Robson Bight (Michael Bigg)

Ref. No.: 406

Fish

Robson Bight Preservation Committee of the Top Island Econauts Society. 1980.

The Lowers Tsitika River and Robson Bight Area: an inventory of salmonid and marine resources. Report submitted to Fisheries and Oceans, and B.C Fish and Wildlife Branch, Victoria, B.C. 67p.

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We would like to thank George Reid of the Fish and Wildlife Branch for the donation of helicopter time to enable us to do our first river swim and to view the upper part of the system. (It's still the longest mile and a half I've ever swam!). Peter Barrett, the helicopter pilot on both our flights, not only flew us in to the lower Tsitika River twice, but generously donated half the time necessary for the second swim.

Thanks must also go to Ralph Delisle and his Marine Science 12 class. The class spent a very full and productive (for us, anyway) day marking out transects and enumerating the underwater flora and fauna of Robson Bight.

Mike Brownlee and Bruce Hillaby of Fisheries and Oceans generously lent us materials for the fish trip we placed within the river system.

The Top Island Econauts aided us with manpower and a generous donation to aid in the purchase of equipment necessary to complete the project, while other individuals too numerous to mention on an individual basis lent a hand from time to time in beach seining or operating the trap.

The Ecological Reserves Unit (Ministry of Lands, Parks and Housing) also donated monies towards the completion of the project, and sent us considerable data which aided in the writing of the final report. They also offered to duplicate the final copy for distribution to interested parties.

Finally, I would like to thank the Salmonid Enhancement Program for their support. Without their initial interest in salmonid stocks in local rivers, we would not have been able to collect the data presented here.

INTRODUCTION AND BACKGROUND

The development of the Tsitika Watershed Integrated Resource Plan (TWIRP) has probably been among the most intensive and comprehensive multiple use plans in British Columbia. However, because of the isolated location of the Tsitika River and the bay into which it flows, Robson Bight, there are several areas of inherent weakness within the plan. Amongst these weaknesses are the lack of data regarding the fisheries resources of the river and the estuary, the lack of firm commitments to ecological reserves within the drainage system and Robson Bight and the ambiguity of the plan in terms of log disposal and development of the estuary and/or other portions of the bight.

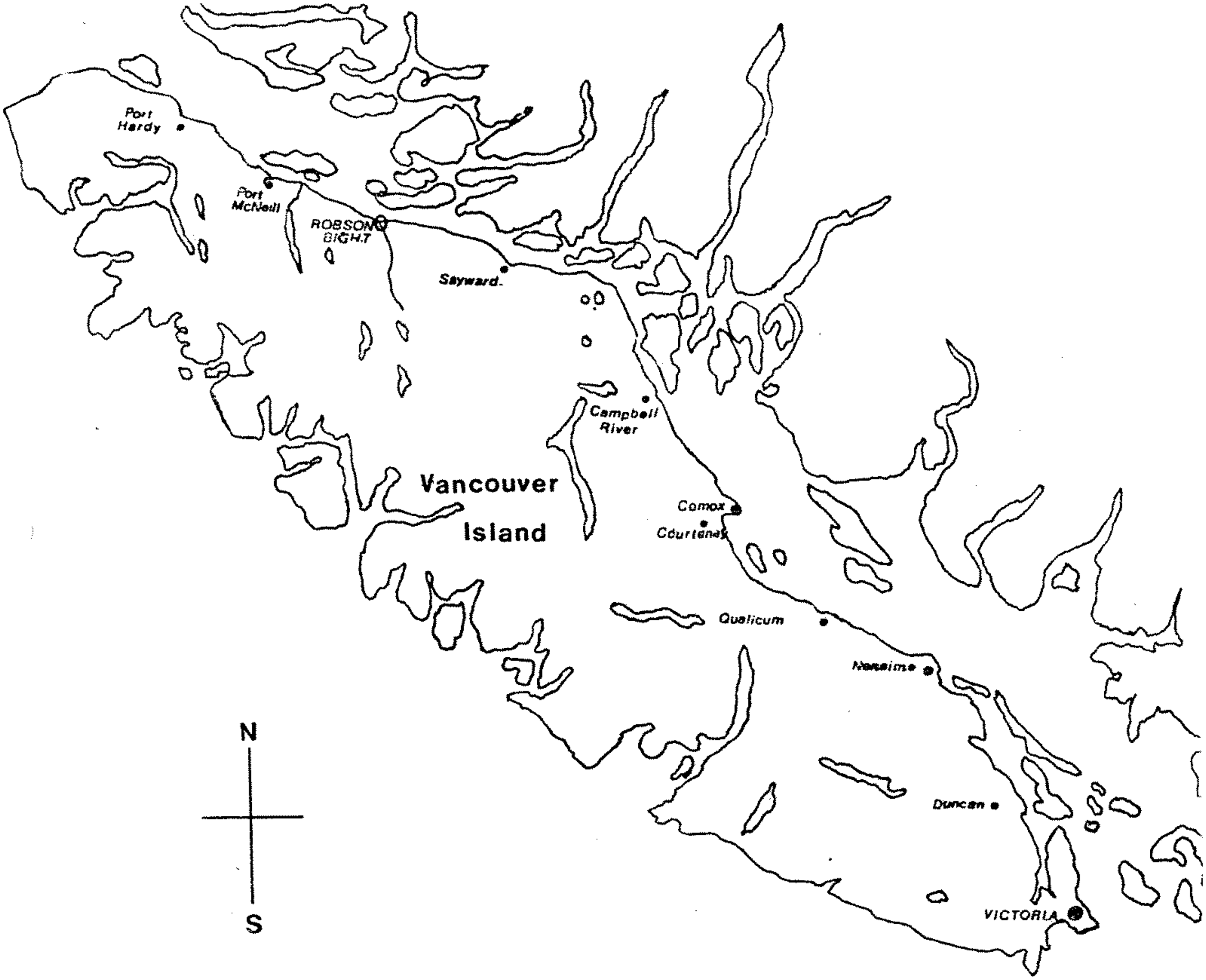
As the logging company concerned, MacMillan Bloedel, has not yet expressed definite plans for or against development of the estuary area, and because at present there is very little data available on the estuary and fisheries resources, the Top Island Econauts (a local diving society concerned with the marine environment) contracted with the Salmonid Enhancement Program to gather some data regarding the potential of the Tsitika River - Robson Bight area as a salmonid production and rearing area. In addition, because of interest from the local Federal Fisheries office, we attempted to gather data on other marine values as well, since there were both time and opportunities to gather this data while collecting data on the salmonid resources.

A BRIEF HISTORY OF THE TSITIKA RIVER - ROBSON BIGHT AREA

There has been a great deal of controversy regarding the Tsitika River Watershed since the early 1970's. At that time, it was one of the last unlogged watersheds on the east coast of Vancouver Island. In late 1972, the entire Tsitika drainage was proposed for ecological reserve status. In 1973, a moratorium was placed on logging and

FIGURE 1

LOCATION OF TSITIKA RIVER - ROBSON BIGHT AREA


Port Hardy
Port McNeill
ROBSON BIGHT
Sayward
Campbell River
Vancouver Island
Comox
Courtenay
Qualicum
Nanaimo
Duncan
VICTORIA
N
S

related activities in the Tsitika-Schoen Lake area in order to examine logging plans in the context of how they would relate to other possible la.. uses (ecological reserves, parks). A study group was struck to examine alternative uses of the area and subsequently proposed four alternative uses of the area (Paish, 1975).

Public hearings were then held in several Vancouver Island communities to gather public input prior to the Environment and Land Use Committee (ELUC) of the provincial government making a policy decision. Finally, in 1978, the provincial government announced that an integrated resource management plan for the Tsitika River Watershed would be prepared, but that the logging moratorium would continue until the plan was prepared and approved. The Plan would be prepared by a planning group which would consist of representatives from the logging companies which have tenures within the drainage (MacMillan Bloedel, Canadian Forest Products Ltd., and Rayonier Canada Ltd.), the B.C. Fish and Wildlife Branch, the Ecological Reserves Unit of Lands, Parks and Housing, Environment Canada - Fisheries and Oceans, and the B.C. Forest Service, which would coordinate the planning process. Due to public pressure, representatives of the public and the United Fishermen and Allied Workers Union were added to the planning group.

After the plan was drafted and public meetings were again held to gather feedback from the public, a final draft of the plan was submitted in the fall of 1978. The plan's implementation has subsequently been under the direction of the Tsitika Follow-up Committee (TFC), which is made up of representatives of the same groups who originally designed the plan.

DESCRIPTION OF THE TSITIKA RIVER - ROBSON BIGHT AREA

The Tsitika River Watershed measures 39,518 hectares, with a total ma...tem length of 42 kilometers (TWIRP report, 1978). Although the lower drainage is a broad "U"-shaped valley, much of the drainage, particularly around Mount Derby, Claud Elliot Lake, and Russel Creek, is steep. Because of the elevation of the upper reaches of the watershed (Mount Derby, for example is 1770 meters), much of the winter precipitation is in the form of snow. Often snow remains in the higher elevations until late May or early June. Although we could find no records for precipitation for the upper areas of the river, a value for the lower elevation reaches of the river was given as 255 millimeters. It would be expected that the upper reaches could have considerably more precipitation than that.

Because of a shortage of time, money, and manpower, we restricted our activities primarily to the lower two kilometers of the river, although we did manage two river swims to count adult salmondids from Catherine Creek, which is some seven kilometers above tidal influence. The river from Catherine Creek to the ocean is characterized by long stretches in which the major substrate and margins are coarse cobble and boulders. There are several canyon areas with smooth sides, some of which form pools of considerable depth (greater that five meters). In the canyon areas, there are also several waterfalls, some of which are definitely obstacles to pink and chum salmon (*Oncorhyncus gorbuscha* and *O. keta* respectively). These same obstacles also probably hold back other salmonid species such as coho (*Oncorhyncus kisutch*) and steelhead trout (*Salmo gairdneri*) during periods of low flow.

Within the canyon area, there is one major log jam. Due to the depth of the pool this log jam does not act as a deterrent to fish movement. Below the canyon area, at the junction where the river splits into two main channels before flowing to the sea (Figure 2) there is another log jam in the right hand channel. This log jam probably acts as a barrier during times of low flow, since the left channel can almost dry up during those periods.

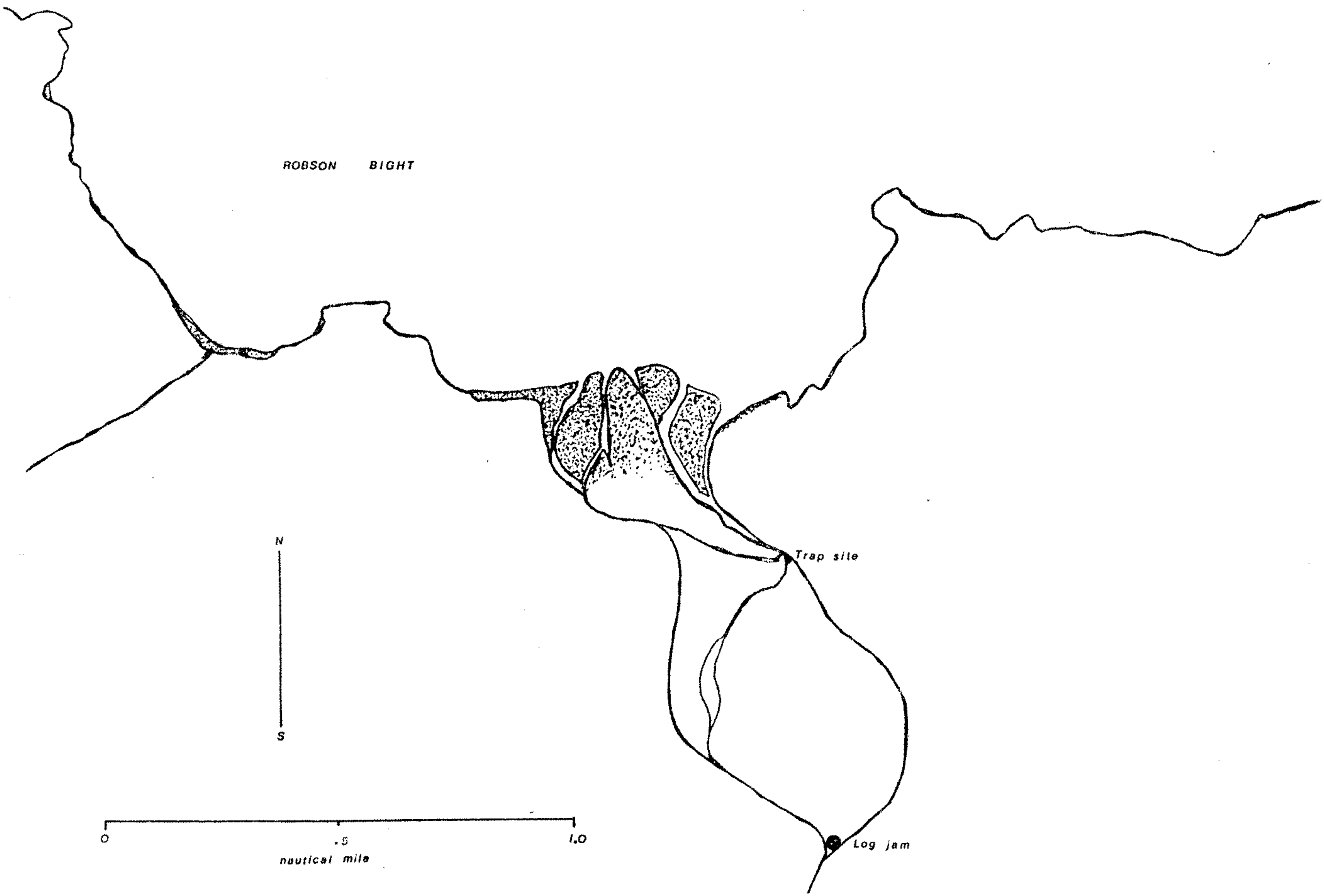
Beyond this portion of the subtidal, the shoreline fell away quickly into deeper water, with a substrate of rock, cobble, and fines from the river. Off to the sides of the estuary, patches of bull kelp (Nereocystis luetkeana) are found attached to rocky outcroppings, mixed with Laminaria saccharina and Cymathere triplicata.

FIGURE 2

LOWER TSITIKA RIVER FROM AREA OF LOG JAM

FIGURE 2

LOWER TSITIKA RIVER FROM AREA OF LOG JAM



ROBSON BIGHT
Trap site
N
S
Log jam
0
.5
1.0
nautical mile

The river below this log jam is relatively slow, with some short riffles, although the gradient by and large is slight. Pools are much sh ower in this reach of the river, and the bottom has a few more areas of gravel suitable for spawning. The banks appear to be fairly stable, except in the region of the log jam, where it is obvious that the river has changed course many times between left and right channels.

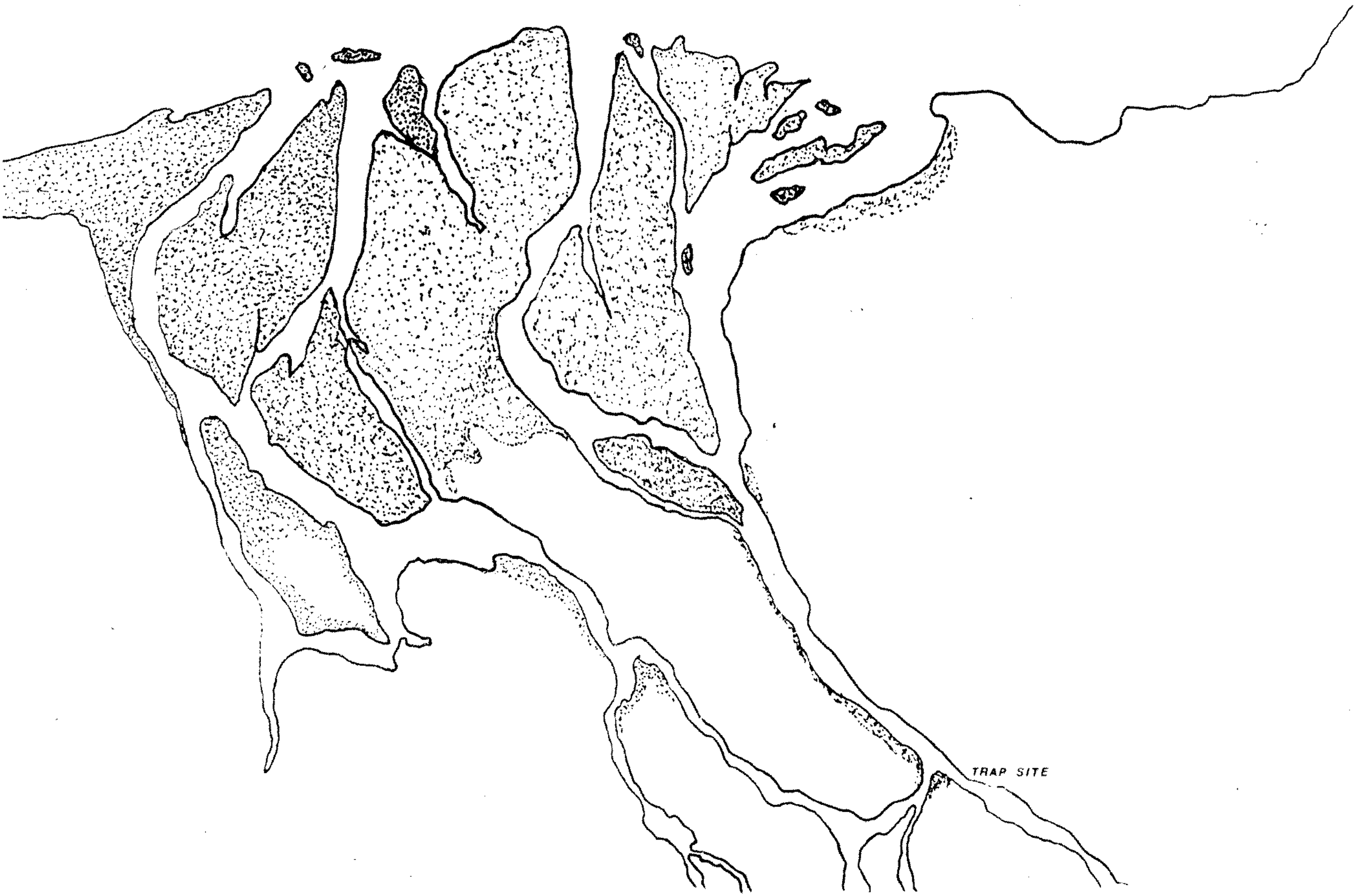
The estuary at the mouth of the Tsitika River is a relatively simple estuary in many ways (Figure 3). The river divides upstream some two kilometers above mean high tidal influences in the river channel. From this split in the river, the two main channels flow down either side of two large forested islands, both of which are covered with stands of Douglas fir and Sitka spruce (Ceska, 1981). The banks in this area appear to the unstable, while the river channel is extremely braided. The lower estuary area, which abuts the Sitka spruce stands, consists of many grasses and sedges, four of which form distinctive community types. These are dune wild rye grass (Elymus mollis), Bering's hair grass (Deschampsia beringensis), sea plantain (Plantago maritma) and the sedge (Carex lyngbyei). The two major communites are the Bering's hair grass and sedge, which cover the areas of the estuary where some soil has been deposited below the treeline. They form a mat of very hummocked vegetation which is often covered by the tide and which rears many invertebrates in the cavities between the hummocks. Towards the outer margins of the grass communities there is considerable fucus. Entermorpha intestinalis and a green filamentous alga (Spongomorpha coalita) are found in the channel areas of the lower river. Barnacles and limpets are common in this area of the intertidal, attached to the cobble which is the main substrate of the outer estuary.

Still in the estuary proper is the upper subtidal area which is exposed during only extremely low tides. Amongst the algaes we saw in this area were Porphyra perforata, Iridaea cordata, Alaria marginata, Rhodomela larix, and Ulva sp. In the lower subtidal areas off the estuary, we found some clumps of eelgrass (Zostera marina), although the beds were neither extensive nor particularly dense.

FIGURE 3

TSITIKA RIVER ESTUARY

REPRESENTS INTERTIDAL AREAS


TRAP SITE

FISH TRAPPING

INTRODUCTION

Although logging of the Tsitika River Watershed is proceeding, there is still relatively little data available regarding the salmonid rearing capabilities of the river system or of Robson Bight, the bay into which the river flows. A pilot study was done by the Habitat Protection Division of Fisheries and Oceans, although this study was cursory, since MacMillan Bloedel Ltd. had not yet committed themselves to a particular course in disposing of their cut tumber.

In doing their studies, Fisheries and Oceans relied heavily on "Gee" traps and small one-man pole seines to sample the lower river. Their success was limited, since they missed the major outmigration of pink and chum fry due to starting their program too late in the season. In addition, their captures using the "Gee" traps and seines were low, probably in part due to the unsuitability of the lower river for pole seining.

To augment the data which Fisheries and Oceans had collected, we felt it necessary to install a fish trap of some sort in the river. This would allow us to monitor movement of outmigrants in the system, and might also give us some ideas of relative species abundance, total numbers, condition factors and timing of migration. Such a trap would also allow us to sample individual fish for scales, weight and other physical parameters.

It was necessary that we utilize a trap which would be relatively easy to maintain effectively, and that we could leave in the river or at least that would not be so cumbersome that we could not readily remove it from the river. This precluded the possibility of any large or semi-permanent trap, as we would not be in the area enough to remove the trap if the river rose suddenly during the week. We were also concerned that the trap be one which would not cause massive mortalities if river flows changed abruptly. For these reasons, we selected a fyke net - live box trap.

METHODOLOGY

In the Tsitika watershed, water levels change rapidly due to the steepness of the watershed gradient, heavy rains, and large amounts of snow. Further, with a limited number of people available at any time to operate a fish trap, a design had to be chosen which was readily removable from the river when not in use and which would not cause excessive mortalities.

The trap location selected is located upriver approximately 0.4 kilometers upstream from the lowest island of the estuary (Figure 2). This site was selected for a number of reasons. The channel is well defined, with the strongest and deepest portion of the river leading to the trap. The site is located downstream from and at the outside of a slight bend in the river channel, which Conlin and Tutty (1979) suggest as the most heavily utilized portion of the channel by juvenile outmigrants. The river gradient is moderate at the site, which meant that approach velocities were not so slow as to make the trap ineffective nor so fast as to impinge fish. Velocities ranged between 1 and 2.1 meters per second during the time periods in which we operated the trap.

Because of the fluctuations in flow and the width of the river channel, a fyke net-live box sytem was used (Conlin and Tutty, 1979). Two sills were installed in trenches in the river bottom, angling upstream on either side from the mouth of the fyke net. The sills were constructed of 2" x 12" planks and filled with rock and gravel. The sills were then fastened down with short lengths of metal bar driven into the substrate.

Hinged screens were attached to the sills so that they could be raised by guy ropes attached to the shore. When the trap was not in operation, the guy wires could be loosened, allowing the screens to lie flat on the river bottom. These screened panels, covered with ½" mesh, effectively widened the mouth of the fyke net to a width of four meters.

The fyke net was suspended from metal "T"-bars driven into the river bottom and overlapped the screens on the panels. From the fyke ne a six inch pipe led to a holding box. The holding box measured approximately 4' x 4' x 3'. Windows along the sides of the box were covered with 1 cm mesh. To prevent injury to captured fish, we covered the screens with marquisette netting.

The trap was operated on weekends when weather permitted between mid April and the end of June of 1980, when the outmigration of juveniles appeared to end. Although we had previously installed sills at either side of the fyke net, high water washed out one of the sills before we could commence trapping. Because of the time limits placed upon us and the continual high flows, it was decided that we would continue to trap with only one set of screens adjacent to the fyke net. The loss of the one set of screens lowered the effective width of the trap to approximately 3 meters.

RESULTS:

Although we installed the trap in early March, it was not until 13 April, 1980 that we could commence trapping because of inclement weather and high flows in the interim. Effectively, this meant that we missed the pink and chum fry migrations, as during the whole of our trapping operations we picked up only five pink fry and four chum fry (Table #1). The fyke net we used might be somewhat at fault as well in that the upper portions of the net were so coarse that any fry which entered the net could easily have been swept through the mesh of the sides as well as into the throat of the trap.

Trapping commenced early enough to pick up a good portion of the coho smolts and steelhead presmolts. Interestingly, the coho smolt run started and ended much earlier than did the steelhead presmolt migration. The coho smolt outmigration appeared to be well underway when we commenced trapping on 13 April (Graph #1) and peaked between May 10 and May 18 (due to high water and the long intervals between trapping operations, it is impossible to be more accurate) before coming to an end by 7th June.

During our operation of the trap in the Tsitika River, we actually trapped only one hundred sixty-seven coho smolts. Of these, fifty-five were subsampled on three separate occasions (May 10th, 11th and 20th) for scale samples, lengths, and weights. All of the scale samples which were read (a random sample of thirty) indicated one year of residence in fresh water. Condition factors were calculated for all fish sampled. Although the condition factors calculated for fish trapped on May 10th and May 11th were similar (means of .806 and .766 respectively), the condition factors for coho trapped and sampled on May 20th were substantially higher (1.026). On the other hand, coho smolts trapped in early May were generally larger in size (with a mean of 102 mm May 10th and 11th) whereas by the end of May mean size had decreased to 95mm.

Steelhead presmolts did not begin to show in the trap in significant numbers until May 26th, at which time the coho smolt movement was virtually ended. Their numbers gradually rose to a peak of 18 on June 8th, after which they gradually decreased in number again. Of a total of seventy-nine presmolts which were trapped, twenty-five were subsampled for scale, length, and weight data, while most of the remainder were measured. Although the first of the steelhead presmolts had poor condition factors (.860 on May 8th), overall condition factors were high (mean of 1.029), ind ating, as did their lack of silver coloration, that these fish were not yet actually smolting. Analysis of scales indicated that of the seventy-five samples examined, 65% had reared in fresh water for one year, 30% had spent two years in fresh water, and the remaining five per cent had spent three years in fresh water.

Trapping success for steelhead smolts was extremely poor. This is probably due to their larger size and greater swimming power as opposed to the other fish species and size classes which we captured. In total, we captured thirteen steelhead smolts. Four were subsampled for scales, lengths, and weights, Of these, scale readings indicated that three smolts had reared in fresh water for three years, while the fourth (and largest) had reared in fresh water for four years.

Although such could not be interpreted from the trapping results, it is probable that the steelhead smolt outmigration showed the same trends as the presmolt migration. On June 14th, near the peak of the presmolt migration, volunteers with the project snorkeled from the trap to the river mouth, counting fifty steelhead smolts, most of them holding in brackish water in the estuary. In the Keogh River, another local system, smolt and presmolt outmigration appear to be tied closely together in timing, lending some support to this supposition.

I would suspect that the Tsitika River is reasonably well seeded with steelhead fry, because of the number of presmolts migrating out. Although it is possible that the fish picked up in the trap were merely rearing fish becoming more active as the water warmed, resulting in more incidental captures, I feel that many of the captures were the result of displacement of juveniles from rearing territory. My reasoning for this suspicion is that captures followed the same type of curve in numbers that migrating coho followed, while incidental capture should have been either constant in value or flow-related. Captures of steelhead presmolts stopped in early July, although the flows were not lower than they had been in June.

Results (contd..)

One fish species which we could not find in any species list for the Tsitika River is the eulachon (Thaleichthys pacificus). Eulachons begin ent ing the river between mid and late April. Spawning occurs in the lower two kilometres of the river, where there is some suitable sand between the large boulders of the substrate. The run peaked between early and mid May, although the precise timing could not be determined, primarily due to high water. Thirty-four of the forty-four eulachons trapped were measured, giving an average length of 184 mm, while thirteen were weighed (mean weight of 49 grams).

The other fish species which occurred in the trap in significant numbers is the Dolly Varden char (Salvelinus malma). Dolly Varden smolts and presmolts appeared to migrate outof the river somewhat before steelhead. Numbers were not significant to verify this, in part because the Dolly Varden tend to migrate at the stream margins and bottom, which means that many of them would go around or under the trap. Mean lengths on Dolly Varden presmolts and smolts were found to be 117 mm and 119 mm respectively.

(For a complete summary of length-weight data, see Table #2 and Graphs 1, 2 & 3.)

TABLE #1

A Summary of Trapping Results for the Tsitika River - 1980

Date	Number Trapped							
	Coho Smolts	Coho Fry	Steelhead Smolts	Steelhead Presmolts	Steelhead Fry	Pink Fry	Chum Fry	Chinook Fry
April 13	8	2	3	0	0	4	2	0
April 27	28	2	4	0	0	1	2	0
May 10	55	0	2	3	0	0	0	0
May 11	29	---------- water over trap, not operative --------------------						
May 18	31	0	1	2	2	0	0	1
May 20	10	0	1	0	0	0	0	0
May 26	5	0	1	11	1	0	0	1
June 7	0	0	0	18	1	0	0	0
June 14	1	0	0	14	0	0	0	0
June 15	0	0	1	13	0	0	0	0
June 21	0	0	0	8	1	0	0	0
June 22	0	0	0	9	0	0	0	0
June 29	0	0	0	1	0	0	0	0
July 12	0	0	0	0	0	0	0	0
July 19	0	0	0	0	0	0	0	0
TOTALS	167	4	13	79	5	5	4	2

TABLE #1 (continued)

Date	Dolly Varden Smolts	Dolly Varden Presmolts	Dolly Varden Fry	Cutthroat Presmolts	Eulachons	Coast-range Sculpins	Prickly Sculpins	Pacific Lampreys
	Number Trapped							
April 13	0	1	0	0	0	2	1	0
April 27	0	1	0	0	1	3	1	0
May 10	0	4	0	0	22	0	0	1
May 11	---------- water over trap, not operative ----------							
May 18	0	2	0	1	7	0	0	0
May 20	5	4	0	1	4	0	0	0
May 26	2	3	0	0	6	1	3	0
June 7	0	0	0	0	0	0	1	0
June 14	0	1	0	0	4	0	2	1
June 15	0	0	0	0	0	0	0	1
June 21	0	0	1	0	0	0	0	1
June 22	0	0	0	0	0	0	0	0
June 29	0	1	0	0	0	0	0	0
July 12	0	0	0	0	0	0	0	0
July 19	0	0	0	0	0	0	0	0
TOTALS	7	17	1	2	44	6	8	4

In addition to the above fish species trapped in the Tsitika River, we observed several three-spined sticklebacks (Gasterosteus aculeatus) swimming in a side channel to the mainstem near the trap.

TABLE #2

SUMMARY OF LENGTH, WEIGHT, AND CONDITION FACTORS

Date	Species	Mean Length (mm)	Mean Weight (gm)	Mean Condition Factor
May 10/80	Coho smolts	111	11.1	.806
May 11/80	Coho smolts	102	8.3	.766
May 20/80	Coho smolts	95	8.9	1.026
May 10/80	Steelhead presmolts	89	6.7	.860
May 20/80	Steelhead presmolts	110	13.3	1.006
June 7/80	Steelhead presmolts	89	8.0	1.059
May 10/80	Steelhead smolts	165	32.3	.719*
May 18/80	Steelhead smolts	157	33.0	.853*
June 7/80	Steelhead smolts	143	26.2	.896*
May 10/80	Dolly Varden presmolts	130	16.7	.758
May 20/80	Dolly Varden presmolts	105	11.6	.887
May 20/80	Dolly Varden smolts	111	12.1	.872

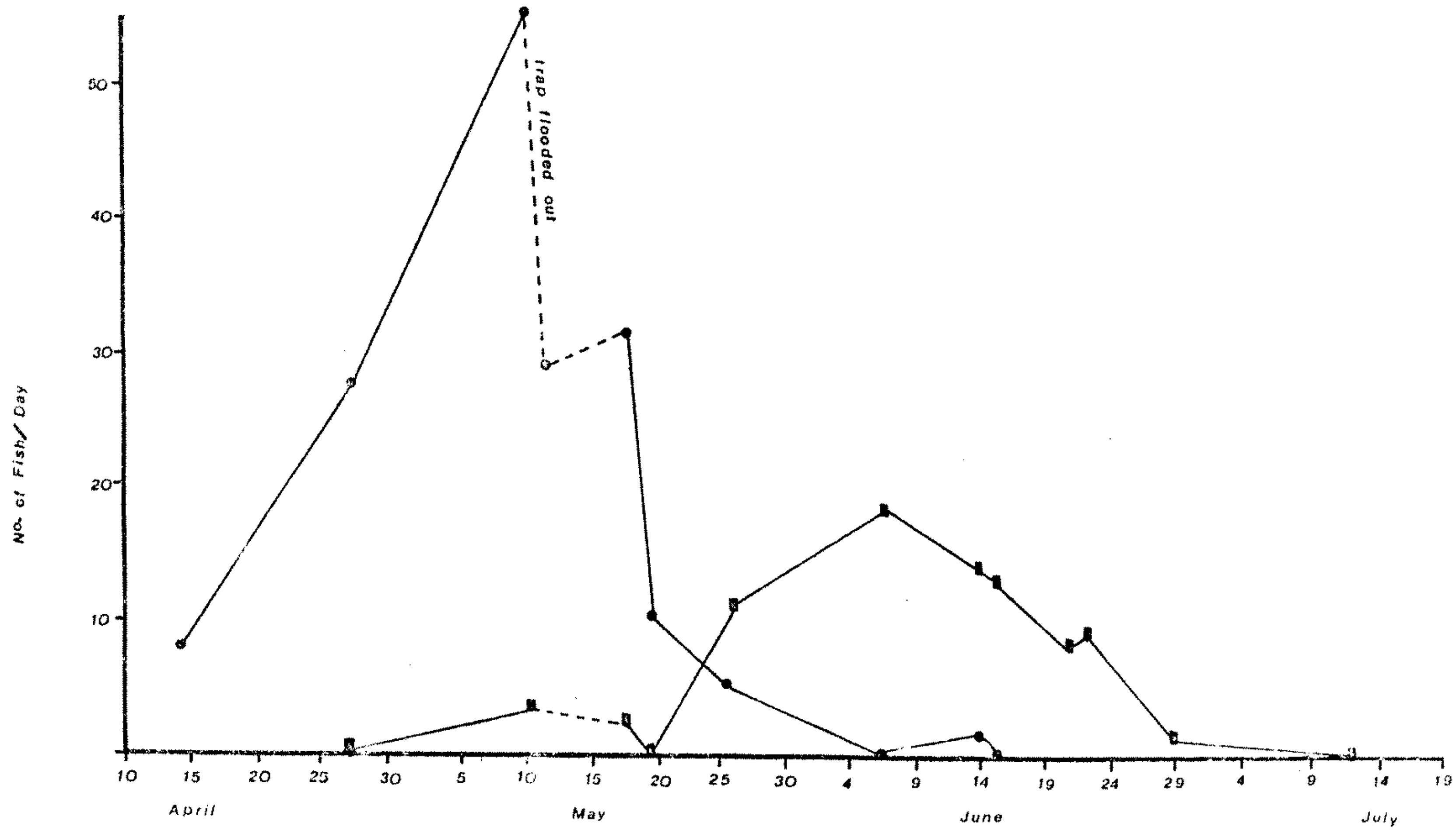
* Single samples only

GRAPH 1

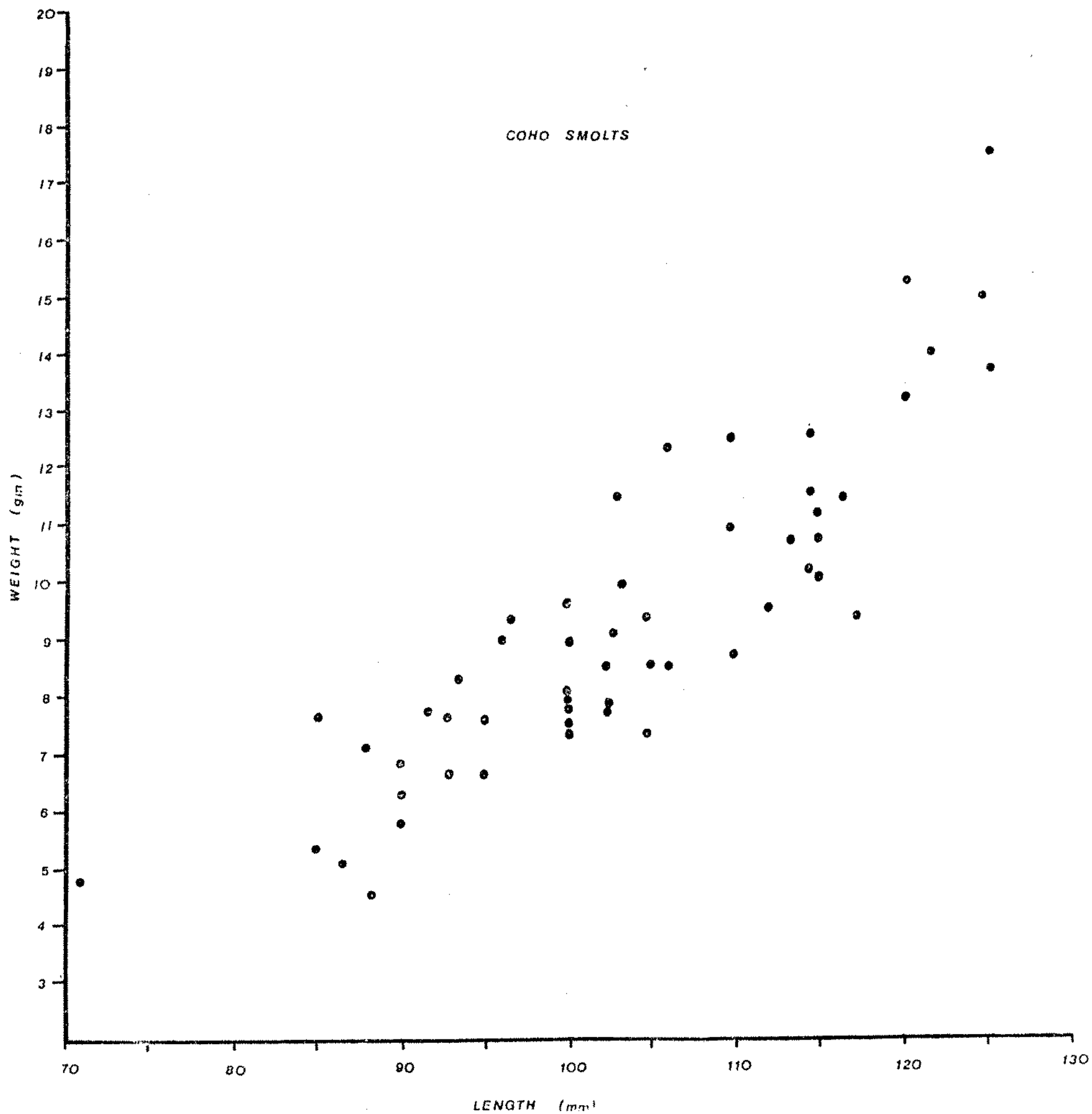
TIMING OF MIGRATION FOR JUVENILE SALMONIDS IN TSITIKA WATERSHED

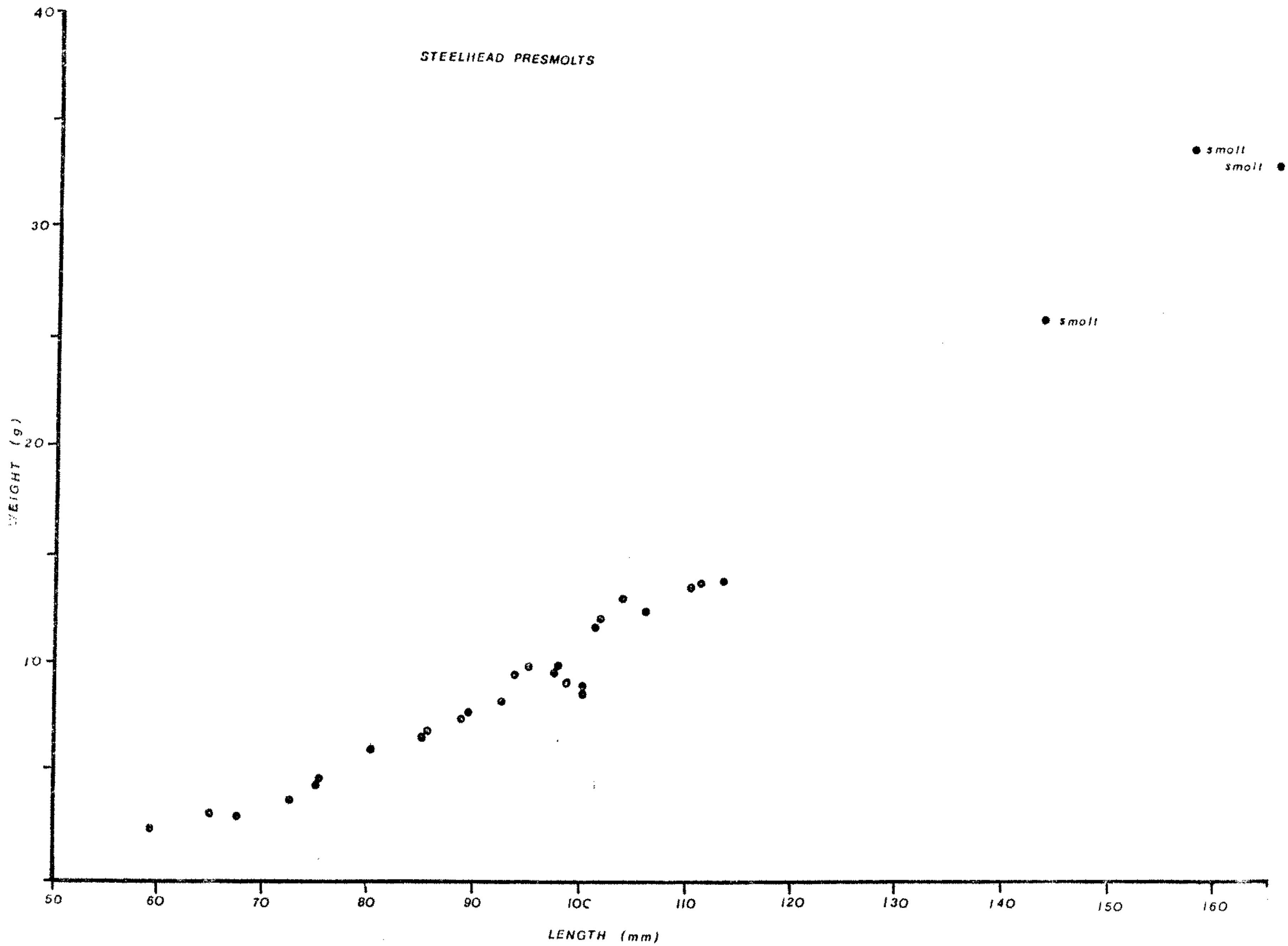
o——● REPRESENTS COHO SMOLTS

■——■ REPRESENTS STEELHEAD PRESMOLTS



No. of Fish/ Day
trap flooded out
50
40
30
20
10
10 15 20 25 30 5 10 15 20 25 30 4 9 14 19 24 29 4 9 14 19
April
May
June
July


COHO SMOLTS
WEIGHT (gm)
LENGTH (mm)
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
70
80
90
100
110
120
130



STEELHEAD PRESMOLTS
smolt
smolt
smolt
40
30
20
10
WEIGHT (g)
50
60
70
80
90
10C
110
120
130
140
150
160
LENGTH (mm)

ADULT SALMONID COUNTS

INTRODUCTION

According to the TWIRP report, the Tsitika River Watershed supports all of the Pacific salmonid species: pink salmon (Oncorhynchus gorbuscha), chum salmon (Oncorhynchus keta), coho salmon (Oncorhynchus kisutch), sockeye salmon (Oncorhynchus nerka) and chinook salmon (Oncorhynchus tshawytscha). In addition, anadromous Dolly Varden char (Salvelinus malma), cutthroat trout (Salmo clarki clarki) and summer run steelhead trout (Salmo gairdneri) are produced within the system, as are their nonmigrant varients. Nonsalmonids within the system include prickly sculpin (Cottus asper) and the Pacific lamprey (Entosphenus tridentatus).

The TWIRP report gives population estimates for the salmonids as follows: 6,000 pink salmon, 1,200 chum salmon, 2,000 coho salmon, and 3,500 summer and winter run steelhead trout. The report only mentions that the numbers of sockeye and springs are small, and that all of the other fish species mentioned above are unknown. As most of these counts were probably estimates derived from shore counts, we decided to augment them through our own floating counts.

Because of the difficulty in covering much of the river through floating counts due to the inaccessibility of most of the system, most of our floats were done in the lower two kilometers of the river, although we managed to do two float counts from the confluence of Catherine Creek with the Tsitika River, a point approximately 6.5 kilometers upstream from the river mouth.

METHODOLOGY

River floats were made from approximately 1.5 to two kilometers above the river mouth throughout the months of July, August, and September. This area was covered because of its ease of accessibility and because it allowed us to cover most of the water which would be used by holding pink and chum salmon. Generally, our swims would follow the right hand channel of the river and terminate in the sea. Two of our swims commenced at Catherine Creek, one of which was done May 18, 1980, and the other on October 5, 1980.

In the second of our swims from Catherine Creek, we were interested not only in the numbers of adult salmonids in the river (primarily pink slamon, chum and summer run steelhead trout), but also in categorizing the lower reaches of the river in terms of habitat type and spawning suitability.

In addition, we did a number of floating counts from the fish trap (Figure 2) which we used to gauge the success of the trap at any particular time and flow.

RESULTS

During the first couple of swims which we did in early May from the trap to the river mouth, we saw almost no fish at all. Because the water temperature was s. l low ($8^{\circ}C$), very few juvenile salmonids were out of the gravel. Of those, the majority which we saw were juvenile steelhead and cutthroat trout, lending credance to the opinion that the lower river is primarily used by these species for rearing.

On May 18th, we were dropped at Catherine Creek by helicopter (courtesy of the Fish and Wildlife Branch) and did a floating count from there to the river mouth. Four divers took part in the count, and counted twenty-seven adult steelhead during their swim. We felt that it was probable that we only saw two-thirds of the steelhead present where visibility was good, meaning that at the time there were at least forty fish in the areas we passed through where the visibility was reasonable. In addition, there were a number of pools that we passed through in which we could not see the bottom of the river, or where the lighting from above made vision impossible. Of the fish that we saw, most were dark fish, having held from the summer previous, although two of the fish appeared to be either fresh-run fishor very well mended kelts. During this same swim, we counted sixty-five juveniles of the Salmo genus, probably mainly steelhead, and four coho juveniles.

During a subsequent swim on May 20th fromthe log jam to the river mouth, we observed two adult steelhead. These fish appeared to be kelts. In addition, we counted seventy-three steelhead and cutthroat juveniles (parr) and twenty-two steelhead smolts. As these smolts measured approximately 150 to 200 millimetres and we were picking up few smolts of this size in the trap, we felt that we were missing many of the outmigrating smolts with the trap. We also saw two adult cutthroat trout (approximately 350 millimetres) and about eighty eulichans. The small size of the fish observed, poor visibility, and the fact that there were only two divers meant that the divers probably saw only ten percent of the juvenile fish and eulichans, although it is likely that they again saw two-thirds of the larger trout.

Several swims were done in June and July from the trap or the log jam to the river mouth (summarized in Table #3). The first swim which we did in which adult salmon were sighted was on July 20th. Although the river had been extremely low prior to this, rain the previous night had brought the river up

contd....

somewhat. During this swim from the lower edge of the log jam, three adult steelhead, 185 juveniles of the Salmo genus, twenty-seven coho juveniles, one juvenile Dolly Varden, two adult Dolly Varden, and one cutthroat adult were sighted. The swim was continued into portions of the river channel which were subtidal, at which point forty pink salmon and fifteen Dolly Varden adults were seen. Again, because of poor visibility, I feel that the divers sighted only ten percent of the juvenile salmonids. It is also likely that there were many more pink salmon and Dolly Varden than were sighted, because of their ability to see and/or feel our approach in the open water and turn before we sighted them. The importance of this particular swim is that it fixes the date of entry for pink salmon within the Tsitika for that particular year fairly accurately as a swim one week later revealed pink salmon to have entered the river in the interim.

During swims from above the trap on July 27th, August 3rd, and August 17th we counted five hundred, fifteen hundred, and thirty-five hundred pink salmon respectively. The second and third swims were from the trap to the ocean, whereas the first swim had been from below the log jam. Thus, expanding our counts because of the distribution of fish in the river during this first and our October swim, we felt that there were probably about four thousand fish in the river August 3rd and eight to nine thousand pink salmon in the river by August 17th.

Even during the swim we made in October, after a substantial freshet must have flushed all of the dead and dying fish out of the lower river, we counted five hundred pinks from Catherine Creek to the river mouth. Although there is no doubt that some of these fish had been counted in previous swims, some fish had also entered the river, spawned, and been flushed out without our counting them, as we could not reach the area during the month of September.

Our river swim from the trap on August 3rd also showed approximately one hundred and fifty coho within the lower river area. We saw that number again on our swim of August 17th, but saw only fifty on our float from Catherine Creek on October 5th. Although it was likely that a large number had entered the river in the interim, they had probably also moved above Catherine Creek and into the tributaries in preparation for spawning.

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Although Dolly Varden spent considerable time around the estuary and could be angled off the river mouth from May, we did not see any adults in the river until ly 20th. Even then, the majority we counted (thirty or thirty-five) were holding in the intertidal areas. On August 3rd, we counted twelve Dolly Varden between the trap and the river mouth, and thirty-five in the same area on August 17th. By October, they had probably all entered the river, when we counted approximately three hundred between Catherine Creek and the river mouth. It is likely that at this time we counted only two-thirds of the Dolly Varden present, owing to their size and the poor visibility. Thus, at this time, there were probably about four to five hundred in the lower river alone.

Although our swims allowed us to estimate the size of the pink salmon escapement, such was not possible with chum, coho, steelhead, and Dolly Varden. Chum and Coho salmon both enter the river after our last swim was done. In addition, we could not hope to cover the areas to which coho, steelhead, and Dolly Varden could potentially migrate after entering the river.

(For a complete summary of fish counts, see Table #3).

TABLE #3

FLOATING FISH COUNTS IN TSITIKA RIVER

DATE	LOCATION	SHA	SHJ	COA	COJ	DVA	DVJ	PA	CTA
April 27	Trap	0	4 (40)	0	0	0	0	0	0
May 11	Trap	0	5 (50)	0	0	0	0	0	0
May 18	C. Ck.	27 (40)	65 (650)	0	140 (1400)	0	0	0	0
May 20	L.J.	2	95 (950)	0	80 (800)	0	0	0	2
June 14	Trap	0	56 (560)	0	20 (200)	0	0	0	1
June 22	Trap	0	45 (450)	0	0	0	0	0	0
July 20	L.J.	3 (5)	185 (1850)	0	27 (270)	35* (52)	1 (10)	40* (80)	1
July 27	Trap	0	41 (410)	0	15 (150)	4 (6)	2 (20)	500 (750)	2
August 3	Trap	0	65 (650)	150 (225)	11 (110)	12 (18)	1 (10)	1500 (2250)	0
August 17	Trap	0	41 (410)	150 (225)	21 (210)	35 (52)	3 (30)	3500 (5250)	3
October 5	C. Ck.	105 (158)	500 (5000)	50 (75)	60 (600)	200 (300)	7 (70)	150 (225)	5 (8)

* Include fish seen in estuary

HABITAT CLASSIFICATION

Introduction

Pink and chum salmon within the Tsitika River are restricted to the lower four .lometres of the system due to several waterfalls and chutes. In addition, the lower areas of the river produce many of the juvenile salmonids which we trapped throughout the season. The area of the river below Catherine Creek (7.5 kilometres from the river mouth) is also important in that the canyon pools found in this section offer important holding water for adult summer run steelhead and adult salmonids during times of low flows or prior to their being in spawning condition.

Although Fisheries and Oceans had released some data to the public in the form of the fisheries folio map for the Tsitika River, the information released was not specific in either the substrate make-up or in breaking down the habitat type beyond a pool: riffle ratio. Because of our interest in salmonid production and its limiting factors in the system, we decided to examine the lower portion of the river (owing to time and financial constraints we could not examine other portions) in terms of the actual habitat types present, the substrate, and the area's suitability for both spawning and rearing.

Methodology

Two floating counts were done from the confluence of Catherine Creek and the Tsitika River, one on May 18th and the other October 5th. In both cases, the divers were flown to the site via helicopter and took approximately four hours to complete the swim. In our swim from Catherine Creek to the river mouth on Ocobter 5th, we were looking specifically at the habitat of the lower river and its spawning and rearing capabilities.

The river channel was broken down into different general habitat types: pools, tails, runs, riffles, and chutes. Pools were considered to be deeper than one metre, of slow velocity with smooth surfaces (except for turbulence at heads and margins), and generally wider than they were deep (although canyon pools were sometimes an exception to this guideline). Tails were considered to be the short stretches at the ends of pools in which the water shallowed appreciably before the termination of the pool. These were often either fan - or "V" - shaped. Runs were sections of the river in which the depth was moderate (.75 - 2.0 metres), with a moderate water velocity (surface indicating

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Methodology contd..

turbulence but not broken by white water). Riffles were areas in which the water surface was broken up by white water or standing waves and where the dept as generally shallow (usually less than one metre). Chutes were the areas in which the gradient increased rapidly, with high water velocities, much turbulence, and standing wave action.

The substrate was broken down into five categories: sand, gravel, cobble, rubble, and sandstone.

In collecting the data, length of an individual habitat type was estimated. As that habitat type was traversed, notes were made on a waterproof slate regarding the substrate make-up of that particular habitat type. The data were then tabulated in terms of numbers of lineal metres of each habitat and substrate type.

Results:

In examining the capabilities of this portion of the river to support spawning, we found that the critical limiting factor was lack of suitable substrate. Bovee (1978) lists depths, velocities, and substrates for steelhead and cutthroat trout, as well as coho, chinook, and sockeye salmond. All of the aforementioned salmonids tend to spawn over broad velocity ranges (usually from approximately .2 metres/sec. to 1.0 metre/sec.) although each species has slightly different preferred velocities.

Although approximately five per cent of the river is suitable for spawning in terms of depth and velocity (Bovee, 1978), very little of the area with suitable depth or velocity has appropriate substrate. Conversely, much of the area where suitable spawning gravel has been deposited is in slow moving and deep holes, where it is not much utilized. By our rather crude estimates, we felt that only one to two per cent of the river is suitable for spawning up to the confluence with Catherine Creek.

Rearing habitat does not appear to be in such short supply. Much of the substrate consists of large boulders and rubble. In the area below Catherine Creek, approximately 35 percent of the river bottom consists of this substrate. Bovee (1978) suggests that all of the salmonids which he has examined with the exception of coho salmon tend to inhabit areas made up largely of boulders and cobble, although some will no doubt be found in less suitable areas. Coho

contd...

Results contd..
salmon tend to select both finer substrate (primarily gravel and cobble) and lower velocities for rearing.

Turbulence caused by the numerous riffles and chutes also affords juvenile salmonids with considerable cover in the lower Tsitika. Although some of the chutes are too rapid themselves to afford shelter to rearing juvenile salmonids, the turbulence they cause in the water downstream offers cover to many small salmonids. During our river swims, we found many juvenile salmonids, primarily steelhead and cutthroat trout holding under the turbulence. The other salmonid which we saw closely associated with this type of habitat was the adult Dolly Varden.

Approximately four hundred lineal metres of the river consists of deep canyon pools. These pools, primarily cut through the sandstone, not only provide rearing habitat for large numbers of juvenile salmonids, but provide holding water for adult salmonids (coho, steelhead, chinook, cutthroat, and Dolly Varden) during low flows and prior to spawning.

In the main stem of the river from Catherine Creek to the river mouth, the most frequently occurring juvenile salmonids are rainbow trout (Salmo gairdneri) and cutthroat trout (Salmo clarki). During our swim from Catherine Creek to the river mouth, one diver concentrated solely on counting juvenile salmonids, counting 591 fish of the Salmo genus. In addition, he counted 60 juvenile coho and eight Dolly Varden. It is likely that the ratio was somewhat skewed towards members of the trout genus because we did not investigate some of the backwaters and side channels which produce many of the coho. In addition, as was suggested earlier, Dolly Varden tend to stay close to the bottom and river margins and were probably not reported in a representative fashion. Nonetheless, our observations suggested that the lower mainstrem of the river is primarily utilized by members of the Salmo genus, whereas coho, which were more numerous in our trap, are produced elsewhere in the system.

(For a complete breakdown of habitat and substrate type, see Table #4).

TABLE #4

HABITAT CLASSIFICATION IN LOWER TSITIKA RIVER

Substrate	Pool	Tail	Run	Riffle	Chute
Sand	.5	–	–	–	–
Gravel	4	.6	3	4	–
Cobble	12	–	11	12	–
Rubble	12	1.5	12.5	13	1.5
Sandstone	8	–	2	1.5	1.4

– expressed in percentage of overall lineal distance

DISCUSSION OF SALMONID REARING CAPABILITES OF LOWER TSITIKA RIVER

Originally, when we installed our trap in the Tsitika River, we hoped to use it to arrive at estimates of smolt production from the system. Because of the 'th and flow of the system, this could not be done on a realistic basis. Nonetheless, we did gather certain data which I feel are valuable in light of proposed development plans for the lower valley. Firstly, it is important to note that in absolute numbers, most of the salmonid production takes place in the lower valley. This is mainly because of the inability of the pink and chum salmon to move upstream more than approximately four kilometres because of waterfalls. In addition, even this area of the river is not as productive as might be, due to the poor quality of the substrate for spawning purposes.

In order to maintain fish production at its present levels, it is obvious that this area must be left as undisturbed as possible. Even now, flooding is definitely a problem in terms of disturbing deposited eggs. It is readily conceivable that even standard logging practices could result in sufficient alteration to drainage patterns to wipe out salmonid production in the lower river. In addition, I suspect that upstream logging activity will have detrimental effects in terms of siltation. Again, I must stress that the area of high overall productivity is so limited in area that it must be protected.

In examining the adult salmonid counts which were published in the TWIRP report, I feel that some of the published values were quite low. In 1980, the peak of the two-year pink salmon cycle, the spawning population in the river appeared to number somewhere in the vicinity of ten thousand. In addition, because of the amount of rearing habitat available in side channels and further up the river valley, I would expect that coho production might be somewhat higher than the published figures of two thousand adults. The Keogh River, a smaller system to the northwest of the Tsitika, produces two to four thousand coho per year, while lacking the lower river side channel development and number of tributaries which the Tsitika River has.

Chum salmon were the species which we saw least of because of their late entry and the inhospitality of the river during this time span. We saw no evidence of adult chinooks in the system, although it was obvious from the few fry which we found that they were there in low numbers.

From our floating counts and trapping results, it appears that the lower river mainstem is used primarily by members of the Salmo genus for rearing.

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Although in our swims we could not differentiate between steelhead and cutthroat juveniles, our trapping results indicated that most of the fish we saw were probably steelhead and/or resident rainbow trout. Although most of th steelhead we trapped were one or two years old, it seemed from the condition factors of these fish and their coloration that these were not smolts but rather displaced presmolts. If such is the case, the smolt population is probably made up of two, three, and four year old fish. This is also born out by the population of the Keogh River, which is a smaller and warmer system (hence growth should be quicker), in which much of the steelhead population is made up of fish older than two years old. The habitat of the lower mainstem is definitely good rearing habitat for steelhead, due to the excellent boulder cover, high velocity riffles and chutes, and the deep canyon pools.

As was pointed out earlier, however, there are adequate side channels and low velocity pools to offer good rearing potential for coho as well: through lack of time and money these were not explored as fully as they should have been.

SALMONID ENHANCEMENT OPPORTUNITIES

At present, MacMillan Bloedel is constructing roadways down the Tsitika River Valley to expedite their logging plans. With the approach of these roads to the lower Tsitika River, it is possible that they could be used to gain access to river areas which could conceivably be enhanced in terms of their salmonid production. One of the major blocks to full utilization of the river by more salmonids is the number of waterfalls between Catherine Creek and the river mouth. Four options exist as far as making the water above the falls available to spawning salmon: to level the falls, construct fish ladders, or to carry adult salmonids above the falls, or to construct incubation facilities which could be located where the falls would supply sufficient water pressure for incubation.

The first two options are, in my opinion, prohibitively expensive. In addition, there are other additional difficulties. Levelling the falls would destroy much of the rearing habitat and holding water held in the canyon pools above the falls. Secondly, any such activity would destroy the aesthetic beauty of the area. Thirdly, intensive surveys would be required to determine

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how much spawning habitat would actually be made accessible. It might be that the river is so gravel-poor that the additional areas made accessible would not be sufficient to be cost-efficient.

Although transportation of adult salmonids above the obstructions might be cost-effective, that too depends on the availability of suitable habitat above the existing barriers. In addition, initial survival might be no different than with the present spawning distribution, since spawning now is limited to fairly good habitat.

The last option, an incubation facility, is probably the most effective in terms of overall production, although it might not be cost-effective. Depending on the type of incubation facility and the available manpower to check and maintain the facility, it is probably possible to construct a facility capable of producing several hundred thousand fry relatively cheaply. If it could be put to the logging companies concerned that this might be viewed as mitigation for potential damage, it is possible that they might agree to fund or aid in the funding of the project. Local companies have in the past aided in Salmonid Enhancement Projects. Western Forest Products, for example, loaned the use of a site for a steelhead hatchery and early rearing station on the outlet creek to O'Connor Lake. MacMillan Bloedel allowed the Northern Vancouver Island Chapter of the Steelhead Society to use a site on their property for an incubation box facility. Hopefully, a similar arrangement could be used in the case of the Tsitika River.

Although it might be possible to do some habitat improvement work in the upper river and in some of the tributaries, it appears that any major habitat alteration would have to be a major engineering project, owing to the river size, poor accessibility, massive flow fluctuations, and great bedload movement. The bedload movement also rules out such structures as spawning platforms and channels in the lower river.

ESTUARINE INVERTEBRATES

INTRODUCTION:

In the salmonid life cycle, one of the most important phases is the tran. .r of the fish from a fresh to a salt water environment. In this period of physiological alteration (smolting), the estuary plays a major role in allowing the juvenile salmonid to adjust gradually to increases in salinity and major temperature differences between the river and the sea. In addition, it is often in the estuary that the juvenile salmonid's food types change, with the attendant changes in searching images and prey identification.

In fresh water (with the exception of pink and chum fry, which migrate out immediately after emergence), juvenile salmonids feed on drifting invertebrates. These drifting invertebrates can either be on the surface of the water or suspended in the water column, and can be produced within the river system (autochthonous), or outside of the river system and enter it incidentally (allochthonous). Another major food source for juvenile salmonids in freshwater is the community of invertebrates which live anchored to or moving across the bottom.

When these same juvenile salmonids move into a marine environment, they shift their diet to concentrate on plankton, marine crustaceans, and small fish, depending on the size and species of salmonid concerned. If the estuary produces adequate food, then the juvenile salmonids can spend a greater period of time there, making the stress of transfer less abrupt and traumatic. An attempt was undertaken to identify the most available food species, its density and distribution within the estuary.

METHODOLOGY:

Because of our lack of expertise with marine invertebrates and the constrain placed on our time, we examined only the most obvious macro-organisms available as prey for salmonids. During a number of our river swims, we made notes on the obvious intertidal invertebrates we sighted as we entered the intertidal areas. Once we had identified the predominant invertebrates, their distributions were mapped and their relative densities were measured.

contd..

Methodology contd..

In the case of the caddis fly which we found, distribution was marked on a p made of the lower river and estuary. Density measurements were made by marking off one foot square areas within the caddis range, and counting the organisms within the transects. Estimations of mysid density were made with the aid of a 10 inch diameter plankton haul net, which was used to make one and two metre vertical hauls (depending on depth). After the mysid distribution had been mapped, they were monitored throughout the summer to determine their presence and absence during our data collection.

RESULTS:

Our river swims indicated that the predominating benthic invertebrate available as food for juvenile salmonids during the summer months was a caddis fly larva, which was unfortunately not identified further. The particular caddis fly which we found in the estuary was strictly an estuarine-brackish water species, as all of the casings we found were similar and all of them were found in a specific band in the intertidal. Within this band, densities were high, ranging from ten to twenty-five per square foot. These caddis flies did not appear in any numbers until mid-June. Their numbers after this remained high as long as we sampled them (late August). (For a summary of their densities and distributions, refer to Figure #4 and Table #5.)

The predominant food species we found available to salmonids within the estuary was a mysid organism, Novamysis mercedes. This mysid occupied a broad band in the estuary and across the river mouth. In depth, their distribution was from the bottom to the interhaline level. Although we did not see them in large numbers in more than three metres of water, it is likely that this was because they could spread further throughout the water column. We first noted the mysids in large numbers in early April. We did not use a plankton net to sample them until June 22. During our sampling, we found that the results were always lower than appearance would dictate, since the mysids are rapid swimmers and many would avoid the upward scooping of the plankton haul. Nonetheless, we probably captured approximately 65 percent of the crustaceans actually present in the vertical haul. Because of this sampling error, both actual and estimated results are included in the data table (Table #6).

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Results contd ..

Densities ranged from a low of approximately 4400 per cubic metre to a high 13,250 per cubic metre. Interestingly, these values were both obtained in the same sampling operation. Otherwise, values obtained on the other two days of sampling were more consistent, yielding means of 8300 on June 22 and 6370 on July 7th.

Corrected values for mysids ranged from 6600 to 19,900 per cubic metre, with daily means of 12,450, 9,560, and 13,335 on June 22nd, July 7th and August 17th respectively. It is likely that the value obtained on July 7th is low for two reasons. Firstly, recent freshets might have swept a large number of the mysids from the area. Also, because the sampling was in deeper water, the mysids had more opportunity to avoid the net during its haul to the surface.

Gill net results suggested that the mysids were fed on quite heavily by juvenile salmonids such as coho. In addition, personal observations showed that adult Dolly Varden char, which spend considerable time in the estuary, also fed on the mysids quite extensively.

FIGURE 4

DISTRIBUTION OF CADDIS LARVAE AND NOVAMYSIS MERCEDES IN TSITIKA ESTUARY

REPRESENTS CADDIS DISTRIBUTION

REPRESENTS NOVAMYSIS MERCEDES DISTRIBUTION


TRAP SITE

TABLE #5

CADDIS FLY LARVAE DENSITY IN TSITIKA ESTUARY

Date	Sample No. 1 (per sq. ft.)	Sample No. 2 (per sq. ft.)	Sample No. 3 (per sq. ft.)	Mean Value (per sq. ft.)
May 24	8	12	5	8
June 14	6	15	18	13
July 6	18	22	15	18
July 26	17	13	12	14
August 3	27	19	22	23

TABLE #6

MYSID DENSITY IN TSITIKA ESTUARY

Date	Sample No.1 (per metre ^{3})	Sample No.2 (per metre ^{3})	Sample No.3 (per metre ^{3})	Mean Value
June 22	4400 6600*	7250 10875*	13250 19875*	8300 12450*
July 7	6650 9900*	6800 10200*	5660 8490*	6370 9560*
August 17	8300 12450*	10500 15075*	8320 12480*	8890 13335*

* represents corrected estimates

KELP MAPPING

INTRODUCTION:

tside of the estuary proper, one of the most productive areas in the marine environment is the kelp bed. Kelp plants no only convert nutrients and sunlight to living tissue which can then be grazed on by many organisms, but they offer shelter and substrate to a host of invertebrates and fish. Larger organisms feed on the smaller creatures associated with the kelp beds. As the kelp dies, its decomposition provides nutrients which become available to bacteria and plankton, resuming the food cycle anew.

In Robson Bight there are a number of kelp beds scattered throughout the bay. In addition to the defined beds of bull kelp (*Nereocystis luetkeana*), there were patches of eel grass (*Zostera marina*) off the river mouth. Fucus was profuse on the estuary margins and along the intertidal shoreline. Because these are the productive areas which produce much of the food available to rearing salmonids, we mapped many of the kelp beds in Robson Bight.

METHODOLOGY:

During many of our transects, we madenotes on the kelp types and densities present. In addition, in the case of one kelp patch, we made measurements through the summer on the same one-metre grid to determine growth rates and plant losses. Although not all of the kelp beds were quantified, the estimates of area were included to give some idea of the algal communities in the bight.

RESULTS:

Even when we first established some of our transects, in late March and early April, marine algaes were well-established in many areas. Major kelp beds were found in many areas at this time. Bull or bladder kelp (*Nereocystis luetkeana*) appeared in several concentrations. The largest bed of bull kelp was to the northeast of the rivermouth, anchored offshore and adjacent to an encampment known as the 'Hippy Hut'. By the end of the summer, this kelp bed measured approximately 70 metres by 20 metres in area, which had measured .15 to .25 metres in late March, measured between three and ten metres in length by late August. Mixed in with the bull kelp in this area was a considerable amount of sea lettuce (*Ulva* sp.) as well as *Laminaria saccharina* and *Cymathere triplicata*. *Laminaria saccharina* also occurred on the rocks between the kelp bed and the shore.

Results: contd...

Bull kelp occurred in a number of smaller patches as well. One such area was small bay immediately to the west of the estuary, while other small patches occurred near both the westernmost and easternmost portions of the bight. Laminaria occurred along the shoreline in a number of areas, as did Cymathere triplicata.

The area which appeared to have the greatest diversity of algaes was immediately off the river mouth. The channels cut into the gravel by former freshets were literally carpeted in Porphyra perforata, Iridae cordata, Alaria marginata, Phodomela larix, and Ulva sp.

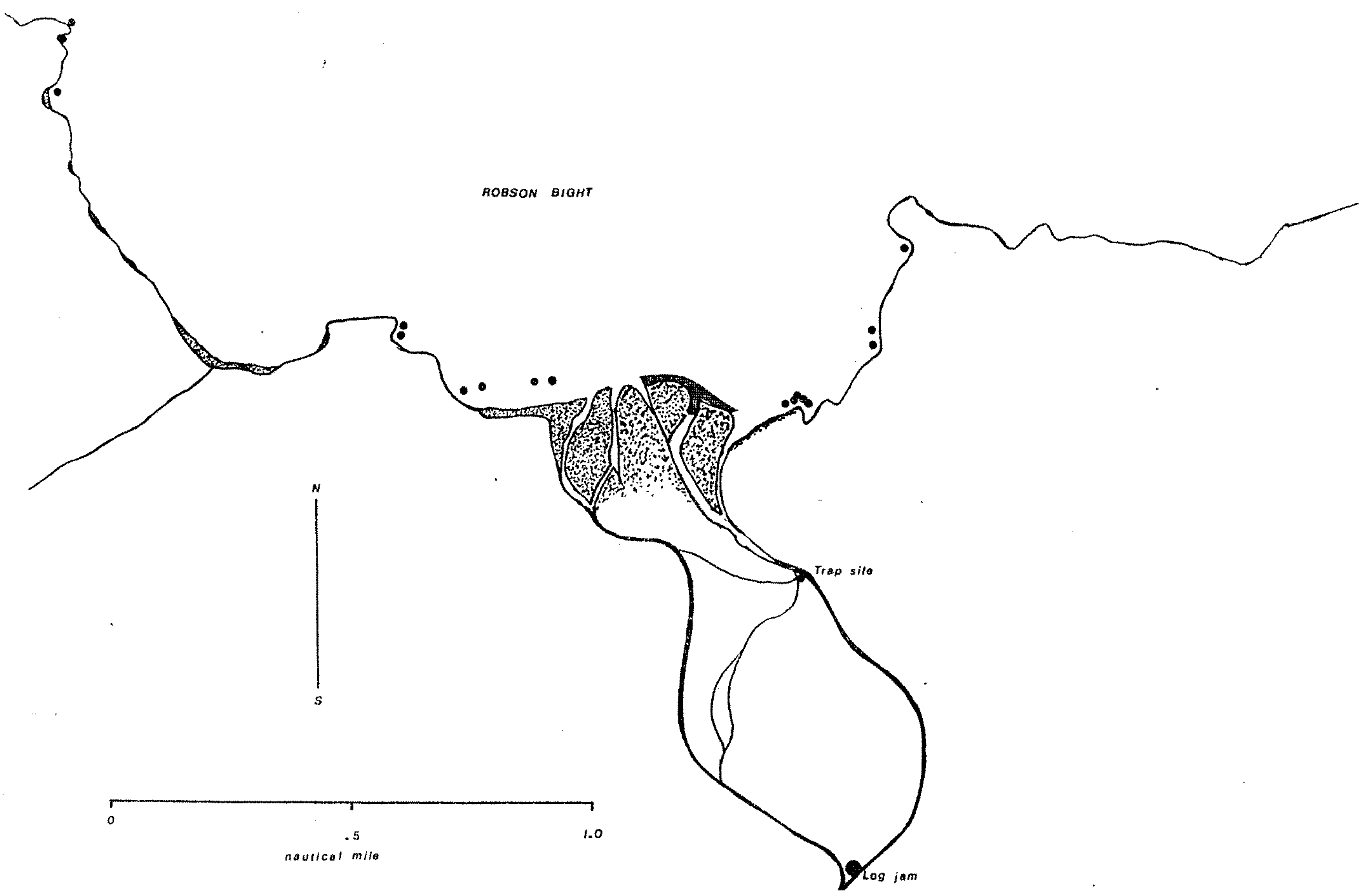
Growth measured in the largest kelp bed indicated that most growing had ended by late July. During our sampling period, the plants within the grid were reduced from four hundred to two hundred and fifty. This reduction was probably in part due to crowding and in part due to the storms which broke on the exposed shoreline. (For a summary of growth and plant losses, see Figure #5).

FIGURE 5

DISTRIBUTION OF KELP BEDS IN ROBSON BIGHT

●● REPRESENTS *NEREOCYSTIS LUETKEANA*

▒ REPRESENTS *ZOSTERA MARINA*


ROBSON BIGHT
N
S
Trap site
Log jam
0
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1.0
nautical mile

BEACH SEINING

INTRODUCTION

During much of the time that we were collecting data in Robson Bight and the lower Tsitika River, large schools of rearing salmon were evident in the bay. They appeared to spend much of their time in the shallows, along the tide line, or in proximity to the kelp beds. In order to sample the juvenile salmonids in Robson Bight and to examine the fauna associated with the marine environment, we established several beach seining stations.

METHODOLOGY:

Beach seining stations were established at three points in the bight. All of these stations were to the west of the river mouth. The seine net, which measured 100 feet long and ten feet deep, was set with the aid of a fourteen foot fibreglass runabout. In each case the net was set parallel to the beach and retrieved by hand. A scuba diver generally followed the net in as it approached the beach, to lift the lead-line over boulders and sunken snags.

RESULTS:

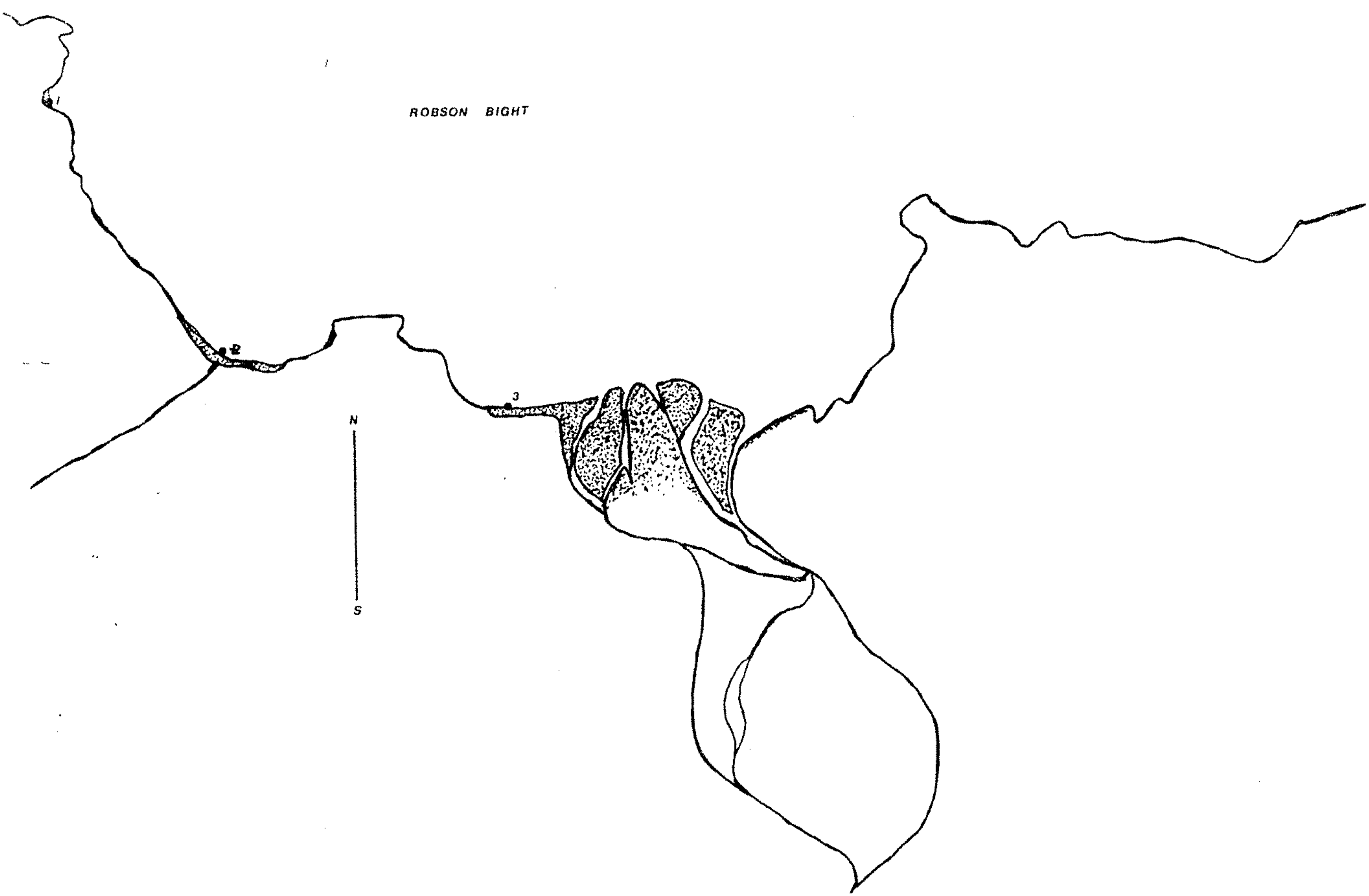
Because of thelength of the net, beach seining was extremely difficult, and the results were not encouraging enough to repeat the exercise at a subsequent date. Although we did pick up pink and chum juveniles with the beach seine, net retrieval was too slow to pick up coho smolts which had been sighted in the area.

At our first site, near the westernmost portion of the bight, we picked up only one chum fry in two sets with the net. We did pick up a number of different species of crabs, two species of shrimp (unidentified), and several rockfish juveniles (unidentified).

Our second site was considerably more productive in terms of juvenile salmonid captures. In two hauls at this site, we captured eight chum fry and two pink fry. The mean length forthe chum fry was 41.5 mm, while mean weight was .76 grams. At this site, again, we picked up a number of crabs, several different species of shrimp, and a number of juvenile rockfish.

Our third site, which was located nearest the river, was relatively poor. Again, we picked up only one chum fry. We did capture a number of

contd..


ROBSON BIGHT
1
2
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Results contd..

sailfin sculpins at this site, as well as several crescent gunnels (*Pholis laet*· red gunnels (*Pholis schultzi*), and rockweek gunnels (*Xererpes fucorum*).

DISCUSSION:

Due to our lack of success and the amount of time required to set the beach seine, the program was discontinued. Because of our low capture rate, we could not make any conclusions as to what species of salmonids were rearing in Robson Bight at the time we were seining. Interestingly enough, a Fisheries and Oceans study team which had seined in Robson Bight the year before had had fairly good success in the area which we found to be most productive.

We did see juvenile salmon (judged to be coho) at all three study sites, but were unable to capture them with the equipment we had.

UNDERWATER TRANSECTS AND MAPPING

INTRODUCTION

When the moratorium on loggingactivity was lifted in the Tsitika Riv... Valley, it was done with the intention that the logging plan developed would be a true integrated resource plan. Several government resource agencies (Ministry of the Environment, Fisheries and Oceans-Canada, Ministry of Forests, Ministry of Lands, Parks and Housing) and the logging companies involved contributed data which were then used in compiling the Tsitika Watershed Integrated Resource Plan. Unfortunately, during the data collection phase, only one study, commissioned by the Ecological Reserves Unit, centred on Robson Bight itself. This study was concerned solely with cataloguing the intertidal areas around the estuary and the estuary itself with the intention that this area should be made an ecological reserve.

As there was no other available data concerning the marine life of Robson Bight and because upstream logging activity could have some effects on the marine communities in the bay, we decided to gather what data we could on the existing communities. Cataloguing the various communities inside the bight might not only suggest some of the reasons why juvenile salmonids spend so much time there, but might also point out sensitive areas which require protection from industrialization.

Because of the vast shore area, the shoreline was broken down into different basic types according to gradient, substrate, and current. Transects were than laid down in the representative areas, and the marine life around them was categorized.

METHODOLOGY:

After examination by boat, the shoreline was broken down into six categories. These six categories were as follows:

1. Rock substrate - high current velocity
2. Rock substrate - low current velocity
3. Cobble-boulder substrate - low current velocity
4. Sand-gravel-mud substrate - low current velocity
5. Gravel substrate - off river mouth
6. Kelp bed - rock substrate

METHODOLOGY cont...

Once the sites had been selected, twenty metre transect lines were laid down perpendicular to the shore. The lower end of each transect line was anchored at 60 feet indepth, then the line was brought as clo__ to the shore as it would reach. Adjacent to the line, a one-metre grid was laid down in a position determined by random number tables. During the transect, all organisms were counted in a one metre swath on either side of the transect, while the organisms inside the one-metre grid were enumerated separately, to give species density.

One transect line, in the kelp bed, was laid parallel to shore along the edge of the kelp bed. This was done so that we could measure the kelp bed and its growth through the summer.

RESULTS:

Due to time constraints, we only managed one dive per transect line, although we had originally planned a minimum of three. Nonetheless, the dives did help give some idea of the composition of Robson Bight. From surface examination, our diving transects, and observational dives (no transects laid out), it appear that approximately five percent of the shoreline would come under the first category. At both the eastern and westernmost points of the bay, tidal currents sweeping past cause large back eddies. These, in conjunction with the rock faces exposed to the tidal action, result in very dense communities of marine life. On both points, the most common flora is a coralline algae. This occurs in both the smooth encrusting form and the articulated branching form. Although there was some nereocystis established at the western point, it did not comprise a major portion of the algal community. Other algaes at both points included ulva and laminaria. Invertebrates were extremely prolific in this region. Although the most prolific in terms of sheer numbers would probably be various forms of sea anenome such as the white-plumed anenome (Metridium senile), starfish were also extremely common. Several large colonies of Pacific giant barnacles (Balanus nubilus) were seen in each of the two areas. Other common shellfish included the pinto abalone (Haliotis kamschatkana) and the purple-hinged scallop (Hinnites giganteus). Less frequently observed invertebrates were the orange peel and opalescent nudibranchs and the sea strawberry hydrocoral. Fish which occurred in these areas in large numbers were the yellowtail rock-fish (Sebastes flavidus), the black rockfish (Sebastes melanops), and the quillback rockfish (Sebastes maliger), and the quillback rockfish (Sebastes maliger). Both the yellowtail and black rockfish were seen in large school numbering several hundred off the western point, and seen in smaller numbers (approximately one hundred) off the eastern point. Quillback rockfish were common in the crevices in both areas. In addition, three large ling cod (Ophiodon elongatus) were seen near the western point while one was seen to the east. Juvenile rockfish and greenling were also sighted in the crevices in these areas.

Approximately 30 percent of the shoreline of Robson Bight was classified as Category #2, which was defined as having a rock substrate and low current velocities. Tidal action was not entirely absent in these areas, but was reduced markedly because of the protection afforded by the bight. As can be seen in the included map (Figure 7), much of the shoreline both to the east and west of the estuary was classified algae, both encrusting and brachiated, although there was less of the brachiated type than in Category #1. Although there was little other flora at the lower depths, there were several types of kelp in the upper areas. Ulva, laminaria, and assorted brown algaes occurred from approximately eight metres down to the surface.

Sea urchins appeared to be the major invertebrate species in these areas. Both the giant red sea urchin (Strongylocentrotus fransiscanus) and the green sea urchin (Stronglocentrotus droebachiensis) were evident in these areas, although the green urchins appeared to be more abundant. Chitons were also abundant, particularly the lined chiton (Tonicella lineata). These occurred primarily from approximately nine to five metres. Star fish were also evident, as were snails (unidentified by divers). Rarer invertebrates were the sea strawberry soft coral. In the upper two to three metres of water, the dominating invertebrates were barnacles, which encrusted the rocky margins.

Several fish species occurred in these areas, although not in the profusion which they occurred near the points of the bay. Kelp greenling (Hexagrammos decagrammus) were common, as were quillback rockfish. Smaller fish such as the blackeye goby (Coryphopterus nicholsi) appeared to be common in these regions (seven were sighted on one transect).

FIGURE 7

HABITAT CLASSIFICATION OF ROBSON BIGHT

CATEGORY 1 - ROCK SUBSTRATE, HIGH CURRENT VELOCITY

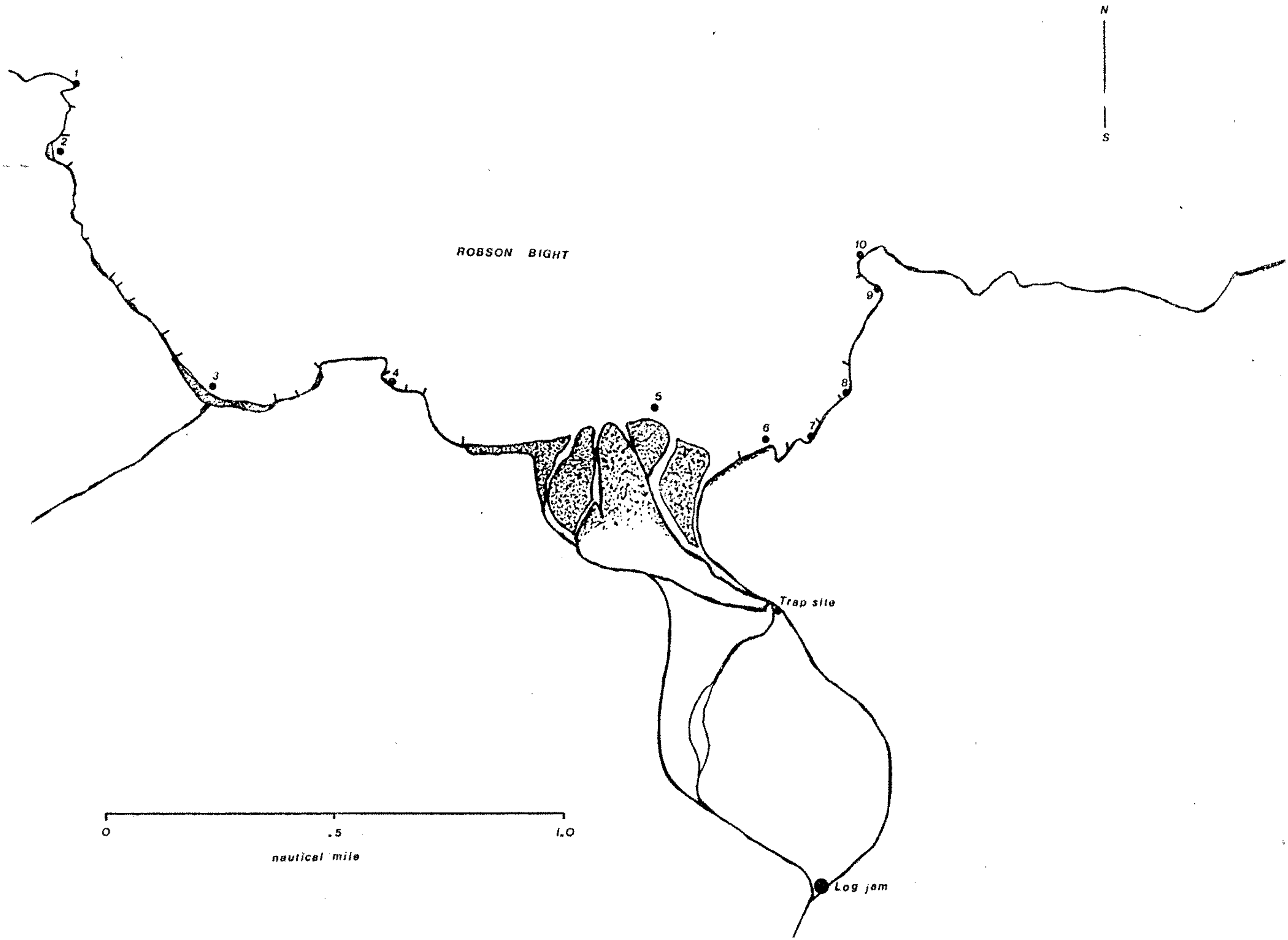
CATEGORY 2 - ROCK SUBSTRATE, LOW CURRENT VELOCITY

CATEGORY 3 - COBBLE-BOULDER SUBSTRATE, LOW CURRENT VELOCITY

CATEGORY 4 - MUD, SAND, GRAVEL SUBSTRATE

CATEGORY 5 - GRAVEL SUBSTRATE, ESTUARINE FAN

CATEGORY 6 - KELP BED, ROCK SUBSTRATE


N
S
ROBSON BIGHT
1
2
3
4
5
6
7
8
9
10
Trap site
Log jam
0
.5
1.0
nautical mile

Results contd..

Category #3, cobble-boulder substrate, made up another 25 percent of the total shoreline. Although these areas had low tidal action, they con ned a surprising variety of life. Again, there was not an overabundance of kelp, and what kelp was there consisted primarily of ulva, laminaria, and cymathere, with some other brown algaes present in smaller numbers. Generally, this algae was above the ten-metre depth.

Marine fauna was much the same as in Category #2, with sea urchins and lined chitons the most frequent invertebrates. In addition, large numbers of tube worms were sighted anchored to the rocks throughout the transect area, particularly at 16 and seven metre depths. There were a number of shrimp seen in these areas towards the lower ends of the transect. Most of the fish seen were kelp greenling, although some higher current rockfish, including a china rockfish (Sebastes nebulosus) were seen in these areas.

Category #4, which was sand, mud, and gravel substrate in low current areas, made up about 15 percent of the total shore length. As might be expected, there was relatively little flora in this area, although there was some ulva scattered across the bottom. Burrowing sea anemones were common in these reaches. Sea urchins and sea cucumbers (Parastichopus californicus) were also common. Shrimp of several species were extremely abundant in these areas. Buried in the sand were moderate numbers of geoducks (Panope generosa). Density measurements made on these bivalves yielded a mean of six per square metre. In one of the transect areas with the type of bottom described, dungeness crabs (Cancer magister) were extremely common. This was during the moulting period, hence their shells were extremely soft. Small squid were also regularly seen in this area. Fish consisted of kelp and painted greenling (Oxylebius pictus) and the starry flounder (Platichthys stellatus).

Category #5 was a category similar to the preceding one in substrate type. This was the category designated to cover the gravel fan at the river mouth. It was classified differently because it was expected (and found) that due to the gravelcreep from river deposits, the bottom life was considerably different. Species diversity was limited in this area, with relatively little algae represented. There was some eel grass (Zostera marina) mixed with brown algaes to the east of the transect area, but no algaes in the actual study site. Sea urchins, sea cucumbers, and shrimp were the most visible invertebrates. Many of the shrimp were the mysids described earlier, although they did not occur in the densities the ad in shallower water. Dungeness crabs were also common in this area. One similarity noted in both areas #4 & #5 was that due to the lack of strong tidal flow, there were large quantities of wood debris on the bottom. In the case of the study site for Category #4, the site was too far from the river mouth for the wood to have been swept from the river unless carried there by wind and tide.

The kelp bed to the east of the river mouth was treated as a separate area for two reasons: firstly, in that bull kelp beds are discreet entities in the bight; and secondly, in that the kelp was anchored to rock shelves which had a much lower average gradient than did the same substrate elsewhere in the bay. Although the dominant form of algae in the area was bull kelp (Nereocystis luetkeana), laminaria, cymathere, and ulva were common as well. In addition, Porphyra perforata, Iridea cordata and Rhodomela larix appeared in or at the margins of the bed, which measured some 70 metres by 20 metres in area.

Fauna in the kelp beds was considerably more diverse than in other sites, as might be expected. Both red and green sea urchins were common in and around the kelp bed. Sea cucumbers were also extremely common. Other invertebrates which were dense in distribution were chitons and keyhole limpets. Tube worms were abundant on the rocky margins, while dog whelks covered both rocks and kelp plants. In addition, there were a number of sea anemone species found. Star fish were represented by four species, the sunflower start (Pycnopodia helianthoides), the morning sun star (Solaster dawsoni), the blood star (Henricia leviuscula), and the leather star (Dermasterias imbricata). Burrowing sea cucumbers were found in the region, although they were not particularly abundant. Pink corraline algae (both encrusting and brachiated) was found on the lower rocks (deeper than two metres), while rocks near the tidal level were covered with barnacles.

Fish life was not particularly evident during the dive, although a number of kelp greenling and blennies were seen. At other times, while gill netting and plankton hauling, we observed both Pacific herring

(*Clupea harengus pallasi*) and salmonid juveniles in and around the kelp beds. Amongst the salmonids captured in the kelp were young coho salmon and adult Dolly Varden char.

DISCUSSION:

Because Robson Bight is an extremely open bay, with tidal action all along the shoreline, and because of the varied substrate, marine life within the bight occurs in several distinct communities. The survey which we have done is an extrmely broad overview of the area, which might easily have missed several distinct community types and many of the algal and faunal species which could be found here. While diving in the bight, we found that visibility became extremely poor in mid-May due to the plankton blooms which were swept into the bay by the tide. This probably explains the occurrence of several species of invertebrates and fish which might not otherwise be found in sheltered bays.

Another point of interest which we found was that there are specific areas where tidal currents seem to be more reduced than in the rest of the bight. These areas are typically of Category #4, with silt and sand bottoms. These areas seemed to collect more bark and debris than the rest of the shore. Although at this point this is a natural phenomenon, we feel some concern about whether these same areas would tend to concentrate wood debris if log booming was to proceed in the bight. It is possible that most of the debris would be swept into deeper water, but might also mean that debris would not only occur in the isolated pockets we found it in during sampling,but spread further throughout the basin.

SUMMARY

Of necessity, this is an extremely brief overview of the lower Tsitika River - Robson Bight area. Many of the questions, which we had originally set out to answer are still unanswered, due to lack of time, money, and manpower. Nonetheless, it does supply some data which might be worthwhile in making recommendations towards further studies. Some of the data might be useful in correcting existing errors and filling in blanks in existing data.

1. The lower Tsitika River mainstem appears to be used primarily by rearing juveniles of the genus Salmo. Coho juveniles were extremely sparse in the mainstem, although they were seen there and in some of the side channels which were not examined as closely.

2. There is considerable displacement of steelhead juveniles, as evidenced by our trapping results. It is unlikely that these are smolts, but that the smolts are probably two, three, and four years of age, with an unknown age distribution.

3. Eulachons spawn in the lower reaches of the Tsitika in reasonably high numbers. Due to the river topography, it is likely that they use only the lower two kilometres.

4. Salmonids spend considerable time rearing in Robson Bight, at least throughout the time period which we used for sampling (April through October). This might be largely due to the amount of feed produced both in the estuary (primarily mysids) and the extensive plankton blooms.

5. Kelp beds in Robson Bight are productive and numerous, although generally not large. Dominant algaes are nereocystis, laminaria, cymathere, and ulva, although other algaes are also quite common.

6. Robson Bight has a varied and productive range of marine communities. Although we have inadequately mapped them, it appears that the whole of the bay is considerably more productive than might be thought.

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