable distance north of the Village of Ross River and cannot be easily accessed by road or by boat. Either a floatplane or helicopter is required to assess and monitor Chinook spawning streams in this area, which is generally not economically feasible on a regular basis.

It is important for the RRDC to obtain information on Chinook salmon utilisation in the Upper Stewart River drainage and find economical ways to monitor salmon populations and their habitats within the drainage. Of particular interest to the RRDC is a tributary of the Hess River known as the Ollie Lakes drainage where Chinook salmon are known to spawn. Situated on the outlet lake is the main camp of a family run hunting outfitting business where Ross River Dena members have often been employed as hunting guides. During their employment at the camp, RRDC members have fished for Chinook salmon at the outlet of Ollie Lakes for subsistence use. Since the outfitting business remains active, this may potentially provide an opportunity for RRDC to conduct annual monitoring programs by enlisting the assistance of members employed at the camp.

Existing information on the salmon resource in the Ollie Lakes drainage is limited to an aerial enumeration survey conducted in 1968 and anecdotal information (Cox 1999). During the 1968 survey, a total of 67 Chinook salmon was observed in the upper 10 miles (est.) (16 km) of the outlet stream. There were no Chinook observed in the inlet stream of the lower lake during this survey, however, mention was made in the survey notes of two Chinook salmon being observed here by people at the hunting camp (Cox 1999). The hunting outfitter, interviewed in 2001 by the author, recalled seeing a large (unknown) number of spawners in the outlet stream during the late 1960's, but noted a considerable decline in the number of fish returning in recent years (Werner Koser, personal communication).

In 2002, the RRDC with the contracted biologist undertook a project to determine the current status of the Chinook run and provide preliminary data on the habitat characteristics in the Ollie Lakes drainage. This report presents the findings from these investigations.

The specific objectives of this project were as follows:

- To inventory and map characteristics of chinook salmon habitat in known spawning area;
- To identify and map possible obstructions to migration and/or disruptions/disturbances to habitat;

- To assess the current level of chinook salmon use;
- To provide training and employment for members of the Ross River Dena Council;
- To foster a stewardship and conservation ethic among user groups of the identified area.

Funding for this study was provided by the Yukon River Panel Salmon Restoration & Enhancement Fund under the U.S./Canada Yukon River Agreement of the Pacific Salmon Treaty.

STUDY AREA

Ollie Creek¹ (outlet stream) flows for about 32 km from its headwaters northwesterly to its confluence with an unnamed tributary of the Hess River (Figure 1). Its headwaters are a chain of lakes, locally referred to as the 'Ollie Lakes', situated approximately 150 km northeast of the community of Ross River. The drainage is fed by tributaries originating in the Hess Mountains and has a total drainage area of approximately 1,248 km².

The drainage lies in the Selwyn Mountain ecoregion, which encompasses the Hess and Logan mountains (Yukon Ecoregions Working Group 2004). These are rugged, high mountain ranges with many supporting alpine glaciers. The ecoregion has high annual precipitation, and as a result, permafrost in the valleys is often absent or discontinuous due to the insulating effect of heavy snowfall. The region was heavily glaciated during the McConnell glaciation of the Yukon. During the postglacial period, streams incised into the glaciated terrain left flights of stream terraces and built alluvial fans.

The Ollie Lake system drains through a valley comprised of sub alpine vegetation. White spruce trees are stunted and grow sporadically in a matrix of dwarf willow and birch shrubs with a ground cover of lichen and moss. Riparian vegetation is comprised primarily of a dense cover of dwarf willow shrubs and grass/sedge communities.

Human activity in the area includes hunting and trapping of wildlife and mineral exploration. A hunting outfitter's camp is located on the outlet lake above the area of spawning. Access to the drainage can be gained by floatplane or overland from the North Canol Road on foot or horse.

¹ The outlet stream is not named on topographic maps but is referred to as Ollie Creek for the purposes of this report.



Figure 1. Ollie Lakes Drainage

METHODS

The study area was accessed by floatplane (Turbo Otter) operated by Black Sheep Aviation out of Mayo. The flight was scheduled for August 16 but delayed until the 17th due to poor weather conditions. A base camp for field investigations was set up at the hunting outfitter's cabin offered by the outfitter for our use. A lake boat, also provided by the hunting outfitter, was used to access the creek from the lake. Reaches of Ollie Creek were accessed by canoe.

Juvenile Chinook salmon (jcs)

On August 17-18, 2002, 19 Gee-type minnow traps were set in various habitat types in reaches 1 & 2 of Ollie Creek, downstream of the outlet lake, and in the lower reach of the inlet stream of the lower lake to determine the presence of jcs. Each trap was baited with a walnut-sized portion of Yukon River origin salmon roe suspended in a perforated plastic sandwich bag. After approximately 24 hours, the traps were retrieved and catches identified and enumerated. Captured juvenile salmon were measured for length and weight (using a digital scale accurate to ± 0.1 grams).

The results of the trapping program were expressed as the number of fish trapped per number of hours the trap was set (CPUE). Biological data including: average length, average weight and average condition factor, was determined for jcs captured. Condition factor (K) was calculated for salmon fry using the formula: $K = \text{weight (grams)} \times 100 / [\text{length (cm)}]^3$. The condition factor is used as an indicator of the general health and condition of salmonids.

Beach seining was used to determine the presence of other fish species. Seining was restricted to depths of less than one meter in areas where a suitable landing site was available.

Adult Chinook salmon

A visual count of adult Chinook salmon was conducted from shore during the on-ground field investigations between August 17 and August 19. Chinook carcasses found were sampled for DNA material by removing a small portion of fin tissue. Tissue samples were preserved in 95% alcohol and later sent to Fisheries & Oceans Canada (DFO), Whitehorse for DNA analysis.

An aerial survey of the Ollie Lakes drainage was conducted to enumerate adult Chinook salmon and determine extent of spawning. The survey was conducted on August 25 using a Bell 206B Jet-ranger helicopter out of Ross River. Starting from the uppermost lake in the chain of lakes, the drainage was flown downstream approximately 25 km to the confluence of an unnamed tributary entering Ollie Creek from the southeast (Figure 3). Turbid water discharging from this tributary obscured visibility beyond this point and the survey was ended.

Benthic community

A benthic sample was collected using a 30 cm D-frame invertebrate kick net sampler with a 363 micron mesh. Invertebrates were dislodged from the substrate at three locations for a total sample area of one square metre. Dislodged invertebrates and debris collected in the net held downstream of the disturbed substrate were then transferred to a one litre nalgene bottle, preserved in a 10% formalin solution and later sent to Laberge Environmental Services of Whitehorse to be sorted, identified and enumerated.

Physical Measurements

Basic water quality components including: temperature, pH and dissolved oxygen were measured in-situ using an Oxyguard Handy Beta Oxygen Meter and pHep ®3 (Hanna Instruments) pH tester. Velocity and discharge were determined using the floating object method at a site approximately 200 m downstream of the outlet lake. A water sample was taken from Ollie Creek for analysis of nutrients, anions and metals. The samples were transported on ice and shipped to Norwest Laboratories in Surrey, B. C. for analysis upon return to Whitehorse.

Habitat characteristics

Prior to field investigations, preliminary reach breaks were identified from air photo interpretation (1:40,000 scale flown in 1949). A 2 km section of Ollie Creek was investigated downstream of the outlet of the lowermost lake. Four distinct reaches were identified in this section of the creek (Figure 2). The lower 250 m of the inlet creek of the lower lake was also investigated. Habitat features were identified and recorded at selected sites within each reach. Characteristics described for each reach investigated included: channel form, average channel width (wetted and bankfull), stream stage, habitat units (pool, riffle, run), average depth, bank characteristics, streambed material, riparian zone composition and available cover. Inventory procedures were based on the methodology and description of characteristics in the Stream Survey Field Guide - Fish Habitat Inventory & Information Program (DFO, MOE/B.C.).

RESULTS

Juvenile Chinook salmon (jcs)

A total of 51 juvenile Chinook salmon (jcs) was captured in minnow traps set in reaches 1 and 2 of Ollie Creek and one jcs was captured in the inlet stream. The total trapping hours in Ollie Creek was 308.75, representing a catch per unit effort (CPUE) of 0.2. The average fork length of jcs captured was 72.3 mm and the average weight, 4.3 g. The condition factor (K), which is used as an indicator of the general health and condition of salmonids, averaged 1.13. Generally, a higher condition value is preferred to a lower value (Moodie 2000) although no standards for comparison have yet been developed for the Yukon River system. A higher condition factor could mean greater over-wintering success. Results of minnow trap catches are presented in Appendix 2.

It is assumed that jcs captured were all young-of-year (0+) (fry emerged in 2001). Although no scale samples were taken for age determination of jcs captured, weight at length comparisons of fry in Croucher Creek in the Upper Yukon River system (Moodie 2000) indicate the general length range of young-of-year (0+) jcs to be between 40 - 90 mm.

Other fish species captured in traps and in seine sets in the outlet and inlet streams included: Slimy Sculpins at various life stages, juvenile Burbot and one juvenile Arctic Grayling.

Adult Chinook salmon

During on-ground field investigations a total of 34 live and 3 dead Chinook salmon spawners was observed on redds in reaches 1 and 2 of Ollie Creek. There were no adults observed in the lower reach of the inlet stream. Spawning activity appeared to be at its peak as most salmon were observed on redds in groups or pairs.

During the aerial survey on August 25, a total of 11 live and 10 dead Chinook salmon spawners was observed. All Chinook observed were located in the upper 6 km of Ollie Creek (Figure 3). There were a few vacant redds observed and most salmon were unpaired suggesting that peak spawning activity had passed.

Survey conditions were rated good from the uppermost lake in the Ollie Lake system to a point approximately 25 km downstream of the outlet. Water conditions up to this point were very clear. Turbid water flowing from a glacial fed stream entering Ollie Creek from the southeast obscured visibility below this point. Although sunny conditions were observed during the initial part of the survey, cumulous clouds built up to the north resulting in light isolated rain showers toward the end of the survey. These conditions did not hamper visibility, however, as the pilot was able to flow at very low level due to the open canopy through the creek valley.

Benthic community

Analysis of the benthic sample collected indicates a diverse and abundant invertebrate community in Ollie Creek. Pollution intolerant insects including, Plecoptera (stoneflies) and Ephemeroptera (mayflies), were well represented in the sample collected indicating good water quality (Appendix 3). The majority of the invertebrates (over 85%) were stoneflies belonging to the family Perlodidae followed by mayflies from the families Ephemerellidae and Siphonuridae. The third most abundant group of invertebrates were aquatic earthworms (Oligochaeta) belonging to the family Lumbriculidae, which inhabits cold mountain streams.

Physical measurements

In-situ water quality measurements taken in Ollie Creek and the inlet stream of the lower lake on August 18-19 are presented in Table 1.

Table 1 In-situ water quality measurements, Ollie Creek, August 18, 2002.

	Outlet stream	Inlet stream
Water temperature	11.1°C	9.6°C
Dissolved Oxygen	11.8 ppm	11.5 ppm
Dissolved Oxygen (% saturation)	106 %	99%
Water clarity	Clear	Clear
pH	7.5	7.5
Velocity*	0.69 m/sec	-
Discharge	4.46 m ³ /sec	-

*estimated using floating orange method

The results of the water quality sample collected during this study are presented in Appendix 4. Of the 28 metals analysed, 11 were below the method detection limit in the sample. Overall, the surface water quality had very low concentrations of metals and nutrients.

Habitat characteristics

Ollie Creek drains a chain of ponds and narrow lakes descending from an elevation of 1,040 metres to 940 metres at the mouth of the creek. Shallow, narrow streams connect the upper ponds and lakes. During the overflight, evidence of old and recent beaver activity was observed in these streams. The stream connecting the lower two lakes (inlet stream) is wider with good flow and cobble/boulder substrates. No beaver activity was observed in this stream.

The habitat descriptions and site photographs of the stream reaches in Ollie Creek and the lower reach of the inlet stream of the lower lake investigated on ground are presented in Appendix 1.

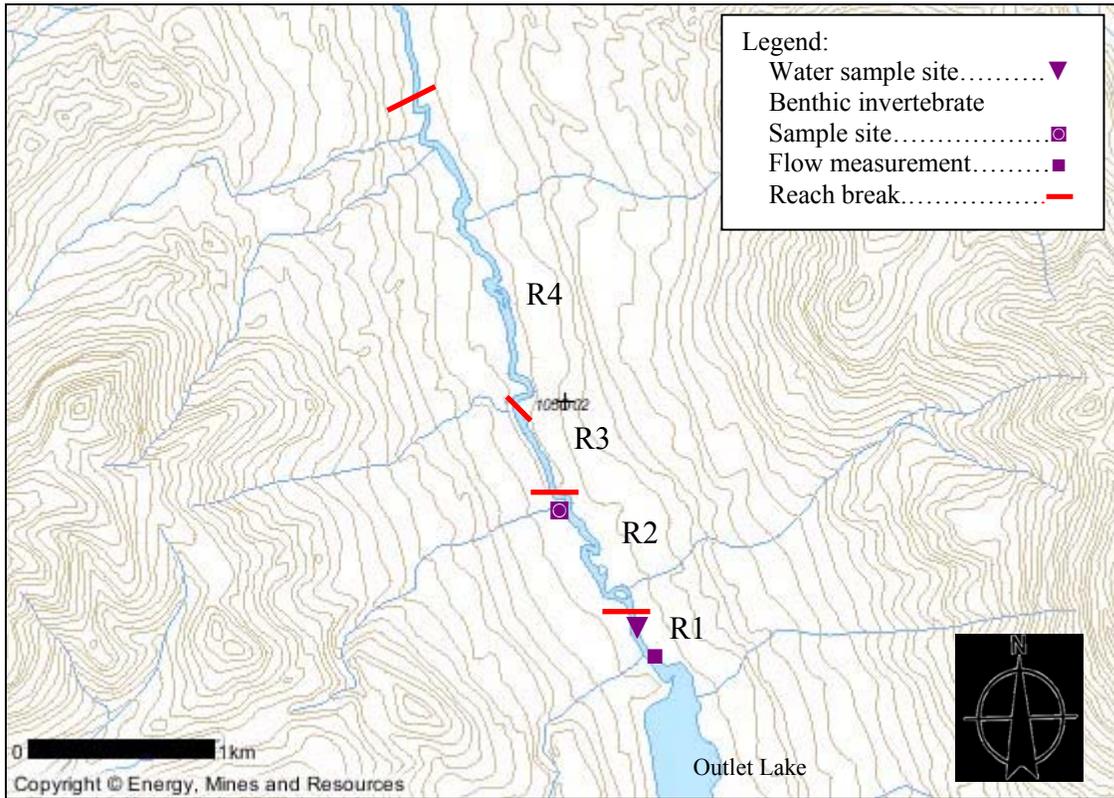


Figure 2. Reach breaks and sample sites, outlet of Ollie Lakes

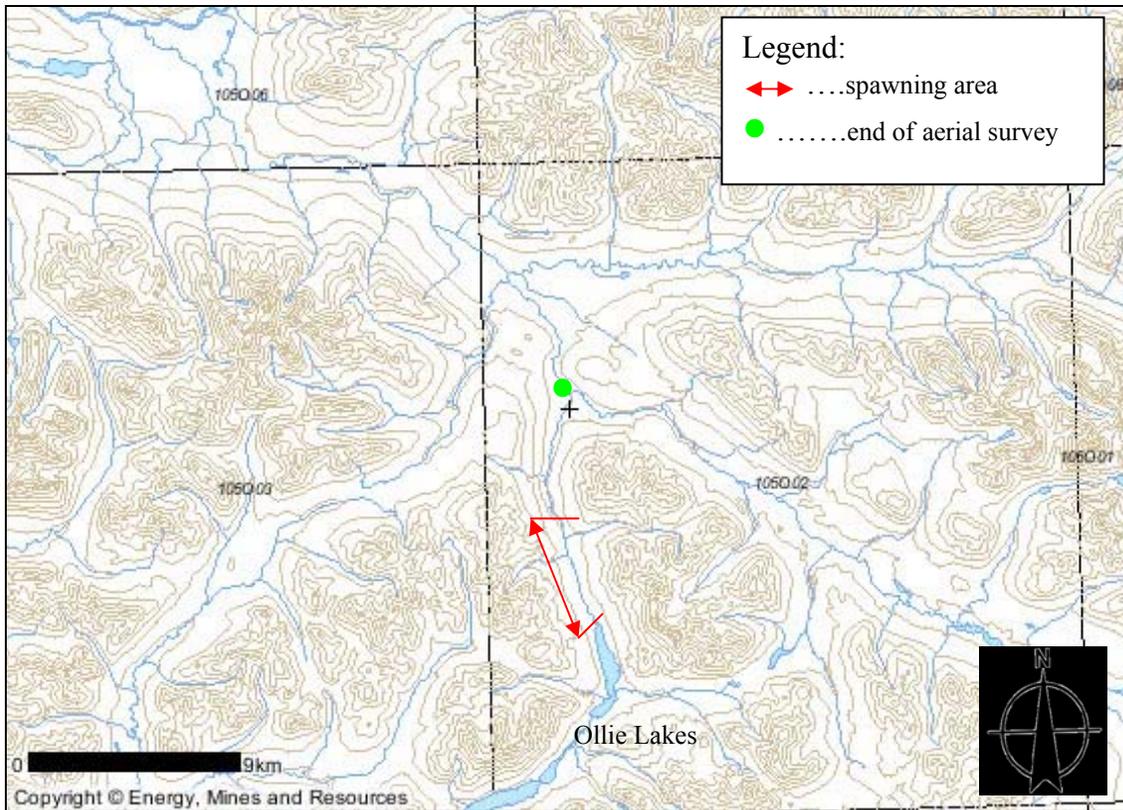


Figure 3. Extent of observed Chinook salmon spawning during aerial survey

DISCUSSION

Investigations of the biological and physical characteristics of Ollie Creek in 2002 indicate that conditions are presently adequate for all life stages of Chinook salmon. The primary area of spawning appears to be within the first 6 km of Ollie Creek downstream of the outlet lake. Limited spawning is likely possible in the inlet stream of the lower lake.

The Ollie Lakes drainage has remained essentially unaffected by human activity. Accounts by a hunting outfitter, which indicate a relative abundance of Chinook salmon in Ollie Creek at one time and the present available habitat, indicate that the drainage is currently capable of supporting a higher population of Chinook salmon. Careful consideration should be given to land use practices that could have potential deleterious effects on the habitat of this drainage and rivers downstream.

Recommendations for further study include the following:

1. Continue monitoring the Chinook salmon population in the Ollie Lakes drainage.
2. Monitor water conditions including water quality and water temperature on an annual basis to provide information that can be used to compare changes over time. It may be possible to set up a monitoring station by enlisting the assistance of the outfitter or hunting guides.

ACKNOWLEDGMENTS

The author would like to thank Testloa Smith and Stu Withers for assistance in conducting the field assessments and Bonnie Burns of Laberge Environmental for benthic analysis. A special thanks is extended to Werner and Peter Koser for sharing their knowledge of the area and providing the use of their cabin and boat.

REFERENCES

Cox, Jody 1999. Salmon in the Yukon River Basin, Canada – a compilation of historical records and written narratives. Cre-17-98.

Moodie, S., J.A. Grout, and A. von Finster, 2000. Juvenile Chinook Salmon (*Oncorhynchus Tshawytscha*) utilization of Croucher Creek, a small non-natal tributary of the Upper Yukon River during 1993. Can. Manusc. Rep. Fish. Aquat. Sci. No. 2531.

Yukon Ecoregions Working Group, 2004. Selwyn Mountains. In: Ecoregions of the Yukon Territory: Biophysical properties of Yukon landscapes, C.A.S. Smith, J.C. Meikle and C.F. Roots (eds.), Agriculture and Agri-Food Canada, PARC Technical Bulletin No. 04-01, Summerland, British Columbia, p. 149-156.

APPENDIX 1. REACH DESCRIPTIONS

Ollie Creek – Outlet of Ollie Lakes

Reach 1 - Reach extending approximately 430 m downstream from outlet of Ollie Lakes.

Sample site: UTM coordinates: 9V 4 03 434E 69 95 327N

Date investigated: August 17

Reach characteristics

Channel form	Unconfined, sinuous
Wetted width	15 m
Channel width	17 m
Water stage	Medium
Gradient	< 1%
Habitat units	80% run/glide, 20% riffle
Water depth (average)	0.45 m
Banks	Low, stable, vegetated, sand and gravel
Substrates	50% small cobble, 40% large cobble, 10% gravel, interstitial sand
Riparian vegetation	Grasses/sedge, willow shrub predominant, occasional/rare white spruce.
Cover	An estimated 20% of reach provides cover for fish. Composition of total cover: 50% cutbank, 50% overhanging vegetation.
Comments:	2 live chinook spawners observed in reach



View of Reach 1, Ollie Creek, looking upstream approximately 250 meters downstream of outlet of Ollie Lakes.

Ollie Creek – Outlet of Ollie Lakes

Reach 2 - Total reach length: approximately 700 m.

Sample site: UTM coordinates: 9V 4 03 504E 69 95 562N

Date investigated: August 18

Reach characteristics

Channel form	Occasionally confined, irregular wandering, occasional vegetated island
Wetted width	14.5 m
Channel width	15 m
Water stage	Medium
Habitat units	70% run, 30% riffle, An estimated 50% of the reach length with connecting still water areas and side channels.
Water depth (average)	0.50 m
Banks	vegetated sand/gravel banks rising to 1.2 m, Unstable shale slope on west bank rising to approximately 10 m.
Substrates	40% gravels, 40% small cobble, interstitial sand, 20% fines (muck) in still water areas.
Riparian vegetation	Grasses/sedge, mosses, occasional horsetail, dwarf willow shrub predominant, occasional/rare white spruce.
Cover	An estimated 50% of reach provides cover for fish. Composition of total cover: 50% side channel/still water areas, 40% cutbank, 10% overhanging vegetation
Comments:	One male chinook carcass – length 670 mm (POH)



View of Reach 2, Ollie Creek, looking west. Note still water areas and connecting side channels.

Ollie Creek – Outlet of Ollie Lakes

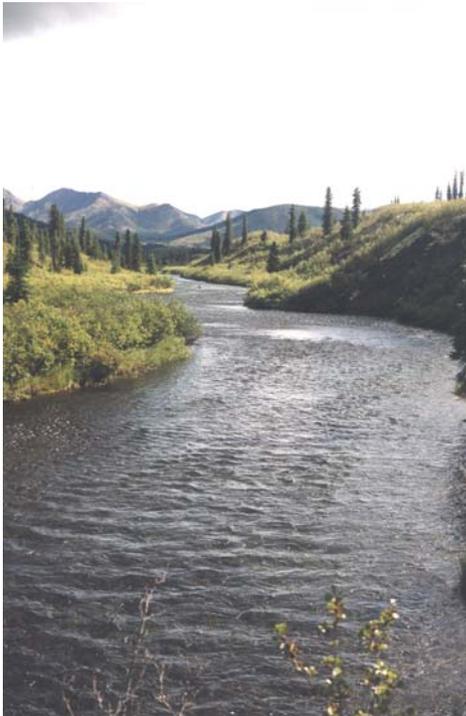
Reach 3 - total reach length: approximately 525 m

Sample site: UTM coordinates: 09 4 02 876E 69 96 477N

Date investigated: August 18

Reach characteristics

Channel form	Confined on west bank
Wetted width (ave.)	18 m
Channel width (ave.)	19 m
Water stage	Medium
Gradient	< 1%
Habitat units	50% riffle; 50% run
Water depth (ave.)	0.45 m
Banks	Stable sloping vegetated banks, and unstable slopes of shale.
Substrates	10% gravel, 80% large cobble, 2% boulder, interstitial sand
Riparian vegetation	Grasses, dwarf willow shrub, dwarf birch on higher ground, occasional/rare white spruce, slopes with caribou moss and grasses
Cover	Estimated 30% cover. Composition of total cover: 40% cutbanks, 40% overhanging vegetation, 20% boulder
Comments:	Observed 25 live chinook spawners and 1 male carcass (POH 760 mm, MEF 850 mm)



View of Reach 3, Ollie Creek, looking upstream.

Ollie Creek – Outlet of Ollie Lakes

Reach 4 - total reach length: approximately 1.6 km

Sample site: UTM coordinates: 9V 4 02 848E 69 96 886N

Date investigated: August 18

Reach characteristics

Channel form	unconfined, irregular wandering
Wetted width (ave.)	23 m
Channel width (ave.)	25 m
Water stage	Medium
Habitat units	90% riffle, 10% run
Water depth (ave.)	0.35 m
Banks	Low, stable, consist of organics/moss
Substrates	40% gravel, 30% small cobble, 20% large cobble, 5% boulder, 5% sand
Riparian vegetation	Grasses/sedges, moss, thick dwarf willow shrub, dwarf birch on higher ground.
Cover	estimated 20% cover for fish. Composition of total cover = 70% cutbank, 20% overvegetation (grasses), 10% boulders.
Comments:	Good chinook spawning potential



View of Reach 4, Ollie Creek, looking downstream.

Inlet Stream of Lower Ollie Lake

Inlet stream - surveyed 250 m upstream of outlet lake.

Sample site: UTM coordinates: 09 403247 E 69 91 193N

Date investigated: August 17

Reach characteristics

Channel form	Occasionally confined, irregular meander
Wetted width	12 m
Channel width	20 m
Water stage	Medium
Habitat units	60% run, 20% riffle, 20% deep pool
Water depth (average)	0.50 m
Banks	West bank low, stable, consisting of organics, east bank rising to 4 m, stable, well vegetated slope of gravel & sand.
Substrates	70% gravel, 20% sand (muck in pool), 10% cobble
Riparian vegetation	Grasses/sedge, dwarf willow shrub predominant, occasional/rare white spruce.
Cover	An estimated 40% of surveyed area provided cover for fish. Composition of total cover = 40% deep pool, 30% overhanging vegetation, 20% cutbank, 10% LOD.
Comments:	Good rearing habitat provided

Appendix 2. Juvenile Chinook Salmon Collection Data, Ollie Lakes Drainage, August 18-19, 2002.

REACH 1 – outlet stream of Lower Ollie Lake (Ollie Creek)					
Date	Method	Total CH Captured	Length (mm)	Weight (g)	Incidental * Catch (total #)
Aug. 18	G-traps, ¼" mesh, 7 traps	25	73	4.6	GR (1)
			67	4.1	
			67	3.9	
			74	4.7	
			68	3.9	
			74	4.2	
			74	4.0	
			77	5.4	
			68	3.0	
			77	5.2	
			73	4.4	
			75	5.2	
			69	3.6	
			84	6.6	
			70	3.4	
			67	3.3	
			73	5.1	
			70	3.6	
			70	4.9	
			73	4.2	
			76	4.6	
66	2.8				
66	3.1				
65	4.0				
80	5.7				
Aug. 18	Beach seine - 2 sets	0	-	-	SS (8) GR-adult (1)

REACH 2 – outlet stream of Lower Ollie Lake					
Date	Method	Total CH Captured	Length (mm)	Weight (g)	Incidental * catch (total #)
Aug 19	G-trap, ¼" mesh, 7 traps	26	73	3.8	BB (3) SS (3)
			73	4.4	
			73	3.8	
			78	5.7	
			70	3.8	
			76	5.5	
			85	6.4	
			70	4.1	
			77	5.1	
			71	3.6	
			75	4.9	
			71	3.7	
			66	3.1	
			72	3.8	
			70	3.7	
			67	3.2	
			65	3.9	
			70	3.6	
			80	5.4	
			69	3.5	
			71	4.1	
			80	5.7	
			77	5.1	
			72	4.2	
			70	3.9	
			68	4.0	

Inlet stream of Lower Ollie Lake					
Aug 18	G-traps, ¼" mesh 5 traps	1	72	4.2	SS (5)
Aug 18	Beach seine – 1 set	0	-	-	SS (16)

- **Fish species:** **BB** – burbot; **GR** – Arctic Grayling; **SS** – Slimy Sculpin

Appendix 3. Benthic Invertebrates, Ollie Creek – Reach 2, August 18, 2002.

Taxon	Reach 2	
	# of individuals	% of community
PHYLUM ARTHROPODA		
Class Insecta		
Pupae	2	0.6
Order Diptera (trueflies)		
Family Chironomidae	7	2.2
Order Plecoptera (stoneflies)	1	0.3
Family Perlodidae	270	85.7
Order Trichoptera (caddisflies)		
Family Limnephilidae	2	0.6
Order Ephemeroptera (mayflies)		
Family Ephemerellidae	15	4.8
Family Siphonuridae	4	1.3
Family Baetidae	3	1.0
PHYLUM ANNELIDA		
Class Oligochaeta		
Family Lumbriculidae	11	3.5
Abundance	315	100
Diversity	9	

Appendix 4. Water Quality Analysis, Reach 1- Ollie Creek, August 19, 2002.

	Units	Results	Detection Limit
Inorganic Nonmetallic Parameters			
Phosphate (as P)	mg/L	<0.05	0.05
Metals			
Silicon	mg/L	3.03	0.05
Sulphur	mg/L	19.5	0.05
Mercury	mg/L	<0.0001	0.0001
Aluminum	mg/L	0.052	0.005
Antimony	mg/L	0.0004	0.0002
Arsenic	mg/L	0.0006	0.0002
Barium	mg/L	0.064	0.001
Beryllium	mg/L	<0.0001	0.0001
Bismuth	mg/L	<0.0005	0.0005
Boron	mg/L	0.004	0.002
Cadmium	mg/L	0.0008	0.00001
Chromium	mg/L	<0.0005	0.0005
Cobalt	mg/L	0.0004	0.0001
Copper	mg/L	<0.001	0.001
Lead	mg/L	<0.0001	0.0001
Lithium	mg/L	0.003	0.001
Molybdenum	mg/L	0.002	0.001
Nickel	mg/L	0.0208	0.0005
Selenium	mg/L	0.0027	0.0002
Silver	mg/L	<0.0001	0.0001
Strontium	mg/L	0.134	0.001
Thallium	mg/L	<0.00005	0.00005
Tin	mg/L	<0.001	0.001
Titanium	mg/L	0.001	0.0005
Uranium	mg/L	<0.0005	0.0005
Vanadium	mg/L	0.0003	0.0001
Zinc	mg/L	0.11	0.001
Zirconium		<0.001	0.001
Physical and Aggregate Properties			
Temperature of observed Ph	°C	26.7	
Total suspended solids	mg/L	<1	1
Other			
PH		7.67	
Calcium	mg/L	23.8	0.2
Magnesium	mg/L	10.1	0.2
Sodium	mg/L	0.6	0.4
Potassium	mg/L	0.5	0.4
Iron	mg/L	0.01	0.01
Chloride	mg/L	<0.5	0.5
Fluoride	mg/L	0.17	0.04
Nitrate – N	mg/L	<0.004	0.004
Nitrite – N	mg/L	<0.002	0.002
T- Alkalinity (as CaCO ₃)	mg/L	47	5
Hardness (as CaCO ₃)	mg/L	101	

