

RESULTS OF A THREE YEAR MONITORING PROGRAM OF LOG HANDLING
ACTIVITIES ON BABINE LAKE
1983-1985

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INTRODUCTION

In the early 1980's Houston Forest Products (HFP), the licensee with the cutting rights in the Morrison Arm watershed, identified an immediate need to rapidly access and harvest insect infected wood from this area. In 1982 HFP applied to the Ministry of Forests (MOF), the Ministry of Lands, Parks and Housing (MLPH) and the Department of Fisheries and Oceans (DFO) for approval to store and transport logs in Babine Lake since they did not have road access at that time. The application included:

- 1) The watering and storage of logs at the northern end of Morrison Arm.
- 2) Towing the logs to Richardson Bay located just south of Topley Landing on the main arm of Babine Lake. and,
- 3) Storage and dewatering of these logs in Richardson Bay.

DFO expressed concern with this proposal due to the extremely high fisheries values in Babine Lake and the potential for a negative impact as a result of log handling activities. This concern led to discussions with MOF and HFP and a subsequent agreement to proceed with the project was made. This agreement included a detailed monitoring program that was designed to determine if the dumping, storage, transportation, and dewatering of logs on Babine Lake was having a detrimental effect on the aquatic environment, particularly the salmonid resource. Also included in this agreement, was the provision that HFP would modify or suspend their water-based operations if the monitoring program revealed that the log handling operation was resulting in a significant impact on the fisheries resource.

It was felt that this monitoring program would be particularly useful since previous research investigating the environmental impacts of this type of industrial activity were restricted to marine and estuarine environments. It was also thought that the results of this study could be applied to other lakes recognizing the influence of site specific conditions (ie. water circulation patterns).

This monitoring program was organized into three main components and took place over a three year period. Section 88 funds (MOF) were allocated, and the Westwater Research Center of the University of British Columbia was retained to conduct the study. The program was organized over a three year period as follows:

- 1983 Pre-impact: Biological, chemical and physical data were gathered from the dump, storage and dewatering sites as well as control sites to document the pristine conditions.
- 1984 Comparison: Log handling sites currently being used on the lake, as well as historical sites were investigated.
- 1985 Post-impact: The 1983 program was repeated in order to document any changes in environmental conditions as a result of HFP's operation.

The results from these studies have been documented and are available from the Westwater Research Center (see References).

In cooperation with the Westwater Research Center, DFO conducted a three year sampling program documenting the temporal and spatial distribution of juvenile salmonids as follows:

1983: Downstream trapping of juvenile salmonids on the Morrison River, trawling the surface waters of Morrison Arm and Richardson Bay, and the underwater photo documentation of the lake substrate in the dump, storage, dewatering and control sites.

1984: Downstream trapping of juvenile salmonids on the Morrison River, beach seining the surface waters of Morrison Arm, and the underwater photo documentation of the lake substrate in the dump, storage, dewatering and control sites.

1985: The 1984 program was repeated.

This report presents the data collected during the downstream trapping and beach seining programs. The trawl data are presented in a 1984 draft report by Mr. U. Orr, DFO, Prince Rupert (Orr, 1984). The underwater photographs are located in the DFO Habitat office in Prince Rupert and are available on a loan basis.

METHODS AND RESULTS

Downstream Trapping

A 2'*3' inclined plane trap (IPT) was used to capture juvenile salmon in order to determine the timing of their downstream migration of the Morrison River. The trap was equipped with pontoons and anchored in the thalweg at a point approximately 1 kilometer upstream of the lake (Morrison Arm). The trap was operated in the same location in all three years (see Figure 1). Fish were removed and enumerated twice daily, and 30 fry were sampled for nose-fork length on approximately 3 day intervals. Surface water temperatures were recorded and a staff gauge was installed to enable the documentation of water levels.

Tables 1, 2, and 3 present the catch data as well as water temperature and levels for 1983 to 1985. The graphs that accompany each of these tables illustrates these data. Tables 4 and 5 include the nose-fork lengths measured in 1984 and 1985 respectively.

Beach Seining

A beach seine measuring 25*2 meters was used to sample juvenile salmonids during 1984 and 1985. Ten sites were established along Morrison Arm (see Figure 1) and three surveys were conducted each year. Three replicate sets were made at each site and the catch averaged (CPUE). Salmon fry and yearlings were anaesthetized in a solution of

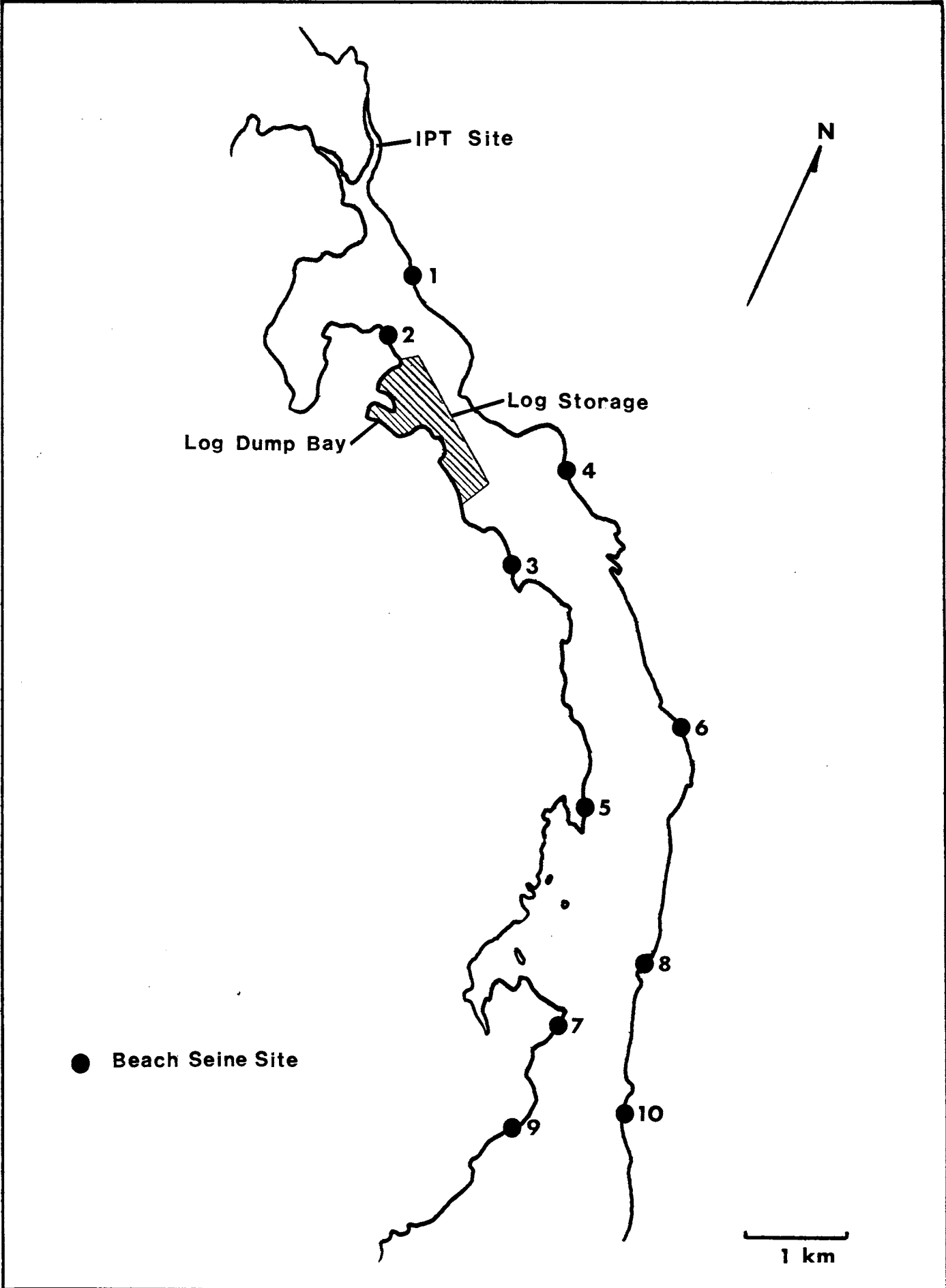


Figure 1: Morrison Arm , Babine Lake

tricaine methanesulfonate (MS222) and nose-fork length measured to the nearest mm. The remaining fish were enumerated and released.

Table 6 summarizes the beach seine catch by CPUE for 1984 and 1985. These results are illustrated in the associated graphs. Tables 7 and 8 presents the catch for each set for 1984 and 1985 respectively. The nose-fork length data are listed in Tables 9 and 10.

DISCUSSION

The purpose of this document is simply to present the data which were collected over the three year monitoring period. However, a number of conclusions can be drawn from the sampling program. These are:

- 1) The pattern and timing of juvenile sockeye salmon, as well as total numbers, migrating downstream Morrison River to the Morrison Arm of Babine Lake varied significantly from year to year. This information was very useful since it was observed that the utilization of the dump site by rearing sockeye fry was much higher in 1983 as compared to 1985. One would naturally tend to assume that rearing salmonids were avoiding this area as a consequence of log dumping and storage. However, a comparison of the downstream trapping results indicates that 37,122 fry were caught during a 19 day period in 1983 (Table 1) as opposed to 4,675 fry trapped during 23 days in 1985 (Table 3). It is obvious that the absence of large numbers of fry in the dump site in 1985 can not be contributed solely to the log handling activities.
- 2) It was found, however, that the fry that were utilizing the log dump area in 1985 disappeared later in the spring due to low dissolved oxygen in the epilimnion. This phenomenon was contributed to a rise in the surface water temperature resulting in increased microbial action on a slime that was associated with the logs stored in the protected bay where the log dump was located. It is believed that wood sugars leaching from the logs provided a nutritious environment for this microbial growth. Also associated with this slime was a filamentous green alga(e) of unknown species. This increased microbial action, combined with the limited water circulation of this area, resulted in severely depressed dissolved oxygen in the epilimnion and was no longer suitable as rearing habitat. The Westwater Research Center has documented these results in detail (Levy, et. al., 1985).
- 3) This impact of the log handling activities had management implications. Firstly, the extent and frequency of this impact had to be documented. Secondly, HFP's operations had to be modified to prevent the reoccurrence of this phenomenon. Mr. Dave Bustard, a biological consultant located in Smithers, was hired to investigate this matter in 1986. His findings indicated that the area of depressed dissolved oxygen was confined to the small bay where the log dump was located. Low dissolved oxygen levels were not found in the remaining portion of the log storage area due to better water circulation (Bustard, 1985). Discussions with HFP resulted in the company agreeing to reschedule their towing program so that the logs stored within the small bay were removed

prior to warm weather. I feel that this modification of their program has eliminated this impact.

- 4) The beach seining results are very erratic with an extremely high variance. This is a consequence of the schooling behavior of these fish. While one set may catch only a few fry, the next set may capture a large school of several hundred to a thousand. For this reason, a stastical analysis of the beach seine results is not possible. Other sampling methods, such as the grid observation technique used by Westwater, should be considered in future monitoring of this kind.
- 5) One of the major management implications of these results is to aviod log handling activities in areas of high fisheries values and poor water circulation. Applying all of the results of the Babine program to other areas should be done with caution since the site specific conditions may play a significant role in the actual impacts.

As mentioned earlier, the main purpose of this report is to present the data which were collected in a usable format. All the tables and associated graphs are stored on a 5 1/4" floppy disc included in this document. The List of Tables provides the file name with each table. The program used to prepare this report was Symphony by Lotus. The files (excluding the graphs) can, however, be used with Lotus 123.

REFERENCES

- 1) Bustard, D., (1985). Dissolved Oxygen Studies in a Log Storage Site at Morrison Arm, Babine Lake. 1986. 11 pp.
- 2) Levy, D.A., K.J. Hall, and I. Yesaki. (1984) Log Transportation Impacts in Babine Lake: Pre-Impact Conditions in Houston Forest Products Operating Sites. Westwater Research Center, U.B.C. 90 pp.
- 3) Levy, D.A., K.J. Hall, and I. Yesaki. (1985) Log Transportation Impacts in Babine Lake Phase II 1984: Comparison of Conditions in Active and Historical Operating Sites. Westwater Research Center, U.B.C. 160 pp.
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- 5) Power, E.A., and P.L. Wentzell. (1985) Experimental Study of Log Storage Impacts in Babine Lake 1985: Effects on Water Quality, Bacteria, Zooplankton and Sockeye Fry. Westwater Research Center, U.B.C. 79 pp.
- 6) Yesaki, I. and D.A. Levy. (1986) Log Transportation Impacts in Babine Lake: Supplementary Benthic Data Report. Westwater Research Center, U.B.C.
- 7) Orr, U. (1984) A Preliminary Report on Fish Sampling and Photo Documentation of Morrison Arm & Richardson Bay, Babine Lake, 1983. Draft Report, Department of Fisheries and Oceans, Prince Rupert, B.C.

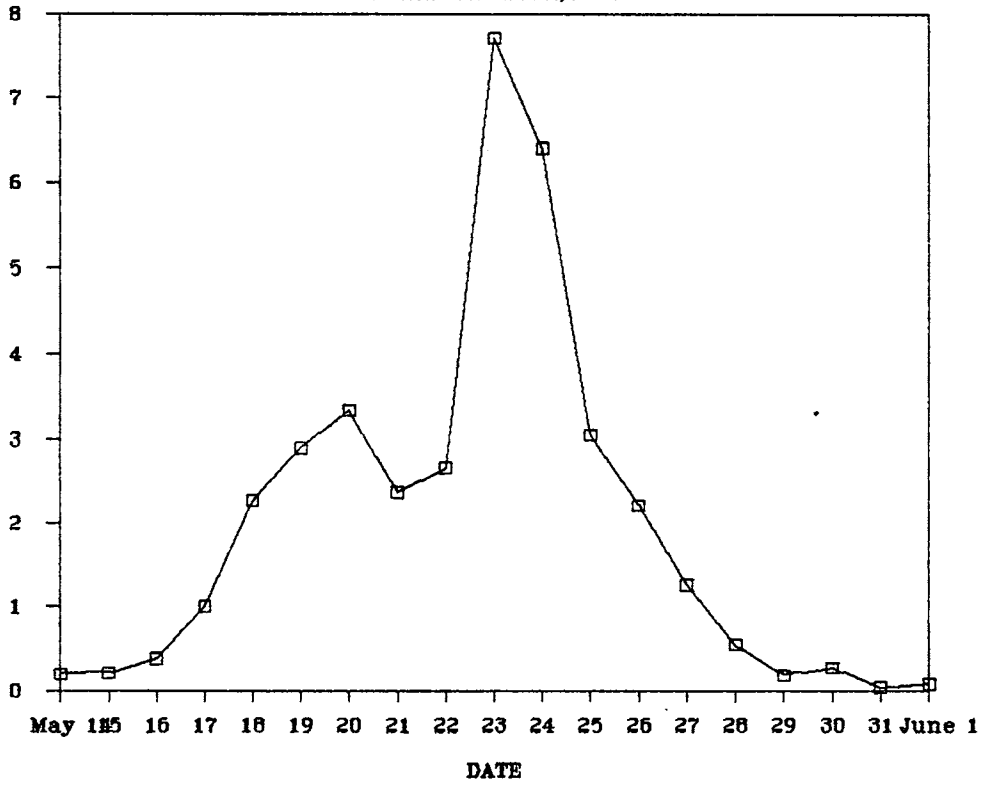
Table 1 Inclined Plane Trap Catch Results In Morrison River
1983

Date	Sockeye Fry	Sockeye Smolts	Coho Fry	Pink Fry	Water Temp.	Water Level
May 14	200	0	0		8.0	
15	214	5	4		8.0	
16	382	11	0		11.0	
17	1000	4	3		10.0	
18	2266	0	8		11.0	
19	2907	5	11		10.0	
20	3340	0	0			
21	2370	0	0			
22	2660	0	0			
23	7710	4	0			
24	6400	2	0			
25	3060	1	5		12.0	
26	2216	0	0		11.0	
27	1259	0	0		13.0	
28	542	0	0		13.0	
29	194	0	0		15.0	
30	276	0	18		15.0	
31	42	0	0		15.0	
June 1	84	0	2		16.0	
Totals	37122	32	51	0		

SOCKEYE FRY CAUGHT IN IPT

MORRISON RIVER, 1983

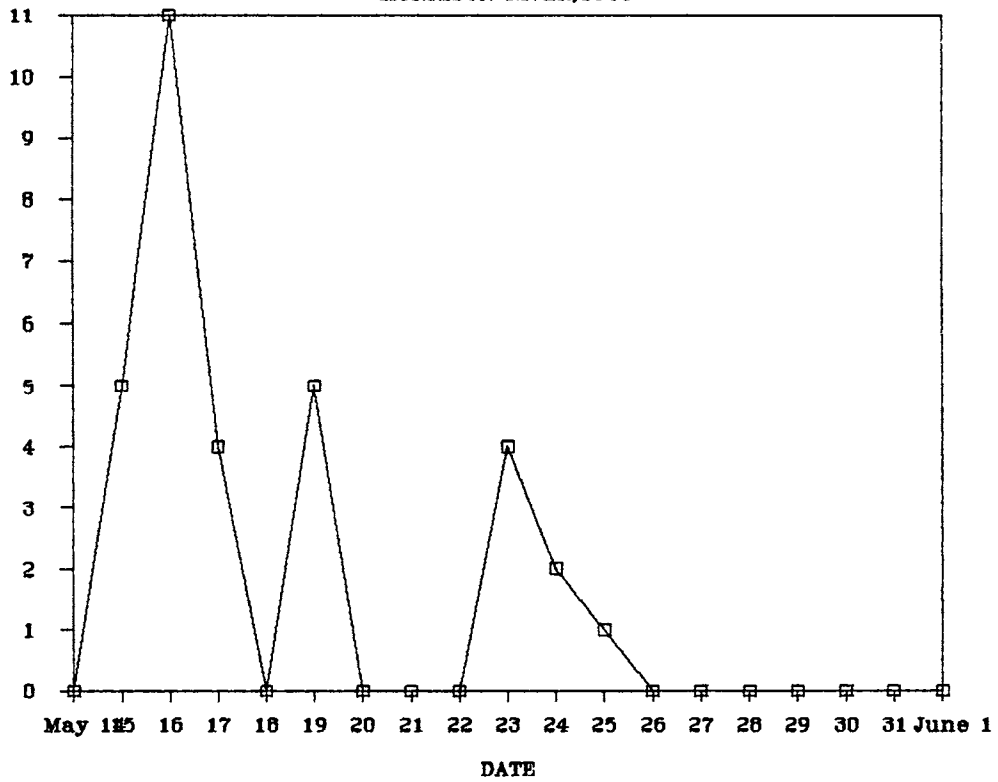
SOCKEYE FRY
(Thousands)



SOCKEYE SMOLTS CAUGHT IN IPT

MORRISON RIVER, 1983

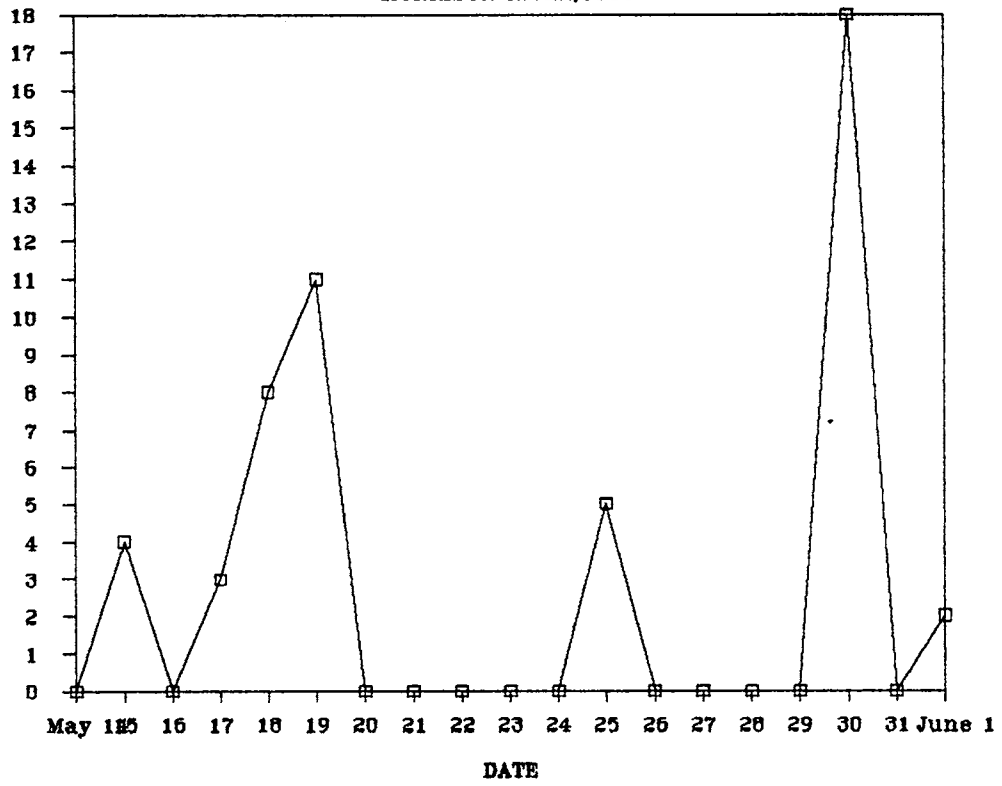
SOCKEYE SMOLTS



COHO FRY

COHO FRY CAUGHT IN IPT

MORRISON RIVER, 1983



WATER TEMP. MORRISON RIVER, 1983

WATER TEMP (C)

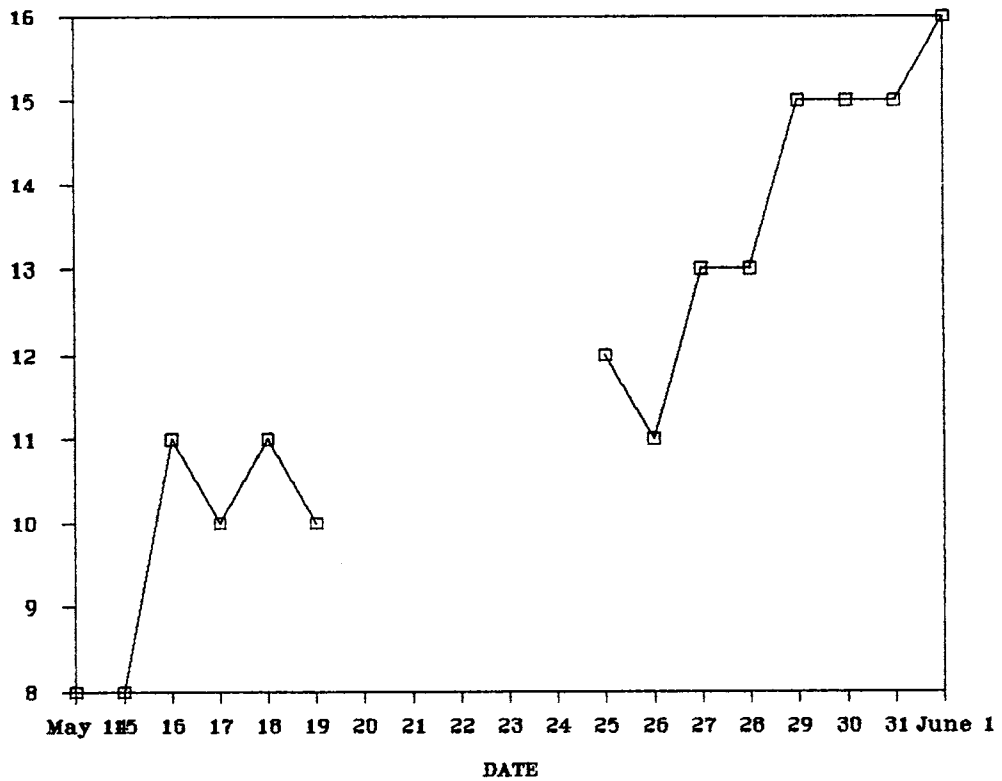


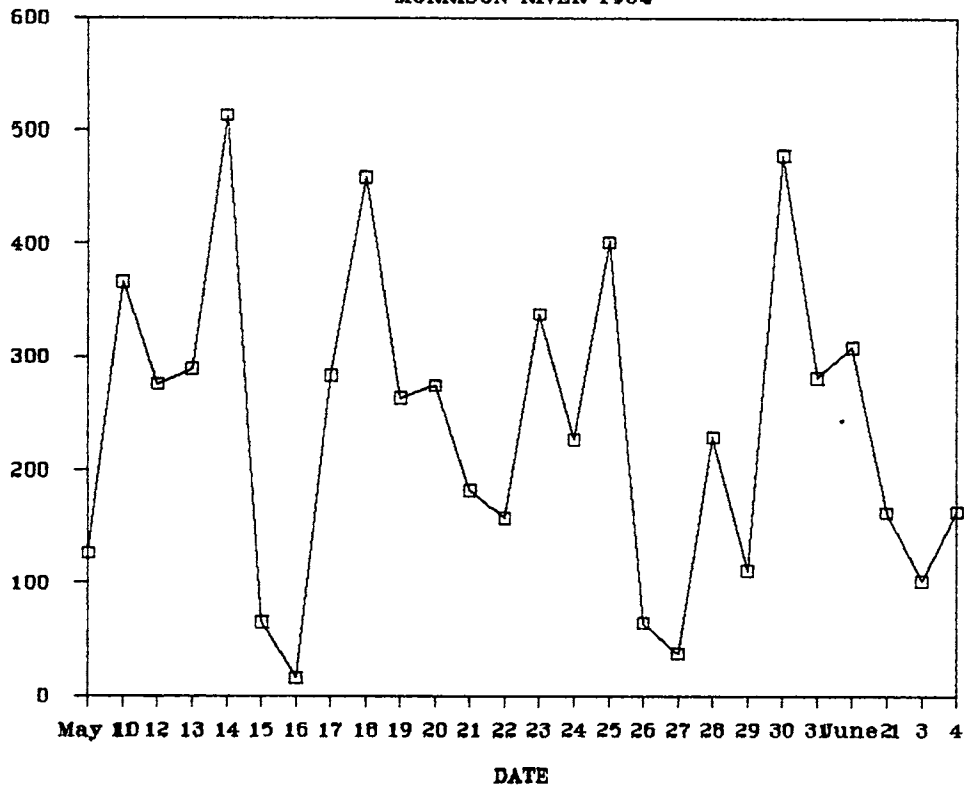
Table 2 Inclined Plane Trap Catch Results In Morrison River
1984

Date	Sockeye Fry	Sockeye Smolts	Coho Fry	Pink Fry	Water Temp.	Water Level
May 10	127	1	8	29	5.6	
11	367	5	12	53	5.8	0.790
12	276	12	8	57	5.8	0.790
13	289	8	13	44	5.5	0.790
14	513	13	26	31	5.7	0.800
15	65	18	51	19	5.3	0.875
16	16	4	6	8	5.7	0.960
17	284	2	48	15	6.3	1.000
18	459	0	66	3	6.0	1.010
19	264	1	58	1	6.0	1.020
20	275	0	78	5	6.0	1.035
21	182	0	71	2	6.5	1.030
22	158	3	59	2	6.3	1.020
23	338	12	105	2	6.1	1.070
24	228	4	41	2	6.6	1.020
25	402	1	39	0	7.2	1.020
26	64	0	24	0	7.7	1.025
27	37	0	18	0	9.6	1.030
28	230	0	20	0	8.4	1.010
29	111	1	24	3	8.4	1.020
30	478	4	23	0	9.3	1.020
31	282	0	24	0	8.8	1.025
June 1	309	3	25	0	8.7	1.025
2	163	0	14	0	8.6	1.040
3	102	0	6	0	9.3	1.035
4	164	0	8	0	7.7	1.025
Totals	6183	92	875	276		

SOCKEYE FRY CAUGHT IN ITP

MORRISON RIVER 1984

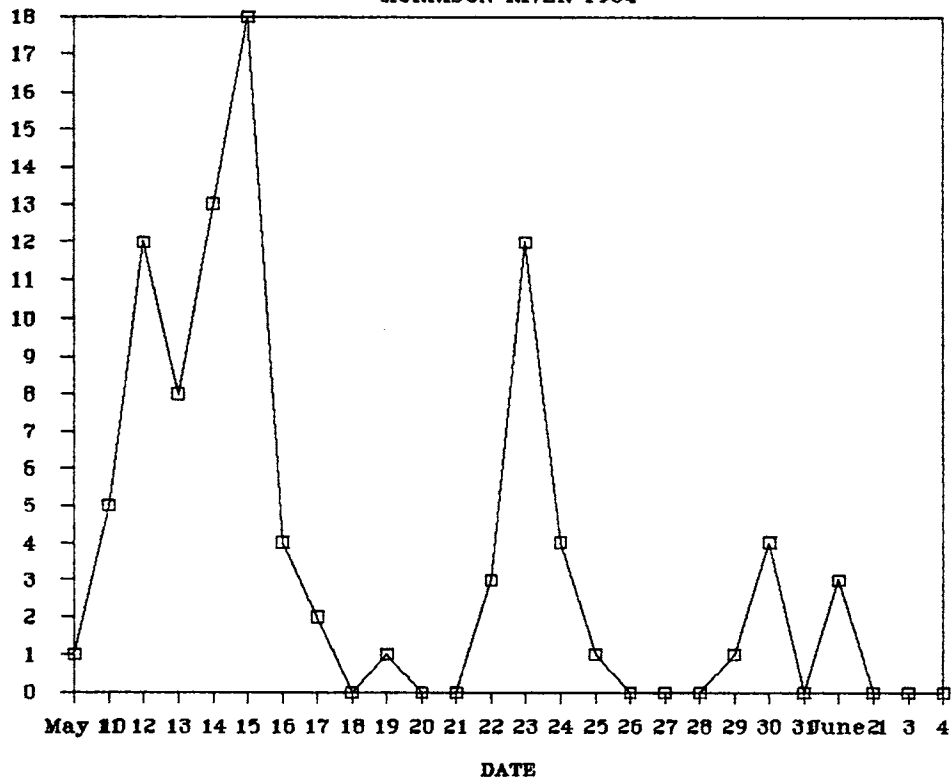
SOCKEYE FRY



SOCKEYE SMOLTS CAUGHT IN ITP

MORRISON RIVER 1984

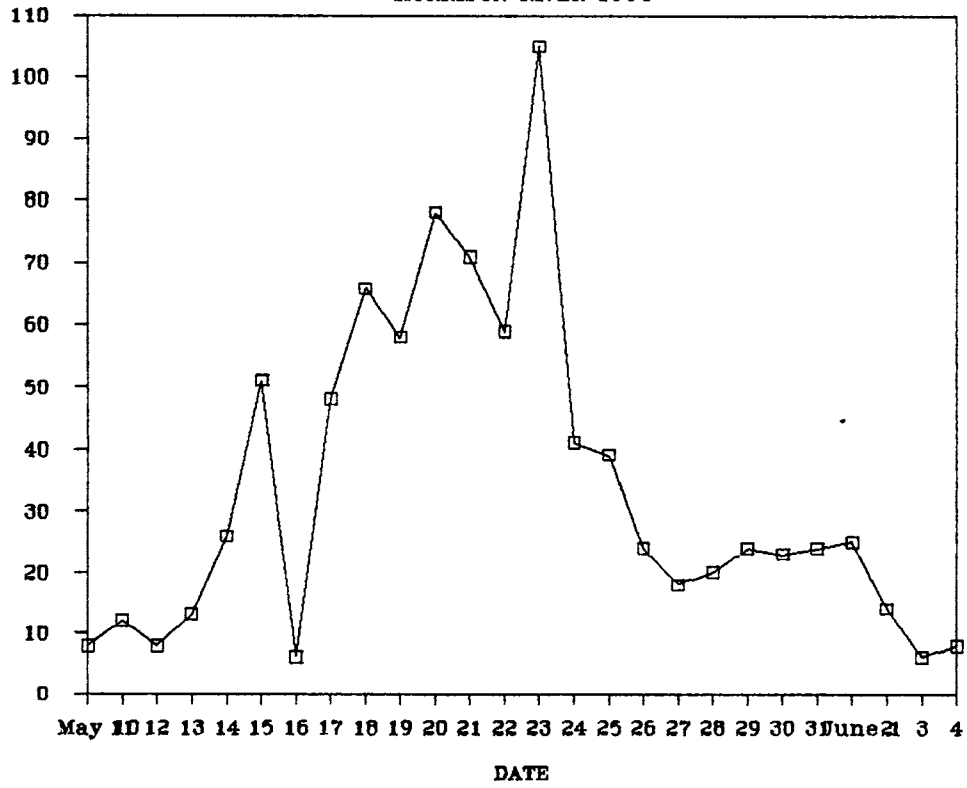
SOCKEYE SMOLTS



COHO FRY

COHO FRY CAUGHT IN ITP

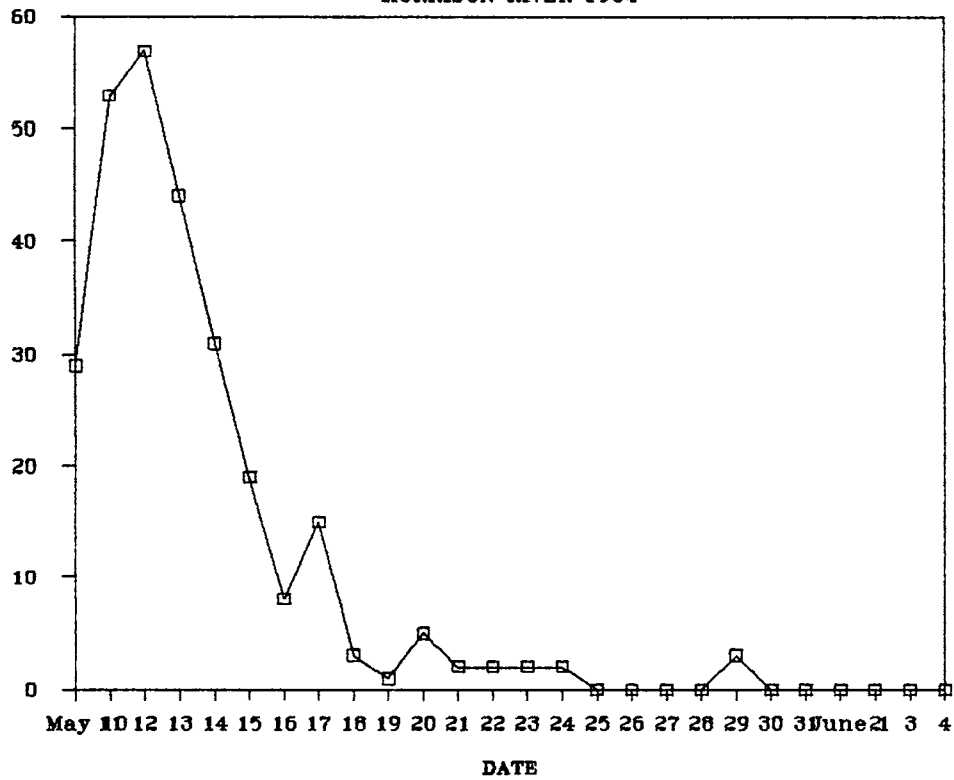
MORRISON RIVER 1984



PINK FRY

PINK FRY CAUGHT IN ITP

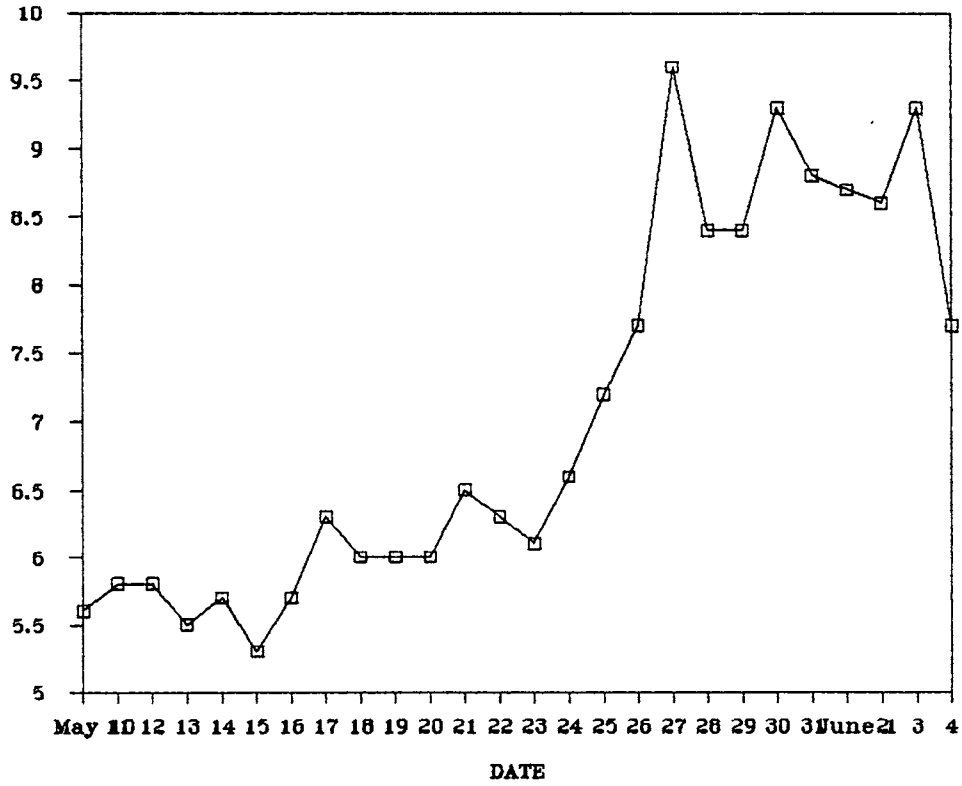
MORRISON RIVER 1984



SURFACE WATER TEMPERATURE

MORRISON RIVER 1984

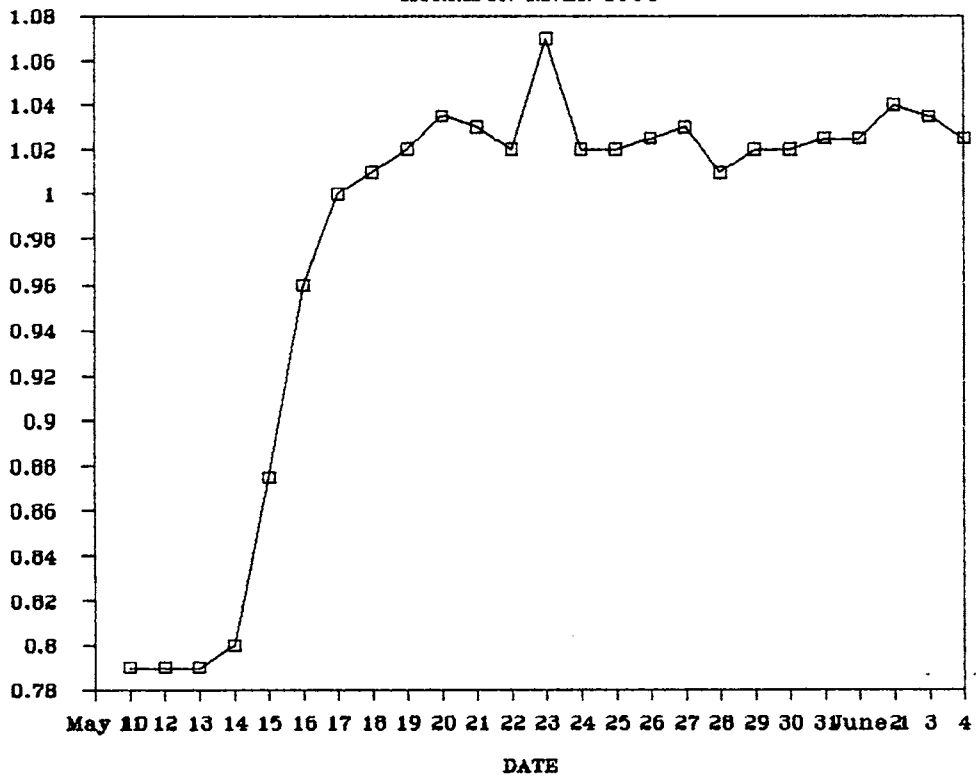
TEMPERATURE (C)



RIVER WATER SURFACE LEVEL

MORRISON RIVER 1984

WATER LEVEL (M)



(5)

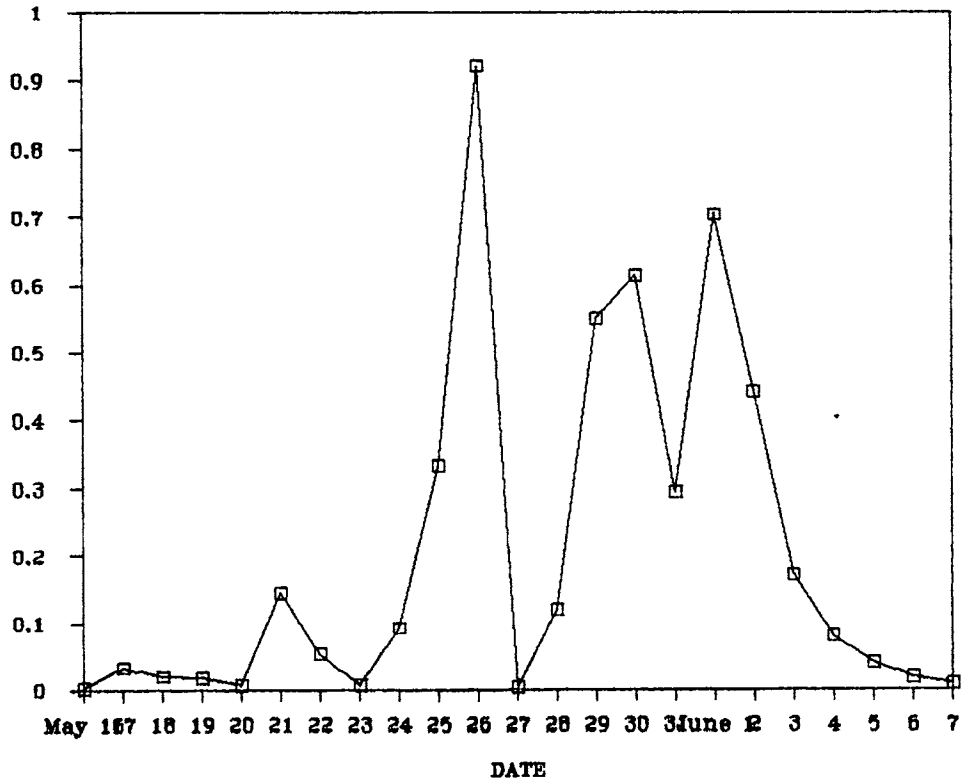
Table 3 Inclined Plane Trap Catch Results In Morrison River
1985

Date	Sockeye Fry	Sockeye Smolts	Coho Fry	Pink Fry	Water Temp.	Water Level
May 16	3	0	5	1	5.6	0.375
17	33	1	4	2	5.9	0.410
18	20	3	4	3	8.0	0.455
19	18	22	5	2	9.6	0.515
20	7	7	2	0	9.5	0.550
21	144	11	14	2	10.1	0.585
22	53	24	8	2	10.1	0.615
23	7	4	11	0	9.3	0.630
24	91	12	17	0	10.3	0.670
25	333	19	19	0	10.9	0.695
26	922	15	26	0	11.3	0.730
27	4	0	1	0	11.5	0.755
28	119	0	6	0	13.3	0.780
29	551	2	34	0	13.2	0.790
30	614	0	49	0	13.4	0.805
31	294	0	80	0	13.8	0.810
June 1	704	1	82	0	16.3	0.835
2	441	0	73	0	14.7	0.850
3	170	0	64	0	14.3	0.855
4	80	0	30	0	11.6	0.880
5	40	0	13	0	13.7	0.865
6	18	0	17	0	12.8	0.880
7	9	0	12	0	12.9	0.870
Totals	4675	121	576	12		

SOCKEYE FRY CAUGHT IN IPT

MORRISON RIVER 1985

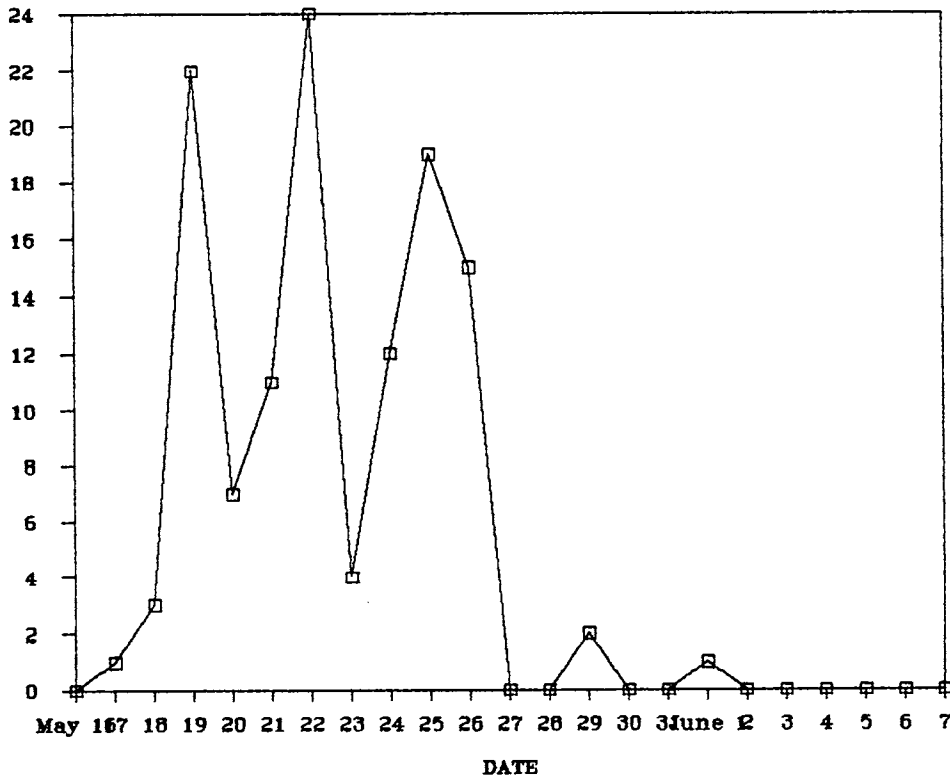
SOCKEYE FRY
(Thousands)



SOCKEYE SMOLT CAUGHT IN IPT

MORRISON RIVER 1985

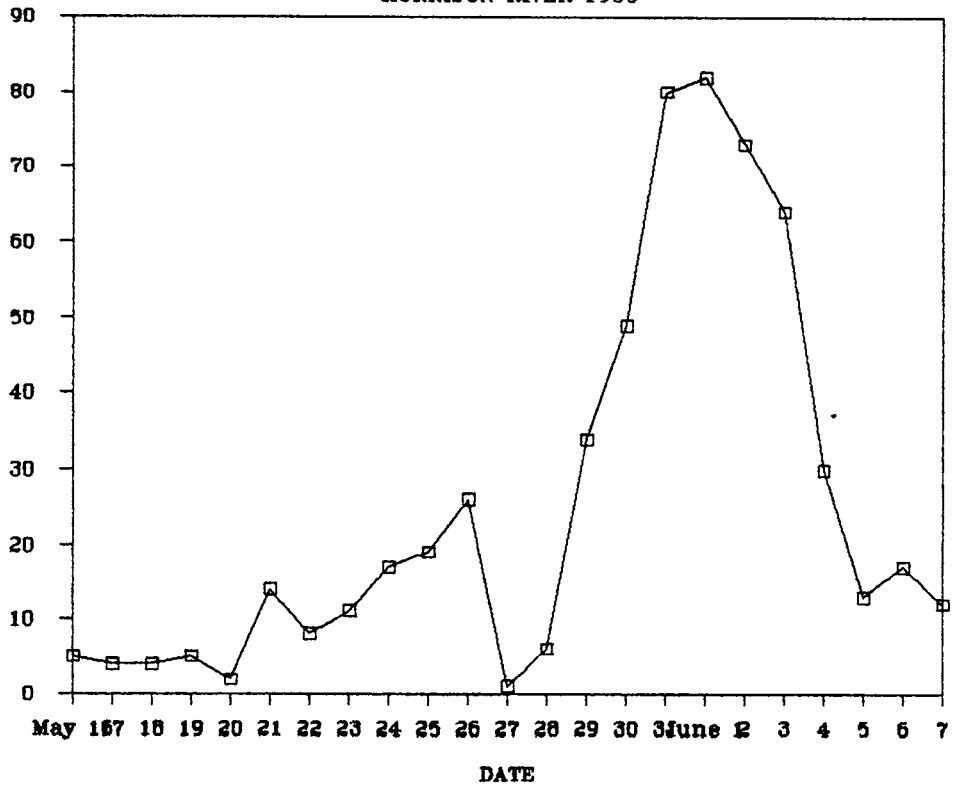
SOCKEYE SMOLT



COHO FRY

COHO FRY CAUGHT IN IPT

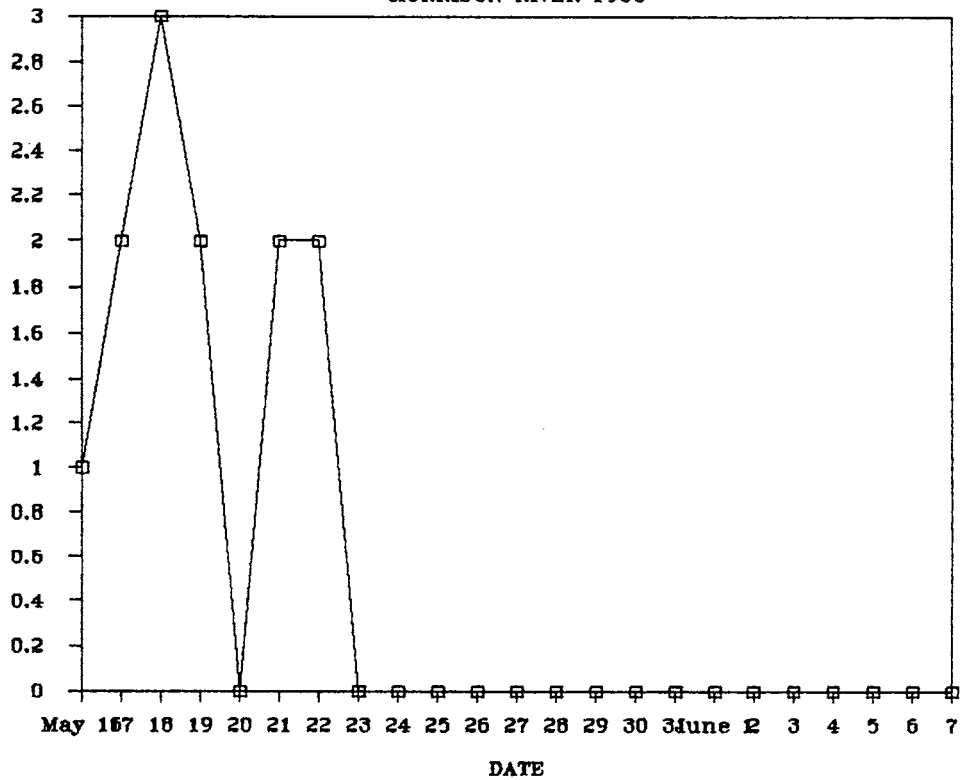
MORRISON RIVER 1985



PINK FRY

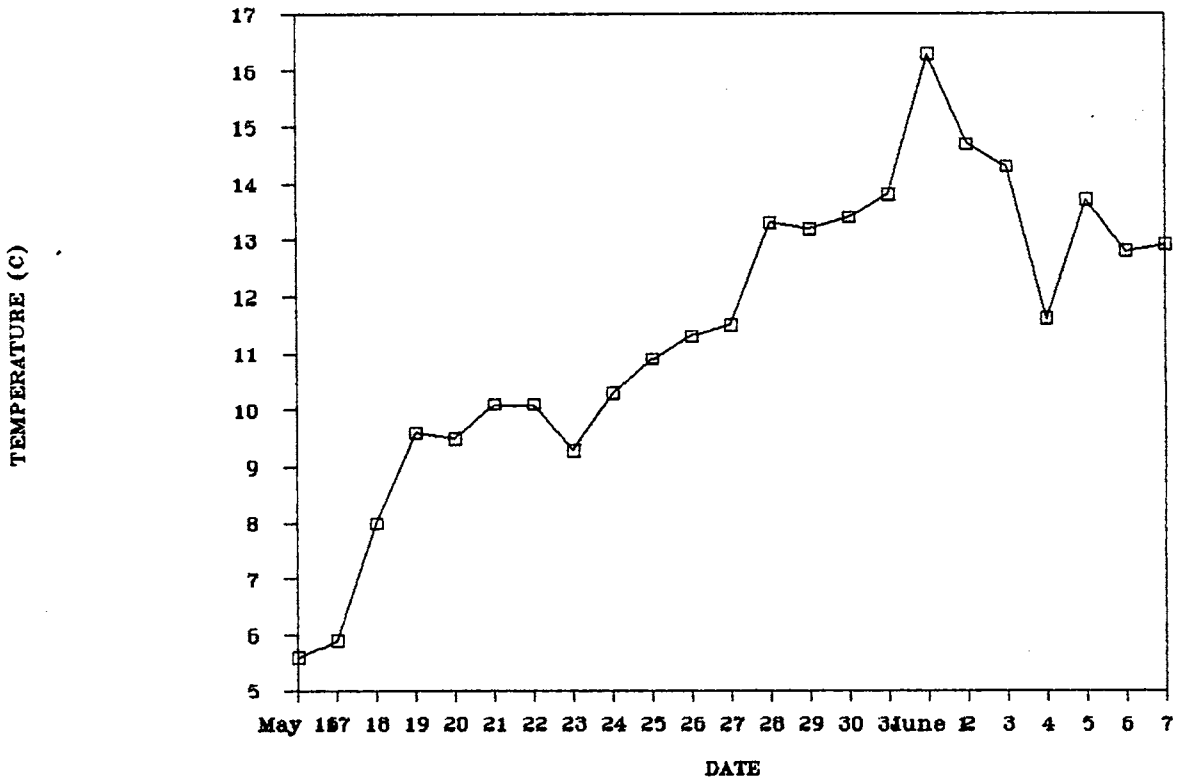
PINK FRY CAUGHT IN IPT

MORRISON RIVER 1985



SURFACE WATER TEMPERATURE

MORRISON RIVER 1985



RIVER WATER SURFACE LEVEL

MORRISON RIVER 1985

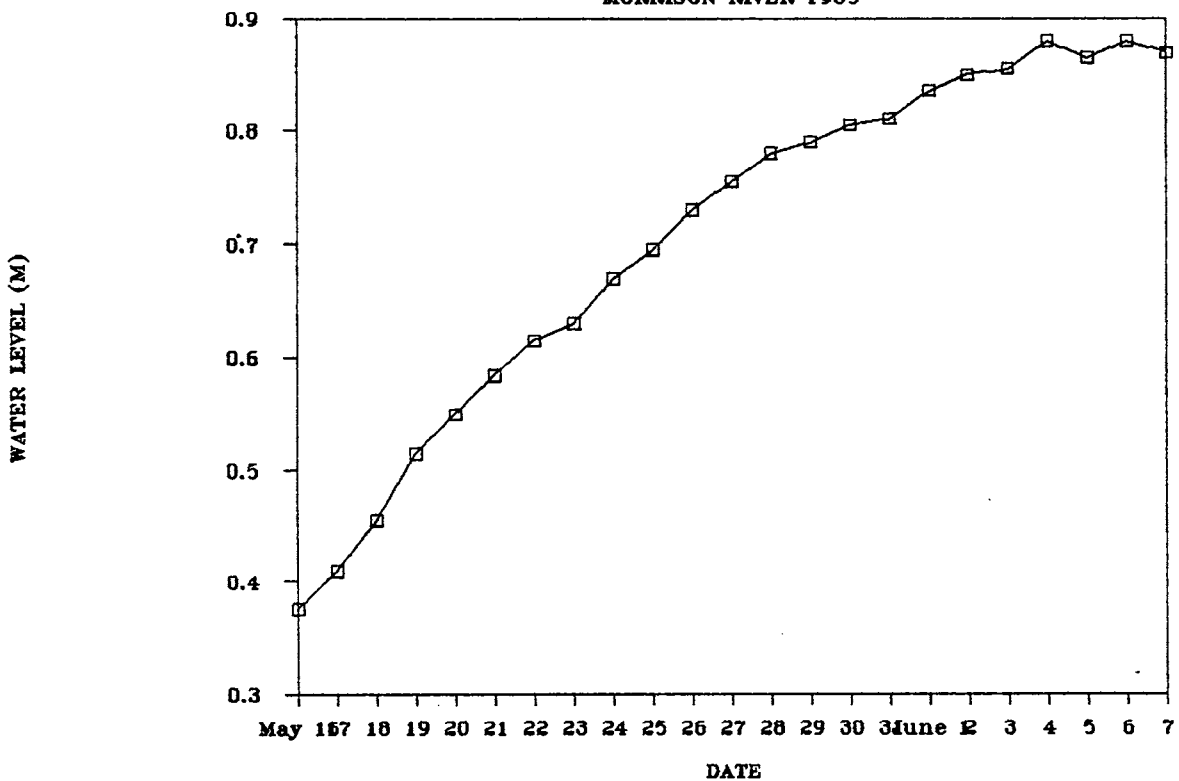


Table 4 Lengths (mm) of Juvenile Salmon Caught in the IPT
1984

	May 18				May 21			
	sock fry	pink fry	coho fry	sock smolts	sock fry	pink fry	coho smolts	sock smolts
	32	37	34	62		36	68	64
	29	35	33	63		37	68	61
	31	36	35	64			72	60
	31		32	60			66	64
	32		36	59			67	64
	31		33	62			69	63
	27		32	63			69	64
	30		35	60			72	68
	30		34	61			68	65
	32		34				65	61
	32		35				70	62
	32		33				68	62
	30		32				62	65
	34		36				66	61
	31		27				66	62
	33		32				68	61
	29		34				64	61
	29		36				31	57
	28		35				32	65
	31		35				32	66
	33		34				33	61
			33				36	65
			35				32	64
							35	58
							34	63
							34	63
							35	63
							34	66
							34	59
							33	63
MEAN:	30.81	36.00	33.70	61.56	ERR	36.50	52.77	62.70
STD:	6.79	18.02	7.14	19.53	ERR	21.08	19.51	11.70
NUMBER:	21	3	23	9	0	2	30	30

Table 4 (cont) Lengths (mm) of Juvenile Salmon Caught in the IPT
1984

May 25				May 26				
sock fry	pink fry	coho fry	sock smolts	sock fry	pink fry	coho fry	sock smolts	
30		32	:	31		35		
31		35	:	29		34		
32		32	:	30		37		
29		35	:	32		32		
29		35	:	33		35		
30		34	:	30		35		
30		35	:	32		34		
29			:	34		38		
30			:	33		34		
			:	31		32		
			:	31		34		
			:	30		33		
			:	32		31		
			:	30		34		
			:	30		32		
			:	31		35		
			:	32		32		
			:	29				
			:	33				
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			:	32				
			:	33				
			:	31				
			:	29				
			:	32				
			:	32				
			:	32				
			:	34				
			:	30				
			:	32				
MEAN:	30.00	ERR	34.00	ERR	31.47	ERR	33.94	ERR
STD:	0.94	ERR	1.31	ERR	1.45	ERR	1.80	ERR
NUMBER:	9	0	7	0	30	0	17	0

Table 4 (cont) Lengths (mm) of Juvenile Salmon Caught in the IPT
1984

May 29				June 1					
sock fry	pink fry	coho fry	sock smolts	sock fry	pink fry	coho fry	sock smolts		
31		34	:	30		32	94		
32		36	:	31		36	84		
32		33	:	30		34	87		
32		33	:	28		33			
32		32	:	32		34			
34		35	:	31		32			
33		34	:	32		34			
37		34	:	30		35			
31		35	:	29		33			
31		32	:	30		34			
31		33	:	31		32			
33		36	:	30		35			
32		35	:	29		34			
32		36	:	34		33			
31		35	:	31		34			
32		35	:	31		36			
35		34	:	32		35			
33		31	:	30		34			
32		36	:	32		36			
31		32	:	32		32			
35		38	:	31		30			
32		32	:	32		35			
31		34	:	31		33			
33		32	:	31		34			
33			:	28		34			
33			:	29					
30			:	28					
30			:	31					
32			:	32					
31			:	31					
-----				-----					
MEAN:	32.23	ERR	34.04	ERR	:	30.63	ERR	33.76	88.33
STD:	1.50	ERR	1.70	ERR	:	1.38	ERR	1.42	4.19
NUMBER:	30	0	24	0	:	30	0	25	3

Table 4 (cont) Lengths (mm) of Juvenile Salmon Caught in the IPT
1984

		June 4	
	sock fry	pink fry	coho fry sock smolts
	32		37
	31		32
	39		32
	29		34
	38		39
	30		34
	31		35
	31		36
	31		
	31		
	36		
	31		
	27		
	28		
	32		
	30		
	28		
	30		
	29		
	31		
	35		
	32		
	30		
	31		
	36		
	31		
	30		
	30		
	31		
	31		
MEAN:	31.40	ERR	34.88 ERR
STD:	2.74	ERR	2.26 ERR
NUMBER:	30	0	8 0

Table 5: Lengths (mm) of Juvenile Salmon Caught in the IPT
1985

May 21				May 24				
sock fry	pink fry	coho fry	sock smolts	sock fry	pink fry	coho fry	sock smolts	
31		32	94 :	31		32	82	
30		34	80 :	31		34	78	
32		35	82 :	31		34	80	
32		35	89 :	30		35	82	
31		35	70 :	31		36	82	
33		34	85 :	31		31	80	
30		34	83 :	31		32	64	
32		34	80 :	32		36	87	
32		33	77 :	29		32	89	
32		34	85 :	31		35	94	
30		34	83 :	31		32	80	
32		36	:	32		35	79	
32		33	:	31		33		
33			:	31		34		
32			:	31		35		
29			:	30		31		
31			:	34				
31			:	33				
32			:	30				
32			:	31				
32			:	31				
33			:	33				
30			:	31				
32			:	32				
30			:	30				
31			:	31				
33			:	29				
31			:	31				
31			:	30				
29			:	32				
MEAN:	31.37	ERR	34.08	82.55 :	31.07	ERR	33.56	81.42
STD:	1.13	ERR	1.04	6.22 :	1.08	ERR	1.71	7.23
NUMBER:	30	0	13	11 :	30	0	16	12

Table 5:(cont) Lengths (mm) of Juvenile Salmon Caught in the IPT
1985

May 29				June 1					
sock fry	pink fry	coho fry	sock smolts	sock fry	pink fry	coho fry	sock smolts		
30		33	:	30		34	103		
30		32	:	32		35			
31		33	:	28		34			
29		30	:	28		34			
30		34	:	28		34			
28		35	:	30		34			
30		34	:	29		33			
35		31	:	33		35			
30		33	:	29		35			
31		34	:	33		37			
28		33	:	34		32			
29		34	:	28		32			
30		32	:	33		34			
30		35	:	38		34			
28		38	:	34		34			
31		34	:	29		31			
29		34	:	29		32			
34		33	:	30		35			
33		35	:	28		35			
28		33	:	28		36			
30		34	:	29		32			
30		34	:	38		33			
31		36	:	32		33			
31		35	:	37		34			
28		34	:	28		35			
31		33	:	29		36			
31		34	:	29		32			
29		33	:	31		34			
31		34	:	33		33			
31		34	:	28		34			
MEAN:	30.23	ERR	33.70	ERR	:	30.83	ERR	33.87	103.00
STD:	1.68	ERR	1.47	ERR	:	3.06	ERR	1.38	ERR
NUMBER:	30	0	30	0	:	30	0	30	1

Table 5:(cont) Lengths (mm) of Juvenile Salmon Caught in the IPT
1985

		June 4		
	sock fry	pink fry	sock smolts	
	29		33	
	30		35	
	32		36	
	29		31	
	29		32	
	29		33	
	28		33	
	35		31	
	29		33	
	29		34	
	30		33	
	29		32	
	30		32	
	28		39	
	28		35	
	29		32	
	29		33	
	31		33	
	31		32	
	30		33	
	29		32	
	28		34	
	28		32	
	23		32	
	28		32	
	28		34	
	28		33	
	29		32	
	36		33	
	29		31	
MEAN:	29.33	ERR	33.00	ERR
STD:	2.25	ERR	1.64	ERR
NUMBER:	30	0	30	0

Table 6: Summary of Beach Seine Catch (CPUE), 1984/1985

1984

SITE	RUN 1	RUN 2	RUN 3
	May 13-17	May 21-25	May 27-June 1
1	1.3	3.7	59.7
2	7.0	43.3	53.3
3	12.7	2.0	2.0
4	1.3	118.4	0.7
5	2.0	11.0	3.7
6	120.3	22.7	223.7
7	0.0	0.0	3.0
8	1.0	63.0	0.0
9	0.0	1.3	0.0
10	0.0	0.0	179.0
TOTAL:	13.6	44.6	46.8

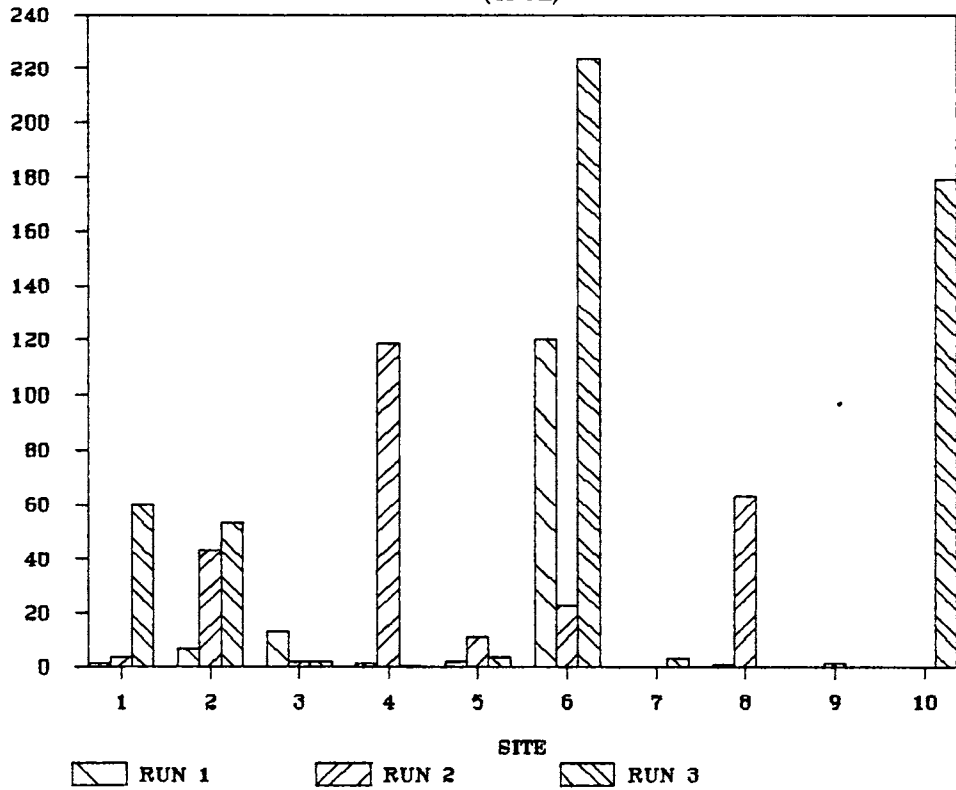
1985

SITE	RUN 1	RUN 2	RUN 3
	May 19-21	May 25-26	June 2-3
1	98.3	2.7	8.7
2	37.0	35.3	4.0
3	1.3	14.7	67.0
4	84.7	0.3	1.0
5	0.3	6.0	0.0
6	40.7	211.7	0.0
7	0.3	0.0	0.0
8	0.3	0.0	237.0
9	0.0	0.0	0.3
10	0.0	0.0	0.3
TOTAL:	84.9	62.4	71.9

SOCKEYE FRY

Beach Seine Catch 1984

(CPUE)



SOCKEYE FRY

Beach Seine Catch 1985

(CPUE)

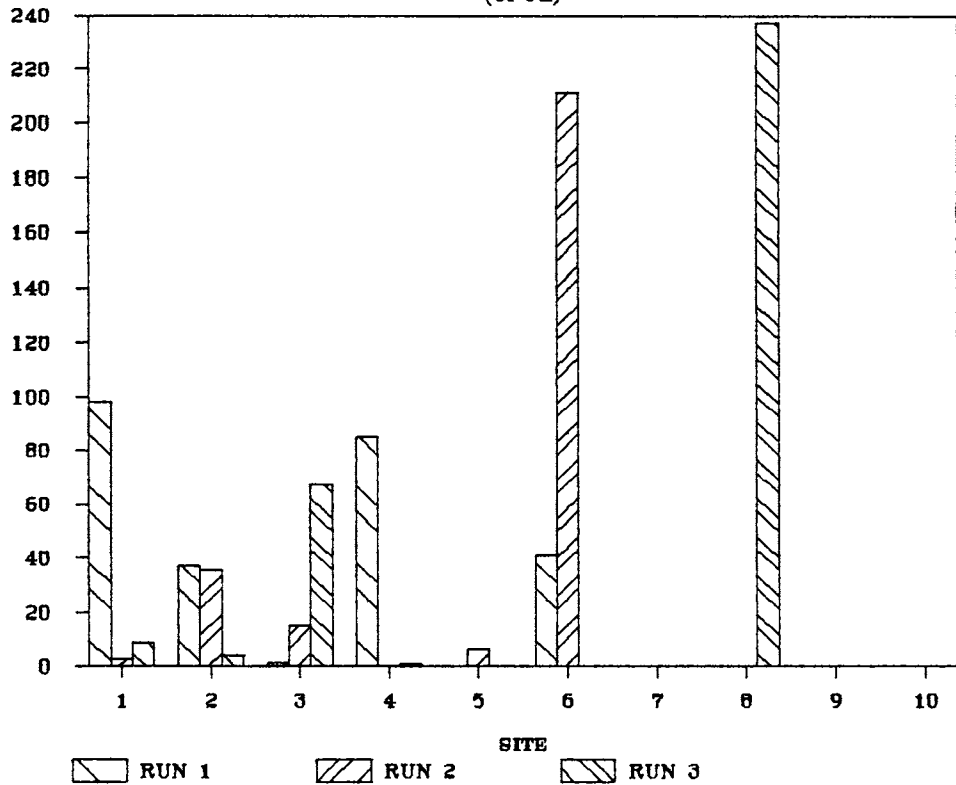


Table 7: Summary of Beach Seine Catch, 1984

Site	Date	Set	Sock (fry)	Sock (smolts)	Coho	Pink	Chin	Rainbow
1	May 13	A	1					1
		B	2					
		C	1					1
2	May 13	A	2					11
		B	5					2
		C	14			1		2
3	May 13	A		2		2		
		B						
		C	38					
4	May 13	A	1					
		B	3					1
		C						
5	May 16	A	4					
		B		1				2
		C	1					1
6	May 16	A	169	2	1	3		
		B	2					
		C	163			5		
7	May 16	A	0					2
		B	0					1
		C	0					4
8	May 17	A	2					1
		B	1					
		C	0					2
9	May 17	A	0					2
		B	0	56		1		
		C	0					3
10	May 17	A	0					
		B	0					2
		C	0					

Table 7:(cont) Summary of Beach Seine Catch, 1984

Site	Date	Set	Sock (fry)	Sock (smolts)	Coho	Pink	Chin	Rainbow
1	May 21	A	10					
		B	1					1
		C						1
2	May 21	A	2					11
		B	5			1		2
		C	14					2
3	May 21	A	3					
		B	3	230				
		C						
4	May 22	A						1
		B						
		C	205			1		
4	May 24	A	805					1
		B	2					
		C	9					
5	May 25	A						
		B	32					
		C	1	3				
6	May 25	A						
		B	66			3		
		C	2					2
7	May 25	A						
		B		12				
		C		3				
8	May 22	A	101					
		B	89			1		
		C						
9	May 24	A						2
		B		56		1		
		C						3
10	May 25	A						
		B						
		C						

Table 7:(cont) Summary of Beach Seine Catch, 1984

Site	Date	Set	Sock (fry)	Sock (smolts)	Coho	Pink	Chin	Rainbow	
1	May 27	A	171	3	2				
		B	8						
		C		9					20
2	May 29	A	147	5	13			1	
		B	11		13				
		C	2						
3	May 29	A		2					
		B	1						1
		C	4						
4	May 29	A	1						
		B	1						
		C							
5	May 29	A							
		B	10	46					
		C	1	3					
6	May 29	A	575			4			
		B							
		C	96						
7	June 1	A							
		B	2						
		C	7						1
8	June 1	A							
		B							
		C		14					
9	June 1	A			1				
		B							
		C		4					
10	June 1	A				1			
		B		59					
		C	537						1

Table 8: Summary of Beach Seine Catch, 1985

Site	Date	Set	Sock (fry)	Sock (smolts)	Coho	Pink	Chin	Rainbow
1	May 19	A	158					
		B	129					
		C	2					
2	May 20	A	83					
		B	11					
		C	17					
3	May 20	A						
		B						
		C	4					
4	May 20	A	2					
		B	240					
		C	12					
5	May 20	A						1
		B	1					1
		C						
6	May 20	A	51	1				
		B	52					
		C	19					
7	May 20	A						2
		B						1
		C	1	1				
8	May 21	A						
		B	1	26				
		C						
9	May 21	A						
		B						
		C						
10	May 21	A						
		B						
		C						

Table 8:(cont.) Summary of Beach Seine Catch, 1985

Site	Date	Set	Sock (fry)	Sock (smolts)	Coho	Pink	Chin	Rainbow
1	May 25	A	2					
		B	3					
		C	3					1
2	May 25	A	87		1			
		B	12					
		C	6					
3	May 25	A						
		B	13					
		C	31					
4	May 25	A		1				
		B		1				
		C	1					
5	May 25	A						
		B	18					
		C			1			
6	May 25	A	109	1				
		B	523		1			
		C	3	2				
7	May 26	A				1		
		B						
		C						
8	May 26	A						
		B						
		C		1				
9	May 26	A						
		B						
		C		2	2			
10	May 26	A						
		B						
		C						

Table 8:(cont.) Summary of Beach Seine Catch, 1985

Site	Date	Set	Sock (fry)	Sock (smolts)	Coho	Pink	Chin	Rainbow
1	June 2	A	20		16			
		B	2		16			
		C	4		5			
2	June 2	A	7		1			
		B	2					
		C	3		2			
3	June 2	A			16			
		B	93					
		C	108					
4	June 2	A	2	1				
		B	1					
		C						
5	June 2	A						
		B						
		C						
6	June 2	A						
		B						
		C						
7	June 3	A						
		B						
		C						
8	June 3	A			30			1
		B	1					
		C	710					
9	June 3	A						
		B						
		C	1					
10	June 3	A						
		B						
		C	1					

Table 9: Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 2 May 21

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	32			90	
	29			67	
	29			72	
	33			70	
	30			69	
	30			79	
	28				
	32				
	29				
	31				
	30				
	31				
	31				
	30				
	30				
	30				
	31				
	31				
	31				
	31				
	29				
	29				
	35				
	30				
	33				
	32				
	30				
	30				
	31				
Mean:	30.63	ERR	ERR	74.50	ERR
STD:	1.45	ERR	ERR	8.64	ERR
Number:	30	0	0	6	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 3 May 21

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	33			86	
	30			87	
	33			70	
	32			73	
	31			76	
	32			80	
				71	
				94	
				92	
				70	
				75	
				68	
				88	
				80	
				65	
				71	
				77	
				91	
				77	
				86	
				70	
				63	
				90	
				81	
				68	
				89	
				80	
				85	
				73	
				75	
Mean:	31.83	ERR	ERR	78.37	ERR
STD:	1.17	ERR	ERR	8.75	ERR
Number:	6	0	0	30	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 4 May 22

	sock fry	pink fry	coho fry	sock smolt	coho smolt

	30				
	31				
	31				
	31				
	30				
	33				
	28				
	32				
	34				
	30				
	33				
	31				
	32				
	32				
	31				
	32				
	31				
	30				
	31				
	30				
	32				
	33				
	32				
	33				
	33				
	31				
	33				
	31				
	30				
	30				

Mean:	31.37	ERR	ERR	ERR	ERR
STD:	1.33	ERR	ERR	ERR	ERR
Number:	30	0	0	0	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 5 May 25

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	31			70	
	32			82	
	33			72	
	31				
	33				
	33				
	33				
	33				
	33				
	34				
	32				
	32				
	31				
	30				
	34				
	30				
	32				
	34				
	34				
	31				
	35				
	31				
	34				
	34				
	31				
	32				
	29				
	31				
	34				
	31				

Mean:	32.27	ERR	ERR	74.67	ERR
STD:	1.51	ERR	ERR	6.43	ERR
Number:	30	0	0	3	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 6 May 25

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	32				
	34				
	32				
	30				
	32				
	33				
	32				
	38				
	33				
	32				
	33				
	31				
	29				
	30				
	31				
	32				
	30				
	32				
	32				
	33				
	29				
	30				
	32				
	33				
	30				
	31				
	34				
	33				
	32				
	33				

Mean:	31.93	ERR	ERR	ERR	ERR
STD:	1.78	ERR	ERR	ERR	ERR
Number:	30	0	0	0	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 7 May 25

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

				81	
				72	
				66	
				68	
				85	
				90	
				95	
				81	
				85	
				69	
				73	
				80	
				73	
				72	
				70	

Mean:	ERR	ERR	ERR	77.33	ERR
STD:	ERR	ERR	ERR	8.69	ERR
Number:	0	0	0	15	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 8 May 22

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	35	37			
	32	40			
	30				
	32				
	32				
	32				
	33				
	35				
	32				
	32				
	32				
	34				
	32				
	31				
	35				
	32				
	34				
	33				
	29				
	31				
	33				
	31				
	34				
	33				
	33				
	30				
	27				
	32				
	35				
	35				

Mean:	32.37	38.50	ERR	ERR	ERR
STD:	1.88	2.12	ERR	ERR	ERR
Number:	30	2	0	0	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 9 May 24

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	31	38		85	
	30	40			
	31	39			
		39			
		40			
		39			
		40			

Mean:	30.67	39.29	ERR	85.00	ERR
STD:	0.58	0.76	ERR	ERR	ERR
Number:	3	7	0	1	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 1 May 27

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	30		35	87	120
	29		36	83	130
	28			90	112
	33			87	112
	27			75	140
	31			77	115
	33			84	125
	31			97	124
	31			68	125
	35			86	140
	33			78	145
	31			65	132
	31				115
	32				137
	31				127
	32				135
	31				112
	33				145
	30				
	32				
	29				
	32				
	31				
	31				
	31				
	32				
	31				
	30				
	33				
	32				
Mean:	31.20	ERR	35.50	81.42	127.28
STD:	1.63	ERR	0.71	9.20	11.41
Number:	30	0	2	12	18

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 2 May 29

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	32		35	73	
	30		34	75	
	36		38	88	
	31		31	102	
	33		36	87	
	30		37		
	35		37		
	30		38		
	32		36		
	30		36		
	31		35		
	32		34		
	30		36		
	29		35		
	30		37		
	31		38		
	34		37		
	34		33		
	30		37		
	34		37		
	30		36		
	29		35		
	30		36		
	33		35		
	32		34		
	32		35		
	31				
	32				
	31				
	32				
Mean:	31.53	ERR	35.69	85.00	ERR
STD:	1.78	ERR	1.64	11.68	ERR
Number:	30	0	26	5	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 3 May 29

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	31	37		72	
	36			71	
	30				
	31				
	32				

Mean:	32.00	37.00	ERR	71.50	ERR
STD:	2.35	ERR	ERR	0.71	ERR
Number:	5	1	0	2	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 4 May 29

	sock fry	pink fry	coho fry	sock smolt	coho smolt
	29				
	30				

Mean:	29.50	ERR	ERR	ERR	ERR
STD:	0.71	ERR	ERR	ERR	ERR
Number:	2	0	0	0	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 5 May 29

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	34			67	
	34			78	
	32			72	
	32			70	
	32			76	
	36			73	
	30			73	
	37			95	
	38			100	
	33			90	
	32			63	
				68	
				73	
				63	
				63	
				72	
				94	
				74	
				85	
				110	
				69	
				77	
				99	
				72	
				65	
				76	
				73	
				71	
				76	
				69	

Mean:	33.64	ERR	ERR	76.87	ERR
STD:	2.46	ERR	ERR	12.07	ERR
Number:	11	0	0	30	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 6 May 29

	sock fry	pink fry	coho fry	sock smolt	coho smolt

	33	36			
	35	38			
	34	39			
	34				
	33				
	33				
	29				
	33				
	34				
	31				
	33				
	34				
	32				
	32				
	31				
	34				
	34				
	32				
	34				
	35				
	34				
	33				
	32				
	34				
	34				
	37				
	35				
	31				
	30				
	37				

Mean:	33.23	37.67	ERR	ERR	ERR
STD:	1.79	1.53	ERR	ERR	ERR
Number:	30	3	0	0	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 7 June 1

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	34	38			
	33				
	29				
	29				
	35				
	34				
	29				
	30				
	31				

Mean:	31.56	38.00	ERR	ERR	ERR
STD:	2.46	ERR	ERR	ERR	ERR
Number:	9	1	0	0	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 8 June 1

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
				80	
				70	
				83	
				78	
				63	
				82	
				78	
				78	
				76	
				87	
				65	
				85	
				83	
				86	

Mean:	ERR	ERR	ERR	78.14	ERR
STD:	ERR	ERR	ERR	7.47	ERR
Number:	0	0	0	14	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 9 June 1

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

				73	
				70	
				73	
				75	

Mean:	ERR	ERR	ERR	72.75	ERR
STD:	ERR	ERR	ERR	2.06	ERR
Number:	0	0	0	4	0

Table 9:(cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1984

SITE 10 June 1

	sock fry	pink fry	coho fry	sock smolt	coho smolt
	34	35		72	
	34	41		65	
	35			68	
	35			77	
	32			72	
	34			75	
	35			64	
	34			80	
	32			75	
	36			84	
	34			73	
	34			79	
	33			79	
	33			84	
	33			82	
	34			78	
	31			80	
	30			74	
	35			74	
	34			73	
	39			76	
	31			79	
	35			67	
	33			72	
	35			64	
	34			89	
	31			76	
	31			75	
	33			94	
	33			75	
Mean:	33.57	38.00	ERR	75.83	ERR
STD:	1.81	4.24	ERR	6.83	ERR
Number:	30	2	0	30	0

Table 10: Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 1 May 20

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
30					
31					
32					
30					
31					
29					
31					
31					
30					
30					
30					
29					
28					
27					
30					
32					
31					
30					
31					
29					
28					
32					
29					
27					
30					
29					
29					
32					
27					
28					
Mean:	29.77	ERR	ERR	ERR	ERR
STD:	1.50	ERR	ERR	ERR	ERR
Number:	30	0	0	0	0

Table 10:(cont) Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 2 May 19

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	32				
	30				
	31				
	31				
	31				
	29				
	31				
	30				
	28				
	30				
	32				
	32				
	29				
	28				
	29				
	29				
	27				
	28				
	28				
	31				
	31				
	29				
	29				
	28				
	27				
	27				
	29				
	29				
	27				
	28				

Mean:	29.33	ERR	ERR	ERR	ERR
STD:	1.58	ERR	ERR	ERR	ERR
Number:	30	0	0	0	0

Table 10:(cont) Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 3 May 20

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	No fish caught				

Mean:	0.00	ERR	ERR	ERR	ERR
STD:	ERR	ERR	ERR	ERR	ERR
Number:	1	0	0	0	0

Table 10:(cont) Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 4 May 20

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
31					
31					
31					
29					
31					
30					
30					
31					
30					
32					
30					
31					
30					
31					
30					
32					
33					
27					
32					
30					
31					
29					
29					
30					
32					
29					
30					
31					
32					
29					
Mean:	30.47	ERR	ERR	ERR	ERR
STD:	1.25	ERR	ERR	ERR	ERR
Number:	30	0	0	0	0

Table 10:(cont) Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 6 May 25

	Sock fry	pink fry	coho fry	sock smolt	coho smolt

	31				
	33				
	31				
	31				
	29				
	28				
	31				
	31				
	31				
	30				
	31				
	29				
	31				
	28				
	32				
	31				
	33				
	28				
	29				
	32				
	30				
	29				
	28				
	30				
	31				
	24				
	30				
	31				
	32				
	30				

Mean :	30.17	ERR	ERR	ERR	ERR
STD:	1.82	ERR	ERR	ERR	ERR
Number :	30	0	0	0	0

T 10: (cont) Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 1 June 2

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	28		39	83	114
	27		34	70	99
	27		32	63	120
	29		32	68	118
	31		30	72	125
	27			68	125
	28			71	123
	33				126
	32				153
	28				122
	29				120
	29				117
	28				127
	31				121
	28				116
	30				111
	33				122
	28				112
	30				121
	34				100
	30				126
	31				100
	29				121
	30				100
	30				
	29				

Mean:	28.48	0.00	27.83	61.88	113.56
STD:	1.92	ERR	3.44	6.16	11.54
Number:	26	0	5	7	24

Table 10:(cont) Nose-Fork Lengths(mm) of Fish Caught Beach Seining, 1985

SITE 3 June 2

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	30				
	31				
	31				
	28				
	31				
	29				
	33				
	34				
	32				
	31				
	31				
	32				
	32				
	29				
	28				
	34				
	30				
	30				
	30				
	33				
	31				
	30				
	33				
	31				
	29				
	32				
	31				
	31				
	29				
	32				
Mean:	29.94	0.00	0.00	0.00	0.00
STD:	1.60	ERR	ERR	ERR	ERR
Number:	30	0	0	0	0

Table 10: (cont) Nose-Fork Lengths (mm) of Fish Caught Beach Seining, 1985

SITE 8 June 3

	Sock fry	pink fry	coho fry	sock smolt	coho smolt
	32			72	127
	33			65	138
	34			78	130
	32				112
	34				100
	32				113
	35				131
	34				69
	36				120
	30				120
	34				119
	33				115
	32				117
	31				122
	32				124
	33				123
	34				128
	30				133
	29				113
	33				127
	30				130
	36				127
	34				132
	35				120
	30				134
	35				
	30				
	29				
	32				
	34				
Mean:	31.55	0.00	0.00	53.75	116.31
STD:	2.03	ERR	ERR	6.51	13.80
Number:	30	0	0	3	25