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PRELIMINARY RESULTS OF A BASELINE STUDY
OF THE LOWER TSITIKA RIVER AND ESTUARY,
MAY, JUNE AND JULY, 1979

*Habitat Protection Division,
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INTRODUCTION

In response to a request from the Tsitika Follow-up Committee a pilot investigation was undertaken by the Habitat Protection Division, Resource Services Branch, Department of Fisheries and Oceans, to examine the fisheries resources associated with the Lower Tsitika River, estuary and marine foreshore. The study was cursory in nature in view of the short notice for its commencement (Spring 1979) and the lack of supportive resources made available for the program. The estuary study was precipitated principally by the log handling facility proposed by MacMillan Bloedel Ltd. As the estuary site was only one of a number of options that are currently under review, a major program was not considered appropriate at this time.

The 39,518 ha, 42 km long Tsitika River watershed is located on northeastern Vancouver Island, approximately midway between Kelsey Bay and Port McNeill (see Figure 1). The broad U-shaped valleys rise from sea level to 1,769 m in elevation. The two main tributaries are Catherine and Claud Elliot Creeks. The elevation of the drainage area

ranges from sea level to 1,769 m. Precipitation at lower levels averages about two hundred and fifty-four cm per year. Tsitika River mean monthly discharges are tabulated for the years 1975, 1977 and 1978 (Table 1).

The Tsitika River and tributaries support one of the most diverse fisheries resources on Vancouver Island. Anadromous salmon species that return to the river each year include approximately 6,000 pink salmon (Oncorhynchus gorbuscha), 1,200 chum salmon (Oncorhynchus keta), 2,000 coho salmon (Oncorhynchus kisutch) and a small number of sockeye (Oncorhynchus nerka) and chinook salmon (Oncorhynchus tshawytscha). Anadromous trout species include approximately 3,500 summer and winter-run rainbow (steelhead) trout (Salmo gairdneri), and an unknown number of cutthroat trout (Salmo clarki clarki) and Dolly Varden char (Salvelinus malma) (see Table 2). Resident stream and lake populations include rainbow and cutthroat trout, Dolly Varden char and the prickly sculpin (Cottus asper). The Pacific lamprey (Entosphenus tridentatus) is also found in the drainage.

Pink and chum salmon are confined to the lower reaches of the Tsitika River by a canyon and 1.2 m waterfall located 3.2 km upstream of tidewater. Coho salmon and steelhead trout are found throughout the drainage. Resident species

are found throughout the system particularly in the Tsitika and Claud Elliot mainstems and Claud Elliot and Fickle Lakes.

The role of estuaries in the early life history of salmonids is only now just being more fully understood. Perhaps the most sensitive area in any watershed is the estuary. This is where the river meets the sea. It has been defined in the physical sense as "a semi-enclosed body of water which has a free access to the open ocean and within which sea water is measurably diluted with fresh water derived from land drainage" (Pritchard, 1967). However, ecologically, an estuary is a living system. It abounds with all forms of life, from bacteria to tiny crustaceans to fish and wildlife. It undergoes almost violent fluctuations diurnally with changing sea levels, as the tide rises and falls, exposing the tide flat habitat to occasionally freezing temperatures in winter and warm, desiccating conditions sometimes in summer. Seasonally, conditions may range from extremely large river discharge, as a result of snow melt, high precipitation and runoff; to acutely low flows when temperatures are high and precipitation is absent or small. Thus plants and animals surviving in this harsh environment must be able to withstand large and often abrupt changes in conditions. Species that cannot withstand such changes are eliminated, and through the process of natural selection,

the hardier forms survive. The resulting populations consist of relatively few hardy species. Temperate estuaries are considered to be areas of comparatively low species diversity.

The food web in an estuary is rather complex, the strands of which represent the pathways by which food, and therefore energy, moves from the producers to the consumers. Each strand radiating from the centre of the food web represents a particular food chain, and the strands running concentrically around the centre of the web represent the different trophic levels or level of phylogenetic development in the food chain. The number of food chains in an estuary is rather small because of the limited number of species which survive the naturally stressed conditions. Therefore, one must regard the estuarine ecosystem as quite vulnerable, because of the few pathways by which energy can move from the primary producers to the consumers at the top of the food pyramid (i.e., salmonids).

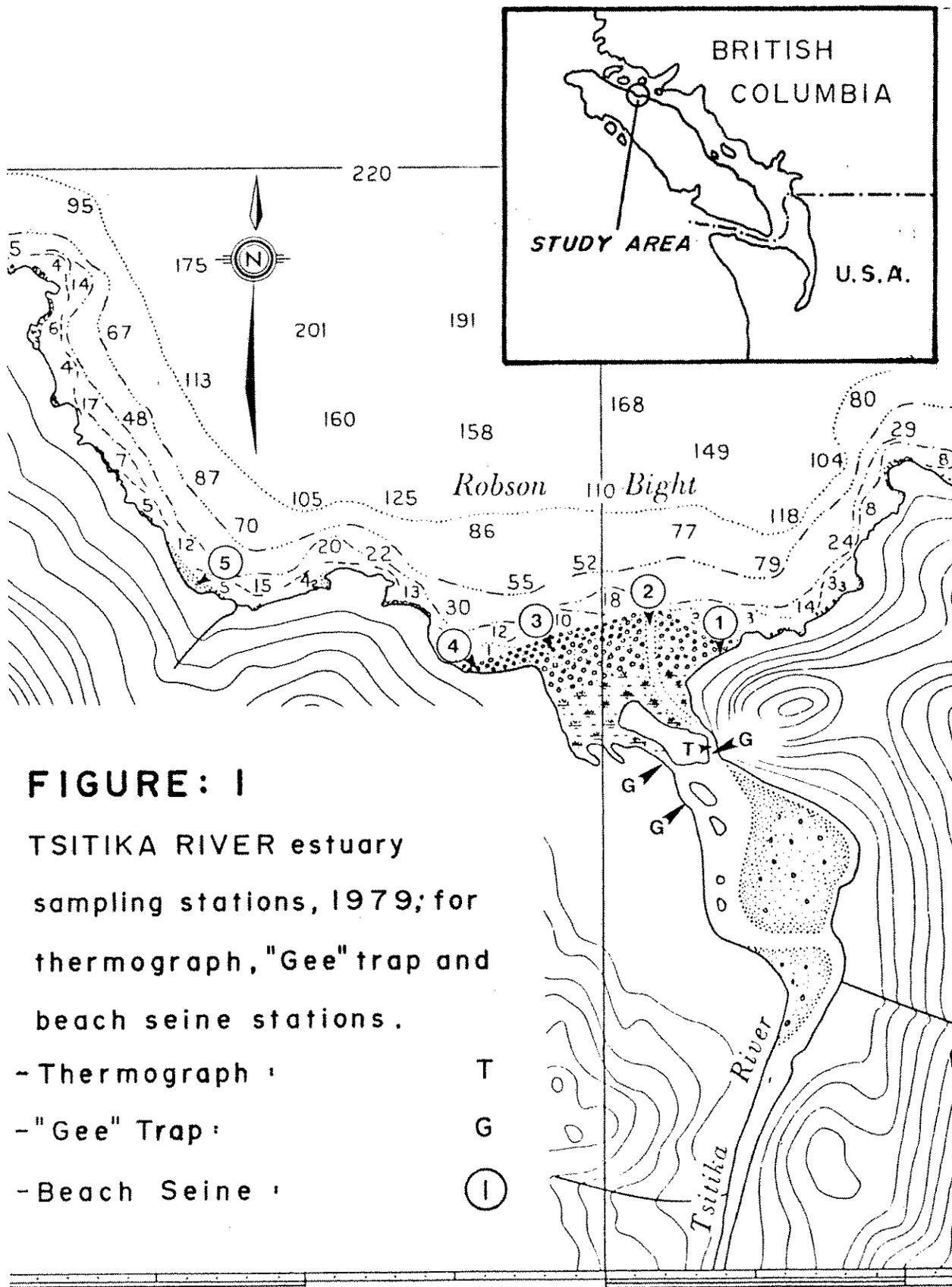
The Tsitika Estuary Study was designed to satisfy the following objectives:

- (1) To determine the extent and duration of juvenile salmonid distribution and utilization of the Lower Tsitika River and its estuary.
- (2) To assess the ecological requirements of the various juvenile salmonid species as identified in the analysis of their distribution relative to various estuarine and lower river habitat types.
- (3) To examine the presence and extent of other associated estuarine and marine fisheries resources.

*missed points & chum
i.e. in estuary & also
sampled*

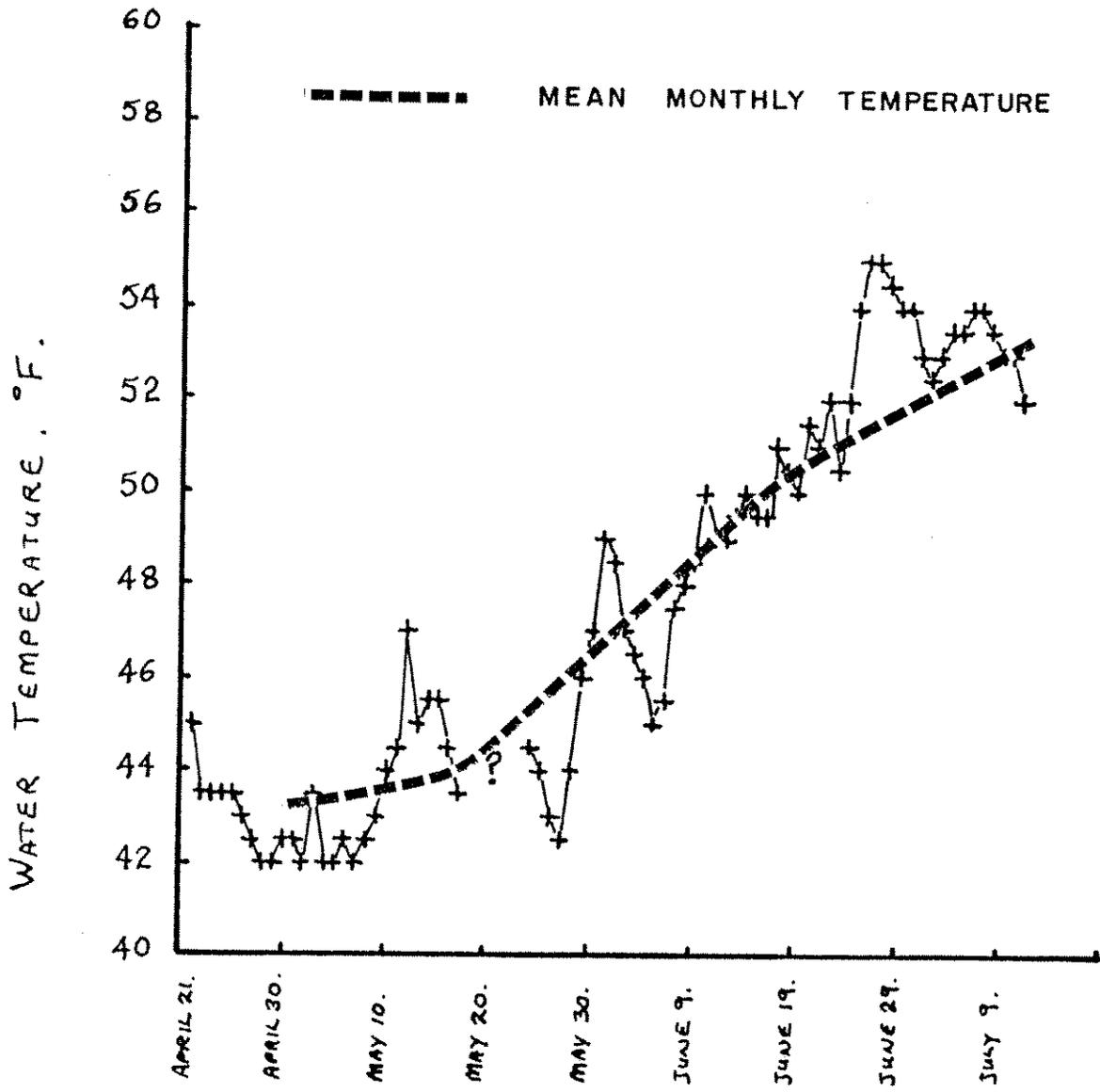
*subgrass beds
highly productive*

This report outlines the results of the 1979 Sampling Program, including the relative distribution of the salmonid species through the study period, their age classes, sampling effort and length/weight relationships. Analysis of diet (stomach data) is in progress, nearing completion, and designed to form an appendix to this report when finalized.



TSITIKA RIVER 1979

FIGURE 2



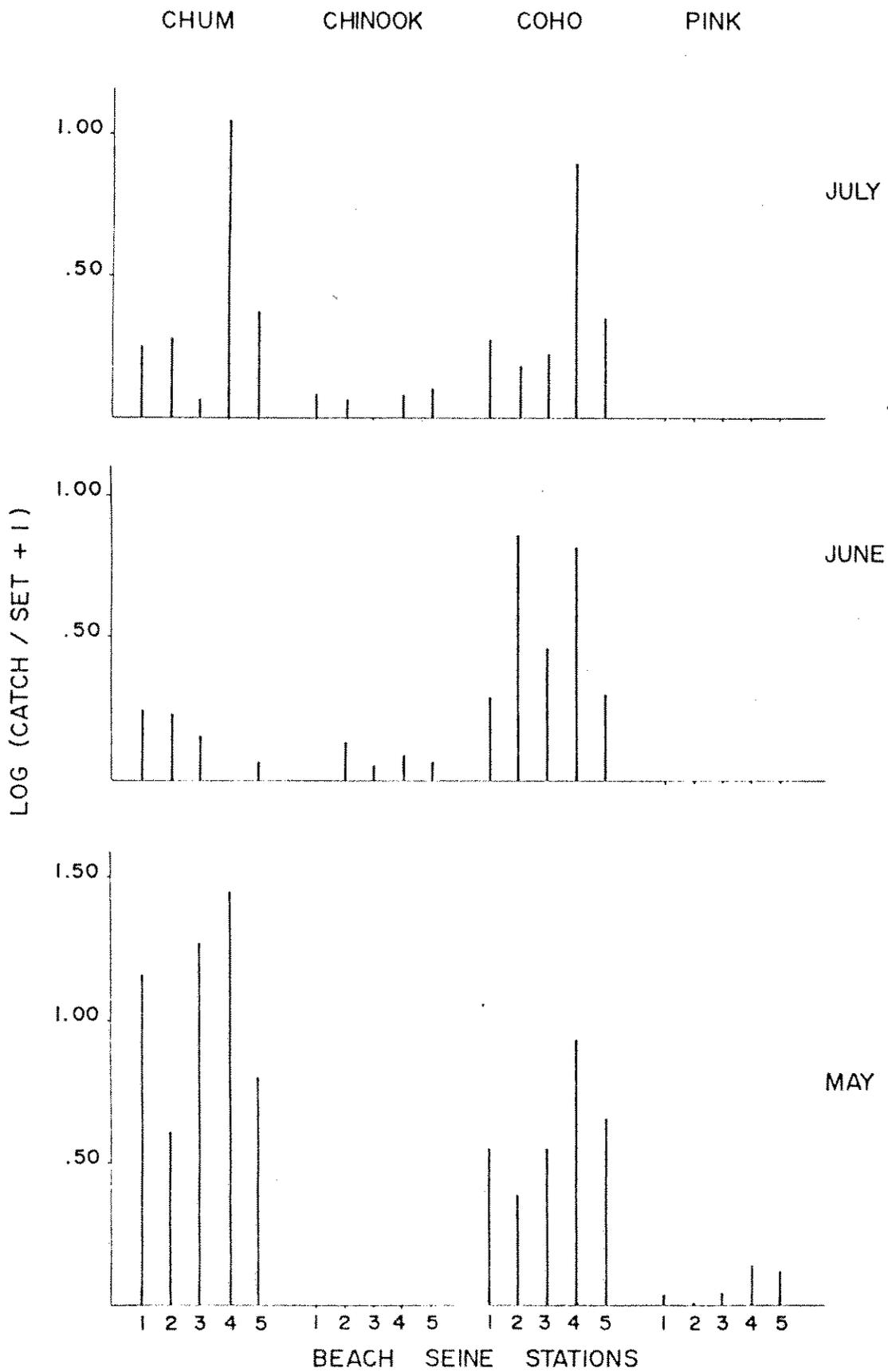


FIGURE 3 : EFFORT HISTOGRAMS FOR COHO, CHINOOK, CHUM AND PINK CAPTURED AT BEACH SEINE STATIONS 1 THROUGH 5 DURING MAY, JUNE and JULY 1979 ON THE TSITIKA ESTUARY

TABLE 1: MEAN MONTHLY DISCHARGES FOR TSITIKA RIVER BELOW
 CATHERINE CREEK FOR THE YEARS 1975, 1977 & 1978

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
1975	652	330	406	478	1,200	1,120	492	363	143	1,020	3,640	1,410	938
1977	470	1,240	893	1,120	691	615	422	125	199	1,100	1,570	1,010	784
1978	608	655	942	488	548	744	219	267	701	816	1,070	340	615

SURFACE WATER DATA - BRITISH COLUMBIA

INLAND WATERS DIRECTORATE
 WATER SURVEY OF CANADA

TABLE 2: ESCAPEMENT RECORD FOR TSITIKA RIVER

Year	Sockeye	Chinook	Coho	Chum	Pink	Steelhead
1947			UNK	UNK	UNK	
48			N/O	25	N/O	
49			3500	7500	7500	
50			750	400	1500	3500
51			750	1500	7500	
52			750	750	7500	
53			1500	1500	7500	
54			3500	1500	15000	
55			3500	1500	7500	
56			3500	1500	15000	
57			1500	N/O	30000	
58			3500	750	15000	
59			1500	750	7500	
60			750	N/O	200	
61			1500	N/O	750	
62			1500	N/O	200	
63			1500	N/O	3500	
64			1500	200	400	
65			3500	N/O	3500	
66			1500	75	75	
67			UNK	UNK	UNK	
68			N/O	N/O	750	
69			N/O	N/O	200	
70			N/O	N/O	25	
71			N/O	N/O	7500	
72				400	750	
73				300	4000	
74					5000	
75					2000	
76					4000	

Time		
Arr.	SEPT.	AUG.
Start	OCT.	SEPT.
Peak	OCT.	SEPT.
End	NOV.	OCT.

COMMON NAME	SCIENTIFIC NAME	TOTAL CAUGHT IN ESTUARY
Coho	<i>Oncorhynchus kisutch</i>	1,412
Chum	<i>Oncorhynchus keta</i>	1,236
Chinook	<i>Oncorhynchus tshawytscha</i>	58
Pink	<i>Oncorhynchus gorbuscha</i>	27
Steelhead	<i>Salmo gairdneri</i>	5
Dolly Varden	<i>Salvelinus malma</i>	3

TABLE 3: SPECIES LIST, IN ORDER OF MAGNITUDE, FOR SALMONIDS
CAPTURED BY BEACH SEINE IN THE TSITIKA RIVER
ESTUARY DURING MAY, JUNE AND JULY, 1979

Date of Sample	<u>River Steelhead</u>		<u>River Coho</u>		<u>Estuary Coho</u>	
	May 10/79	May 10/79	May 10/79	May 10/79	May 9/79	May 9/79
Number in Sample	11 (26)	12	12	45	(52)	
Age (yrs.)	2+ (?)	1+	1+	1+	(?)	
Mean Length (cm.)	10.74 (9.14)	4.93	4.93	9.72	(9.88)	
Variance	2.64 (5.89)	7.16	7.16	0.77	(0.77)	
Standard Deviation	1.63 (2.43)	2.68	2.68	0.87	(0.88)	
Minimum (cm.)	8.5 (5.3)	3.1	3.1	7.70	(8.0)	
Maximum (cm.)	14.0 (13.9)	10.6	10.6	12.0	(12.1)	
Range (cm.)	5.5 (8.6)	7.5	7.5	4.3	(4.1)	

TABLE 4: AGE AND LENGTH DATA FOR COHO AND STEELHEAD SMOLTS CAPTURED BY "GEE" TRAPS IN THE RIVER AND BY BEACH SEINE IN THE ESTUARY ON CONSECUTIVE DAYS. BRACKETED NUMBERS REPRESENT DATA FROM FISH WHICH WERE NOT AGED

Month	Station	Number of Sets	CHUM			CHINOOK			COHO			PINK		
			Total Catch	Catch Per Set										
May	1	34	147	13.36	-	-	-	88	2.59	3	0.09			
	2	32	98	3.06	-	-	49	1.53	1	0.03				
	3	32	161	17.89	-	-	83	2.59	4	0.13				
	4	32	250	7.81	6	0.19	248	7.75	9	0.41				
	5	29	152	5.24	-	-	103	3.55	10	0.34				
June	1	36	28	0.78	-	-	35	0.97	-	-				
	2	36	27	0.75	14	0.39	224	6.22	-	-				
	3	36	9	0.44	4	0.11	67	1.86	-	-				
	4	36	-	-	8	0.22	202	5.61	-	-				
	5	36	6	0.17	6	0.17	36	1.0	-	-				
July	1	27	21	0.78	5	0.19	24	0.89	-	-				
	2	27	24	0.89	3	0.11	14	0.52	-	-				
	3	27	4	0.15	-	-	18	0.67	-	-				
	4	27	273	10.11	5	0.19	188	6.96	-	-				
	5	27	36	1.33	7	0.26	33	1.22	-	-				

TABLE 5: TABLE OF SAMPLING EFFORT FOR CHUM, CHINOOK COHO AND PINK SALMON FOR MAY, JUNE AND JULY 1979 AT ALL BEACH SEINE STATIONS IN THE TSITIKA RIVER ESTUARY

C O H O

Month	Beach Seine Station	Season Total Catch	Mean Catch/Set	Variance	S.D.
May	1	88	1.83	3.87	1.97
June	1	35	0.97	0.50	0.71
July	1	24	0.89	0.05	0.22
May	2	49	1.13	4.75	2.18
June	2	224	6.22	34.91	5.91
July	2	14	0.52	0.06	0.24
May	3	83	2.44	12.74	3.57
June	3	67	1.86	4.44	2.11
July	3	18	0.67	0.16	0.40
May	4	248	8.23	103.62	10.18
June	4	202	5.61	16.87	4.11
July	4	188	6.96	12.89	3.59
May	5	103	3.16	23.11	4.81
June	5	36	1.00	0.26	0.51
July	5	33	1.24	0.05	0.22

TABLE 6: CATCH PER UNIT EFFORT STATISTICS FOR COHO SALMON CAPTURED AT BEACH SEINE STATIONS 1 THROUGH 5

C H I N O O K

Month	Beach Seine Station	Season Total Catch	Mean Catch/Set	Variance	S.D.
May	1	-	-	-	-
June	1	-	-	-	-
July	1	5	0.19	0.10	0.32
May	2	-	-	-	-
June	2	14	0.39	0.50	0.70
July	2	3	0.11	0.01	0.11
May	3	-	-	-	-
June	3	4	0.11	0.02	0.13
July	3	-	-	-	-
May	4	6	N/A	N/A	N/A
June	4	8	0.22	0.20	0.45
July	4	5	0.18	0.03	0.17
May	5	-	-	-	-
June	5	6	N/A	N/A	N/A
July	5	7	0.26	0.05	0.23

TABLE 7 : CATCH PER UNIT EFFORT STATISTICS FOR CHINOOK SALMON CAPTURED AT BEACH SEINE STATIONS 1 THROUGH 5

N/A = data not calculated

C H U M

Month	Beach Seine Station	Season Total Catch	Mean Catch/Set	Variance	S.D.
May	1	147	3.20	12.83	3.58
June	1	28	1.03	3.22	1.79
July	1	21	0.81	0.50	0.71
May	2	98	2.21	16.09	4.01
June	2	27	0.75	0.49	0.70
July	2	24	0.89	0.65	0.80
May	3	161	3.60	23.35	4.83
June	3	9	0.44	0.16	0.40
July	3	4	0.15	0.07	0.25
May	4	250	5.74	49.68	7.05
June	4	-	-	-	-
July	4	273	2.44	3.12	1.77
May	5	152	4.50	32.66	5.72
June	5	6	0.17	0.04	0.19
July	5	36	1.33	1.38	1.16

TABLE 8: CATCH PER UNIT EFFORT STATISTICS FOR CHUM SALMON CAPTURED AT BEACH SEINE STATIONS 1 THROUGH 5

SAMPLING PROCEDURES

Every precaution was taken to reduce sampling error while beach seining, however, the boulder beaches at stations 1, 2 and 3 may have affected the accuracy of many of the sets due to "hang-ups" on the barnacle encrustations. These "hang-ups" could not be avoided in most cases, and may account for the variation in catch per unit effort at these stations. Later on in the season, as the kelp beds grew to maximum height, further sampling errors may have been introduced by interference from the kelp as the seine was retrieved over the plants.

a. 1) Five beach seine stations were established in Robson Bight. Four were situated across the mouth of the Tsitika River and one control station north of the estuary (Figure 1).

Station five was considered more representative of a marine habitat than the other four. The other four represented estuary habitat.

Two sizes of beach seine were tried initially - one measured 100 feet long by 8 feet deep, the other measured

50 feet long by 8 feet deep. The larger beach seine was discarded as it was considered too cumbersome and slow for maximum efficiency.

An 18 foot, flat-bottomed Smokercraft boat powered by an 85 HP Mercury outboard jet was used for all seining operations. The net was set offshore and parallel to the beach in each instance and retrieved by hand to the beach.

Sampling frequencies varied with weather and water conditions, but generally each set was made during daylight hours over all stages of the tide.

2) Galvanized wire "Gee" traps baited with salmon roe and/or corn niblets were used to sample the lower river habitats. These traps have been used successfully in other systems where large numbers of coho and chinook smolts were required for tagging.

3) Small, one-man pole seines were also used to sample backwater channels and pools in the lower river reaches.

b. All fish species captured by seine and trap were counted and identified. Selected salmonid individuals were preserved for length, weight and stomach content measurements.

Stomach data will not be presented in this paper. Scales were also taken for age determination. The scales were analysed in our scale laboratory (1090 West Pender, Vancouver) and the stomachs were analysed in our laboratory at the Pacific Environment Institute, West Vancouver.

c. A Weksler, thirty-day, thermograph was installed on the lower main branch of the river to record water temperatures over April, May, June and July (Figure 2). The thermograph was checked and calibrated at the beginning of each sample period.

RESULTS

a) Lower River

Limited success with "Gee" traps and stick seines was experienced. The major downstream migration of pink and chum salmon was missed due to the late start of the program. Steelhead, coho and Dolly Varden char were the most common salmonids captured in the "Gee" traps. In total, 37 steelhead, 12 coho and 3 Dolly Varden char were captured using these traps. The steelhead and coho captured by this method had a mean length and standard deviation of 9.14 (± 2.43) and 4.93 (± 2.68) centimeters respectively (Table 4).

Of the 11 steelhead smolt scales read all were age 2+. The aged coho smolts were yearling outmigrants (1+).

b) Estuary and Adjacent
Marine Foreshores

The most common salmonid species captured, in order of magnitude, at stations 1 to 4 were coho, chum, chinook, and pink (Table 3). Figure 3 shows histograms of the log of the catch per unit effort for all five beach stations and all species of salmon for May, June and July. Pink and chinook salmon were conspicuously the least numerous species captured at all stations. Coho were common at all stations over the three months. Chum salmon abundance declined in June and July, with the exception of a large number (273) being captured at station 4 in July. A large variation in chum catch per unit effort occurred at all stations in May (Table 8). Largest chum catches occurred at station 4 with high variations in numbers per unit effort. Pink salmon were not captured in the beach seines after May.

For coho, beach seine station 4 had the largest catches and mean numbers for the effort. The numbers of coho captured at this station also varied the least over all stations (Table 6). Numbers of coho also varied the least after May at all stations; except during June at station 2.

Coho smolts sampled for age determination from the estuary were predominately 1+'s and their scale patterns exhibited large estuarine growth. Some scale patterns suggested an early entrance to the estuary; these fish possibly reared entirely in the estuary. The coho smolts sampled for scale analysis from the estuary had a mean length of 9.72 ± 0.87 cm. Those measured for length only had a mean length of 9.88 ± 0.88 cm. (Table 4).

Coho smolts captured in the estuary were significantly larger ($t = 11.19$, 62 d.f., $P < 0.05$) than those captured in the river and exhibited much less variation in length (Table 4).

Peak catches for chum and coho occurred on the estuary during May (Figure 2) with coho being present in relatively high numbers for June and July also.

DISCUSSION

The downstream migration of pink and chum salmon was not intercepted by our crew. Significant numbers of coho smolts were not captured in the "Gee" traps to permit a qualified estimate of their peak outmigration. Future studies should include instream sampling with floating incline plane traps set in place no later than the last two weeks in March.

The nearshore waters in Robson Bight teemed with salmon smolts from June through July. Large schools of them accumulated around the tall kelp beds near shore. Their presence was observed as they jumped and swam away from our approaching boat. Other fishes such as stickleback, kelp perch and juvenile rockfish frequented the nearshore kelp beds as well.

A relatively extensive eelgrass bed grows on the subtidal slopes off the mouth of the river between stations 3 and 4. This bed is patchy and is mixed with wide-bladed, short-styped brown algae. This algae/eelgrass bed supports a significant population of dungeness and rock crab.

CONCLUSIONS

Catch data from the four beach seine stations are inconclusive as to which area on the estuary is the most important rearing habitat for salmonids. Station 4 catches for coho and chum salmon were consistently high and this may indicate an area with more desirable qualities for rearing for these species.

Coho captured in the estuary were significantly larger ($P < 0.05$) than those captured in the river (Table 4).

Since these data were collected on two consecutive days it is likely that the fish were from different populations. Interpretation of the scale patterns from the estuary coho indicated that at least some of these coho entered salt water (estuary) at a very early age. It is possible then that some of these individuals were from the Tsitika River and had reared in the estuary rather than the river.

Chum salmon smolts captured in June and July were obviously from other systems. These smolts were at least 100 mm long (personal observation) and since they were almost twice the size of those captured in May, likely represented a portion of some large population moving through and rearing in the vicinity of the Tsitika River estuary.

The numbers of coho and chum salmon present in the estuary and along the foreshore at station 5 indicates that the Tsitika River estuary and adjacent foreshores are important rearing habitats for these species in the Johnstone Strait area.

The objectives of the study, as outlined in the introduction, were not fully reached, however some qualified statements may be made:

1. Coho and steelhead smolts rear in the lower reaches of the Tsitika River for at least one year and up to two

years respectively. Earlier records, (i.e. March and April) were not obtained. Coho and chum salmon utilize the estuary and adjacent foreshore zones extensively from May to July.

2. The various habitat types of the Tsitika River and its estuary; gravel/cobble beach, eelgrass and kelp beds, support a particularly unique and relatively large array of marine and estuarine organisms including dungeness crabs, rock crabs, juvenile and adult rockfish, as well as an enormous biomass of small invertebrates such as mysids and amphipods. Its small size, relative to some more southerly estuaries, makes it more unique and perhaps less capable of withstanding major impacts through developments within its ecological zones than other large estuaries.

3. The presence of juvenile rockfish and dungeness crabs in the eelgrass and kelp beds at the mouth of the river suggest that the Tsitika River estuary supports non-salmonid fisheries resources. Pandalid shrimp were also collected in the beach seines at low tide, adding another important invertebrate to the list of commercially valuable species.

RECOMMENDATIONS

While this sampling program is considered pilot in nature, the preliminary results and the "observed" uniqueness of the area dictate the following recommendations to ensure that the inherent biological values of the area are adequately assessed:

1. Accurate enumeration of the juvenile salmonid downstream outmigrants must be undertaken in the Tsitika River.
2. A relatively intense marking program of juvenile salmonids (both downstream migrants and estuary and marine transients) should be undertaken to determine the importance of the foreshore (estuary and marine) for rearing of local and non-local species.
3. Sampling programs and scuba-equipped diver transects be established to collect data on subtidal plant, vertebrate and invertebrate fisheries resources associated with the estuary and marine foreshore. In addition, particular observations of fish behaviour (salmonids included) around the tall kelp beds (*Nereocystis* sp.) should be recorded across the delta front.

4. Collection of fish populations by beach seine (and perhaps surface trawl) should be replicated with the addition of several more stations representative of the lower riverine and marine environments.

5. Whales?