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**1981 SURVEY OF SALMONIDS
SPAWNING IN SELECTED STREAMS
OF KNIGHT INLET, BRITISH COLUMBIA**

by

R. FIELDEN & T. SLANEY

**prepared for
NEW PROJECTS UNIT
SALMONID ENHANCEMENT PROGRAM
DEPARTMENT OF FISHERIES AND OCEANS
VANCOUVER, B.C.**

**prepared by
AQUATIC RESOURCES LIMITED
VANCOUVER, B.C.**

MARCH, 1982

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SUMMARY

1. A bio-reconnaissance of salmon spawning in the Knight Inlet area was commissioned by the Department of Fisheries and Oceans and conducted by Aquatic Resources Limited between July 15 and October 31, 1981. The objective of the study was to provide biological, chemical and physical information which is to be used in the planning and implementation of salmonid enhancement facilities in the area.
2. All of the streams studied flow in steep sided, heavily glaciated valleys, which result in extremely rapid response to rainfall or snowmelt and flash floods are common. This effect is somewhat damped in Glendale and Mussel Creeks which are stabilized by lakes. Because the watersheds of the Ahnuhati, Franklin, Klinaklini, Kwalate and Mussel Rivers are all heavily glaciated, freshets extend through September and the waters are clouded by rock flour.
3. All of the streams sampled had extremely soft, low conductivity water. The remainder of the parameters analyzed were well within the recommended limits for salmonid culture.
4. Ripe adults of most species suitable for egg takes could be taken in the lower reaches of the rivers by trap, gaff or seine. The major problems would be in collecting coho and chinook from the Ahnuhati River and Glendale River coho as these fish are green as they pass the lower portions of the rivers and would be very difficult to collect in the upper reaches.
5. Migration timing and escapement numbers are summarized in the table on the following page.

SUMMARY OF SALMON ESCAPEMENTS
OBSERVED IN KNIGHT INLET, 1981

SPECIES	RIVER	RIVER ENTRY	SPAWNING			ESTIMATED ESCAPEMENT A.R.L/DFO*
			START	PEAK	END	
Chum	Glendale CK	Sep 20	Sep 20	Oct 15	Nov 01	450/300
	Mussel CK	Oct 07	Oct 07	Oct 20	?	300/300
	Ahnuhati R	Jul 23	Aug 06	Aug 30	Sep 15	3,000/3,000
	Franklin R	A				?
Coho	Glendale CK	-	A			300/300
	Mussel CK	Aug 20	Oct 20	A		5,600/500
	Ahnuhati R	Aug 28	A			1,700/2,100
	Franklin R	Oct 29	A			?
Chinook	Glendale CK	N/O				
	Mussel CK	B	Sept 15	Oct 01	Oct 15	950/1,000
	Ahnuhati R	B	Aug 15	Sep 01	Sep 15	200 /N/O
	Franklin R	N/O				
Pink	Glendale CK	Jul 24	Sep 07	Sep 26	Oct 24	23,000/20,000
	Mussel CK	Aug 29	Sep 01	Sep 15	Oct 15	20/20
	Ahnuhati R	Jul 23	Aug 06	Aug 30	Sep 15	6,700/7,000
	Franklin R	N/O				
Sockeye	Glendale CK	-	-		Oct 03	5/N/O
	Mussel CK	Sep 01	Sep 30			50/N/O
	Ahnuhati R	Sep 16	Sep 08			/35
	Franklin R	N/O				

B Before Study Initiation July 15/81
N/O None Observed
A After Study Completion
? Unknown
* DFO File Data

ACKNOWLEDGEMENTS

We would like to express our appreciation to a number of people who assisted with this study. J.R. Fielden, P. Bentzen, B.A. Stockwell and G. Black all helped with data collection in the field. Facilities were provided by Traer and Mahood Contracting Ltd. and by British Columbia Forest Products limited, whose representative, Mr. S. Potter, provided valuable assistance.

During the analysis and report preparation phase, Y. Yole of the DFO scale laboratory interpreted the scales. G. Hoskins of DFO Diagnostic Services in Nanaimo provided the disease analysis of carcasses collected in 1981 as well as a review of earlier pathology work in Knight Inlet. Water samples were analysed at the DFO Cypress Creek Laboratory in West Vancouver.

This report was reviewed by W. Griffioen, B. Shepherd and B. Anderson who provided many helpful comments.

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PART 1

INTRODUCTION

The Department of Fisheries and Oceans Canada (DFO) is building a spawning channel and hatchery complex at Glendale Creek in Knight Inlet. In addition, DFO is considering future enhancement facilities on Mussel Creek, and the Ahnuhati River. Aquatic Resources Limited was commissioned by the Department to conduct an adult salmonid reconnaissance program on four river systems in Knight Inlet; Glendale Creek, Mussel Creek, Ahnuhati River and Franklin River. The five species of salmon, pink (Oncorhynchus gorbuscha), chum (O. keta), sockeye (O. nerka), coho (O. kisutch) and chinook (O. tshawytscha), were surveyed to provide baseline information for the facilities. Several trips were also made to Kwalate Creek, after a request was made from the DFO during the study, to look at its enhancement capabilities. The Franklin River and Kwalate Creek have been proposed as the site of satellite operations to the Knight Inlet facilities at Glendale Cove and Mussel Creek. Other reports being prepared concurrently include a limnological study of Tom Browne Lake which will contribute to the Glendale water supply (Black and Birch, 1982) and a survey of adult salmonids in the Kakweiken River (Slaney and Milko, 1982).

1.1 OBJECTIVES

The general objectives of the study were to:

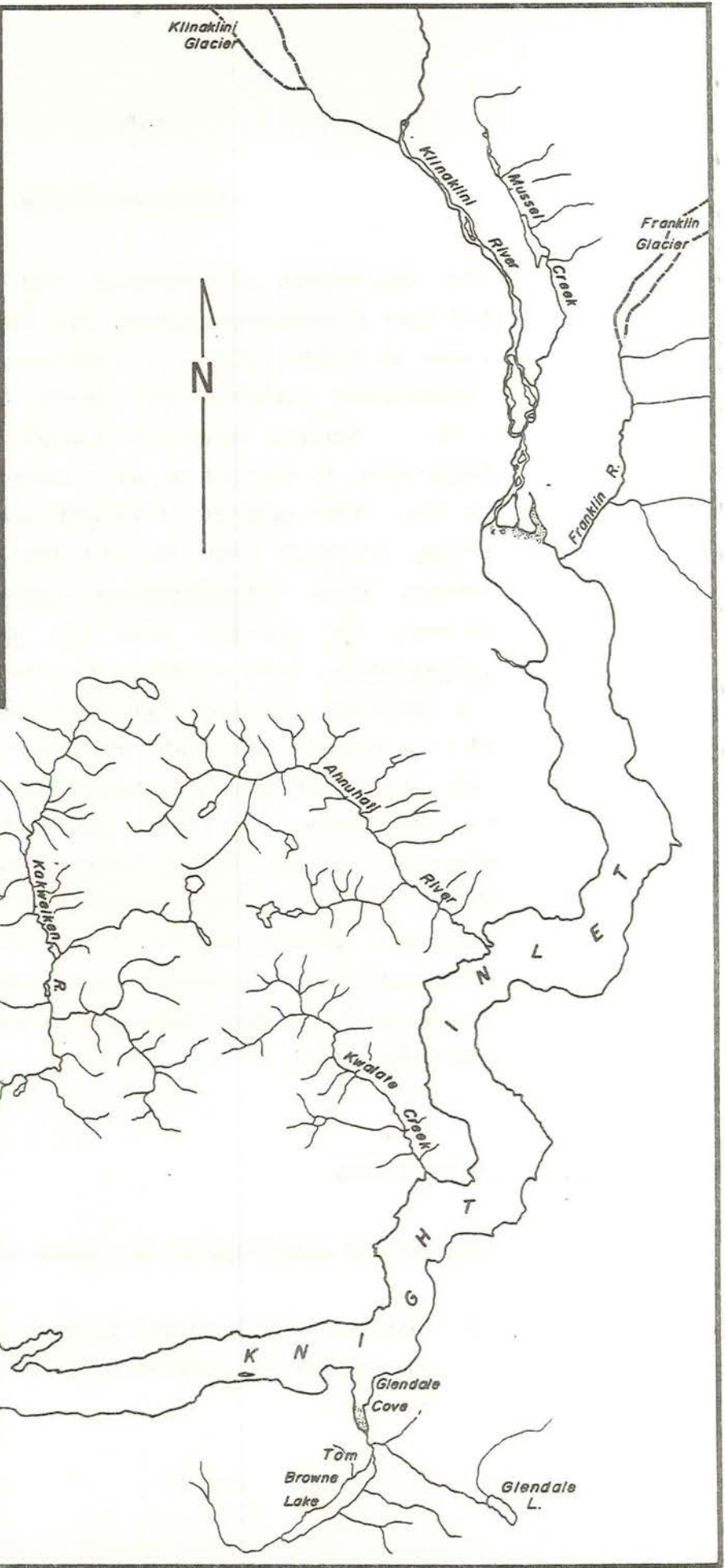
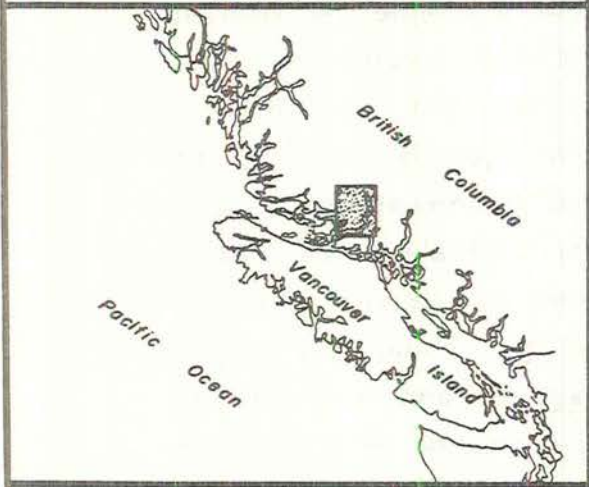
- i) Conduct weekly visual surveys on each system, to assess escapement and establish time of arrival, spawning and end of run.

Figure I.O-1
GLENDALE STUDY AREA

prepared for
DEPARTMENT OF FISHERIES & OCEANS

Project: VS 941 Scale 1:325,000

prepared by
AQUATIC RESOURCES LIMITED
March, 1982



- ii) Obtain data on population biological characteristics from carcass surveys.
- iii) Note holding and spawning areas where fish are amenable to capture. Suggest capture areas and techniques for future egg takes.
- iv) Collect moribund post-spawning adult salmon from Mussel Creek for disease analysis.
- v) Provide data on temperature and water levels for each system during the study and collect samples for water quality analysis.

1.2

DESCRIPTION OF THE STUDY AREA

Knight Inlet is a mainland inlet 220 kilometers north of Vancouver indenting the coast for 120 kilometers (fig. 1.0-1). The inlet is up to 530 m deep and averages approximately 3 km in width. It is bounded on both sides by mountains 1,200 to 1,800 m high.

The Glendale Creek watershed is situated 48 km from the head of Knight Inlet and lies within a region of low rolling mountains on the edge of the coast range. The system includes two large lakes, Tom Browne Lake and Glendale Lake and covers an area of 136 km². Tom Browne Lake (7 km long) is drained by Tom Browne Creek (1.5 km long) which flows into Glendale Cove. Glendale Lake (2 km long) is drained by Glendale Creek (7.5 km long) which flows into Tom Browne Creek 1 km from the mouth. Except for a few kilometers of the lower end of Glendale Creek, most of the low lying areas have been logged.

Table 1.2-1

GLENDALE CREEK ESCAPEMENT RECORD

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947	UNK		UNK	UNK	UNK	
48	UNK		UNK	UNK	UNK	
49	3500		7500	35000	15000	
50	3500		3500	35000	35000	
51	7500		3500	15000	15000	
52	3500		7500	15000	15000	
53	3500		7500	7500	7500	
54	1500		750	7500	15000	
55	1500		7500	3500	75000	200
56	1500		3500	3500	75000	
57	3500		1500	7500	75000	
58	1500		7500	3500	75000	
59	750		3500	1500	175000	
60	1500		1500	1500	35000	
61	750		3500	7500	100000+	
62	N/O		3500	3500	100000+	
63	N/O		1500	35000	100000+	
64	N/O		1500	55000	150000	
65	N/O		400	75	50000	
66	N/O	25	400	15000	220000	
67			200	35000	75000	
68	N/O	N/O	400	15000	162500	
69			N/O	1000	50000	
70	25	25	200	35000	150000	
71			200	400	150000	
72	25		75	15000	9500	
73	10		50	40000	200000	
74				2000	30000	
75	100		25	400	150000	
76	200		N/O	1600	150000	
77			N/O	450	16000	
78			2000	1500	275000	
79			10	1500	21000	
80				1500	250000	

N/O - None Observed
UNK - Unknown

DF0 file data

The area around Glendale Lake and the upper reaches of Glendale Creek were logged in the 1950's. Currently Dougan Logging is taking timber in the vicinity of Tom Browne Lake and the hatchery site situated near the confluence of Tom Browne Creek and Glendale Creek. R & N Logging are harvesting the higher elevations near Glendale Lake and along Glendale Creek several kilometers above the Tom Browne Creek confluence. Roads extend from Heydon Bay in Loughborough Inlet, along Glendale Lake on down Glendale Creek to within a few kilometers of Tom Browne Creek. Another set of roads runs from Jackson Bay along both shores of Tom Browne Lake to the hatchery site. Glendale Creek supports a strong even year run of pink salmon, a consistent return of 500-1500 chum and an irregular number of coho (Table 1.2-1). Sockeye returns have been sporadic in recent years and only occasional returns of chinook and steelhead have been reported. Pink salmon eggs were collected from Glendale Creek for transplants to Newfoundland in 1962-66 and for transplants to the Tsolum River in 1975. (Lear, 1975; F.C. Withler pers. comm.).

Mussel Creek, which is gazetted as Devereux Creek, is a tributary of the Klinaklini River which flows into the head of Knight Inlet. The Klinaklini is a large glacial river that extends for over 160 km into the Chilcotin area. Mussel Creek joins the Klinaklini River 8 km from the mouth. The creek drains an area of 74 km², is 19 km long and is passable to fish for 17 km. There are three lakes in the system; Mussel (Devereux) Lake (2.5 km long), Laura Lake (1.7 km long) and Fifth Lake (0.5 km long). On the east side of the creek is Jubilee Mountain, 2800 m high, and on the west side is a ridge, 600 m high, which separates Mussel Creek and the Klinaklini River. DFO escapement records (Figure 1.2-2) for Mussel Creek are irregular as they have often been included with the lower Klinaklini River. All of the lower areas surrounding Mussel Creek have been logged in the past 20 years and logging continues at higher elevations in the watershed. Roads

Table 1.2-2

KLINAKLINI RIVER ESCAPEMENT RECORD

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947	UNK	UNK	UNK	UNK	UNK	UNK
48	UNK	UNK	UNK	UNK	UNK	UNK
49	400	3500	UNK	15000	7500	UNK
50			7500	75000		
51	400	7500	7500	35000	3500	3500
52			No Records			
53	1500	15000	15000	15000	7500	UNK
54	3500	15000	3500	3500	3500	UNK
55	3500	15000	7500	3500	7500	3500
56	3500	15000	15000	15000	3500	
57	3500	7500	7500	35000	1500	
58	7500	7500	7500	35000	3500	
59	7500	15000	7500	15000	3500	
60	3500	15000	3500	15000	3500	
61	1500	7500	7500	35000	3500	
62	3500	3500	7500	15000	1500	
63	3500	7500	3500	7500	3500	N/O
64	7500	7500	3500	15000	7500	N/O
65	3500	7500	3500	1500	400	N/O
66	3500	3500	3500	3500	3500	200
67	3500	3500	3500	750	750	UNK
68	750	7500	3500	750	3500	UNK
69	400	400	3500	75	N/O	
70	1500	3500	3500	7500	750	
71	750	400	400	750	750	
72	400	1500	3500	35000	750	
73	400	3500	3500	30000	75	
74	700	3500	3500	7500	75	
75	1500	7500	3500	7500	75	
76	800	7500	3500	20000	300	
77	1600	7500	3500	7500	75	
78	800	7500	3500	20000	300	
79		3000				
80*	5	500				

* - Mussel Creek
UNK - Unknown
N/O - None Observed

DF0 file data

now run the full length of Mussel Creek and are maintained in excellent condition as they are main lines for the logging operation.

The Ahnuhati River is situated on the west side of Knight Inlet 27 km from the head and lies within a steep narrow valley surrounded by mountains of up to 2,000 m. The watershed drains an area of 178 km² and contains six small lakes all of which are above 750 m in elevation. The river has a total length of 23 km, 19 of which are passable to fish. The major tributary, Tanockteuch Creek, which enters the Ahnuhati River 6 km from the mouth, is very steep, and has little potential for spawning. The DFO spawning records show that the Ahnuhati system historically supported all five species of pacific salmon and steelhead trout, however only coho, chum and pink have been seen in recent years (Table 1.2-3). British Columbia Forest Products started logging the lower part of the valley in 1978. Roads were built for 4 km up the valley, starting from the bay on the north side of the river mouth. This road is in good condition however the bridge across the river has been removed and the road on the south side of the river is inaccessible.

The Franklin River is a large glacial river that also drains into the head of the Knight Inlet from a valley east of the Klinaklini Valley. This river is derived from meltwater of glaciers in the Waddington and Whitemantle Mountain Ranges. The Franklin Glacier is the biggest glacier in the system and originates at the foot of Mt. Waddington (4,016 m), the highest mountain in the coast range. The Franklin River is 17.5 km long and has a drainage basin of 680 km². There are three main tributaries; Fissure Creek, Crevice Creek and Stanton Creek, all of which are glacial. The system once supported chinook, coho and chum; however only coho and chum have been reported in

Table 1.2-3

AHNUHATI RIVER ESCAPEMENT RECORD

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947			UNK	UNK	UNK	
48			UNK	UNK	UNK	
49			UNK	UNK	UNK	
50			7500	35000	7500	
51	750	750	15000	35000	7500	3500
52	400	400	15000	35000	15000	1500
53	400	750	15000	35000	3500	1500
54	200	400	400	7500	400	750
55	400	200	15000	7500	7500	1500
56	400	400	15000	15000	400	
57	400	750	750	1500	750	
58	750	400	15000	35000	7500	
59	75	200	7500	7500	7500	
60	400	200	750	7500	7500	
61	N/O	200	750	7500	35000	
62	N/O	400	7500	7500	35000	
63	N/O	N/O	400	7500	7500	
64		N/O	750	15000	35000	
65		25	3500	750	15000	
66		25	1500	750	75000	
67		N/O	75	7500	3500	
68		N/O	750	3500	55000	UNK
69		N/O	N/O	2500	1500	UNK
70		N/O	400	3500	35000	
71		N/O	25	1500	3500	
72		N/O	400	3000	3000	
73		N/O	400	4000	3000	
74		400	400	1000	15000	
75			400	2500	20000	
76			400	3000	100000	
77		75	450	5000	4000	
78			500	10500	120000	
79			450	21300	5000	
80		4	250	12000	340000	

N/O - None Observed
Unk - Unknown

DFO file data

Table 1.2-4

FRANKLIN RIVER ESCAPEMENT RECORD

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947						
48						
49						
50			NO RECORDS PRIOR TO 1951			
51		750	200	750		
52		400	750	1500		
53		750	1500	750		
54		750	750	1500		200
55		1500	1500	400		200
56		750	1500	1500		
57		400	1500	3500		
58		400	1500	1500		
59		200	1500	1500		
60		75	1500	750		
61		75	1500	3500		
62		400	3500	750		
63		400	750	750		
64		400	400	750		
65		1500	1500	750		
66		750	400	400		
67		N/O	N/O	N/O		
68		N/O	400	400		
69		N/O	N/O	N/O		
70			N/O	N/O		
71			UNK	UNK		
72			200	750		
73			200	750		
74			300	750		
75			200	200		
76			N/O	400		
77				450		
x 78						
x 79						
x 80						

x - Very rarely checked
 UNK - Unknown
 N/O - None Observed

DF0 file data

recent years (Table 1.2-4). Both runs are very late and enter the system in late October or November. The lower elevations of the Franklin Valley have been logged for about 1 km from the mouth and logging continues at higher elevations. Roads paralleled both sides of the lower 10.5 km of the river however, only the first 7.5 km on the west side is easily accessible. Above that point the road deteriorates and a four wheel drive vehicle is required. Access to the east bank is limited to foot or trail bike as the bridge is in poor repair.

Kwalate Creek is in many ways physically similar to the Ahnuhati River, although slightly smaller. It drains into the west side of Knight Inlet 42 km from the head. There are cascades at the mouth of the creek which impede the migrations of coho and block the passage of chum and pinks. Salmon escapements to the Kwalate Creek have only been monitored sporadically as access to the upper reaches of the river is quite difficult. Nonetheless, the escapement record shown in Table 1.2-5 does indicate the restricted nature of the chum and pink runs. The Kwalate Valley has not been logged.

Table 1.2-5

KWALATE CREEK ESCAPEMENT RECORD

YEAR	SOCKEYE	CHINOOK	COHO	CHUM	PINK	STEELHEAD
1947			UNK	UNK	UNK	UNK
48			UNK	UNK	UNK	UNK
49			3000	250	800	UNK
50			3500	750	750	3500
51		200	3500	1500	750	750
52		75	1500	750	1500	200
53		75	3500	200	400	75
54		75	400	200	750	200
55		200	3500	400	750	75
56		75	3500	750	750	
57		75	400	750	400	
58		75	400	400	750	
59		75	3500	400	1500	
60		N/O	1500	750	3500	
61		N/O	1500	400	750	
62		N/O	1500	75	200	
63		N/O	1500	75	200	
64			750	25	25	
65			1500	N/O	400	
66		25	1500	N/O	75	
67			75	25	25	
68			400	25		
69		N/O	200	N/O	N/O	
70			400			
71			400	N/O	25	
72			200			
73			200			
74			500			
75			2000			
76			1000	100	100	
77			300	300	100	
78			800	100		
79			100			
80			300	50	100	

N/O - None Observed
UNK - Unknown

DFO file data

PART II

METHODS

2.1 PHYSICAL AND CHEMICAL OBSERVATIONS

2.1.1 Weather

Weather data for B.C. Forest Service fire weather calculations were collected by Traer and Mahood Contracting Ltd. at a site near Mussel Creek 2 km upstream from the mouth. The measurements were made every day at 1300 hr throughout the study to October 15. Additional data on the area dating back to 1970 was obtained from the B.C. Forest Service, Campbell River office.

2.1.2 Water Levels and Temperatures

Staff gauges were placed in the lower reaches of all four systems (Figures 3.2-1, 3.2-2, 3.2-3, 3.2-4). Temperatures were taken with a handheld thermometer. A maximum-minimum thermometer was used in Mussel Creek and temperatures were recorded daily along with the water level. Levels and temperatures were recorded in the rest of the systems at least once a week.

2.1.3 Water Quality

Water samples were taken once from each system on September 8 and once again on October 20 from Mussel Creek. Water samples were collected near the surface in three plastic containers; a 200 ml bottle with 1 ml of nitric acid added for the analysis of extractable metals; a 200 ml bottle with 1 ml of nitric dichromate preservative for mercury analysis; and a 2 l container for analysis of pH, nutrients, residues and other general parameters. Temperature and pH were taken in situ by

hand held thermometer and Hach kit. The samples were packed in ice and delivered by air within 48 hours to the DFO Cypress Creek laboratory in Vancouver for analysis.

2.2 SPAWNER ENUMERATION

2.2.1 Stream Survey

The study streams were subdivided into homogenous reaches (figures 3.2-1, 2, 3, 4 and 5) on the basis of their physical characteristics. Regular visual estimates of escapement and spawning in each reach were made throughout the season. During August and September, notes and photos were taken for habitat descriptions of each reach. Counts on each system were conducted by two observers on foot at least once a week. The lower 3 km (Reach 1) of the Ahnuhati River were floated in wetsuits one day and the next day the rest of the river was walked up to the end of reach 2. Reach 1 of Mussel Creek was also floated while the rest of the count was conducted on foot.

2.2.2 Aerial Survey

On September 8 and October 20, aerial surveys of the study area streams were conducted by helicopter to obtain an independent visual estimate of salmonid abundance and distribution and to survey the upper reaches which could not be reached on foot. The flights were planned to coincide with the peak spawning activity of chinook in late August and coho in mid October. The first survey, however, was delayed to September 8 because of rain and fog.

2.2.3 Carcass Recovery

Carcasses were recovered where possible to obtain population characteristics for each of the species in each system. Sex, postorbital-hypural length (POH) and egg retention were recorded and scale samples were taken. Five scales were removed three from one side and two from the other in the

preferred area above the lateral line, below and slightly behind the dorsal fin. Scale samples were then shipped to the DFO scale laboratory in Vancouver for age determination. The fecundity and egg retention of female carcasses were determined by removing the ovaries which were then preserved in formalin, and later, counted.

2.3 PATHOLOGY SURVEY

On October 13 and 14, three parasitologists headed by Mr. Hoskins of DFO Diagnostic Services, Pacific Biological Station, sampled diseases and parasites in post spawning adult salmon retrieved from Mussel Creek. The parasitologists set up their equipment near the spawning grounds and specimens to be sampled were retrieved by the field crew by gaff, gillnet and electroshocker.

All of the fish were examined for pathological anomalies which could impede fish survival. The procedures used included:

- Gross external and internal examination
- Assay for the detection of viral disease agents.
- Aseptic streaking of kidney tissue into TSA culture medium.
- Examination of stained kidney tissue smears for foreign agents.
- Detailed dissection of the viscera for unusually severe levels of parasite infection.
- Examination of the flesh for lesions caused by the parasite Henneguya sp.

**PART III
RESULTS AND DISCUSSION**

3.1 PHYSICAL AND CHEMICAL OBSERVATIONS

3.1.1 Weather

The air temperature and precipitation recorded at the Knight Inlet Forest Fire Station are shown in Figure 3.1-1. The air temperatures were recorded at 1300 hrs daily and are thus somewhat different from the standard Atmospheric Environment Service measurements. The advantage in this case is that long term fire weather records are available and the 1981 weather can be compared to the means of the previous ten years (1971-1980) (Table 3.1-1).

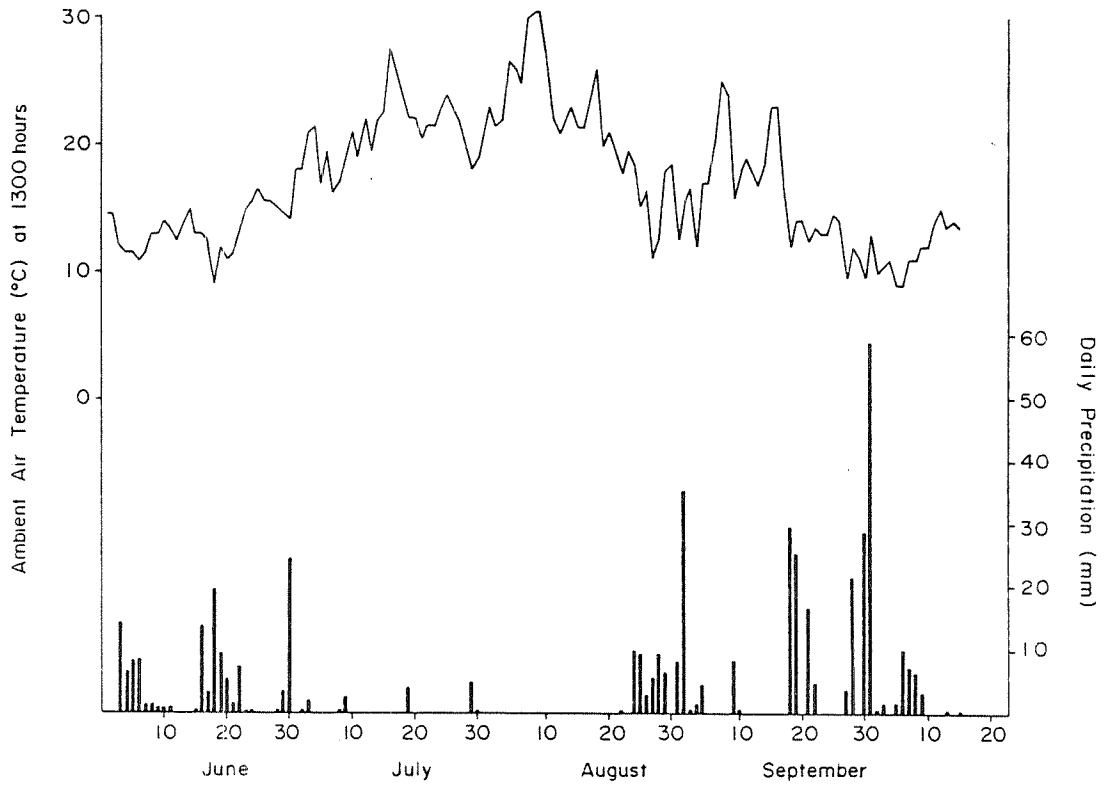
**TABLE 3.1-1
COMPARISON OF 1981 CLIMATIC MEANS WITH 10 YEAR (1971-1980)
MEANS RECORDED AT THE HEAD OF KNIGHT INLET, B.C.**

Month	Temperatures*2 (°C)						Precipitation	
	High		Low		Mean		(mm)	
	1981	10 yr	1981	10 yr	1981	10 yr	1981	10 yr
May	23.5	26.0	8.0	5.0	15.2	15.0	108.7	88.1
June	22.5	29.0	12.0	8.0	16.3	17.3	588.5	109.7
July	27.5	32.0	16.0	7.0	20.9	18.9	14.4	72.0
August	30.5	31.0	11.0	11.5	21.3	19.3	53.5	73.0
Sept	25.0	29.5	9.5	8.0	16.0	15.7	181.3	177.7
Oct*1	15.0	-	9.0	-	11.9	-	90.3	-

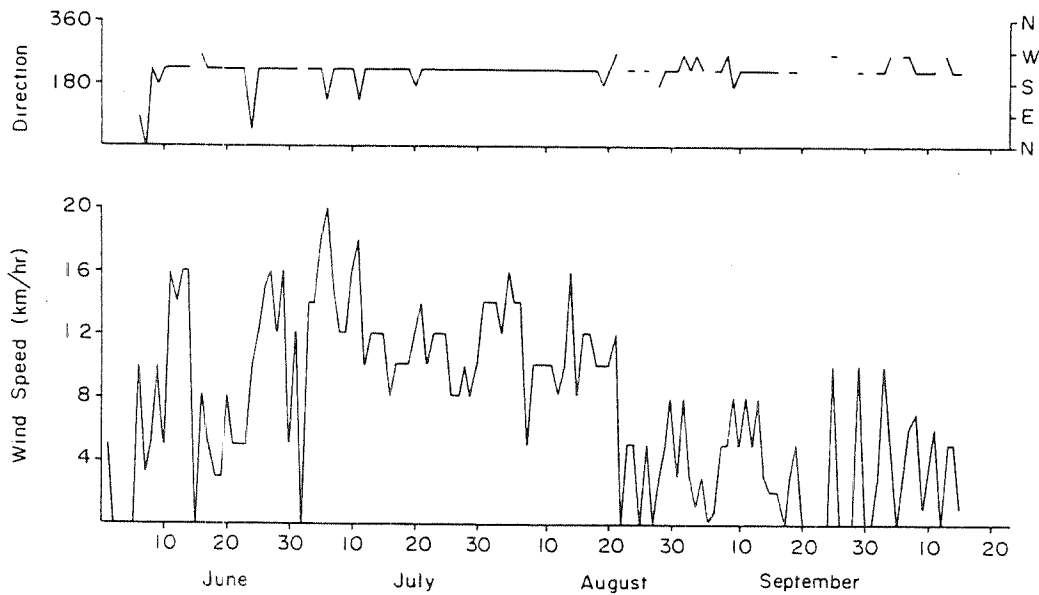
*1 To October 15 only

*2 Ambient air temp recorded at 1300 hrs.

Figure 3.1-1 Air temperature and precipitation recorded at Knight Inlet. Forest Fire Weather Station, 1981



Wind direction and speed, Knight Inlet June-October 1981



Like other areas on the coast, May and June of 1981 in Knight Inlet were wetter and slightly cooler than normal. In 1981 the July and August rainfalls were well below normal (14.4 and 53.5mm) and the temperatures were slightly above normal (20.9 and 21.3°C). In September there was 181.3 mm of rain and the mean temperature was 16.0°C, much closer to the seasonal normals. The fire weather station has not previously operated in October and comparisons were thus not feasible.

The wind direction and speed shown in Figure 3.1-1 reflect the strong, thermally induced southerly wind which blows up the inlet almost every day from June to August. The inlet was calm most mornings until the wind began to blow at about 1000 h. The breeze built to a peak about 1700 h which appeared to be about 30% stronger than the 1300 h readings shown. By sunset the inlet was usually calm again. The long fetch up the inlet permits a 1-1.5 m chop to build which does not affect larger vessels, but which must be taken into consideration if small boats are used for transportation.

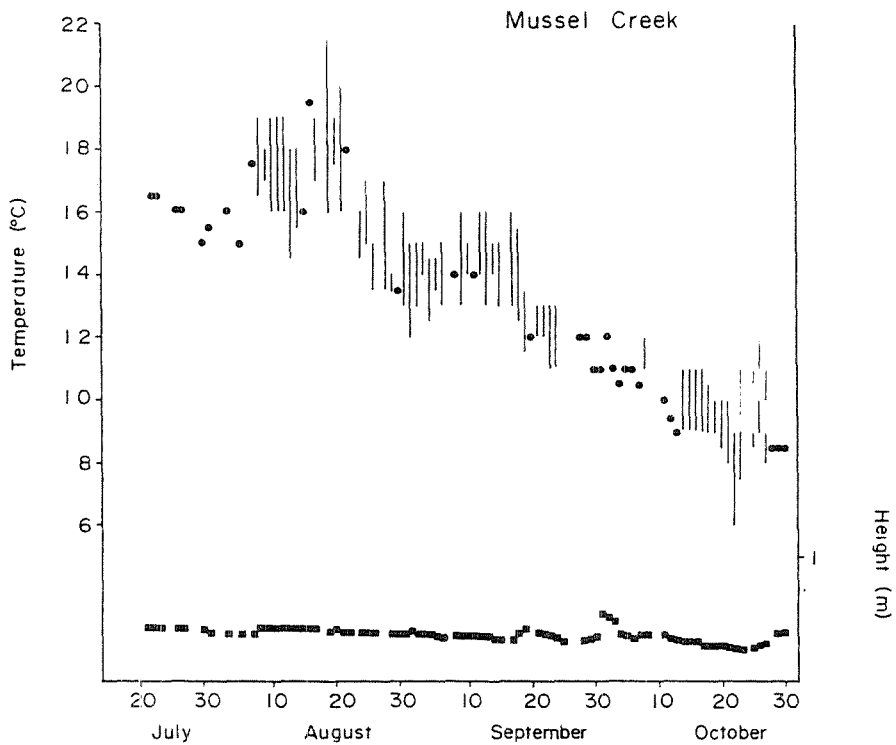
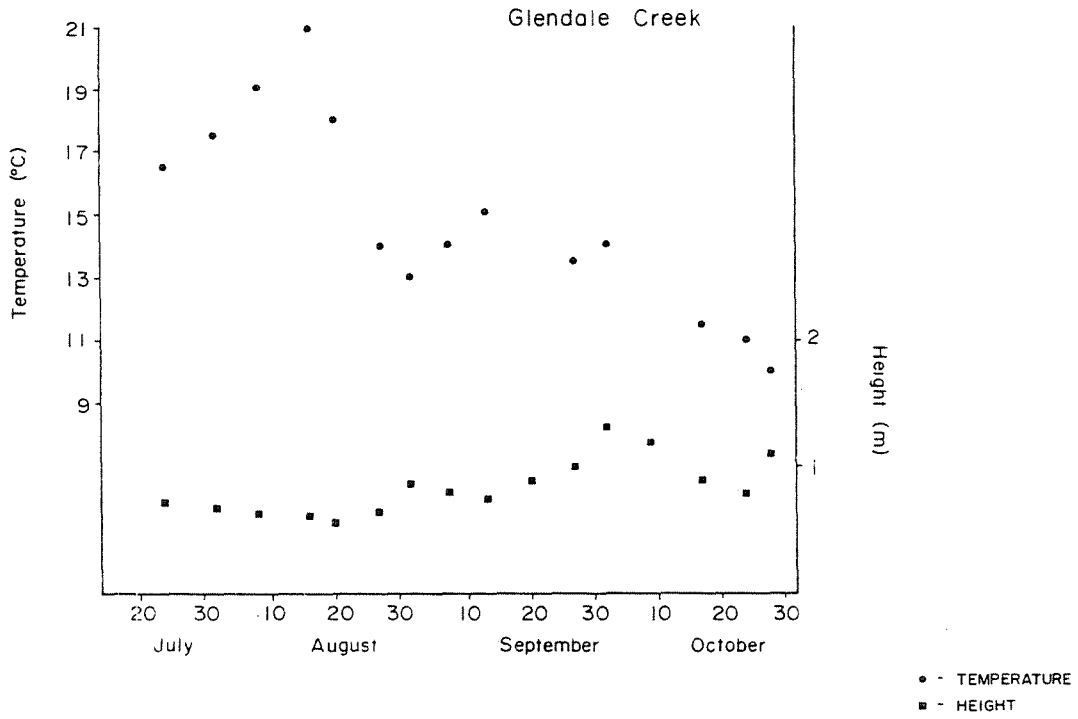
The thermal wind pattern begins to break down in late August and there were numerous calm days in September and October 1981. Under these conditions, the inlet was often covered by fog which slowed boat transport and curtailed float plane operations. In October there were periods of up to four days when planes could not get into Knight Inlet.

3.1.2 Water Levels and Temperatures

Glendale Creek

Water temperatures shown in Figure 3.2-2 and Table 3.1-3 ranged from 21.0°C on August 10 to 10.0°C on October 28. Mean monthly temperatures declined during the study from 17.9°C in August to 11.6°C in October. Water levels ranged

Figure 3.1-2 Water Temperatures and Height of Glendale and Mussel Creeks, 1981



from a low of .56 m on August 20 to a high of 2.0m on October 1 after a 58 mm rainfall. Changes in water levels were much less dramatic than on other systems in the area because of the two lakes on the system, the valleys are not steep and although the area around Tom Browne Lake is logged, the Glendale valley is well forested. The average monthly levels were: August, 0.62 m; September 0.85 m; and October, 1.21 m.

TABLE 3.1-3

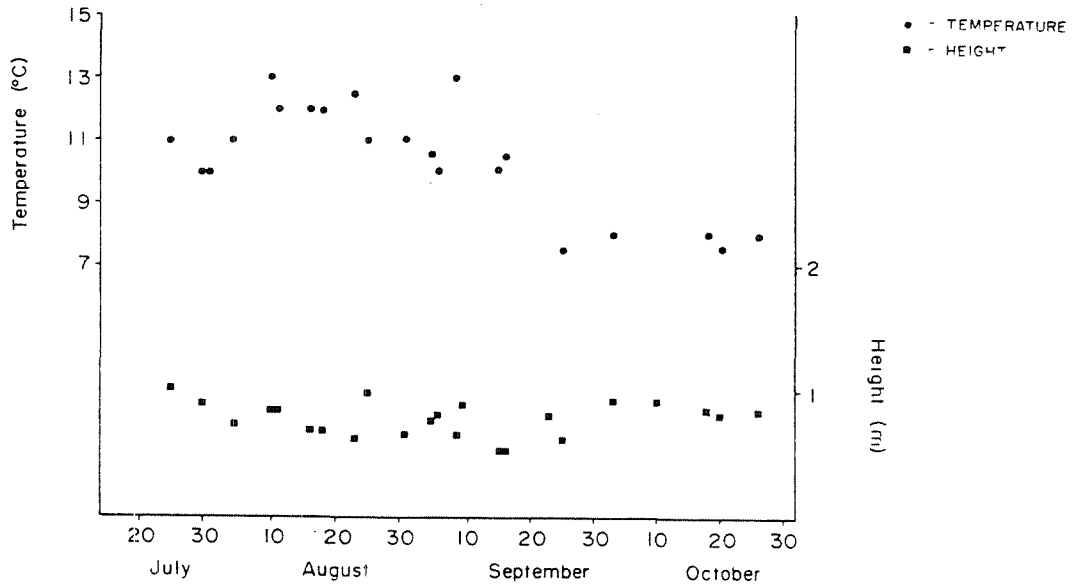
Mean Water Levels and Temperatures, 1981

	July*	August	September	October
Temperature (°C)				
Glendale Ck		17.9	13.9	11.6
Mussel Ck	15.9	17.1	14.0	9.1
Ahnuhati R		10.6	10.3	7.9
Franklin R		2.6	2.7	4.3
Level (m)				
Glendale Ck		0.62	0.85	1.21
Mussel Ck	0.41	0.40	0.36	0.39
Ahnuhati R		0.76	0.70	0.98
Franklin R		1.05	0.52	0.00

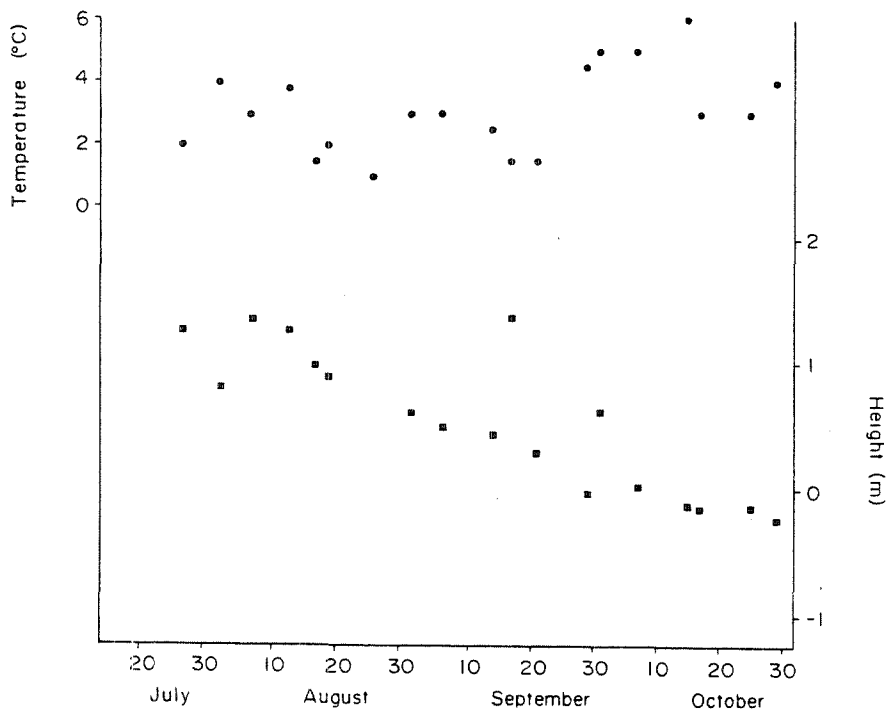
* incomplete

Figure 3.1-3 Water Temperatures and Height of the Ahnuhati and Franklin Rivers, 1981

Ahnuhati River



Franklin River



Mussel Creek

Between July 20 and October 30 water temperatures in Mussel Creek (Figure 3.1-2) ranged from a maximum of 21.5°C on August 19 to a minimum of 7.5°C on October 23. The greatest daily range was 4.5°C on August 19.

Water levels in Mussel Creek were recorded from July 20 to October 30 and ranged from a low of 0.31m recorded on October 23-26, to a high of 0.58 m recorded on October 1 after a heavy rain. Changes in water levels associated with heavy rainfall, as occurred on September 30 and October 1 were moderate, although it has been heavily logged. This is probably due to the three lakes on the system and because the valley floor is not very steep.

Levels rose during hot weather in the summer due to melting snow and ice on the Jubilee Range. As air temperatures cooled in September and October water levels generally became lower except for periods associated with heavy rainfall in the watershed.

Ahnuhati River

In the Ahnuhati River water temperatures ranged from 7.5°C on October 20 to 13.0°C on August 10. Mean monthly temperatures were: August, 10.6°C; September 10.3°C; and October, 7.9°C. Water levels ranged from a low of 0.52 m on September 15 and 16 to a high of about 3.0 m on October 1 when 87.7 mm of rain fell over a period of 2 days. The latter height being an estimate as the River overflowed its banks and submerged the gauge. The levels fell back to 0.91 m after another 2 days. The watershed of this river is very steep and the stream is subject to extremely rapid changes in water levels after rainfall. The mean monthly levels were August, 0.76 m;

September, 0.70 m; October 0.98 m. Melt water helped to keep flows up during the summer and the water became quite turbid at times. The lowest levels were encountered in September during cooler weather when little rain fell.

Franklin River

Temperatures in the Franklin River ranged from a high of 6°C on October 15 to a low of 1°C on August 26 (Figure 3.1-3). The mean monthly temperatures were: August, 2.6°C; September, 2.7°C; and October, 4.3°C. Water temperatures increased as the weather got colder and the glaciers melted at a slower rate. The effects of meltwater were also reflected in the water levels which declined through September and October.

The three major tributaries to the Franklin River are Fissure, Crevice and Stanton Creeks. All of these are glacially fed and have hydrologic regimes similar to the mainstem. There are three additional streams which are ground water fed and drain into the west side of the river (Figure 3.1-7). These appear to be somewhat warmer however, no measurements were taken.

3.1.3 Water Quality

The results of water quality sampling are presented in Table 3.1-5. The parameters were examined in relation to water quality criteria for salmon culture recommended by Sigma Resource Consultants (1979) and Shepherd (1982).

The pH, measured in the laboratory, of the two Mussel Creek samples were at optimum levels while the rest of the systems sampled had lower pH, but were within the recommended values for salmon. Hardness in all the samples except Mussel Creek was below the recommended values. Low levels of hardness (<20 mg/l CaCO₃) can result in an increase in the incidence and

TABLE 3.1-5
SUMMARY OF WATER QUALITY ANALYSIS

Stream:	Recommended	Glendale Creek		Tom Browne Ck	Mussel Creek		Ahnuhati R	Kwalate Ck
Date: 1981	Levels	Jan 19	Sept 08	Jan 19	Sept 08	Oct 20	Sept 08	Sept 08
Temperature		8.0	14.0		18.0	9.0	13.0	8.0
pH-Field	6.5-8.5		5.8		05.8	05.6	7.0	5.0
pH-lab		6.4	6.7	6.4	7.4	7.5	6.5	06.6
Total Alk (CaCO ₃)		3.98	7.24	4.20	16.9	19.3	2.9	4.34
Sulfate (SO ₄)	<90	1.5	2.3	1.8	13.6	15.6	1.0	02.30
Chloride	<17	<.50	0.67	0.69	<0.5	0.58	<0.50	00.57
Total PO ₄	<0.050	0.0056	0.0066	0.0057	0.0075	0.0065	0.0067	<0.005
Nitrite	<0.012	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Nitrate	<0.12	<0.063	0.11	<0.089	0.034	0.070	0.04	0.126
Ammonia (total)	<0.002	0.0050	0.0597	0.0050	0.012	0.015	0.0092	0.0063
Silica (SI)	<10-60	1.50	2.21	1.97	1.94	2.33	0.83	01.71
Turbidity (FTU)	1-60	1.3	<1.0	2.5	1.2	<1.0	<1.0	<1.0
Conductivity (mhos/cm)	150-2000	12.1	20.7	15.5	67.0	76.5	6.5	14.4
Hardness (CaCO ₃)	20-400	5.45	6.42	5.66	26.5	30	1.3	4.22
Arsenic	<0.05	0.15	<0.075	<0.15	<0.075	<0.075	<0.075	<0.075
Barium	<1.000	0.0035	0.0041	<0.0046	0.0233	0.0178	0.0032	0.0038
Cadmium	<0.0004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	<0.010	<0.015	<0.0075	<0.015	<0.0075	<0.0075	<0.0075	<0.0075
Chromium	<0.010	<0.015	<0.0075	<0.015	<0.0075	0.162	<0.0075	<0.0075
Copper	<0.006	<0.001	<0.001	<0.001	<0.001	<0.001	0.0019	<0.001
Mercury	<0.00005	0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Manganese	<0.05	0.0004	0.0075	0.0092	0.0056	<0.001	0.002	<0.003
Molybdenum		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Nickel	<0.01	<0.04	<0.04	<0.08	0.04	<0.04	<0.05	<0.04
Phosphorus	<0.0001	<0.30	<0.15	<0.30	0.15	<0.15	<0.15	<0.15
Lead		<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony		<0.08	<0.04	<0.08	0.04	<0.04	<0.04	<0.04
Selenium	<0.001	<0.015	<0.075	<0.015	0.75	<0.075	<0.075	<0.075
Tin		<0.2	<0.1	<0.2	<0.1	<0.1	<0.1	<0.10
Strontium		<0.0077	0.0108	0.0085	0.0052	<0.0443	0.003	0.055
Titanium		<0.0085	0.0098	0.0085	0.019	<0.004	0.0115	0.0087
Vanadium		<0.05	<0.02	<0.05	0.02	<0.02	<0.02	<0.02
Zinc	0.005	0.008	<0.0012	<0.001	<0.003	<0.0046	0.0016	<0.001
Aluminum	<0.010	<0.192	0.12	0.236	0.099	<0.05	0.061	<0.05
Iron	<1.00	0.102	0.154	0.234	0.166	0.0543	0.157	0.0199
Silicon	<10-60	1.21	2.07	1.6	2.01	1.93	0.76	1.6
Calcium	4-150	1.83	2.11	1.76	9.46	11.0	0.537	1.51
Magnesium	<10.0	0.213	0.28	0.307	0.7	0.62	0.1	0.54
Sodium		0.668	1.1	0.98	0.88	0.91	0.5	0.54
Potassium		0.163	0.293	0.279	0.87	0.998	0.215	0.305
Filterable Residues	<2,000	22	25	25	46	53	16	14
Non-filterable Residues	<3.0	<5	<5	<5	<5	<5	<5	<5

Values exceeding recommended levels for salmon culture (Shepherd 1982; Sigma, 1979) are circled
Values are mg/l unless stated.

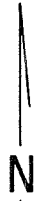
Figure 3.2-1
GLENDALE CREEK

prepared for
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Project VS 941 Scale 1:57,000

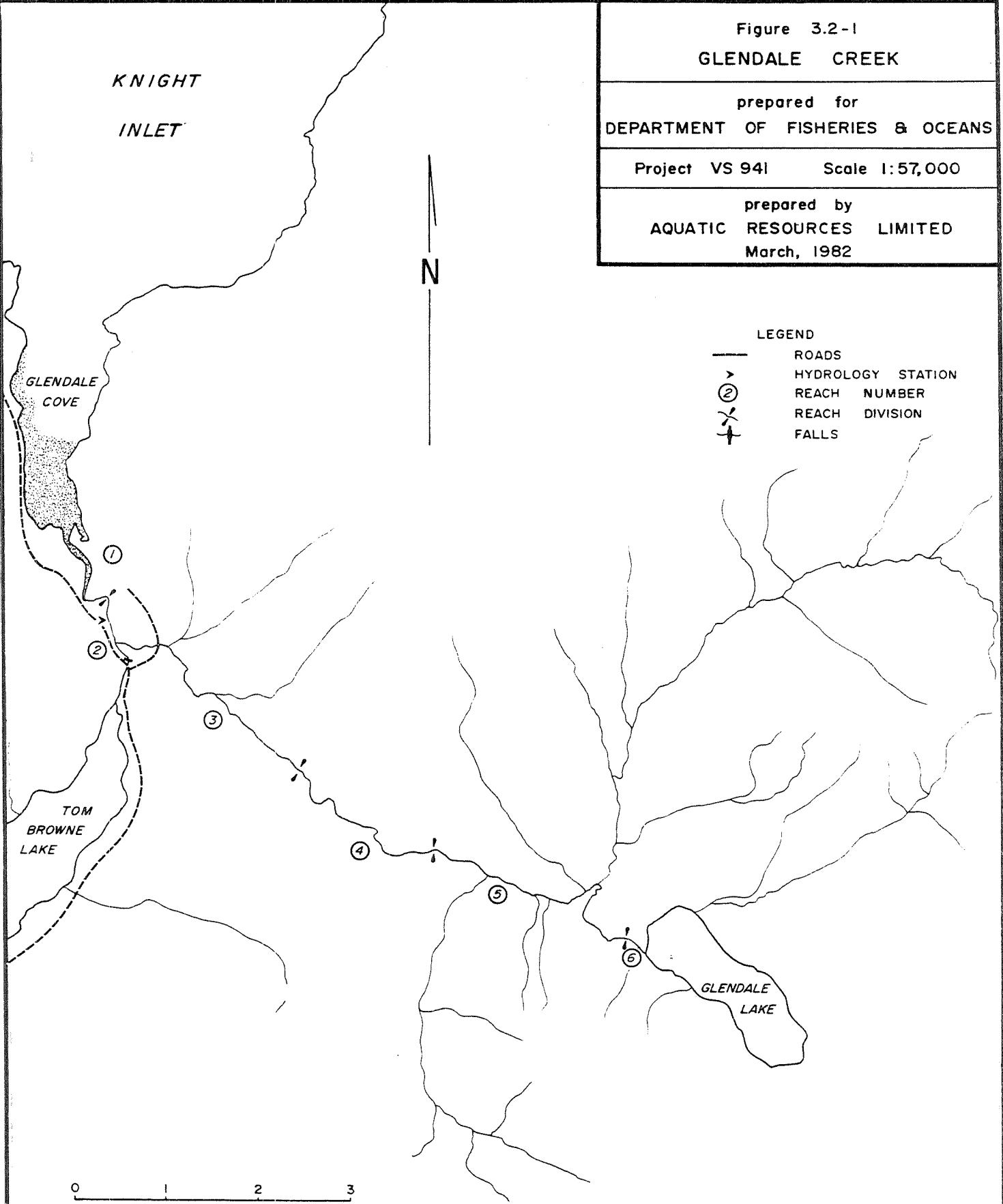
prepared by
AQUATIC RESOURCES LIMITED
March, 1982

KNIGHT
INLET



LEGEND

- ROADS
- > HYDROLOGY STATION
- ② REACH NUMBER
- X REACH DIVISION
- + FALLS



0 1 2 3
KILOMETERS

severity of kidney disease (Wedemyer et al., 1976). Low alkalinity (<20 mg/l CaCO₃) also reduces the buffering capacity of water and may adversely affect normal fish growth and development. Conductivity was low in all of the systems however, all other parameters monitored fell within acceptable limits.

3.2 SPAWNING AREA DESCRIPTIONS

3.2.1 Tom Browne and Glendale Creeks (Photos and Notes taken August 15, 1981)

Reach 1

Reach 1 contains the first 2 km of Tom Browne Creek which are under tidal influence (Figure 3.2-1). The channel is irregular and braided in several areas, particularly at the mouth. The flow is placid over a 0.2-6 cm gravel bottom. At the mouth there are extensive tidal flats of fine 0.2-2.0 cm gravel which extend for over a kilometer at low tide. The flat banks of the creek are composed of sand and gravel in this area. For approximately a kilometer upstream of the tidal flats the creek flows through a saltwater marsh (Photo 1). The banks in this section are generally flat or slumping gravel, however, some sections have steep banks of fine consolidated sand and gravel on which the marsh is growing. In one spot the creek is undercutting the bank and causing large blocks of the bank to fall into the stream channel. The channel is about 60 m wide in this area and averages 0.25 m deep with some pools up to 1.5 m deep.



Photo 1. Saltwater marsh in lower portion of Reach 1
Tom Browne Creek



Photo 2. Upper portion of Reach 1, Tom Browne Creek. Most of the pink salmon held in these pools during August and September.

In the upper portion of the reach, alders and salmonberries predominate on reposed gravel banks which are approximately 30 m apart (photo 2). The vegetation shades 30% of the channel. In this section there are some logs and roots in the channel as well as large (<60 cm) boulders of colluvial origin, although the channel bottom is primarily 1-6 cm gravel. In this area the stream is 0.5 m deep with several large pools to 1.5 m. A large number of pinks held in these pools during August and September. The water in this reach and throughout the rest of the system is clear with a brown stain and usually permitted 2 m visibility during the spawning season.

Reach 2

This reach is approximately 1 km long, 40 m wide, 0.2 to 0.5 m deep and extends to Tom Browne Falls just below Tom Brown Lake (Photo 3). The channel is straight and confined by the valley wall on the right bank. There are few bars or pools.

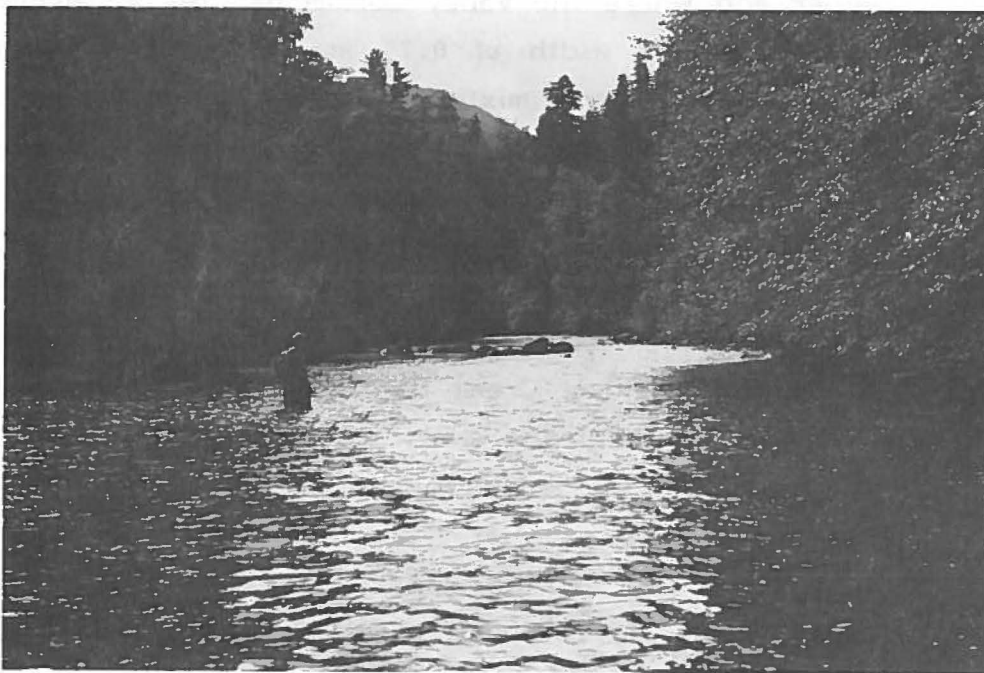


Photo 3. Reach 2 of Tom Browne Creek looking upstream from the F.R.B. weir.

On the left bank in the lower reach, the hatchery site was cleared of first growth timber (except a 10 m green strip) during the study. The riparian vegetation is primarily alder and salmonberry which provide cover for 30% of the channel. Tom Browne Falls is a series of steps in bedrock which rise 7 m over a distance of 10-15m. Sea-run cutthroat were seen scaling the falls by jumping from one step to the next during low water at the beginning of September. The majority of chums and a large proportion of the pinks spawned in Reach 2.

Reach 3

Reach 3 includes the lower 3 km of Glendale Creek which is a tributary to Tom Browne and flows into Tom Browne Creek just above the hatchery site on the east bank. The reposed banks of 4-25 cm gravel and cobble are fairly stable, however, some areas have eroded causing a few small log jams and some channel debris (Photo 4). The channel, 25 m wide and 0.3 m deep is irregular and occasionally confined, particularly in the upper end where the valley bottom narrows to several hundred meters from a width of 0.75 km in the lower reach. The channel bottom is a mixture of gravel (0.2-6 cm) and cobbles (6-25 cm) with scattered (<25 cm) boulders interspersed in some areas. There are numerous small pools of up to 1.5 m depth. Alders and a few conifers shade about 30% of the channel. Salmonberry and devil's club are the main species of undergrowth. About 1 km from the confluence of Tom Browne Creek and Glendale Creek there is a new bridge over Glendale Creek to the hatchery site. In the upper end the north-east side was being logged by R & N Logging during the study. A 30 m greenstrip was left along the creek in this reach. The south-west side of the upper reach was logged 25-30 years ago. About 11,000 pinks or 55% of the Glendale Creek escapement spawned in Reach 3.



Photo 4. Reach 3 of Glendale Creek. Most of the pink salmon spawned in this area.

Reach 4

Reach 4 is 2 km long and extends to R & N Logging's first bridge across Glendale Creek. The gradient is steeper and as a consequence the flow is rolling and at times tumbling over a bottom that is mainly boulder (>25 cm) with a few areas of gravel and cobble (Photo 5). The channel is still irregular but more confined in a narrower valley. The banks are mainly boulder and reposed but some areas are steep where the creek has cut through fine gravel matrices. There is some channel debris, however, not as much as in Reach 3 because of the reduced bank erosion taking place. Throughout reach 4 and up to Glendale Lake the valley bottom was logged 30-35 years ago. The riparian vegetation is mainly alder providing 30-40% channel cover. Approximately 10% of the pinks spawned in this reach.

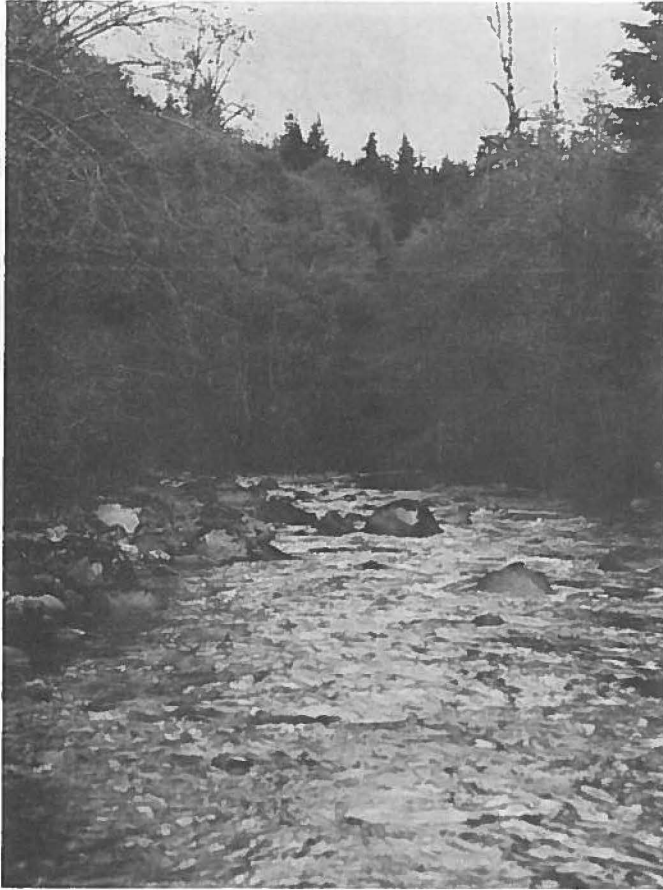


Photo 5.
In Reach 4,
Glendale Creek
becomes steeper
and flows quickly
over a boulder
substrate.

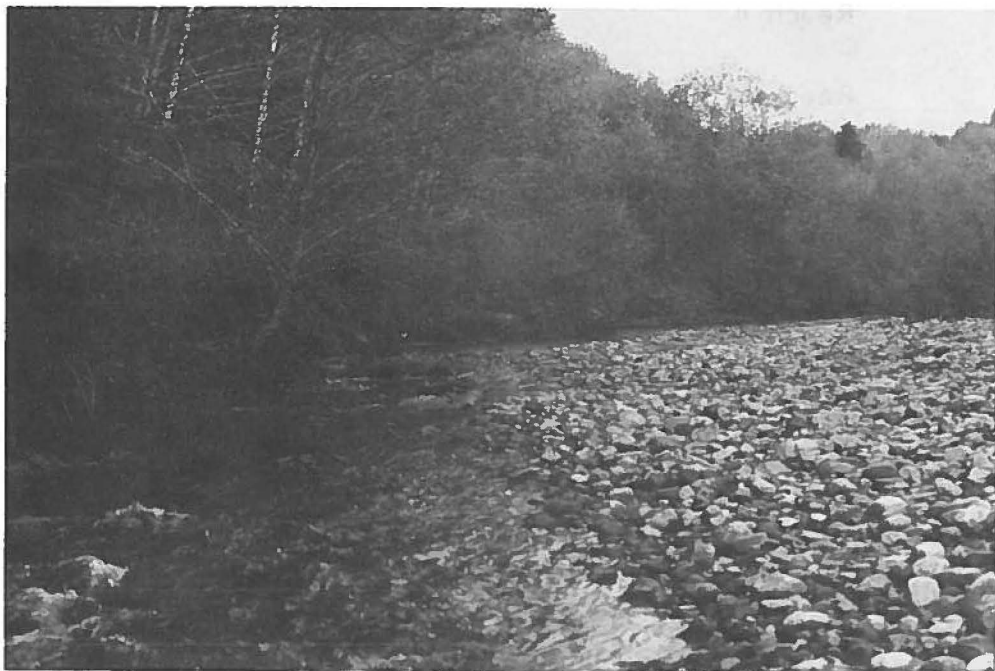


Photo 6. Glendale Creek reach 5 has an irregular channel and widely varied substrate.

Reach 5

The gradient in Reach 5 is not as steep as reach 4 but steeper than Reach 3 (photo 6). This section is 2 km long, 15-20 m wide, 0.25 m deep and contains a few small pools. The valley is broad and the irregular channel is less confined. The stream bed is mainly 6-25 cm cobble with a mixture of some gravel and the occasional boulder. The resposed banks are composed of the same materials and are being eroded in a few areas, causing some channel debris composed of logs and roots. The vegetation shades 40-50% of the channel. A second R & N Logging Bridge crosses the creek in the middle of the reach. About 20% of the pinks spawned in this area.

Reach 6

Reach 6 is 0.5 km long and extends to Glendale Lake. The creek flows placidly down an irregular meandering channel 20-30 m wide and about 0.5 m deep. the bottom is of fine 0.2 cm material as are the steep consolidated banks. There is a considerable amount of channel debris, particularly near the lake where numerous logs crisscross the channel. Few adults were noticed in this reach.

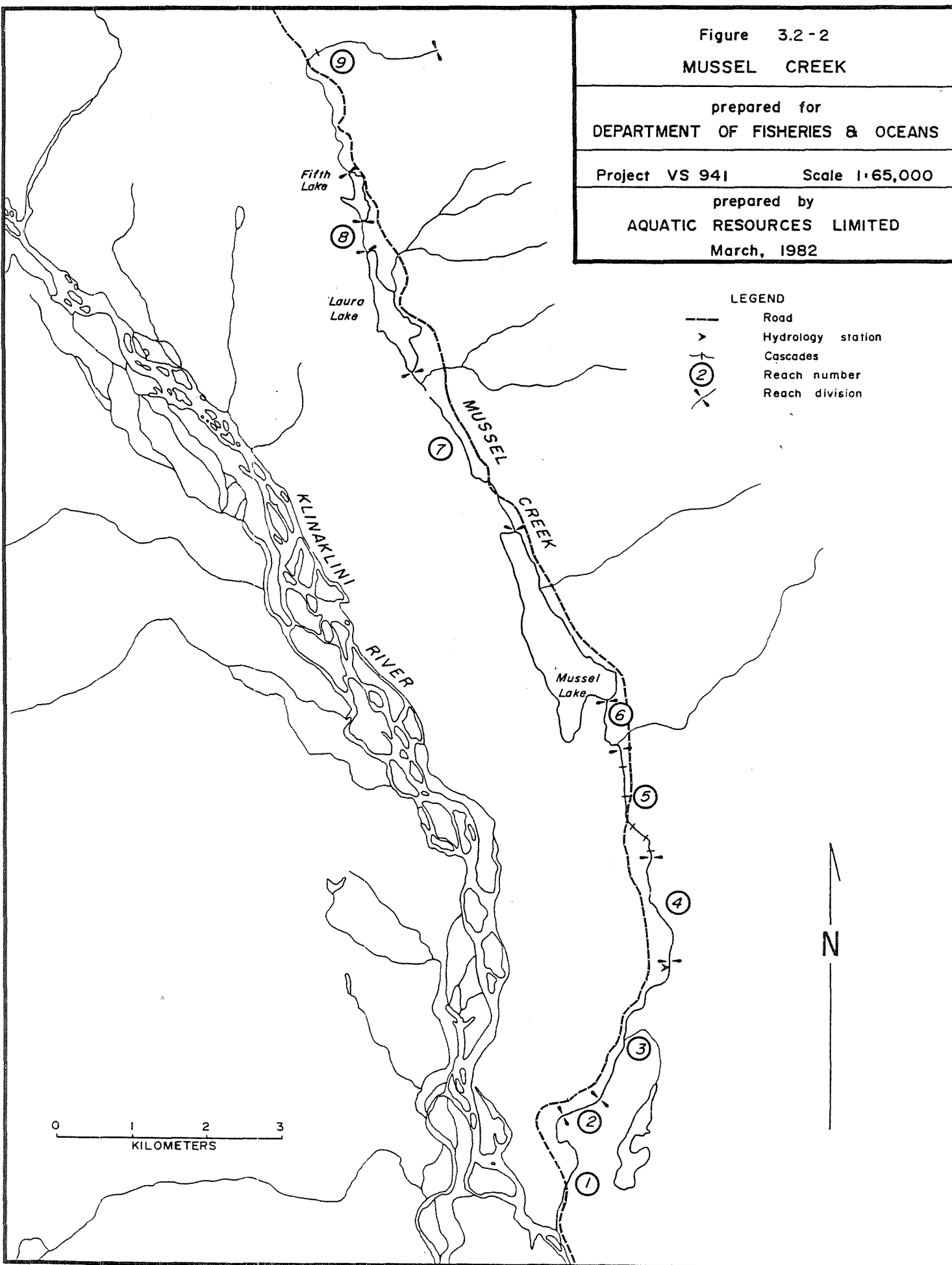
Glendale Creek terminates at Glendale Lake (Figure 3.1-5). The lake is 74 m above sea level, 2.2 km long and covers an area of 124 ha. One small creek drains into the south-west side of the lake however the major flow comes from a stream which enters at the north end. No fish wre observed in this creek during the study until October 24 when 100-200 ripe coho were observed holding in the lake by the creek mouth.

Figure 3.2-2
MUSSEL CREEK

prepared for
DEPARTMENT OF FISHERIES & OCEANS

Project VS 941 Scale 1:65,000

prepared by
AQUATIC RESOURCES LIMITED
March, 1982



LEGEND

- Road
- v Hydrology station
- ┆ Cascades
- ② Reach number
- X Reach division



0 1 2 3
KILOMETERS

3.2.2 Mussel Creek (Photos and Notes taken August 1981)

Mussel Creek flows down a shallow valley which lies between the Waddington Range and the Klinaklini River before entering the Klinaklini River about 8 km from Knight Inlet (Fig 3.1-6) and well above the limit of tidal influence.

Reach 1

Reach 1 of Mussel Creek extends from the confluence of Mussel Creek and the Klinaklini River to a point 1 km upstream (Photos 7 and 8). The creek, varying in depth from 0.3 to 1 m with 6 pools up to 4 m, meanders slowly through this area. The bottom is mainly of fine sand and silt with some gravel in the faster areas. In the shallower, slower moving areas the bottom is covered with Potamogetan sp. The banks, 25 to 30 m apart, are covered with sedges, grasses, and

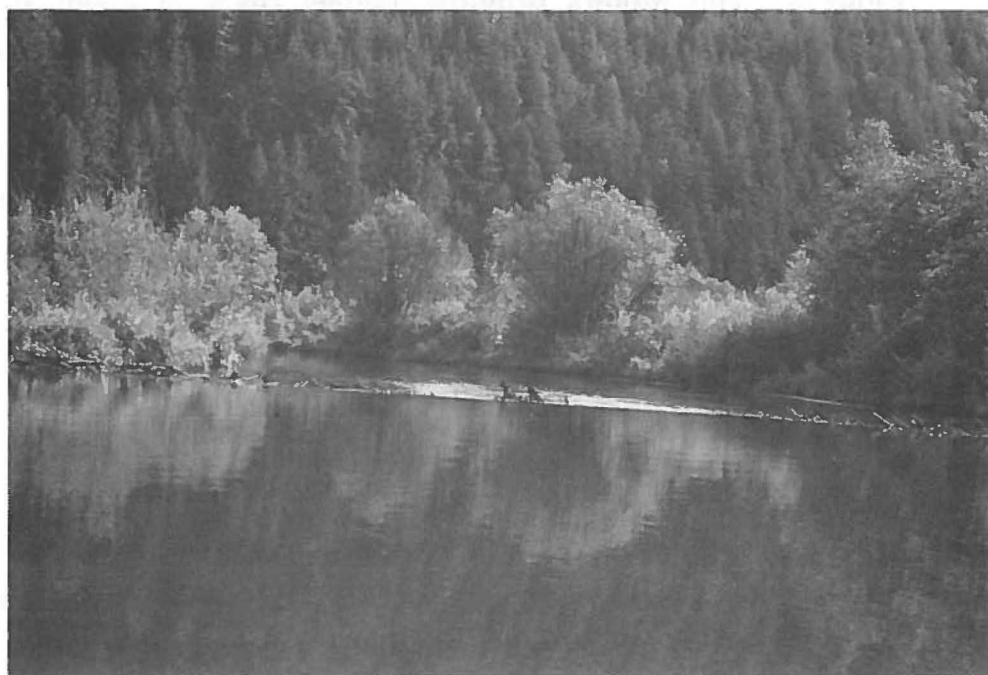


Photo 7. Mussel Creek is shallow and slow in reach 1 and is crossed in several places by beaver dams and debris.



Photo 8. A few of the cut banks in Reach 1 of Mussel Creek cover deep holes where most species held before moving onto the spawning grounds.

willows. The willows provide channel cover of about 10% of the water surface and several marshes are connected to the creek on either side. The banks are steep, but low and are of sand and silt. In the lower part of the reach the channel is confined by the valley wall on the right bank whereas the upper portions of the reach are unconfined. Few salmon spawned in this reach, but chinook and to a lesser extent the other species held here before moving upstream. Large numbers of juvenile coho and cutthroat were also observed.

Reach 2

Reach 2 extends 0.5 km past section 1 and is faster moving with a mean slope of approximately 2%. The channel averages about 15 m in width with a gravel bottom about 0.5 m deep, and includes a few pools which drop to 1 m deep. Alder and elderberry bushes are the dominant vegetation in the lower end with conifers becoming more prevalent upstream. The vegetation provides cover for 50-60% of the channel. The

banks are eroding in several areas adding channel debris, and causing some small log jams to form as well as a few branches in the channel. Towards the top of the reach, the irregular channel becomes confined by the valley walls. All of the chum and pinks as well as 10% of the chinooks spawned in this reach.

Reach 3

This section is 2 km long, about 10 m wide, 0.5 m deep and reaches the second bridge that crosses Mussel Creek. The gradient throughout this reach is steeper (averaging 3%) and the stream flows faster, has fewer pools and the bottom is primarily a cobble and boulder (10-100 cm) composition. (Photos 9 and 10). Throughout the reach there are gravel bars that occur in the lee of the debris, particularly close to the banks. A mixture of conifers, alder and salmonberry grow along the banks, providing 40 to 50% channel cover. The

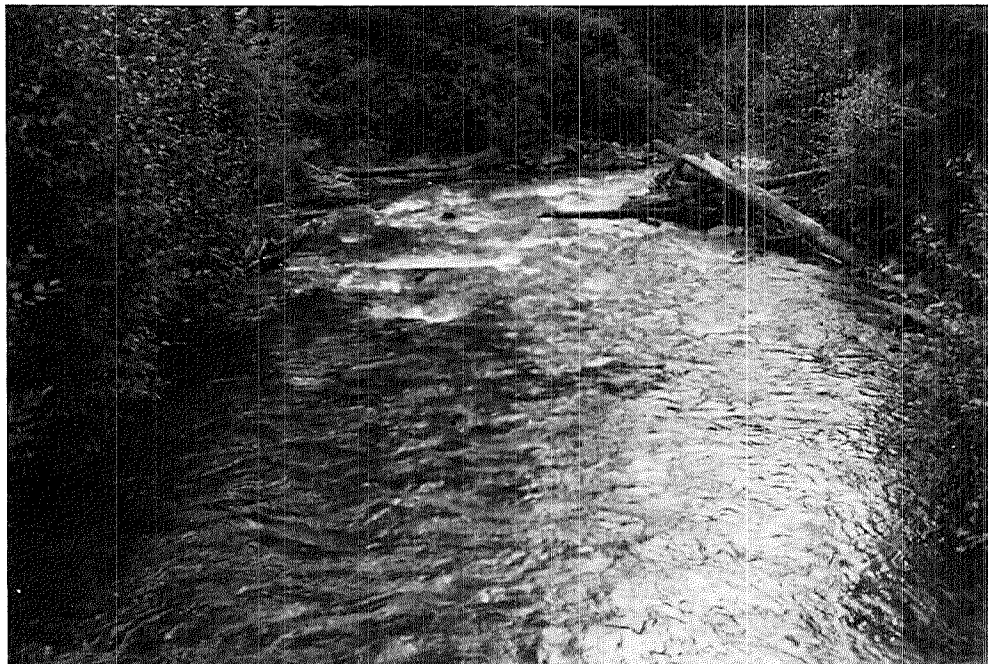


Photo 9. Mussel Creek Reach 3. Chinook spawned in riffle areas throughout this reach.

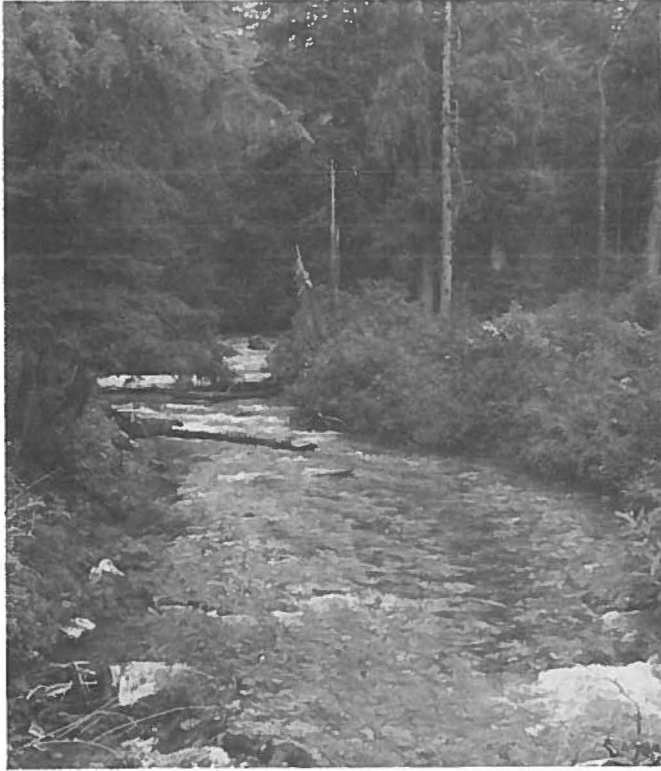


Photo 10.
Mussel Creek
Reach 3 is for the
most part quite
straight with a
cobble/ boulder
substrate.

channel is mainly straight and confined by the valley walls. There is some channel debris but the reposed boulder banks are fairly stable, so there is not as much as in Reach 2. About 20% of the chinook spawned in the small gravel riffles throughout this reach.

Reach 4

Past the second bridge, the creek becomes slower with an average gradient of approximately 2%. The stream is braided in several spots and has numerous pools which are up to 1.5 m deep (Photos 11 and 12). The bottom of this 1.5 km section is 10 to 15 m wide, averages 0.25 m deep and is composed of gravel and cobbles. Although the watershed has been logged, both banks retain a greenstrip composed of alders, conifers, salmonberry and elderberry, which provides cover for 40-50% of the stream surface. The channel, occasionally confined by the



Photo 11. Mussel Creek becomes braided in Reach 4 and has numerous pools up to 1.5 m deep.

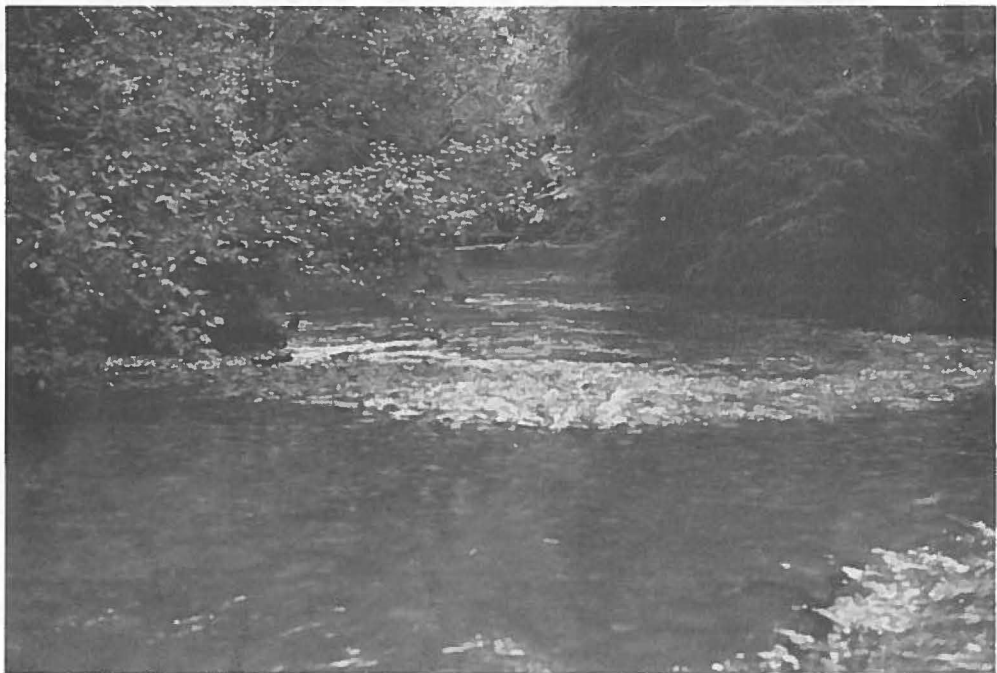


Photo 12. Typical chinook spawning area in gravel riffle above a pool in Reach 4 of Mussel Creek.

valley walls, has reposed banks of cobbles and boulders as well as some steep banks of organic material. There is a small amount of organic channel debris but generally the banks are stable. Approximately 70% of the chinook in Mussel Creek held in the pools throughout this reach in August and the first part of September, before spawning in the gravel above the pools.

Reach 5

In Reach 5, which extends to within 1 km of Mussel Lake, the creek drops 120 m over a length of 1.75 km and is narrow and fast with a boulder bottom. The creek flows in a broken and tumbling manner (Photo 13). Because the creek has been logged to the banks in this area, the vegetation is second growth and is primarily alder, salmonberry, elderberry and devil's club which shades about 50% of the channel. The channel is straight with boulder banks which are reposed and stable so there is little channel debris, and the stream is confined. No fish were observed in this reach.



Photo 13. Mussel Creek falls rapidly through Reach 5.



Photo 14. Although flows in Reach 5 of Mussel Creek are quite rapid, there are numerous small holding pools and velocity breaks behind boulders. There is little spawning gravel but coho and sockeye appeared to have no trouble ascending.

Reach 6

For almost 1 km below Mussel Lake the creek is 0.5 to 1 m deep, 15 m wide and flows slowly over a sand-gravel bottom that is covered with Potamogetan sp. close to the lake (Photo 15) and with a thick layer of mussels in the lower portion of the reach. The vegetation is similar to Reach 5 and provides 20-30% channel cover. There are 4 pools approximately 2 m deep that adult coho hold in during September. The silty meltwater from the ice fields in the Jubilee Range settles out in Mussel Lake so that Reach 6, is clear all year. Just below Reach 6, however, a small turbid feeder stream from an ice field above Mussel Lake reduces the visibility to 0.5 m in the rest of the Creek during warm weather. In Reach 6 the irregular channel is not as confined as reach 5 and the low

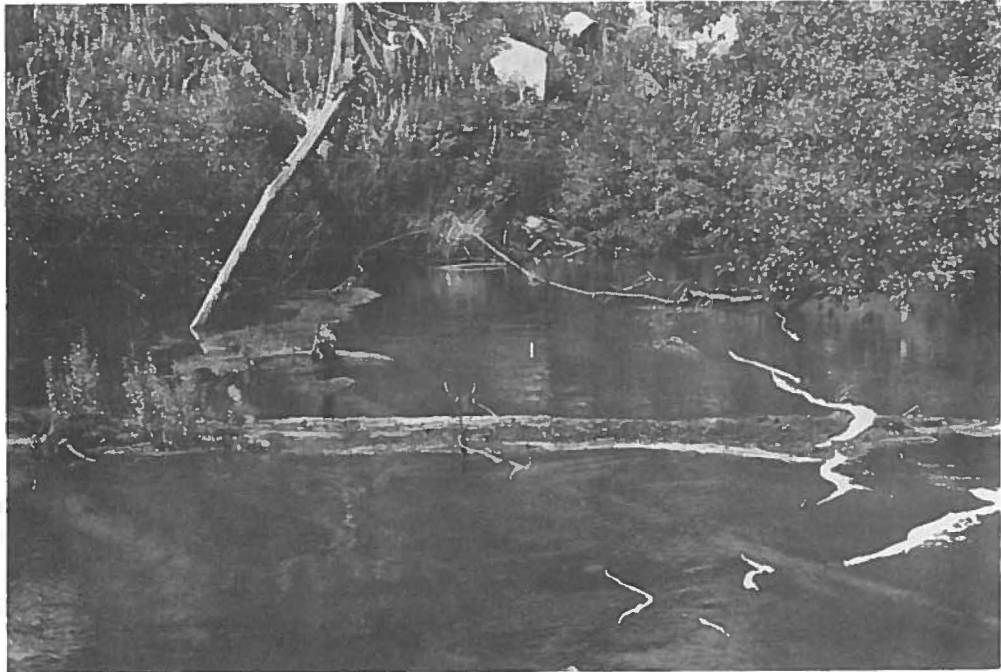


Photo 15. Reach 6 of Mussel Creek is quite slow and, near the lake, is covered by Potamogetan sp.

steep banks are composed of fine consolidated materials which are subject to erosion so there are numerous trees in the channel. About 25 coho used this reach for spawning and several hundred coho held in the four pools during September before moving upstream.

Mussel (Devereaux) Lake separates Reaches 6 and 7. The lake is at 220 m elevation and covers an area of 140 ha. Although there are flat areas at both ends, the east and west shores rise steeply and the lake appears quite deep. No soundings were taken. Kokanee and cutthroat were observed however no anadromous salmonids were seen in the lake.

Reach 7

Reach 7 is 3 km long and lies between Laura and Mussel Lakes. It varies between 0.5 and 1.5 m deep, and is 8 to 10 m wide. For the first 0.5 km below Laura Lake the creek flows fairly fast while closer to Mussel Lake the terrain becomes

flatter and more marshy so the creek flows placidly and has a fine sand and gravel bottom. In the upper reach the cobble, boulder banks are reposed while in the lower reach the banks are low, steep and of a fine consolidated material. The banks are eroding in some areas creating organic channel debris. The irregular channel is unconfined in the lower end and confined on the left bank upstream near Laura Lake. This section becomes very silty during warm weather, reducing visibility considerably. The majority of the holding coho and spawning kokanee were observed in Reach 7. Reaches 7 and 8 are separated by Laura Lake which is 1.7 km long and covers an area of 31 ha.

Reach 8

Reach 8 is the 0.5 km section which lies between Laura and Fifth Lakes. The creek, flowing through first growth timber, is 5 m wide, 0.5 m deep and has a thick growth of mussels on a gravel bottom. The west bank is confined by bedrock while the east side is fine consolidated material. There is considerable channel debris at the top of the reach caused by logs that have floated to the outlet of Fifth Lake. This section has good visibility all year round. A few kokanee were the only fish observed spawning in this reach. Reaches 8 and 9 are separated by Fifth Lake which is 0.6 km long and 8.3 ha in area.

Reach 9

The headwaters of Mussel Creek make up Reach 9 and originate mainly from groundwater and snowmelt in the Jubilee Range. Silt from melting icefields causes this reach to be quite turbid during warm weather. For the first kilometer above Fifth Lake the creek follows an irregular, braided and unconfined course through a marshy area. The banks are low and allow the area beside the creek to be inundated frequently. In the next kilometer the creek meanders through meadows in a channel 3-5 m wide and 0.2-0.8 m deep. In this area the banks are

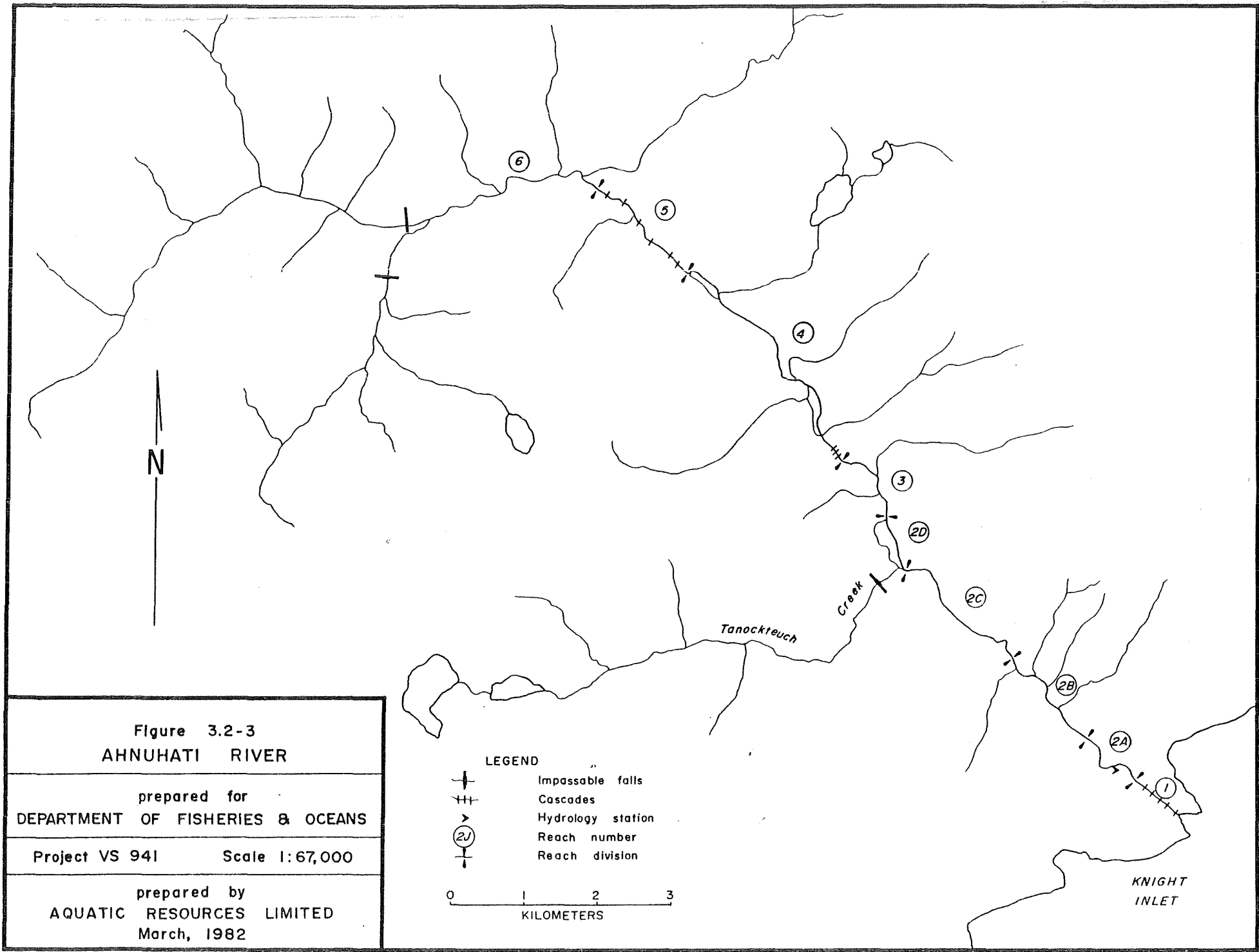







Figure 3.2-3
AHNUHATI RIVER

prepared for
DEPARTMENT OF FISHERIES & OCEANS

Project VS 941 Scale 1:67,000

prepared by
AQUATIC RESOURCES LIMITED
March, 1982

LEGEND

-  Impassable falls
-  Cascades
-  Hydrology station
-  Reach number
-  Reach division

0 1 2 3
KILOMETERS

although low and of fine consolidated materials. Above this area the gradient of the creek increases rapidly to 40% and is no longer passable to fish. No adult salmon were observed in this reach but coho fry were observed in the lower portions just above Fifth Lake.

3.2.3 Ahnuhati River (Photos and Notes Taken October 20, 1981)

The Ahnuhati River drains into Knight Inlet 27 km south of its head. The mouth of the river cuts through a rocky headland and there is little in the way of an estuary, as the bottom quickly drops off into the inlet preventing any emergent vegetation or saltwater marsh to develop (figure 3.2-3). Tidal influence extends into the river for a distance of about 100 meters. There are numerous small icefields in the upper areas of the watershed, and during warm weather the water becomes slightly murky due to rock flour.

Reach 1

For the first 0.7 km the river channel is straight, varying in width between 50 and 75 m and in depth between 1 and 1.5 m. The bottom texture at the mouth is bed rock for the first 200 m and thereafter boulders up to 2 m in diameter which cause a broken and tumbling water flow, particularly near the mouth where benches in the bedrock cause small cascades at low tide. The river discharges into a small, protected bay whose bottom drops off rapidly. All species were observed holding in the bay below the cascades at low tide. In the river, the banks, stable and steep, are part of the valley walls. A 10 m greenstrip was left for a distance of 4 km along the river, when the valley was logged in 1978-1979. The dominant vegetation in the greenstrip, as well as the rest of the unlogged valley along the river, is primarily alder and conifers with thick underbush of salmonberry, elderberry and devil's club. The vegetation shades about 10% of the channel. Few salmon spawned in this reach.

Reach 2

Reach 2 extends as a series of glides, pools and riffles for 7 kilometers and has an irregular channel which is approximately 75 m across and generally 1 m deep. Unlike Reach 1, it is not entrenched and is only occasionally confined by the valley walls which are 0.5 km apart in this area. The flat to reposed banks are composed mainly of fluvial materials which are, for the most part, stable but in some areas are failing and undergoing active erosion. In these areas there are logs and some organic debris in the channel, (Photo 16). Evidence of lateral channel movement is found in several areas where bars exhibit several vegetation sequences. Most of the channel bottom in this section is a mixture of gravel and cobbles. Sand and silt predominates in the deeper pools. In several sections, each no more than 100 m in length, there are large blocks of colluvial material in the channel. Reach 2 is where 90% of the pinks and 75% of the chum spawned and where chinook and coho held before moving upstream.

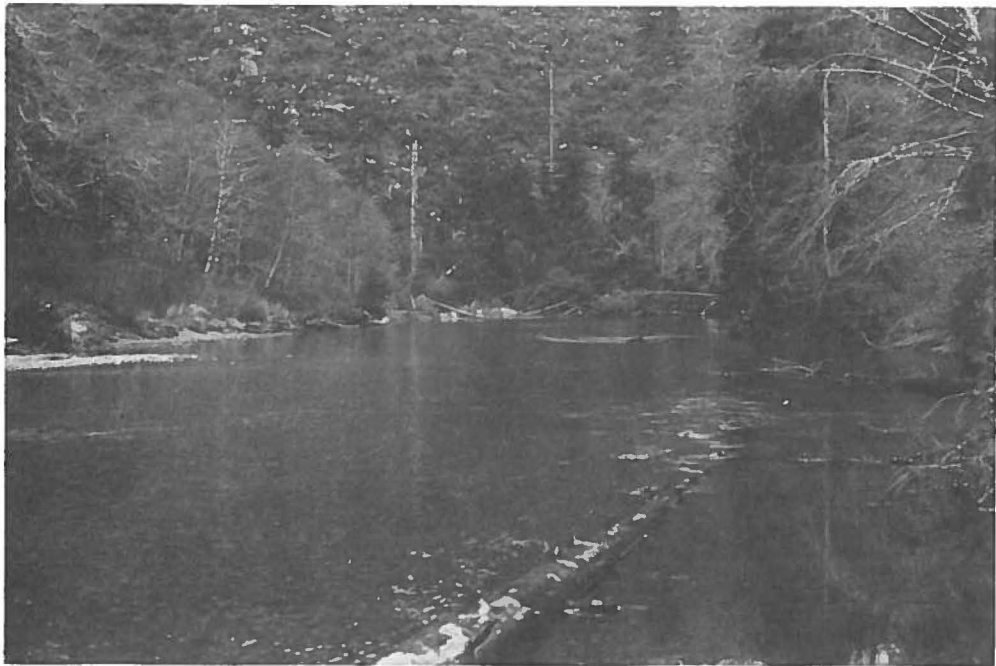


Photo 16. Most of the pink salmon spawning in the Ahnuhati utilized the long, shallow glides of reach 2.

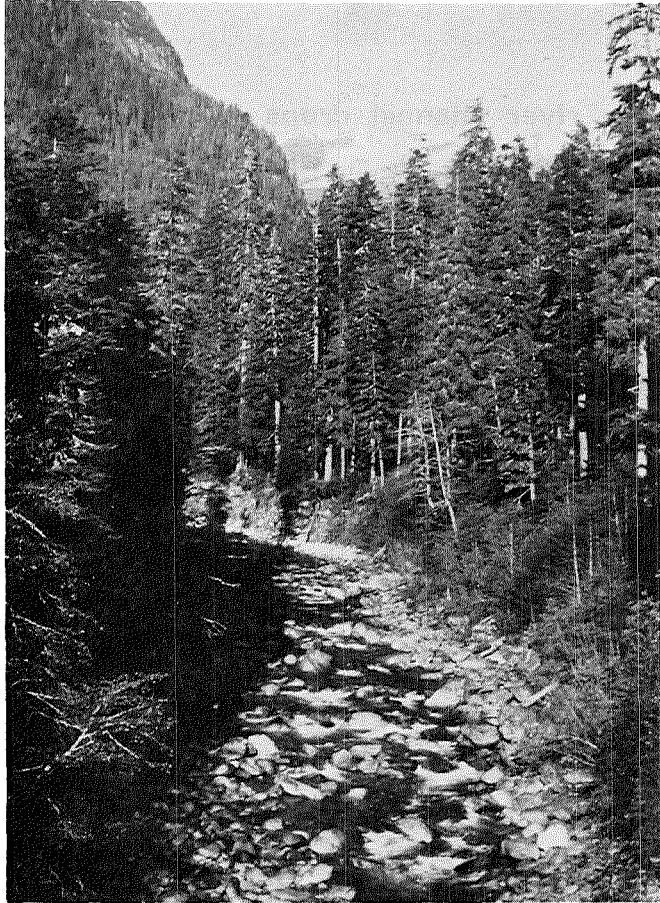


Photo 17.
There are few pools or spawning areas in Reach 3, however the cascades are easily passed by all species.

Reach 3

The river flows for 1 km down a steep 4% gradient in a broken and tumbling manner over a 0.5m-2 m boulder bottom. The banks in this area are of fluvial material and are eroding in some areas, however, there is little channel debris. There are few pools and little area for spawning or holding (photo 17).

Reach 4

The river in this 4 km reach is similar in character to Reach 2, although a little faster flowing, hence the substrate tends to be more cobble size and there are fewer pools. The chinooks all spawned in this reach as well as 2% of the pinks and 25% of the chum.

Reach 5

In this reach, the river channel drops 100 m over a distance of 1.5 km. The channel is 50 m wide and follows a straight course. It contains many large boulders up to 3 m in diameter which appear to be of colluvial origin. The flow is broken and tumbling, making this reach of little value to spawning or holding fish.

Reach 6

The last reach, before 2 m falls bar fish passage, is 3.4 km long approximately 15 m wide and 0.2-0.5 m deep. The gradient is slight and in several sections there are long glides with 0.2-10 cm gravel-cobble bottoms that appear to be ideal spawning areas. Pinks are reported to be pushed into this reach during years of large escapements (Joe Fielden, District Protection Officer; Pers. Comm.) The upper reach follows an irregular meandering course through an area where avalanches have cleared the larger vegetation, like conifers, from most of the banks. There are several avalanche tracks in the lower end where the river does not meander as much.

3.2.4 Franklin River (Photos and Notes Aug 30, 1981)

The Franklin River is 17.5 km long and extends from the toe of the Franklin Glacier to the head of Knight Inlet. In the first 13 km below the glacier the river is generally 50 to 100 m wide and flows very fast over a boulder bottom (Photo 18). In a few areas of this section the river sprawls out over large gravel flats up to 400 m wide (Photo 19). In the last 4.5 km before its mouth the river becomes braided and constantly changes course over gravel flats up to 500 m wide. In the summer, during high water, these flats are completely inundated. There are no pools or slow moving areas through the entire length of the river which has an average grade of 2%.



Photo 18. For the first 13 km below the glacier the Franklin River is 50 to 100 m wide and flows very quickly over a boulder substrate.

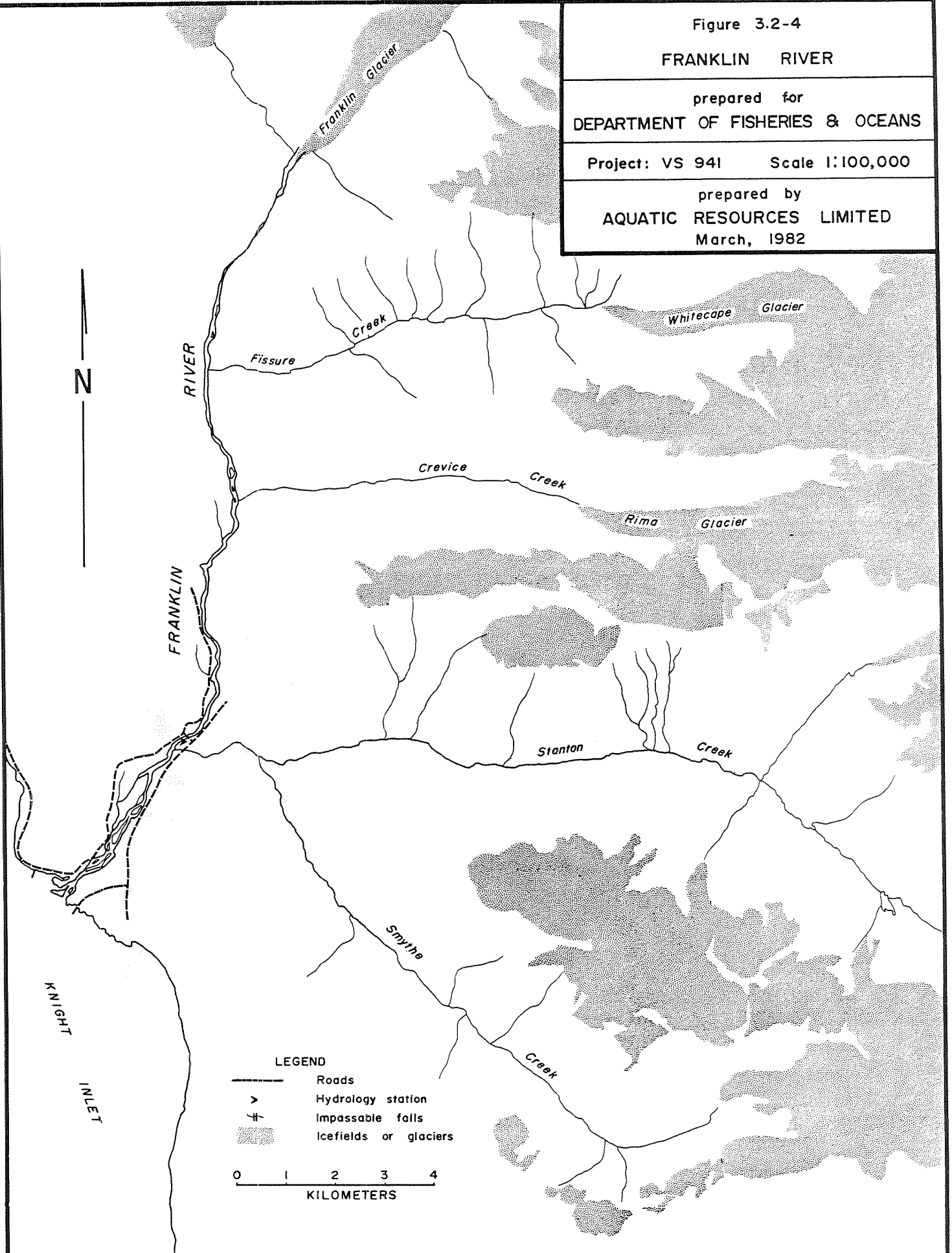
Figure 3.2-4

FRANKLIN RIVER

prepared for
DEPARTMENT OF FISHERIES & OCEANS

Project: VS 941 Scale 1:100,000

prepared by
AQUATIC RESOURCES LIMITED
March, 1982



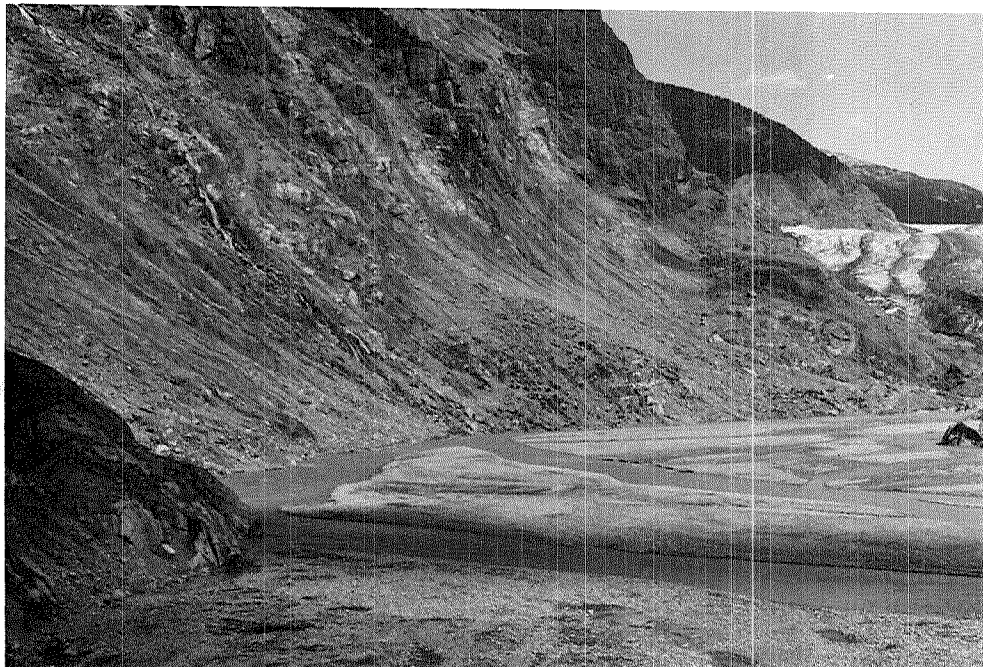


Photo 19. There is very little vegetation in the upper reaches of the Franklin Valley. In some areas the river becomes braided and flows over gravel flats up to 500 m wide.

The retreat of the glacier is very recent so that as distances increase above the valley floor and downstream from the glacier toe, the vegetation becomes thicker and progresses through different successional stages starting from lichens and mosses to alder, willow and cottonwood to conifers. For the first 4 km below the glacier the valley is almost barren of vegetation except for mosses and lichens, up to an elevation of 300 m above the valley floor. In the next 3 km alder, cottonwood and a few small spruce trees are the dominant vegetation. The last 11 km have been logged and regrown in deciduous trees and conifers (Photo 20).



Photo 20. The lower 11 km of the Franklin River has been logged and has recovered in alders and conifers.

Fissure Creek (Photo 21), Crevice Creek, and Stanton Creek are the three main tributaries to the system. Being glacial, they are similar in character to the Franklin River in that they are fast, silty and cold during the summer months. None of these creeks appear to be significant to salmon because they are very steep, there are no rearing areas, and the boulder substrate is too coarse for spawning.



Photo 21. The lower reaches of Fissure Creek, like those of Crevice and Stanton Creeks are shallow and braided. Above the Valley floor they rise steeply.




There are a few small creeks fed by ground water and surface run off which flow into the lower portion of the Franklin River. They are generally short, only a few meters wide and have fine silt to gravel bottoms. The first of these creeks enters 2 km from the mouth of the Franklin River on the west bank. It is only 200-300 m long and reduced to a trickle in the summer. A second creek, 8 km up the valley on the west bank, is the largest and longest of these creeks. It is 3-5 m wide, approximately 1 km in length and has a gravel bottom. A beaver dam forms a pond about 0.5 km from the Franklin River. On the east bank there are three other small creeks which enter the river between 7 and 9 km up the valley that could be used by rearing coho.

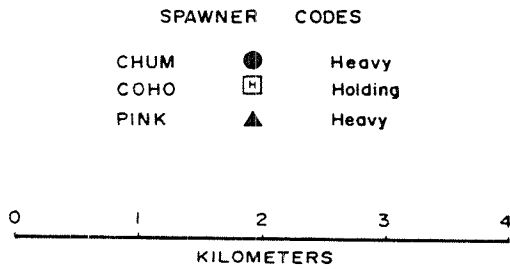
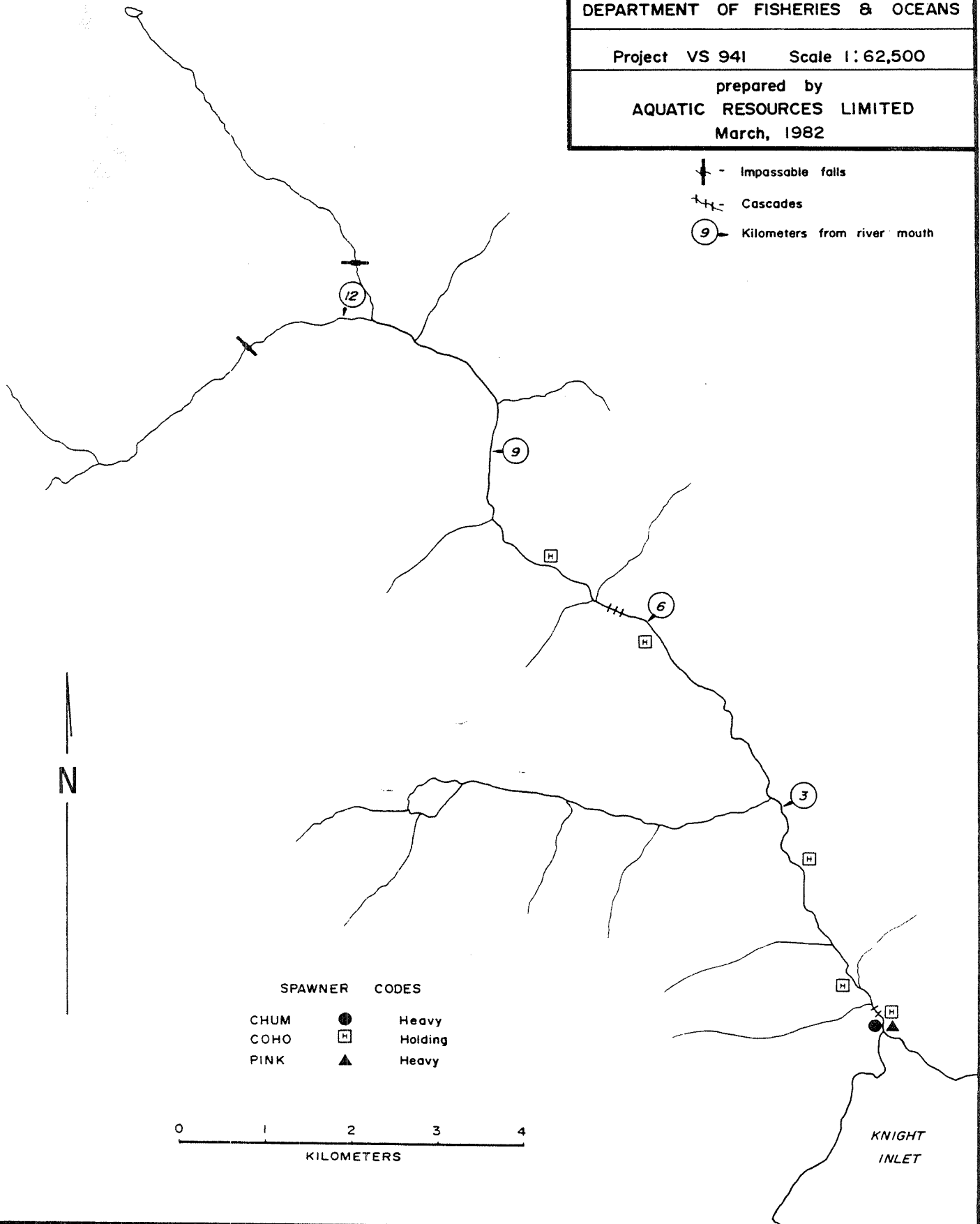
Figure 3-2-5
KWALATE CREEK

prepared for
DEPARTMENT OF FISHERIES & OCEANS

Project VS 941 Scale 1:62,500

prepared by
AQUATIC RESOURCES LIMITED
 March, 1982

-  - Impassable falls
-  - Cascades
-  - Kilometers from river mouth



KNIGHT
 INLET

3.2.5 Kwalate Creek

Kwalate Creek has a set of cascades 400 m from the mouth that prevents the passage of pinks and chums to the upper reaches of the river. The creek was briefly surveyed for its enhancement potential. The lower 7 km of the creek were examined by foot on August 28 and October 23 and the full 16 km length of the creek was flown by helicopter on October 20. At the mouth of the creek is a small saltwater marsh 0.5 m deep and stretching for 100 m on either side of the creek (Photo 22). Above the marsh, the first 400 m of the creek flows fairly fast in a straight channel over a boulder bottom that includes patches of gravel and cobble in the lee of the larger boulders (Photo 23). The boulder banks are reposed and stable. All pink and chum spawn in this lower reach because the next 100 m is a series of cascades which prevents them from going any further. The creek drops 8-10 m over a



Photo 22. Saltwater marsh at the mouth of Kwalate Creek.

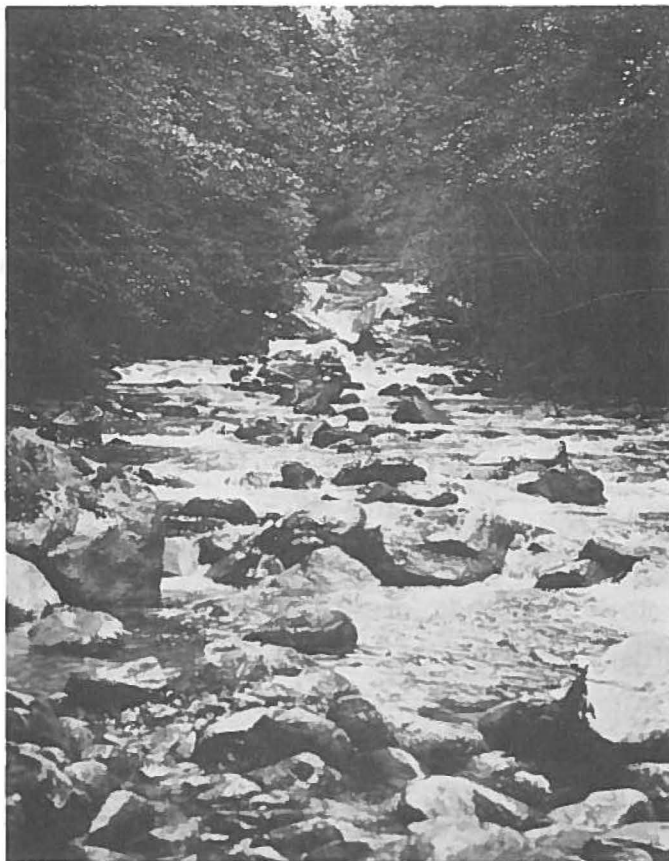


Photo 23.
Most of the chum and pink salmon spawning in Kwiate Creek used this 400 m channel between the salt marsh and the cascades.

bedrock bottom in this section. At the top is a falls about 2.5 m (photo 24) high which had 500-750 coho schooled below it on August 28. Past the cascades, the creek flows for 12 km in an irregular channel with cobble-gravel bottom (Photo 25) and an average gradient of 2%. Throughout this reach there are numerous pools, glides and riffles that appear to be ideal spawning grounds. There is some channel debris due to the erosion of the reposed gravel banks in certain areas. Like the Ahnuhati River, this valley is steep and water levels can rise dramatically during heavy rains as indicated from the large gravel bars in the lower reach. Very few coho fry were observed in the lower 7 or 8 km walked but the upper reach

between 9 and 10 km which was seen from the helicopter, appeared from the helicopter survey to be more suitable habitat for coho. Another small set of cascades exists 6 km from the mouth but they are probably passable to chums and pinks. The riparian vegetation, a mixture of alders and conifers, covers 30-40% of the channel in this area. Above 10 km the river becomes steeper with a boulder substrate and scattered patches of gravel. Fish passage appears to be blocked at 13.2 km by a 5 m falls.

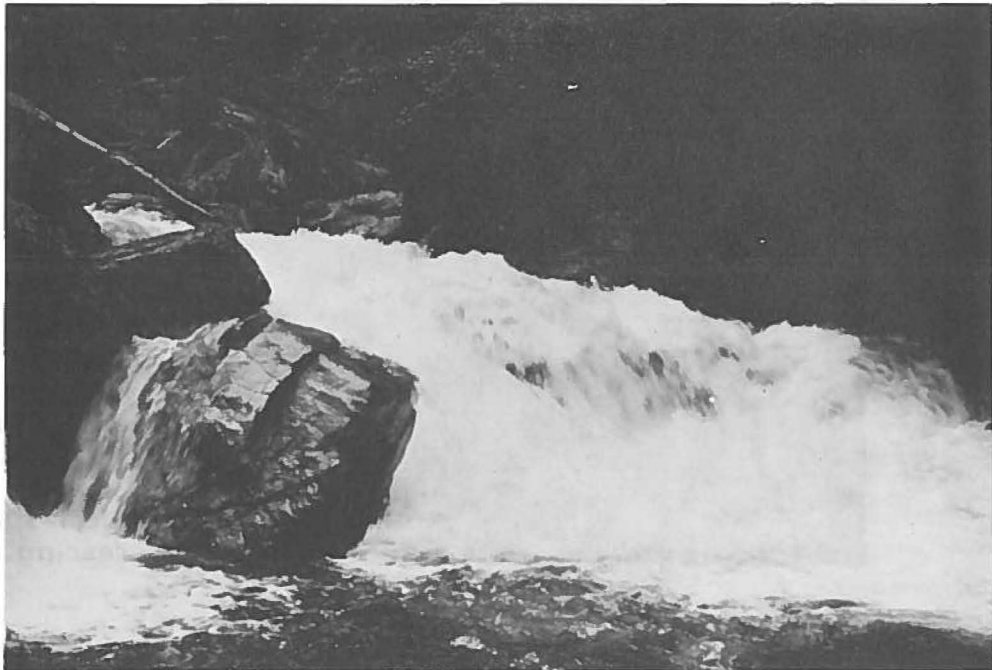


Photo 24. This 2.5 m falls at the top of Kwalate Cascades obstruct the passage of pink and chum and may block coho at some water levels.



Photo 25.
Much of the 12 km
between the lower
and upper falls of
the Kwalate River
appear to contain
ideal spawning and
rearing areas.

3.3 CHUM SALMON

Spawning chum salmon were observed in the Glendale, Mussel and Ahnuhati Rivers. Earlier reports also include a late October–November run in the Franklin River which was not observed by the 1981 study which terminated October 31. The migration timings observed in 1981 are shown in table 3.3-1. There were major differences in the migration timings of the Knight Inlet streams. The Ahnuhati River run began July 23 and the die-off was complete Sept 15, whereas the Mussel Creek and Glendale River runs were much later, beginning in late September and continuing until late October. In all of the streams the chum appeared to begin to spawn within a week after entering the river.

TABLE 3.3-1
Summary of chum spawning timing in Knight Inlet

System	Enter river	Spawning		
		Start	Peak	End
Glendale Ck	Sept 20	Sept 20	Oct 15	Nov 01
Mussel Ck	Oct 07	Oct 07	Oct 20	?
Ahnuhati R	Jul 23	Jul 28	Aug 03	Sept 15
Franklin R	--	--	--	--

3.3.1 Distribution and Timing

The Knight Inlet streams were regularly walked once a week during immigration and twice a week during spawning. No fish were tagged. As a result it was not possible to estimate spawner

turnover ratio. A seven day turnover period similar to that suggested by Mattson and Rowland (1963) was therefore used for population estimations.

Glendale Creek

The first chum seen in Glendale Creek were spawning in the lower portion of Reach 3 (Figure 3.3-1) on September 20 after a heavy rain. Spawning reached a peak in the first and second week of October after another increase in water level.

One chum was seen in the upper end of Reach 5 and six chum in Reach 3, however, most of the spawning (95%) took place throughout Reach 2 of Tom Browne Creek. On the last count on October 24 only 65 adults, many of them spawned out, were left. Total escapement was estimated to be about 500.

Mussel Creek

Chum were first encountered in Mussel Creek on October 7 on a float through Reach 1 (Figure 3.3-2) and were in fairly bright condition. A week later on October 13, 10 chum were seen spawning in Reach 2 for the first time. By October 21, 60 chum were estimated to be holding in Reach 1 and 68 were counted spawning in Reach 2. On the last count 70 spawners were counted in Reach 2. Chum were not encountered in any other reaches. The escapement up to the last count was estimated to be about 300 fish based on a 7 day turnover. Since the last count was made before the end of the run, a complete assessment of the escapement on timing could not be made, however, it appears that the chum hold for a short time in Reach 1 then move into Reach 2 to spawn.

Ahnuhati River

Three chum were encountered on the first visit to the river on July 23. On July 28, the lower 3 km of the river were floated and 40 bright chum were estimated to be holding in Reach 1.

Figure 3.3-1
 CHUM & PINK SALMON
 in Glendale Creek

prepared for the
 DEPARTMENT OF FISHERIES & OCEANS

Project VS 941 Scale 1:34,000

prepared by
 AQUATIC RESOURCES LIMITED
 March, 1982

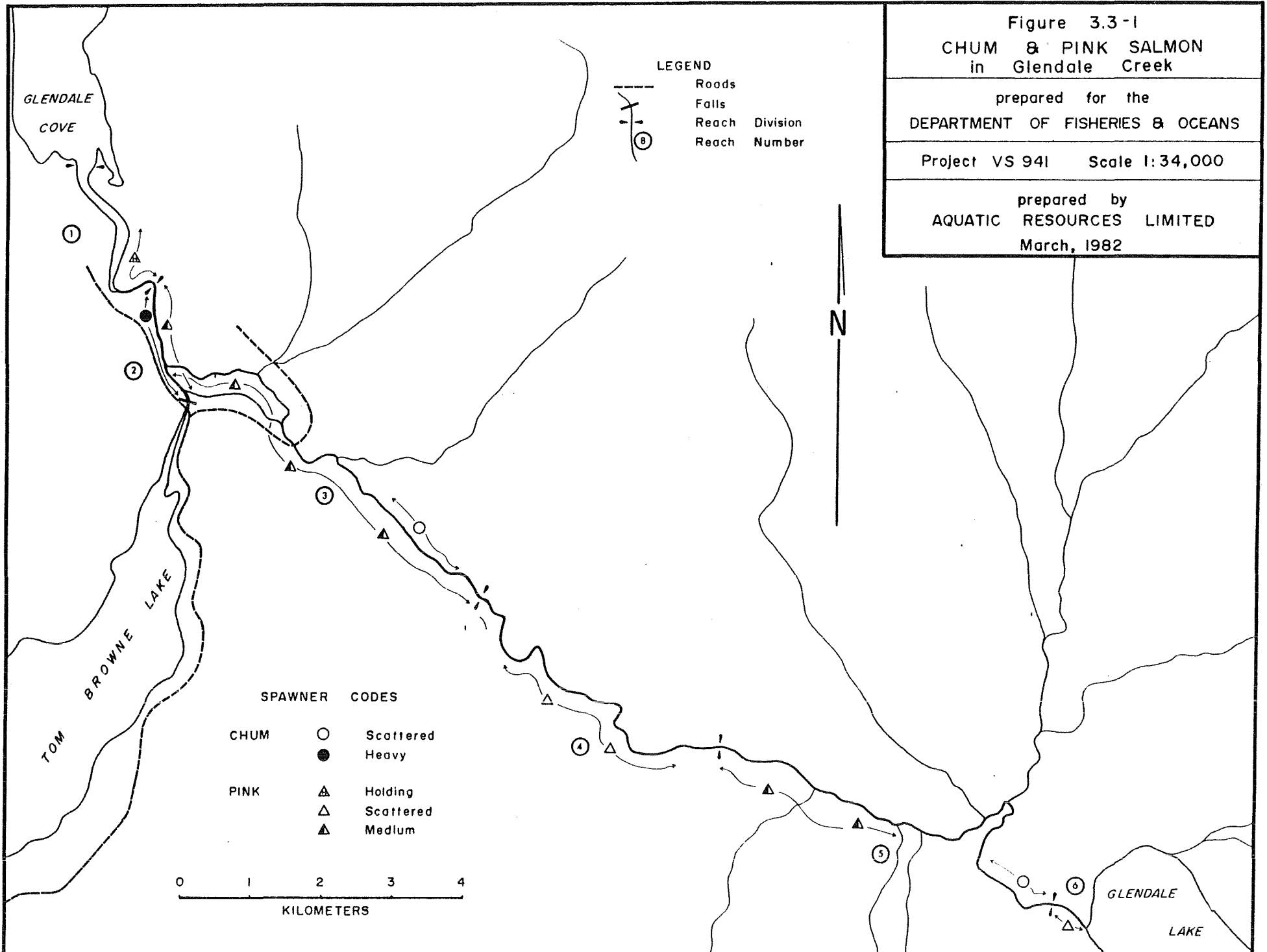
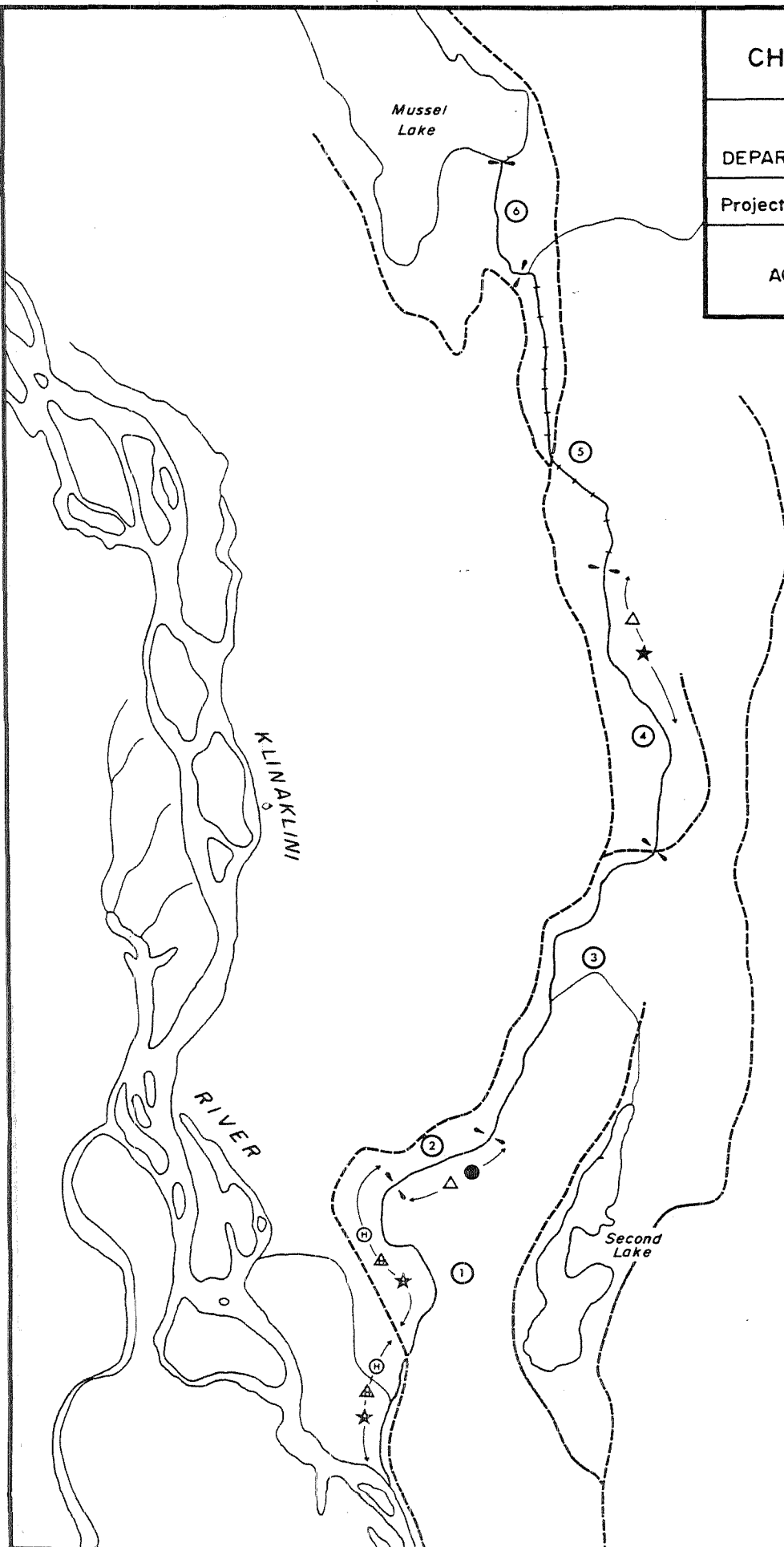


Figure 3.3-2
CHUM, PINK & SOCKEYE
 in **Mussel Creek**

prepared for the
 DEPARTMENT OF FISHERIES & OCEANS

Project No. VS 941 Scale 1:32,000

prepared by
 AQUATIC RESOURCES LIMITED
 March, 1982



LEGEND

- ROAD
- CASCADES
- REACH DIVISION
- ⑥ REACH NUMBER

SPAWNER CODES

- | | | |
|---------|---|-----------|
| PINK | △ | Holding |
| | △ | Scattered |
| CHUM | ⊙ | Holding |
| | ● | Heavy |
| SOCKEYE | ☆ | Holding |
| | ★ | Scattered |



Spawning started a week later, peaked at the end of August and was over by the middle of September. Spawning was heaviest in Reach 2, particularly in the smaller side channels of sections 2b and 2c (Figure 3.3-3). Chum were also observed during the aerial survey of September 8 to be spawning in the lower and middle sections of reach 4. About 20% of the run spawned in this reach. The total escapement was estimated to be 3000 fish. After not seeing any for three weeks 2 bright chums were seen in Reach 1 during the middle of October.

Franklin River

Chum have been recorded in the Franklin River from 1951 to 1976, averaging 900 fish per year, with the run arriving in late October and spawning in November (DFO escapement records). No chum were observed in the Franklin River up to the end of October 1981, when the study ended.

Kwalate Creek

On August 28 approximately 200 chum were observed holding and spawning in the short (400 m) reach below the cascades near the mouth of the Creek. No chum were observed above the rapids.

3.3.2 Population Sampling

The chum salmon population characteristics discussed in the following sections are all based upon carcass recoveries which are summarised in Table 3.3-2. The low number of recoveries from Mussel Creek is due to the later timing of the run, which did not finish spawning until after the conclusion of the study on October 31.

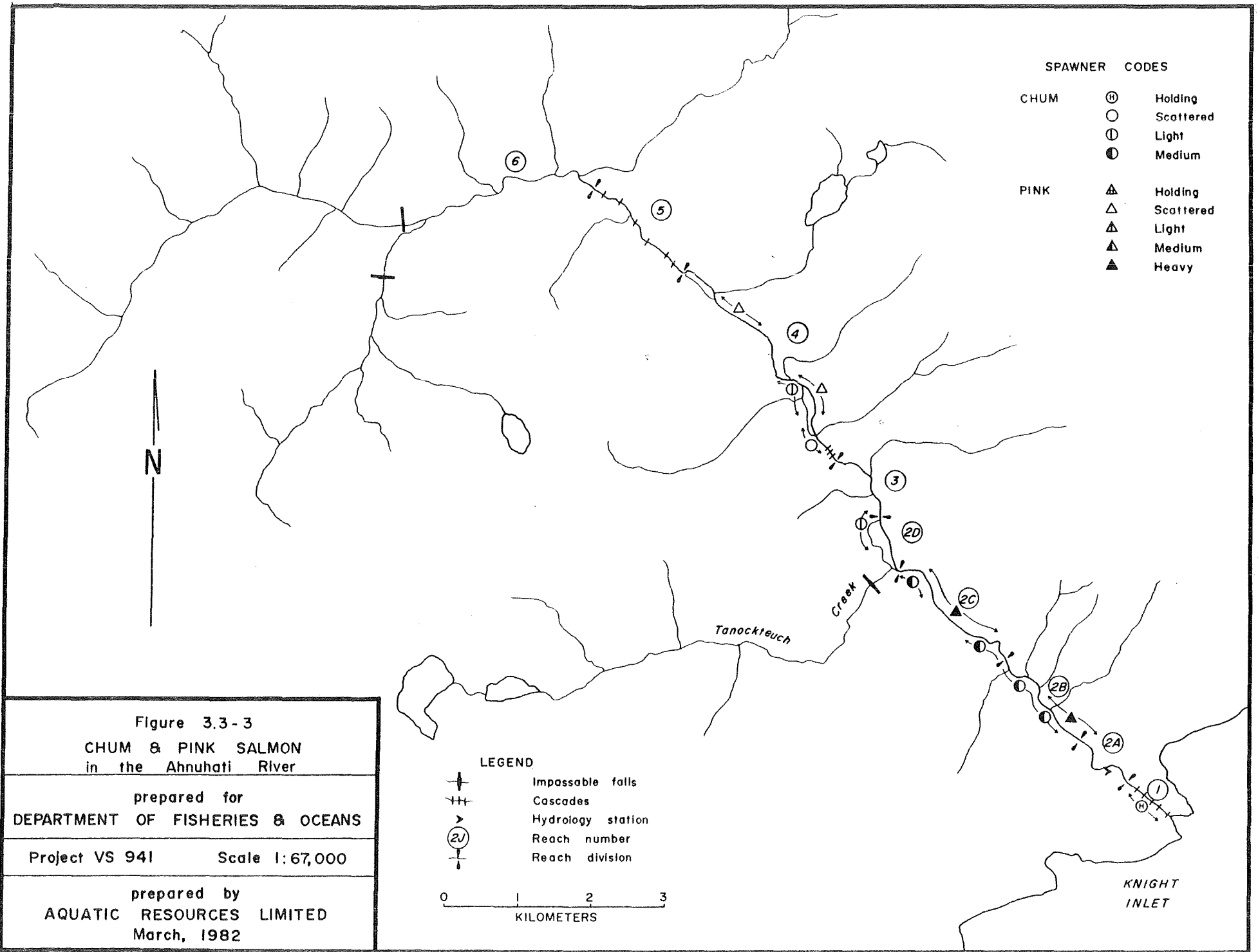


TABLE 3.3-2
Chum Carcasses Recovered

System	Male	Female	Total
Glendale Ck	9	15	24
Mussel Ck	1		1
Ahnuhati R	9	13	22

3.3.3 Sex Ratio

The Sex ratio of the sample of 22 chum carcasses from the Ahnuhati River was 0.7M:1F and of 24 chum from Glendale Creek was 0.6M:1.7F. The bias in favour of females may not reflect the true population ratio because males generally leave the redds and move downstream after spawning while females remain on the redds until they die (Bakkala, 1970). This kind of difference was also noted in carcass recoveries reported by Glova and McCart (1979) and Murray and Hamilton (1981). Hunter (1959) reported an overall ratio closer to 1:1 in ten years of returns an Hook Nose Creek.

3.3.4 Age Composition

Of the 24 chum carcasses recovered from the Ahnuhati River, only 15 were successfully aged. The majority (75%, n=12) of both males and females were 3 years and the rest (n=3) were 4 years (Table 3.3-3). The Glendale chums were generally older and represented by three age classes. The majority of the fish

(50%) were age 4, 35% were age 3 and 15% were age 5. In other surveys, the relative proportions of age 3 and age 5 fish have been shown to vary widely. Age 3 fish were most abundant in the Kemano River (Murray & Hamilton 1981), while 4 year fish were more common in Mathers Creek (Glova et al, 1979). In the Nitinat River age 3 fish were predominant in 1979 (McCart et al, 1980), although Fedorenko et al (1979) had reported that between 1947 and 1977 the distribution was 28% age 3, 59% age 4 and 13% age 5. McCart et al suggested that the variation is related to brood year escapements.

TABLE 3.3-3
Age Composition of Chum Carcasses Sampled

System	Sex	Age			
		?	3	4	5
Glendale Ck	M	1	3	4	1
	F	3	4	6	2
Mussel Ck	M			1	
Ahnúhati R	M		5	1	
	F		7	2	

3.3.5 Size Distribution

The size distribution of the chum carcasses recovered is shown in Table 3.3-4. The average POH length of Ahnuhati River female chum was 57.7 cm (n=13) while males averaged 59.0 cm. (n=9). Females ranged from 52.7 to 68.5 cm while the males

TABLE 3.3-4
Size of Chum Carcasses Recovered

System	Sex	n	Mean POH (cm)	Range
Glendale Ck	M	9	62.7	55.5-83.0
	F	13	59.0	50.0-69.5
Mussel Ck	M	1	61.5	
Ahnuhati R	M	9	59.0	47.3-67.0
	F	15	57.7	52.7-68.5

ranged from 47.3 cm to 67.0 cm. The Glendale River chums, being older, were somewhat larger than those in the Ahnuhati, with the average length of the females 59.0 cm (n=15) and males 62.7 cm (n=9). The males ranged from 55.5 to 83.0 cm and the females ranged from 50.0 to 69.5 cm. In comparison to other chum stocks the Glendale and Ahnuhati chums are generally smaller than average (Table 3.3-5).

TABLE 3.3-5
Postorbital-hypural Length (cm) for Selected Stocks of Chum Salmon

System	Male			Female			Reference
	3	4	5	3	4	5	
Qualicum R. 1978	56.0	59.8	62.3	58.0	58.7	60.0	Lister, 1979
Sucwoa.R 1978	73.5	77.4	78.2	65.6	71.9	75.5	Glova & McCart, 1979
Canton Ck. 1978	70.8	76.2	71.0		71.4		Glova & McCart, 1979
Conuma R. 1978	72.3	76.4	70.2	64.4	71.2	72.0	Glova & McCart, 1979
Tlupana R. 1978		73.7			67.6	76.0	Glova & McCart, 1979
Deserted R. 1978	70.0	76.0	77.5	65.9	71.2	73.5	Glova & McCart, 1979
Mathers Ck. 1978	66.8	74.3	74.6	67.5	70.3	72.3	Glova <u>et al</u> , 1979
Kemano R. 1979	57.6	64.0	67.7	55.0	59.9	62.2	Murray and Hamilton, 1981
Glendale Ck. 1981	51.7	71.5	65.0	58.1	59.6	65.8	
Ahnuhati R. 1981	60.3	65.6		54.1	59.0		
Mean	64.3	68.5	70.8	61.0	66.0	69.7	
Range	51.7- 73.5	59.8- 77.4	62.3- 78.2	54.1- 67.5	58.7- 71.9	60.0- 76.0	

3.3.6 Fecundity and Egg Retention

Eight female chum carcasses were sampled in the Ahnuhati River; one was 30% spawned out, three were completely spawned and the rest had less than 1% egg retention. In Glendale Creek of ten females, six were completely spawned out and four had less than 1% eggs retention. These results are similar to those reported elsewhere in the literature (Table 3.3-6).

TABLE 3.3-6
 Egg Retention in Chum Salmon from Selected B.C. Streams

System	Year	Egg Retention Rate	Reference
Glendale Ck	1981	3.3%	present study
Ahnuhati R	1981	0.4	present study
Mathers Creek	1977	1.5	Shepherd, 1978
Mathers Creek	1978	1.3	Glova <i>et al</i> , 1979
Kemano River	1979	8.6	Murray and Hamilton, 1981
Tupana Inlet (5 streams)	1978	0.5-2.0	Glova and McCart 1979

3.4 COHO SALMON

Coho were observed in all of the Knight Inlet streams studied. However, the field program terminated before they began to spawn in significant numbers except in Mussel Creek. (Table 3.4-1).

TABLE 3.4-1
SUMMARY OF COHO SPAWNING TIMING IN KNIGHT INLET

System	Enter River	Spawning		
		Start	Peak	End
Glendale Ck.	Aug 26	?	?	?
Mussel Ck.	Aug 20	Oct 20	Oct 30	?
Ahnuhati R.	Aug 28	?	?	?
Franklin R.	Oct 29	?	?	?

3.4.1 Distribution and Timing

Glendale Creek

The first coho were observed on August 26 in Reach 2 of Tom Browne Creek (Figure 3.4-1). During the third week in October there were an estimated 100 coho throughout Glendale Creek and 100-200 mature coho off the mouth of a tributary on the north side of Glendale Lake. By the time of the last count on October 24, spawning had not been observed. This may have been due to the low water condition, although many of the fish appeared mature. It is probable that more adults were still to enter the river during later high water levels.

Mussel Creek

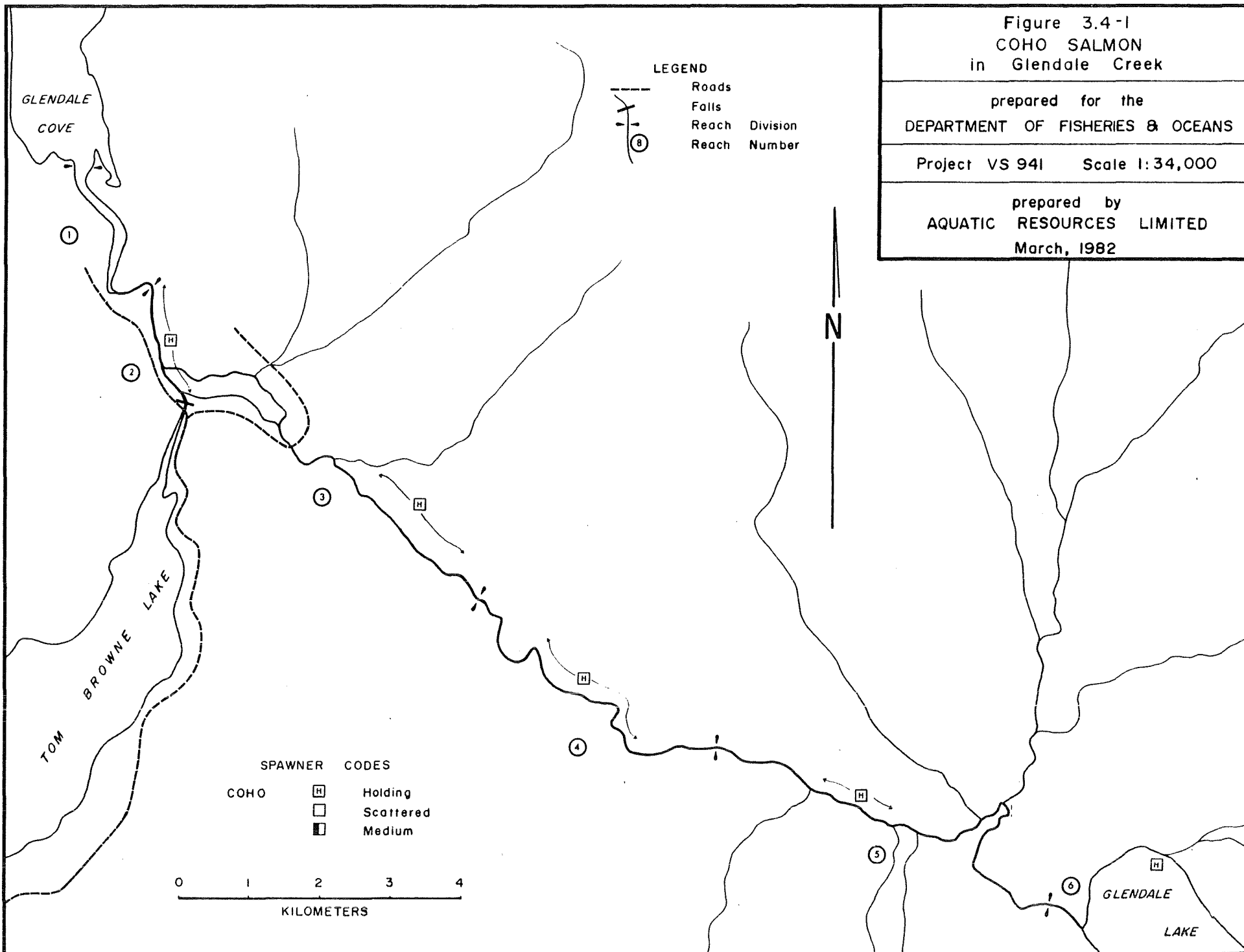
Coho were first observed in Reach 1 on August 20 (Figure 3.4-2). Throughout September and the early part of October, 50-70 coho were estimated to be in this area. About 200 coho were observed holding below Mussel Lake in four pools within Reach 6 throughout most of September. A few coho were also observed holding in pools of Reaches 4 and 7 during late September and October. The coho first started spawning in the third week of October. During increased water levels on

Figure 3.4-1
COHO SALMON
in Glendale Creek

prepared for the
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Project VS 941 Scale 1:34,000

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March, 1982



LEGEND

- Roads
- ⊥ Falls
- Reach Division
- Reach Number

SPAWNER CODES

- | | | |
|------|---|-----------|
| COHO | ⊠ | Holding |
| | □ | Scattered |
| | ■ | Medium |

0 1 2 3 4
KILOMETERS

Figure 3.4-2
 COHO SALMON
 in Mussel Creek

prepared for
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Project VS 941 Scale 1:65,000

prepared by
 AQUATIC RESOURCES LIMITED
 March, 1982

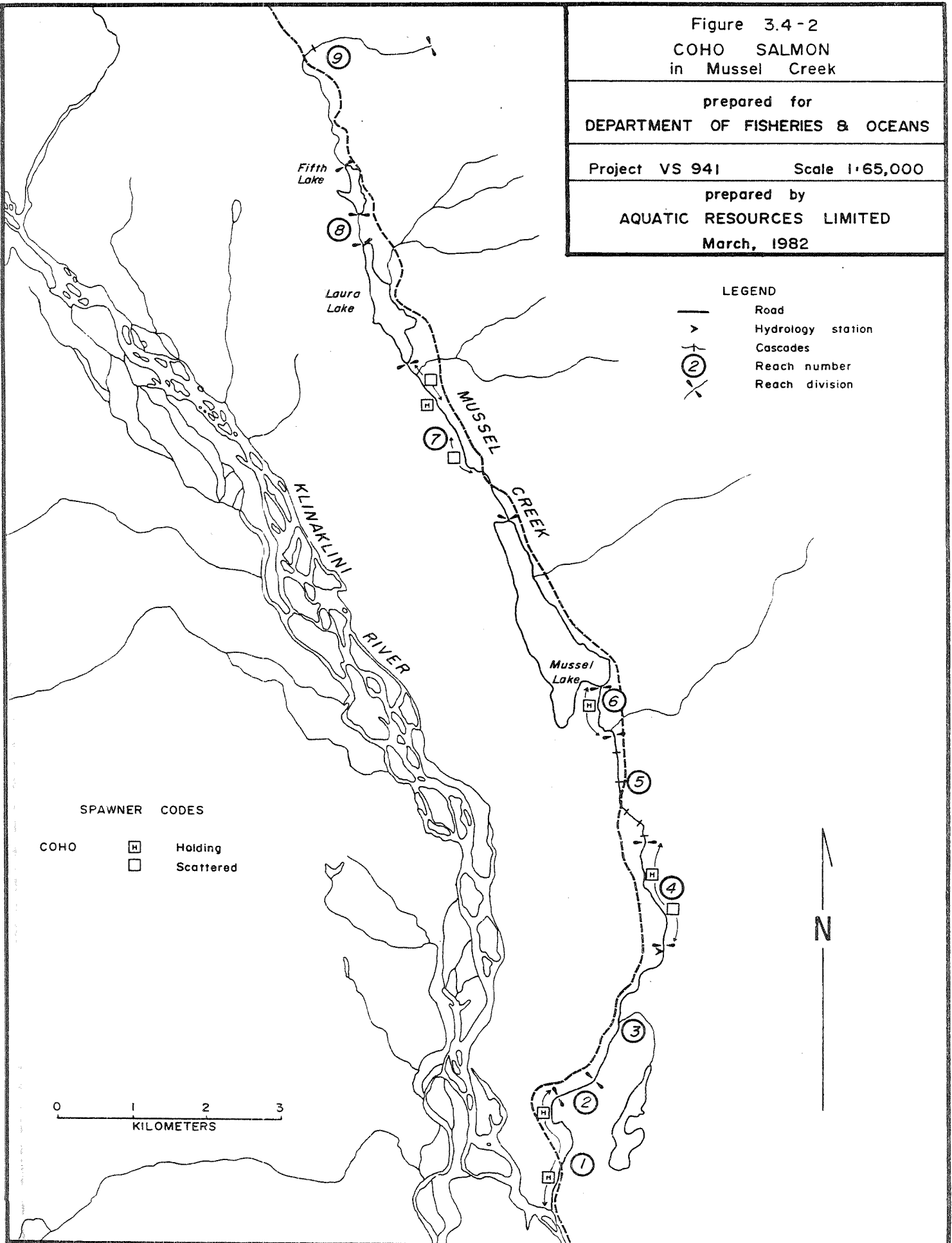
LEGEND

- Road
- > Hydrology station
- + Cascades
- ② Reach number
- X Reach division

SPAWNER CODES

- | | | |
|------|---|-----------|
| COHO | Ⓜ | Holding |
| | □ | Scattered |

0 1 2 3
 KILOMETERS



October 29 and 30 the majority of coho (300) were found spawning in side channels of Reach 4 and up part of Reach 7. A week previously only 50 spawners and 50 holding fish were estimated to be in this reach. It appears that the coho had been holding in Mussel Lake waiting for higher water levels. Reach 4 had the next greatest concentration of spawners (150) in the mainstream and side channels. At the end of October there appeared to be 600 to 1000 coho in the system. DFO records of previous years indicate that spawning peaks in November and ends in December.

Ahnuhati River

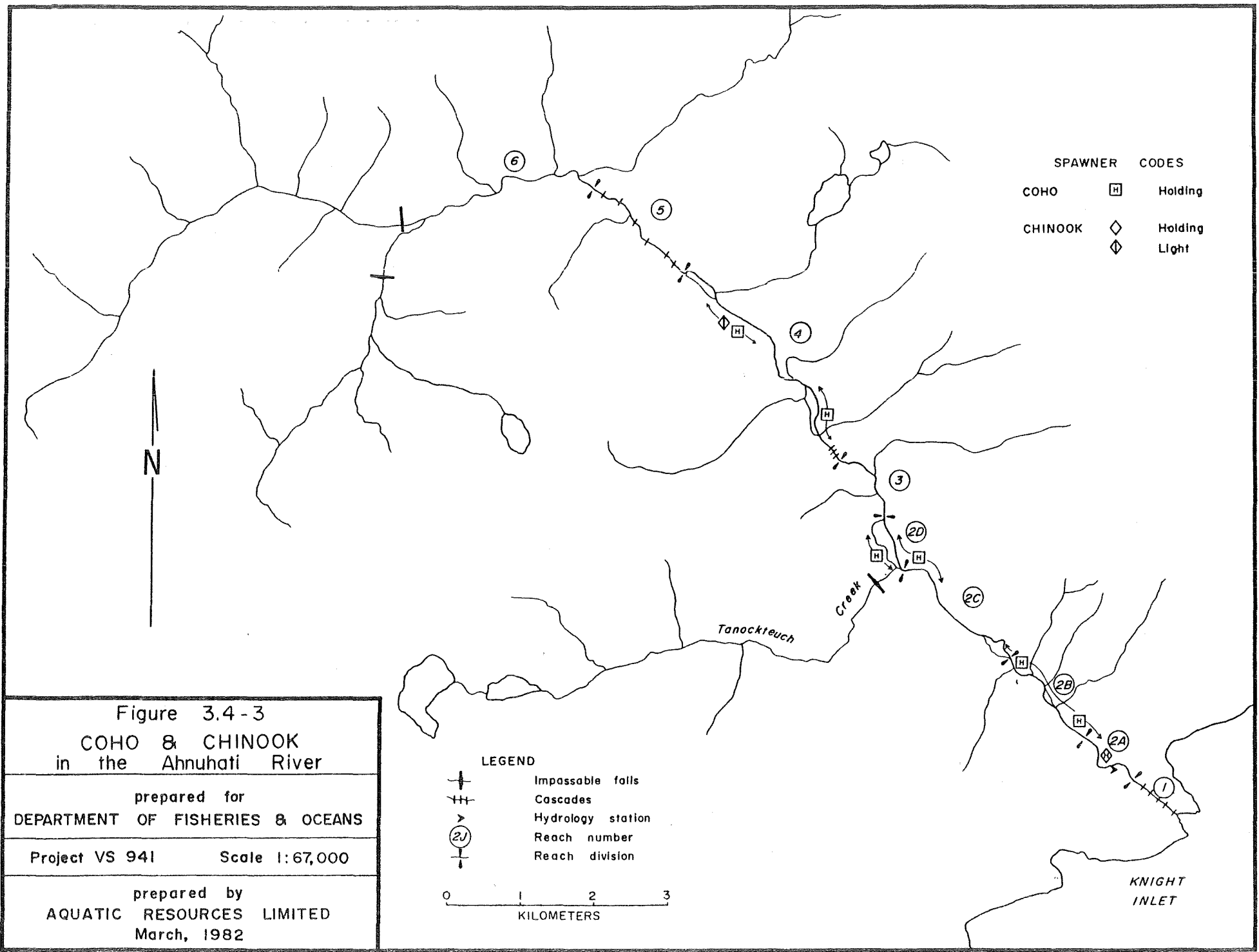
Coho first appeared in the river in the fourth week of August. Under low clear water conditions on October 18 and 20, 1650 coho were estimated to be in the river. Approximately half of these were holding in Reach 2 and half in Reach 4 (Figure 3.4-3). During the aerial survey on October 20 no coho were seen above Reach 4. Spawning had not started by the time of the last walk on October 26.

Franklin River

Only one coho was observed in the Franklin River during the 1981 study. It was found digging a redd in a small tributary on the west side of the Franklin River on October 29. Earlier in the study, a few coho juveniles were also observed in this area. Up to 3500 coho have been recorded spawning in the Franklin River during November (DFO Escapement Records).

Kwalate Creek

On August 28, 750-1,000 coho were estimated to be holding below the cascades at the mouth of the creek. An additional 300 coho were observed in the first kilometer above the cascades. A helicopter reconnaissance on October 20 revealed a total of 305 coho in the river, with about 210 in the first



SPAWNER	CODES
COHO	⊠ Holding
CHINOOK	◇ Holding
	◊ Light

Figure 3.4-3
COHO & CHINOOK
 in the Ahnuhati River

prepared for
DEPARTMENT OF FISHERIES & OCEANS

Project VS 941 Scale 1:67,000

prepared by
AQUATIC RESOURCES LIMITED
 March, 1982

LEGEND

- ⊠ Impossable falls
- ⦶ Cascades
- > Hydrology station
- ⊙ Reach number
- ⊢ Reach division

0 1 2 3
 KILOMETERS

kilometer above the cascades, 10 at km 1.5, 50 below the small cascades at km 5.2, 12 at km 8 and an additional 23 fish scattered between km 9 and 10. On October 23, the lower 7 km of the river were surveyed on foot, 70 coho were observed below the lower cascades and 150 above. There were no indications of spawning.

3.4.2 Size, Age, and Fecundity

The only coho sampled during the study were taken from Mussel Creek where six carcasses were obtained and three coho were caught in a gillnet and released. POH lengths ranged from 39.5 to 62.0 cm. The average POH length of the females was 54.0 cm and the average male 53.5 cm. The coho in Reach 4 were noticeably larger than those observed spawning in Reach 7. The three coho caught in reach 7 by net averaged 44.5 cm while those in Reach 4 averaged 58.3 cm. All of the coho aged were 3₂ except one which was 4₃. Fecundity counts were obtained from 3 female pre-spawning mortalities which had an average of 4000 eggs each (2,536; 3,600; 5,484).

3.5 CHINOOK SALMON

DFO escapement records indicate that all of the Knight Inlet streams studied in 1981 have historically supported chinook stocks. However, in the 1981 study springs were observed only in the Ahnuhati River and Mussel Creek (Table 3.5-1). The Ahnuhati River fish spawn in a relatively inaccessible portion of the river after holding briefly near the mouth. Spawning ground surveys on this system were therefore possible only on the two days of helicopter survey. The Mussel Creek run is much larger and most of the spawning takes place in the easily accessible lower river and was monitored more closely.

TABLE 3.5-1
SUMMARY OF CHINOOK SALMON SPAWNING IN KNIGHT INLET

System	Enter River	Spawning		
		Start	Peak	End
Glendale Ck.	N/O			
Mussel Ck.	--	Sept 15	Oct 01	Oct 15
Ahnuhati R.	--	Aug 15?	Sept 01	Sept 15
Franklin R.	N/O			

N/O - none observed.

3.5.1 Distribution and Timing

Glendale Creek

No chinook were observed in Glendale Creek in 1981. In 1966 and 1970, 25 chinook were counted when the Fisheries Research Board had a counting fence on the system.

Ahnuhati River

The lower 3 km of the river were first floated on July 28. An estimated 20 chinook were holding throughout this area (Figure 3.4-3). In subsequent floats, fewer fish were observed until all of the springs were gone in late September. It appears that the chinook moving through this area peaked before or at the beginning of the survey. No chinook were observed in surveys on foot through the rest of Reach 2 except for 1 chinook jack carcass found in Reach 2. In the aerial survey on September 8, chinook were not observed above Reach 4. A crew dropped off at the top of Reach 4 counted 33 spawners and 3 carcasses throughout that reach. The majority of the fish were spawning in the middle of the reach in riffles of a braided section with a cobble bottom. Many of the fish appeared spawned out, so it appears the peak of spawning occurred a week or two earlier.

No springs were observed during the October 20 flight. Historically up to 750 chinook have been recorded between 1951 and 1974, (DFO Escapement Records).

Mussel Creek

During the first survey of Reach 1 on July 16, 15 chinook were spotted from a boat, however there were probably many more that were not visible in the deeper pools (Figure 3.5-1). On August 5 in a float through this area, 200 chinook were estimated to be holding in the pools. At the end of August and the first week of September, an estimated 400-500 chinook were holding in this area. By the third week of September, this number was reduced to 150. On July 31, 100 chinook were found holding in the small pools of Reach 4, where no fish had been seen five days earlier. Numbers in this area increased to 500-650 by the beginning of September. Spawning began in the middle of September, peaked by the end of September and finished by the middle of October. The chinook holding in Reach 1 appeared to spawn in Reaches 2 and 3 with an estimated 100-150 spawning in Reach 2 and 200-300 in Reach 3. The 500-600 fish which had been holding in the pools of Reach 4 spawned in the riffles above the pools. Carcasses and moribund post-spawners were rapidly removed by the twenty or more bears feeding along Reaches 2, 3 and 4. It was therefore not possible to estimate spawner turnover rates. Total escapement was estimated at 900-1,000 fish, based upon the chinook holding in Reaches 1 and 4 before spawning started.

Franklin River

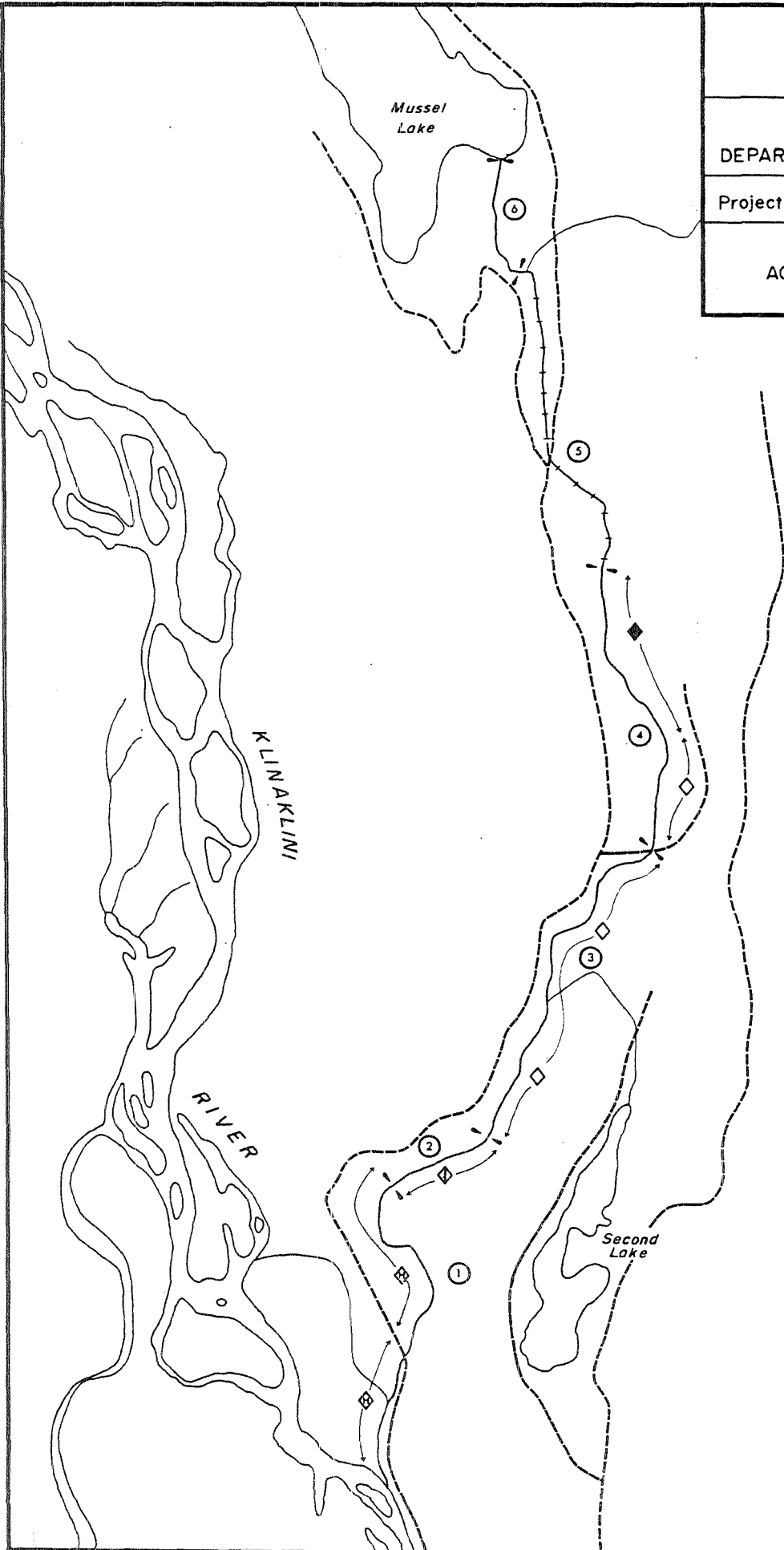
No chinook were observed in the Franklin River. DFO spawning records indicate an average of 600 chinook in the

Figure 3.5-1
CHINOOK SALMON
in Mussel Creek





prepared for the
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Project No. VS 941 Scale 1:32,000






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March, 1982



LEGEND

-  ROAD
-  CASCADES
-  REACH DIVISION
-  REACH NUMBER

SPAWNER CODES

-  HOLDING
-  SCATTERED
-  LIGHT
-  MEDIUM
-  HEAVY



system from 1951 to 1966. However, there have not been any recent returns.

3.5.2 Population Sampling

Predation of carcasses by grizzly bears hampered efforts to recover carcasses in Mussel Creek. For example, on September 30, the remains of an estimated 60 carcasses were found in Reach 4 but data could only be taken from five. Four carcasses were retrieved from the Ahnuhati River however only one was intact enough to sex and measure.

3.5.3 Sex Ratio

In Mussel Creek the sex ratio of 35 chinook carcasses recovered was 1.92M:1F (1.25M:1F excluding jacks). The sole carcass recovered from the Ahnuhati River was male.

3.5.4 Age Composition

Twenty-six carcasses from Mussel Creek were scale sampled (Table 3.5-2). Of these, 12 had scales that were regenerated or too resorbed to read. Age 5₂ was the dominant age class and constituted 57% of the total sample. Half of the sample of six males was 5₂, while 75% of the eight females were 5₂. All but one chinook were sub-2. Jacks were arbitrarily defined on the basis of size (POH \leq 40 cm) and constituted 23% of the 35 chinook recovered. Jacks could represent a higher proportion of the carcasses than in the population because they may not have been taken by bears as readily due to their small size. The scales of the one sample from the Ahnuhati River had resorbed and could not be read.

TABLE 3.5-2

Scale Age of Chinook Carcasses from Mussel Creek

Sex	5 ₁	3 ₂	4 ₂	5 ₂	6 ₂
M		3	1	2	
F	1			6	1

3.5.5 Size Distribution

The average POH length of the 35 carcasses recovered from Mussel Creek was 57.1 cm (range 24.5-78.0 cm). The 12 females averaged 72.0 cm and ranged from 78.0 to 56.0 cm while the average male was 59.4 cm (range 75.5 to 47.0 cm). Jacks ranged from 24.5 to 35.0 cm (n=8) and had an average length of 31.5 cm. The mean POH length of age 5₂ Mussel Creek chinooks is similar to those from some other B.C. streams with age 5₂ fish (Table 3.5-3).

TABLE 3.5-3

POH Length (cm) of Age 5₂ Chinook from selected B.C. Streams

	Males	Females	References
Bowron R.	73.7	71.0	Hickey et al 1981
Willow R.	73.9	70.4	" " "
Slim Ck.	72.2	69.2	" " "
Stuart R.	<u>76.7</u>	<u>72.6</u>	Murray et al 1981
Mean	<u>74.1</u>	<u>70.8</u>	
Mussel Ck.	75.3	72.3	

3.5.6 Fecundity and Egg Retention

No unspawned females were recovered so fecundity data was not obtained. Of the seven females checked for egg retention, four were completely spawned out. The rest had less than 1% retained eggs.

3.6 PINK SALMON

Pink salmon were observed in the Ahnuhati River as well as Mussel and Glendale Creeks, but were not seen in the Franklin River. Spawning times (Table 3.6-1) in Glendale and Mussel Creek were quite similar, peaking in mid September despite earlier low water delays in Glendale Creek. In the Ahnuhati River the run was about a month earlier, with spawning complete by September 15.

TABLE 3.6-1

SUMMARY OF PINK SPAWNING TIMING IN KNIGHT INLET, 1981

System	Enter River	Spawning		
		Start	Peak	End
Glendale Ck	Jul 24	Sep 07	Sep 26	Oct 24
Mussel Ck	Aug 29	Sep 01	Sep 15	Oct 15
Ahnuhati R	Jul 23	Aug 06	Aug 30	Sep 15
Franklin R	N/O			

N/O - None observed

3.6.1 Distribution and Timing

Glendale Creek

On the first survey (July 24) 100 pinks were holding in the pools of the upper part of Reach 1 (Figure 3.3-1). The number of fish holding in this reach gradually increased to about 4000 fish by the end of August. Very few pinks were holding in the rest of the creek during this time. Water levels, which had been very low, rose at the end of August. The pinks then moved up throughout the system, with about 55% in Reach 3. Spawning started in the first week of September but did not peak until the end of September after another increase in water level. Spawners were well distributed throughout the system except for sparse concentrations in Reaches 4 and 6. Spawning was finished by the third week in October. Many of the redds that were dug during the high levels at the beginning of the month went dry at the low flows later on. The total escapement was estimated at 20,000.

Ahnuhati River

Pinks started moving into the river during the end of July. Spawning started at the end of August, peaked the first week of September and ended the beginning of October. Ninety percent of the spawning took place in the glides and riffles throughout Reach 2 and the rest spawned in the lower and middle sections of Reach 4 (Figure 3.3-3). The total escapement was estimated at 4000-5000.

Mussel Creek

A total of 16 pinks were counted in Mussel Creek. The first were seen holding in Reach 1 on August 29. The first spawners were observed in the middle of September and the last on October 13. Ten of the spawners were in Reach 2 and two were in Reach 4 (Figure 3.3-2).

Franklin River

No pinks were observed and none have been recorded.

Kwalate Creek

On August 28, 750-1,000 pink were observed holding and spawning in the short reach below the cascades (Figure 3.2-5). Pink salmon were not observed above the rapids.

3.6.2 Size Distribution and Sex Ratio

The Glendale pink carcasses recovered (n=46) had an average POH length of 44.0 cm for females and 47.7 cm for males. Females ranged from 39.7 to 47.0 cm. long and males ranged from 36.3 to 53.5 cm long. The sex ratio in this sample was 1.7M:1F.

3.7 SOCKEYE SALMON

Glendale Creek

Only five sockeye were seen between August 1 and September 12 in the lower reaches of the Glendale system. However, loggers operating in the area reported a run in late June. DFO records indicate an average of 2500 sockeye, in the years 1949-1961, spawning throughout the system. In 1981, kokanee were collected in Tom Browne Lake during a concurrent limnology study (Black and Birch, 1982).

Ahnuhati River

On September 8 a pair of sockeye were observed spawning in Reach 4. Four additional sockeye were observed in section 2c on October 3. Although no recent returns have been reported, an average of 400 sockeye per year were recorded spawning in the Ahnuhati River from 1951 to 1960 (DFO Escapement Records).

Mussel Creek

A total of 50 sockeye were observed in Reaches 1 and 4 of Mussel Creek (Figure 3.3-2). The first were observed on September 5 and they started spawning at the end of September. During the last float through reach 1 on October 21, 20 sockeye were seen; ten of them were spawning, although some of the others were still bright. Several thousand kokanee were also observed spawning in Reaches 6 and 7 during the end of September and beginning of October.

Franklin River

No sockeye were observed or have been recorded (DFO Escapement Record).

3.8 PATHOLOGY SURVEY

The goal of the pathology survey was to sample 30 moribund chinook post-spawners from Mussel Creek. Unfortunately, bear predation was quite severe in this area and most of the fish were removed from the system immediately after spawning. The available samples (4 chum, 3 coho, 13 chinook and 3 sockeye) were collected October 13 and 14. In the absence of significant numbers of these species an additional 30 spent kokanee were collected by electroshocking.

The samples were analysed by staff of the DFO Diagnostic Services and no abnormally heavy levels of parasite infection or other pathological conditions such as neoplastic tumours were found. No evidence was found of infection of the muscles by the protozoa Henneguya and, except for a single sockeye, no prespawning mortalities were observed. In terms of enhancement implications, the most significant findings were a high incidence of furunculosis in the chinook examined and infectious hematopoietic necrosis (IHN) in the sockeye.

3.8.1 Chum

All of the four chum examined were judged to be in normal condition for spent salmon. One sample was lightly infected by furunculosis and all of the fish were lightly infected by the copepod Salmincola.

3.8.2 Coho

No remarkable infections were found beyond light infections of Salmincola and the kidney protozoan Myxidium.

3.8.3 Chinook

Five of the thirteen chinook examined were infected by furunculosis. This is a rather high incidence for wild chinook and may have important implications for enhancement, as furunculosis is a major cause of losses amongst cultured salmonids in North America. In addition, very light infections of Salmincola and Myxidium were found. It should be noted that dead, partially decayed specimens were included in the sample due to the shortage of live, spent fish.

3.8.4 Sockeye

Three fish were examined including one unspawned but moribund specimen. The virus assay on the unspawned fish was positive for infectious hematopoietic necrosis (IHN). In British Columbia, although other salmonid species are known carriers, IHN causes problems only in sockeye and kokanee. IHN could cause problems if sockeye are cultured in this area. No other important infectious agents were found.

Most of the thirty kokanee collected were completely spent, but were in excellent condition, free of abrasions, fungus or external parasites. The notable disease agents found were: furunculosis, Salmincola, Philonema (a nematode in the body cavity) and Chloromyxidium, a gall bladder protozoa.

3.9 ENHANCEMENT IMPLICATIONS

3.9.1 Water Quality

Most of the water quality parameters examined were within the recommended limits for salmon culture. All of the systems except Mussel Creek were softer than recommended, and conductivity was low in all of the systems.

3.9.2 Pathology

Samples were collected from the Glendale and Mussel systems in 1981. Additional data was obtained from DFO Diagnostic Services files. The principal diseases and disease agents which have been found in the Glendale study area and which have been known to cause significant problems in salmonid culture are shown in Table 3.9-1.

TABLE 3. 9-1
PRINCIPAL DISEASES AND DISEASE AGENTS FOUND IN
GLENDALE STUDY AREA

System Case Number(s)	Mussel Ck 81-398 81-402	Glendale Ck 74-087 81-192 81-193	Kakweikan R. 74-088
<u>Salmincola</u>	x	x	x
Furunculosis	x	x	x
IHN	x		
ERM		x	
BKD		x	
<u>Gyrodactilus</u>			x
<u>Trichodina</u>			x

Salmincola and Furunculosis were present in all of the systems studied. In addition, each stream contained agents which were unique and not found in others. However, except for IHN in the Mussel Creek sockeye, none of the problems were severe enough to preclude operation of a central enhancement facility for the Knight Inlet area (G. Hoskins, pers comm).

3.9.3 Potential Egg Take Sites and Methods

Glendale Creek

A fence and upstream trap at the location of the old fisheries fence just below the confluence of Glendale Creek and Tom Browne Creek would be the best location to capture adults for an egg-take. When the Fisheries Research Board built their fence in this area, they found that it was necessary to build an extremely solid structure which could withstand submersion during storm freshets.(F.C. Withler, pers comm). Although fence construction at this location is expensive, the site is close to the hatchery where adults could be held and below the main spawning grounds. Beach seining adult chum and pinks on the spawning grounds would interfere less with the wild stock, but a greater number of adults could be captured with a trap. Little holding would be required as the fish did not move upstream until they were fairly mature.

Mussel Creek

Chinook collections for an egg-take could either be made by seining on the spawning grounds or by trapping in the lower reaches. The most accessible place to build a trap would be at the mouth of the creek where the first bridge crosses. However, since the fish are bright when they pass this spot in July to August, high holding mortalities could result. In addition, operating a trap in this area could be awkward as the Klinaklini River makes the water very turbid in this area and, at times causes flow reversals.

A more suitable spot to construct a trap might be at the top of Reach 1. Although this area is several hundred meters from the road, it can be reached by boat. As the system is lake

fed, carries little debris, and is very stable, a temporary, broom-stick fence should be sufficient. The trap could be left open to allow the fish that hold and spawn in Reach 4 to pass by, then closed during the last week in August or beginning of September to capture these chinook that hold in Reach 1 before moving into Reaches 2 and 3 to spawn. In 1981 these fish started to move during the middle of September and were more mature than those that passed earlier and could have been taken with fewer holding mortalities. The one problem with this area is the large population of bears which might harass fish or field crew and cause damage to the trap. Holding pens could be placed in some of the pools that are up to 3 m deep where bears would be less likely to get at them although the best way to avoid bears may be to truck fish up to holding pens located on Mussel Lake.

An alternative would be to beach seine spawning chinooks in Reach 4. Holding mortalities and bears would be less of a problem with this method. The chinook hold in schools of 25 to 100 fish during the day and seem to move on to the spawning grounds during the night, particularly at the beginning of spawning. It may be more difficult to get as many fish as with a trap, and high water levels during spawning could hamper seining efforts. Net seining would interfere less with wild stock, especially unwanted species, and would involve handling only those fish that are to be used for brood stock.

Coho from Mussel Creek would have to be caught with an upstream trap because they tend to spawn during high water levels and are not very concentrated. Coho could be trapped either in Reach 1 or at the bottom of Reach 7. A trap in Reach 7, close to Mussel Lake, would be easier to manage and construct than in Reach 1 because there is a smaller discharge and the coho could be held in pens in the lake. Most of the

coho spawned in Reach 6, however the majority of them did not move into this section until they were almost ready to spawn, near the end of October. There are some potential problems in that the fish this year seemed to move at a time of higher discharge when trap management would be difficult. The alternative would be a trap in Reach 1 which would catch less mature fish so holding them would be more of a problem.

Because chum and pinks are few in number and scattered in distribution, they also might be easiest to capture in a trap. Chum appear to move into Reach 2 from Reach 1 to spawn when they are mature, so there would be little or no holding time required for them to ripen for an egg-take. The chum started to appear in Reach 2 during the second week of October and pinks started to appear during the end of August.

Ahnuhati River

A broomstick fence and trap on this stream would be difficult to construct and harder to maintain. The river is fairly large and can rise rapidly during heavy rain in the watershed. This was demonstrated on October 1 when the river rose 2.2 m after two days of rain totalling 88 mm. Chums and pinks could be seined in the lower 4.8 km which is accessible by road from the mouth. Chinook, however, would either have to be caught in the lower section when they pass through in June and July, or caught on the spawning grounds higher up. Because these fish are in the river from one to two months before spawning, there could be holding problems if brood stock were taken in the lower reaches. In the upper reaches, capturing chinooks on the spawning grounds would be both expensive and difficult since this area is not very accessible, their numbers are low, and they are sparsely distributed.

Franklin River

Coho spawning in the small tributaries in October and November could be caught in upstream traps in the lower reaches. Enhancement would be limited by the small amount of rearing habitat.

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APPENDIX 1
WEATHER RECORD
at Knight Inlet Forest Fire Weather Station

	JULY		AUGUST		SEPTEMBER		OCTOBER	
	Temp	Precip	Temp	Precip	Temp	Precip	Temp	Precip
1	18 °C	- mm	23	-	15.5	35.1	13	58.8
2	18	0.5	21.5	-	16.5	0.6	10	0.1
3	21	2.0	22	-	12	1.4	10.5	1.5
4	21.5	-	26.5	-	17	4.7	11	-
5	17	-	26	-	17	0.1	9	2.0
6	19.5	-	25	-	20.5	-	9	10.1
7	16	-	30	-	25	-	11	7.5
8	17	0.1	30.5	-	24	-	11	6.5
9	19	2.5	30.5	-	15.5	8.3	12	3.5
10	21	-	27	-	18	0.4	12	-
11	19	-	22	-	19	-	14	-
12	22	-	21	-	18	-	15	-
13	19.5	-	22	-	17	-	13.5	0.2
14	22	-	23	-	18.5	-	14	-
15	22.5	-	21.5	-	23	-	13.5	0.1
16	27.5	-	21.5	-	23	-		
17	26	-	23.5	-	17	-		
18	24	-	26	-	12	29.4		
19	22	4.0	20	-	14	25.2		
20	22	-	21	-	14	-		
21	20.5	-	19	-	12.5	16.7		
22	21.5	-	17	0.5	13.5	5.0		
23	21.5	-	19.5	-	13	-		
24	23.0	-	18.5	10.0	13	-		
25	24.0	-	15	9.5	14.5	-		
26	23.0	-	16.5	3.0	14	-		
27	22.0	-	11	5.9	9.5	4.0		
28	20.0	-	12.5	9.4	12	21.7		
29	18.0	5.0	18	6.5	11	-		
30	19.0	0.3	18.5	-	9.5	28.9		
31	21.0	-	12.5	8.5				

APPENDIX II

STREAMFLOW AND TEMPERATURE

STATION: Mussel Creek

Month: July

Month: August

A2

Date	Temperature (°C)				Streamflow	
	time	max	min	prcnt	level (m)	discharge (m ³ /sec)
22	P.M.			16.5	0.41	
23	P.M.			16.5	0.41	
26	A.M.			16.0	0.42	
27	A.M.			16.0	0.42	
30	A.M.			15.0	0.41	
31	A.M.			15.5	0.39	

Date	Temperature (°C)				Streamflow	
	time	max	min	prcnt	level (m)	discharge (m ³ /sec)
3	0900			16.0	.38	
5	0900			15.0	.38	
7	1200			17.5	.38	
8	1700	19.5	16.5	19.5	.42	
9	0900	18.0	16.5	16.5	.41	
10	0830	19.0	16.0	16.5	.42	
11	1945	19.0	16.0	19.0	.43	
12	0900	19.0	16.0	17.0	.43	
13	0930	18.0	14.5	18.0	.43	
14	0930	18.0	15.5	16.0	.42	
15	0745			16.0	.41	
16	2100			19.5	.41	
17	0900	19.0	17.0	16.0	.41	
19	0900	21.5	16.0	18.5	.39	
20	0900	19.0	17.5	18.0	.40	
21	0900	20.0	16.0	18.0	.38	
22	0900			18.0	.38	
24	1500	16.0	14.5	16.0	.39	
25	1630	17.0	15.0	15.0	.39	
26	1300	15.0	13.5	15.0	.38	
28	2000	17.0	13.5	15.0		
29	0830	14.0	13.5	13.5	.37	
30	0800			13.5	.37	
31	0800	16.0	13.0	14.0	.37	

APPENDIX II

STREAMFLOW AND TEMPERATURE

STATION: Mussel Creek

Month: September

Month: October

Date	Temperature (°C)				Streamflow	
	time	max	min	prcnt	level (m)	discharge (m ³ /sec)
1	0800	15.0	12.0	13.0	.41	
2	0730	15.0	13.0	14.0	.39	
3	0800	15.0	14.0	14.0	.38	
4	1900	14.5	12.5	14.5	.37	
5	0900	14.5	13.5	13.5	.36	
6	0800	15.0	13.0	13.0	.35	
8	0715			14.0	.36	
9	0800	16.0	13.0	14.0	.37	
10	1330	15.0	14.0	15.0	.37	
11	0830			14.0	.36	
12	0730	16.0	14.0	14.0	.36	
13	1730	16.0	13.0	15.0	.36	
14	0730	15.0	14.0	14.0	.34	
15	0730	15.0	13.0	13.0	.34	
17	0820	16.0	13.0	14.0	.34	
18	0830	15.5	12.5	14.0	.39	
19	0900	13.5	11.5	12.5	.42	
21	0830		12.0	12.0	.39	
22	0745	13.0	12.0	12.0	.38	
23	0730	13.0	12.0	12.0	.38	
24	0845	13.0	11.0	11.0	.35	
25	0730	13.0	11.0	11.0	.33	
28	0800			12.0	.33	
29	1130			12.0	.33	
30	0830			11.0	.36	

Date	Temperature (°C)				Streamflow	
	time	max	min	prcnt	level (m)	discharge (m ³ /sec)
1	0800			11.0	.58	
2	1700			12.0	.56	
3	0745			11.0	.53	
4	0730			10.5	.44	
5	0945			11.0	.42	
6	0800			11.0	.40	
7	0930			10.5	.41	
8	1400	12.0	11.0	11.0	.42	
11	1400			10.0	.41	
12	1130			9.5	.39	
13	1130	9.5	9.0	9.5	.39	
14	0750	11.0	9.0	9.0	.37	
15	0800	11.0	9.0	9.0	.36	1.3
16	0730	11.0	9.0	9.5	.36	
17	0720	11.0	9.0	10.0	.34	
18	0815	10.5	9.0	9.5	.33	
19	1900	10.0	9.0	10.0	.33	
20	0645	10.0	8.5	8.5	.33	
21	0915	10.0	8.0	8.0	.32	
22	0950	9.0		8.0	.32	
23	0715	9.0	7.5	8.0	.31	
25	0815	9.0	8.5	9.0	.31	
26	0715	10.0	9.0	9.0	.31	
27	0715	9.0	8.0	8.0	.34	
28		8.5	8.5	8.5		
29	0800	8.5	8.5	8.5	.43	
30	0750	8.5	8.5	8.5	.43	

APPENDIX II

STREAMFLOW AND TEMPERATURE

Franklin River

Date	Temperature (°C)				Streamflow	
	time	max	min	prsnt	level (m)	discharge (m ³ /sec)
July 27	1100			2.0	1.25	
Aug. 2	1000			4.0	.80	
7	1400			3.0	1.34	
13	1140			3.8	1.26	
17	1100			1.5	.98	
19	1100			2.0	.88	
26	1000			1.0		
Sept. 1	1300			3.0	.60	
6	1700			8.0	.48	
14	1500			2.5	.42	
17	1500			1.5	1.36	
21	2000			1.5	.28	
29	1400			4.5	-.05	
Oct. 1	0900			5.0	.60	
7	1600			5.0	.02	
15	1300			6.0	-.14	
17	0750			3.0	-.15	
25	1600			3.0	-.15	
29	1600			4.0	-.25	

Ahuhati River

Date	Temperature (°C)				Streamflow	
	time	max	min	prsnt	level (m)	discharge (m ³ /sec)
July 25	1100			11.0	1.03	
28	1600			10.0	.90	
29	1200			10.0		
Aug. 4	1300			11.0	.74	
10	1400			13.0	.85	
11	0900			12.0	.85	
16	0945			12.0	.70	
18	1200			12.0	.68	
23	1200			12.5	.62	
25	1130			11.0	.99	
31	1100			11.0	.65	
Sept. 3	1100			10.5	.76	
4	0930			10.0	.81	
8	1700			13.0	.65	
9	1200				.89	
15	1300			10.0	.52	
16	0940			10.5	.52	
23	1300				.80	
Oct. 1					3.00	
3	1000			8.0	.91	
10	1000				.93	
18	1200			8.0	.85	
20	1700			7.5	.82	
26	1200			8.0	.84	

APPENDIX III
CARCASS RECOVERY

Stream: Glendale Creek

Species: Chum

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition	
Sept. 28	F	55.5 cm.	-	-	Spawnd	
	F	56.5	-	-	Spawnd	
Oct. 17	F	62.0	2	5	Spawnd	
	F	56.0	50	3	Spawnd	
	F	58.0	2	3	Spawnd	
	M	63.2	-	4	Spawnd	
	M	58.0	-	4	Spawnd	
	F	64.7	-	4	Spawnd	
	M	82.0	-	4	Spawnd	
	M	83.0	-	4	Spawnd	
	F	69.5	-	5	Spawnd	
	M	58.0	-	-	Spawnd	
	M	65.0	-	5	Spawnd	
	F	57.2	-	4	Spawnd	
	Oct. 24	M	51.0	-	3	Spawnd
		F	59.5	-	4	Spawnd
F		61.0	0	4	Spawnd	
F		58.0	0	3	Spawnd	
F		52.0	0	-	Spawnd	
F		56.0	0	4	Spawnd	
M		54.0	-	3	Spawnd	
F	60.5	0	3	Spawnd		
M	50.0	-	3	Spawnd		
F	59.0	1	4	Spawnd		

APPENDIX III
CASCASS RECOVERY

Stream: Glendale

Species: Pink

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Sept. 13	F	46.7 cm.		2 ₁	Pink
	M	43.5		2 ₁ 1	Mature
	M	47.0		2 ₁	Bright
	M	40.2		-	Pink
	M	45.0		-	Pink
	F	39.7		2 ₁	Spawned
	M	36.3		2 ₁	Pink
	M	43.6		-	Pink
	M	47.0		-	Spawned
	F	47.0		2 ₁	Mature
28	F	43.5			Spawned
	F	42.0			Spawned
	F	43.0			Spawned
	M	46.0			Spawned
	F	42.5			Spawned
	M	47.0			Spawned
	M	46.0			Spawned
	M	49.0			Spawned
	M	47.0			Spawned
	F	44.0			Spawned
F	48.5			Spawned	
M	50.5			Spawned	
M	50.0			Spawned	

APPENDIX III
CARCASS RECOVERY

Stream: Glendale

Species: Pink

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Sept. 28	M	51.5 cm.			Spawned
	F	43.0			Spawned
	F	45.0			Spawned
	M	48.5			Spawned
	F	45.0			Spawned
	M	53.5			Spawned
	M	48.5			Spawned
	M	41.0			Spawned
	F	43.5			Spawned
	M	44.5			Spawned
	M	47.5			Spawned
	F	44.5			Spawned
	F	43.0			Spawned
	F	43.5			Spawned
	M	49.5			Spawned
	M	47.0			Spawned
	M	48.5			Spawned
	M	48.5			Spawned
	M	44.5			Spawned
	M	40.0			Spawned
M	51.0			Spawned	
M	38.0			Spawned	
F	43.0			Spawned	

APPENDIX III
CARCASS RECOVERY

Stream: Mussel Creek

Species: Coho

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Sept. 19	F	54.3 cm.	2534	3 ₂	Green
30	F	57.0	3600	3 ₂	Green
Oct. 11	M	59.0	-	4 ₃	Mature
14	F	62.0	-	3 ₂	Mature
	F	60.0	5864	3 ₂	Mature
	M	48.0	-	R	Mature
	F	39.5	-	3 ₂	Mature
	F	46.0	-	R	Mature
22	F	59.3	-	3 ₂	Mature

APPENDIX III
CARCASS RECOVERY

Stream: Mussel Creek

Species: Chinook

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Aug. 31	F	78.0 cm.	-	5 ₂	Green
Sept. 19	M	60.7	-	R	Mature
30	M	35.0	-	R	Spawnd
	M	50.0	-	R	Spawnd
	M	29.5	-	-	Spawnd
	M	29.5	-	-	Spawnd
	M	24.5	-	-	Spawnd
Oct. 5	F	74.5	0	5 ₂	Spawnd
	M	34.5	-	R	Spawnd
	F	78.0	3	6 ₂	Spawnd
	M	47.5	-	R	Spawnd
	M	51.5	-	R	Spawnd
	M	65.5	-	3 ₂	Spawnd
	M	60.0	-	3 ₂	Spawnd
	M	52.5	-	R	Spawnd
	M	55.0	-	R	Spawnd
	M	32.0	-	-	Spawnd
Oct. 6	F	77.5	20	5 ₂	Spawnd
	M	35.0	-	-	Spawnd
	M	66.5	-	3 ₂	Spawnd
	M	57.5	-	R	Spawnd
	F	67.5	-	R	Spawnd

APPENDIX III
CARCASS RECOVERY

Stream: Mussel Creek

Species: Chinook

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Oct. 11	F	61.0 cm.	-	R	Spawnd
	F	72.0	0	5 ₂	Spawnd
	M	75.5	-	5 ₂	Spawnd
	M	75.0	-	5 ₂	Spawnd
	M	47.0	-	-	Spawnd
	F	75.0	2	5 ₁	Spawnd
	F	78.0	0	5 ₂	Spawnd
Oct. 14	F	73.0	-	-	Spawnd
	F	74.0	-	-	Spawnd
	M	51.2	-	R	Spawnd
	M	65.5	-	4 ₂	Spawnd
	M	32.5	-	-	Spawnd
	F	56.0	0	5 ₂	Spawnd

APPENDIX III
CARCASS RECOVERY

Stream: Mussel Creek

Species:

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Oct. 22	Chum M	61.5 cm.	-	4	Spawned
	Sockeye F	39.5	100%	4 ₂	Green
	F	51.5	-	5 ₂	Spawned

APPENDIX III
CARCASS RECOVERY

Stream: Ahnahati River

Species: Chum

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Aug. 6	F	59.4 cm.	0	-	Spawnd
18	F	60.5	80%	-	Spawnd
25	M	62.5	-	-	Spawnd
	F	60.5	-	-	Spawnd
	F	68.5	-	-	Spawnd
Sept. 5	F	53.5	0	3	Spawnd
	F	54.7	15 eggs	3	Spawnd
	M	65.5	-	4	Spawnd
	F	52.7	0	3	Spawnd
	M	59.0	-	3	Spawnd
	M	62.0	-	3	Spawnd
	F	60.0	-	4	Spawnd
	M	63.0	-	3	Spawnd
	M	57.5	-	3	Spawnd
8	F	58.0	200	4	Spawnd
	M	60.0	-	3	Spawnd
	M	54.0	-	-	Spawnd
16	F	54.5	-	3	Spawnd
	F	54.3	100	3	Spawnd
	F	55.0	70	3	Spawnd
	F	58.5	250	3	Spawnd
	M	47.3	-	-	Spawnd

APPENDIX III
CARCASS RECOVERY

Stream: Ahnuhati River

Species: Pink

Date	Sex	P.O.H. Length	Egg Retention	Age	Condition
Sept. 3	M	50.5 cm.			Spawnd
Sept. 16	F	43.6			Spawnd
	F	43.5			Spawnd
	F	42.5			Spawnd
	F	47.1			Spawnd
	F	44.0			Spawnd
	F	45.0			Spawnd
	F	44.0			Spawnd
	F	47.8			Spawnd

APPENDIX IV

STREAM SURVEY

Stream: Glendale Creek

Species: Chum

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	Oct. 17		5	6
	24			10
2	Sept. 26		7	
	Oct. 17		322	10
	24		65	15
3	Sept. 20		2	
	26		3	4
	Oct. 24			1
5	Oct. 16			1

APPENDIX IV

STREAM SURVEY

Stream: Glendale Creek

Species: Coho

Stream Section	Date	Number Holding	Number Spawning	Carcasses
2	Aug. 26	2		
	Sept 2	4		
3	Sept. 7	2		
	Oct. 18	1		
4	Sept 26	6		
	Oct 18	14		
5	Sept 12	10		
	25	6		
	Oct. 18	85		
Glendale Lake	24	100-200		

APPENDIX IV

STREAM SURVEY

Stream: Glendale Creek

Species: Pink

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	July 24	100		
	Aug. 1	100		
	8	100		
	15	1300		
	20	2000		
	27	4000		
	Sept. 2	2500-3500		
	7	10000-15000		
	12	10,500		
	20	7000		
	27	4000-9000	1000	
Oct.	17		258	300
	24		15	
2	Aug. 3	2		
	27	300		
	Sept. 2	750		
	7	1500	100	2
	12	1400	100	
	20	800	800	1
	27		2400	14
Oct. 17		500	179	
3(a)	Aug. 1	5		
	8	10		
	15	30		
	27	100		
	Sept. 2	2000		2
	7	1500	100	2
	12	2800	100	
	20	950	260	
	27	100	1300	124
	Oct. 17		180	400
3(b)	Sept. 2	4000-5000		
	7	4000	100	2
	12	4000	200	
	20	1060	2300	7
	26		5300	130
	Oct. 17		200	304
4	Sept. 26		1700	30
	Oct. 17		30	153
5	Sept. 26	400	3200	106
	Oct. 17		376	574

APPENDIX IV
STREAM SURVEY

Stream: Glendale Creek

Species: Sockeye

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	Aug. 1	2		
2	Sept. 12	2		
3	Aug. 1	1		

APPENDIX IV
STREAM SURVEY

Stream: Mussel Creek

Species: Chum

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	Oct 7	20		
	Oct 21	60		1
2	Oct 13		10	
	22		68	
	29		70	

APPENDIX IV

STREAM SURVEY

Stream: Mussel Creek

Species: Chinook

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	July 26	15		
	Aug. 5	200		
	14	100		
	24	100		
	29	450		
	Sept. 5	350-450		
	22	150		
Oct. 7	50		4	
2	July 26	5		
	Aug. 5	10		
	29	30		
	Sept. 17		30	
	Oct. 5		80	
	13		20	5
	21		0	0
3	Sept. 24		150	
	Oct. 3		90	20
4	July 31	100		
	Aug. 5	105		
	9	100-200		
	14	200-250		
	19	200		
	26	400-500		
	Sept. 5	550-650		
	11	470-550		
	19		75-100	
	24	480	160	4
	30	250	250	60
Oct. 5		275	20	
	11	42	12	
	14		10	

APPENDIX IV

STREAM SURVEY

Stream: Mussel Creek

Species: Coho

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	Aug. 29	50-70		
	Sept. 5	60-65		
	22	40-50		
	Oct. 7	60		
	21	125		
2	Oct. 22		5	
	29		5	
4	Sept. 30			
	Oct. 14	30		
	22 30	50	150	
6	Aug. 26	100		
	Sept. 1	200		
	10	200		
	15	200		
	30	30 (poor count)		
	Oct. 21 25		20 5	
7	Sept. 24	12		
	Oct. 21 29	50	50 300	2 10

APPENDIX IV

STREAM SURVEY

Stream: Mussel Creek

Species: Sockeye

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	Sept. 22	4		
	Oct. 21	10	10	2
4	Sept. 5	8		
	11	10		
	24	20		
	30		21	
	Oct 11		4	

APPENDIX IV

STREAM SURVEY

Stream: Ahnuhati River

Species: Chum

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	July 23	1		
	28	40		
	Aug. 4	3		
	10	2		
	16	20		
	Sept. 3	10		
	15	1		
	Oct. 1			
2 (a)	Aug. 4	100-200		
	10	100		
	16	20		
	Sept. 3	20		
2 (b)	Aug. 4	300		
	10	500-1000		
	16	300		4
	Sept. 3	300	200	25
	15		30	20
	23		1	
	Oct. 18	1		
2 (c)	Aug. 4	120		
	11	400		
	Sept. 4	100	100	60
	16		9	25
2 (d)	Aug. 4		20	1
	11	100	20	3
	18		300	
	23		300	
	Sept. 4		200	5
4	Sept. 8		100	50

APPENDIX IV
STREAM SURVEY

Stream: Ahnuhati River

Species: Coho

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	Aug. 28	30		1
	Sept. 3	50		
	15	50		
	23	60		
	Oct. 18	2		
2 (a)	Sept. 3	200		
	15	100		
	23	60		
	Oct. 18	190		
	26	100		
2 (b)	Sept. 3	800		
	15	150		
	23	200		
	Oct. 18	280		
	26	175		
2 (c)	Sept. 3	400		
	16	300		
	25	200-250		
	Oct. 3	200-300		
	20	320		
4	Oct. 20	845		

APPENDIX IV

STREAM SURVEY

Stream: Ahnuhati River

Species: Chinook

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	July 28	8		
2	July 28	10		
	Aug. 4	5-10		
	16	2		
	Sept. 5	1		
	15	2		
	16			1 (Jack)
4	Sept. 5		33	3

APPENDIX IV

STREAM SURVEY

Stream: Ahnuhati River

Species: Pink

Stream Section	Date	Number Holding	Number Spawning	Carcasses
1	July 28	100-200		
	Aug. 10	100		
	16	10		
	25	2		
	Sept. 3	200		
	15	50		
2 (a)	23	2		
	July 28	10		
	Aug. 4	300		
	10	100		
	16	60		
	Sept. 3	250		
2 (b)	15	150		
	23	10		
	July 28	10		
	Aug. 4	700		
	10	500-1000		
	16	1300		
2 (c)	Sept. 4	1500	400	
	15	250	100	50
	23	100	100	150
	July 29	1		
	Aug. 6	200-300		
	11	500		
2 (d)	18	500		
	23	500		
	Sept. 4	300	500-700	
	16	200	300	100
	25	5	250	20
	Oct. 3		100	5
4	Aug. 6	10		
	11	50		
	18	50		
	Sept. 4	15	120	5
	16		75	35
	25		45	
4			200-300	5

APPENDIX IV
STREAM SURVEY

Stream: Ahnuhati River

Species: Sockeye

Stream Section	Date	Number Holding	Number Spawning	Carcasses
2	Sept. 16 25	1	4	
4	Oct. 3	1	2	



MEMORANDUM NOTE DE SERVICE

TO A → Bruce Shepherd
 New Projects Coordinator
 1090 West Pender Street
 Vancouver, B.C.

FROM Gary Hoskins
 DE Diagnostic Service
 Pacific Biological Station
 Nanaimo, B.C.

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE -- N / RÉFÉRENCE 25-16-1
YOUR FILE -- V / RÉFÉRENCE
DATE January 11, 1982

SUBJECT Mussel Creek Disease Survey
 OBJET

Samples were collected from Mussel Creek, head of Knight Inlet, on October 13, 1981. All were examined for pathological anomalies which may influence fish survival. Procedures used were:

1. Gross external and internal examination;
2. Assay for the detection of viral disease agents;
3. Aseptic streaking of kidney tissue onto TSA culture medium;
4. Examination of stained kidney tissue smears for foreign agents;
5. Detailed dissection of the viscera for unusually severe level of parasite infection;
6. Examination of the flesh for lesions caused by the parasite Henneguya sp.

The samples collected consisted of:

<u>Case Number</u>	<u>Species</u>	<u>Number of Fish</u>
81-403	Chum	4
81-398	Chinook	13
81-402	Kokanee	30
81-402	Sockeye	3
81-404	Coho	3

The samples were collected with the assistance of Mr. T. Slaney. Unfortunately, the chum, coho and chinook runs were almost over and few suitable (spent) fish were available. In the absence of sufficient numbers of these species, thirty spent kokanee were collected by electroshocking and examined as outlined above.

Results and observations

Chum - all fish were judged to be in normal condition for spent salmon.
 - one was lightly infected by furunculosis.
 - all lightly infected by the copepod, Salmincola.

Chinook - 5/13 infected by furunculosis. This is a rather high incidence for wild chinook.
 - very light infections by Salmincola and the kidney protozoan parasite, Myxidium, were found.
 - because of a shortage of live, spent fish less suitable, dead, partially decayed specimens were included.

.... /2

Kokanee - most fish collected were completely spent, all were in excellent physical condition, free of abrasions, fungus or external parasites. An unspent female, approximately 170 cm in length, contained 350 eggs.
- the notable diseases or disease agents found were furunculosis, Salmincola, Philonema (a nematode in the body cavity) and Chloromyxidium (a gall bladder protozoa).

Sockeye - only three examined, but one was collected, unspawned in a moribund condition. The virus assay was positive for infectious hematopoietic necrosis (IHN) and may explain the moribund condition of this particular fish.
- no other important infectious agents were found.

Coho - except for light infections of Salmincola and Myxidium no remarkable infections were found.

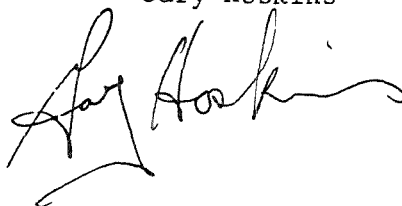
Summary

The rather high incidence of furunculosis in the chinook and the IHN found in the sockeye are the only diseases encountered which may influence the success of any intensive culture activity planned for this area. Furunculosis is a major cause of losses among cultured salmonids throughout North America. In British Columbia, although other species of salmonids are known carriers, IHN causes problem only among sockeye and kokanee.

No abnormally heavy levels of parasite infection or other pathological conditions such as neoplastic tumors were found.

No evidence was found in any species of infection of the muscles by the protozoa, Henneguya. And, except for the single sockeye, no prespawning losses or moribund fish were encountered.

Gary Hoskins



GH:pd