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KLUSHA CREEK CHINOOK HABITAT ASSESSMENT

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for

Yukon River Panel

and

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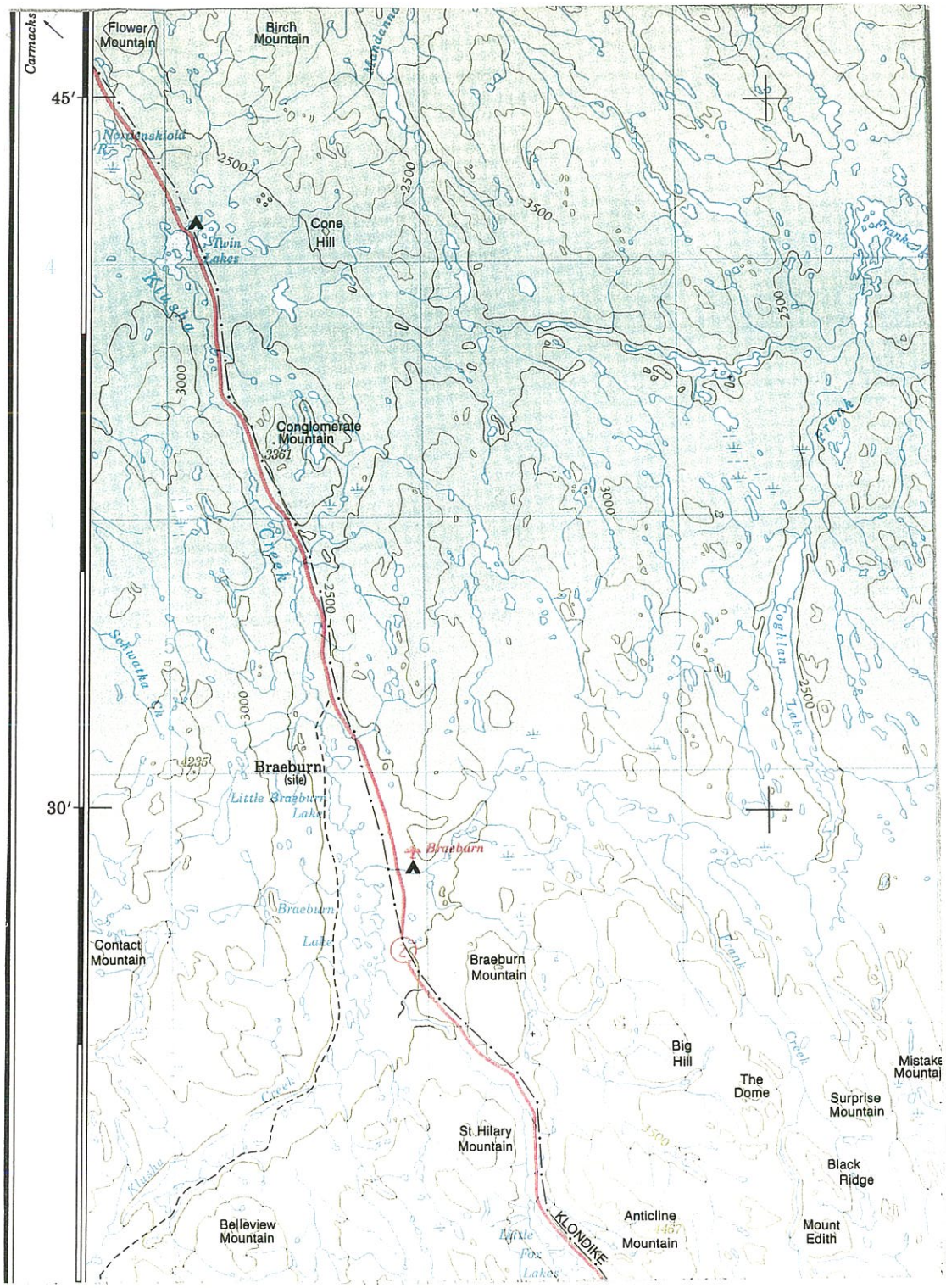
INTRODUCTION:

Klusha Creek flows northward from headwaters located west of the Miner's Range through Braeburn Lake and West Twin Lake, ultimately draining into the Nordenskiold River. This stream is known to have traditionally supported a run of chinook salmon which were harvested near the mouth of Braeburn Lake (J. Bellmore, Little Salmon Carmacks First Nation, pers. comm.; A. von Finster, 1995; Fisheries and Oceans, Whitehorse, 1963). However, in recent years no chinook spawners have been reported in the stream. A large number of beaver dams currently exist throughout the length of the Klusha Creek, and anecdotal evidence indicates that beaver activity is the primary cause for chinook salmon no longer ascending the creek to spawn. A large forest fire swept through the area surrounding the creek in the late 1950's, and following this event much of the old growth spruce forest was replaced, primarily with aspen poplar. This situation would be ideal for an increase in beaver populations in the area, and lends credence to the belief that beaver dams have eliminated chinook spawning within the stream. Klusha Creek flows through several small lakes and ponds immediately below the outlet of Braeburn Lake, but the number of lakes and ponds decreases as the stream nears West Twin Lake (A. von Finster, 1995). Below West Twin Lake beaver activity is reported to be very high, and few areas of free-flowing water exist due to the large number of beaver dams (J. Bellmore, Little Salmon Carmacks First Nation, pers. comm.) An old growth spruce forest still exists in the lowest reaches of the stream. The trapping concession in the area surrounding the lower reaches of Klusha Creek is held by a member of the Little Salmon Carmacks First Nation but the area has not been actively trapped for several years. The primary objective of the study described in this report is to provide a full small stream habitat assessment of the lower reaches of Klusha Creek. The study will focus primarily on the section from West Twin Lake to the confluence with the Nordenskiold River The purpose of the habitat assessment is to determine objectively the potential of the stream to support a spawning population of chinook salmon, and if beaver dams truly are the primary limiting factor. If Klusha Creek has the potential to support a significant level of chinook spawning, and beavers are the problem restricting their ascension in the stream, then a plan to remove the beavers and associated blockages to upstream migration by salmon could be eventually be developed.



Study Area:

The area to be investigated included the reaches of Klusha Creek from Braeburn Lake to the confluence with the Nordenskiold River. Because of a greater likelihood of success in reestablishing a population within the lower reaches of the stream, the focus of the investigation will be on the area from West Twin Lake to the Nordenskiold River (61° 45"N 136° 00"W).

METHODS:

The chinook habitat assessment was completed in accordance with methods outlined in "Guidelines for Small Stream Investigations Restoration/Development of Chinook Salmon Spawning Populations" (Habitat Management Sector, Yukon & NBC, 1995) as a basis for the investigation.

The first step in the project involved identifying and collecting existing information on Klusha Creek and its traditional/historical usage as a chinook spawning stream, as well as scientific and technical investigations completed to date. This process primarily involved speaking with Little Salmon Carmacks First Nation members and researching documents at the Fisheries and Oceans library in Whitehorse to investigate salmon harvest patterns and significant events which might have affected the chinook populations in this stream.

Water quality monitoring and assessment was another important component of the chinook habitat assessment in Klusha Creek. Water quality "stations"established in Klusha Creek were monitored on a monthly basis during the course of the study. The water quality component of the investigation was carried out over the course of one full year from June of 1997 through until June of 1998 to determine annual changes occuring within the creek, and included both a summer and winter component. Physical data collected for water quality assessment included stream velocity and discharge. This was completed by measuring the total width of the stream at the sampling site on the survey date and then measuring stream depth and velocity at 1-2 metre interval across the width of the stream. Stream velocity was established using a Price® meter and wading rod.Cross-sectional area of the stream was established by the formula: Area = Width x (average) Depth. Stream discharge was calculated as Volume = Area x Velocity. Water chemistry data collected at the sampling station included water temperature, dissolved oxygen and pH. Dissolved oxygen and pH were measured using electronic meters.Water temperature was determined utilizing a thermometer which was built in to the oxygen meter. On occasions when cold temperatures precluded the use of the meter temperature was taken with an alcohol filled thermometer, dissolved oxygen levels and pH were completed by titration using a Hach® kit. Water samples were collected at three separate times during the course of the study and sent to a commercial laboratory (Norwest Labs, Langley, B.C.) for extractable metals analysis. After collection water samples were maintained at 1-4^0 C while being transported to the laboratory for analysis. One sample was taken in September to assess overland flow, while a sample taken in February took in base surface flow and maximum groundwater contribution. A third sample was taken in April during the spring freshet.

The third step involved in conducting the chinook habitat assessment in Klusha Creek involved the field investigations component of the study. The summer component involved a habitat assessment of the lower reaches of Klusha Creek, from West Twin Lake to the confluence with the Nordenskiold River. This component of the study was completed in early September of 1997 by travelling along the stream on foot and by small craft, the primary purpose of this part of the investigation being to determine any obstructions to upstream migration and spawning by chinook salmon. During the habitat assessment several sets of data were collected which included the mapping of obstructions within the stream. Mapping of the substrate, noting evidence of previous redds and quality of the substrate was completed during this process also. Reach lengths were measured by use of a hip chain. Descriptions of riparian vegetation and instream vegetation were also made. Evidence of utilization of the stream by humans and/or wildlife was also completed during the habitat assessment portion of the study.

The other component of the habitat assessment portion of the Klusha Creek study involved minnow trapping to identify the species of fish present in the stream and to identify habitat utilization by chinook fry. The trapping was concentrated in the lower reaches of the stream from West Twin Lake to the Nordenskiold River. Minnow trapping was conducted in August of 1997 immediately below the outlet of West Twin Lake and again below the outlet of Airport Lake for a series of 48 hour sets. Minnow trapping was also conducted in June of 1998 immediately upstream of the confluence with, and both upstream and downstream in, the Nordenskiold River utilizing 6 sets for 8 hours each. Minnow trapping was conducted in accordance with the procedures outlined in the document "Baiting of G-type Minnow Traps" issued by the Habitat Branch of Fisheries and Oceans, Whitehorse.

At the conclusion of the field investigations portion of the study the data collected was analyzed and compiled into this final report.

RESULTS:

I) Historical Utilization and Existing Documentation:

Little Salmon Carmacks First Nations members report that chinook salmon were harvested from Klusha Creek, usually at a point downstream of Braeburn Lake up until the late 1950's. There has been no native harvest or reported sightings of chinook salmon in Klusha Creek since that time however. Beaver activity is reported to have increased significantly in the lower reaches of the creek over the last several decades.

Technical investigations of Klusha Creek include a fisheries survey completed in 1978 in preparation for a proposed oil pipeline (Foothills Pipe Lines (Yukon) Ltd., 1978). This study contains some water quality data, habitat description and seining and dipnetting during the open water season. This study contained no winter component. A late winter survey of Klusha Creek was conducted in 1996 for Fisheries and Oceans Habitat and Enhancement Branch by Laberge Environmental Services. This investigation consisted of a one time sampling of the creek at a point between Braeburn Lake and West Twin Lake in March of 1996. Ice cover, substrate, bank stability, riparian vegetation and water quality data are all presented in the final report along with photographs of the site. Archival data from Fisheries and Oceans, Whitehorse reports that "spring" salmon were observed spawning in Emerald Creek which drains into Emerald Lake at mile 71.5 of the Dawson Highway, in August of 1963". The stream described as Emerald Creek is in fact Klusha Creek, and Emerald Lake refers to what is now known as West Twin Lake.

II) Water Quality Data:

Several problems were encountered during the water quality data collection portion of the study. The first of these involved the establishment of a second water quality station. An attempt was made to establish a water quality station approximately 1500 metres downstream of the West Twin Lake outlet, a point which is accessible from the Klondike Highway by a small dirt road. Due to the depth of what appeared to be organic silt on the streambed it was not possible to wade across the stream without sinking into the bottom. The water at this point was also quite deep (1.25 - 1.5 metres) due to beaver dams immediately downstream. It was then attempted to establish water quality station number two at another road accessible point, immediately downstream of the Airport Lake outlet. The exact same conditions of deep silt substrate which were encountered downstream of the West Twin Lakes outlet also existed at this site. After unsuccessful attempts to carry out the sampling procedures at this site it was also abandoned. From that point forward all water quality/quantity data was collected from water quality station number one, located approximately 100 metres downstream from the Braeburn Lake outlet.

Figure 1: Water Quality Station in Klusha Creek immediately below Braeburn Lake outlet; July 1997. Upstream view.

Figure 1a: Water Quality Station in Klusha Creek immediately below Braeburn Lake outlet; July 1997. Downstream view.

Figure 2: Water Quality Station in Klusha Creek immediately below Braeburn Lake outlet; December, 1997. Upstream view.

Figure 2a: Water Quality Station in Klusha Creek immediately below Braeburn Lake outlet; December 1997. Upstream view.

Figure 3: Water Quality Station in Klusha Creek immediately below Braeburn Lake outlet during ice-out. May 1998.

With the exception of high water temperatures during the months of July and August, the water quality parameters assessed during the course of the study remained within acceptable limits for chinook salmon. During the January and April samplings the dissolved oxygen levels appear to be somewhat depressed (< 6.0 mg/l). These levels of dissolved oxygen may be correct as there is an ice-covered lake located immediately upstream, or it is also possible that these readings represent an error due to a malfunction of the oxygen meter.

The general trends observed in the water quality data were that the dissolved oxygen levels were depressed during the winter, but were found to be fairly consistent in the 9 mg/l range during the summer months. The usual clear inverse correlation between temperature and dissolved oxygen levels often observed in other streams did not appear in the data collected during the course of this study. The pH levels of the water rose during the spring, and remained elevated over the course of the summer months relative to the winter readings. Water temperatures decreased very slowly over the course of the winter and were never dropped below 1.5C, probably due to the mediating effects of deep water discharge from the lake.

Dissolved metals analysis showed no clear trends in terms of intra-annual changes Table (2A-2C), and overall levels of dissolved metals appeared to be stable.Most dissolved metals in the water were below detection limits throughout the year. Zinc and copper, which were the two dissolved metals of interest for chinook habitat analysis, did not give indications of being exceptionally high. Levels of dissolved copper were highest in April during the spring freshet, and were below detection limits during the February sampling. Levels of dissolved zinc were highest in September and were at minimum detection limits during the February and April sampling dates.

Water quantity data for the time period that the stream was sampled (Table 1) shows that the peak discharge for Klusha Creek was recorded during the December samping period. The lowest discharge for this stream during the one year survey occurred during the month of September 1997 when the volume of water leaving Braeburn Lake was 0.34 m^3/s. Another low discharge reading occurred at the June 1998 sampling, but this result should be read with caution as May of 1998 represented a level of precipitation 43% below the thirty year average in the area (Environment Canada, Whitehorse). This reduction in precipitation could significantly decrease water levels. With the exceptions of the September 1997 low and the December high discharge levels, the volume of water leaving Braeburn Lake was relatively consistent throughout the year of the study. Water quantity data could not be collected during the May 1998 sampling date as Braeburn Lake had just begun to "ice out"; wading into the stream and taking readings with the meters was not possible due to large pieces of ice flowing by (Figure 3).

Klusha Creek Water Quality Monitoring Station

Site Location: Approximately 75 metres downstream from Braeburn Lake outlet.

Substrate: Cobbles

Reach Type: Glide

Banks: Left bank steep; 2.5m. Right bank; gradual slope.

Riparian: Poplar, grass, willow, white spruce.

Habitat: Overhanging vegetation, small woody debris, instream vegetation.

Table 1: Water quality and discharge data collected monthly from Klusha Creek water quality Station #1 from June 1997 to June 1998. No data collected for Oct. 1997. *Indicates determined with Hach Kit.

	Dissolved Oxygen (mg/l)	pH	Temp. (C)	Depth (cm.)	Width (m.)	Mean Velocity (m/s)	Volume (m^3/s)
June 1997	9.63	8.49	16.3	40	14.8	0.13	0.51
July	9.15	8.26	18.1	35	14.7	0.12	0.49
August	9.30	8.21	15.3	35	14.7	0.12	0.48
September	10.6	8.20	9.5	36	12.0	0.10	0.34
October	-	-	-	-	-	-	-
November	9.25	8.23	2.6	36	14.2	0.13	0.46
December	6.75	8.17	2.1	37	14.0	0.15	0.70
January	5.70	8.05	2.3	36	14.0	0.12	0.51
February	9*	8*	1.5	35	13.8	-	-
March	9.22	7.5*	1.9	35	13.5	0.13	0.48
April	5.30	8.0*	3.0	37	14.0	0.13	0.54
May	6.73	8.41	3.7	-	-	-	-
June 1998	8.59	8.48	16.1	26	12.5	0.12	0.33

Note: During the April 1998 sampling date the carcass of a dog was found in the creek at the site of the monitoring station. Consultation with local residents indicated that the dog had drowned in the open water section of the lake at the mouth of the creek during the winter. The carcass must have been flushed from the lake with meltwater brought about by increasing spring temperatures. The owners of the animal had a cabin along the east shore of Braeburn Lake which was used for recreational purposes. Although they had apparently been informed of the location of the dogs remains they made no effort to remove it from the stream

Table 2: Dissolved metals analysis for Klusha Creek surface water sample taken 75 metres downstream from Braeburn Lake outlet on September 28, 1997.

Species	Level (mg/l)	Species	Level (mg/l)	Species	Level (mg/l)
Aluminum	< 0.01	Iron	< 0.003	Sodium	8.81
Antimony	< 0.02	Lead	< 0.005	Strontium	0.421
Arsenic	< 0.02	Lithium	< 0.002	Sulfur	9.7
Barium	0.0493	Magnesium	16.1	Thallium	< 0.003
Beryllium	< 0.0002	Manganese	0.0023	Thorium	< 0.005
Bismuth	< 0.02	Molybdenum	< 0.005	Tin	< 0.005
Boron	0.02	Nickel	< 0.002	Titanium	< 0.001
Cadmium	< 0.0005	Phosphorus	< 0.06	Uranium	< 0.06
Calcium	49.1	Potassium	1.7	Vanadium	0.003
Chromium	< 0.001	Selenium	< 0.02	Zinc	0.003
Cobalt	< 0.001	Silicon	4.46	Zirconium	0.001
Copper	0.002	Silver	< 0.001		

Table 3: Dissolved metals analysis for Klusha Creek surface water sample taken 75 metres downstream from Braeburn Lake outlet on February 10, 1998.

Species	Level (mg/l)	Species	Level (mg/l)	Species	Level (mg/l)
Aluminum	< 0.01	Iron	< 0.003	Silver	< 0.001
Antimony	< 0.02	Lead	< 0.005	Sodium	9.53
Arsenic	< 0.02	Lithium	< 0.002	Strontium	0.468
Barium	0.0535	Magnesium	18.9	Sulfur	11.0
Beryllium	< 0.0002	Manganese	0.0044	Thorium	< 0.005
Bismuth	< 0.02	Mercury	< 0.0001	Tin	< 0.005
Boron	< 0.02	Molybdenum	< 0.005	Titanium	< 0.001
Cadmium	< 0.0005	Nickel	< 0.002	Uranium	< 0.06
Calcium	54.1	Phosphorus	< 0.06	Vanadium	0.003
Chromium	< 0.001	Potassium	2.0	Zinc	0.001
Cobalt	< 0.001	Selenium	< 0.02	Zirconium	< 0.001
Copper	< 0.002	Silicon	4.78		

Table 4: Dissolved metals analysis for Klusha Creek surface water sample taken 75 metres downstream from Braeburn Lake outlet on April 22, 1998.

Species	Level (mg/l)	Species	Level (mg/l)	Species	Level (mg/l)
Aluminum	< 0.01	Iron	0.01	Silver	< 0.001
Antimony	< 0.02	Lead	< 0.005	Sodium	9.21
Arsenic	< 0.02	Lithium	0.003	Strontium	0.47
Barium	0.0546	Magnesium	16.6	Sulfur	11.0
Beryllium	< 0.0002	Manganese	0.0032	Thorium	< 0.005
Bismuth	< 0.02	Mercury	< 0.0001	Tin	0.006
Boron	0.01	Molybdenum	< 0.005	Titanium	< 0.001
Cadmium	< 0.0005	Nickel	< 0.002	Uranium	< 0.06
Calcium	54.2	Phosphorus	< 0.06	Vanadium	< 0.002
Chromium	< 0.001	Potassium	2.5	Zinc	0.001
Cobalt	< 0.001	Selenium	< 0.06	Zirconium	< 0.001
Copper	0.003	Silicon	5.42		

III) HABITAT MAPPING:

The habitat mapping portion of the study showed that the reaches of Klusha Creek were fairly consistent along their lengths with respect to habitat type, and that changes in reach type were relatively few. For these reasons general descriptions of habitat type will be given as opposed to tabulating the data for each segment of the stream surveyed.

West Twin Lake to Airport Lake:

The first segment of Klusha Creek mapped were the reaches extending from the outlet of West Twin Lake to Airport Lake. This section represents a total length of 7.5 kilometres. The most obvious feature of this segment of the stream was the large number of both intact and decaying beaver dams and beaver lodges found in this area. A total of 17 beaver dams which appeared to be intact and were being maintained in a state of good repair, existed within this segment of the stream (Figures 6, 8 & 9). Deep pools were common in these areas of beaver activity. A total of 5 beaver dams which appeared to have been abandoned, were found in the same reaches of the stream. There was an obvious concentration of active beaver dams and lodges (Figure 7) in the upper segments of this portion of the stream, especially in the 2 km. immediately downstream from the West Twin Lake outlet, while the abandoned beaver dams were predominant found in the lower reaches of this segment of Klusha Creek. Beaver activity in the creek had displaced a wooden bridge located 1,440 metres downstream from the West Twin Lake outlet. The beaver(s) had built a dam against the upstream side of the bridge. The force of the water had lifted the bridge from its piers and moved it several metres downstream.

Substrate types in this segment of the stream consisted of a mainly organic silt bottom in the areas of beaver activity. The first 1,600 metre segment below the West Twin Lake outlet exhibited a deep silt substrate, with instream vegetation and occasional boulders present. Riparian vegetation in this first segment was dominated by grasses and willow although alder and aspen poplar were also common (Figure 5). Dead white spruce occurred regularly within the wetted width of the stream (Figure 4).

At a point approximately 1,900 metres downstream from the West Twin Lake outlet the characteristics of the stream began to change; the channel was narrower and more defined with alternating glide and riffle sections replacing the pool habitat found further upstream. These features existed over approximately 1,600 metre segment of the stream. Within this reach the stream gradient was higher. Cobble and gravel substrates were present, although the cobbles were

usually in the smaller size range. There was less woody debris and instream vegetation found in this segment of the stream, relative to the upstream portion.Within this reach of the stream beaver dams were found, but with far less freqeuncy than in the reach located immediately downstream of the West Twin Lakes outlet. Riparian vegetation in this segment of the stream was dominated by alders, with dogwood, grasses, and willow also commonly found. White spruce occurred, but only intermittently. Signs of fish having spawned in this reach of Klusha Creek were also observed. A series of mounds of coarse gravel/small cobbles which appeared to be nests were noted in the streambed. These mounds had an estimated mean diameter of 30 centimeters. No other evidence of fish activity was observed in this area during the mapping of the stream.

At a point approximately 3,500 metres downstream from the West Twin Lake outlet the characteristics of the stream changed once again. This third segment of the stream, which continued for a distance of 2,100 metres, is best described as a glide zone of moderate velocity displaying "marshy"attributes. In this section of the stream the substrate was relatively homogenous consisting of silt and instream vegetation with occasional deep pools. Numerous root masses with associated large woody debris which would create partial blockages of the stream to larger fish, were also seen throughout this stream segment. One active beaver dam was seen at the beginning of this long reach, and several older abandoned dams were found near the bottom. Riparian vegetation exhibited a minimum of variation, and was dominated by grasses, with some willow and occasional areas of white spruce.

The fourth reach of Klusha Creek which terminated at the Airport Lake inlet, was an alternating glide/riffle zone 1,800 metres in length with alternating substrate consisting of either gravel, or a combination of organic silt and instream vegetation.The most significant differences found in this reach compared to the preceding reach were, a more defined channel, the appearance of numerous back channels or ponds, an increase in the number of deep instream pools, and most notably, a large increase in the amount of large and small woody debris, and instream rootmasses. This increase of instream debris produced an associated rise in the number of partial and complete stream blockages. These made travel by small craft arduous, and could affect the movement of larger fish within the stream. Riparian vegetation was a combination of grass, willow, and white spruce which varied in their relative abundance. Beaver activity was also obvious in this reach with the presence of a beaver house, at least two active, and several abandoned beaver dams. Beaver activity was usually directly associated with a back channel or pond. These stream features continued up to the Airport Lake inlet.

Airport Lake to Nordenskiold River:

The final segment of Klusha Creek which extends for a distance of 2,600 metres from the Airport Lake outlet to the confluence with the Nordenskiold River is best classified as a single reach which can best be described as a glide zone of low velocity. The stream characteristics of this reach make it unique from all other upstream segments of Klusha Creek which were investigated during this study .This segment of the stream was by far the most homogenous with respect to the stream features observed, and the degree of variation of all instream features and riparian vegetation in this final reach were minimal. The most noteable feature of this final reach of Klusha Creek was a deep organic silt substrate which occurred throughout, up to the confluence with the Nordenskiold River. In conjunction with the deep silt was instream vegetation which had grown into heavy mats and rose up to the surface of the stream (Figure 10). Large and small woody debris were found regularly within this segment of the stream. Partial and complete blockages of the stream by woody debris were continous and sufficient to impede movement of large fish, such as chinook spawners. Travel within this reach was difficult. In places the vegetative mat was sufficient to impede passage by small craft, and this required the surveyors to portage. The blockages of the stream by woody debris also impeded travel. Exiting from the canoe within the stream channel to circumvent these stream blockages, caused the surveyors to sink to their hips into the deep silt, and self-extraction from this predicament was often difficult. These occurrences provide evidence regarding the depth of silt on the streambed. Occasional deep pools also occurred within this reach. Riparian vegetation in this lowest reach consisted primarily of a mature white spruce forest with a mixture of grass and willow occurring immediately adjacent to the stream bank. Evidence of a number of abandoned beaver dams, most of which were in an advanced state of deterioration, were found within this reach. The only sign of current beaver activity in this segment of the stream was a single beaver lodge, and fresh beaver droppings found immediately below the Airport Lake outlet. The only fish activity witnessed in this reach of the creek were several small (estimated 30-40 cm.) Northern Pike in weedy areas near the mouth of the creek..

Figure 4: Upstream view in Klusha Creek from bridge located 1,440 metres downstream from West Twin Lake outlet showing large flooded area created by beaver activity. July 1997.

Figure 5: Shoreline on east bank of Klusha Creek 1,440 metres downstream from West Twin Lake outlet. Note that all aspen poplar trees have been removed by beavers and only small alders remain. July 1997.

Figure 6: First of numerous beaver dams encountered in Klusha Creek during habitat survey; Located approximately 500 metres downstream from West Twin Lake outlet. September 1997.

Figure 7: Large beaver lodge located in Klusha Creek approximately 500 metres below West Twin Lake outlet.

Figure 8: New beaver dam construction in Klusha Creek approximately 1,000 metres downstream from West Twin Lake outlet. September 1997. Primarily aspen poplar components.

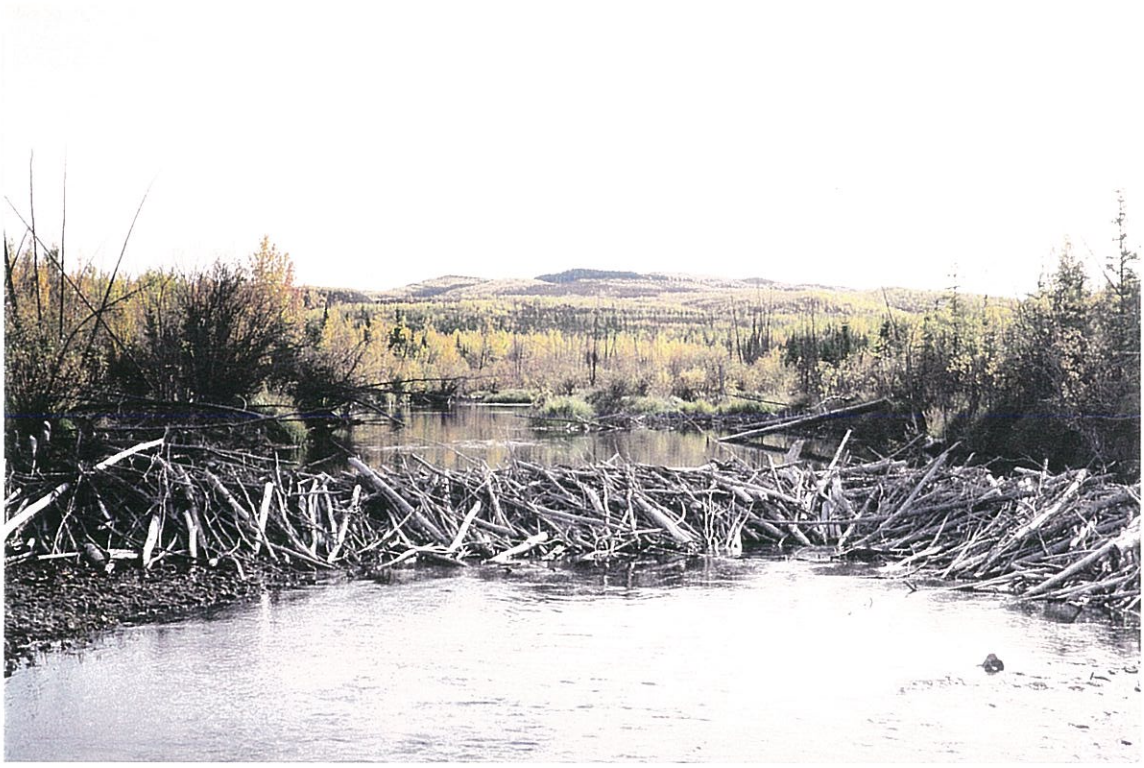


Figure 9: Established beaver dam in Klusha Creek approximately 1,200 metres below West Twin Lake outlet. September 1997. Note increase in water levels behind the dam.

Figure 10: Example of typical habitat found in lowest reaches of Klusha Creek below Airport Lake. Deep silt and heavy mats of instream vegetation cause low water velocity in this section. June 1998.

IV) MINNOW TRAPPING:

29/06/97 - 2 minnow traps set in Klusha Creek immediately downstream from site of washed out bridge 1440 - 1450 metres below outlet of West Twin Lake. Set at 0930 h and retrieved on 30/06/97 approximately 24 hours later.

Set 1: empty
Set 2: empty

2 minnow traps set in Klusha Creek in immediate vicinity of Airport Lake outlet. Traps set at 1030h and retrieved on 30/06/97 approximately 24 hours later.

Set 1: empty
Set 2: empty

1 minnow trap set in Klusha Creek approximately 500 metres downstream from Airport Lake outlet. Trap set at 1045h and retrieved on 30/06/97 approximately 24 hours later.

Set 1: empty

31/08/97 - 2 minnow traps set in Klusha Creek immediately downstream from site of washed out bridge 1440 - 1450 metres below outlet of West Twin Lake. Set at 1530h and retrieved on 02/09/97 at approximately 1800h.

Set 1: empty
Set 2: empty

2 minnow traps set in Klusha Creek in immediate vicinity of Airport Lake outlet. Traps set at 1630h and retrieved on 02/09/97 at approximately 1700h.

Set 1: empty
Set 2: empty

1 minnow trap set in Klusha Creek approximately 500 metres downstream from Airport Lake outlet. Trap set at 1645h and retrieved on 02/09/97 at approximately 1715h.

Set 1: empty

30/06/98 - 2 minnow traps set in mouth of Klusha Creek at a point approximately 200 metres upstream from confluence of Nordenskiold River. Trap set at 1200h on 30/06/98 and retrieved on 30/06/98 at approximately 2000h. Habitat in immediate vicinity of traps was substrate of silt and heavy instream vegetation in immediate vicinity of a deep pool. Large woody debris also present in area of sets.

Set 1: empty
Set 2: empty

30/06/98 - 2 minnow traps set in Nordenskiold River at points approximately 50 and 300 metres upstream from confluence of Klusha Creek respectively. Traps were set at 1200h and retrieved at 2000h on 30/06/98. Both sets were in the vicinity of deep pools with silt substrate and large woody debris.

Set 1: empty*
Set 2: empty*

* It should be noted that juvenile chinook salmon which appeared to be of 0+ year class were seen in the immediate vicnity of the areas in which these traps were set, but did not enter the traps.

30/06/98 - 1 minnow trap set in Nordenskiold River at a point approximately 250 metres downstream from confluence of Klusha Creek. Trap was set at 1200h and retrieved at 2000h on 30/06/98. Trap was set in pool habitat with a silt substrate and below overhanging vegetation and large woody debris.

Set 1: empty

CONCLUSIONS AND RECOMMENDATIONS:

The information collected during the course of this study shows that Klusha Creek appears, in general, to exhibit many habitat characteristics typical of small streams within the Yukon Territory, anomalies were found with respect to the intra-annual discharge and temperature patterns during the course of this investigation.

Water quality data indicates that the extreme temperatures found during the summer months exceeded the levels which would make this stream acceptable as spawning or rearing habitat for chinook salmon (Sigma Consultants, 1983). Temperature and dissolved oxygen levels varied inversely, as would be expected. The pH increased over the spring and summer months, and decreased over fall and winter, a pattern which has been observed in other small streams in the Yukon. Dissolved metals in the water appear to be below toxic levels for salmon activity (Sigma Consultants, 1983). The intra-annual discharge within Klusha Creek showed an atypical pattern, with the peak discharge being measured in December and the minimum in September. It is important however, to keep in mind that this study covers the course of a single season, and that the 1997-98 year might not representative of the typical annual pattern of discharge. A second important consideration related to interpretation of water quality/quantity data is that all of the data was collected in the highest portion of the stream, at the Braeburn Lake outlet, as a second water quality station could not be established. The water quality/quantity data presented here may not be an accurate representation of conditions which exist in the lower reaches of Klusha Creek. Much of the upper portions of Klusha Creek (between Braeburn and West Twin Lake) remained open during the course of the winter, which would keep dissolved oxygen levels high, and would in general be conducive for overwintering of eggs and alevins.

Mapping of the lower reaches of the stream revealed two key factors which would impede the possible utilization of this stream as spawning and/or rearing habitat by chinook salmon. These factors are extensive stream blockages due to beaver activity, and heavy siltation. A heavy layer of silt was found covering the substrate throughout much of the lower portions of Klusha Creek. These areas of siltation usually, but not always, occurred in conjunction with beaver activity within the stream. In areas of siltation where there was no indication of current beaver activity, naturally occurring stream blockages were usually numerous. These stream blockages lower the velocity of the stream, and thereby prevent the flushing of fine materals from the streambed. The quantity of silt found on the streambed indicates that this situation has likely existed for some time. Alders were common along the streambanks in most areas of beaver activity, and these trees appear to supply the beavers both with food, and structural components for their lodges and dams.

Aspen poplar which regularly occur just beyond the stream banks also helps to maintain the beaver population. The blockages in the stream seem to have created some extensive marshy areas in regions of low gradient upstream from Airport Lake.

The only area of the Klusha Creek which, at the present time, appears to have acceptable substrate and flow conditions for spawning chinook salmon occurs above Airport Lake. The substrate in this area is a gravel and small cobble mix found in association with riffle zones. The total area in which these conditions were found was restricted, and overall the amount of suitable spawning habitat currently available should be considered quite limited.

Streambank stability appears to be good in general, owing to the growth of grasses, alders and willow along most of the length of Klusha Creek from West Twin Lake to Aiport Lake. The established riparian vegetation should limit the influx of silt into the stream during the spring freshet.

Minnow trapping data indicates that very little fish habitat or activity currently exists within Klusha Creek, downstream of the West Twin Lake outlet. It should be noted however that West Twin Lake is a popular destination for weekend anglers, and that therefore fish populations in the lake would apper to be healthy.

Human impact on Klusha Creek with respect to maintaining water purity and fish health is another consideration. A number of cabins have been built along the east shore of Braeburn Lake right up to its outlet into Klusha Creek, and there is a significant level of human activity in the area. Also, the Klondike Highway follows the stream for several kilometres above the West Twin Lake inlet. The dumping of waste, such as the animal carcass described earlier, may be inadvertant, but will always have the potential to impact negatively on stream resources when there is considerable human activity in the area.

In the late 1950's a large portion of what was, at the time, a mature spruce forest surrounding the lower reaches of Klusha Creek was destroyed by fire. Since that time the spruce trees have largely been replaced by the willow, alders, grasses and aspen poplars which are present today. The loss of the forest undergrowth, and riparian vegetation following the fire probably caused the soil to become unstable, and subsequently large quantities of silt would flush into the stream during spring freshet, and with each succesive rainfall. Also, the species of trees which grew in place of the spruce after the fire were conducive to the influx and maintenance of a large population of beavers. The damming of the stream by the beavers under the conditions described above, would create the large wetland areas and the heavy load of fine materials which are found in the creek today. The lowest reach of Klusha Creek, the section from Airport Lake to the confluence with the Nordenskiold River is the first section which would need to be "reclaimed"

before restocking of the creek with chinook salmon fry could be undertaken. This lowest section of the creek appears to have a low gradient and insufficient velocity to flush the heavy silt load from the streambed. Increasing stream flow and removal of much of the silt load over the streambed would be the first necessary step in reclaiming the stream for salmon.

The original objectives of this study were to determine the chinook salmon spawning and rearing potential of Klusha Creek, and if beavers truly are the major limiting factor. Given the limitations of the data collected during the study the following conclusions can be made with respect to the study objectives. Firstly, given that the water quality station was located some distance upstream, and that there were intra-annual anomalies of temperature and flow relative to other streams in the Yukon Territory, in general, the water in the lower reaches of Klusha Creek should be sufficient in quality and quantity to support populations of both spawning and rearing chinook salmon. Secondly, much of the streambed below West Twin Lake is presently covered by a heavy layer of organic and inorganic silts. The deposition and accumulation of these fine materials appears to have occurred in conjunction with the damming of the stream by beavers. In the limited stream reaches where good flows exist, the exposed substrate is of a suitable grade for use by spawning chinook. If the fine materials were removed, it is likely that the amount of suitable streambed available for spawning within the lower reaches of Klusha Creek would prove to be extensive. Thirdly, beaver activity in the lowest reaches of the creek appears to be on the decline, which may indicate that the quality of beaver habitat in these areas has "peaked"in the cycle. This type of decline occurs as the deciduous growth initiated following the forest fires of the late 1950's begins to slow, and the replacement of this growth by coniferous species, such as white spruce, begins. Fourthly, the amount of woody debris and other instream structures, as well as the number of back channels found in the stream indicate that there is a large amount of rearing habitat available for chinook salmon fry. The fifth, and final conclusion which can be drawn from this study is that independent accounts from both Little Salmon Carmacks First Nation elders and Fisheries and Oceans, Canada, indicate chinook salmon have historically utilized Klusha Creek for spawning from the Nordenskiold River at least to the outlet of Braeburn Lake.

The two major objectives of this study were to determine the potential of Klusha Creek to support a spawning population of chinook salmon, and to determine if beavers truly are the limiting factor to chinook spawning in the stream. Considering the conclusions which can be drawn from data outlined above, there appears to be good reason to believe that this stream can support a spawning population of chinook salmon. There is also considerable evidence to support the theory beaver dams have been a significant factor in the loss of chinook salmon spawning habitat from Klusha Creek. This loss of spawning habitat appears to have occurred primarily

because of the blanketing of the substrate by a heavy layer of fine materials which accumulated when flows in the stream were reduced by beaver dams.

The utilization of Klusha Creek by chinook spawners was still occurring albeit to an unknown degree as late as 1963. This was at least four years after the loss of the old growth forests in proximity to Klusha Creek to fire. There have been no confirmed sightings of chinook spawners in Klusha Creek post-1963. It is plausible that during the early 1960's the old growth forest along the streambanks, which was lost during the burn of the late 1950's, was in the process of being replaced by deciduous the species, favoured by beavers. The blanketing of the spawning grounds by organic and inorganic fine materials would have begun at this time, in response to the damming of the stream by beavers. Silt has continued to accumulate on the streambed up until the present time. It appears that the accumulation of fine materials over the substrate, and the blocking of upstream access by chinook spawners are the major impediments to reestablishing a spawning population within Klusha Creek. This study identified no other changes to habitat or water quality within the stream which could initiate such a catastrophic decline in salmon populations. It therefore follows that removal of the beavers and their dams from the stream would increase the flow in the stream and flush the accumulated sediments from the streambed. This would be the primary step necessary to reestablish a population of chinook spawners in Klusha Creek.

There are several important considerations regarding the possible impacts caused by the removal of beaver dams from the stream. These considerations include the potential effect of lowering the water levels in the Klusha Creek watershed. Several wetland areas as well a number of small lakes exist in conjunction with Klusha Creek. Airport Lake is an important recreational area and meeting place for the Little Salmon Carmacks First Nation. At least one pair of Trumpeter Swans and several other species of waterfowl nested and raised young in this lake during the open water period of the survey. As mentioned above, West Twin Lake and Braeburn Lake also have recreational value. Removal of the beaver dams and other blockages from the stream to allow upstream passage by chinook spawners could conceivably affect seasonal variations in water levels in any or all of these areas, to an unknown degree.

Another consideration associated with possible impacts associated with removal of beaver dams from the stream is the effect of the movement of large quantities of silt into downstream areas in the Nordenskiold River. The quantities of silt on the streambed of Klusha Creek are considerable. This is especially true of the reach from Airport Lake to the confluence of the Nordenskiold River. Removal of blockages from the upstream portions of Klusha Creek would be expected to increase the velocity of the stream. This would likely cause the silt to flush downstream fairly rapidly following removal of the beaver dams. The Nordenskiold River is

known to contain chinook salmon spawning and rearing habitat. The movement of large quantities of silt into the stream over a short period of time could potentially cause the loss of eggs or alevins due to hypoxia, as these fine materials settled onto the spawning beds. Also other aquatic life in the Nordenskiold River could be adversely affected by the sudden release of large quantities of silt from Klusha Creek.

The other point which should be taken into consideration is that the "removal" of the beavers and their dams from Klusha Creek will probably occur naturally over time. Over the next few decades the aspen poplar, alder and willow which currently prevail in the stream drainage will begin to recede as the spruce forest once again begins to reestablish itself. In conjunction with the return of the spruce forest the loss of food and habitat supplied by the aspen poplar and alders will cause beavers to move out of the area. Over time their dams will decay and the increased flow will wash the silt load from the streambed. These changes will improve salmon habitat in the stream, and if Klusha Creek is capable of supporting spawning and rearing populations of chinook salmon they should reestablish themselves naturally given sufficient time.

The beaver population along Klusha Creek appears to be very large. Eradication of the beavers from the stream would require a sustained effort. At the present time the price of beaver pelts is relatively low and there is little incentive for licensed trappers to harvest beaver pelts. The other option for removal is to hire someone to shoot the beavers during the open water season. The habitat in this area is prime for beavers, and it is likely that after the existing beavers were removed, migration into the area by young beavers, or those from more marginal areas would occur readily. There is also an ethical question to be considered in regard to a program of beaver removal from the creek. A number of people are opposed to this type of program, arguing that healthy beaver populations are as much an integral part of the natural environment as are the fish populations.

This study has provided documentation regarding the the potential of Klusha Creek to support a population of chinook spawners and the effects of beavers on chinook salmon within the stream. More information is required before the ultimate decision on whether or not to remove the beavers from the creek in preparation for the reestablishment of chinook salmon populations can be made. The next step in the process would be to implement an impact study to determine more specifically the effects of removing the beaver dams from the stream.

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