

**Investigations into Fish Habitats of Tributaries to the
Pelly and Macmillan Rivers
2002**

**Prepared For
Selkirk Renewable Resource Council**

As part of project CRE-27-02

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Restoration and Enhancement Fund**

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March 2003

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1.0 ABSTRACT

Investigations into fish habitats and fish utilization of tributaries to the Macmillan and Pelly Rivers upstream of the confluence of these two rivers (Figure 1) were conducted during July and August, 2002. The emphasis of these investigations was to determine current fish values of the tributaries and denote spawning areas. Adult chinook salmon were recorded for the first time in the Tummel River. Extensive areas of under-utilized spawning habitat were recorded on the Earn River. Sampling in mix water zones of the tributaries with the Pelly and Macmillan Rivers showed these areas support significant numbers of several fish species, particularly juvenile chinook salmon and juvenile whitefish (spp.). Juvenile chinook salmon were well dispersed in the larger, clear water tributaries and in rivers, but were found sporadically in the smaller tributaries. A total of 13 fish species were encountered during the study including; chinook salmon, slimy sculpin, Arctic grayling, northern pike, lake chub, long nose sucker, burbot, round whitefish, broad whitefish, least cisco, lake whitefish, inconnu and Arctic lamprey.

2.0 INTRODUCTION

The Pelly River and its main tributaries, especially the Macmillan River, comprise an important chinook salmon spawning and rearing habitat. Other than some of the larger spawning aggregations, little information has been collected in this drainage in terms of identifying or characterizing important habitat areas. Water quality information in the drainage is poorly understood and with little documentation. The headwaters of the drainage are heavily mineralized and several natural acid drains occur. Mining activity occurs in these headwater areas, with several mines either abandoned or still operating. The prospects for more mining activities in the area remain high. Gaining an understanding of the important habitat areas allows characterization of those habitats and provides the tools for informed fisheries management in the Pelly drainage. This in turn will help ensure that the Pelly River stocks continue to be an important component of Yukon River chinook salmon stocks.

The objectives of this project were as follows:

- To initiate detailed fisheries assessments from tributaries to the Pelly River.
- To initiate the mapping of spawning areas near the confluence of the Macmillan and Pelly Rivers.
- To increase communication and strengthen the partnership between the Selkirk Renewable Resource Council (SRRC) and the Selkirk First Nation (SFN) Lands and Resources Dept
- To provide training and employment for Selkirk First Nation community members and continue to foster a stewardship and conservation ethic towards salmon and salmon habitat in the SFN traditional territory.

3.0 STUDY AREA

The project study area lies entirely within the Selkirk First Nation Traditional Territory and includes the Pelly River upstream of Pelly Crossing to Harvey Creek and the tributaries to the Macmillan River, upstream of the Pelly to Moose River (Figure 1). The main area of focus was upstream of the confluence of the Macmillan and Pelly Rivers. Three tributaries to the Pelly River including the Earn River, Tummel River and Harvey Creek were investigated. A total of 21 tributaries to the Macmillan River were investigated.

4.0 METHODS

The Macmillan River between the Pelly and Moose Rivers has 33 tributaries as identified on 1:250,000 scale topographic maps. Most of the smaller tributaries have not been named; therefore for the purpose of this investigation each tributary was assigned a sequential number. Starting at the downstream end the first tributary was labelled tributary #1; Moose River at the upstream end was labelled tributary #33. Three major tributaries to the Pelly River upstream of the confluence of the Pelly and Macmillan Rivers were investigated (Figure 1)

Tributary orders used in this report are based on “Staler hierarchy of streams model” where a First(1st) order tributary has no feeder creeks entering it, second (2nd) order creeks have at least 2 1st order tributaries coming together, a Third (3rd) order tributary has 2, 2nd order tributaries coming together, and a Fourth (4th) order tributary has 2, 3rd order feeders. It takes at least 2 streams of any given order to form a stream of the next higher order (Strahler, 1957).

Field investigations were staged from Pelly Crossing, Yukon. The study area was accessed on two separate occasions by boat from Pelly Crossing. Tributaries to the Macmillan were investigated between July 29 and August 3, 2002. The three tributaries to the Pelly River were investigated between August 8 and 12, 2002.

Investigations focused on the lower reach of each tributary, including the zone of river influence, and then upstream for several hundred meters. Each tributary was assessed and described in terms of physical parameters and aquatic habitat including: average depth, average width (wet and dry), substrate, flow characteristics (pool, riffle, glide), available cover, channel and bank characteristics, and riparian vegetation. Potential rearing, over-wintering and spawning habitat quality were visually assessed. Water temperatures were recorded using a digital thermometer. A photographic documentation and record was made for each tributary. Surrounding vegetation and adjacent forest type and stage of succession was documented to provide an ecological context. Existing land uses such as cabins, camp sites or mining activities were also documented. The location, longitude and latitude, for each site was taken from a Garmin hand held GPS unit. The information was recorded on general description forms that were completed at each tributary; this data was later transferred to an Excel spreadsheet.

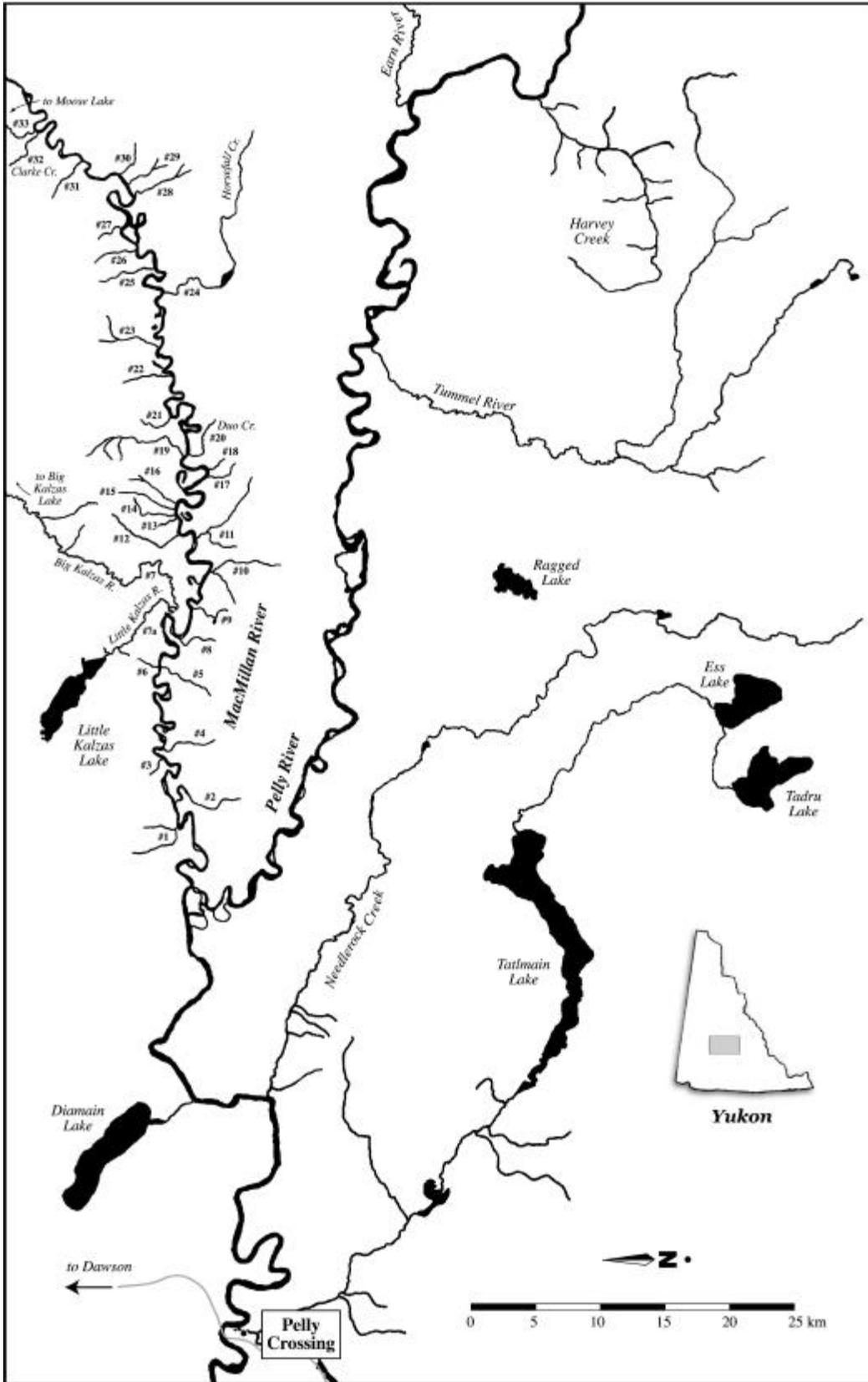


Figure 1. Study area for Pelly and MacMillan Rivers, tributary investigations, showing tributary numbers assigned to tributaries for the 2002 investigations.

During fisheries assessments, minnow traps, electro-fishing, seine nets, gill nets, angling and visual observations were used to determine fish presence. All fish captured, all capture data and all visual observations were recorded in the field and later entered into an Excel spreadsheet.

Electro-fishing was conducted in most tributaries however was not done at several suitable locations due to heavy rainfall at the time of investigation. Beach seining was only done at locations with suitable shoreline configurations. Beach seining was only conducted as a tool to denote fish presence/absence. Catch per effort from seining can be misleading as the effectiveness of seine pulls varied due to such factors as shoreline configuration water depth.

Minnow traps (Gee type, ¼" mesh) have been shown to be highly effective for Yukon River chinook salmon fry (Moody, 1993). Traps were baited with salmon roe suspended in the trap in a perforated plastic bag, and were set in a variety of habitat types following DFO's protocol for G-type minnow traps. When possible, traps were set overnight for a 24 hour period; however in situations when return visits on the following day were not possible, sets were made for periods ranging from 2 to 7 hours. Due to the variability in set duration, minnow trapping CPUE data should be interpreted somewhat cautiously. Effort extended for all minnow trapping is expressed as number of fish caught per 24 hours per all traps set in the tributary to provide a comparative value between creeks.

Fish captured were handled delicately to allow for live release after sampling. Anaesthetics were not used. All fish captured or observed were identified as to species and general life stage (fry, juvenile, sub-adult, adult). A sub-sample of juvenile chinook salmon (jcs) was measured for fork length (+/- 1mm) and round weight (+/- 0.1 g). Weights were taken using a digital scale accurate to ± 0.1 gram and only in situations when the jcs were not in a stressed situation.

Relative condition factor (K) was calculated for jcs from tributaries where a length and weight measurements were recorded using the formula: $K = W * 10^5 / L^3$

Where W = round weight in grams

L = fork length in millimetres

A laser range finder was used to determine distances on the tributaries. Water quality was assessed using an F-set3 Multi Meter. Velocities were estimated using the floating object method. Discharge calculations were made by selecting a homogeneous 10 meter long reach of the tributary, average depth was measured as was average width; velocity was calculated by taking at least 10 separate timings, spread across the tributary of the floating orange to cover the 10 meter distance. Velocity was corrected for surface and bottom drag by using 0.8 as a correction factor, discharge was calculated with the formula; $Width \times Depth \times (Velocity \times 0.8)$.

Benthic sample collections were made at 4 tributaries, Earn River, Harvey Creek, Tummel River and Kalzas River. The collections were taken with a surber sampler (area = 0.0929 m²) which had a 300 micron mesh. The bed material within the frame was cleaned and washed by hand, with the fast flowing current carrying the disturbed bottom fauna and detritus into the collection bag. The level of effort for each sample and at each site was comparable. Triplicate samples were collected at each site and were combined to be analyzed as a single composite sample for each of these creeks. The captured invertebrates and detritus were placed in one litre nalgene bottles, preserved with 10% formalin. The samples were sorted, identified and enumerated by Bonnie Burns in Whitehorse, Yukon.

An aerial survey of the primary tributaries within the study area was conducted from a helicopter on August 17, 2002, when adult chinook salmon had moved onto their spawning grounds. The exact timing of the survey was decided in consultation with the Department of Fisheries and Oceans. The objective of the aerial surveys was to denote aggregations of spawning salmon within the tributary creeks and, if possible, the Pelly and Macmillan Rivers, and also to identify potential barriers to fish migration.

A search of the DFO FISS files was conducted. Files were searched for any and all information for all of the tributaries within the study area.

5.0 RESULTS

A total of 21 of the 33 tributaries to the Macmillan River were investigated. Tributaries not investigated typically had very little or no flow and it was determined they did not provide any measure of fish habitat at the time investigated, or, were inaccessible from the river due to the creek entering an old oxbow away from the river channel, or crews were unable to locate the outlet area. Individual descriptions of each tributary have been presented in Appendix 1.

Of the three tributaries to the Pelly River investigated both Earn and Tummel Rivers are 4th order (or greater) tributaries and Harvey Creek is a 3rd order tributary. Of the 33 tributaries to the Macmillan River, 21 were investigated, 10 of these were 1st order, 6 were 2nd order, 4 were 3rd order and 2 were 4th order (or greater)(Moose River and Big Kalzas River).

Very little background data for the study area was located during literature searches. Some information on the freshwater species utilization of the large headwater lakes Earn Lake and Big Kalzas Lake has been compiled. Limited information on Little Kalzas lake has also been compiled.

5.1 Fish Habitat and Utilization Evaluations

Minnow trapping effort varied at individual creeks, times set varied from 1.5 hours to 27 hours in duration, catches ranged from 0 to 93 jcs. The highest CPUE (93.7 jcs/24 hours) was recorded at Harvey Creek, where 7 traps were set for a period of 3 hours. Earn River had the highest individual trap catches. Minnow trap results have been presented in Table 1.

Electro fishing was conducted in 4th order tributaries and in tributaries that a return visit to collect overnight minnow trap sets was not possible. Earn River, Big Kalzas River and Harvey Creek showed the highest jcs utilizations. Electro-fishing results have been presented in Table 2.

Beach seining was limited to locations with suitable shoreline for landing seines and by water depth. Most of the suitable locations were located near the outlet of the tributaries in gravel apron areas. Mix water zones of the tributaries had significantly higher utilization by species other than jcs in all seines pulled in those areas. Significant numbers of jcs were recorded by beach seining in Moose River, Earn River and in the mix water zone of tributary #19. Beach seining results have been presented in Table 3.

Length weight relationships and condition factors (K) have been presented in Table 4. The highest condition factors were recorded in Earn River with an average of 1.25. The lowest condition factor (0.83) was recorded from the mix water zone of Tributary 19. Lengths ranged from 50 to 81 millimeters, and weights ranged from 1.1 to 8.1 grams.

Of the four 4th order tributaries, all had good, although varied fish habitats and showed significant levels of fish utilization. The Earn River, a high value natal river, showed much higher fish utilization (particularly salmon) than any of the other large tributaries during the field investigation. Moose River had a constant high turbidity level although still maintained coarse substrates. It was difficult to sample and likely supports a more diverse fish community than was indicated by study results. Big Kalzas River had new channels and much new woody debris in its lower reaches, making sampling during the field investigations difficult. The upstream reaches, particularly near Big Kalzas Lake likely provide important fish habitats; however these areas were not investigated during this study. On 2 separate occasions (field investigation and aerial survey) a single adult salmon was observed on The Tummel River. The Tummel River has been suspected as being a natal river but had not previously been documented as such. The Tummel River had high fish values and benthic utilization documented during field investigations.

There was a wide variation in quality of habitat within the 3rd order tributaries with Little Kalzas and Harvey Creeks both showing high utilization. The Little Kalzas system was likely the richest ecological community investigated during this study, it had a variety of habitat types, did not have beaver dam barriers and had an ambient temperature at least 4°C, warmer than any other tributary or the main rivers. The higher temperature may relate to hot springs in the headwater areas. The short stretch of Harvey Creek between

the beaver dams and the Pelly River had a high degree of utilization by jcs and adult Arctic grayling. Lone Hill Creek had very limited habitats and low levels of utilization by jcs, grayling and slimy sculpins. Clarke Creek had very limited utilization by jcs, slimy sculpins, northern pike and Arctic grayling, the low utilization levels are likely attributable to a distinct lack of cover within the creek.

The quality of fish habitats within the 1st and 2nd order drainages varied widely throughout the study area with some providing excellent, small, fish habitats and others providing little to no fish habitat. Most of the 1st order tributaries were ephemeral and dry at the time of investigation. Several of the 1st and 2nd order tributaries cascaded into the river and provided no upstream access for fish. Most of the small tributaries that flowed across the Macmillan flood plain for any distance showed signs of extensive beaver utilization. Only a few actually had current beaver activity.

Of the tributaries investigated, Harvey Creek had the highest average catch per unit of effort (CPUE) for juvenile chinook salmon for both minnow trapping (93.7 jcs/24hrs) and electro-fishing. Harvey Creek had limited amounts of habitats due to a beaver dam 600 meters upstream from the Pelly River that created a barrier to fish passage. The most extensive highly used habitat for juvenile chinook salmon was the Earn River. Average CPUE from overnight set minnow traps was 44.7 jcs/24 hrs.

Length and weight measurements were taken from jcs at 6 different locations, 5 sets of samples from tributaries and a single sample set from the mix water zone of Tributary #19 (Table 4). Samples from the mix water zone of Tributary #19 had the lowest average K factor (0.83) and Earn River had the highest K factor (1.25). Condition factors within the other tributaries ranged from 1.01 to 1.25. Earn River had the smallest jcs with an average length of 57.9 mm and an average weight of 2.49 grams. The greatest size range, including both the smallest and the largest jcs were recorded at Big Kalzas River, the largest individual fish recorded was 81 mm and 8.1 grams, the smallest jcs recorded was 50 mm and 1.1 grams, the average weight was 3.62 grams. Good sample sizes for fork length measurements were recorded at most tributaries where significant numbers of jcs were captured; weight measurements were not taken as extensively, with target weight samples from each tributary of 10 fish. The small sample size should be considered when reviewing the data.

In general, juvenile chinook salmon dispersion varied among all tributaries investigated. Utilization of large (4th order and greater) clear water tributaries was consistently high. Utilization of the smaller tributaries (<4th order) by jcs varied throughout the study area and for the most part when present was limited to a short area near the outlet to the main river. In most of the tributaries both slimy sculpin and Arctic grayling were abundant, burbot, round whitefish, northern pike and lake chub were occasionally encountered. A single Arctic lamprey was observed on Duo Creek.

The mix water zones where a tributary entered a larger river were consistently highly utilized fish habitat. The most extensive areas of fish utilization were recorded in areas where an alluvial apron or gravel bar occurred in the mix water zone and created shallow

riffles. These areas were utilized by juveniles of several species of fish including juvenile chinook salmon, slimy sculpin and a large variety of coregonids (broad whitefish, lake whitefish, inconnu, Arctic grayling, round whitefish and least cisco). Of note was that K factor for jcs taken in these areas was significantly lower than from samples taken from within the tributaries.

5.2 Helicopter Surveys

A helicopter supported survey of the study area was conducted on August 17, 2002. Due to the size of the study area and lack of road access our ability to conduct extensive helicopter surveys was limited. Turbidity precluded any visibility within the Macmillan River, visibility in the Pelly River was very limited, although did become clearer upstream of a landslide 30 km upstream of the confluence with the Macmillan River. No aggregations of salmon were observed in either of these major rivers.

The larger tributaries were the main focus for the surveys; however clarification of the outlets of some of the smaller tributaries was also conducted. The main focus of the surveys was placed on the Earn, Kalzas and Tummel Rivers.

The Tummel River had several Bald Eagles however only a single adult salmon carcass was observed near the outlet. Visibility was difficult and most of the deeper holes were invisible from the air. The Tummel River was flown for a distance of approximately 8 kilometers upstream of the Pelly River.

The Earn River was flown from its confluence with the Pelly River to Earn Lake, a direct distance of approximately 15 kilometers. A total of 395 adult chinook salmon were observed and recorded within the river during the flight. The majority of salmon observed were in three discreet and distinct areas of well developed spawning dunes, typical of major chinook spawning areas immediately downstream of large headwater lakes. The most densely utilized area was between 2 and 3 kilometers downstream of the lake. Of note was that less than half of the spawning dune areas were being well utilized by current year spawners and even areas with the highest densities of current year spawners showed much unused available spawning habitat.

On the Kalzas River the survey began upstream of Grey Hunter Creek and extended downstream to the confluence with the Macmillan River a distance of approximately 15 kilometers. Visibility was moderately poor due to light conditions and water color. In the lower reaches turbidity precluded observing adult salmon. A total of 12 chinook salmon adults were observed. A further 2 adult chinook salmon were observed in the lower reaches of Little Kalzas River during a short fly over.

5.3 Benthic Community Evaluation

Four different tributaries, Kalzas River, Earn River, Harvey Creek and Tummel River, were sampled for benthic invertebrates. The benthic community at Harvey Creek was the most abundant and most diverse, and was dominated by chironomids. Few Plecopterans or Trichopterans were found here, but Ephemeropterans were subdominant. The other

sites were fairly similar to each other in terms of abundance and richness. Ephemeroptera was the dominant or co-dominant group at each of these three sites. The majority of Ephemeropterans at these sites was in the family Heptageniidae. The benthic data have been presented in Appendix II

Of special note was the presence of a dipteran family, Blepharicridae (net winged midges) which was documented in Tummel River. The genus Philorus of this family has not previously been recorded in the Yukon.

The combined results from the benthic analysis have been forwarded to Environment Canada for inclusion in the Yukon Benthic data base.

Table 1: Summary of minnow trapping results* for all tributaries investigated between July 29 and August 11, 2002. Includes sets made in tributaries to Pelly and Macmillan Rivers. Catch per unit of effort (CPUE)= number of juvenile chinook salmon captured per 24 hours per all traps set in that tributary.

Ck #	Order	Name	# traps set	Effort (hrs set)	Catch (jcs)	Avg CPUE (jcs)	Other species
n/a	4 th	Tummel R.	7	15 hrs	21,9,6,8,0,1,5,1,5	12.8	1 BB, 1 chub
n/a	4 th	Earn River	12	25 hrs	19,28,46,67,64,32,7 6,75,27,26,93,6	44.7	1 chub
n/a	3 rd	Harvey Creek	7	3 hrs	6,2,2,43,0,29,0	93.7	
#7	4 th	Kalzas River	12	24 hrs	2,13,16,5,2,6,6,18,2 2,5,0,0	7.9	
#8	1 st	unnamed	2	27 hrs	0,7	3.1	
#9	1 st	unnamed	4	26 hrs	0,0,0,0	0	
#10	2 nd	unnamed	10	24 hrs	11,2,1,0,0,0,0,0,0,0	1.4	1 ss
#11	2 nd	unnamed	7	22 hrs	0,0,0,0,0,0,0	0	
#14	1 st	unnamed	4	7 hrs	0,0,0,0,0	0	
#19	2 nd	unnamed	7	3.5 hrs	0,0,0,0,0,0,0	0	
#20	3 rd	Duo Creek	14	20 hrs	All traps = 0	0	
#24	3 rd	Lone Hill Ck	6	2.5 hrs	All traps = 0		
#33	4 th	Moose R.	4	1.5 hrs	0,0,0,0	0	

* Species codes used in tables; jcs= juvenile chinook salmon, SS= slimy sculpin, BB= burbot, AG= Arctic grayling, NP= northern Pike, Chub= lake chub, AL= Arctic lamprey, LNS= long nose sucker, RWF= round whitefish.

Table 2. Summary of electro-fishing and catch* results for all tributaries investigated between July 29 and August 11, 2002 on the Pelly and Macmillan river tributaries.

Creek # & order	Tributary Name	Effort (secs)	JCS	SS	BB	AG	NP	AL	Chub	LNS
n/a 4 th	Earn River	961	118	51ad, >200 fry	1	1 ad	2			4
n/a 3 rd	Harvey Creek	510	89	13		4 ad	0	0	0	0
#33 4 th	Moose River	160	0	1	0	0	0	0	0	0
#33 4 th	Moose River	436	8	12	0	0	2	0	0	0
#33 4 th	Moose River	454	1	32	0	0	0	0	0	0
#32 3 rd	Clarke Creek	658	2	26	0	5	1	0	0	0
#24 3 rd	Lone Hill Creek	391	12	29	0	0	0	0	0	0
#20 3 rd	Duo Creek	125	0	1	0	0	0	0	0	0
#20 3 rd	Duo Creek	340	0	9	0	0	0	0	1	0
#20 3 rd	Duo Creek	258	0	12	1	2	0	1	0	0
#19 2 nd	Creek # 19	152	3	7	0	0	0	0	0	0
#7 4 th	Kalzas River	225	18	56 ad, >100 fry	0	14 fry	3	0	0	0
#7tri 3 rd	Little Kalzas	262	5	12	0	0	0	0	0	0
#10 2 nd	Creek # 10	310	3	12	0	0	1	0	0	0

* Species codes used in tables; jcs= juvenile chinook salmon, SS= slimy sculpin, BB= burbot, AG= Arctic grayling, NP= northern Pike, Chub= lake chub, AL= Arctic lamprey, LNS= long nose sucker, RWF= round whitefish.

Table 3. Summary of fish* recorded from beach seining conducted between July 29 and August 11, 2002. Includes effort made in tributaries to Pelly and Macmillan Rivers

Ck # & order	Name	Area Seined	Catch JCS	Catch SS	Catch AG	Catch RWF	Catch Others
n/a 4 th	Tummel R.	5 x 25m ²	4		2	3	1
n/a 4 th	Earn River	65 m ²	27	1	24	9	
n/a 4 th	Earn River	60 m ²	>100	2	>125	>100	
n/a 4 th	Earn River outlet/ Pelly	70 m ²		95 (fry)		1	77-LNS, 21-BWF (fry), 2-LWF(fry), 1-LC(fry)
#33 4 th	Moose River	200 m ²	72	33	3		
#19 2 nd	Unnamed (outlet area)	60 m ²	109	3	11	1	

*Species codes used in tables; jcs= juvenile chinook salmon, SS= slimy sculpin, BB= burbot, AG= Arctic grayling, NP= northern Pike, Chub= lake chub, AL= Arctic lamprey, LNS= long nose sucker, RWF= round whitefish.

Table 4: Summary of weight-length information including condition factor (K) for juvenile chinook salmon sampled at tributaries to the Pelly and Macmillan Rivers, July 29 to August 11, 2003.

Tributary	Length range (mm)	Avg. length (mm)	Weight range (gms.)	Avg. weight (gms)	K factor range	Avg. K factor
Tummel River	61-77(n=9)	67.8	1.9-5.2(n=9)	3.28	0.84-1.28(n=9)	1.03
Earn River	50-77(n=111)	64.0	1.1-3.9(n=19)	2.49	0.82-1.48(n=19)	1.25
Harvey Creek	57-77(n=44)	65.2	2.0-4.1(n=11)	2.94	0.92-1.17(n=11)	1.01
Big Kalzas R.	55-81(n=46)	67.7	2.3-8.1(n=13)	3.62	0.88-1.52(n=13)	1.13
Unnamed #10	55-75(n=11)	66.0	2.2-4.7(n=11)	3.34	0.93-1.32(n=11)	1.16
Unnamed #19	59-78(n=12)	69.1	1.5-3.9(n=12)	2.83	0.62-1.22(n=12)	0.83
Lone Hill Ck	55-68(n=6)	62.2				

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Horler, Aileen Johnston, R.A.C. Cronkite, G.M.W., 1983. *An Assessment of the Fisheries Resources in 18 Lakes Within the Yukon Territory, Canada*. Yukon River Basin Study, Project Report: Fisheries No. 4, December 1983.

Strahler, A.N., 1957. *Quantitative analysis of watershed geomorphology*. Trans. Am. Geophys. Union, vol, 38, pp. 913-920.

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APPENDIX 1

TRIBUTARY DESCRIPTIONS

Pelly River Tributaries

Tummel River

Sample Site: 62°45.390'N/ 135°03.358'E

Watershed Code: 850 2682

Drainage Basin Area: 657 km²

Headwaters: Both the North and South branches of the Tummel River originate on the north west flank of the Glenlyon Range and flow in a north west direction. Downstream of the confluence of these two main tributaries the Tummel flows in a northerly direction to its confluence with the Pelly River.

Tributary Order: 4th order

Date of Investigation: August 11 and 12, 2002



The Tummel River approaching the Pelly River.

CHANNEL CHARACTERISTICS:

Surveyed Length:	450 meters
Average Channel Width:	22 meters
Average Wetted Width:	17 meters
Average Velocity:	22 meters
Average Depth:	0.5 meters
%Pool, Riffle, Run/ Glide:	20% riffle, 70% glide and 10% pools
Channel:	Highly meandering, with well developed point bars opposing cut bank areas
Banks:	Stable but open rising 0.5 to 2.0 meters
Water Color:	Clear with light tannin stain
Instream Cover:	Organic and woody debris, debris piles, depth and cutbank areas
Crown Closure:	<10% consisting of willow or alder
Riparian Vegetation:	Alder willow riparian zone giving way to mature spruce and poplar

BED MATERIAL: Substrates were well sorted, moderately compacted and consisted of 50% gravel, 25% sand and 25% cobble, an occasional boulder was observed.

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m ³ /sec)	Method	Calculated Basin Yield
August 11, 2002	6.38	Floating orange	

BENTHIC INVERTEBRATES:

Benthic samples were collected from the second main riffle upstream of the Pelly River. The Tummel River was similar to Earn and Kalzas Rivers in terms of abundance and richness. The benthic community was dominated by Ephemeroptera and was co-dominated by chironomids. Of special note was the presence of a Dipteran family, Blephariceridae (net-winged midges). The genus of Philorus of this family has not been recorded in the Yukon data base, which has documented Yukon freshwater invertebrates since 1973.

FISHING EFFORT AND CATCH DATA:

Fish collection techniques used on Tummel River included minnow traps and seining. A total of 9 minnow traps were set for an average of 15 hours each and captured between 0 and 21 juvenile chinook salmon, the average CPUE was 12.8 jcs/24hrs. A lake chubb and a burbot were also captured in the minnow traps. A series of 5 short seine pulls in the lower reach and outlet areas of the river recorded 2 juveniles and 1 sub-adult round whitefish, 2 juvenile Arctic grayling, 4 juvenile chinook salmon and 1 lake chub.

An adult chinook salmon was observed entering the river.

For jcs captured in Tummel River length ranged from 61-77 mm, with an average of 67.8 mm (n= 9). Weight ranged from 1.9-5.2 grams, with an average of 3.28 grams (n=9).

The overall condition factor (K) ranged from 0.84 to 1.28, with an average of 1.03. Jcs from Tummel River were of similar size and condition to the other main tributaries investigated during the investigation.

HELICOPTER SURVEY

The lower 8 kilometers of the Tummel River were flown by helicopter on August 17, 2002. No live salmon were observed in the river, although a single chinook carcass was observed a short distance upstream of the Pelly River. Three bald Eagles were observed during the flight, indicating the likely hood of other salmon utilizing this system.

GENERAL INFORMATION AND OBSERVATIONS:

The Tummel River outlet was the location of a trading post. This post was taken out by the river during the 1940's. The river is reported to have moved over 100 meters up the Tummel River drainage since that time. An old cat trail follows the Tummel River valley from the confluence of the North and South branches to the Macmillan River. This trail has been maintained and still operates as a snowmobile trail.

On August 11, 2002, a single adult chinook salmon was observed in the Tummel River a short distance upstream from the Pelly River. This sighting and the observation of the chinook carcass during the helicopter survey are the first recorded observations of adult salmon utilizing this river.

EARN RIVER

Sample Site: Confluence of Earn and Pelly Rivers and upstream. 62°44.205'N/
134°41.450'E

Watershed Code: 853

Drainage Basin Area: 1,536 km²

Headwaters: The Earn River drains a large valley between the Wilkinson Range and Menzie Mountain. Several headwater lakes occur, the largest is Earn Lake which is fed from Stokes Lake, several smaller lakes occur upstream of Stokes Lake.

Tributary Order: 4th order

Date of Investigation: August 11, 2002



Earn River a short distance upstream of the Macmillan River.

CHANNEL CHARACTERISTICS:

Surveyed Length: 700 meters
Average Channel Width: 18 meters
Average Wetted Width: 18 meters
Average Velocity: 0.8 meters/second
Average Depth: 0.5 meters
%Pool, Riffle, Run/ Glide: 10% pool, 20% riffle, 30% run, 40% glide
Channel: Meandering, flat bottom, very regular, even depth
Banks: Distinct and even, confining, rise average 0.5 meters, 30% cut banks
Temperature: 12.9°C
Water Color: clear with very light tannin stain
Instream Cover: loose cobbles, stick debris near sides and occasional log jam pools
Crown Closure: 5%, only at river margins
Riparian Vegetation: willow/alder fringe with poplar, spruce, cranberry and willow adjacent.

BED MATERIAL: Consisted of 60% cobble, 10% boulder, 20% gravel and 10% silt. Substrates were loosely compacted and shifting in mid-channel.

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m ³ /sec)	Method	Calculated Basin Yield
August 11, 2002		Floating Object	

WATER QUALITY: pH= 8.19
conductivity = 476 Us/cm.

BENTHIC INVERTABRATES

The benthic community at Earn River was similar to that of the Kalzas and Tummel Rivers in terms abundance and richness. Ephemeroptera was by far the most dominant order with the family Heptageniidea representing over 60% of the sample. Detailed benthic community information has been presented in Appendix II.

HELICOPTER SURVEY:

The Earn River was surveyed by helicopter for adult chinook salmon on August 17, 2002. The river was flown from the confluence with the Pelly River to Earn Lake, a direct distance of approximately 15 kilometers. A total of 395 adult chinook salmon were recorded on the flight, the salmon occurred in three discreet reaches of the creek, the most densely utilized area was between 2 and 3 kilometers downstream of the lake. Several areas of well developed dunes occur in the Earn River. These very distinct dunes occur in series through reaches of the river, all three areas of high utilization by salmon on the survey were areas of this type. Of note was that less than half of the spawning dunes areas were being well utilized by current year spawners and even areas with the

highest densities of current year spawners showed much unused available spawning habitat.

FISHING EFFORT AND CATCH DATA:

Fishing effort on the Earn River included minnow trapping, electro-fishing, and seining. Minnow traps recorded a high level of utilization with a CPUE of 44.7 jcs/24 hrs, a very large chub was also captured but escaped prior to sampling. Electro-fishing recorded numerous juvenile chinook salmon, numerous slimy sculpins (adult and fry), as well burbot, northern pike (juveniles), long nose sucker (juveniles) and Arctic grayling (adult) were recorded. Seining was conducted in the outlet area and mix water zone. Large numbers of juvenile chinook salmon and slimy sculpin were recorded in the areas of flow immediately preceding the mix water area. In the mix water area numerous coregonids were present, broad whitefish fry were especially common, round whitefish and Arctic grayling juveniles and sub-adults were abundant, lake whitefish and least cisco fry were recorded.

For jcs captured in Earn River length ranged from 50-77 mm, with an average of 64.0 mm (n= 111). Weight ranged from 1.1-3.9 grams, with an average of 2.49 grams (n=19). The overall condition factor (K) ranged from 0.82 to 1.48, with an average of 1.25. Jcs from Earn River were smaller in size to the other main tributaries investigated during the investigation however had the highest average condition factor of 1.25.

Two, adult chinook salmon were observed in a pool 250 meters upstream of the Macmillan during the field investigation.

GENERAL INFORMATION AND OBSERVATIONS:

High wildlife values and significant chinook salmon spawning areas has led to the Earn River being nominated for protected area status. A big game outfitters main camp is located on Earn Lake.

Harvey Creek

Sample Site: 62°38.702'N/ 134°41.173'E

Watershed Code: 850 3263

Drainage Basin Area: 147 km²

Headwaters: This tributary originates at a small lake high on the south face of Front Mountain. From this lake the creek flows in a south west direction then curls around a small unnamed mountain before turning to flow in a north east direction through a steep sided valley along the west side of Harvey Mountain

Tributary Order: 3rd order

Date of Investigation: August 10, 2002



Harvey Creek 200 meters upstream of the Pelly River.

CHANNEL CHARACTERISTICS:

Surveyed Length:	1,100 meters
Average Channel Width:	9 meters
Average Wetted Width:	6 meters
Average Velocity:	0.8 m/second
Average Depth:	0.2 meters
%Pool, Riffle, Run/ Glide:	60% run, 20% riffle, 10% pool and 10% rapid
Channel:	Confined drainage with a small flood plain apron
Banks:	Stable and shallow, with boulder armor
Temperature:	9.6°C
Water Color:	Clear with very light tannin stain
Instream Cover:	Pools with woody debri, boulder areas and a beaver dam plunge pool with much associated woody debri.
Crown Closure:	30% willow alder overhang
Riparian Vegetation:	Willow – alder fringe with poplar adjacent

BED MATERIAL: Substrates consisted of a cobble gravel mix in the lower 200 meters with boulders becoming more common above. By 400 meters from the Pelly River Boulders dominated the substrates with 60%. Substrates were loose and unconsolidated.

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m ³ /sec)	Method	Calculated Basin Yield
August 10, 2002	0.85	Floating object	

WATER QUALITY: pH = 8.15
Conductivity = 380 Us/cm

BENTHIC INVERTABRATES

Of the tributaries investigated the benthic community at Harvey Creek was the most abundant and diverse and was dominated by chironomids. Few Plecopterans or Trichopterans were found here, but Ephemeropterans were subdominant. Detailed benthic analysis has been presented in appendix II.

FISHING EFFORT AND CATCH DATA:

Fishing effort on Harvey Creek consisted of minnow trapping and electro-fishing. Both techniques recorded the highest densities of juvenile chinook salmon for the entire study. Minnow traps had a CPUE of 93.7 jcs/24 hrs for 3 hour sets. The highest densities observed during electro-fishing were immediately below the lower beaver dam. Several groups of adult Arctic grayling were observed and slimy sculpin were also recorded.

For jcs captured in Harvey Creek length ranged from 57-77 mm, with an average of 65.2 mm (n= 44). Weight ranged from 2.0-4.1 grams, with an average of 2.94 grams (n= 11). The overall condition factor (K) ranged from 0.92 to 1.17, with an average of 1.01. Jcs from Harvey Creek were of similar size and condition to the other main tributaries investigated during the investigation.

GENERAL INFORMATION AND OBSERVATIONS:

A series of 2 beaver dams occur at 600 and 850 meters upstream of the Pelly River, both dams hold back 2 meters of head and have near vertical faces. A drop pool below the first beaver dam flows into a deep boulder strewn run, heavy overhead vegetation and thick woody debri provide excellent fish habitat. Estimates from electro-fishing and visual observations indicated that the number of juvenile chinook salmon utilizing this area was >1,000 individuals, slimy sculpin and adult grayling were also more common in this area.

MACMILLAN RIVER TRIBUTARIES**Tributary #3: Unnamed**

Sample Site: 62°52.661'N / 135°42.287'E
At outlet to Macmillan River

Watershed Code: 851 0320

Drainage Basin Area: 17.5 km²

Headwaters: Drains a steep south facing gulley at the western end of the Macmillan Range

Tributary Order 2nd order

Date of Investigation: August 3, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	First 250 meters upstream of Macmillan River
Average Channel Width:	3.2 meters
Average Wetted Width:	1.8 meters
Average Velocity:	1 m/second
Average Depth:	0.08 meters
%Pool, Riffle, Run/ Glide:	90% run, 10% stick riffle
Channel:	Braided and shifting through open flood plain
Banks:	Abrupt rising 0.5 meters, sedge covered
Temperature:	6.2°C
Water Color:	Clear with a light chalkiness
Instream Cover:	Cut bank sides and overhanging vegetation
Crown Closure:	75%
Riparian Vegetation:	Willow sedge meadows

BED MATERIAL: Substrates consisted of moderately compacted 80% sand and 20% gravel, dewatered creek edges were covered with silt deposits.

FISHING EFFORT AND CATCH DATA:

Fishing effort in this small tributary was limited to electro-fishing, several juvenile chinook salmon and a single slimy sculpin were recorded. A seine pulled in the mix-water zone had very high catches of juvenile chinook salmon, round whitefish and arctic grayling

GENERAL INFORMATION AND OBSERVATIONS:

The creek braids into two separate channels 30 meters before entering the Macmillan River. Large numbers of juvenile fish were recorded in the outlet/ mix-water area of this creek and the Macmillan River, species recorded include juvenile chinook salmon, juvenile round whitefish and juvenile and sub-adult Arctic grayling.

Tributary #4: Unnamed

Sample Site: 62°53.661' N/ 135°42.287'E

Watershed Code: 851 0768

Drainage Basin Area: 20 km²

Headwaters: Drains a steep north facing ravine on the Pelmac Ridge

Tributary Order 1st order

Date of Investigation: August 3, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	100 meters upstream of Macmillan River
Average Channel Width:	2.5 meters
Average Wetted Width:	2.5 meters
Average Velocity:	0.5 m/second
Average Depth:	0.15 meters
%Pool, Riffle, Run/ Glide:	90% run with 10% stick riffles
Channel:	Entrenched
Banks:	Vertical to overhanging with a rise of 1-5 meters, well vegetated
Temperature:	5.6°C
Water Color:	Clear
Instream Cover:	Willow debri and undercut banks
Crown Closure:	100% willow overhang within 10 meters of the Macmillan River
Riparian Vegetation:	Alder willow fringe with spruce adjacent

BED MATERIAL: Substrates were moderately compacted and consisted of 50% gravel and 50% sand.

GENERAL INFORMATION AND OBSERVATIONS:

This tributary fans out across the Macmillan River flood plain into three defined channels; the middle channel has further braiding. This small tributary offers very small and limited fish habitats, is cold and clear and was not sampled for fish.

Tributary #5: Unnamed

Sample Site: 62°53.716' N / 135°33.962' E
Near the confluence with the Macmillan River

Watershed Code: 851 0789

Drainage Basin Area: 22 km²

Headwaters: Drains 2 north facing hanging valleys before dropping down a steep ravine of the Pelmac Ridge to the Macmillan flood plain.

Tributary Order: 2nd order

Date of Investigation: August 3, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	350 meters
Average Channel Width:	3.5 meters
Average Wetted Width:	3.2 meters
Average Velocity:	0.35 m/second
Average Depth:	0.15 meters
%Pool, Riffle, Run/ Glide:	100% even and slow glide
Channel:	Deeply entrenched
Banks:	Gentle or occasionally cut banks of unconsolidated mud
Temperature:	5.7°
Water Color:	Crystal clear
Instream Cover:	Very limited with some pockets of fine organic debri and occasional cut banks and small pools.
Crown Closure:	50% overhead alder
Riparian Vegetation:	Alder with poplar adjacent

BED MATERIAL: Substrates consisted of unconsolidated sand and silts in the lower 200 meters then changed 50% sand, 30% gravel and 20% cobble. Cobbles only occurred in thalwag areas.

WATER QUALITY: pH= 8.06
conductivity = 468 Us/cm.

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m³/sec)	Method	Calculated Basin Yield
August 3, 2002	0.134 (m ³ /sec)	Floating Orange	

FISHING EFFORT AND CATCH DATA: This creek provided excellent visual observation opportunities and no fish were observed. Very little fish habitat exists in this creek, as very little cover occurs coupled with extremely clear visibility.

Tributary #7: Kalzas River

Sample Site: 62°53.537'N/ 135°29.177'E. Outlet to Macmillan River

Watershed Code: 851 1674

Drainage Basin Area: 1,894 km²

Headwaters: The Kalzas River drains a large valley faced on the south east by the Clarke Hills and to the north west by a high ridge with Grey Hunter Peak at the western end and the Kalzas Peaks to the north east. Flows are attenuated by Kalzas Lake, a large headwater lake (40 km²), which has a smaller lake feeding it.

Tributary Order: 4th order

Date of Investigation: August 2, 2002



Big Kalzas River, 250 meters upstream of the Macmillan River.

CHANNEL CHARACTERISTICS:

Surveyed Length:	2,000 meters
Average Channel Width:	40 meters
Average Wetted Width:	30 meters
Average Velocity:	1 m/second
Average Depth:	0.5 meters
%Pool, Riffle, Run/ Glide:	60% run, 20% riffle, 20% pool, with several connected and still oxbow channels
Channel:	Open well established flood plain, meanders extensively with old oxbow channels apparent, channel typically has cut bank opposing gravel bar followed by straight reaches with Instream gravel bars.
Banks:	20 meter high clay cliffs occur at the confluence, upstream banks abrupt unconsolidated gravel mixed with mud. Many new channel areas.
Temperature:	12°C
Water Color:	Dark tannin staining
Instream Cover:	Depth pools cobbles and woody debri, many new cut bank areas
Crown Closure:	5% willow alder overhang and sweeper spruce
Riparian Vegetation:	Alder/ willow fringe on deposition side opposed by mature spruce in eroding areas

BED MATERIAL:

Substrates were unconsolidated, well sorted and consisted of 40% cobble, 40% gravel and 10% sand.

STREAM FLOW CHARACTERISTICS:

The Kalzas River was too large to estimate discharge.

WATER QUALITY: pH= 7.97

Conductivity= 196 Us/cm

BENTHIC INVERTEBRATES

Benthic samples were collected from the Kalzas River on August 17, 2002, at a site several hundred meters upstream of the confluence with the Little Kalzas River. The benthic community at Kalzas River was similar to that of Earn and Tummel Rivers in terms of abundance and richness. The community was dominated by a single species of Plecoptera and was closely followed by Ephemeropterans. Detailed assessments of the benthic community have been presented in Appendix II.

FISHING EFFORT AND CATCH DATA:

Minnow traps set in Kalzas River had good catches in 24 hour sets with an average CPUE of 7.9 jcs/24hrs. Electro fishing was difficult and limited to shorelines and small eddies, 225 seconds of electro-fishing recorded 18 jcs, 56 and >100 slimy sculpin (adults and fry respectively), 14 Arctic grayling (fry) and 3 juvenile northern pike.

For jcs captured in Kalzas River length ranged from 55-81 mm, with an average of 67.7 mm (n= 46). Weight ranged from 2.3- 8.1 grams, with an average of 3.62 grams (n=13). The overall condition factor (K) ranged from 0.88 to 1.52, with an average of 1.13. Jcs from Kalzas River were in general of similar size and condition to the other main tributaries investigated during the investigation; the largest jcs of the investigation (81 mm and 8.1 gms) was captured in the Kalzas River. This fish did not exhibit characteristics of second year juvenile and age was assumed to be 0+.

A 2.5" x 12 meter gillnet set in the outlet / mix water zone for 1.5 hrs captured 5 long nose sucker adults, 2 northern pike adults, 1 inconnu adult and 1 adult (jack) chinook salmon.

HELICOPTER SURVEY: A helicopter survey of the Kalzas River was flown on August 17. The survey began upstream of Grey Hunter Creek and extended downstream to the confluence with the Macmillan River a distance of approximately 15 kilometers. Visibility was moderately poor due to light conditions and water color. A total of 12 chinook salmon adults were observed. A further 2 were observed in Little Kalzas River.

GENERAL INFORMATION AND OBSERVATIONS:

The Kalzas River is a dynamic river especially in the lowest reach below Little Kalzas. New channels have recently been cut in the reach between the Macmillan River and the Little Kalzas. The 4.5 kilometers of river flow as shown on topographic maps, has changed to a distance of 1.8 kms. The Kalzas River is a large, fast water, difficult to

sample and likely supports a much more diverse fish community than observed during this investigation. Sampling efforts were not made in stable reaches of the river upstream of the confluence with Little Kalzas.

Biological information from Big Kalzas Lake was collected in 1982 and '83 by DFO as part of a fisheries resource assessment. This study documented biological information related to size, condition, age, sex composition, maturity and growth by species (Horler et al, 1983).

Tributary to Tributary #7: Little Kalzas River

Sample Site: 62°53.533'N/ 135°27.775'E Confluence with Big Kalzas

Watershed Code: 851 1674 011

Drainage Basin Area : 434 km²

Headwaters: Little Kalzas River drains a small hanging valley bounded by the McCarthur Group to the north and the Macmillan Range to the south. Little Kalzas Lake occurs midway down the drainage and attenuates flow. The Little Kalzas meets the Big Kalzas approximately 2 km upstream of the confluence with the Macmillan River.

Tributary Order: 3rd order

Date of Investigation: August 3, 2002



Little Kalzas River, 200 meters upstream of Big Kalzas River.

CHANNEL CHARACTERISTICS:

Surveyed Length:	600 meters
Average Channel Width:	20 meters
Average Wetted Width:	12 meters
Average Velocity:	1.7 m/second
Average Depth:	0.35 meters
%Pool, Riffle, Run/ Glide:	70% run and 30% riffle, 40% of creek had cut banks with side eddies
Channel:	Well defined, lightly meandering with cut banks opposing deposition point bars
Banks:	Gentle to abrupt, rise 1.8 meters
Temperature:	16.7°C
Water Color:	Mostly clear with light tannin stain and slight grey murkiness
Instream Cover:	Turbulence, depth, cut banks and woody debri
Crown Closure:	15% alder and spruce sweepers
Riparian Vegetation:	Alder fringe with large mature spruce adjacent

BED MATERIAL: Substrates consisted of 60% gravel, 30% cobble and 10% fines. The substrates were loose and unconsolidated.

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m ³ /sec)	Method
August 3, 2002	5.60	Floating object

FISHING EFFORT AND CATCH DATA:

Due to access constraints fishing effort in Little Kalzas River was limited to electro-fishing. The water was very swift and further constrained sampling efforts. For 262 seconds of shock time, 5 juvenile chinook salmon, 12 slimy sculpin and 3 unidentified fishes were observed. The unidentified fish were either chubs, whitefish or cyprinids. Electro-fishing at the confluence of Little and Big Kalzas for 137 seconds shock time recorded 5 juvenile chinook salmon, 5 juvenile Arctic grayling, 23 slimy sculpin and 1 adult northern pike.

GENERAL INFORMATION AND OBSERVATIONS:

During helicopter surveys of Big Kalzas River 2 adult chinook salmon were observed in the Little Kalzas a short distance upstream of the confluence. Little Kalzas River is well documented as having substantial chinook spawning capacity, particularly near the lake outlet.

The ambient water temperature of Little Kalzas River was substantially warmer than that found elsewhere in the study. Hotspring Creek which flows out from the valley between Mount Van Bibber and Black Ram Peak, likely accounts for the thermal increase as a hot spring does occur in the drainage.

Very little information has been collected on the Little Kalzas system. Some cursory investigations which describe chinook spawning at the outlet of the lake were conducted in 1997 by Jane Wilson for the SFN.

Tributary #8: Unnamed

Sample Site: Outlet to Macmillan River. 62°52.860'N / 135°31.217'E

Watershed Code: 851 2100

Drainage Basin Area: 7.5 km²

Headwaters: A small tributary that flows north of a small face of the Pelmac Ridge.

Tributary Order: 1st order

Date of Investigation: August 1, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	30 meters
Average Channel Width:	3 meters
Average Wetted Width:	1 meter
Average Velocity:	<1 m/second
Average Depth:	0.1 meters
%Pool, Riffle, Run/ Glide:	100% riffle
Channel:	“U” shaped with open flood plain
Banks:	Abrupt, rising 2.5 meters near River, becoming gentle rising 1 to 2 meters away from River.
Temperature:	3.5°C
Water Color:	Mostly clear with light chalkiness
Instream Cover:	30% filled with woody debris
Crown Closure:	60% alder willow overhang
Riparian Vegetation:	Alder willow with mature spruce away from creek

BED MATERIAL: 90% fine gravel with 10% coarse gravel occurring in thalweg areas, loosely compacted.

FISHING EFFORT AND CATCH DATA:

This tributary had very limited fish habitats, most occurred in the first 20 meters of the creek. 2 minnow traps set near the outlet in the only habitats deep enough for the traps captured 0 and 7 jcs.

Tributary #9: Unnamed

Sample Site: 62°52.426’N / 135°28.381’E

Watershed Code: 851 2281

Drainage Basin Area: 6.5 km²

Headwaters: Drains a small north facing bench of the Pelmac Ridge

Tributary Order: 1st order

Date of Investigation: August 1, 2002



Tributary # 9, a few meters upstream of the Macmillan River.

CHANNEL CHARACTERISTICS:

Surveyed Length:	30 meters
Average Channel Width:	0.5 meters
Average Wetted Width:	0.5 meters
Average Velocity:	0.5 m/second
Average Depth:	0.2 meters
%Pool, Riffle, Run/ Glide:	55% riffle, 35% glide, 10% pool
Channel:	Deeply entrenched and interrupted by a beaver dam 30 m u/s of Macmillan River
Banks:	Vertical rise up to 4 meters
Temperature:	7.2°C
Water Color:	Clear
Instream Cover:	Thick accumulations of woody debri
Crown Closure:	Minimal crown closure but extensive woody debri suspended over channel
Riparian Vegetation:	Willow and poplar

BED MATERIAL: Substrates consisted of well sorted gravel with mud banks in the lowest reach of the creek. Above the gravels substrates become 100% covered with woody debri.

FISHING EFFORT AND CATCH DATA:

Four minnow traps were set in this tributary for an overnight period. No traps captured fish and no fish were observed.

GENERAL INFORMATION AND OBSERVATIONS:

A beaver dam 30 meters from the Macmillan River holds a head of 3.5 meters of water creating a pond 60 x 100 meters

Tributary #10: Unnamed

Sample Site: 62°51.700'N / 135°24.932'E, Outlet to Macmillan River

Watershed Code: 851 2932

Drainage Basin Area: 37 km²

Headwaters: Drains a low hilly area at the western end of the Pelmac Ridge. The headwater area contains several small lakes that feed into this creek.

Tributary Order: 2nd order

Date of Investigation: August 1, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	150 meters
Average Channel Width:	12 meters confining to 2.5m within 50m of River
Average Wetted Width:	6 meters confining to 2.0m within 50m of River
Average Velocity:	< 0.5 m/second
Average Depth:	0.2 meters
%Pool, Riffle, Run/ Glide:	<2.5 m/second
Channel:	Open flood channel with massive amounts of small woody debris, becomes confined 50m upstream of the River
Banks:	Open and gentle max rise to 2m, 10m from creek, become confining 50m upstream of River rise up to 1m
Temperature:	8.9°C
Water Color:	Lightly turbid with heavy tannin stain
Instream Cover:	90% loose woody debris and turbidity
Crown Closure:	60% alder overhang
Riparian Vegetation:	Alder with some willow and mature spruce adjacent

BED MATERIAL: Substrates consisted mud with the occasional fine gravels overlain with large amounts of woody debris

WATER QUALITY: pH= 8.06

conductivity = 468 Us/cm.

FISHING EFFORT AND CATCH DATA:

This tributary had good fish habitats; although small they were well protected by woody debris. Ten minnow traps set overnight had an average CPUE of 1.4 jcs/24hrs, only 3 of the traps captured fish and 1 of these traps also had a slimy sculpin. Visual observations of 2 juvenile chinook salmon were made in the creek.

For jcs captured in Tributary #10 length ranged from 55-75 mm, with an average of 66.0 mm (n= 11). Weight ranged from 2.2-4.7 grams, with an average of 3.34 grams (n=11). The overall condition factor (K) ranged from 0.93 to 1.32, with an average of 1.16. Jcs from Tributary #10 were of similar size and condition to the other main tributaries investigated during the investigation.

Tributary #11: Unnamed

Sample Site: 62°52.120’N / 135°21.810’E

Watershed Code: 851 2953

Drainage Basin Area: 22 km²

Headwaters: Drains a shallow bowl on the eastern foot of the Pelmac Ridge. Two small head water lakes and another small lake in the mid reaches occur.

Tributary Order: 2nd order

Date of Investigation: August 1, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	350 meters
Average Channel Width:	4.0 meters
Average Wetted Width:	4.0 meters
Average Velocity:	>0 m/second
Average Depth:	1.5 meters
%Pool, Riffle, Run/ Glide:	100% slow glide
Channel:	U shaped, deep and well defined
Banks:	Abrupt
Temperature:	13.2°C
Water Color:	Dark tea, high degree of tannin stain
Instream Cover:	Water depth and turbidity
Crown Closure:	40% willow/ alder overhang
Riparian Vegetation:	Mature willow, alder, birch and spruce

BED MATERIAL: Substrates were comprised entirely of mud

WATER QUALITY: pH= 7.55
conductivity = 502 Us/cm.

FISHING EFFORT AND CATCH DATA:
Overnight sets of 7 minnow traps captured no fish.

GENERAL INFORMATION AND OBSERVATIONS:
Much of the creek had such slow flow as to make the water stagnant. Flows were too slight for measurement and some areas appeared totally still. This creek was viewed as poor fish habitat.

Tributary #12: Unnamed

Sample Site: 62°53.046 N/ 135°21.609 E

Watershed Code: unknown

Drainage Basin Area: 7.5 km²

Headwaters: A small drainage with headwaters originating on a ravine on the south West flank of Kalzas Mountain. The lower portion of the creek flows across the Macmillan River flood plain

Tributary Order 1st order

Date of Investigation: August 1, 2002

GENERAL INFORMATION AND OBSERVATIONS:
This creek was dry at the time of investigation. A major mud slump occurred along the lower drainage path during the 1930's, the slump is reported to extend up the valley for approximately 2 kilometers. The creek channel that remains at the outlet to the Macmillan River was mud choked, indistinct and appeared to flow seasonally.

Tributary #13: Unnamed

Sample Site: 62°53.322'N / 135°19.605'E

Watershed Code: unknown

Drainage Basin Area: 7.5 km²

Headwaters: Originates on the south shoulder of Kalzas Mountain.

Tributary Order: 1st order

Date of Investigation: August 1, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	50 meter
Average Channel Width:	1.0 meters
Average Wetted Width:	1.0 meters
Average Velocity:	0.5 m/ second
Average Depth:	0.1 meters
%Pool, Riffle, Run/ Glide:	95% fast glide, 5% riffle
Channel:	Loosely confined and directed by large Instream woody debri
Banks:	Open and gentle
Temperature:	6.7°C
Water Color:	Clear
Instream Cover:	Instream woody debri

BED MATERIAL: Substrates consisted of silty mud with fine gravel in the channel.

GENERAL INFORMATION AND OBSERVATIONS:

This creek provides little in the way of fish habitat due its small size and no fishing effort was extended.

Tributary # 14: unnamed

Sample Site: 62°53.332'N / 135°19.435'E

Watershed Code: unknown

Drainage Basin Area: 5 km²

Headwaters: Originates on the South face of Kalzas Mountain and follows a very steep drop to the confluence with the Macmillan River

Tributary Order: 1st

Date of Investigation: August 1, 2002

GENERAL INFORMATION AND OBSERVATIONS:

This tributary cascades into the Macmillan River over a drop 1.8 meters in height. Several dry channels exist, indicating seasonal flows. The water was crystal clear. No fishing effort was exerted.

Tributary #15: Unnamed

Sample Site: 62°53.358'N / 135°19.300'E

Watershed Code: unknown

Drainage Basin Area: 5.5 km²

Headwaters: Originates high on the south face of Kalzas Mountain and follows a steep gradient to its confluence with the Macmillan River.

Tributary Order: 1st order

Date of Investigation: August 1, 2002

GENERAL INFORMATION AND OBSERVATIONS:

This creek was dry at the time of investigation. The dry incised channel was 0.3 meters wide by 0.4 meters deep. Substrates consisted of heavy silt and woody debris.

Tributary #17: Unnamed

Sample Site: 62°53.3'N / 135°19.'E

Watershed Code: unknown

Drainage Basin Area: 15.5 km²

Head waters: Originates in a hilly region to the east of the Pelmac Ridge and flows in a north easterly direction to its confluence with the Macmillan River. The creek has 3 small headwater lakes.

Tributary Order: 1st

Date of Investigation: August 1, 2002

GENERAL INFORMATION AND OBSERVATIONS:

This creek was inaccessible due to a new island formed in the Macmillan River. An old hard rock mine site is reported to exist at one of the headwater lakes.

Tributary #18: Unnamed

Sample Site: 62°52.115'N / 135°15.507'E

Watershed Code: unknown

Drainage Basin Area: 2.5 km²

Headwaters: Drains a small hilly area and flows in a north westerly direction to its confluence with the Macmillan River.

Tributary Order: 1st order

Date of Investigation: August 1, 2002

GENERAL INFORMATION AND OBSERVATIONS:

This small tributary was dry at the time of investigation. The channel was filled with debri. A large bank slump occurred on the Macmillan River immediately downstream of this creeks confluence.

Tributary #19: Unnamed

Sample Site: 62°53.034'N / 135°14.484'E

Watershed Code: 851 3518

Drainage Basin Area: 32 km²

Headwaters: Drains the large valley on the south eastern flank of Kalzas Mountain.

Tributary Order: 2nd order

Date of Investigation: August 1, 2002



The mix water zone of tributary #19.

CHANNEL CHARACTERISTICS:

Surveyed Length:	300 meters
Average Channel Width:	3.0 meters
Average Wetted Width:	3.0 meters
Average Velocity:	1.25 m/second
Average Depth:	0.20 meters
%Pool, Riffle, Run/ Glide:	100% riffle
Channel:	Straight with very little meandering, does split into 2 channels 30 meters from River
Banks:	Confining rise 1.0 meters
Temperature:	5.8°C
Water Color:	Crystal clear
Instream Cover:	Very limited cover in riffle cobbles

BED MATERIAL: Substrates consisted of well sorted cobbles and gravel

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m ³ /sec)	Method	Calculated Basin Yield

WATER QUALITY: pH = 7.97
conductivity = 245 Us/cm.

FISHING EFFORT AND CATCH DATA:

Electro-fishing for 152 seconds observed 3 jcs, and 7 slimy sculpins. Daytime sets of 3 minnow traps captured no fish. Seining in the mix water area of this creek with the Macmillan River showed the shallow gravel areas to have significant utilization by juvenile chinook salmon.

For jcs captured in the mix water zone of Tributary #19 and the Macmillan River length ranged from 59-78 mm, with an average of 69.1 mm (n= 12). Weight ranged from 1.5-3.9 grams, with an average of 2.83 grams (n=12). The overall condition factor (K) ranged from 0.62 to 1.22, with an average of 0.83. Jcs from this sample had the lowest average condition factor recorded during the investigation.

Tributary #20: DUO CREEK (aka White Creek)

Sample Site: 62°52.893'N/ 135°13.135'E
At confluence with the Macmillan River.

Watershed Code: 851 3945

Drainage Basin Area: 180 km²

Headwaters: Arises on the south west flank of Dromedary Mountain and then flows across an area of undulating hills connecting several small lakes before turning north to enter the Macmillan River.

Tributary Order 3rd Order

Date of Investigation: July 31 and August 1, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	800 meters
Average Channel Width:	8 meters
Average Wetted Width:	5 meters
Average Velocity:	>0 m/sec
Average Depth:	.35 meters
%Pool, Riffle, Run/ Glide:	30% riffle and 70% glide
Channel:	Deeply entrenched
Banks:	Steep rising 3 to 5 meters, heavily wooded
Temperature:	12.9°C
Water Color:	Chalky with visibility limited to 0.35 meters
Instream Cover:	80% Instream woody debris and turbidity
Crown Closure:	Becomes 90% within 100 meters of Macmillan River
Riparian Vegetation:	Alder, willow, birch with mature spruce adjacent

BED MATERIAL:

Mud, with fine gravels in the thalweg areas and substrates 50% covered by woody debris.

STREAM FLOW CHARACTERISTICS:

Date	Discharge (m ³ /sec)	Method	Calculated Basin Yield
August 1, 2002	0.15 m ³ /sec	Floating object	

FISHING EFFORT AND CATCH DATA:

Overnight sets of 14 minnow traps captured no fish. Extensive electro-fishing observed 22 slimy sculpin, 2 juvenile Arctic grayling, 1 sub-adult burbot and an Arctic Lamprey ameocyte.

GENERAL INFORMATION AND OBSERVATIONS:

Duo Creek, locally known as White Creek, has a very low gradient near its confluence with the Macmillan River. River water charged the creek 75 meters at the time of investigation. Both recent and historic beaver dams were in evidence although no current activity was observed. Johnson Edwards commented that in the 1950's people used to paddle canoes up to the small lakes associated with this creek for muskrat hunting. The creek now has an impenetrable tangle of overhanging alder that definitely would preclude travel on this waterway.

Tributary #22: Unnamed

Sample Site: 62°54.755'N / 134°06.890'E
Outlet to Macmillan River

Watershed Code: unknown

Drainage Basin Area: 19 km²

Headwaters: Flows South off a steep valley on the Kalzas Range

Tributary Order: 2nd order

Date of Investigation: July 31, 2002

CHANNEL CHARACTERISTICS:

Creek flows as a small rill which tumbles over a boulder cobble mix at a steep slope (est. 3-5%). The channel flows straight from the river for 70 meters through a tangle of alder and willow. Fish habitat is limited in this creek due to fast flow over steep gradients with few and small resting opportunities.

The water is clear with a light blue chalky color.

Tributary #23: Unnamed

Sample Site: 62°54.160'N / 135°04.649'E, Outlet to Macmillan River.

Watershed Code: unknown

Drainage Basin Area: 13 km²

Headwaters: Flows south of a steep face of the Kalzas Range

Tributary Order: 1st order

Date of Investigation: July 31, 2002

CHANNEL CHARACTERISTICS:

This clear water rill cascades into the Macmillan River in several small channels. Each channel drops over a bank between 1 and 2 meters in height. Fish access to the creek is effectively cut by the steep drop.

Tributary #24: LONE HILL CREEK (aka Horsfall or Horsetail Creek)

Sample Site: 62°54.330'N/ 134°59.350'E

Watershed Code: 851 4797

Drainage Basin Area: 110 km²

Headwaters: Arises on the N/W slope of the Wilkinson Range and drains the gully between that range and Lone Mountain. Several small lakes, connected by small tributaries feed the mid reaches of the creek.

Tributary Order Third order tributary

Date of Investigation: July 31, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	250 meters
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Average Channel Width:	6.0 meters
Average Wetted Width:	5.0 meters
Average Velocity:	>1 m/sec
Average Depth:	0.5 meters
%Pool, Riffle, Run/ Glide:	100% riffle, with occasional deeper holes beneath riffling surface waters
Channel:	Confined, bottom sculpted by log debris with deep holes opposite shallow riffles
Banks:	Abrupt, rising 3 to 8 meters on both banks
Temperature:	7.7°C
Water Color:	Clear
Instream Cover:	50% Instream large woody debris
Crown Closure:	70% overhead cover
Riparian Vegetation:	Alder, spruce with some birch and cranberry.

BED MATERIAL:

Substrates consist of a loose shifting gravel/sand mix. Cobbles begin showing in thalweg areas after moving more than 250 meters upstream from the Macmillan River.

WATER QUALITY: pH= 8.05
conductivity = 325 Us/cm.

FISHING EFFORT AND CATCH DATA:

Day time sets of 4 minnow traps captured no fish. Electro-fishing for 391 seconds recorded 12 jcs and 29 slimy sculpin.

GENERAL INFORMATION AND OBSERVATIONS:

This creek enters a rock walled canyon 1.5 kilometers upstream of the Macmillan River. The upper reaches, though not investigated, may provide good quality fish habitats

Tributary #32: CLARKE CREEK

Sample Site: 62°59.608'N/ 134°44.810'E Outlet to Macmillan River.

Watershed Code: 851 5405 012

Drainage Basin Area: 134 km²

Headwaters: Arises in the Clarke Hills then flows in a southerly direction to its confluence with the Macmillan River.

Tributary Order: 3rd tributary

Date of Investigation: July 31, 2002

CHANNEL CHARACTERISTICS:

Surveyed Length:	500 meters
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Average Channel Width:	7 meters
Average Wetted Width:	5 meters
Average Velocity:	> 1 m/sec
Average Depth:	0.3 meters
%Pool, Riffle, Run/ Glide:	80% riffle and 20% glide
Channel:	Confined channel with a shallow and flat bottom
Banks:	Mostly abrupt rising 1 to 3 meters
Temperature:	10.5°C
Water Color:	Clear with very light yellowing
Instream Cover:	Very limited with 5% Instream organic wads.
Crown Closure:	40%
Riparian Vegetation:	Alder, willow and spruce mix

BED MATERIAL:

Consisted of 80% small gravel and 20% sand, loosely consolidated with moving and shifting bed loads.

WATER QUALITY: pH= 7.9
conductivity =504 Us/cm.

FISHING EFFORT AND CATCH DATA:

Extensive electro-fishing for 658 seconds observed 2 jcs, 26 slimy sculpin, 5 juvenile/sub-adult Arctic grayling and a juvenile northern pike. Fish habitats are limited by lack of cover and very clear water.

GENERAL INFORMATION AND OBSERVATIONS:

The location of the outlet of Clarke Creek, shifted from shoreline erosion, has moved over 200 meters closer to the outlet of Moose River in the past few years. This small creek did have a trading post (abandoned in 1948) at its confluence with the Macmillan River. Most of the buildings from the trading post have fallen into the river; the last small shed was slumping into the Macmillan at the time of this survey.

Tributary # 33: MOOSE RIVER

Sample Site: 63°00.010'N/ 134°42.679'E
Reach extending 3 kms upstream of confluence with Macmillan River.

Watershed Code: 851 5405

Drainage Basin Area: 1,050 km²

Headwaters: Moose River originates in two headwater lakes set between Clarke Hills and Plateau Mountain, the largest lake is Moose Lake. The river flows in a south/west direction to its confluence with the Macmillan River

Tributary Order 4th order

Date of Investigation: July 31, 2002



Moose River, approximately 1 kilometer upstream of the Macmillan River.

CHANNEL CHARACTERISTICS:

Surveyed Length:	3 kilometers
Average Channel Width:	25 meters
Average Wetted Width:	25 meters
Average Velocity:	Approximately 0.5m/second
Average Depth:	0.7 meters
%Pool, Riffle, Run/ Glide:	100% Glide, with slight eddies along shore
Channel:	Entrenched
Banks:	Well defined and abrupt rising 0.8 to 2.0 meters
Temperature:	13.4°C
Water Color:	Creamy brown, turbid with 0.4 meter visibility
Instream Cover:	Good cover with turbidity and 10% Instream organic debris.
Crown Closure:	5-10%
Riparian Vegetation:	Thick alder fringe on 70% of banks with occasional patches of spruce. Spruce forest adjacent

BED MATERIAL: Consisted of small gravels in thalweg areas with silty mud towards river margins.

WATER QUALITY: pH= 8.09

conductivity = 221 Us/cm

FISHING EFFORT AND CATCH DATA:

Moose River was very difficult to sample, much of the river was too deep to wade and other areas had muck bottom. Electro-fishing was conducted along shorelines and from the boat, a total of 9 jcs, 45 slimy sculpin and 2 juvenile northern pike were observed. A 2.5' x 12 meter gillnet set for 1 hour in the outlet mix water eddy captured no fish.

GENERAL INFORMATION AND OBSERVATIONS:

Moose River is a large and very turbid tributary. The size of this tributary and lack of visibility made this tributary very hard to sample for fish. It does not appear as first class salmon habitat, however did support some juvenile chinook rearing. Spawning habitat was reported to exist at the upper reaches of the River closer to Moose Lake by J. Edwards.

APPENDIX 2 Benthic Invertebrates

River or Creek:	Earn River		Big Kalzas R.		Tummel R.		Harvey Cr.	
Lat/Long:	62° 44.205'N 134° 41.450' W		62° 53.537'N 135° 29.177' W		62° 45.411'N 135° 3.775' W		62° 38.702'N 134° 41.173' W	
Date, 2002	August 11/02		August, 2002		August, 2002		August 10/02	
	No.	%	No.	%	No.	%	No.	%
PHYLUM ARTHROPODA								
Class Insecta								
Insect - unidenfied pupae	2	3.3					3	1.6
Order Trichoptera								
Family Hydropsychidae	11	18.0			6	12.8		
Family Brachycentridae								
Brachycentrus sp.			26	40.6				
Family Rhyacophilidae			2	3.1	1	2.1	3	1.6
Order Plecoptera	1	1.6	1	1.6	3	6.4		
Family Perlidae	1	1.6	1	1.6				
Family Nemouridae							2	1.1
Order Ephemeroptera	1	1.6	3	4.7			1	0.5
Family Heptageniidae	37	60.7	19	29.7	14	29.8	17	8.9
Family Baetidae	4	6.6	1	1.6	1	2.1	4	2.1
Family Ephemerellidae	1	1.6	4	6.3	3	6.4	16	8.4
Family Siphonouridae							24	12.6
Order Diptera								
Family Anthericidae	1	1.6						
Family Chironomidae	2	3.3	6	9.4	16	34.0	114	60.0
Family Tipulidae								
Hexatoma sp.			1	1.6				
Family Blephariceridae								
Philorus sp.					1	2.1		
Family Simuliidae					2	4.3	2	1.1
PHYLUM ANNELIDA								
Class Oligochaeta							4	2.1
TOTAL PER SITE:	61		64		47		190	
TAXONOMIC RICHNESS PER SITE:	10		10		9		11	