ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC AND YUKON REGION
NORTH VANCOUVER, B.C.

MARINE MONITORING IN ALBERNI INLET NEAR THE MacMILLAN BLOEDEL PULPMILL PORT ALBERNI, B.C.

1984, 1986, 1988, 1990

EP REGIONAL DATA REPORT: DR 92-11

By

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REVIEW NOTICE

Data reports are prepared to make preliminary data available without full analysis or interpretation. This report, prepared under contract, has been reviewed by Environmental Protection, and approved for limited distribution. For further information, please contact:

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ABSTRACT

Environmental Protection has monitored marine waters around coastal pulpmills since 1976. Alberni Inlet has been part of this annual routine marine monitoring programme. Water quality records were kept of temperature, salinity, dissolved oxygen and colour relative to water depth. Marine sediment was collected for trace metals, volatile residue, particle size and chlorophenol analysis. Trawls of fish and crustaceans were collected, identified and analyzed for trace metals.

This data report summarizes the sampling done in Alberni Inlet by Environmental Protection in September 1984, August 1986, July 1988 and August 1990. Methods used for collection and analysis are described and results are presented without analysis or interpretation. The sole intent of this report is to provide historical data for the Port Alberni pulpmill.

RESUME

La Protection de l'Environnement a échantillonné les eaux marines réceptrices aux environs des usines de pâte côtières depuis 1976. Alberni Inlet a fait partie d'un programme d'échantillonnage marin de routine annuel. Les données de qualité de l'eau sont concentrées sur la température, salinité, oxygène dissous, et couleur en relation à la profondeur d'eau. Des échantillons instantanés de sédiment furent recueillis pour des analyses de métal à l'état de trace, de résidu volatil, grosseur de particules, et des analyses de chlorophenols. Des poissons et crustacés attrapés au chalut furent recueillis, identifiés et analysés pour métaux à l'état de trace.

Ce rapport de donnée résume l'échantillonnage fait dans l'Alberni Inlet par la Protection de l'Environnement en Septembre 1984, 1986, 1988 et Avril 1990. Les rapports de données résument les méthodes utilisées pour l'échantillonnage et l'analyse. Les résultats sont présentés en tables ou graphiques sans analyse ni interprétation. La seule intention de ces rapports est de fournir des données historiques de Port Alberni.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents data collected by EP during September 1984, August 1986, July 1988 and August 1990 from Alberni Inlet. A detailed analysis and interpretation of the data is beyond the scope of this report.

1.1 Study Area

Alberni Inlet is a typical stratified estuary and has been extensively studied and described since the work of Tully (1949) (Figure 1). The inlet receives about 10 tonnes per day (T/D) BOD (Biochemical Oxygen Demand) loading from the pulpmill and only 173 kg/D from the next largest input, the city sewage treatment plant (BC Ministry of Environment, Lands and Parks, 1980 data).

Periodic depressions of dissolved oxygen in the inlet have been attributed to reduced phytoplankton activity linked to high effluent colour values (Parker and Sibert, 1972). The shading effect of high colour in the water apparently reduced primary production.

1.2 Mill Operations

Mill operations began in 1947 (unbleached kraft 220 T/D) and have expanded to the present level of kraft and groundwood production of 1,294 ADT/D (air dried tonnes per day). Primary clarifiers were installed in 1966 to remove wood solids from mill effluent and in 1970 secondary biological treatment facilities were constructed to lower the BOD loading from the mill by 50%. Sullivan (1978) presented data on the effect of changing bleaching sequences on the amount of colour in the mill effluent. Ranges of 38 to 67% colour reduction were noted using modified (HEH) bleaching sequences in May-July 1975.

Production and effluent data for 1985-7 are presented below:

PRODUCTION			TSS*		BOD5	
			LOADING		LOADING	
YEAR	ADT/D	DAYS	kg/ADT	T/D	kg/ADT	T/D
1985	1,232	336	8.90	11	8.00	9.86
1986	1,131	308	9.87	11	7.91	8.95
1987	1,294	359	7.98	10	7.65	9.90
LIMITS:	FEDERAL PROVINCIAL			11.4 14.5		23.7 14.5

* TSS - Total Suspended Solids

The mill conducted five toxicity tests and obtained an 80% compliance rate in 1987 with the Provincial Limit of a 96h LC50 using 80% effluent. The mill was 90% compliant with Federal TSS limits and 100% compliant with Federal BOD limits.

1.3 Fisheries Resource Information

Alberni Inlet supports a wide variety of resource species: chinook, sockeye, coho and chum salmon, steelhead, herring, rock cod, flounder, prawns and crabs. A major commercial gillnet and seine fishery occurs in Alberni Inlet up to Polly Point. About 1.2 million sockeye and 50,000 chinook are caught annually by gillnet and seine boats. Alberni Inlet is also the site of a major sport fishery for chinook, coho and sockeye, although no landing information is available.

Waldichuk (1987) expressed concern that low dissolved oxygen waters present in Alberni Inlet may form a migration barrier to salmon stocks destined for the Somass River. This has been an ongoing concern considering the declining salmon stocks of the west coast.

In November 1989, a national dioxin study by Environment Canada and Fisheries and Oceans Canada demonstrated the presence of dioxins and furans in harvested fish and shellfish in the vicinity of several pulpmills. Port Alberni was not on this list.

2.0 MATERIALS AND METHODS

Sampling in Alberni Inlet was done from the C.S.S. *Vector* on 11-12 September 1984, 27 August 1986, 26 July 1988 and 14 August 1990. Stations were located using ship's LORAN-C and radar, and positions are described in Appendices III-VI.

Figure 2 depicts the sample locations used for dioxin tests in 1990 on species destined for human consumption. Figure 3 shows the location of 1988 sampling sites.

Tables 1 to 4 summarize water quality, sediment and tissue parameters sampled, plus species collected, and techniques are summarized in Table 5.

Lab analyses were done at the EP/DFO West Vancouver laboratory. Photographs were taken at each site to characterize the area. Intertidal sediments were collected where possible.

TABLE 1: ALBERNI INLET SAMPLING SUMMARY, SEPTEMBER 1984

STATION	WATER			SEDIMENT				
	DO	CTD	COLOUR	NFR	PS	SVR	O & G	TM
1	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X
3	X	X	X	X				
4				X	X	X	X	X
5	X	X		X				
6					X	X	X	X
7	X	X		X				
8				X				
10	X	X	X	X	X	X	X	X
11	X	X	X	X	X	X	X	X
12					X	X	X	X
14	X	X	X	X	X	X	X	X
15	X		X	X	X	X	X	X
16					X	X	X	X
18	X	X	X		X	X	X	X
19	X	X	X	X	X	X	X	X

SPECIES	TISSUE		
	TM muscle	TM gill	TM liver
English sole (*Parophrys vetulus*)	X		X
Slender sole (*Lyopsetta exilis*)	X		
Pacific hake (*Merluccius productus*)	X	X	X
Ratfish (*Hydrolagus collei*)	X	X	X

DO Dissolved Oxygen
CTD Conductivity, Temperature, Depth
NFR Non-filterable Residue
PS Particle Size
SVR Sediment Volatile Residue
O & G Oil and Grease
TM Total metals and mercury

TABLE 2: ALBERNI INLET SAMPLING SUMMARY, AUGUST 1986

STATION	WATER			SEDIMENTS			
	DO	CTD	COLOUR	PS	SVR	O & G	TM
1	X	X	X	X	X	X	X
2				X	X	X	X
3	X	X	X	X	X	X	X
4				X	X	X	X
5				X	X	X	X
6	X	X	X	X	X	X	X
7				X	X	X	X
8	X	X	X	X	X	X	X
10	X	X	X	X	X	X	X
11				X	X	X	X
12				X	X	X	X
13				X	X	X	X
15				X	X	X	X
18				X	X	X	X
19	X	X	X	X	X	X	X
I-1				X	X	X	X
I-3				X	X	X	X
I-4				X	X	X	X

SPECIES	TISSUE	
	TM muscle	TM liver
Ratfish (*Hydrolagus colliei*)	X	X
Pacific hake (*Merluccius productus*)	X	X

DO Dissolved Oxygen
CTD Conductivity, Temperature, Depth
PS Particle Size
SVR Sediment Volatile Residue
O & G Oil and Grease
TM Total metals and mercury

TABLE 3: ALBERNI INLET SAMPLING STATIONS AND SUMMARY, JULY 1988

STATION	SEDIMENTS					BIOTA		WATER	
	SVR PS	TM	PCBs	CP/RA	ODOUR	INVERTS	TRAWLS	DO CTD	COLOUR
1	X	X	X	X	X	X		X	X
2	X	X	X	X	X	X			
3	X	X	X	X	X	X		X	X
4	X	X			X				
13	X	X	X	X	X				
5	X	X	X	X	X	X	X	X	X
14	X	X	X	X	X				
11	X	X	X	X	X				
12	X	X			X				
10	X	X			X			X	X
19	X	X			X			X	X
32								X	X
34								X	X
A-4								X	X
SB-1	X	X	X	X	X	X		X	X
UT-1	X	X			X		X	X	X

TABLE 3 (cont.): ALBERNI INLET SAMPLING STATIONS AND SUMMARY, JULY 1988

SPECIES	TISSUE			
	TM liver	CP liver	PCB liver	Histo-pathology
Ratfish *(Hydrolagus collei)*	X	X	X	
English sole *(Parophrys vetulus)*				X
Slender sole *(Lyopsetta exilis)*				X
Pacific hake *(Merluccius productus)*	X			
Prawn *(Pandalus platyceros)*		X	X	
Dungeness crab *(Cancer magister)*		X	X	

DO — Dissolved Oxygen
CTD — Conductivity, Temperature, Depth
PS — Particle Size
SVR — Sediment Volatile Residue
CP/RA — Chlorophenols & chloroanisoles, resin acids
PCBs — Polychlorinated phenols (Aroclor 1260)
TM — Trace metals and mercury

2.1 Water Samples

Samples for water quality measurements were collected throughout Alberni Inlet at 13 sites in September 1984, six sites in August 1986, 10 sites in July 1988, and six sites in August 1990. For the purposes of inter-year data presentation, the stations were divided into three groups:

Inner Harbour:	Harbour area to Stamp Point and Polly Point
Outer Harbour:	Polly Point to Sproat Narrows
Reference:	Uchucklesit Inlet

Samples were collected at discrete depths with polypropylene N.I.O. (National Institute of Oceanography) water bottles using standard oceanographic techniques. Conductivity, temperature and depth (CTD) profiles were taken using a Guildline 8770 CTD/DO sensor.

2.1.1 Analytical Procedures - Water.

Oxygen concentrations were determined in the ship's lab using the azide modification of the Winkler method. The equations of Gameson and Robertson (1955) were used in the calculation of percent dissolved oxygen saturation:

$$C=\frac{475-(2.65xS)}{33.5+T}$$

$$\%Saturation=\frac{A}{C}x100$$

where: C = saturation of oxygen in the sample water
S = salinity of the sample water
T = corrected temperature of the sample water
A = observed dissolved oxygen concentration in the sample

Nutrient samples were immediately frozen after collection (Strickland and Parsons, 1971), then analyzed using an automated colourimeter (Technicon Auto-analyzer II). Tri-stimulus colour values of previously frozen samples were determined spectrophotometrically in the lab.

2.2 Sediment Samples

Benthic samples were collected from 12 stations in 1984, 18 in 1986 and 11 in 1988. They were analyzed for particle size, sediment volatile residue and trace metals. In 1988 mercury, PCBs, CP and resin acid analyses were also done.

Sediment grabs were taken in 1988 at the stations depicted in Figure 3 using a stainless steel 0.1 m^2 Smith-MacIntyre grab. The surficial (2 cm) sediment layer was collected using a plastic scoop, avoiding the sediment near the sides of the grab. Samples for trace metal, volatile residue and particle size analysis were placed in paper sediment bags inside plastic bags and immediately frozen. Sediments collected for PCB and resin acid analysis were collected using a heat-treated metal spoon and stored frozen in heat-treated glass jars.

2.2.1 Analytical Procedures - Sediment. Sediment samples were analyzed by the EP/DFO West Vancouver Laboratory for oil and grease, trace metals, volatile residue and particle size according to the procedures described by Swingle and Davidson (1979). Oil and grease analysis included Freon 113 extractable compounds: hydrocarbons, fatty acids, soaps, waxes, fats and oils. Trace metal samples were freeze-dried and passed through a 100-mesh (0.177 mm) nylon sieve then digested in a 4:1 nitric-hydrochloric acid solution, and analyzed using a Perkin-Elmer Inductively Coupled Argon Plasma (ICAP) Optical Emission Spectrophotometer. Low-level cadmium was analyzed using a Jarrel Ash 850 Atomic Absorption Spectrophotometer (AAS) with an FLA 100 graphite tube furnace.

2.3 Tissue Sampling

Tissue samples were collected using a small otter trawl which consisted of a 3.8 cm mesh net with a 5.8 m throat. The trawl was towed with a 3:1 scope for approximately 0.5 km. Trawl catches were enumerated by species. Tissue samples were taken from selected fish specimens using a stainless steel scalpel and forceps and included dorsal muscle (with skin removed), liver and soft gill tissues. All tissue samples were frozen individually (except gill composites) onboard in whirlpac bags for later analysis. Table 4 lists the species found in 1988 otter trawls.

2.3.1 **Analytical Procedures - Tissue**. Tissue trace metals were analyzed at the West Vancouver Laboratory according to procedures described by Swingle and Davidson (1979) as follows: tissue samples were thawed, blended, freeze-dried and oxidized in a low temperature asher. The ash containing the metallic salts was then dissolved in warm concentrated nitric acid. Samples were analyzed on the Inductively Coupled Argon Plasma (ICAP) Optical Emission Spectrophotometer. Tissue levels that were below the ICAP detection limit for cadmium and lead were analyzed by the Jarell Ash 850 Atomic Absorption Spectrophotometer (AAS) with an FLA 100 graphite tube furnace.

For mercury, the blended and freeze-dried samples were dissolved in a 4:1 sulphuric acid-water mixture. These solutions were further oxidized with 50% peroxide, heated, cooled and diluted with potassium permanganate. The resultant solutions were then analyzed by "cold vapour" AAS with background correction.

2.4 Quality Control

Standard reference materials Lobster Tail (NRC), Oyster Tissue (NBS), Bovine Liver (NBS), BCSS Marine Sediment (NRC) and MESS Marine Sediment (NRC)were analyzed with each batch of samples processed. If significant differences were observed between measured and certified values, methods were checked and the samples re-run. Quality control results are recorded, and are available at the Environment Canada laboratory in West Vancouver.

TABLE 4: LIST OF SPECIES, ALBERNI INLET OTTER TRAWLS (AT-1 and UT-1), JULY 27, 1988

SPECIES	STATION AT-1	STATION UT-1
White Anemone (*Metridium senile*)	6	0
Orange Anemone (*Stomphia* sp.)	2	0
Coonstripe Shrimp (*Pandalus danae*)	1	0
Crangon Shrimp (*Crangon commun*)	40	108
Sidestripe Shrimp (*Pandalopsis dispar*)	9	6
Smooth Pink Shrimp (*Pandalus jordani*)	0	30
Octopus (Cephalopoda)	0	2
English Sole (*Parophrys vetulus*)	3	0
Large Slender Sole (*Lyopsetta exilis*)	2	2
Medium Slender Sole (*Lyopsetta exilis*)	16	32
Small Slender Sole (*Lyopsetta exilis*)	15	66
Blackbelly Eelpout (*Lycodopsis pacifica*)	19	4
Midshipman (*Porichthys notatus*)	6	2
Pacific Staghorn Sculpin (*Leptocottus armatus*)	1	0
Ratfish (*Hydrolagus collei*)	3	0
Stickleback (Gasterosteidae)	3	0
Pacific Tomcod (*Microgadus proximus*)	19	0
Pacific Hake (*Merluccius productus*)	0	2
Pygmy Poacher (*Odontopyxis trispinosa*)	0	4
Long Spine Combfish (*Zaniolepsis latipinnis*)	0	2
Prawn (*Pandalus platyceros*)	5	0
Crab (*Cancer magister*)	4	0

TABLE 5: SUMMARY OF ENVIRONMENTAL PROTECTION METHODS FOR WATER, SEDIMENT AND TISSUE ANALYSES

SAMPLE TYPE	METHODS	REFERENCE
WATER		
Salinity, temperature, depth	CTD	Goyette & MacLeod, 1984
Dissolved Oxygen	Azide Modification of Winkler	Swingle & Davidson, 1979 Gameson & Robertson, 1955
Colour	Spectrophotometer	Swingle & Davidson, 1979
SEDIMENT		
Particle Size	Freeze drying, Screening	Swingle & Davidson, 1979 Griffiths, 1967
Trace Metals	ICAP Optical Emission Spectrophotometer	Swingle & Davidson, 1979 Millward & Kluckner, 1989
Volatile Residue	Wt. loss on ignition 550°C for 1 hr.	Swingle & Davidson, 1979
TISSUE		
Trace Metals	ICAP Optical Emission Spectrophotometer	Swingle & Davidson, 1979

3.0 RESULTS

3.1 <u>Water Quality</u>

Salinity, temperature, dissolved oxygen (DO), % oxygen saturation and colour data from Port Alberni water quality stations are listed in Tables 6 to 10. Results of effluent monitoring for the Port Alberni mill on June 14, 1990 for chloroanisoles, chlorophenols and resin acids are found in Appendix II.

TABLE 6: WATER QUALITY, SEPTEMBER 11, 1984

STATION	DEPTH (m)	DO (mg/L)	COLOUR (ADMI)	NFR (mg/L)
1	0	5.90	35	15.7
	5	3.30	5	16.7
	10	3.00	5	16.7
2	0	7.85	18	16.7
	5	3.30	5	18.0
	10	3.05	5	17.1
3	0	7.35	24	9.0
	5	3.30	5	16.6
	10	3.20	8	18.6
	15	2.80	5	18.4
4	0	-	-	10.7
	5	-	-	16.9
	10	-	-	19.8
	15	-	-	19.2
5	0	6.90	-	9.9
	5	4.75	-	18.1
	10	4.40	-	18.9
	19	2.80	-	22.7
7	0	7.05	-	16.0
	5	3.80	-	19.1
	10	-	-	17.7
	20	4.15	-	21.4
	30	2.55	-	25.0
8	0	-	-	22.6
	5	-	-	18.9
	10	-	-	19.2
	20	-	-	21.8
	55	-	-	31.5
10	0	7.40	18	21.0
	5	4.85	5	21.6
	10	4.40	5	12.9
	20	4.00	5	19.7
	50	2.85	5	11.7
	63	1.90	5	14.1
11	0	7.85	17	18.5
	5	7.45	6	22.0
	10	3.60	5	18.9
	15	3.20	5	17.5
14	0	6.70	25	10.3
	5	3.10	5	26.2
15	0	7.00	27	12.4
	5	3.60	8	15.0
	10	3.80	5	20.8
	14	3.10	5	18.0
18	0	7.70	11	-
	5	5.30	5	-
	10	4.90	5	-
	50	3.30	5	-
	95	3.10	5	-
19	0	8.50	5	12.9
	5	5.60	26	18.5
	10	5.65	5	18.6
	50	3.90	5	19.1
	120	3.20	5	20.2

- No data available due to sampling error

TABLE 7: WATER QUALITY, AUGUST 27, 1986

STATION	DEPTH (m)	SALINITY (ppt)	TEMPERATURE (°C)	DO (mg/L)	% SATURATION	COLOUR (ADMI)
INNER HARBOUR						
1	0	9.7	22.3	8.3	103.1	13
	2	27.0	13.7	5.8	67.9	9
	5	30.9	10.5	3.2	35.8	6
	10	31.4	9.8	2.6	28.7	7
3	0	13.2	21.3	8.5	105.9	11
	2	27.0	14.0	5.2	61.2	7
	5	31.4	9.8	3.3	36.5	8
	10	31.6	9.5	2.7	29.7	7
	15	31.7	9.3	2.8	30.6	7
6	0	10.5	22.1	7.7	95.8	13
	2	28.1	13.2	3.5	40.8	10
	5	30.8	10.7	-	-	7
	10	31.5	9.9	3.0	33.2	7
	15	31.6	9.5	3.2	35.2	7
OUTER HARBOUR						
8	0	13.9	21.0	8.2	102.0	12
	2	19.7	18.3	2.5	30.6	9
	5	31.3	10.6	3.5	39.4	7
	10	31.6	9.9	4.3	47.7	6
	15	31.7	9.6	3.8	41.9	6
	25	32.0	8.9	5.7	61.9	6
	50	32.7	8.2	2.5	26.8	7
10	0	12.0	21.6	8.2	102.0	10
	2	24.4	16.0	6.6	79.6	9
	5	29.8	12.0	4.9	56.3	7
	10	31.7	9.7	4.0	44.2	6
	15	31.4	9.4	3.9	42.7	6
	25	32.0	9.1	3.2	34.9	6
	50	32.3	8.7	2.6	28.2	6
19	0	17.0	20.5	8.7	109.3	12
	2	21.8	15.1	8.3	96.7	12
	5	31.5	10.5	5.9	66.3	7
	10	31.7	10.2	6.2	69.3	7
	15	31.8	9.9	5.6	62.2	6
	25	32.2	8.9	5.3	57.7	7
	50	32.4	8.7	3.8	41.2	5
	120	32.4	8.9	4.2	45.8	5

TABLE 8: WATER QUALITY, JULY 26, 1988

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (ppt)	DO (mg/L)	% SATURATION
INNER HARBOUR					
1	0	20.9	5.3	5.5	64.9
	2	18.6	-	3.9	-
	5	9.7	31.3	0.7	8.2
3	0	22.8	3.3	5.1	61.5
	2	13.2	12.4	4.1	42.8
	5	9.6	31.5	1.0	11.1
	10	9.3	31.8	1.3	14.6
	15	9.3	31.9	1.3	14.4
32	0	22.3	4.0	4.7	56.4
	2	19.8	9.1	5.4	63.7
	5	9.8	31.3	0.9	9.9
	10	9.4	31.8	1.3	14.1
	15	9.3	31.7	2.2	24.1
34	0	21.9	4.7	4.9	58.4
	2	17.0	16.2	4.1	48.4
	5	9.6	31.4	1.5	16.5
	10	9.4	31.7	0.6	6.0
5	0	20.9	6.8	6.8	80.9
	2	19.2	9.0	5.4	63.1
	5	9.7	31.0	1.3	14.3
	10	9.4	31.8	0.3	3.3
	15	9.3	31.9	1.0	10.6
	20	9.2	32.0	1.1	12.1
OUTER HARBOUR					
10	0	21.4	6.3	6.9	82.6
	2	21.3	10.0	5.3	64.7
	5	10.2	30.5	1.7	18.8
	10	9.3	31.8	1.9	21.8
	15	9.2	32.0	1.7	18.8
	20	9.2	32.0	1.0	10.6
	50	8.8	32.3	2.2	24.3
	60	8.7	32.3	2.7	28.9
19	0	20.5	12.0	7.5	91.4
	2	17.3	17.5	5.5	65.2
	5	9.9	30.5	2.7	29.7
	10	9.1	31.9	2.8	30.6
	15	9.1	32.0	2.7	29.0
	20	9.1	32.0	2.8	30.7
	50	8.7	32.3	2.9	31.2
	120	8.6	32.4	2.8	30.5

TABLE 8: WATER QUALITY, JULY 26, 1988

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (ppt)	DO (mg/L)	% SATURATION
OUTER HARBOUR					
A-4	0	18.7	19.0	7.5	92.2
	2	17.0	21.2	6.0	72.3
	5	9.6	31.4	3.8	41.8
	10	9.3	31.9	3.6	39.4
	15	9.0	32.0	3.2	34.9
	20	8.9	32.1	3.3	35.3
	50	8.3	32.6	2.7	29.1
	120	8.0	32.8	2.3	24.6
	200	8.0	32.9	2.5	26.7
REFERENCE AREA					
UT-1	0	-	18.2	8.5	-
	2	13.0	29.0	6.8	79.5
	5	9.9	31.7	4.7	52.2
	10	9.4	31.9	4.1	44.9
	15	9.2	31.9	1.0	43.4
	20	8.0	32.0	3.6	37.9
	50	8.3	32.6	2.7	29.1
	65	8.3	32.7	2.5	26.9
SB-1	0	19.9	9.6	7.1	84.3
	2	15.9	25.9	7.5	91.2
	5	10.8	31.3	7.1	80.2
	10	9.3	31.8	3.6	39.9
	18	9.0	32.0	3.3	35.9

- Missing data

TABLE 9: WATER QUALITY DATA, JULY 28, 1988

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (ppt)	DO (mg/L)	% SATURATION
INNER HARBOUR					
1	0	20.2	2.0	5.8	66.3
	2	20.1	7.8	4.8	56.6
	5	11.8	29.0	0.5	6.1
	10	9.4	31.7	0.5	5.2
3	0	20.2	3.3	6.8	78.6
	2	20.3	5.2	5.5	64.2
	5	14.5	24.5	2.0	22.9
	10	9.3	31.8	0.7	8.1
	15	9.2	32.0	1.2	13.1
5	0	20.1	4.5	6.3	73.1
	2	20.0	6.3	4.9	57.2
	5	10.7	29.6	1.1	12.7
	10	9.4	31.7	0.7	7.1
	15	9.3	31.9	1.0	10.6
	20	9.1	32.0	1.1	12.3
OUTER HARBOUR					
10	0	19.8	6.7	6.3	73.5
	2	19.5	11.5	5.1	60.8
	5	11.9	27.4	2.0	22.6
	10	9.4	31.8	1.8	19.3
	20	9.1	32.1	1.3	14.3
	50	8.7	32.3	2.5	27.2
	60	8.7	32.3	2.4	26.5
19	0	18.9	13.1	6.4	76.1
	2	18.4	15.2	5.2	62.1
	5	10.9	29.7	2.7	30.2
	10	9.4	31.6	2.7	29.6
	15	9.1	31.9	2.8	30.6
	20	9.1	32.0	2.9	31.7
	50	8.7	32.3	3.2	34.7
	120	8.6	32.4	2.9	30.9
A-4	0	17.3	19.6	7.1	84.6
	2	16.6	21.1	6.2	74.1
	5	15.7	24.6	5.7	68.4
	10	9.3	31.8	3.8	41.7
	15	9.1	32.0	3.2	34.9
	20	8.9	32.1	3.2	34.8
	50	8.3	32.7	1.8	19.4
	120	8.0	32.9	2.6	27.8
	200	8.0	32.9	2.5	26.3
REFERENCE AREA					
UT-1	0	19.1	20.8	7.8	97.7
	2	16.9	25.6	6.3	78.0
	5	12.5	31.2	6.3	73.4
	10	9.3	31.8	3.7	40.5
	15	9.1	31.9	3.0	32.7
	20	8.9	32.0	3.5	38.1
	50	8.3	32.6	2.5	26.9
	65	8.2	32.7	2.5	26.9

TABLE 10: WATER QUALITY, AUGUST 14, 1990

STATION	DEPTH (m)	TEMPERATURE (°C)	SALINITY (ppt)	DO (mg/L)	% SATURATION
1	0	22.7	5.9	5.3	64.8
	2	21.9	14.4	4.9	62.1
	5	15.4	26.8	0.1	1.3
	10	10.8	30.8	2.8	31.5
3	0	-	-	5.6	-
	2	21.9	12.4	5.4	67.7
	5	15.6	25.6	1.7	20.5
	10	10.6	31.1	2.3	25.8
	15	10.2	31.4	2.6	29.0
10	0	20.9	15.2	5.9	73.9
	2	20.8	15.1	5.8	72.4
	5	15.8	25.1	4.8	57.9
	10	10.8	31.2	4.4	49.7
	15	10.3	31.4	3.6	40.3
	20	10.1	31.5	3.1	34.5
	50	9.1	32.1	2.5	27.3
	100	8.9	32.3	2.3	25.0

- No Data

3.2 Sediment Quality

Results of sediment sampling in Alberni Inlet are summarized in Tables 11 to 20. Sediment chemical and physical characteristics were sampled at 12 stations in 1984, 15 in 1986, and 13 in 1988. For the purposes of inter-year data presentation, the stations were divided into two groups:

Inner Harbour: Harbour area to Stamp Point and Polly Point
Outer Harbour: From Polly Point towards mouth of inlet

The visual descriptions and physico-chemical parameters of the sediments collected from the Inner Harbour indicate degraded benthic conditions (Tables 11 to 15):

- reducing (anaerobic) sediments
- high oil and grease levels
- high sediment volatile residues
- large amounts of wood fibre and bark debris
- few benthic invertebrates

The most severely impacted sediments in 1986 were found nearest the outfall (Stations 1, 2, 11, 13) to a distance of about 0.9 km. When the visual appearance of the stations were examined between years, it was apparent that the stations nearest the outfall were consistently described as degraded and anoxic. Sediment quality at other stations was more variable between years.

These findings are consistent with information on the diversity and abundance of benthic invertebrates in Alberni Inlet (McGreer, 1984). There were reduced numbers of taxa and abundance of invertebrates found within 750 m of the mill outfall. Amphipod species were noticeably absent from most samples. Abundances were highly variable between years.

The widespread contamination of the Inner Harbour with high levels of oil and grease, and large amount of bark debris reflect the multiple inputs into the harbour: pulpmill effluent, log-booming and storage debris, sewage treatment plant, sawmill and lumber mill.

Sediments in the Outer Harbour were generally less impacted in terms of oils and grease, and bark debris. Although the sediment volatile residues were similar in both areas, the Outer Harbour had generally aerobic sediments. The following changes in concentrations were apparent:

INNER HARBOUR

Mercury - declined since 1980

Cadmium - mainly declined

Copper - no pattern apparent

Lead - no pattern apparent

Zinc - general decline

OUTER HARBOUR

Mercury - declined since 1980

Cadmium - unchanged from 1981

Copper - increased

Zinc - declined since 1980

These trends were not corrected for differences in lab percent recovery of each metal, which may differ between years.

TABLE 11: DESCRIPTION OF SEDIMENT, SEPTEMBER 12, 1984

STATION	DEPTH (m)	VISUAL DESCRIPTION
INNER HARBOUR		
1	8	black fibres and *Beggiatoa*, bacterial; reducing
2	13	1) fine black reducing fibres with *Beggiatoa*; yellow slime 2) same as above; no yellow slime
4	21	1) not as black as Station 12; somewhat coarser; many white bivalves (1 doz/grab); *Capitella; Solemya reidii*, (several/grab) 2) same as above with coarser wood fibres; i.e., chunks of bark
6	27	slightly reducing sand/silt; wood particles; worm tubes
11	20	1) light brown silt overlying black reducing muck 2) same as above; worm tubes
12	22	very fine wood fibres; expanding grey/black mud; H_2S odour; worm tubes; *Solemya reidii; Capitella;* white bivalves
14	8	1) dark black reducing mud and wood debris 2) same as above; *Beggiatoa*
15	17	very fine clay/mud substrate; non-reducing; coarse wood debris; transluscent white tunicates attached to worm tubes
16	11	mostly bark; some fine black reducing sediment
OUTER HARBOUR		
10	70	grey/green mud with errant polychaetes; not strongly reducing; a few small stones; no bivalves visible; debris; bark; twigs
18	102	brown, non-reducing mud; worm tubes and branches
19	131	brown, non-reducing sediment; worm tubes

TABLE 12: DESCRIPTION OF SEDIMENT, AUGUST 27, 1986

STATION	DEPTH (m)	VISUAL DESCRIPTION
INNER HARBOUR		
1	14	black reducing mud with white bacteria, *Beggiatoa*; wood fibres and bark; amphipods swimming in water
2	16	1) black, reducing, fine mud; oily; no signs of life 2) black, reducing, fine mud with white fibres and bacterial growth only; no signs of life
3	18	brown sandy mud with bivalves; many polychaete tubes and maldanids
4	22	grey/brown silt and mud, non-reducing; white bivalves; errant polychaetes
5	22	soft, non-reducing sediment; worm tubes
6	28	1) non-reducing; no wood waste; small pebbles 2) non-reducing sediment; some wood debris
11	19	1) thin coating of brown silt overlying black reducing mud and gravel; *Solemya reidii* 2) no brown coating of silt; reducing with bacteria
12	23	fine grey mud with polychaete tubes and small white bivalves and errant polychaetes
13	13	1) fine, black, reducing mud; oily; wood fibres; no signs of life 2) brown sandy silt; wood bark; crab legs; eelgrass; small white bivalve; gastropod
15	17	aerobic brown mud with worm tubes; many white clams; bark and twigs
OUTER HARBOUR		
7	36	1) soft, grey, non-reducing sediment; shell/pebble fragments 2) soft, grey, non-reducing sediment; wood debris
8	61	soft, non-reducing sediment; some wood debris
10	65	soft, grey/brown, non-reducing sediment
18	107	soft, brown, non-reducing sediment
19	127	soft, non-reducing sediment; worm tubes

TABLE 13: DESCRIPTION OF SEDIMENT, JULY 26-28, 1988

STATION	DEPTH (m)	VISUAL DESCRIPTION
INNER HARBOUR		
1	12	black reducing mud; no biota present; debris included white fibres, leaves, bark, pieces of wood, oil from grab
2	14	black surfaced, reducing, grey-green mud; some polychaetes present; debris of twigs, bark, leaves, white fibres, 1 clam shell
4	23	odourless grey-brown mud; some polychaete tubes present; bark and leaves
3	19	odourless, grey-green, clay-like mud; numerous clams and polychaete tubes; woodstem debris
13	19	grey-green mud; clams, tunicates and numerous polychaetes present
5	25	grey-green sandy mud; numerous clams, polychaetes and tubes; debris of bark, shells, wood
14	11	black surfaced, grey-black reducing mud; polychaetes present; wood, bark, and fibre debris
11	21	grey-black reducing mud; no biota present; fibres and some wood debris finer mud than that of station 14
12	24	grey-black surfaced grey-green mud; slight reducing odour; polychaetes present; fibrous debris
OUTER HARBOUR		
10	71	grey-green sandy mud, with grey-brown surface; polychaetes and clams present; debris of shells and fungi
19	131	grey-brown sand, without odour; polychaetes present; shell and bark debris; second grab more a grey-green clay texture
REFERENCE AREA		
SB-1	18	odourless brown mud, with a grey-brown surface; numerous clams and polychaetes present; shells were the only debris
UT-1	64	green mud; heart urchins present; shells were the only debris

<u>TABLE 14</u>: SEDIMENT DATA, SEPTEMBER 12, 1984, ALBERNI INLET

STATION	DEPTH (m)		MEAN PARTICLE SIZE	SILT AND CLAY				SVR (%)				OIL AND GREASE			
	1	2		MEAN	Replicates 1	Replicates 2	C.V. (%)	MEAN	Replicates 1	Replicates 2	C.V. (%)	MEAN	Replicates 1	Replicates 2	C.V. (%)
INNER HARBOUR															
1	8	8	fine sand	11.45	12.7	10.2	15	14.75	14.4	15.1	3	2450	2600	2300	9
2	13	13	fine sand	14.15	14.9	13.4	7	11.45	10.4	12.5	13	1100	1100	1100	0
4	21	20	fine sand	25.95	28.3	23.6	13	9.88	9.8	10.0	2	500	400	600	28
6	27	25	medium sand	18.60	15.0	22.2	27	8.92	9.1	8.7	3	350	600	100	101
11	20	20	fine sand	21.05	19.5	22.6	10	11.50	10.9	12.1	7	1250	1300	1200	6
12	23	21	fine sand	24.20	27.0	21.4	16	9.97	10.2	9.7	3	900	900	900	0
14	8	8	fine sand	15.35	12.2	18.5	29	14.70	15.3	14.1	6	2150	1900	2400	16
15	17	17	medium sand	19.45	17.8	21.1	12	12.70	11.8	13.6	10	850	700	1000	25
16	11	10	fine sand	9.80	10.1	9.5	4	23.30	20.5	26.1	17	3350	3400	3300	2
MEAN	16	16	fine sand	17.78	17.5	18.1		13.02	12.5	13.6		1310	1300	1300	
MAX	27	25		25.95	28.3	23.6		23.30	20.5	26.1		3350	3400	3300	
10	70	70	medium sand	22.85	23.6	22.1	5	11.60	11.7	11.5	1	450	400	500	16
18	102	108	medium sand	15.10	19.7	10.5	43	15.40	15.1	15.7	3	450	600	300	47
19	130	132	medium sand	18.15	20.4	15.9	18	13.35	13.2	13.5	2	500	500	500	0
MEAN	101	103	medium sand	18.70	21.2	16.2	22	13.45	13.3	13.6	2	467	500	433	
MAX	130	132		22.82	23.6	22.1	43	15.40	15.1	15.7	3	500	600	500	

TABLE 15: SEDIMENT DATA, AUGUST 27, 1986

STATION	DEPTH (m)		MEDIAN PARTICLE SIZE		SILT & CLAY				SVR (%)				OIL & GREASE (µg/g)			
			Size (mm)	Description	MEAN	Rep.1	Rep.2	C.V. (%)	MEAN	Rep.1	Rep.2	C.V. (%)	MEAN	Rep.1	Rep.2	C.V. (%)
INNER HARBOUR																
1	14	14	0.125	fine sand	18.9	16.8	21.0	16	17.61	19.1	16.0	12	1645	2000	1290	31
2	16	16	0.125	fine sand	20.5	22.0	18.9	11	2.8	12.2	13.4	7	733	575	890	30
3	18	18	0.063	v. fine sand	28.5	30.1	26.9	8	12.5	12.2	12.8	3	771	718	824	10
4	22	22	0.125	fine sand	29.7	30.8	28.6	5	12.0	12.0	11.9	1	429	389	468	13
13	13	13	0.12 to 0.25	medium sand	18.3	24.0	12.6	44	17.9	16.7	19.0	9	1250	1140	1360	12
5	23	21	0.125	fine sand	31.1	30.7	31.4	2	11.6	10.9	12.3	9	507	453	560	15
15	17	17	0.125	fine sand	25.5	24.8	26.1	4	13.4	12.5	14.2	9	728	611	845	23
11	19	19	0.125	fine sand	25.0	21.2	28.7	21	10.5	8.2	12.8	31	976	1010	942	5
12	23	23	0.063	v. fine sand	30.2	28.6	31.7	7	13.2	13.6	12.8	4	939	991	886	8
6	29	26	0.250	medium sand	16.2	17.4	15.0	10	12.3	11.4	13.2	10	406	392	419	5
OUTER HARBOUR																
10	65		1.000	v. coarse sand	17.4	17.4			15.6	15.6			378	378		
7	36	36	0.125	fine sand	22.6	22.8	22.4	1	12.3	12.8	11.8	6	486	567	405	24
8	62	60	0.500	coarse sand	20.6	19.2	21.9	9	14.6	14.0	15.2	6	458	431	484	8
18	107	106	0.250	medium sand	15.1	16.0	14.1	9	19.4	17.2	21.6	16	390	412	368	8
19	126	127	0.500	coarse sand	14.9	16.9	12.8	20	18.1	17.7	18.5	3	270	256	284	7
INTERTIDAL SITES																
I-1			1.000	v. coarse sand	0.1	0.1	0.1	0	1.4	1.6	1.3	14	34.8	30.7	38.8	16
I-3			0.250	medium sand	0.4	0.2	0.5	61	0.8	0.8	0.8	6	14.8	14.3	15.2	4
I-4			0.250	medium sand	0.3	0.3	0.2	28	0.8	0.7	0.7	4	32.5	34.8	30.1	10

TABLE 16: SEDIMENT DATA, JULY 26, 1988

STATION	DEPTH (m)	MEDIAN PARTICLE SIZE		SILT AND CLAY (%)	SVR (%)	PCBs (μg/g)
		Size(mm)	Description			
INNER HARBOUR						
1	12	0.063 0.063	very fine sand very fine sand	43.1 33.7	17.2 17.7	0.33 0.07
2	14	0.063 0.063	very fine sand very fine sand	28.8 33.6	10.6 10.0	0.05 0.07
3	19	0.063 0.063	very fine sand very fine sand	44.8 41.3	9.5 10.8	0.11 0.12
4	23	<0.063 <0.063	silt and clay silt and clay	51.0 53.2	9.4 10.1	- -
13	19	0.125 0.125	fine sand fine sand	26.4 24.2	13.3 14.7	0.10 0.04
5	25	0.063 0.063	very fine sand very fine sand	44.2 48.8	11.0 10.0	0.03 0.04
14	11	0.125 0.125	fine sand fine sand	31.1 30.7	16.1 15.7	0.01 0.05
11	21	0.063 0.063	very fine sand very fine sand	37.4 35.7	13.6 13.6	0.11 0.18
12	24	0.063 0.063	very fine sand very fine sand	37.2 33.7	11.0 11.2	- -
MAX	**25**			**53.2**	**17.7**	**0.33**
MEAN	**19**			**37.7**	**12.6**	**0.09**
STD	**5**			**8.4**	**2.8**	**0.08**
CV (%)	**28**			**22.4**	**22.1**	**87.09**
OUTER HARBOUR						
10	71	0.125 0.063	fine sand very fine sand	29.9	13.2	-
19	131	0.063 0.125	very fine sand fine sand	33.4	12.8	-
MAX	**131**			**38.7**	**18.2**	
MEAN	**101**			**34.1**	**15.2**	
STD	**42**			**3.6**	**2.6**	
CV (%)	**42**			**10.6**	**17.1**	
REFERENCE AREA						
SB-1	18	0.125 0.125	fine sand fine sand	25.0 29.1	21.4 21.8	-
UT-1	66	0.250 0.125	medium sand fine sand	25.0 15.7	15.9 16.7	-
MAX	**66**			**29.1**	**21.8**	
MEAN	**42**			**23.7**	**19.0**	
STD	**34**			**5.7**	**3.1**	
CV (%)	**81**			**23.9**	**16.3**	

\- Not detected

TABLE 17: SEDIMENT TRACE METAL CONCENTRATIONS, SEPTEMBER 12, 1984

STATION	TOTAL METALS (ug/g dry wt) Hg	Al	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Mg	Mn	Na	Ni	P	Pb	Si	Sr	Ti	V	Zn
INNER HARBOUR																					
1	.401	31000	58.1	.5	12000	.40	23.9	60.8	79	42400	13300	435	7530	36	824	< 3	1190	55.4	2950	148	212
	.306	33600	63.8	.5	12200	.40	25.8	62.1	79.4	42300	13400	445	5900	36	811	< 3	1140	55.7	3000	151	248
2	.342	34600	64.7	.5	12700	.70	29.5	61.6	83.5	42900	14000	469	6430	36	867	3	1200	58.3	3200	159	204
	.425	36400	67.1	.5	12000	.90	25.7	66.1	93.7	44100	15100	481	8240	38	951	6	1310	65.8	3290	163	267
4	.448	32400	68.2	.3	12100	1	19.4	63.4	79.1	42700	13700	445	5760	35	904	< 3	1500	56.5	2560	140	338
	.449	32000	65.5	.3	12200	1.10	18.3	63.1	80.2	42100	13900	444	6900	34	970	< 3	1250	58.3	2470	139	336
14	.344	32200	57.8	.5	13500	.50	26.1	62.1	83.2	42000	13300	466	6010	36	888	< 3	1010	61	3140	157	245
	.303	30600	56.1	.4	12300	< .30	25	58.3	76.5	42400	13200	455	5120	36	817	< 3	950	49.4	2800	146	182
	.275	28200	50.2	.3	11400	< .30	21.5	54	71.3	39600	12300	422	4780	33	765	< 3	1060	45.2	2540	136	169
16	.513	34900	59.1	.5	12500	.70	22	60	95.5	44400	15200	458	10000	38	971	< 3	1420	69	3110	164	284
	.708	34500	58.7	.4	12300	1.30	33.4	70	99.3	44700	14700	477	9100	41	952	< 3	1410	70.2	2960	164	421
15	.523	30600	54.8	< .2	11000	.80	19.2	63.5	83.8	43100	13500	430	6350	36	995	< 3	1070	57.1	2090	139	270
	.524	29300	48.3	< .2	11500	.90	22	62.5	82	42800	13300	424	6340	36	1000	< 3	1310	55.5	2040	136	271
	.773	33400	65.7	.3	12500	.90	22.2	68.9	89	46000	14300	450	8000	36	1220	< 3	1330	67	2580	156	299
11	.281	36100	61.5	.5	11700	.50	22.3	66.5	98	48300	15200	484	6970	39	962	< 3	930	56.6	3100	164	208
	.299	35200	58	.5	11900	.50	27.2	68.3	97.7	49700	15200	492	6770	41	993	4	1130	55.7	3140	165	211
	.477	36300	68.9	.6	12200	.80	27.7	69.1	95.4	47200	14500	488	7300	38	1100	8	1650	62.1	3200	163	252
12	.710	28600	56.3	< .2	11000	2.80	19.7	60.3	76.8	42400	13700	428	9590	36	870	< 3	1110	50.3	2120	131	286
	.710	28600	53.1	< .2	10900	3	22.6	60.3	79.9	42700	13900	432	9760	38	878	< 3	1220	49.6	2110	131	289
	.658	31700	64.1	.4	11600	2.80	16.9	61.7	79.9	41900	14300	430	11600	37	889	< 3	1610	56.8	2760	140	284
6	.532	36600	66.4	.5	12600	.70	21.8	70.4	89.8	45100	15300	466	7970	38	998	< 3	1900	63.6	3000	157	289
	.382	35200	66.4	.4	12000	.90	20.1	68.4	81.4	44500	14900	459	8290	36	971	< 3	1870	61.2	2710	150	253
MAX	.773	36400	68.9	.6	13500	3	33.4	70	99.3	49700	15200	492	11600	41	1220	8	1650	70.2	3290	165	421
MEAN	.473	32350	60	.4	12055	1.08	23.5	63.5	85.2	43685	14000	452	7475	37	931	3	1244	57.8	2766	150	264
STD	.163	2635	5.9	.1	618	.88	4.1	4.1	8.5	2435	803	22	1866	2	105	1	204	6.6	426	12	60
CV(%)	34.4	8.2	9.9	33.2	5.1	81.2	17.4	6.4	10.0	5.6	5.7	4.9	25.0	5.5	11.3	37.0	16.4	11.5	15.4	8.2	22.6
OUTER HARBOUR																					
10	.575	36000	62.10	.4	12900	1.20	23.8	76.5	87	44700	16300	471	8730	39	1000	< 3	1090	66.4	2730	152	224
	.873	36300	60.70	.5	13000	1.20	19.4	75.1	80.3	44500	16500	465	10100	38	1000	< 3	1000	66.9	2750	155	241
	.928	38000	63.3	.5	13300	1.10	18.9	77	93	46000	17400	479	10900	38	1030	< 3	1530	69.7	2840	160	255
18	.728	39400	70.7	.5	14700	.70	23.6	75.2	111	52300	20300	550	11400	39	1530	< 3	1670	88.8	3290	196	194
	.682	40500	62.8	.3	15200	.70	23.6	75.6	114	51400	21200	565	9660	41	1260	< 3	1470	82.4	3400	201	202
19	.676	37900	52.9	.5	15900	.70	22	73.9	101	48700	20000	638	12000	35	1610	< 3	1670	103	3040	174	175
	.609	38000	58.8	.5	15000	.80	24.1	74.4	104	47000	19600	624	10400	34	1400	< 3	1400	97.7	3000	176	173
MAX	.928	40500	70.7	.5	15900	1.20	24.1	77	114	52300	21200	638	12000	41	1610	3	1890	103	3400	201	255
MEAN	.724	38014	60.5	.5	14400	.91	22.2	75.4	99.8	47800	18757	542	10570	38	1261	3	1650	82.1	3007	173	209
STD	.131	1587	6.7	.1	1314	.24	2.2	1.1	10.7	3120	1982	72	1306	2	259	0	184	15.0	260	19	32
CV(%)	18.1	4.2	11.1	17.2	9.1	26.4	9.9	1.5	10.7	6.5	10.6	13.4	12.4	6.4	20.5	0	11.1	18.3	8.7	11.2	15.2

NOTE: All measurements of Sn (<2), Mo (<0.8) and As (<8) were below detection limits

TABLE 18: SEDIMENT TRACE METAL CONCENTRATIONS, AUGUST 27, 1986

TOTAL METALS (ug/g dry wt)

STATION NO	Hg	Al	As	Ba	Be	Ca	Cd *	Co	Cr	Cu	Fe	Mg	Mn	Mo	Na	Ni	P	Pb	Si	Sn	Sr	Ti	V	Zn
INNER HARBOUR																								
1	.130	25000	<9	47.9	<.2	9000	.32	16	48	78.3	37200	12800	396	1.5	10200	33	675	35	520	5	48.4	1520	115	152
	.155	27400	<8	47	<.2	8500	.24	17.5	49	73.5	38500	13200	402	1.4	9400	32	600	33	480	4	47	1460	116	116
2	.113	24900	<8	42.9	.3	10400	.29	14.3	46.4	71.1	39600	12000	420	.9	6010	30	620	28	440	9	44.9	1830	126	110
	.137	27000	<8	49.8	.2	10100	.45	17	48.2	80.9	39100	12700	408	1.3	9730	31	666	33	370	9	49.6	1850	128	128
3	.234	26800	<8	47.4	.2	8910	.50	19	50.9	85.1	38500	13200	424	2.9	11400	32	718	35	430	8	50.7	1730	124	262
	.201	27700	<8	50.2	.2	9400	.31	23	53.1	83.4	39000	13100	433	2.1	9000	33	744	32	380	9	52.1	1800	131	213
4	.273	28600	<8	55.5	.2	9130	.30	15.6	53.3	79.6	38300	13300	414	<.8	10000	31	661	29	330	4	50.4	1600	119	223
	.238	28100	<8	53.5	.3	9140	.47	18.9	50.5	74.3	36600	13100	401	<.8	9710	31	713	33	370	8	50.7	1500	116	205
13	.164	27700	<8	43.8	.2	9120	.53	21.8	48.2	90.8	36300	13200	407	4.7	11700	31	621	35	460	8	48.9	1770	124	191
	.208	26700	<8	43.3	.2	9400	.82	19.7	49.1	84.1	34900	12700	416	4.3	9360	31	623	35	400	10	49.9	1740	121	308
5	.315	28900	<9	63.5	.2	9260	.61	21.3	54.5	73	38100	13100	416	1.5	9430	33	644	31	330	6	50.9	1530	121	172
	.303	28700	<8	69.5	.3	9290	.91	17.8	56.4	78	39000	13100	421	<.8	9010	33	604	33	340	7	52.9	1670	125	221
15	.233	28600	<8	63.9	.2	8490	.33	14.5	51.1	68	35100	12900	388	<.8	10200	30	722	29	350	4	50	1460	114	230
	.358	29500	<8	63.5	.2	8540	.67	17.4	54.1	77.4	36600	13300	400	<.8	11300	33	669	34	320	5	52.4	1530	120	256
11	.159	27400	<8	63.6	.3	10000	.26	20.5	54.6	78.4	39300	12300	463	2.2	7150	34	747	34	360	7	52.2	1670	127	321
	.150	26800	<8	57.3	.2	10100	.28	18.7	53	77.5	39400	12100	423	<.8	6700	32	678	31	400	10	50	1700	127	142
12	.203	27900	<8	59.9	.3	9830	.33	19	58.5	77.7	40000	12400	452	2.5	6960	35	712	30	390	5	53.3	1700	134	262
	.246	29900	<8	62.4	.3	9770	.45	19	59.9	84.4	41400	12900	457	2.5	7640	35	700	33	340	8	55.8	1840	136	207
6	.329	27700	<9	57	.3	9640	.71	18.5	56.6	69.9	36900	12600	411	<.9	8420	33	687	26	380	9	52.9	1600	127	204
	.289	26000	<8	49.8	.3	9720	.57	22.1	55.5	64.2	36000	12200	408	<.8	6260	34	662	28	360	12	49.6	1670	124	222
MAX	.358	29900	9	69.5	.3	10400	.91	23	59.9	90.8	41400	13300	463	4.7	11700	35	747	35	520	10	55.8	1850	136	321
MEAN	.217	27689	8	54.7	.2	9372	.45	18.4	52.2	78.6	38250	12856	419	1.8	9206	32	678	32	389	7	50.6	1674	124	211
STD	.071	1262	0	8.5	.0	368	.20	2.4	3.8	5.6	1015	410	21	1.2	1660	2	43	2	57	2	2.5	131	6	65
CV(%)	33	5	4	16	21	6	44	13	7	7	3	3	5	66	18	5	6	7	15	30	5	8	5	31
OUTER HARBOUR																								
10	.345	36100	<8	64	.3	10200	1.18	23.9	68.8	102	41100	17300	453	<.8	17000	37	868	37	310	8	71.8	1980	149	218
7	.354	27800	<8	57.1	.3	10100	.92	17.8	59.5	74.5	39200	12700	435	<.8	6720	34	906	29	310	11	61	1770	133	186
	.298	29900	<8	59.9	.3	9820	.62	19.3	59.3	73.2	38600	13700	421	<.8	10300	33	805	30	330	7	60.5	1710	127	173
8	.372	33400	<8	59.8	.4	9790	.72	22.4	64.6	91.6	39700	16000	440	<.8	14000	37	760	35	320	10	65.7	1860	137	213
	.393	33200	<9	57	.3	9330	1.19	22.7	63.6	91.9	39300	16000	434	1	14700	36	767	34	390	5	63.9	1810	135	222
18	.309	38600	<8	132	.3	12500	.83	26.8	68.5	115	49500	20000	537	<.8	15200	39	1410	40	320	14	94.1	2310	178	171
	.362	38200	<8	92.1	.3	12300	.84	31	68.4	116	48000	21100	541	<.8	15800	39	1190	40	440	13	85.8	2260	183	177
19	.279	37000	<8	55.7	.3	13200	.76	26.2	68.1	112	44400	20500	514	<.8	20200	36	1130	36	460	11	104	2160	163	145
	.328	32100	<8	35.3	.3	11100	.69	28.9	66.1	107	45600	19400	554	<.8	16500	33	1500	36	570	10	91.8	1900	156	142
MAX	.393	38600	9	132	.4	13200	1.19	31	68.8	116	49500	21100	554	1	20200	39	1500	40	570	14	104	2310	183	222
MEAN	.338	34122	8	68.1	.3	10927	.86	24.3	65.2	98.1	42911	17500	481	.8	14580	36	1037	35	383	10	77.6	1973	151	188
STD	.037	3830	0	28.0	.0	1407	.20	4.3	3.8	16.4	4280	3132	54	.1	3924	2	282	4	91	3	16.5	220	20	30
CV(%)	11	11	4	41	11	13	24	18	6	17	10	18	11	8.1	27	6	27	11	24	28	21	11	13	16
INTERTIDAL SITES																								
I-1	.045	22000	<8	15.9	.2	8430	.04	22	46	79.8	45500	11400	740	<.8	1230	33	477	60	250	20	21.9	2360	152	186
	.044	22300	<8	17.6	.3	9080	.03	23.7	48.4	80.3	47300	11400	737	<.8	1270	34	501	67	310	17	22.7	2560	163	110
I-3	.046	18200	<8	17.7	<.2	8320	.02	16	38.7	29.7	32500	9740	454	<.8	1040	28	371	16	300	10	22.6	1510	90.2	78.3
	.047	16100	<8	17.9	<.2	9150	.02	17.1	45.6	27.5	31200	8500	405	<.8	840	30	402	17	410	10	23	1660	93.2	71.6
I-4	.061	21000	<8	33.1	<.2	10500	<.02	18.2	73.1	42.7	42100	11600	564	<.8	990	38	404	38	990	27	31.9	1590	112	158
	.077	23700	<9	39.5	.2	11000	.10	29	97.6	54.9	45900	13100	597	<.9	1100	40	525	44	1250	16	35.8	1570	122	166
MAX	.077	23700	9	39.5	.30	11000	.10	29	97.6	80.3	47300	13100	740	.9	1270	40	525	67	1250	27	35.8	2560	163	166
MEAN	.053	20550	8	23.6	.22	9413	.04	21	58.2	52.5	40750	10957	584	.8	1092	34	460	40	592	17	26.3	1875	122.1	115.0
STD	.013	2850	0	10.1	.04	1099	.03	4.9	22.6	23.5	7114	1607	141	.0	164	5	60	21	421	6	6.0	460	30.1	31.3
CV(%)	25	14	5	43	19	12	82	23	39	45	17	15	24	5	15	14	13	53	71	30	23	25	25	34

* graphite furnace result

TABLE 19: SEDIMENT TRACE METAL CONCENTRATIONS, JULY 27, 1988

STATION	DEPTH (m)	TOTAL METALS (μg/g, dry wt.)										
		Hg	Al (%)	As	Cd*	Cr	Cu	Fe (%)	Mn	Ni	Pb	Zn
INNER HARBOUR												
1	12	0.120 0.120	2.61 2.65	<8 <8	0.42 0.36	51.0 49.3	75.0 81.7	3.90 3.98	406 464	31 30	10 -	128 114
2	14	0.219 0.226	2.45 2.49	20 10	0.60 0.61	49.5 49.7	68.5 69.7	3.53 3.56	412 416	29 30	<8 10	259 254
3	19	0.185 0.226	2.37 2.84	9 20	0.73 0.64	49.7 53.4	71.5 76.7	3.69 3.85	395 417	28 29	8 <8	204 217
4	23	0.227 0.208	2.64 2.72	9 10	0.74 0.82	51.2 52.2	67.6 70.8	3.69 3.75	389 398	28 29	<8 <8	188 186
13	19	0.364 0.221	2.51 2.75	10 20	0.86 0.99	50.6 55.0	72.9 83.2	3.66 3.80	405 416	28 31	10 10	275 293
5	25	0.250 0.228	2.64 2.52	10 10	0.83 0.92	52.4 50.4	100 76.7	3.87 3.78	400 392	30 28	<8 8	197 172
14	11	0.241 0.160	2.50 2.88	10 10	0.60 0.70	49.3 53.7	76.4 83.3	3.55 3.77	461 438	30 31	9 <8	452 256
11	21	0.223 0.160	2.64 2.54	<8 20	0.67 0.59	49.9 51.8	82.8 81.6	3.93 3.86	415 408	29 32	<8 9	172 197
12	24	0.200 0.164	2.40 2.59	19 10	0.53 0.50	48.4 50.2	76.3 76.5	3.74 3.86	402 413	31 30	8 8	206 185
OUTER HARBOUR												
10	71	0.263 0.251	2.60 2.50	20 9	0.93 0.87	56.1 53.7	66.4 65.3	3.70 3.70	404 397	30 29	<8 <8	222 212
19	131	0.288 0.319	3.00 3.10	28 25	0.66 1.10	61.4 63.7	97.5 100	4.50 4.10	590 471	29 30	<8 <8	157 179
REFERENCE AREA												
SB-1	18	0.150 0.158	2.70 2.70	20 10	1.70 1.40	43.7 43.5	71.0 71.9	3.50 3.30	458 427	18 19	<8 <8	149 153
UT-1	66	0.207 0.180	2.60 2.50	20 10	1.20 1.30	54.6 49.2	58.2 53.6	3.30 3.40	361 452	25 22	<8 <8	143 120

* graphite furnace results

TABLE 20: SEDIMENT CHLOROPHENOLS, JULY 27, 1988

STATION	DEPTH (m)	CHLOROPHENOLS (μg/g, dry wt.)							
		234-tri	235-tri	236-tri	245-tri	246-tri	2345-tetra	2346+2356 -tetra	penta
1	12	<0.0005 <0.0005	<0.0005 <0.0005	0.0039 0.0030	<0.0005 <0.0005	<0.0005 <0.0005	0.0239 0.0229	0.0180 0.0173	0.0023 0.0018
2	14	<0.0005 <0.0005	<0.0005 <0.0005	0.0026 0.0014	<0.0005 <0.0005	<0.0005 <0.0005	0.0036 0.0035	0.0061 0.0065	<0.0001 0.0008
3	19	<0.0005 <0.0005	<0.0005 <0.0005	0.0016 0.0019	<0.0005 <0.0005	<0.0005 <0.0005	0.0036 0.0049	0.0089 0.0118	0.0006 0.0018
13	19	<0.0005 <0.0005	<0.0005 <0.0005	0.0012 0.0006	<0.0005 <0.0005	<0.0005 <0.0005	0.0070 0.0020	0.0147 0.0056	<0.0001 <0.0001
14	11	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0002 <0.0002	<0.0002 <0.0002	<0.0001 <0.0001
11	21	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	0.0185 0.0388	0.0168 0.0137	0.0012 <0.0001
5	25	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0005 <0.0005	<0.0002 <0.0002	0.0018 0.0016	<0.0001 <0.0001

3.3 Biota Quality

Results of biota sampling in Alberni Inlet and the reference site at Uchucklesit Inlet are summarized in Tables 21 to 24. Most metal levels were similar when species were compared. The 1988 data indicate that metal values had a coefficient of variability (CV) of 8% to approximately 70%. All chlorophenolic compounds were near the limit of detection in all species and tissues analyzed. Polychlorinated biphenyls were detected in ratfish liver (3-11 $\mu g/g$) from Alberni Harbour, and in trace amounts (<2.0 $\mu g/g$) in crab and prawn hepatopancreas from the reference site.

Only ratfish (*Hydrolagus collei*) liver was analyzed each year. The concentration of metals in ratfish liver declined from 1984 to 1988, except for lead which was inconclusive due to varying lab detection limits. Trends were not corrected for laboratory differences.

TABLE 21: MEAN METAL LEVELS IN TISSUE COLLECTED SEPTEMBER 11, 1984

SPECIES	TISSUE	N	MEAN METAL LEVELS (μg/g, dry wt.)								
			Al	As	Ba	Cd	Cr	Cu	Hg	Pb	Zn
English sole	muscle	2	7.0	28.5	0.11	0.05	0.54	1.10	0.15	0.34	17.85
	liver	2	16.0	7.0	0.11	0.40	0.40	4.21	0.08	0.71	64.90
Slender sole	muscle	3	7.7	38.7	0.08	0.05	0.57	0.90	0.42	0.32	15.93
Pacific hake	muscle	5	8.2	7.2	0.08	0.04	0.78	1.44	0.45	0.32	14.78
	gill	3	525.0	6.3	1.26	0.13	2.33	7.13	0.27	0.60	86.50
	liver	5	19.6	11.6	0.10	0.23	0.40	12.44	0.11	0.36	72.68
Ratfish	muscle	5	11.6	38.8	0.09	0.04	0.52	1.10	0.56	0.25	12.26
	gill	5	67.2	14.4	0.12	0.06	0.86	5.94	0.14	0.26	45.62
	liver	5	7.2	20.6	0.09	0.13	0.40	10.54	0.09	0.18	14.84

Species

English sole (*Parophrys vetulus*)
Slender sole (*Lyopsetta exilis*)
Pacific hake (*Merluccius productus*)
Ratfish (*Hydrolagus collei*)

TABLE 22: METAL LEVELS IN TISSUES COLLECTED AUGUST 27, 1986

SPECIES	WEIGHT (g)	LENGTH (cm)	TOTAL METALS (µg/g, dry wt.)											
			TISSUE	Hg	Al	As	Cd*	Cr	Cu	Fe	Mg	Ni	Pb	Zn
Ratfish	654	50	Muscle	0.43	<4	18	0.480	1.1	0.6	17.1	1300	<2	<2	14.9
			Liver	0.03	-	8	0.470	<0.4	8.1	739	75	<2	<2	6.7
	737	54	Muscle	0.42	10	31	0.025	0.6	0.5	30.8	1270	<2	<2	80.2
			Liver	0.04	6	7	0.021	<0.4	5.5	451	61	<2	<2	5.6
	761	54	Muscle	0.69	14	31	0.027	1.1	<0.4	26.3	1310	<2	<2	79.5
			Liver	0.09	<4	19	0.100	0.6	14.1	1000	146	<2	<2	16.2
Pacific hake	133	27	Liver	0.57	25	6	0.032	1.4	1.4	63.2	1790	<2	<2	17.8
	256	30	Muscle	1.20	28	4	0.048	1.7	0.5	69.4	17	<2	<2	18.1
			Liver	0.24	9	<4	0.110	0.6	5.7	217	183	<2	<2	72.0

* Graphite furnace method

TABLE 23: METAL LEVELS IN TISSUES COLLECTED JULY 26, 1988

LOCATION	SPECIES	TISSUE	TOTAL METALS (μg/g, dry wt)										
			Hg	Al	As	Cd*	Cr	Cu	Fe %	Mg	Ni	Pb	Zn
ALBERNI HARBOUR													
AT-1	Ratfish	Liver	0.02	<4	9	0.01	<0.4	5.8	2.46	30	7	<4	6.8
	Ratfish	Liver	0.01	<4	8	0.01	<0.4	3.0	2.39	30	5	<4	5.1
	Ratfish	Liver	0.05	<4	11	0.03	<0.4	3.9	8.73	50	<2	<4	4.7
MEAN			0.03	<4	9	0.02	<0.4	4.2	4.53	37	5	<4	5.5
CV (%)			69.20	0	16	69.30	0	33.8	8.04	32	54	0	20.2
REFERENCE AREA													
UT-1	Hake	Liver	0.02	12	9	0.16	<0.4	14.9	1.13	370	<2	<4	53.5

* Graphite furnace method

TABLE 24: ALBERNI HARBOUR TISSUE CHEMISTRY RESULTS, JULY 1988

SITE	SPECIES	TISSUE	PCBs (μg/g)	CHLOROANISOLES (μg/g)			CHLOROPHENOLS (μg/g)							
				2,3,4,5-TETRA	2346+56-TETRA	PENTA	2,3,4,5-TETRA	2,3,4-TRI	2,3,5-TRI	2,3,6-TRI	2,4,5-TRI	2,4,6-TRI	2346+2356-TETRA	PENTA
ALBERNI HARBOUR														
AT-1	Ratfish	Liver	6	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	<0.01
	Ratfish	Liver	3	<0.02	<0.02	<0.01	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.02	<0.01
	Ratfish	Liver	11	<0.02	<0.02	<0.01	<0.2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.2	<0.1
REFERENCE AREA														
UT-1	Dungeness Crab	Hepato	0.18	<0.0002	0.0002	0.0021	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0002	0.0023
	Prawn	Hepato	0.1	<0.0002	0.0004	<0.0001	<0.0002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0002	0.0004

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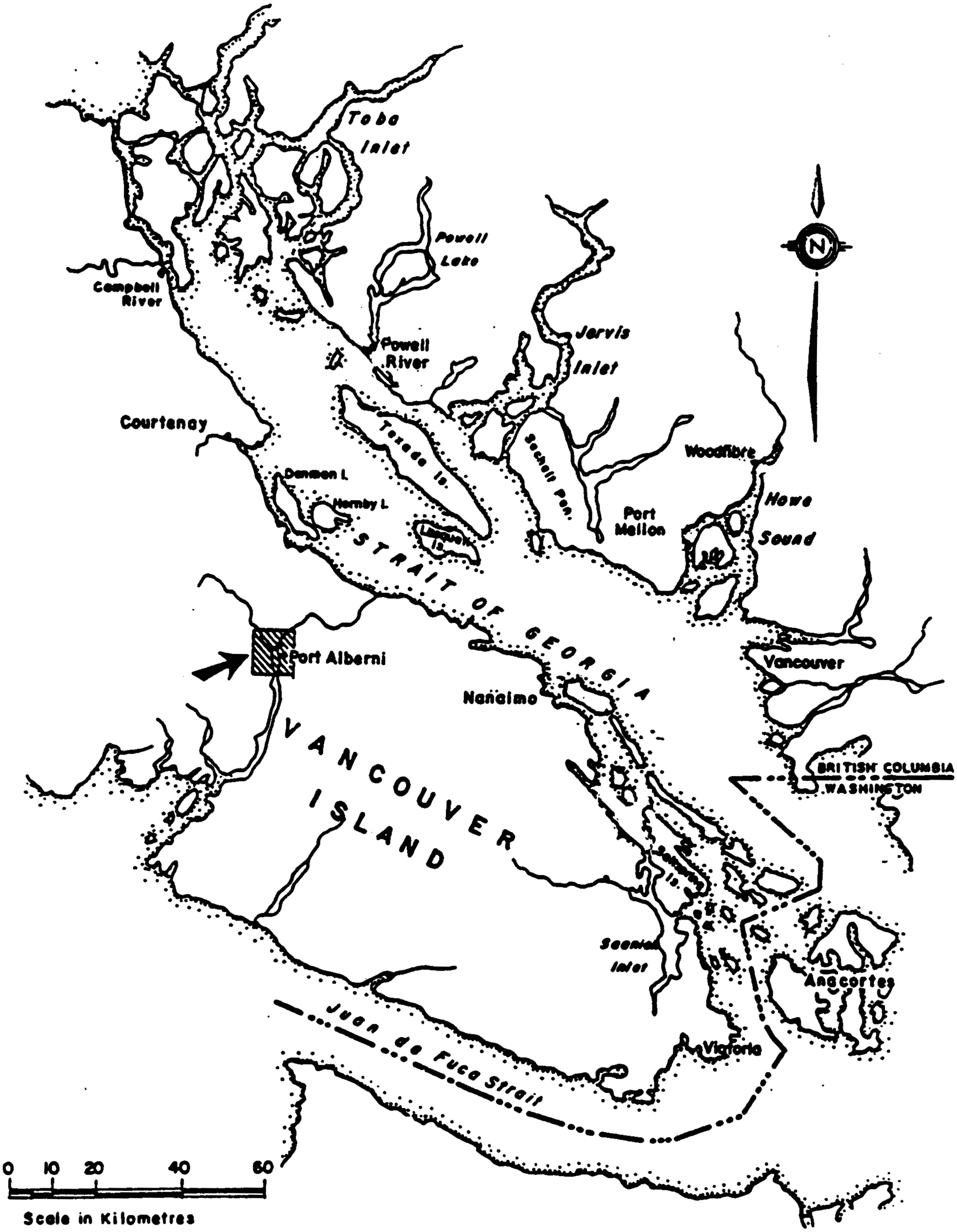
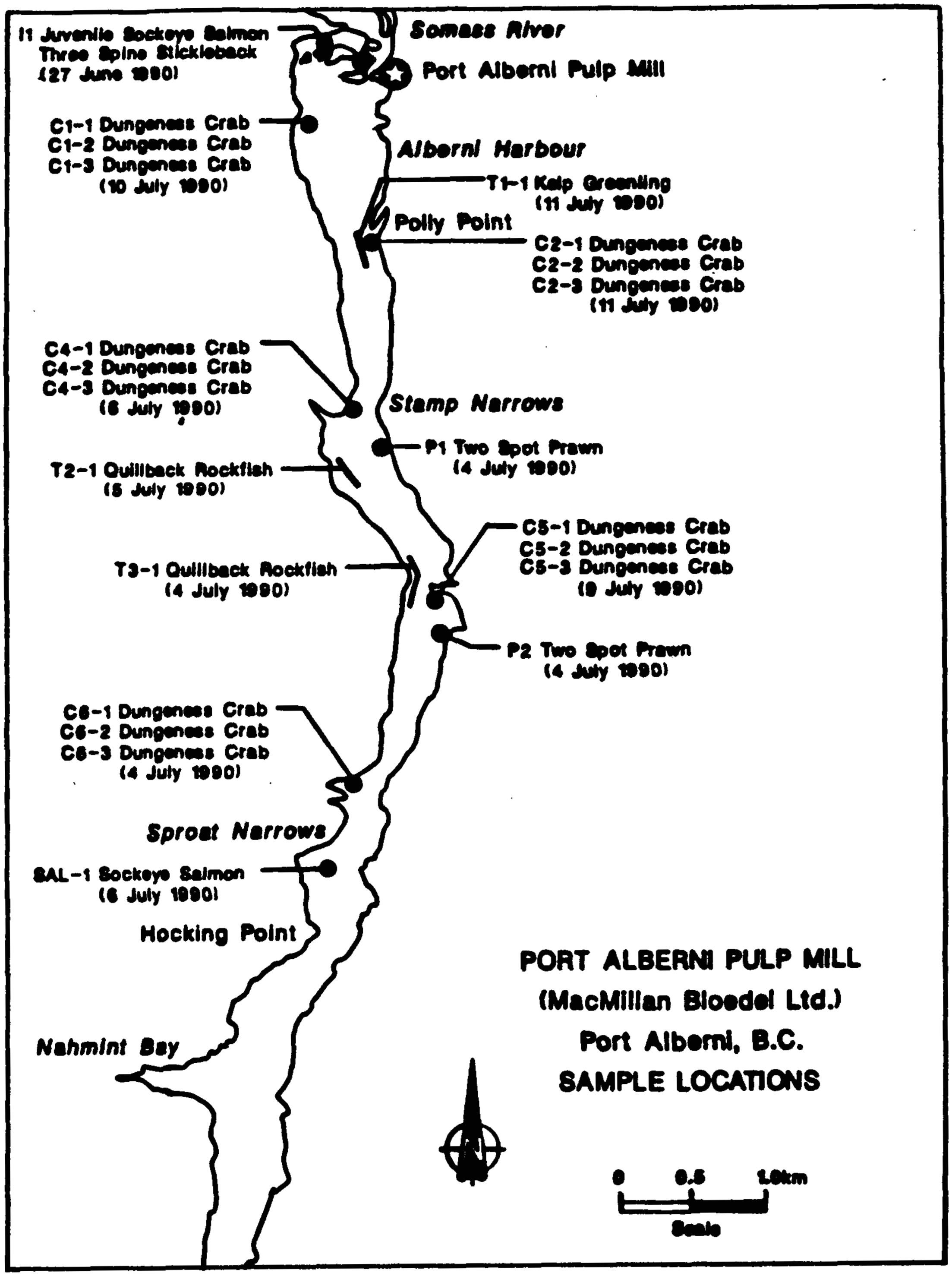


FIGURE 1: LOCATION MAP - PORT ALBERNI



<u>FIGURE 2</u>: PORT ALBERNI DIOXIN SAMPLING SITES, 1990

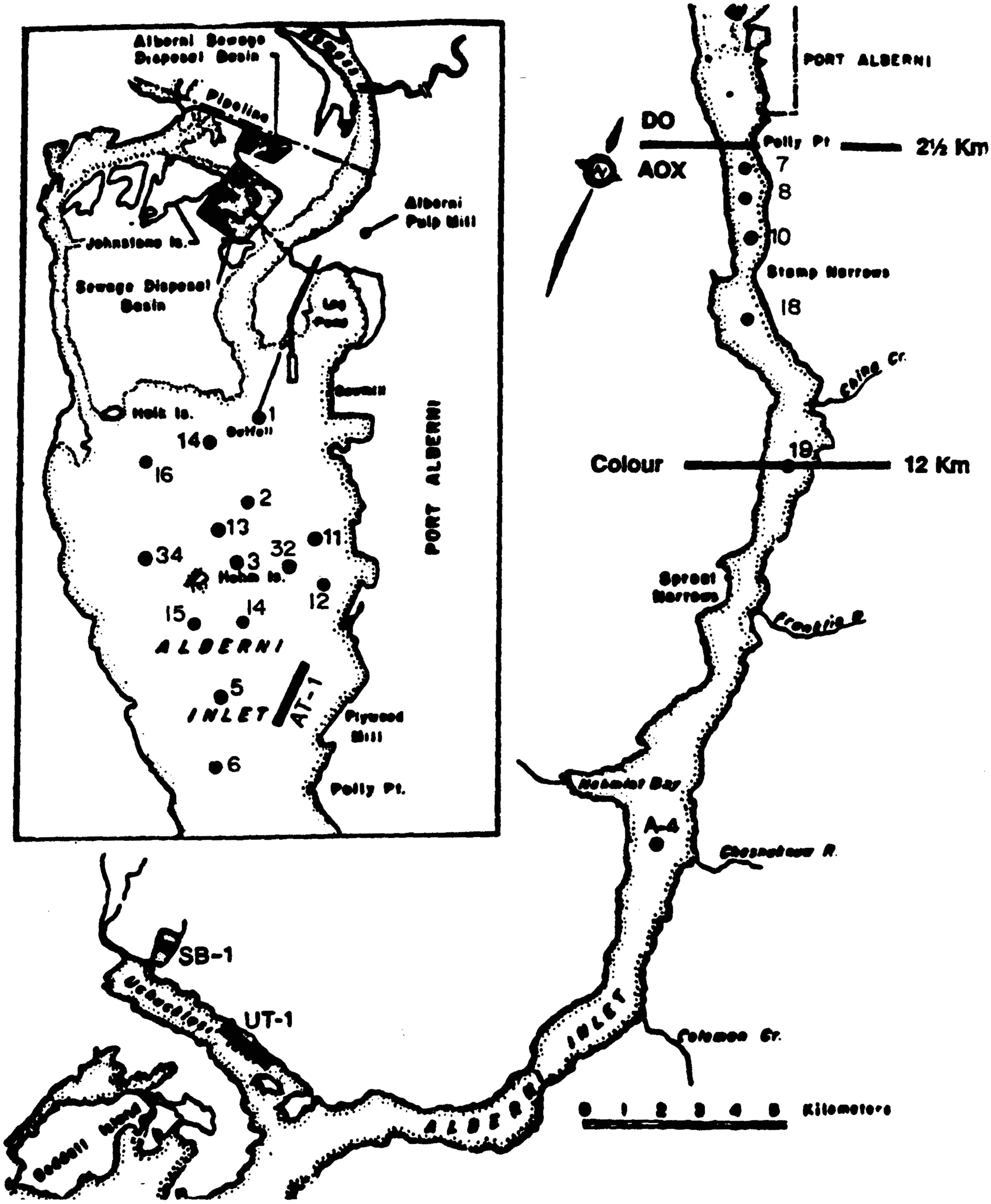


FIGURE 3: PORT ALBERNI SAMPLE SITES, 1988

APPENDICES

APPENDIX I: PACIFIC REGION PULP AND PAPER INDUSTRY EFFLUENT SUMMARY

Company: MacMillan Bloedel Limited
Mill: Alberni
Location: Pt. Alberni

Year: 1987

	===FLOW===		=PRODUCTION=		===TSS (FED)===			==TSS (PROV)==		===BOD5 (FED)===			==BOD5 (PROV)==		==TOXICITY (PROV)==	
	Aver. (m3/d)	# of Days	Av. (ADt/d)	# of days	Av. (kg/ADt)	# of Tests	% Comp.	Av. (tonne/d)	# of Tests	Av. (kg/ADt)	# of Tests	% Comp.	Av. (tonne/d)	# of Tests	# of Tests	% Comp.
Yearly Values	168,430	364	1,294	359	7.98	363	90%*	10.31	363	7.65	49	100%	9.39	49	5	80%

EFFLUENT QUALITY REQUIREMENTS

	FLOW (m3/d)	TSS	BOD5	TOXICITY (%v/v)
Federal (kg/ADt)	---	11.40	23.70	96LC20 = 65
Provincial (tonne/d)	209,000	14.50	14.50	96LC50 = 80

* The suspended solids data for this mill reflects sampling at a site which cannot be used to assess compliance with PPER

APPENDIX II: RESULTS FOR PORT ALBERNI PULP MILL EFFLUENT MONITORING, JUNE 14, 1990

PARAMETER	UNITS	
CHLOROANISOLE/2,3,4,5-TETRA	µg/L	<0.005
/2346+56-TETRA	µg/L	0.022
/PENTA	µg/L	0.016
CHLOROPHENOL/2,3,4,5-TETRA	µg/L	<0.005
/2,3,4-TRI	µg/L	<0.01
/2,3,5-TRI	µg/L	<0.01
/2,3,6-TRI	µg/L	0.05
/2,4,5-TRI	µg/L	<0.01
/2,4,6-TRI	µg/L	1.21
/2346+2356-TETRA	µg/L	0.050
/PENTA	µg/L	0.300
RESIN ACID/12-CHLORO-DHA	mg/L	<0.005
/14-CHLORO-DHA	mg/L	<0.005
/8(14)ABIETIC	mg/L	<0.005
/ABIETIC	mg/L	<0.005
/DEHYDROABIETIC (DHA)	mg/L	<0.005
/DICHLORO-DHA	mg/L	<0.005
/DIHYROISOPIMARIC	mg/L	<0.005
/ISOPIMARIC	mg/L	<0.005
/NEOABIETIC	mg/L	<0.005
/PALUSTRIC	mg/L	<0.005
/PIMARIC	mg/L	<0.005
/SANDARACOPIMARIC	mg/L	<0.005

APPENDIX III: ALBERNI INLET SAMPLING STATION LOCATIONS, SEPTEMBER 11 & 12, 1984

STATION	LATITUDE	LONGITUDE
1	49°14.27'N	124°49.10'W
2	49°14.00'N	124°49.20'W
3	49°13.72'N	124°49.27'W
4	49°13.50'N	124°49.35'W
5	49°13.27'N	124°49.40'W
6	49°13.01'N	124°49.40'W
7	49°12.68'N	124°49.15'W
8	49°12.20'N	124°49.05'W
10	49°11.80'N	124°49.05'W
11	49°13.83'N	124°48.88'W
12	49°13.58'N	124°48.87'W
14	49°14.48'N	124°49.33'W
15	49°13.60'N	124°49.60'W
16	49°14.10'N	124°49.80'W
18	49°10.50'N	124°48.92'W
19	49°08.27'N	124°48.25'W
TRAWL T-1		
START	49°13.10'N	124°49.18'W
FINISH	49°13.38'N	124°49.02'W

APPENDIX IV: ALBERNI INLET SAMPLING STATION LOCATIONS, AUGUST 27, 1986

STATION	LATITUDE	LONGITUDE
1	49°14.27'N	124°49.10'W
3	49°13.72'N	124°49.27'W
4	49°13.50'N	124°49.35'W
5	49°13.27'N	124°49.40'W
6	49°13.01'N	124°49.40'W
7	49°12.68'N	124°49.15'W
8	49°12.20'N	124°49.05'W
10	49°11.80'N	124°49.05'W
11	49°13.83'N	124°48.88'W
12	49°13.58'N	124°48.87'W
13	49°13.84'N	124°49.30'W
15	49°13.60'N	124°49.60'W
16	49°14.10'N	124°49.80'W
18	49°10.50'N	124°48.92'W
19	49°08.27'N	124°48.25'W
TRAWL		
START	49°13.14'N	124°49.20'W
FINISH	49°13.49'N	124°48.95'W
INTERTIDAL STATIONS		
Polly Point	49°12.98'N	124°48.95'W
N. of Katherine Point	49°13.48'N	124°48.76'W
Mill mud flats	49°14.70'N	124°48.76'W
Lupsi Cupsi Point	49°13.68'N	124°49.07'W
Hohm Island	49°13.68'N	124°49.46'W
Hoik Island	49°14.22'N	124°49.94'W
Stamp Point	49°12.82'N	124°49.59'W

APPENDIX V: **ALBERNI INLET SAMPLING STATION LOCATIONS, JULY 26-28, 1988**

STATION	LATITUDE	LONGITUDE
1	49°14.18'N	124°49.10'W
2	49°14.00'N	124°49.20'W
3	49°13.72'N	124°49.27'W
4	49°13.50'N	124°49.35'W
5	49°13.27'N	124°49.40'W
10	49°11.80'N	124°49.05'W
11	49°13.83'N	124°48.88'W
12	49°13.58'N	124°48.87'W
13	49°13.84'N	124°49.30'W
14	49°14.18'N	124°49.33'W
15	49°13.60'N	124°49.60'W
19	49°08.27'N	124°48.25'W
32	49°13.10'N	124°49.18'W
A-4	49°02.70'N	124°51.10'W
SB-1	49°01.43'N	125 01.60'W
TRAWL UT-1		
START	49°00.13'N	125 00.47'W
FINISH	48 59.83'N	125 59.83'N
INTERTIDAL STATIONS		
Polly Point	49°12.98'N	124°48.95'W
N. of Katherine Point	49°13.48'N	124°48.76'W
Lupsi Cupsi Point	49°14.78'N	124°49.07'W
Holk Island	49°14.22'N	124°49.94'W
Holm Island	49°13.68'N	124°49.46'W
S. of Stamp Point	49°12.82'N	124°49.59'W

APPENDIX VI: ALBERNI INLET SAMPLING STATION LOCATIONS, AUGUST 13, 1990

STATION	LATITUDE	LONGITUDE
3	49°13.66'N	124°49.22'W
4	49°13.54'N	124°49.32'W
5	49°13.15'N	124°49.24'W
10	49°10.26'N	124°48.80'W
19	49°08.83'N	124°48.88'W
A-4	49°02.65'N	124°51.14'W
UT-1	49°02.10'N	125 05.90'W
SB-1	49°01.51'N	125 01.71'W