DAVID BUSTARD

1982 INVESTIGATIONS OF ADULT COHO SALMON IN THE TELKWA RIVER

PREPARED FOR

CROWS NEST RESOURCES LIMITED

FEBRUARY, 1983

Environmental & Planning Associates

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BY

DAVID BUSTARD

FOR

READ ENVIRONMENTAL & PLANNING ASSOCIATES LTD.

JANUARY, 1983

February 16, 1983

File: 03024

Crows Nest Resources Limited
Eau Claire Place,
525 - 3rd Avenue S.W.
Calgary, Alberta
T2P 2M7

Attention: Malcolm Ross,
Manager, Environmental & Regulatory Affairs

Dear Malcolm:

Re: Fall Fisheries Studies - Telkwa Project Area

EPA is pleased to deliver the attached report on the fall fisheries studies, titled 1982 Investigations of Adult Coho Salmon in the Telkwa River. While the report concentrates on coho salmon it also provides useful observations of other species present, including Rocky Mountain whitefish, Dolly Varden, steelhead and cutthroat trout. The most intensive effort was applied to Goathorn and Tenas creeks. Work here included water temperatures and flow measurements for correlation with the fish observations.

In spite of considerable effort to locate spawners no evidence of coho spawning was found in Goathorn, Tenas, Pine or Howson creeks during the 1982 field program. Limited spawning and rearing habitats and formation of subsurface ice are indicated as major constraints to use of these streams by coho. Because of potential variability in use due to annual variations in physical conditions and run size, follow up studies are recommended to confirm the initial findings.

Yours truly,

Simon C. Read,
President.

SCR/pm

Encl:

Read **Environmental & Planning Associates** Ltd.

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SUMMARY

1) A study to provide more detailed information on the timing and distribution of adult coho salmon spawning in the Telkwa River basin was conducted between September and December 1982. Five tributary streams and the mainstem Telkwa River were examined for the presence of adult coho.

2) Field studies indicated that an estimated 200 or more adult coho spawn in a 16 kilometre section of river upstream of Jonas Creek in the mainstem Telkwa River and in the lower 1 kilometre of Elliott Creek. All spawning occurred in low gradient sections of the river which appeared to be influenced by groundwater. Spawning areas were in the vicinity of excellent juvenile coho rearing habitat.

3) Upstream movements of spawners out of the Bulkley River probably occurred in mid-October, although field studies were unable to verify this. Most spawning occurred from late October to the end of December, with a peak probably in late November.

4) No evidence of coho spawning was found in Goathorn, Tenas, Pine or Howson creeks despite considerable effort in attempting to locate spawners. Typically these tributaries are steeper-gradient systems than coho prefer to use, and they offer limited potential spawning and rearing habitats compared to the mainstem sites. Observations during November 1982 indicate that extensive subsurface ice, formed during the spawning and egg incubation period, could be a major limiting factor governing the use of these streams by fall-spawning salmon.

1. INTRODUCTION

Coho salmon are the most significant salmon species to occur in the Telkwa River basin. Historical escapement estimates since 1960 for the Telkwa River range from 100 to 1,200 fish annually (Table 1). These estimates are crude due to the long duration of coho spawning, the wide distribution of coho throughout the system and limited visibility typical of the fall spawning period. Past reports by the Resource Analysis Branch (RAB) of coho carcasses recovered in Howson, Goathorn, Pine and the mainstem Telkwa River in mid-September (data on file, B.C. Fish and Wildife Branch, Smithers), have led to some confusion concerning the actual time and location of coho spawning. Coho spawning is typically later than these reported dates in other Bulkley River tributaries.

Field studies were conducted between September and December 1982 to provide more detailed information on the timing and distribution of adult coho spawning in the Telkwa watershed. The studies focused on those areas subject to potential impacts due to proposed coal development in the Goathorn/Pine creek watersheds, but also included areas outside the immediate impact zone to provide some perspective of overall use of the watershed by coho salmon spawners.

Table 1: Telkwa River Coho Escapement Estimates[1]

Year	Numbers	Officer[3]	Comments
1960	D (300-500)	H.E.	- Spawning most in upper end of river.
1961	E (500-1000)	L.G.	September to December.
1962	F 1200	L.G.	- Heavy run - October 10.
1963	N.R.[2]	O.B.	Poor visibility
1964	C 200	O.B.	
1965	C 200	L.G.	- October 10 - November 16.
1966	B 100	L.G.	Road washed out - poor access.
			- October 10 - November 10.
1967	B 100	L.G.	Visibility always limited.
1968	B 100	L.G.	
1969	D 350	A.G.	
1970	C 200	D.M.	
1971	N.R.		
1972	N.R.	A.G.	
1973	N.R.	A.G.	
1974	N.R.	A.G.	
1975	D 350		
1976	D 300	D.M.	
1977	D 500	A.G.	
1978	N.O.[2]	D.M.	- Coho in Pine, Howson, Sinclair and mainstem Telkwa near Jonas Creek.
1979	N.R.		Not inspected
1980	N.O.	D.M.	- October 21 - no fish in Howson Creek area.
1981	N.R.	T.T.	Few pinks in lower Howson Creek.

1 Source: Department of Fisheries and Oceans, Smithers

2 N.R. = Not reported.
N.O. = None observed.

3 H.E. = H. Engelson
L.G. = Lou Gelly
O.B. = O.M. Bussy
A.G. = Al Groat
D.M. = Don Meyers
T.T. = Terry Turnbull

2.1 TRIBUTARY STUDIES

The most suitable technique for examining tributary streams was to walk them looking for live adults or carcasses. Larger pools were angled, but in all cases the tributaries were too small for snorkel observations. Visibility from shore was generally excellent throughout the fall period.

The lower sections of Goathorn Creek (9.0 km), Tenas Creek (8.5 km), Pine (13.5 km) and Howson Creek (3.0 km) were walked during the first week of November. As well, the lower 1 to 3 kilometres of Goathorn, Pine and Howson creeks were examined in late September as this was the period when coho spawners have been reported in these systems in the past (RAB data on file, B.C. Fish and Wildlife Branch, Smithers).

During the September examination, some detailed physical data describing channel slope, substrate characteristics (D90 or the diameter of bed material which is larger than 90 percent of the remaining material), substrate suitability for spawning, presence of organic cover and side channels, and wetted widths were collected. Lower Goathorn Creek was examined on four occasions in an effort to provide an index of timing of coho movements into tributaries, if they did occur.

Staff gauges were installed on Tenas and Goathorn creeks at the lower bridge crossings and were read whenever the field crew was in the study area. The discharge of these two streams was metered on two occasions to calibrate the staff gauge readings, once using a Marsh-McBirney Model 201 current meter and once using a gurley meter. Spot water temperatures were recorded whenever the field crew was in the study area.

2.2 MAINSTEM STUDIES

Aerial reconnaissance was the most effective technique used in evaluating coho use of the mainstem Telkwa River. Three helicopter examinations (total time of 4 hours) were conducted in the Telkwa, with incomplete surveys on November 1 and December 23 and a complete survey between the Telkwa-Bulkley confluence and the headwaters of the Telkwa River conducted on November 18. The helicopter flew at low speeds approximately 50 metres above the river and observations of fish presence, redds, ice conditions, and suitability of the substrate for spawners were recorded. Water clarity was not adequate to permit aerial observations during most of October.

Incidental angling to provide some idea of the timing of upstream movement by coho conducted during late September and October was unsuccessful. Efforts would have to be intensified substantially before this technique would provide a useful index. Snorkel observations in the lower Telkwa were attempted in mid-November but were abandoned due to the presence of frazil ice which severely restricted visibility. Similarly, attempts to conduct observations from an inflatable boat were abandoned when sections of shelf ice were encountered. Much of the Telkwa is judged to be unnavigable at low flows due to the presence of frequent log jams in the upper reach and extensive boulder fields in the lower reach.

3. RESULTS AND DISCUSSIONS

3.1 TRIBUTARY SURVEYS

No coho spawners were observed or angled in Goathorn, Tenas, Pine or Howson creeks during the 1982 surveys. Elliott Creek, located approximately 40 kilometres up the Telkwa River was the only tributary stream found to be used for coho spawning, with 24 adults observed during the November 18 reconnaissance (Figure 1). Detailed results of physical surveys and efforts expended in tributary streams are presented in Appendices 1.1 to 1.4 with water temperature and discharge data in Appendices 2.1 and 2.2. The following section provides a summary of field evaluations of the coho spawning potential of the tributaries examined, with an emphasis on those streams within the potential impact zone.

3.1.1 Goathorn Creek

Less than 1 percent of the substrate of Goathorn Creek was judged to be suitable for coho spawners. Suitable gravels were generally restricted to the tail ends of a few pools. Most of Goathorn Creek is characterized by large cobble (6 - 25 cm) and boulder (>25 cm) materials with the gradient exceeding 2 percent in all sections. Goathorn Creek offers few off-channel rearing sites and provides little organic cover area except in the lowest 1 kilometre section. These types of areas are generally favoured by juvenile coho for rearing.

A 1.5 metre beaver dam located 600 metres upstream from the Telkwa River posed passage problems for adult coho, and it was unclear whether fish would have been able to move beyond this point during the relatively stable flow conditions present in the fall of 1982. Extensive anchor ice had formed through much of Goathorn Creek by

the middle of November, and spawning could not have taken place past this date unless specific areas of groundwater inflows were present.

RAB data (on file, B.C. Fish and Wildlife Branch, Smithers) indicate that five coho carcasses were found in the lower kilometre of Goathorn Creek in 1975, suggesting that some use of this system does occur. The present studies indicate that Goathorn Creek was not utilized by coho spawners in 1982, and that conditions were generally not suited for extensive use of the system by coho.

3.1.2 Tenas Creek

Tenas Creek possesses more spawning gravels than Goathorn Creek. However, the low discharge (approximately 0.15 m^3/s during September to early November) would pose difficulties for adult fish movement upstream, as the stream is simply too shallow to permit upstream migration. The beaver dam on lower Goathorn would also limit coho movements into Tenas Creek, since it occurs downstream from the confluence of these two creeks.

Extensive subsurface ice formed throughout Tenas Creek in mid-November. Because of the low fall flows and icing, Tenas Creek is more suited to the spring spawning steelhead which can gain access into the system during higher flows associated with snowmelt in May and June.

3.1.3 Pine Creek

Similar to Goathorn Creek, less than 1 percent of the substrate in lower Pine Creek is suitable for coho spawning. There are a very limited number of potential spawning sites associated with the tail ends of a few pools in Pine Creek. Most of the creek up

Few coho juveniles were observed upstream of 0.5 kilometres on Howson Creek. However, steelhead fry were dipnetted from marginal areas up to 2 kilometres upstream, suggesting Howson Creek is probably a more significant steelhead stream than a coho stream. RAB data (on file, B.C. Fish and Wildlife Branch, Smithers) indicate 174 coho were observed in lower Howson Creek in mid-September 1975. Again, these observations suggest that despite better habitat potential than other tributaries discussed so far, Howson Creek was apparently not utilized by coho for spawning in 1982 and only the very lowest end had any indication of juvenile use.

3.1.5 Elliott Creek

Elliott Creek was not included in the initial tributary streams to be examined during this study. However, since adult coho were making extensive use of the lower 1 kilometre of Elliott Creek it is useful to note differences between conditions in this watercourse and the other tributaries examined.

Probably the most significant difference is that Elliott Creek was strongly influenced by groundwater inputs which kept water temperatures higher and maintained the lower stretch ice-free through to at least late December. Water temperatures ranged from 2.5° to 3.5° C during the spawning period for coho which extends from late October to late December (Appendix 2.1). All of the other tributaries examined had extensive subsurface ice by mid-November. Ice-free conditions during the spawning period are required for adult fish to excavate their redds. As well, higher water temperatures and lack of subsurface ice benefit developing eggs within the gravel by reducing the risk of freezing.

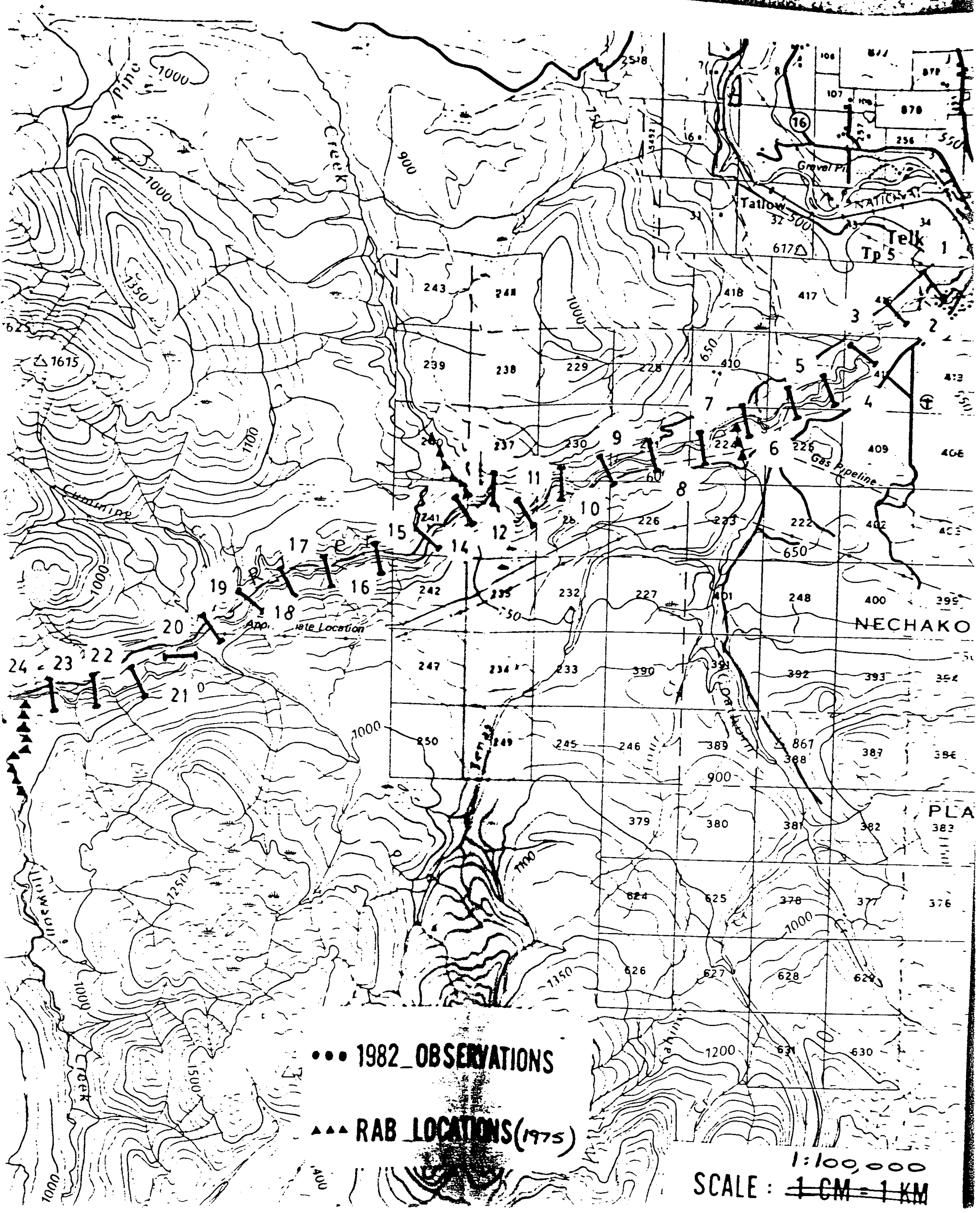
Elliott Creek had a lower gradient than the other systems (0.5 percent slope compared to >1.5 percent in the other creeks). The substrate was predominantly small gravel and extensive pond and wetland areas occur downstream from the spawning site, providing excellent juvenile coho rearing areas easily accessible to newly-emerged fry.

3.2 MAINSTEM TELKWA RIVER SURVEYS

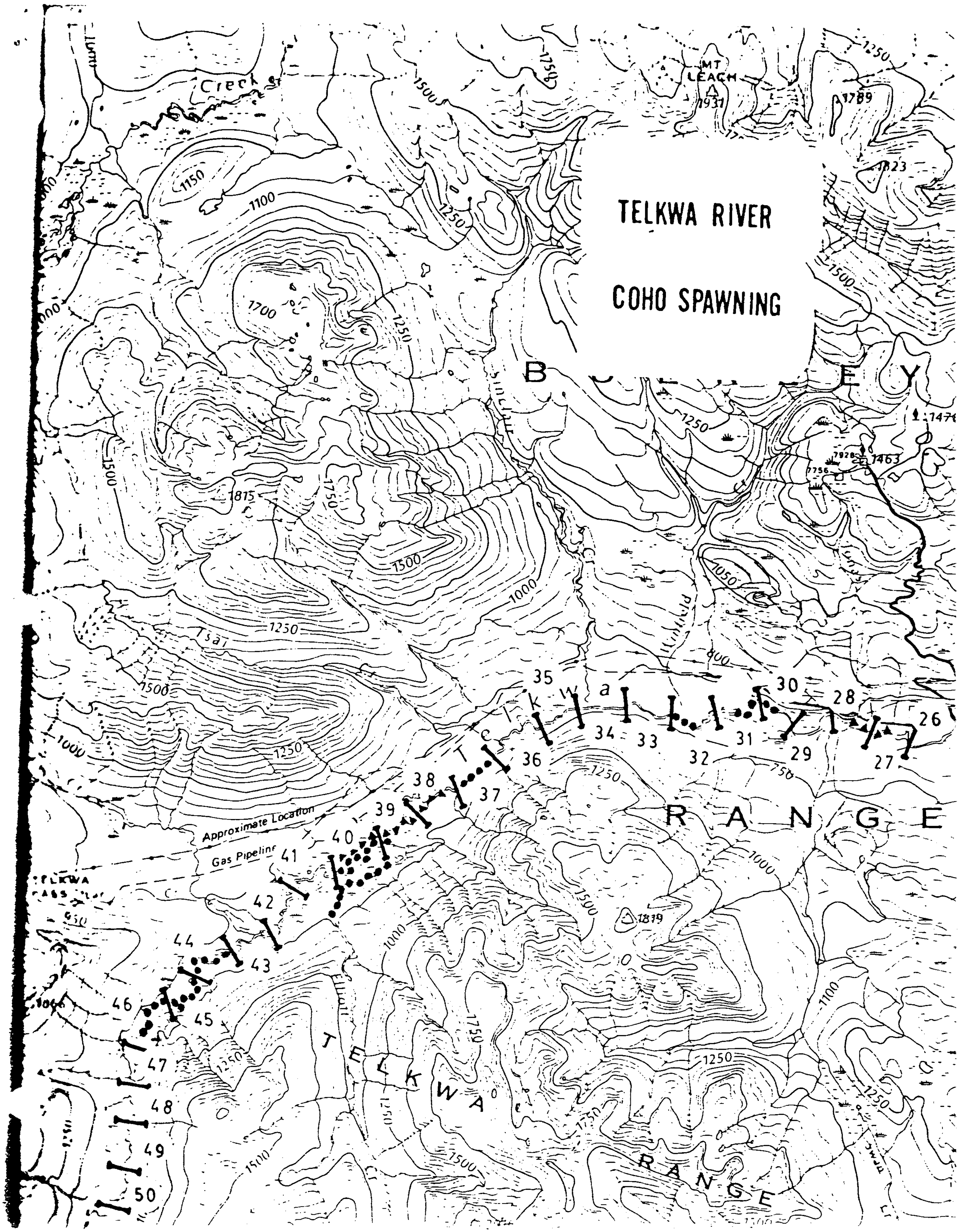
Aerial reconnaissance of the mainstem Telkwa River indicated that adult coho spawn in a variety of sites between 30 kilometres and 46 kilometres up the Telkwa River (Figure 1). The maximum number of coho observed was on November 18 when 80 coho adults were counted in this section of the Telkwa. Since many of these fish were still holding in pools and were associated with cover, and since at least 18 redd sites with no fish present were observed, the total number of coho present could easily have exceeded 200 fish. A 3 kilometre section of the Telkwa River just upstream of Milk Creek consistently held the greatest number of fish during the flights.

Coho spawning occurs between late October and the end of December which is similar to observations in other Bulkley River tributaries such as the Morice and Nanika rivers.

The 1982 studies did not identify when the main upstream migration period occurred in the Telkwa. Coho have been angled in the upper Telkwa in late September (pers. comm., T. Turnbull, Department of Fisheries and Oceans, Smithers). However, in 1982, late September and early October were quite dry, and it is probable that coho movements into the Telkwa occurred during heavy rains in mid-October. Coho were reported moving into other Bulkley River tributaries at this time (pers. comm. T. Turnbull, Smithers).



1982_OBSERVATIONS
RAB_LOCATIONS(1975)
1:100,000
SCALE : 1 CM = 1 KM
NECHAKO
PLA
Telk
Tatlow
Gravel Pit
Gas Pipeline
Approximate Location
Pine
Creek
Cr


TELKWA RIVER
COHO SPAWNING
MT LEACH
1931
1789
1823
BULKLEY
RANGE
Creek
Tsai
Telkwa
Approximate Location
Gas Pipeline
TELKWA PASS
TELKWA
RANGE
1819
1150
1100
1700
1250
1500
1750
1815
1000
1050
800
750
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The lower Telkwa River downstream of Goathorn Creek has some potential spawning areas in side-channel and pool habitats, although no fish were observed in this section of the river. Upstream of Howson Creek, the Telkwa River has a lower gradient and more potential spawning areas, although many of these areas are coated with fines deposited from glacial creeks such as Tsai and Milk creeks. Recently excavated redd areas are quite visible, as the surface gravels are clean compared to adjacent undisturbed areas.

Aside from possessing more good gravel sites, a number of factors seem to favour the use of the upper Telkwa River as opposed to downstream sites. Similar to Elliott Creek, the upper Telkwa remains ice-free until at least late December enabling adults to spawn without encountering anchor and frazil ice. During mid-November, the lower Telkwa had abundant frazil ice and was completely frozen over by late December. Water temperatures in the upper Telkwa River were 1.5°C on November 18 compared to near 0°C in the lower reach. As well, the Telkwa upstream of Jonas Creek has extensive wetland and pond areas suitable for rearing coho. Adults must spawn upstream of these sites for juveniles to be able to utilize them after emergence. Less extensive side-channel and wetland areas also occur in the Telkwa River downstream of Goathorn Creek.

4.0 APPENDICES

Appendix 1 : Results of Telkwa River Tributary Surveys

to a 4 metre barrier at 2.5 kilometres is greater than 2 percent slope with predominantly cobble and boulder substrate. Coho juveniles were not observed beyond 300 metres upstream in Pine Creek, and it was not clear whether these juveniles were from adults spawning in Pine Creek or whether they had just moved upstream from the main - stem Telkwa. Similar to the other tributaries examined, Pine Creek was frozen over by mid-November, making it generally unsuitable for spawning.

RAB data (on file, B.C. Fish and Wildlife Branch, Smithers) indicate that 54 live and 57 dead coho were found in Pine Creek in late September 1975. Both the timing of spawning and the large number of fish involved suggest that these fish may have been pink salmon. Data from 1982 suggest that Pine Creek is not as extensively used by coho as indicated by this earlier RAB data. Habitat conditions in the accessible portion of Pine Creek provide very limited spawning and rearing opportunity for coho salmon.

3.1.4 Howson Creek

Howson Creek offers more potential spawning areas than the other tributaries examined in this study. Pockets of gravel associated with pools and in sidechannel areas particularly between 0.5 kilometres and 2.5 kilometres appear suitable for coho spawners. Howson Creek has a lower gradient (1.5 percent) than the other tributaries, but it is still comprised of predominantly cobble and boulder substrate. The presence of sidechannels and debris cover in the lower 1.5 kilometres of Howson Creek suggest this would be the best coho rearing area. The lower 0.5 kilometre of Howson Creek remained open following cold conditions in early November, suggesting groundwater inputs from several sidechannel areas. However, there was insufficient flow in these sidechannels during this period to accommodate coho spawners. During the late September surveys, seven Dolly Varden were observed spawning in one of these sidechannels.

APPENDIX 1.1 GOATHORN CREEK

Goathorn Creek Reconnaissance

Walked Goathorn Creek upstream 9 km to Cabinet Creek confluence on November 2, 1982. Visibility good. Discharge 0.46 m^3/s. Water temperature 2°C.

0 Km (Telkwa confluence) to 1 Km (bridge crossing)

Predominantly cobble substrate. Less than 1 percent suitable for spawning. Some cover and two side channels. (See Table A1.1 for detailed physical characteristics of this reach).

1 km (bridge crossing) to 2 km (powerline crossing)

Predominantly cobble substrate with one small pocket of gravel. Fry observed along the margin.

2 km (powerline crossing) to 3.5 km (mine site)

Slope 2 - 3 percent
Mainly cobble with a few pockets of potential spawning gravels, particularly just downstream from a large slump on the creek's left side. Five or more juveniles observed at power line crossing.

3.5 km to 5.0 km (upper bridge site)

Slope 3 - 4 percent.
Steep gradient section with predominantly cobble substrate. Water type is mainly broken runs with a few pools occurring generally around debris areas. Estimate only one or two small pockets of gravel are suitable for spawning. Two juveniles observed in the vicinity of mine site.

Table A.1.1: Lower Goathorn Creek - Physical Studies

September 21, 1982
Discharge = 0.89 m^3/s

Station (m)	Slope (%)	Substrate D90 (cm)	Presence of Debris Cover	Presence of Side-Channels	Wetted Width (m)	Comment
0	4.5	50	No	No	7.0	Telkwa confluence
50	4.0	50	Yes	No		
100	2.0	30	Yes	No		
150	2.0	20	No	No		
200	3.0	20	No	No	7.5	
250	2.0	30	Yes	Yes		
300	3.5	25	No	No		
350	2.0	15	No	Yes		
400	1.5	25	No	No	16.0	
450	2.5	25	Yes	No		
500	1.0	15	No	No		
550	2.0	30	Yes	No	8.4	
600	3.0	20	Yes	Yes		Large pond
650	2.0	35	Yes	Yes		Beaver dam built in late October
700	1.5	25	Yes	Yes		
750	1.0	25	No	No		
800	1.0	35	No	No	7.7	
850	2.0	25	No	No		
900	2.0	30	Yes	No		
950	1.5	25	No	No		
1000	2.5	20	No	No	9.0	
1050	4.0	35	No	No		Tenas Creek confluence
1085						Lower bridge
Mean of 22 stations	2.3%	28 cm.	No=57% Yes=43%		9.3 m.	

5.0 Km to 9.0 Km (Cabinet Creek confluence)

Slope approximately 5 percent.
Cobble/boulder substrate. Mainly broken runs and rapids with a few pools. Several large log jams--all passable. Small pockets of potential spawning gravels, but very limited. Ten metre long chute at 6.1 Km. A 1.5 metre drop at this site may pose difficulty to fish moving upstream. Cabinet Creek comprises approximately 65 percent of total volume of Goathorn at confluence.

Lower Goathorn Creek - Miscellaneous Observations

The lower 1.1 km of Goathorn Creek was examined on four occasions between September 21, 1982 and November 2, 1982 to look for adult coho salmon spawning. This section of Goathorn Creek has been identified as a spawning area for coho salmon based on previous work conducted by the Resource Analysis Branch of the B.C. Ministry of Environment. This lower section was walked and angled on each visit. As well, an aerial examination of this section of Goathorn Creek was conducted on November 1, 1982.

No adult coho were observed or angled on any of the visits.

Following is a brief summary of each examination:

September 21/82

Conducted a physical profile of the lower 1.1 km of Goathorn Creek. Less than 1 percent of stream offered suitable spawning.
Good water clarity.
Numerous juvenile fish observed along the margin of the stream.
No adult fish observed or angled.
Angled for one hour at Telkwa confluence. No success.

October 10/82

No adult fish observed despite good clarity.
Juveniles common along the margin.
A beaver dam approximately 1.5 metres high at 0.6 km creates difficult passage for any fish moving upstream. Angled 30 minutes at Telkwa confluence. No success.

October 15/82

Clarity good after three days of heavy rains.
No adult fish observed.
Angled for 30 minutes at Telkwa confluence. One small steelhead observed.

T. Turnbull (DFO, Smithers) indicates that heavy rains during the preceding week have been bringing fish out of the Bulkley into tributaries such as Kathlyn Creek. It is probable that coho movements into the Telkwa River are occurring at this time.

November 2/82

No fish observed or angled despite excellent visibility. Beaver dam would appear to be a barrier to any upstream movement of coho adults.

APPENDIX 1.2 - TENAS CREEK

Tenas Creek was examined on November 4, 1982 from its confluence with Goathorn Creek upstream for 8.5 km. The water temperature was 2°C and shelf ice was present along the edges of much of the stream. Discharge was approximately 0.13 m^3/s.

Access to the upper end of the creek was from a logging setting reached by road from mine property.

No adult spawners or carcasses or evidence of redd digging was observed.

Tenas Creek offers more potential for spawning than Goathorn Creek, with patches of gravel occurring throughout the creek from 1 km upstream to the extent of area walked.

A log jam with a 1.2 metre high falls at 0.7 km could pose difficulty for fall spawners in Tenas Creek. As well, a beaver dam at 8.2 km may pose passage problems.

The very small volume of water and apparent early freezing of Tenas Creek suggests that it offered little potential coho spawning in 1982. Perhaps in years with a large fall freshet the situation may be different and this system might offer potential coho spawning.

Young steelhead fry (?) were observed in the lower 1 km of Tenas Creek. Adult steelhead spawning is known to occur in Tenas Creek 5 - 6 km upstream (Mike Lough, B.C. Fish and Wildlife Branch, Smithers).

APPENDIX 1.3 PINE CREEK

Summary of the lower 1.5 km of Pine Creek

Less than 1 percent of lower Pine Creek offers potential spawning gravels. They are restricted to the tail ends of some pools.

No evidence of juvenile fish appeared beyond 300 metres upstream.

Juveniles were dipnetted in a pool at 300 metres. These included one cutthroat trout fry and several parr. Twenty or more coho yearlings and several coho fry were observed. These fish may be progency from adults spawning in lower Pine Creek or may have moved upstream from the Telkwa River.

Upper Pine Creek Reconnaissance - November 4/82

Pine Creek was examined on foot from 13.5 km down to its confluence with the Telkwa River. No coho adults or carcasses were observed despite excellent visibility. Water temperature was 2°C. A 4 metre impassable barrier (falls) was found at 2.5 km upstream from the Telkwa River.

Access to upper Pine Creek was by road to near Miller Creek.

Pine Creek above the falls has pockets of spawning gravel, a number of large log jams (all passable). Several beaver dam areas would pose additional passage problems.

One juvenile Dolly Varden (?) observed downstream of Miller Creek. In the vicinity of Miller Creek, Pine Creek levels out to a slope of approximately 1.5 percent. There are numerous debris accumulations and many potential spawning gravels at the tail ends of pools. The substrate elsewhere appears cemented with fines.

A number of large active slumps on Pine Creek cause heavy siltation during rains and higher flows.

Table A.1.3: Pine Creek - Physical Studies

September 22, 1982
Discharge estimated to be 0.7 m^3/s

Station (m)	Slope (%)	Substrate D90 (cm)	Presence of debris cover	Presence of side-channels	Wetted width (m)	Comment
0	3.0	8 (D10-cm)	No	No		Telkwa River confluence
50	1.0	8	No	No	8.0	
100	2.5	15	No	No		
150	1.5	5	Yes	Yes		
200	1.5	8	No	No	7.6	
250	2.5	5	No	No		Good spawning gravels
300	2.0	10	No	Yes		Coho fry in sidepools
350	1.5	5 (D90-cm)	No	Yes		
400	2.0	25	Yes	Yes	8.8	Log jam
450	1.0	30	No	No		Some spawning gravel
500	1.5	15	No	No		
550	2.0	Bed & 20	No	No		
600	2.0	30	No	No	11.8	
650	1.5	40	No	No		
700	1.5	25	No	No		
750	1.5	35	Yes	No		
800	1.0	40	No	No	12.1	Steep confining canyon
850	4.0	60	No	No		
900	1.0	30	No	Yes		
950	2.0	40	Yes	Yes		
1000	1.0	70	No	No	6.9	
1050	5.5	Bedrock	No	No		Pocket of gravel in canyon pool
1100	2.0	80	No	No		1 m. chute - not passage problem
1150	1.5	80	No	No		
1200	1.5	100	No	Yes	6.8	
1250	1.5	100	No	No		
1300	1.5	80	Yes	No		
1350	2.0	15	No	No		Bank slump, some potential spawning
1400	1.5	60	Yes	No	9.1	Creek less confined
1450	2.0	40	Yes	No		
1500	1.0	80	No	No	7.8	
Mean of 31 stations	2.3%	50 cm.	No = 77% Yes= 23%		8.9 m.	

APPENDIX 1.4 HOWSON CREEK

Summary of the lower 3.0 km of Howson Creek

The section of Howson Creek from 0.5 km to 2.5 km possesses a number of pockets of suitable spawning gravels, particularly at the tailouts of pools and in some sidechannels. A sidechannel between 550 and 750 metres is used by Dolly Varden spawners and subsequent observations indicate this area remains open through November suggesting the presence of groundwater at this site. Based on observations of juveniles along the margin, Howson is utilized more by steelhead than coho spawners.

Howson Creek was re-examined on November 15, 1982. The system was iced over with thick anchor ice from 0.5 km on upstream. This kind of ice development would severely limit spawning opportunities for coho in this system.

Table A.1.4: Howson Creek - Physical Studies

September 23, 1982
Discharge estimated to be 1.7 m^3/s

Station (m)	Slope (%)	Substrate D90 (cm)	Presence of debris cover	Presence of side-channels	Wetted Width (m)	Comment
0	2.5	35	No	Yes	16.2	Telkwa River confluence
50	1.5	40	No	Yes		
100	1.0	50	Yes	No		
150	2.0	40	No	No		
200	0.5	35	No	Yes	14.1	
250	1.5	25	Yes	Yes		Coho fry observed in sidechannel
300	2.0	40	Yes	Yes		
350	0.5	40	No	Yes		
400	1.5	40	No	Yes	13.8	No spawning areas to 400 m.
450	1.5	35	No	Yes		
500	2.0	25	Yes	Yes		Sidechannel at 450 m. - some gravel CT fry and RMW fry (?)
550	1.5	35	Yes	Yes		
600	1.0	20	Yes	Yes	13.3	550-600 m., some good patches of gravel
650	1.0	35	No	Yes		
700	1.5	45	No	Yes		Sidechannel 550-750 - 7 DV spawners - 8-15 cm. FL 30 m. gravel at 700 m.
750	2.5	25	Yes	No		
800	1.5	25	Yes	Yes	12.6	
850	1.5	40	Yes	Yes		Good holding pool and tailout
900	1.0	40	Yes	Yes		
950	1.0	20	Yes	Yes		
1000	1.5	35	No	Yes	7.5	Few fry in sidechannel
1050	1.0	25	No	Yes		
1100	1.5	40	No	Yes		
1150	1.0	30	No	No		
1200	1.5	40	No	No	8.4	Small pocket of gravel
1250	1.5	35	No	Yes		Large sidechannel at 1250
1300	2.0	25	Yes	Yes		Good pool with gravel at 1350
1350	2.0	30	Yes	Yes		
1400	1.5	35	No	Yes	11.2	No spawning in this area
1450	2.0	45	No	Yes		
1500	1.5	35	No	No		
1550	1.0	40	No	No		
1600	1.0	35	No	No	20.2	1 juvenile observed

Table A.1.4: Howson Creek - Physical Studies - continued

Station (m)	Slope (%)	Substrate D90 (cm)	Presence of debris cover	Presence of side-channels	Wetted Width (m)	Comment
1650	1.0	30	No	No		Small pocket on pool edge
1700	2.5	40	No	No		
1750	1.5	40	No	No		15 m. gravel bank on edge
1800	2.0	40	No	No	14.2	
1850	1.0	25	No	No		7 juveniles at 1850
1900	2.0	25	Yes	No		Good holding pool
1950	1.5	25	No	No		Pockets of gravel
2000	1.0	25	Yes	No	8.5	8 juvenile steelhead caught in dipnet - 2 nice pools with gravel
2050	1.5	15	Yes	No		Excellent pool with cover and gravel
2100	0.5	15	No	No		Grizzly tracks and scats
2150	1.5	40	No	No		Good spawning gravels
2200	1.0	25	No	No	21.9	Small pockets of gravel
2250	1.5	35	No	No		Rock outcrop
2300	0.5	30	No	No		
2350	1.0	35	Yes	No		
2400	2.0	40	No	No	10.6	
2450	1.5	40	No	No		
2500	2.0	50	No	No		Large pool at 2550 m.
2550	0.5	35	No	No		No potential spawning above 2500 m.
2600	2.0	40	No	No	10.4	
2650	1.0	35	Yes	No		
2700	2.5	25	Yes	Yes		
2750	0.5	40	No	Yes		
2800	2.0	35	No	No	10.0	
2850	1.0	45	No	No		
2900	3.0	50	No	No		
2950	1.5	40	No	No		
3000	-	40	No	No	12.8	
Mean of 61 stations	1.5%	35 cm.	No = 69% Yes = 31%		12.9 m.	

Appendix 2 : Water Temperature and Discharge Measurements in Goathorn and Tenas Creeks

Appendix 2.1 Miscellaneous Water Temperatures - Telkwa River and Tributaries - 1982

System	Date	Time	Temp.(°C)	Comment
Goathorn Creek	June 16	14:10	9	At lower bridge site.
	Sept. 21	11:30	8	"
	Sept. 22	11:00	6	"
	Sept. 23	9:00	6	"
	Oct. 10	10:30	6	"
	Oct. 15	16:00	7	"
	Nov. 2	12:00	2	At mine site.
	Nov. 2	14:00	2.5	At lower bridge. Ice forming on edges.
	Nov. 3	a.m.	3	At lower bridge.
	Nov. 15	10:05	0	Extensive anchor ice throughout.
	Dec. 23			Ice and snow cover throughout lower end.
Tenas Creek	Sept. 21	11:30	9	At lower bridge site.
	Sept. 22	11:00	6	"
	Sept. 23	9:00	6	"
	Oct. 10	10:30	6	"
	Oct. 15	16:00	8	"
	Nov. 2	14:00	1	"
	Nov. 3	a.m.	2	"
				Shelf ice.
	Nov. 15	a.m.	0	Extensive anchor ice throughout.
Pine Creek	June 16	16:00	9	At confluence with Telkwa.
	Sept. 22	11:30	6	"
	Nov. 4	9:00	2	Upper Pine near Miller Creek.
Howson Creek	Sept. 23	10:15	7	At confluence with Telkwa.
	Sept. 23	12:15	8	1.5 km. upstream.
	Nov. 15	a.m.	0.5	At Telkwa confluence.
Jonas Creek	June 16	18:00	7	At mouth.
Winfield Creek	June 16	18:00	8	Near mouth.
Elliott Creek	Nov. 18	12:00	3.5	Lower 1 km. of stream.
	Dec. 23	15:00	2.5	"
				Ice free.
Pond Area	June 16	17:00	21.5	Vicinity of Cumming Creek. Coho juveniles present.

Miscellaneous Water Temperatures - Telkwa River - 1982 - Continued

System	Date	Time	Temp.(°C)	Comment
Telkwa River	June 16	p.m.	7.5	Km. 9 - old bridge site. Turbid.
	June 16	p.m.	8	Km. 12 - big rock outcrop. Side channel
	Sept. 21	13:00	8	At Goathorn Creek confluence. Turbid.
	Sept. 22	11:30	6.5	At Pine Creek confluence. Turbid.
	Sept. 23	10:15	6	At Howson Creek confluence. Turbid.
	Oct. 6	13:00	5.5	Km. 2
	Oct. 10	11:50	6	Goathorn Creek confluence.
	Oct. 15	17:00	7	" Turbid.
	Nov. 2	14:00	2.5	Goathorn Creek confluence. Clear.
	Nov. 15	14:00	0.5	Howson Creek confluence. Shelf ice.
	Nov. 16	10:00	0	Km. 2 - slush ice in river.
	Nov. 18	13:00	1.5	Km. 48 - upstream of Milk Creek.
	Dec. 23	15:00	1	Km. 45 - upstream of Milk Creek.

Appendix 2.2 Discharge Measurements - Goathorn Creek

September 21/82 Measured at lower bridge site using a Marsh McBirney Model 201 Current Meter.

November 3/82 Measured at lower bridge site using a Gurley Meter.

Distance	Depth(cm.)	Vel.(cm/Sec.)	Vel. x Area
W.E. = 5.0			
6	23	4	.0092
7	5	18	.0090
8	39	15	.0585
9	30	65	.1950
10	40	57	.2280
11	25	56	.1400
12	29	15	.0435
13	20	57	.1140
14	18	50	.0900
15	2	0	0
W.E. = 15.5			
		Total Discharge=	.8872 m^3/sec.
September 21/82			
Gauge = 42 cm.			(31.3 cfs.)

Distance	Depth (cm.)	Rev.	Time	Vel.	Vel. x Area
W.E. = 0					
2.5	Shallow area with no velocity				
3.5	20	10	68	.110	.0220
4.5	31	15	51	.210	.0651
5.5	37	15	44	.243	.0899
6.5	36	30	43	.475	.1710
7.5	18	3	44	.058	.0104
8.5	19	25	45	.385	.0732
9.5	10	30	47	.439	.0329
W.E. = 10					
				Total Discharge =	.4645 m^3/s
November 3/82					
Gauge = 38 cm.					(16.4 cfs.)

Discharge Measurements - Tenas Creek

September 21/82 Measured at lower bridge site using a Marsh McBirney Model 201 Current Meter.

November 3/82 Measured at lower bridge site using a Gurley Meter.

Distance	Depth (cm.)	Vel.(cm/sec.)	Vel. x Area
W.E. = 0			
1.5	2	0	0
2.0	6	1	.0003
2.5	5	30	.0075
3.0	9	25	.0112
3.5	16	38	.0304
4.0	15	31	.0232
4.5	12	27	.0162
5.0	12	27	.0162
5.5	13	36	.0234
6.0	11	32	.0176
6.5	10	33	.0165
7.0	5	37	.0092
7.5	3	20	.0030
8.0	1	0	0
8.5 = W.E.	2	0	0
		Total Discharge =	.1747 m^3/sec
September 21/82			
Gauge = 8 cm.			(6.2 cfs.)

Distance	Depth(cm.)	Rev.	Time	Vel.	Vel. x Area
0 = W.E.					
1	6	0			
1.5	5	10	43	.165	.0041
2.0	10	20	50	.277	.0138
2.5	14	25	42	.407	.0285
3.0	14	20	42	.326	.0228
3.5	10	20	45	.308	.0154
4.0	7	15	51	.210	.0073
4.5	10	25	48	.362	.0181
5.0	11	15	44	.243	.0133
5.5	10	15	50	.214	.0107
6.0 = W.E.					
				Total Discharge =	.134 m^3/sec
November 3/82					
Gauge = 8 cm.					
Some ice present					(4.7 cfs.)

Staff Gauge Readings

	Date	Height (cm.)	Discharge[1] m^3/sec
Goathorn Creek	Sept. 21	42	.89 m^3/sec
	Sept. 22	42	
	Sept. 23	41	
	Oct. 10	40	
	Oct. 15	43	Rain for past 3 days.
	Nov. 2	37	
	Nov. 3	38	.46 m^3/sec
	Nov. 15	64	Anchor ice has raised water level.
Tenas Creek	Sept. 21	8	.17 m^3/sec
	Sept. 22	7	
	Sept. 23	7	
	Oct. 10	6	
	Oct. 15	7	Rain for past 3 days.
	Nov. 2	8	
	Nov. 3	8	.13 m^3/sec
	Nov. 15	35	Anchor ice influence.

[1] There was insufficient variation in gauge height to develop a stage-discharge relationship for these 2 sites.

Appendix 3 : Results of Telkwa River Surveys

APPENDIX 3.1 Telkwa River - Aerial Reconnaissance for Coho Salmon - November 1/82

Flew by helicopter from the top end of the Telkwa River downstream to approximately Sinclair Creek. This is a first look at the top end of the Telkwa.

Extensive pond areas in this top end appear to offer excellent potential coho rearing areas.

Area 44/45 - 15 coho adults; lots of cover and good pools for holding.

Area 44 - extensive pond area.

Area 43/44 - 40 coho adults; coho appear to be just moving into spawning areas and are holding in pool sites. Most fish are black, not their red spawning colour. Twelve smaller fish; Dolly Varden or Rocky Mountain whitefish.

Area 42 - More glacial material downstream of this point.

Area 40 - 3 coho;
2 coho; top end of large swamp area.
5 Rocky Mountain whitefish (?) same area.
2 coho; large swamp area.

Observations were not conducted downstream of Tsai Creek due to poorer visibility and because we appeared to be just at the beginning of coho spawning. Total 62 adult coho observed.

Wildlife Observations

Two bull moose in river at Area 44 (1.5 km upstream of Milk Creek). Moose calf (?) just recently killed by wolves at Area 45. A single wolf was still on the kill. Total flying time 0.7 hours.

APPENDIX 3.2 Telkwa River - Aerial Reconnaissance for Coho Salmon - November 18/82

Flew by jet ranger helicopter from Bulkley/Telkwa confluence upstream to headwaters of the Telkwa looking for adult coho spawners. Accompanied by Dennis Burlett of DFO, Smithers. We flew at approximately 50 metres above the river at a low air speed.

A total of 104 coho salmon were observed in the Telkwa River and the lower section of Elliott Creek. As well, an additional 18 redd sites were identified, suggesting a minimum of 140 coho were spawning in the Telkwa River. Since many of the fish were holding in deeper areas with log jam cover, it is likely that the total number of spawners is higher than this. All spawners were observed upstream of Jonas Creek, from approximately km 30 to km 44. These upstream sites were open and apparently uninfluenced by ice formation compared to sites lower in the Telkwa. This suggests that groundwater may play an important role in determining sites used by coho for spawning and subsequent incubation.

Viewing Conditions

Visibility was generally excellent except in the lower Telkwa below Pine Creek where the presence of slush ice and some shelf ice caused some problems, particularly in deep areas or in short sections which had frozen over. The weather was high overcast, so shadows were not a problem. Observations were made between 1100 - 1400 hours. There appears to be a short period when the river is clear enough for good visibility from the air before slush ice forms or the river freezes over.

Water Temperatures

Telkwa River at Telkwa - 0°C

Telkwa River at Area 48 - 1.5°C at 1300 hours.

Elliott Creek - lower end - 3.5°C at 1200 hours.

Goathorn, Pine and Howson creeks - iced over except lower 1 km.

General Comments re Spawning Suitability by Section

Numbers refer to accompanying map of the Telkwa River. Approximate 1 km sections.

AREAS	COMMENT
Area 1-3	Some pockets of good spawning gravel - no fish observed. Mainly cobble. Sidechannels in this section are generally too small to accommodate spawning.
Area 4	Little potential.
Area 5	Sidechannel in this section has good potential spawning gravel in the top end.
Area 6	Little potential.
Area 7	Some potential spawning in the tailouts of pools in this section.
Areas 8-10	Little potential spawning, mainly cobble and boulder creeks.
Areas 11-12	Little potential.
	Pine Creek is frozen over. No slush ice above Pine Creek.
Area 13-16	Anchor ice in this stretch. Mainly cobble/boulder substrate.
Area 16-19	A few pockets of good gravel along the edge of the river.
Area 20-24	Predominantly cobble/boulder substrate. Potential spawning would be restricted to small pockets which probably have a lot of fines.
Howson Creek	Lower 1 km open and clear. No fish observed. Groundwater influence in this section? Icing above 1 km.

AREAS	COMMENT
Area 24-25	Long deep slow stretch of water. This is the Reach break. No gravel in 24.
Area 26-27	Long stretches of slow water with silt/sand substrate. Areas with small gravels but probably imbedded with fines. Gravels in vicinity of Jonas Creek; still looks like a lot of sediments. T. Jones (local resident) reports catching Dolly Varden in this stretch.
Area 28-29	Slow, low gradient. A small creek just upstream of Jonas is open and may offer some potential spawning.
Area 30	Large log jams and finely compacted gravel substrate.

All fish and redds were observed from Area 30 on upstream. Redds are reported for areas where coho were not observed.

Area	Fish Observed	Redd Observed	Comment
30	19	1	No fish at redd. Below cableway.
31	4	8	Just upstream of cableway. Redds really stand out in this section as gravels have a lot of surface fines.
32	-	3	Just upstream of Winfield Creek. Small swamp area.
33-35	-	-	
36	-	-	DFO (T. Turnbull) reports unidentified smolts in pond area in this section, 1982.
37	9	-	Several single fish observed. Suspect Dolly Varden.
38	-	-	

Elliott Creek - lowest 1 km - 24 coho actively spawning. The lowest kilometre of this creek is open, low gradient, and used for spawning. Small gravels. Apparent seepage entering this portion of the creek.

40-41	-	-	Lots of fine silt in pools.
42-43	-	-	

Area	Fish Observed	Redd Observed	Comment
44	12 16 20	2 2	Many of the coho observed are still holding in log jams. Suspect spawning activity is just beginning.
45-47	-	-	
48-50		2?	Good potential spawning in this section--multi-channeled. No fish observed. Suspect two redds. Excellent looking rearing area..
	104	18	

Photographs (Negatives in File T1)

Photograph 17 - lower Elliott Creek spawning areas.
18 - 22 - upper Telkwa River.
23 - 30 - sequence of Telkwa River from Elliott Creek downstream to the Telkwa confluence.

Wildlife Observations

1) Pilot Jim Broadbent reported seeing 12 moose and four deer in Ladner Hill area (north of Pine Creek) on previous day, i.e. November 17/82. We have just had a snow storm which may have brought animals into this area.

2) Beaver swimming in Telkwa River just upstream of Jonas Creek.

3) Grizzly tracks along Telkwa River from Milk Creek upstream into headwater area. Appears to have been catching fish at several sites.

4) Two bull moose in headwater swamp area. Area 51. There is approximately 18 inches of snow in this area at present.

5) Bald eagles on Telkwa just downstream from Milk Creek and one observed at km 44.

APPENDIX 3.3 Telkwa River - Aerial Reconnaissance for Coho Salmon - December 23/82

Flew via Okanagan Helicopters; time 0.8 hours. Weather clear and cold (-01°C). There is approximately 1.5 to 2 feet of snow in area around Milk Creek.

D. Bustard examined the upper Telkwa River to determine whether coho spawning was still occurring and to look at ice conditions in the vicinity of areas where coho were known to have spawned earlier.

Fish Observations

A total of 12 coho adults and one carcass were observed in Areas 44 and 45 of the upper Telkwa (2-3 km upstream of Milk Creek). As well, there is evidence of digging throughout this section indicating that most coho spawning is complete by this date. It is interesting to note that this section of the river is wide open, suggesting that groundwater inflows into this area prevent freezing, at least in the early winter. The visibility was excellent, and flows are considerably less than on the previous flight of November 18/82. There is also evidence of a lot of iron in the water in the upper portions of this river (brown algal accumulations).

Water temperature - Telkwa above Milk Creek - 1°C.
- Elliott Creek at mouth - 2.5°C

No fish were observed in Elliott Creek.

It was noted that fish were quite vulnerable to predation at such low flow, clear conditions. Eagles were active in this area and had dragged a number of fish up onto snow patches at the edge of the river. A group of four coho scurried under some shelf ice when we flew over.

Ice Conditions

All areas previously identified as spawning sites for coho were ice-free during this flight. Anchor and frazil ice was forming in stretches of the Telkwa for approximately 2 km upstream of Milk Creek. The Telkwa River downstream of Milk Creek was frozen over except for open water areas around Elliott Creek and around Winfield Creek and the large swamp area downstream of this. Elliott Creek was wide open and clear in the area. Below Area 29, the Telkwa River was predominantly iced over except for a few leads in faster current areas.

Photograph 31 - Telkwa River above Milk Creek
32 - Telkwa River from Howson downstream
33 - Pine Creek confluence with Telkwa
34 - Ladner Hill area - Telkwa

Wildlife Observations

1) 4 bald eagles - Area 43-45 - upper Telkwa (upstream of Milk Creek).

2) 1 moose - 30 km. up Telkwa River.

3) 6 moose - in clearcut just off power line upstream of Goathorn Creek.

4) 6+ moose - open hillside overlooking Telkwa River - Lots 237 and 230.

APPENDIX 3.4 Mainstem Telkwa River - Reconnaissances

October 6/82

Walking and angling survey of lower 2 km of Telkwa River.
Walked upstream from railroad bridge at Telkwa for approximately 2 km. There were two anglers at the mouth of the river and one just upstream 150 metres. Water conditions were relatively clear after 10 days with no rain. Angled two steelhead at 1 km - one hooked and escaped (estimated 7 pounds); one caught - 52 cm (Scale Book 1 #1 and 2). Continued angling upstream at a variety of sites but no fish angled, no fish seen rolling, and no carcasses observed.

Small stream running through the residential area on east side of Telkwa River approximately 1 km upstream is heavily utilized by newly emerged fry--either steelhead or cutthroat fry.

November 15/82

Drifted with inflatable boat from Jonas Creek to Howson Creek in mainstem Telkwa. This is one of the few accessible sections of the Telkwa which looks to be suitable for safe drifting. Others are too heavily encumbered by log jams or boulder fields. RAB maps indicate coho have spawned in this section in the past.

No fish were observed in this section despite excellent holding pools and reasonable gravel sites at tailouts of pools. Visibility was limited by slight colouration.

There was a lot of anchor ice on the substrate, especially along the edges. A long section of surface ice just upstream of Howson Creek prevented any further downstream examination. The past week of cold weather has frozen up most tributaries and parts of the lower Telkwa River.

November 16/82

Prior to this date fall rains had reduced visibility sufficiently make snorkel observations impractical. Today attempted snorkel observations in the lower Telkwa River. Slush ice restricted visibility, preventing an attempted swim in the lower Telkwa to see if coho spawners could be found in this section of the river. Water temperature 0°C.

Ice conditions had deteriorated overnight, which may have been related to heavy snow falling. It was decided that snorkel observations and aerial observations would have to be postponed to a time when ice is not present.

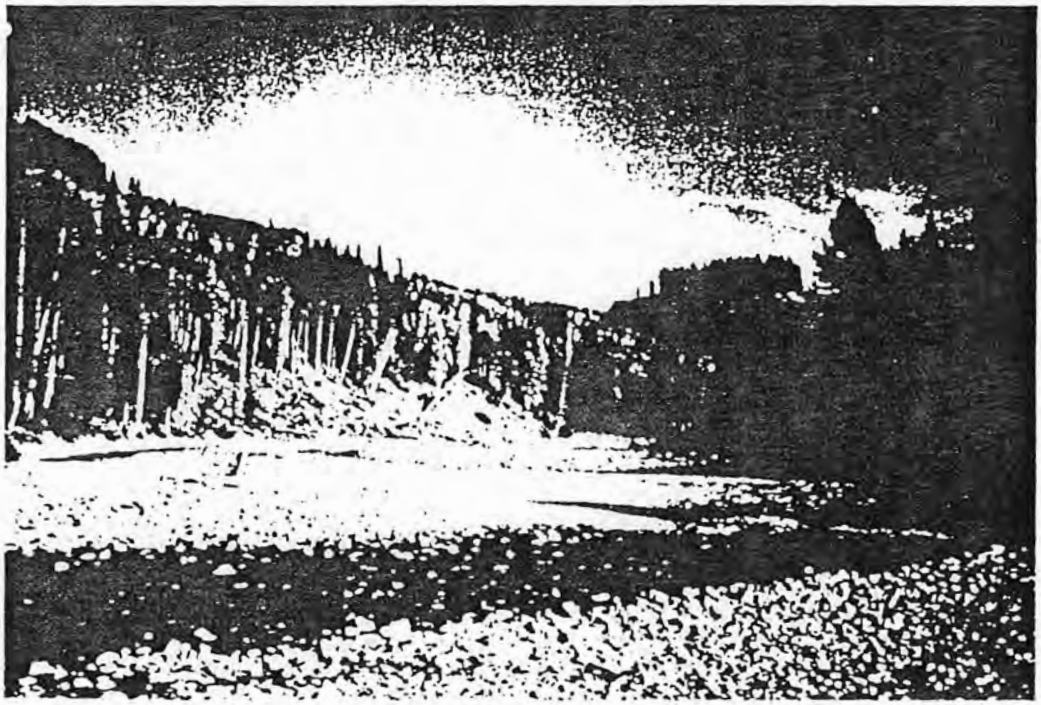
Attempted snorkel observations at the mouth of the Bulkley River. The same problems were encountered--perhaps worse because the Bulkley in this area is so deep that nothing can be observed at the bottom.

One coho (kelt?) observed just upstream of the mouth of the Telkwa River in the Bulkley.

Appendix 4 : Photographs, Telkwa River and Tributaries

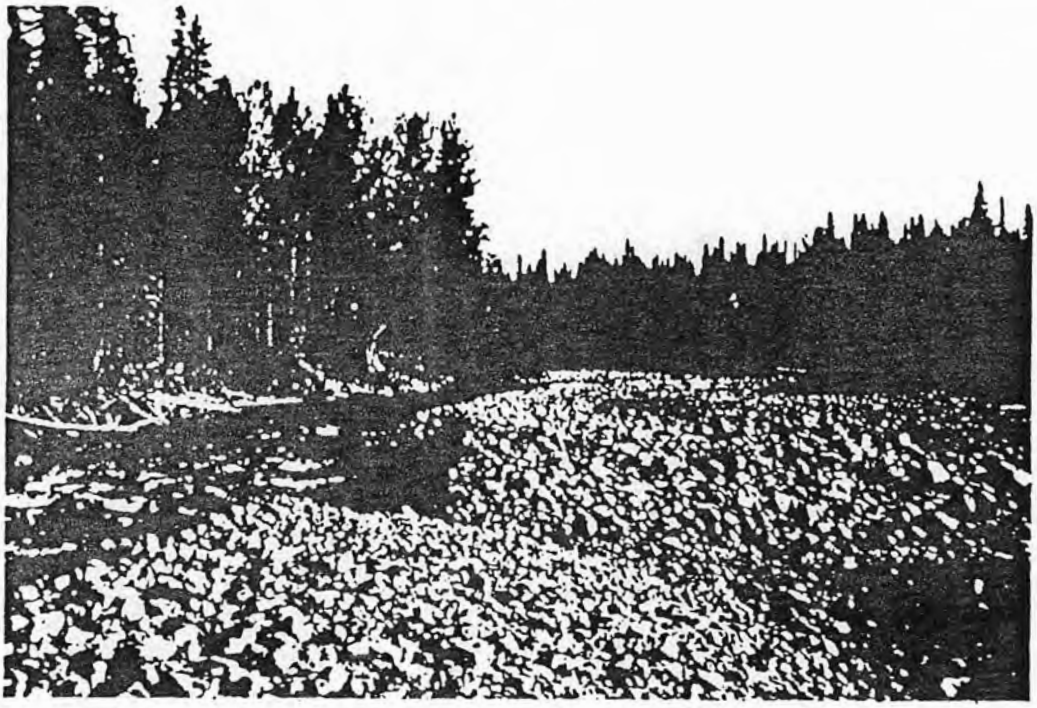
September - December, 1982

1. Canyon area on Pine Creek - approximately 1 Km upstream.



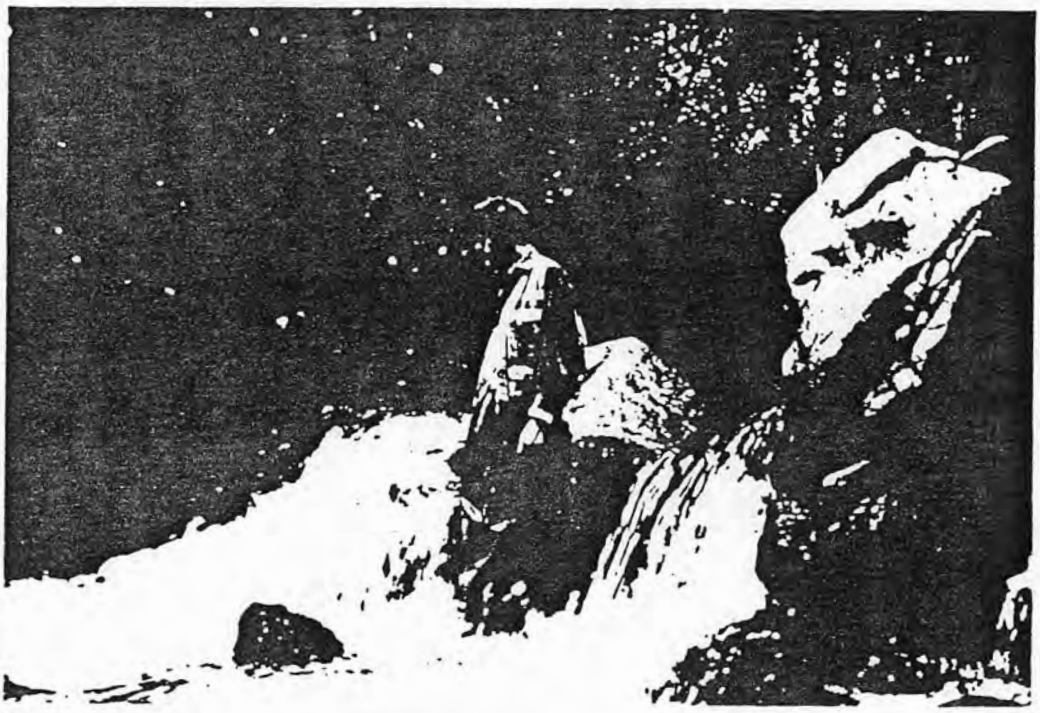
2. Confluence of Pine Creek and Telkwa River.

September 22/82

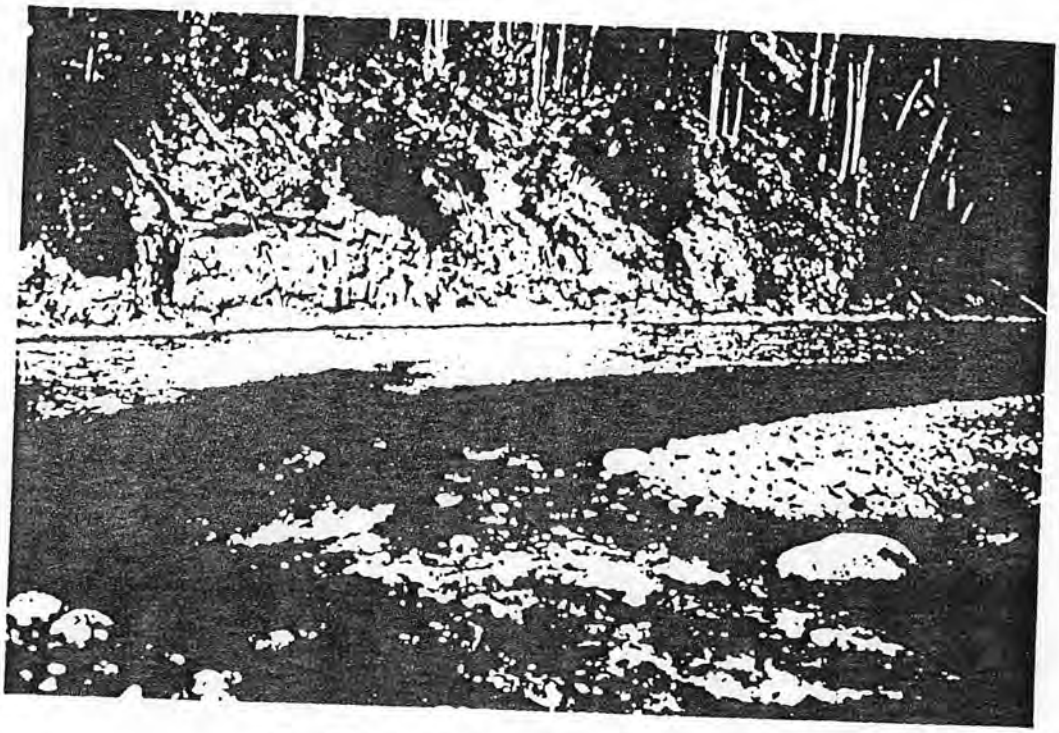


3. Howson Creek - just upstream of Telkwa River.

September 23/82

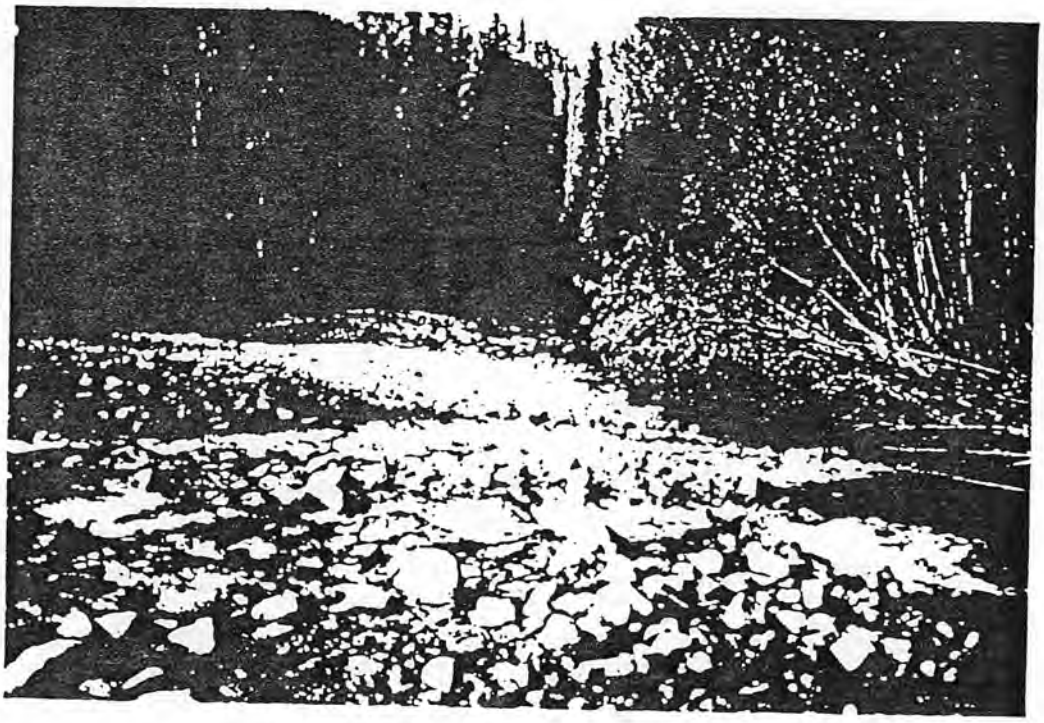


4. Canyon area on Pine Creek - 1.5 Km upstream.



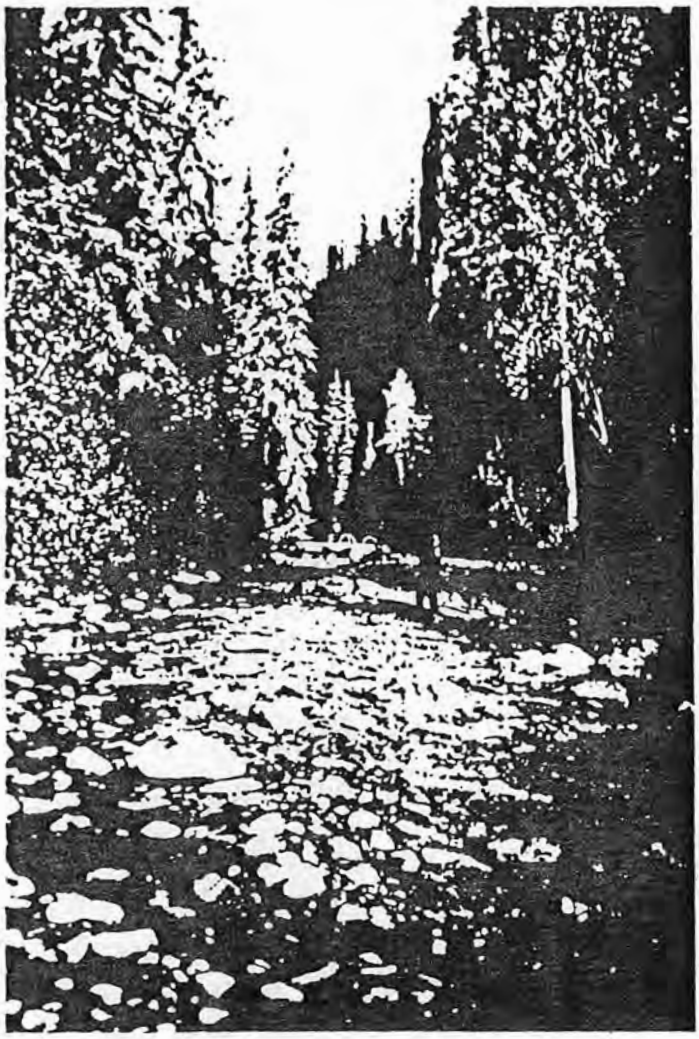
5. Goathorn Creek -
Telkwa River confluence.

September 21/82



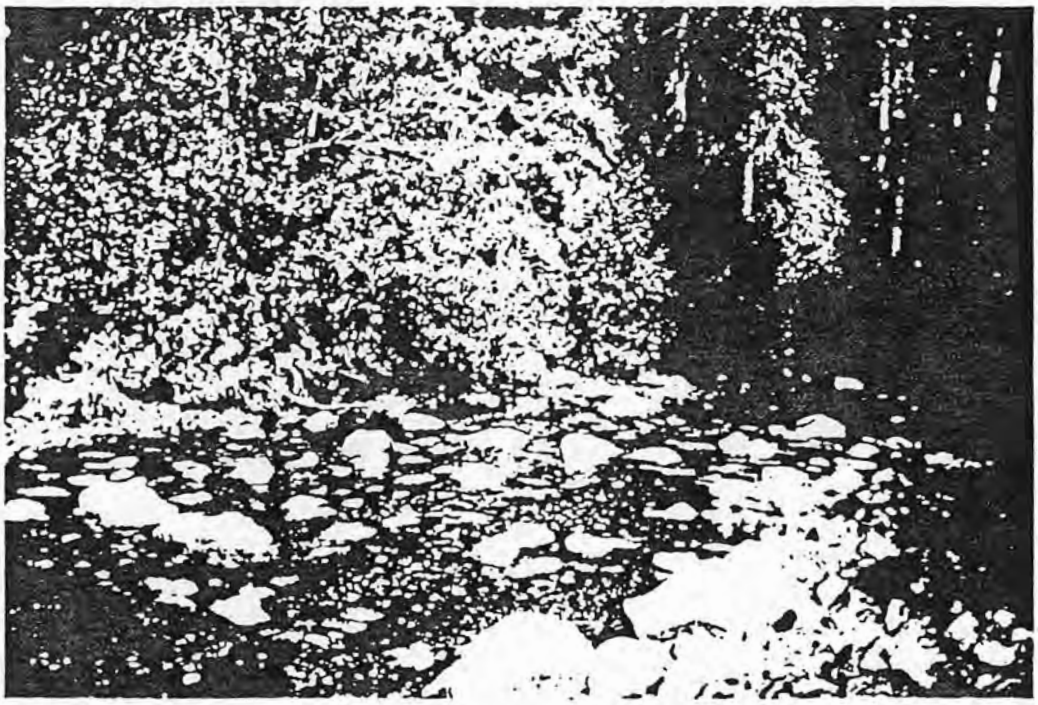
6. Goathorn Creek - downstream
of lower ridge.

September 21/82



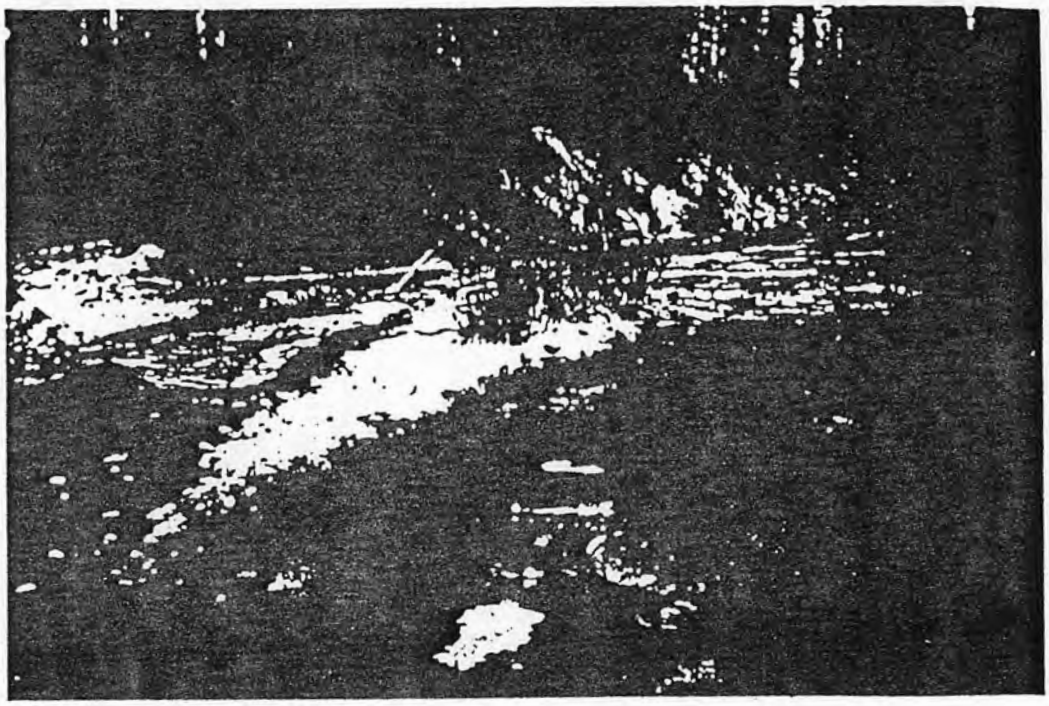
7. Lower Pine Creek - just downstream of canyon.

September 22/82



8. Lower Pine Creek.

September 22/82



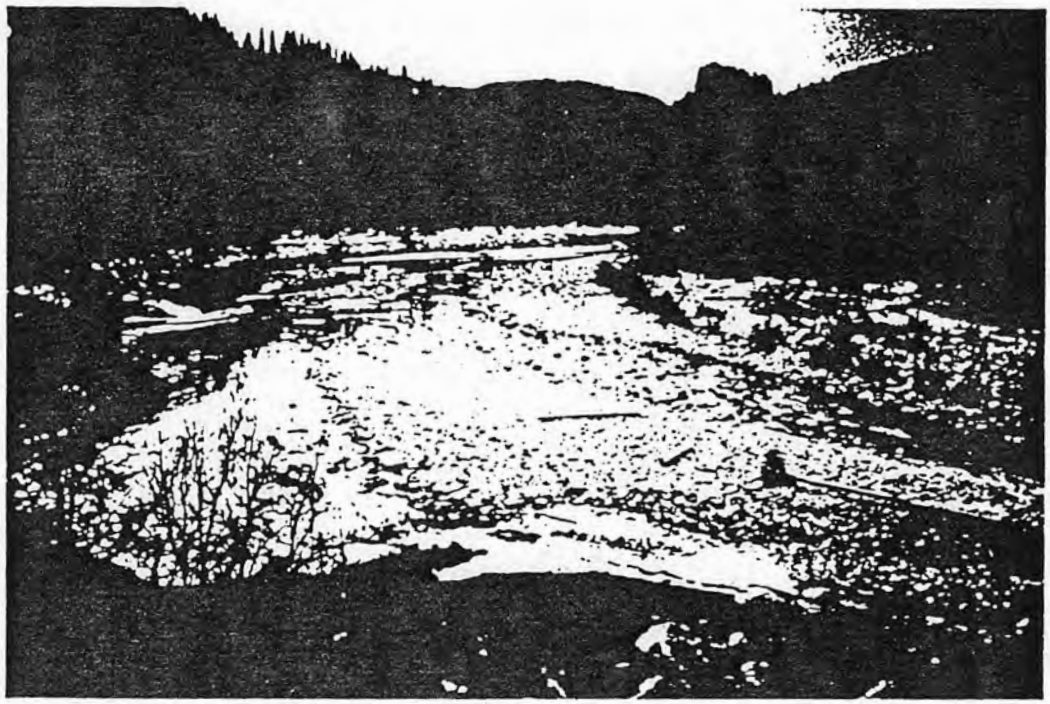
13. Goathorn Creek - subsurface ice forming in early November. Bridge area looking upstream.

November 15/82

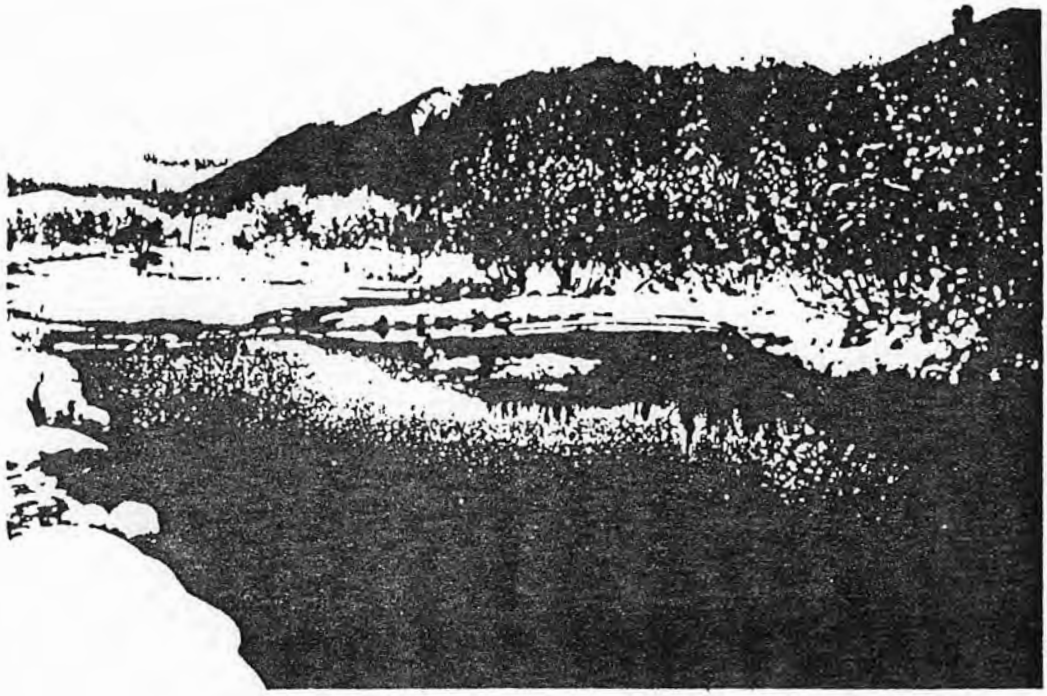
14. Ice formation on lower Telkwa River.

Early November/82

15. Telkwa River just upstream of Howson.
November 15/82



16. Telkwa River - anchor and shelf ice forming during cold weather.
First week of November/82

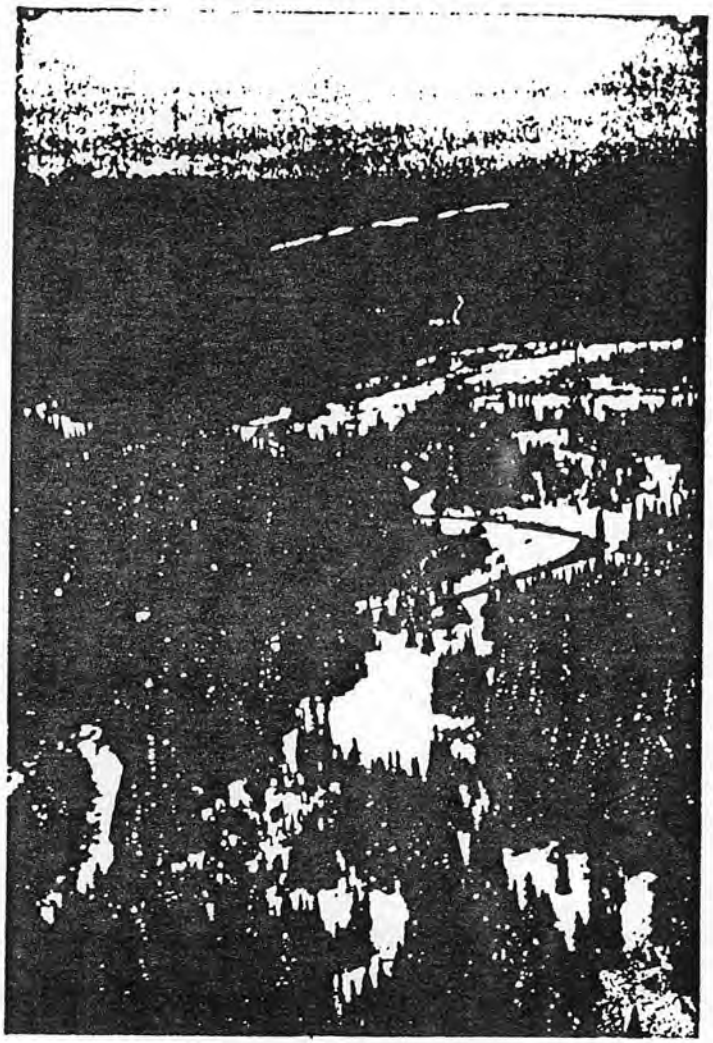


17. Lower Elliott Creek - coho spawning area in lower 1 Km of creek.

November 18/82

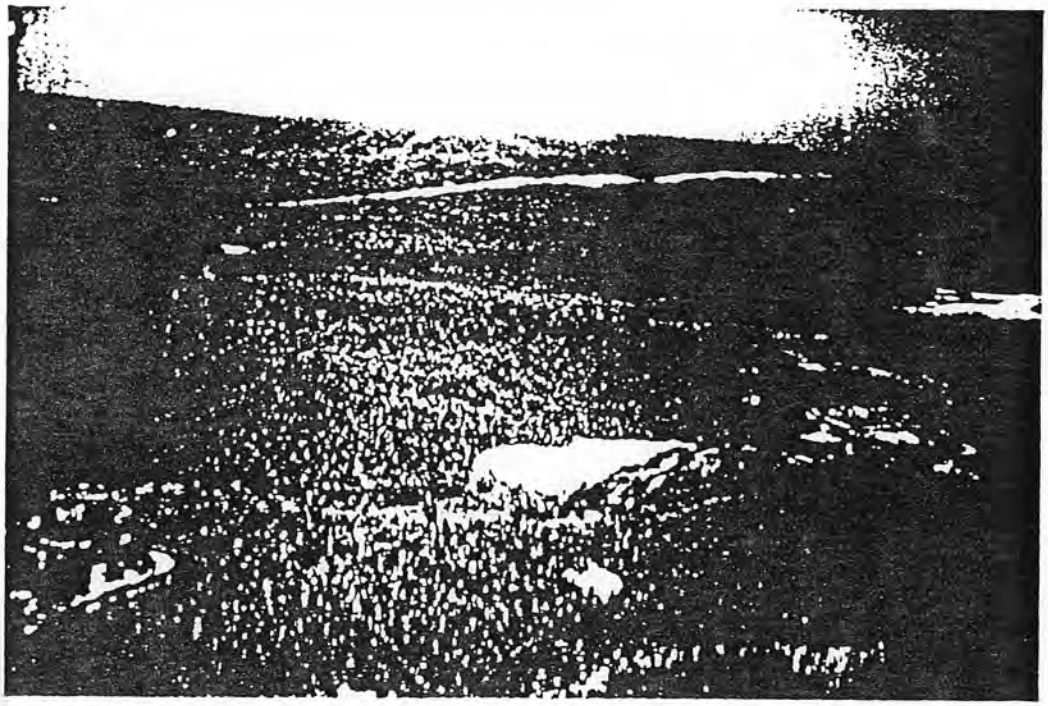
18. Telkwa River above Clean Creek - spawning occurs in this section of river.

November 18/82



19. Telkwa River upstream of Winfield Creek - this is main area of spawning activity.

November 18/82

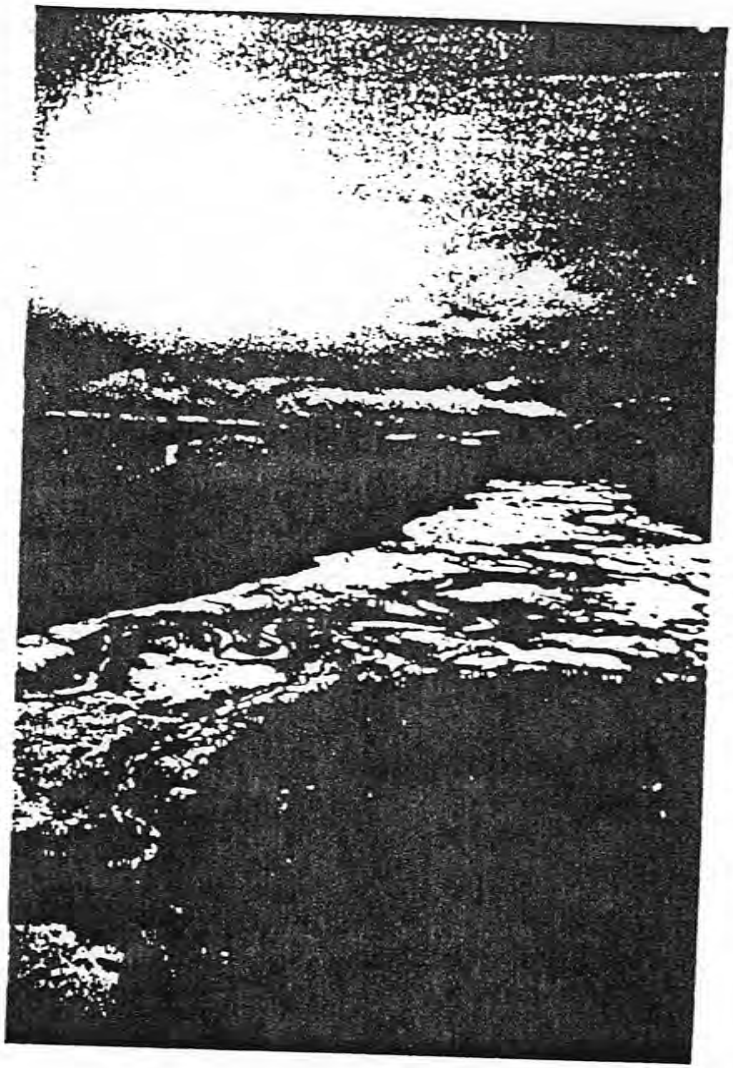


20. Telkwa River in vicinity of Clean Creek tributary.

November 18/82

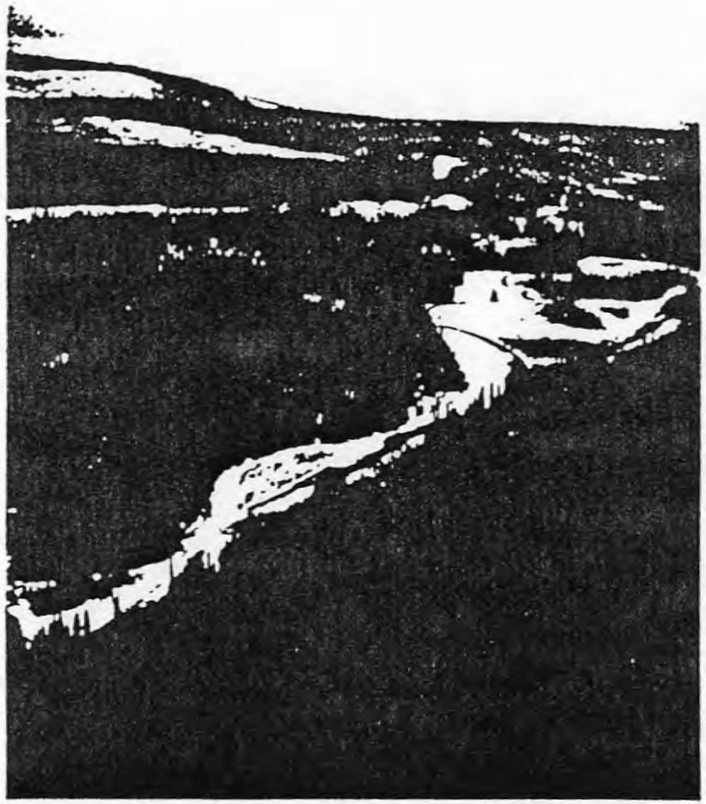
21. Telkwa River above major swamp section - Milk Creek confluence.

November 18/82



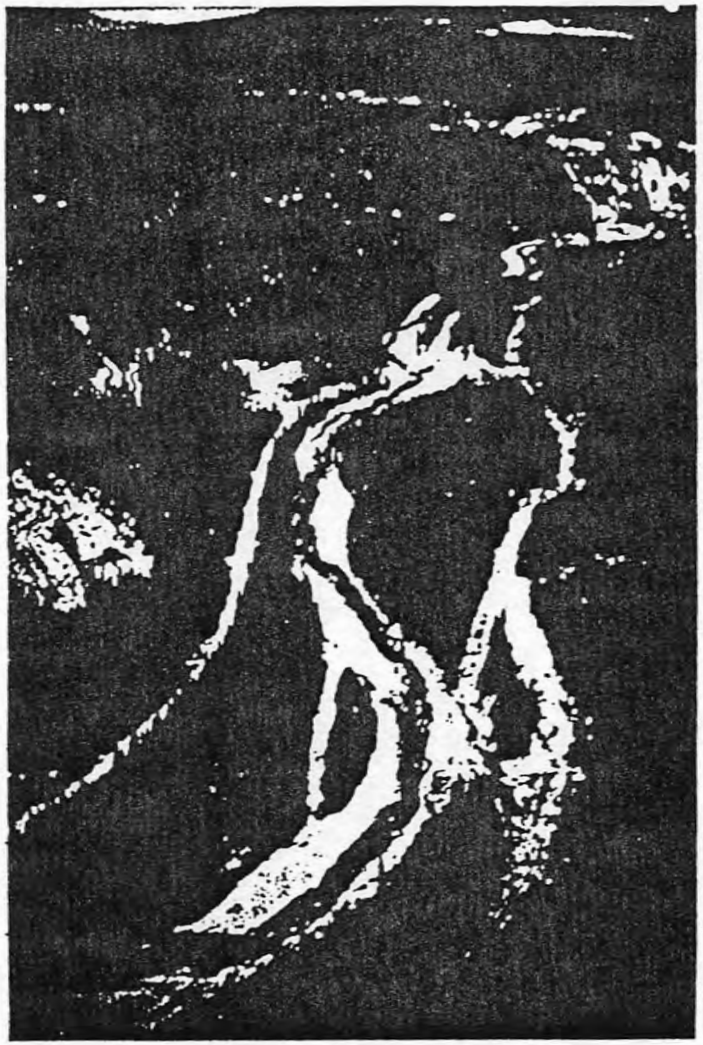
22. Telkwa River in major swamp area downstream of Milk Creek.

November 18/82



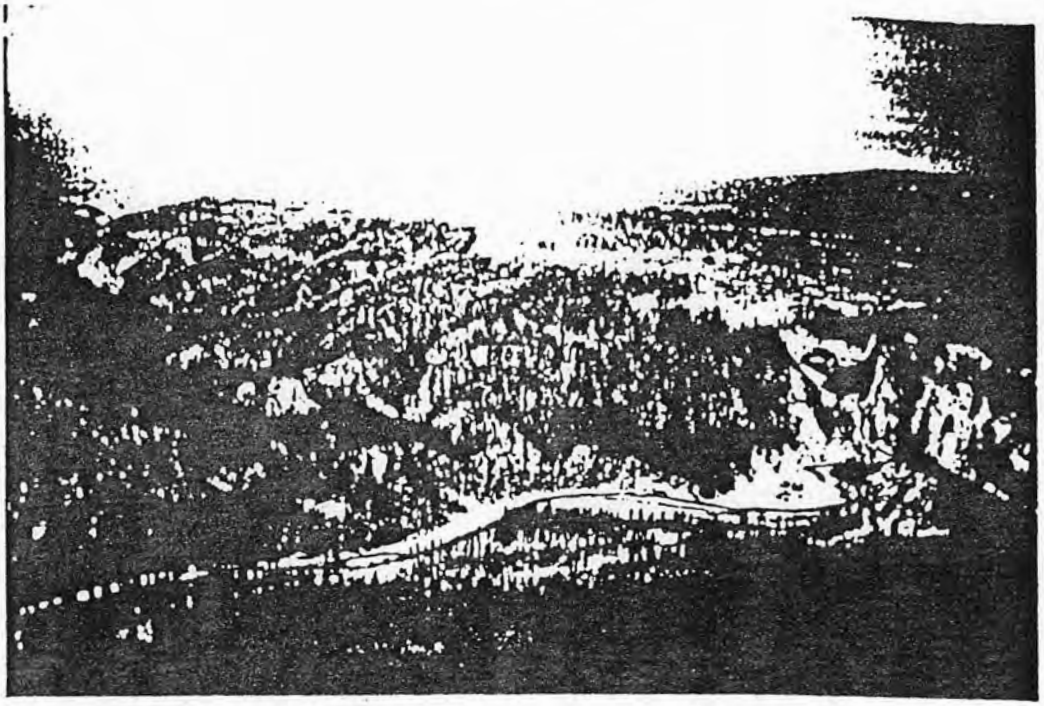
23. Looking down Telkwa River from Howson towards power-line crossing at Jonas Creek.

November 18/82



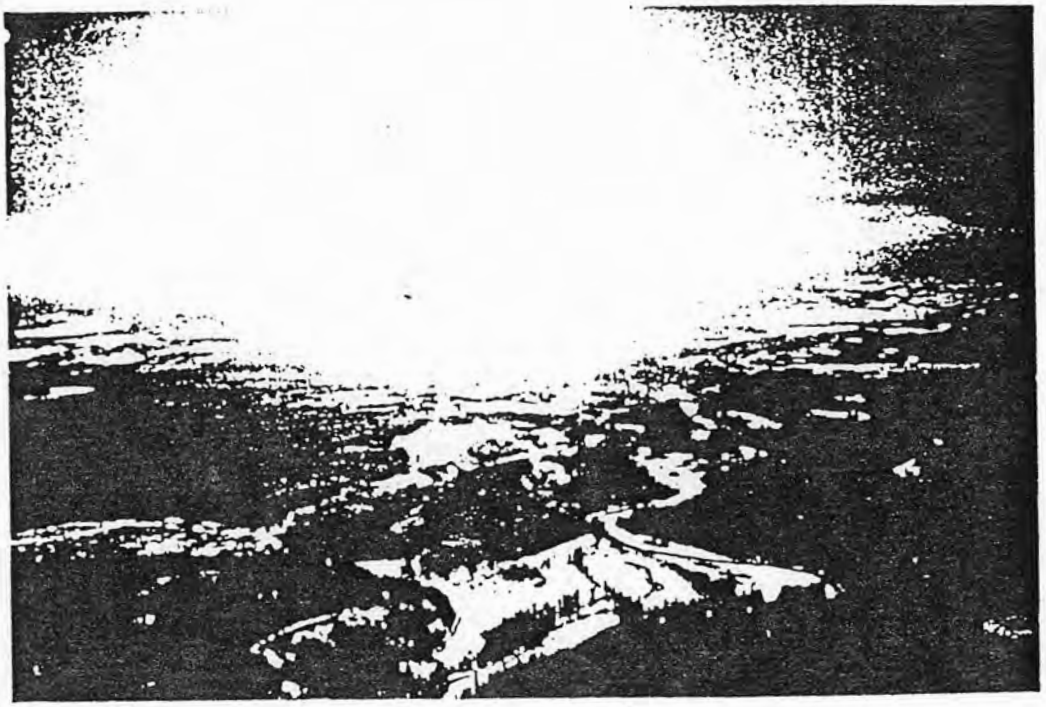
24. Steeper gradient section of Telkwa River between Howson and Pine Creek.

November 18/82



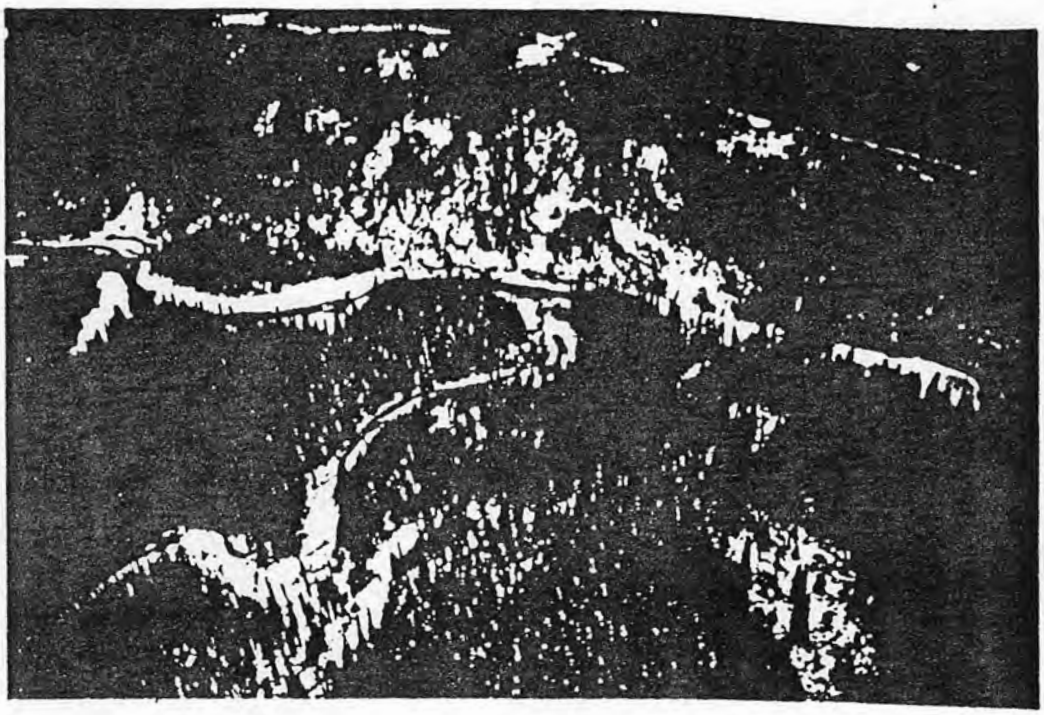
25. Pine Creek confluence with the Telkwa River.

November 18/82



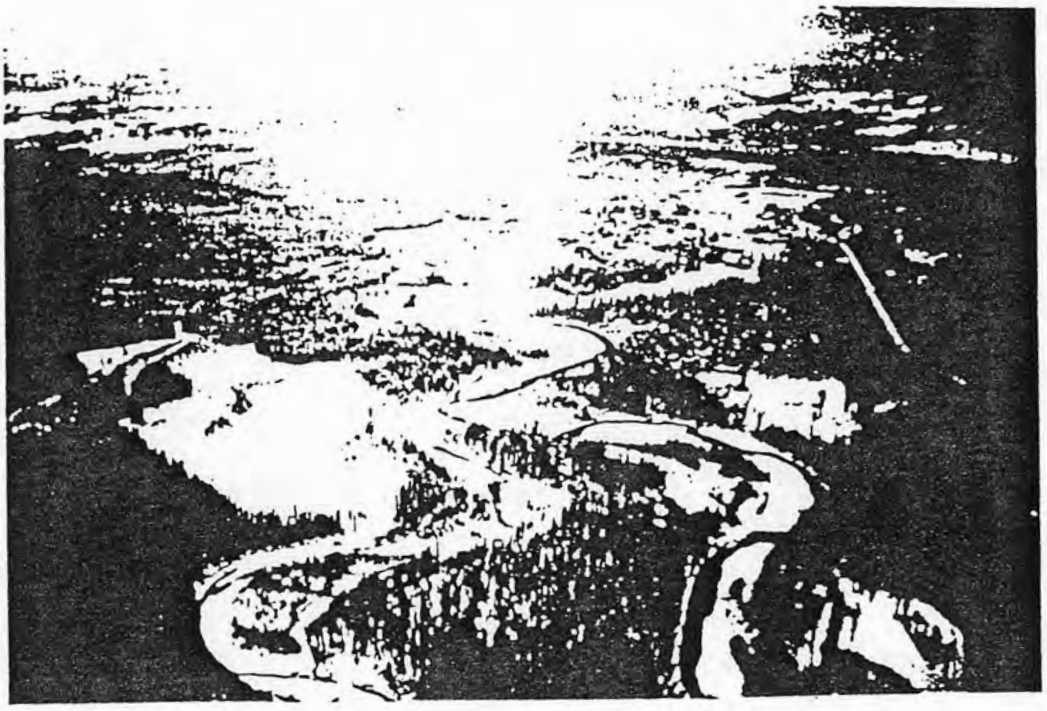
26. Telkwa River looking downstream from Goathorn Creek.

November 18/82



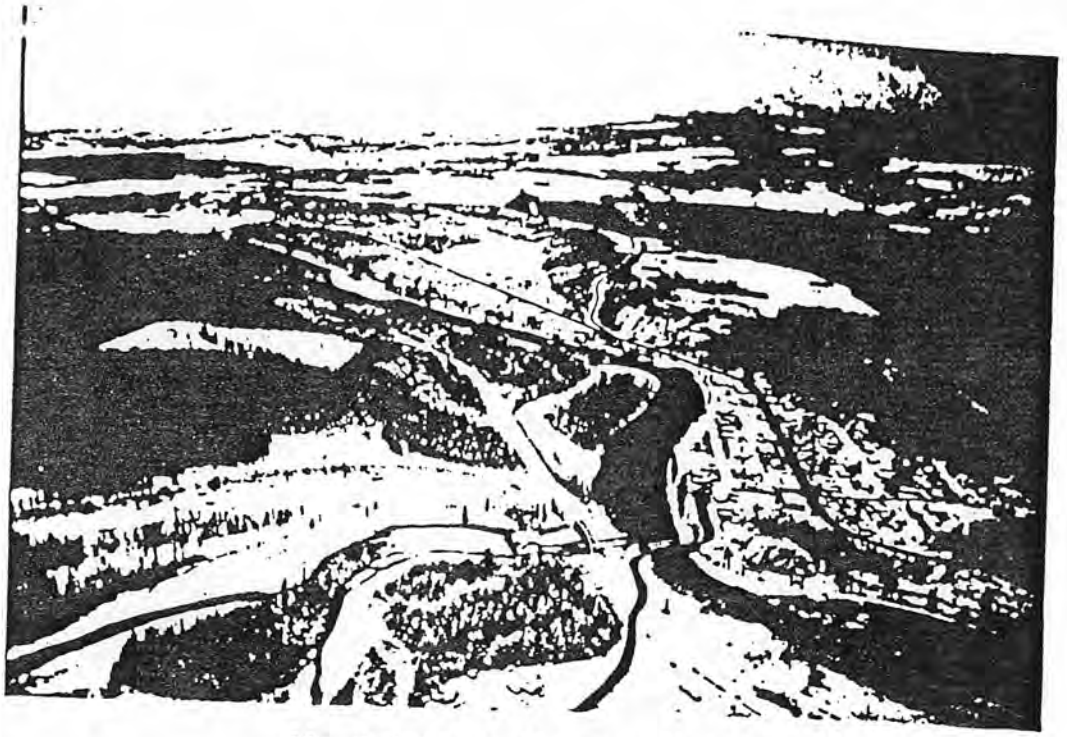
27. Telkwa River - Goathorn Creek confluence.

November 18/82

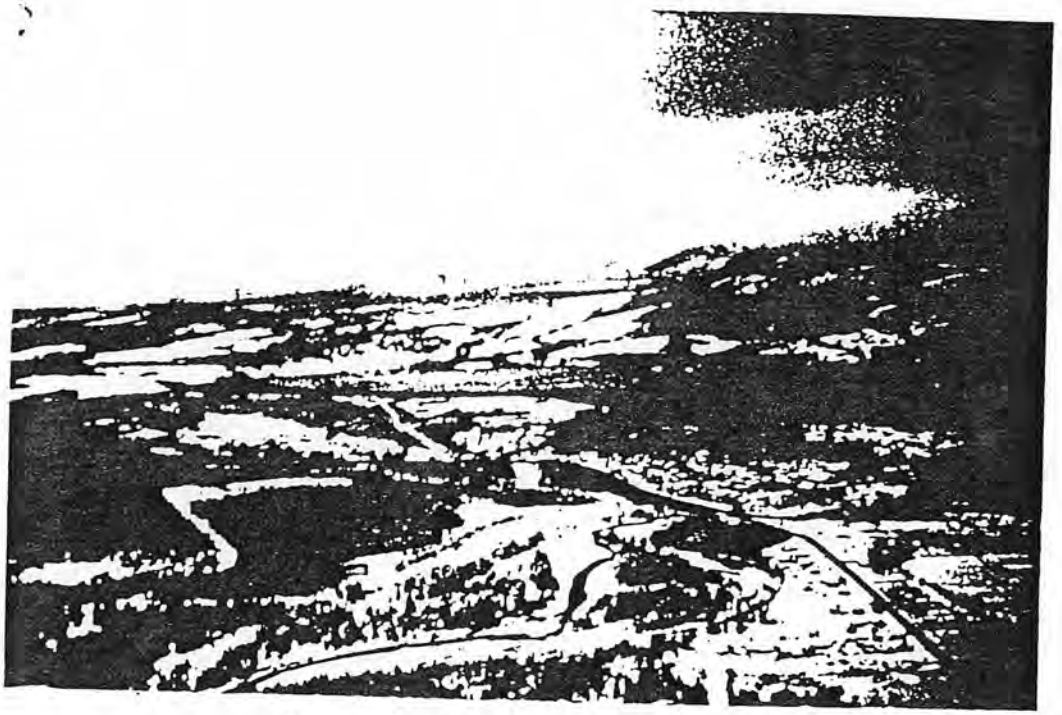


28. Telkwa River - multi-channeled section downstream of Goathorn Creek.

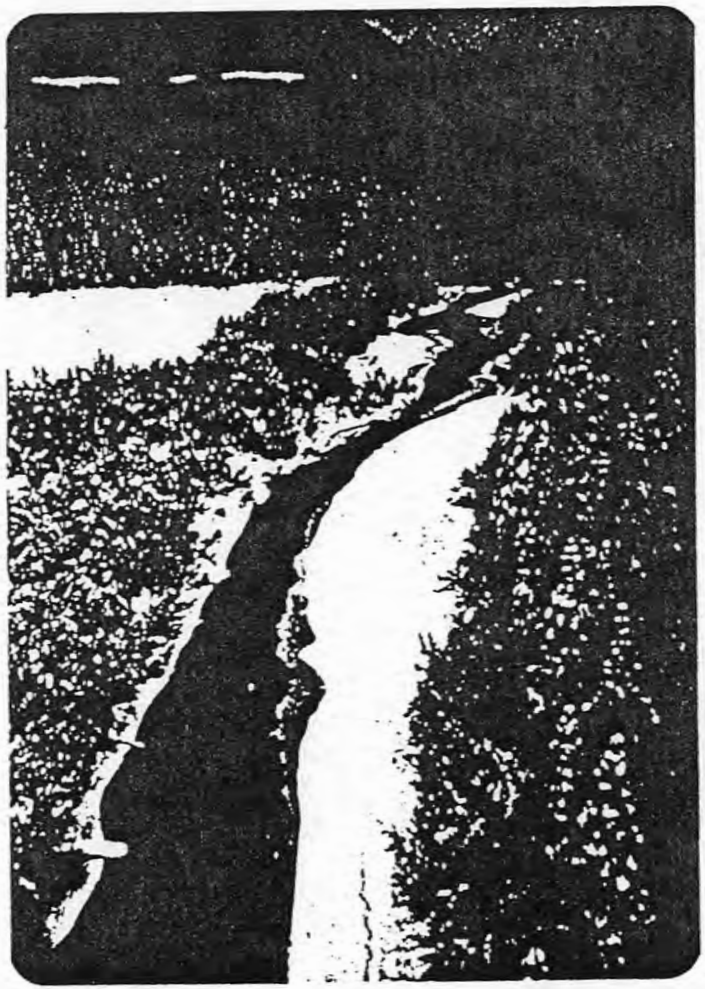
November 18/82



29. Bulkley/Telkwa confluence area.
November 18/82

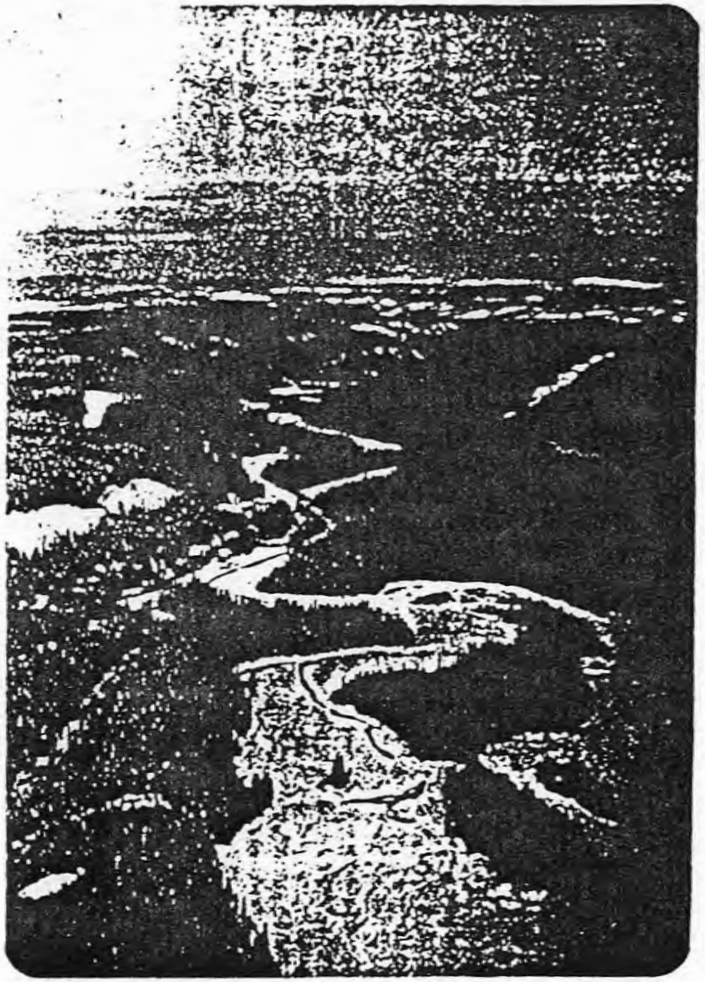


30. Telkwa River/Bulkley River confluence.
November 18/82



31. Telkwa River above Milk Creek

December/82



32. Telkwa River from Howson downstream

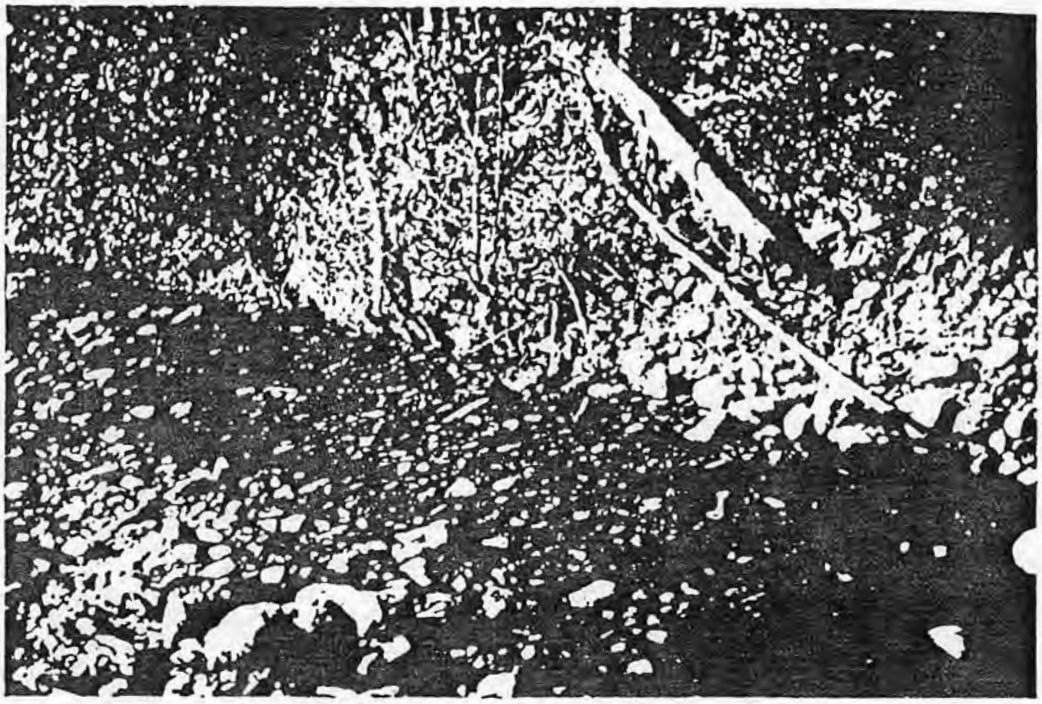
December/82

33. Pine Creek confluence with Telkwa River

December/82

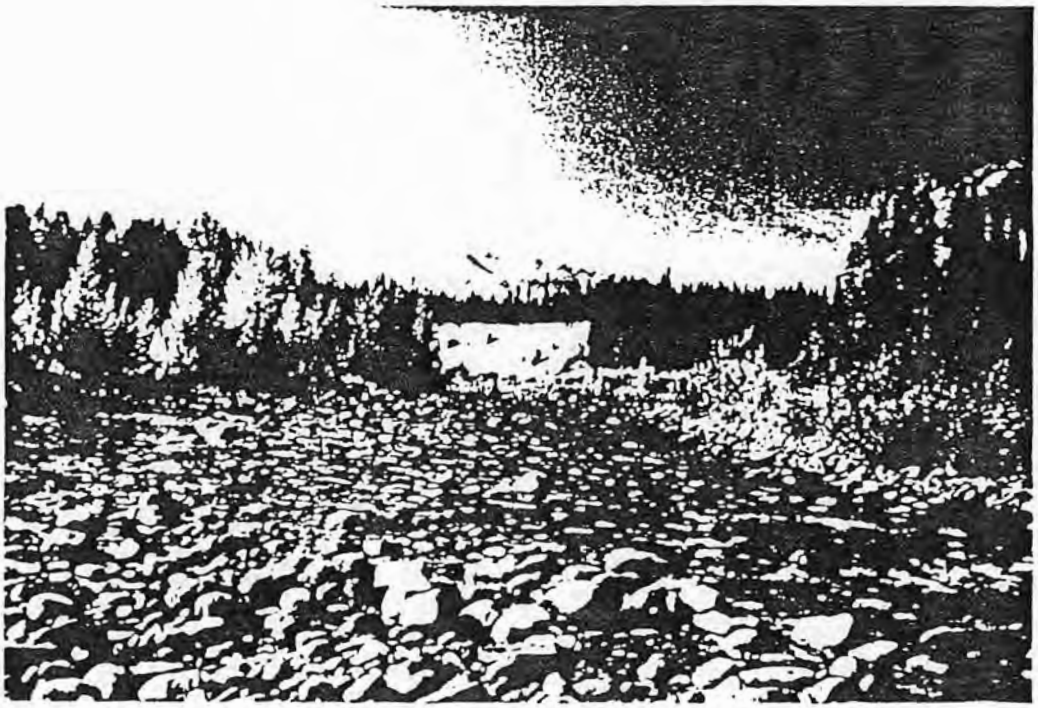
34. Ladner Hill area - Telkwa

December/82



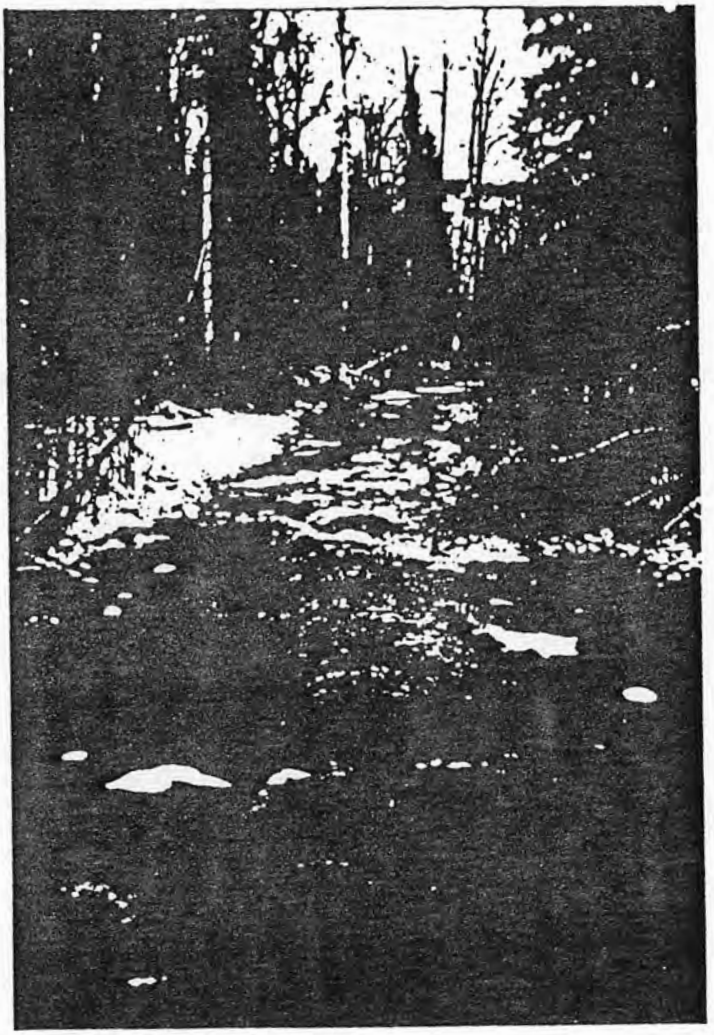
9. Sidechannel of Howson Creek - Dolly Varden spawning occurs in this area which appears to have some seepage input during winter.

September 23/82



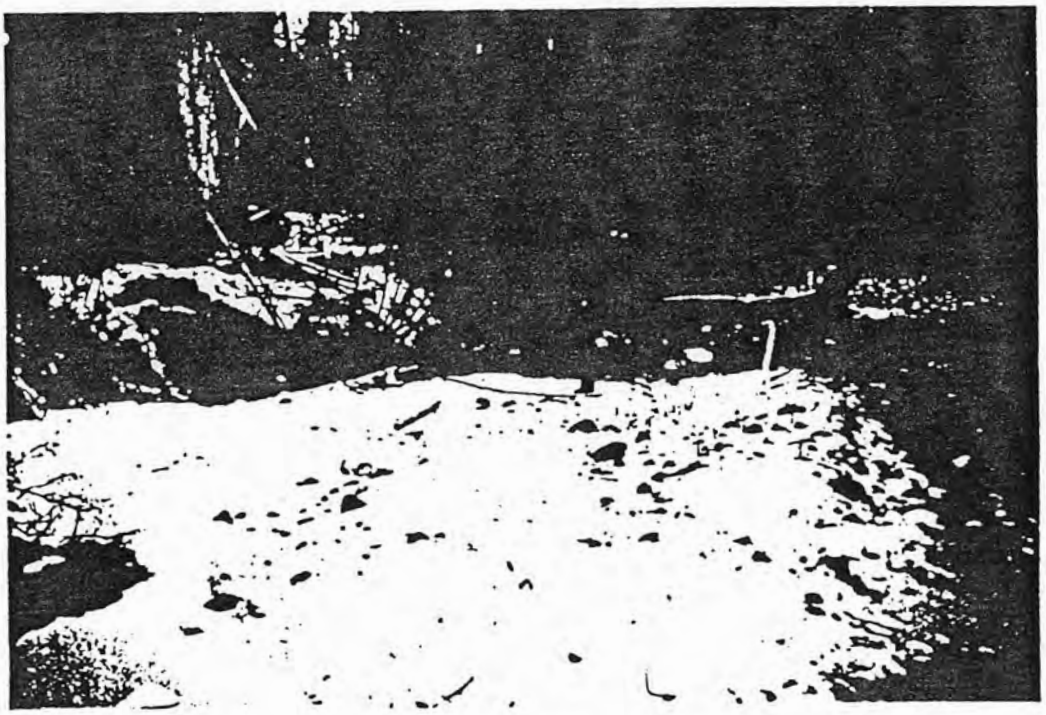
10. Howson Creek approximately 1 Km upstream of Telkwa. Mainly cobble substrate.

September 23/82



11. Goathorn Creek looking downstream - anchor ice formed throughout creek

November 1/82



12. Tenas Creek - approximately 8 Km upstream - lot of subsurface ice formed throughout creek.

November 2/82