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MONITORING OF POLYCHLORINATED BIPHENYLS IN
THE LOWER FRASER RIVER - A DATA REPORT

Prepared for

K. Wile and G. Tanner
Environmental Protection Service
Pacific Region
Kapilano 100 - Park Royal
West Vancouver, B. C.
V7T 1A2

Prepared by

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Project 473

April, 1980

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April 14, 1980

Mr. K. Wile
Environmental Protection Service
Pacific Region
Kapilano 100 - Park Royal
West Vancouver, B. C.
V7T 1A2

Dear Mr. Wile:

Re: Monitoring of Polychlorinated Biphenyls in the Lower Fraser River

We are pleased to present our data report on the monitoring program carried out between February 26 and March 20, 1980.

We trust the report meets your requirements at this time, and that it completes our assignment to your satisfaction.

Yours truly,

E.V.S. CONSULTANTS LTD.



Peter M. Chapman, Ph.D.
Project Scientist

PMC:dp
Encl.

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ACKNOWLEDGEMENTS

We wish to thank K. Wile and G. Tanner of the Environmental Protection Service and R. E. Boedeker of Belkin Paperboard for their assistance and co-operation during the course of this study. All analysis of effluents and fish tissues were done by Can Test Ltd. under the supervision of Mr. J. Park.

E.V.S. Consultants Ltd. would like to acknowledge the principal investigators P. M. Chapman, D. Munday and G. A. Vigers, who undertook this assignment, and the following members of E.V.S. Consultants Ltd. staff: K. Bindra, M. Farrell, M. Whelan and J. Coustalin.

We would also like to thank D. Prissick for typing and collating this report.

1.0 INTRODUCTION

This data report summarizes the results of a monitoring survey program to determine polychlorinated biphenyl (PCB) levels in effluent from the Belkin Paperboard Plant in Vancouver and to assess tissue levels of PCB's in fish that may be related to plant discharge into the Lower Fraser River. In accord with the instructions of the Scientific Authorities, the data is presented without either interpretation or discussion.

2.0 METHODS

2.1 Field Sampling

2.1.1 Effluent sampling

Triplicate composite samples of Belkin final effluent were prepared from each of two samples per week (Tuesdays and Thursdays) over a four week period, for a total of eight triplicate composite samples. The purpose of collecting samples in triplicate was to obtain three uniform 4.5 litre subsamples of effluent. To this end, effluent was collected by means of a hinged scoop with three sampling chambers of equal size (Figure 1). Each chamber, when full, held 300 ml and samples were collected every 15 minutes over a period of 3½ hours. Effluent flow rate was recorded coincident with effluent sampling.

4.5 litre glass sampling containers were provided, pre-cleaned, by the Environmental Protection Service laboratories. The effluent sampler was washed consecutively with acetone, hexane and distilled water prior to use and stored in heat-treated aluminum foil. Samples for chemical analysis were

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2.1.1 Effluent sampling (cont'd.)

taken to the laboratories of Can Test Ltd. within 12 hours of collection.

2.1.2 Fish collection

Sampling for fish was conducted at four locations in the Lower Fraser River (Figure 2). Station 1 was located adjacent to the Belkin plant outfall; station 2 was located in the vicinity of PCB-contaminated sediments previously identified by E.P.S., upstream of the plant; station 3 was a control site on the Pitt River removed from significant industrial influences; and station 4 was located in the area of influence of industrial discharges other than those of the Belkin plant.

A total of five days of fishing effort was expended at the above four sites and a detailed description of these efforts is provided in Appendix 1 (Field Notes for Fish Collections). Fishing methods included the use of floating and sunken gill nets, fish traps, long lines, beach seines and angling. A number of problems were encountered during fishing, including deadheads, snags and log booming traffic. However, despite these problems, reasonable catches were made at all stations with the exception of station 2, where intensive log booming and industrial foreshore development of the river precluded successful fishing. Fish were wrapped in aluminum foil, labelled, frozen and returned to the laboratory for later dissection.

2.2 Laboratory Analyses

All chemical analyses were performed by Can Test Ltd. under separate contract to the Environmental Protection Service.

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2.2.1 Effluent samples

Each 4.5 litre effluent sample was analyzed for total suspended solids, fixed and volatile solids and settleable matter. In addition, starting with samples taken on March 4, samples were also analyzed for non-settleable matter. These determinations were conducted in accordance with parts 208A, 208E and 208F of "Standard Methods for the Examination of Water and Wastewater" (14th edition). Determinations were made of PCB's (Aroclor 1242) in suspended solids and total effluent, using, respectively, the procedure described by the Institute of Paper Chemistry and Can Test Ltd. methods I-3A, I-4A and I-5A.

2.2.2 Fish tissue

Fish were dissected and epaxial white muscle and liver tissues were removed using instruments pre-cleaned in pesticide grade acetone, hexane and distilled water. Muscle tissues were collected from all fish, however, in some instances livers were too small to provide sufficient biomass for analysis and were not removed. Where possible, the fish were sexed and in all cases approximate body lengths and weights were recorded.

Tissues from the same fish species from each site were composited as follows to provide at least 3 g wet weight of tissue for PCB analysis. Where possible, tissues from at least five individuals of each species were composited, however, in some cases more than five individuals were composited due to the small size of certain species. Fish tissues were placed in heat-treated aluminum foil, labelled and frozen for analysis by Can Test Ltd. method I-3A.

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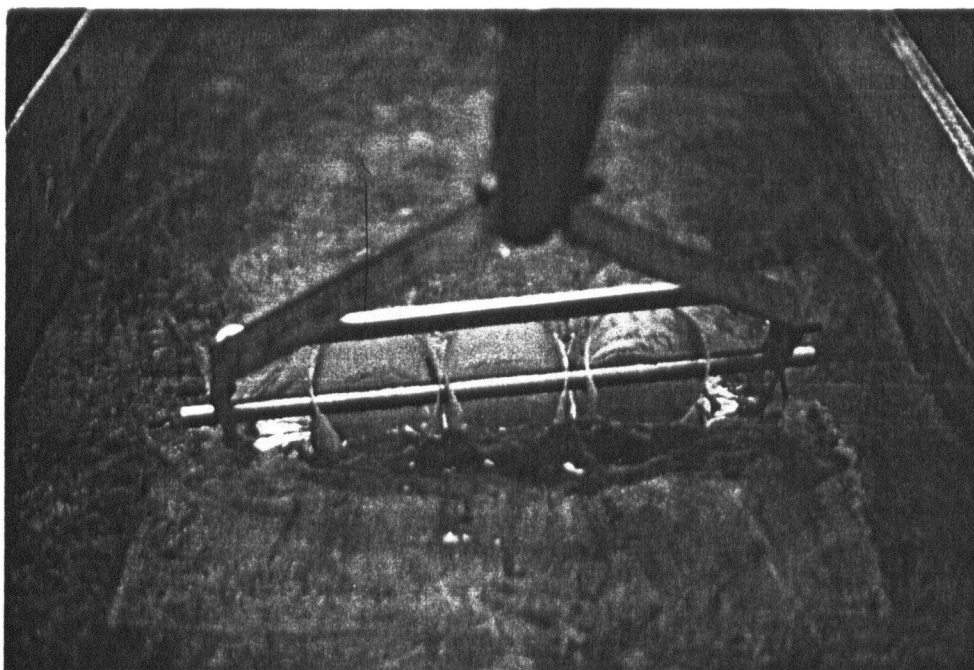
2.2.2 Fish tissue (cont'd.)

The remainder of the fish were re-frozen for future reference.

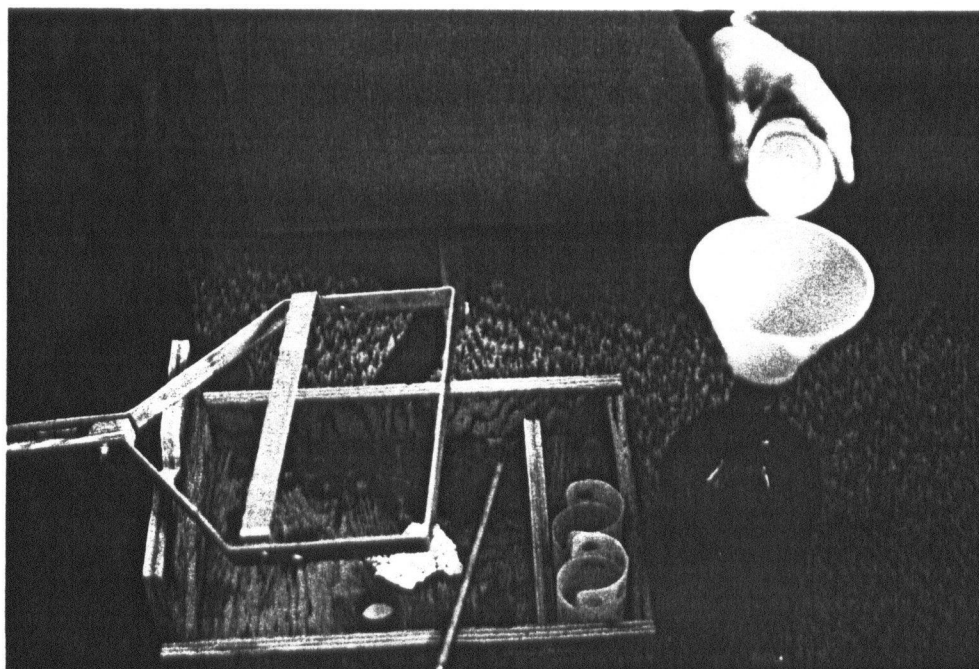
3.0 RESULTS

The data obtained from this monitoring program are presented in tabular form (Tables 1 to 5). Table 1 provides dates, times and flow rates pertinent to the collection of effluent samples. Table 2 provides the results of effluent analyses performed by Can Test Ltd. Table 3 lists the generic and common names of fish collected for PCB analysis. Table 4 provides general data (e.g. sex, length, weight, size of composite sample) for fish collected from each station and analyzed for PCB's. Table 5 describes PCB levels in the epaxial muscle tissues of fish from each station. Fish livers were not analyzed for PCB's, but were removed and frozen for possible future analysis. All reference tissue samples are currently being held by E.V.S. Consultants Ltd.

Figure 1. Effluent sampler used in the present study



1a. Simulated sampling. Sampling cups are of equal size, are hinged, and when level hold exactly 300 ml.



1b. Procedure for transferring sample from sampling cups to sample bottles.

FIGURE 2
LOCATION OF SAMPLING STATIONS FOR FISH COLLECTIONS

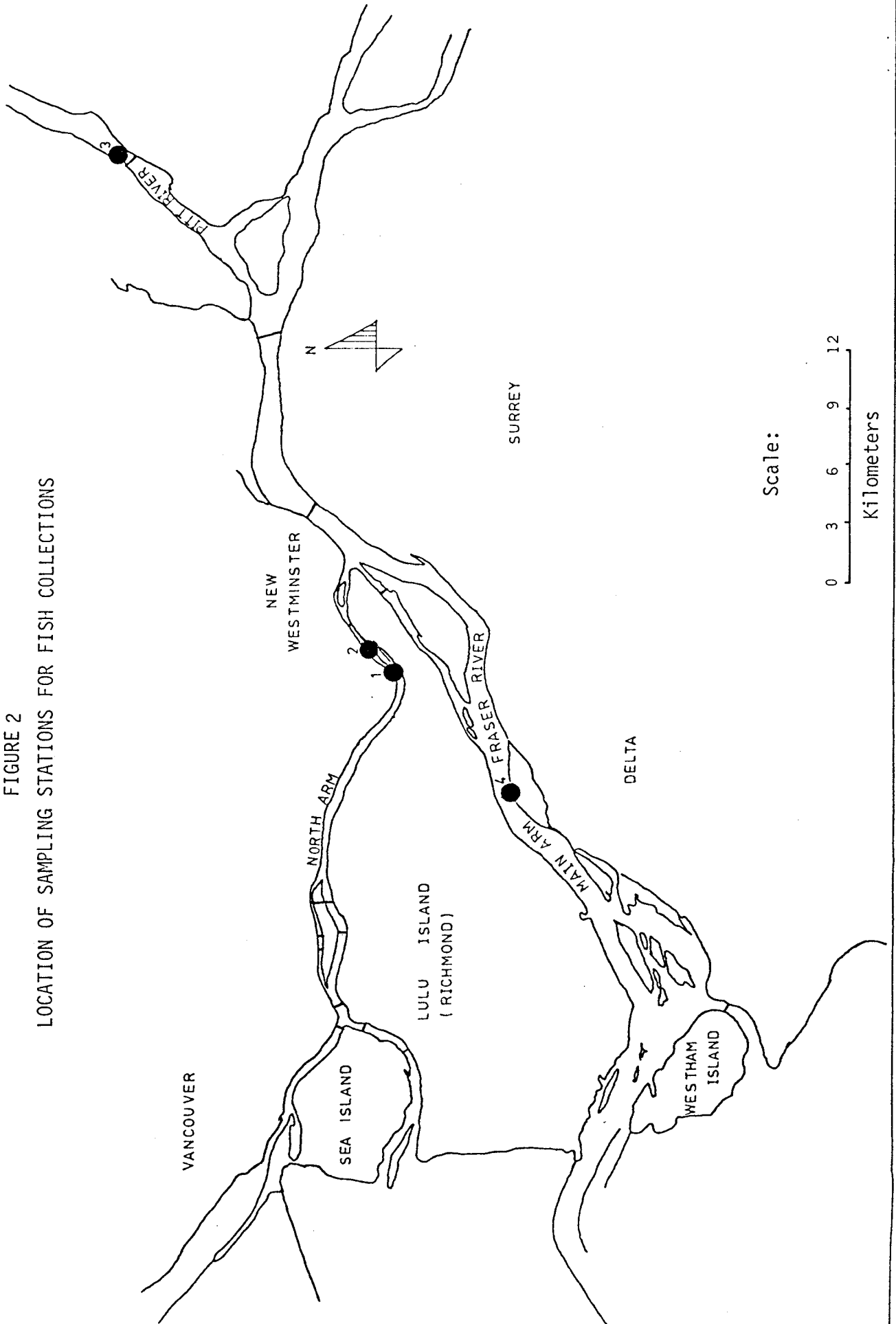


TABLE 1

DATES, TIMES AND FLOW RATES
FOR EFFLUENT SAMPLING

FEB. 26/80		FEB. 28/80	
SAMPLING TIME	FLOW (I.G.P.M.)	SAMPLING TIME	FLOW (I.G.P.M.)
0930	4050	0930	4600
0945	4150	0945	4450
1000	4150	1000	4800
1015	4000	1015	3650
1030	4150	1030	3450
1045	4250	1045	4600
1100	3850	1100	>5000
1115	4750	1115	>5000
1130	4400	1130	>5000
1145	4300	1145	4000
1200	4350	1200	4300
1215	4600	1215	4200
1230	4100	1230	4650
1245	>5000	1245	4950

MAR. 4/80		MAR. 6/80	
SAMPLING TIME	FLOW (I.G.P.M.)	SAMPLING TIME	FLOW (I.G.P.M.)
1030	4600	0915	3200
1045	3850	0930	2950
1100	4300	0945	2700
1115	4100	1000	3800
1130	4400	1015	3800
1145	4100	1030	3800
1200	3900	1045	3650
1215	4000	1100	2500
1230	3850	1115	2900
1245	4150	1130	1900
1300	4500	1145	4000
1315	4150	1200	4100
1330	3800	1215	4100
1345	4150	1230	3800

TABLE 1 (CONT'D.)
 DATES, TIMES AND FLOW RATES
 FOR EFFLUENT SAMPLING

MAR. 11/80 SAMPLING TIME	FLOW (I.G.P.M.)	MAR. 13/80 SAMPLING TIME	FLOW (I.G.P.M.)
1000	4200	0945	2700
1015	4000	1000	3200
1030	4200	1015	3100
1045	3600	1030	3100
1100	4500	1045	3300
1115	4000	1100	3100
1130	3400	1115	3000
1145	3900	1130	3600
1200	3600	1145	4500
1215	4000	1200	3800
1230	3900	1215	4000
1245	4100	1230	3950
1300	4000	1245	3900
1315	sample lost	1300	3800

MAR. 18/80 SAMPLING TIME	FLOW (I.G.P.M.)	MAR. 20/80 SAMPLING TIME	FLOW (I.G.P.M.)
0900	>5000	0915	4000
0915	>5000	0930	3700
0930	4700	0945	3700
0945	5000	1000	3400
1000	4500	1015	3000
1015	>5000	1030	3000
1030	4400	1045	3600
1045	4600	1100	3900
1100	4500	1115	3000
1115	3650	1130	2900
1130	4100	1145	4000
1145	4250	1200	4200
1200	3100	1215	3900
1215	2700	1230	4000

TABLE 2
LEVELS OF SUSPENDED SOLIDS, SETTLEABLE AND NON-SETTLEABLE
MATTER AND PCB'S IN BELKIN EFFLUENT

Date	Replicate	Suspended Solids(mg/l)			Settleable Matter (ml/l)	Non-Settleable Matter (mg/l)	PCB's (Aroclor 1242)		
		Total	Fixed	Volatile			2nd Extraction (Suspended Solids) (mg/kg dry wt.)	1st Extraction (Water & Solids) (µg/l)	Total Concentration (µg/l)
Feb. 26	A	181.	60.	121.	3.0	N.D.	8.5	1.4	2.9
	B	171.	61.	110.	3.0	N.D.	6.6	1.1	2.2
	C	182.	61.	121.	4.0	N.D.	5.5	1.1	2.1
Feb. 28	A	257.	32.	225.	40.	N.D.	3.0	0.44	1.2
	B	390.	49.	341.	60.	N.D.	1.5	0.41	1.0
	C	355.	46.	309.	74.	N.D.	4.8	0.42	2.1
Mar. 4	A	130.	53.	77.	4.	107.	51.	6.0	12.6
	B	117.	53.	64.	2.	90.	100.	1.8	13.5
	C	134.	57.	77.	4.	81.	73.	1.0	10.8
Mar. 6 *	A	694.	174.	520.	74.	123.	98.	13.	81.
Mar. 11	A	125.	29.	96.	2.5	89.	27.	2.2	5.6
	B	116.	25.	91.	1.5	85.	260.	1.8	32.
	C	116.	28.	88.	2.0	96.	39.	3.0	7.5

* Replicates B and C analyzed by other laboratories.

N.D. = no data

TABLE 2 (CONTINUED)

LEVELS OF SUSPENDED SOLIDS, SETTLEABLE AND
NON-SETTLEABLE MATTER AND PCB'S IN BELKIN EFFLUENT

Date	Replicate	Suspended Solids(mg/l)			Settleable Matter (ml/l)	Non-Settleable Matter (mg/l)	PCB's (Aroclor 1242)		
		Total	Fixed	Volatile			2nd Extraction (Suspended Solids) (mg/kg dry wt.)	1st Extraction (Water & Solids) (µg/l)	Total Concentration (µg/l)
Mar. 13	A	40.	14.	26.	<1.0	31.	39.	2.5	4.1
	B	40.5	10.5	30.	<1.0	37.	47.	1.8	3.7
	C	43.	11.5	21.5	<1.0	29.	40.	5.4	7.1
Mar. 18	A	211	73.	138.	5.	68.	35.	3.1	10.5
	B	207.	72.	135.	5.	81.	29.	3.7	9.7
	C	210.	73.	137.	4.	85.	9.8	3.1	5.2
Mar. 20	A	147.	39.	108.	6.	78.8	11.	1.5	3.1
	B	151.	45.	106.	5.5	61.6	13.	0.69	2.7
	C	152.	44.	108.	7.	53.2	13.	0.78	2.8

TABLE 3

GENERIC AND COMMON NAMES OF FISH
COLLECTED FOR PCB ANALYSIS

GENERIC NAME	COMMON NAME
<i>Cottus asper</i>	prickly sculpin
<i>Leptocottus armatus</i>	staghorn sculpin
<i>Salmo gairdneri</i>	rainbow trout
<i>Mylocheilus caurinus</i>	peamouth chub
<i>Platichthys stellatus</i>	starry flounder
<i>Thaleichthys pacificus</i>	eulachon
<i>Oncorhynchus tshawytscha</i>	spring salmon
<i>Salvelinus malma</i>	Dolly Varden
<i>Salmo clarki</i>	cutthroat trout
<i>Ptychocheilus oregonensis</i>	northern squawfish

TABLE 4
GENERAL DATA REGARDING FISH
COLLECTED FOR PCB ANALYSIS

STATION	SPECIES	SEX	LENGTH(cm)	WEIGHT(gm)	TISSUE	POOLED TISSUE WEIGHT(gm)
1	<u>C. asper</u>	F	14.5	48.8	Muscle	5.05
		M	17.0	61.3	Liver	3.72
		M	12.5	28.7		
		M	12.0	18.6		
1	<u>L. armatus</u>	N.D.	18.0	70.8	Muscle	7.18
			14.1	29.1	Liver	4.87
			14.0	29.2		
			16.0	42.8		
			14.0	26.6		
1	<u>S. gairdneri</u>	M	41.0	712.0	Muscle	6.26
					Liver	10.77

N.D. = no data

N.C. = not collected

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TABLE 4 (CONT'D.)

GENERAL DATA REGARDING FISH
COLLECTED FOR PCB ANALYSIS

STATION	SPECIES	SEX	LENGTH(cm)	WEIGHT(gm)	TISSUE	POOLED TISSUE WEIGHT(gm)
1	<u>M. caurinus</u> <u>juveniles</u>	N.D.	6.5	2.2	Muscle	3.69
		N.D.	6.6	2.9	Liver	N.C.
		N.D.	6.2	2.2		
		N.D.	6.5	2.7		
		N.D.	7.1	3.5		
		N.D.	6.0	2.1		
		N.D.	6.9	2.7		
		N.D.	6.1	2.2		
1	<u>P. stellatus</u>	N.D.	6.2	2.2		
		N.D.	23.0	142.9	Muscle	4.92
		N.D.	20.5	87.0	Liver	3.84
		N.D.	6.8	3.5		
		N.D.	6.6	3.2		
		N.D.	7.3	5.2		

N.D. = no data

N.C. = not collected

- 3 -

TABLE 4 (CONT'D.)

GENERAL DATA REGARDING FISH
COLLECTED FOR PCB ANALYSIS

STATION	SPECIES	SEX	LENGTH(cm)	WEIGHT(gm)	TISSUE	POOLED TISSUE WEIGHT (gm)
2	<u>C. asper</u>	M	19.0	133.0	Muscle	3.2
					Liver	2.2
3	<u>C. asper</u>	F	16.0	47.1	Muscle	13.08
		F	15.7	40.5	Liver	5.27
		M	15.4	46.6		
		F	20.8	106.7		
		M	18.0	80.3		
3	<u>T. pacificus</u>	N.D.	6.3	1.5	Muscle	3.65
		N.D.	7.1	1.6	Liver	N.C.
		N.D.	5.8	1.1		
		N.D.	5.9	1.0		
		N.D.	6.7	1.6		
		N.D.	6.1	1.2		
		N.D.	5.8	1.2		
		N.D.	6.6	1.7		

N.D. = no data

N.C. = not collected

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TABLE 4 (CONT'D.)

GENERAL DATA REGARDING FISH
COLLECTED FOR PCB ANALYSIS

STATION	SPECIES	SEX	LENGTH(cm)	WEIGHT(gm)	TISSUE	POOLED TISSUE WEIGHT(gm)
3	<u>P. stellatus</u>	N.D.	9.0	8.3	Muscle	3.25
		N.D.	8.3	7.0	Liver	N.C.
		N.D.	9.3	11.2		
		N.D.	7.1	5.0		
		N.D.	8.1	6.0		
3	<u>O. tshawytscha</u>	N.D.	27.8	203.4	Muscle	9.07
		N.D.	25.2	160.4	Liver	4.29
3	<u>P. oregonensis</u>	M	13.6	29.9	Muscle	4.06
		M	13.4	30.1	Liver	N.C.
4	<u>L. armatus</u>	N.D.	13.2	22.7	Muscle	8.05
		M	20.1	97.0	Liver	6.96
		F	25.6	175.3		
4	<u>S. malma</u>	F	32.4	402.0	Muscle	8.59
					Liver	5.60

N.D. = no data

N.C. = not collected

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TABLE 4 (CONT'D.)

GENERAL DATA REGARDING FISH
COLLECTED FOR PCB ANALYSIS

STATION	SPECIES	SEX	LENGTH(cm)	WEIGHT(gm)	TISSUE	POOLED TISSUE WEIGHT(gm)
4	<u>S. clarki</u>	F	33.0	495.0	Muscle	10.71
					Liver	8.61
4	<u>C. asper</u>	F	16.8	66.3	Muscle	14.88
		M	16.4	62.5	Liver	8.38
		M	20.1	135.2		
		M	17.7	89.2		
		F	19.3	117.2		
4	<u>T. pacificus</u> <i>adult</i>	N.D.	13.8	17.7	Muscle	3.09
					Liver	N.C.
4	<u>P. stellatus</u>	N.D.	7.2	5.1	Muscle	5.13
		N.D.	8.4	7.9	Liver	N.C.
		N.D.	9.2	7.6		
		N.D.	9.6	10.5		
		N.D.	13.8	37.7		

N.D. = no data

N.C. = not collected

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TABLE 4 (CONT'D.)

GENERAL DATA REGARDING FISH
COLLECTED FOR PCB ANALYSIS

STATION	SPECIES	SEX	LENGTH(cm)	WEIGHT(gm)	TISSUE	POOLED TISSUE WEIGHT(gm)
4	<i>T. pacificus</i> <i>juveniles</i>	N.D.	6.9	2.0	Muscle	3.17
		N.D.	5.8	1.1	Liver	N.C.
		N.D.	6.6	1.4		
		N.D.	6.7	1.5		
		N.D.	6.0	1.4		
		N.D.	6.2	1.2		

N.D. = no data

N.C. = not collected

TABLE 5

PCB (AROCOR 1242) LEVELS IN EPAXIAL MUSCLE TISSUES OF VARIOUS FISH SPECIES
COLLECTED FROM THE LOWER FRASER RIVER

Species	Station 1		Station 2		Station 3		Station 4	
	No. of Fish Compositd	PCB Levels (ppm)	No. of Fish Compositd	PCB Levels (ppm)	No. of Fish Compositd	PCB Levels (ppm)	No. of Fish Compositd	PCB Levels (ppm)
<i>C. asper</i>	4	0.32	1	0.32	5	0.034	5	0.032 (Aroclor 1254)
<i>L. armatus</i>	5	0.21	*	*	*	*	3	0.089
<i>S. gairdneri</i>	1	0.17	*	*	*	*	*	*
		(0.23 ppm Aroclor 1254)						
<i>M. caurinus</i>	9	2.4	*	*	*	*	*	*
<i>P. stellatus</i>	5	0.11	*	*	5	0.11	5	0.037 (0.0019 ppm Aroclor 1254)
<i>T. pacificus</i>	*	*	*	*	8 juveniles	0.23	1 adult	0.011 (0.006 ppm Aroclor 1254)
<i>O. tshawytscha</i>	*	*	*	*	2	0.14	6 juveniles	0.08 ppm (Aroclor 1254)
<i>S. malma</i>	*	*	*	*	*	*	*	*
<i>S. clarki</i>	*	*	*	*	*	*	1	0.069
							1	0.075 (0.048 ppm Aroclor 1260)
<i>P. oregonensis</i>	*	*	*	*	2	0.11	*	*

* = species not caught at this station. N.B.: levels reported are in terms of wet weight.

APPENDIX 1

FIELD NOTES FOR FISH COLLECTIONS

Wednesday, February 27

Sampling at Site 1, opposite Belkin Plant

Personnel involved: P. Chapman and D. Munday

Arrived on site at 0700. Set a long line, 2" and 4" gill net and two crab traps; conducted beach seining off the tip of Tree Island and on the shore directly opposite the Belkin plant.

Catch prior to lunch: one rainbow trout, several very small starry flounder, sculpins and minnows. Catch after lunch: two sculpins and minnows.

Lost part of longline when it caught on a snag. Left longline, crabtraps and one gill net in overnight. Left site at 1600.

Thursday, February 28

Sampling at Site 2, $\frac{1}{4}$ mile upstream from Belkin Plant and at Site 1

Personnel involved: D. Munday and M. Farrell

Arrived on site 0730. Checked gear left in overnight - nothing on longline or in gill net but sculpins (freshwater and staghorn) and one rat in traps.

Put out a long line, 2" gill net and one trap at the end of Tree Island; put 4" gill net in same location as previous day along with one trap which later was put in near the diffuser.

Attempted seining on the end of Tree Island and in a shallow area on the opposite side of the river from the Belkin Plant. Caught ten juvenile starry flounder and two different types of minnows.

Checked gear before lunch and found more sculpins in traps. Angled during lunch as the day before local caught a Dolly Varden.

After lunch attempted two more beach seines and caught a few starry flounder. Checked upstream gear but only caught one sculpin. Due to excessive traffic in upstream site, moved gear back down to Site 1, but no other catches recorded.

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Wednesday, March 5

Sampling at Site 4, Tilbury Island opposite Dow Chemical Wharf

Personnel involved: D. Munday and M. Whelan

Arrived on site 0730. Due to problems in finding a launch site, didn't start until 0830.

Installed 4" gill net just downstream of Dow Wharf. Also put one trap in here but, due to current, had to move it upstream. Installed 2" gill net, crab trap and long line in the bay area behind 'bar'.

Attempted angling in the bay area. As tide dropped started beach seining in the area south of Dow Wharf. Caught 10-12 starry flounder, 25 or more juvenile eulachons and one adult eulachon. Checking gear before lunch, caught one staghorn on longlines and two sculpins in traps. Angling across the river from the Dow Wharf produced three staghorn sculpins.

Attempted two beach seines in area across from Dow Wharf and got Dolly Varden, some pink fry and several starry flounder. Checking gear at end of day, caught one rainbow trout, sculpins and starry flounder.

A few problems with gear at the end of the day; finished at 1730.

Thursday, March 6

Sampling at Site 3, Pitt River site

Personnel involved: D. Munday and M. Whelan

Arrived on site 0730, launched from ramp near canoe rental at Pitt River bridge. Proceeded upstream but found no shoreline area for gill nets; entire river was a corridor with log storage on both sides.

Found one area where sunken logs were stored and put in 1", 2" and 4" gill nets, and two traps. Returned to bridge to get fishing rods for angling. Ken Wile and Gerald Tanner arrived 0930 and assisted with angling. E.V.S. personnel attempted beach seines under bridge, which later afforded the only shore line without log storage. Caught a few starry flounder juveniles.

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Decided the only chance to catch any fish was to pack everything up and head downriver to find an area for seining. Did this, but due to log storage and deadheads, managed only five beach seines in two open areas and tore the seine badly on a deadhead. Ended up angling near bridge using four lines baited with fish roe.

Day's catch: 15 juvenile starry flounder (2-3 year fish), 12 prickly sculpins, about 25 minnows, 2 squawfish and 2 juvenile spring salmon.

Thursday, March 13

Sampling at Site 2, $\frac{1}{4}$ mile upstream from Belkin plant.

Personnel involved: D. Munday

Arrived on site 0900. Angled with six double-hooked weighted lines baited with salmon roe and dew worms left in place during effluent sampling. No catches obtained.