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Department of Environment Environmental Protection Service Pacific Region

PISCES IV Submersible Dives 1973 - 1982

Regional Programme Report: 83-20

Compiled by L. Petrie and N. Holman

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ENVIRONMENT CANADA CONSERVATION AND PROTECTION PACIFIC REGION

Abstract

The Environmental Protection Service has employed the PISCES IV three-man submersible since 1973 to visually determine the condition of the benthic habitat in the coastal water of British Columbia affected by some of the major industry sectors (ie. Pulp mills, municipal discharge areas, mine and quarrie sites, and ocean dumpsites).

This report catalogues all the existing information obtained on 128 dives (ie. observations, photographs, film clips, etc.) up to 1982.

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Résumé

Depuis 1973, le Service de la protection de l'environnement emploit le submersible PISCES IV pour l'inspection visuelle de fond benthique des eaux littorales de Colombie Britannique, qui est affecté par quelques-uns des secteurs industriels les plus importants (ie. usines de pâte à papier, sites de décharges municipales, sites de mines et de carrières, et zones de déversement).

Tous les renseignments existants obtenus lors de 128 plongées (ie. les observations, les photos, les films, etc.) effectuées jusqu'en 1982 sont inclus dans ce rapport.

TABLE OF CONTENTS

Page Abstract i ii Resume Table of Contents iii List of Figures iv List of Appendices viii 1 1. Introduction 2 2. Methods Dive Reports 3. 3.1 3 Municipal Discharge 3.2 Pulp Mills 50 3.3 Mines, Smelters, and Quarries 126 Ocean Dumpsites 3.4 211 References 308

LIST OF FIGURES

Figure Page 3 1 Location of Municipal Discharge Sites 2 PISCES Dive Tracks, Five Finger Island Sewage Outfall (1976) 6 3 PISCES Dive Track off Cape Lazo (1976) 8 PISCES Dive Track, Strait of Georgia (off 4 Five Finger Island) 1976 10 5 PISCES Dive Tracks, Five Finger Island Outfall (1978 and 1980) 14 6 PISCES Dive Track, French Creek Sewage Outfall (1978)18 7 PISCES Dive Tracks, Cape Lazo (1978) 27 8 PISCES Dive Track, Macaulay Point Sewage Outfall (1979) 34 9 PISCES Dive Tracks, Sechelt (1979) 41 10 PISCES Dive Track, French Creek Sewage Outfall (1980) 43 11 PISCES Dive Track, Victoria (Macaulay Point) 46 (1980)12 PISCES Dive Track, Victoria (Clover Point) 49 1980 Location of Coastal Pulpmills 13 50 14 PISCES Dive Tracks, Squamish Harbour (1976) 53 PISCES Dive Track, Northumberland Channel 15 (off Harmac Pulp Mill) 1976 56 16 PISCES Dive Track, Cousins Inlet (1976) 60 PISCES Dive Track, Ocean Falls (1976) 17 61 18 PISCES Dive Track, Chatham Sound (1976) 63

Figure

19	PISCES Dive Track, Chatham Sound (Prince Rupert) 1976	65
20	PISCES Dive Track, Satellite Channel (Chemainus)' 1977	68
21	PISCES Dive Track, Alberni Inlet (1977)	71
22	PISCES IV Dive Track Locations, Muchalat Inlet (1977)	75
23	PISCES Dive Track, Tahsis Inlet (1977)	78
24	PISCES Dive Track, Tahsis Inlet (1977)	81
25	PISCES Dive Tracks, Stuart Channel (Crofton Pulpmill) 1978	86
26	PISCES Dive Track, Northumberland Channel (Harmac) 1978	90
27	PISCES Dive Track, Northumberland Channel (Harmac) 1978	94
28	PISCES Dive Track, Powell River (1978)	99
29	PISCES Dive Track(s), Northumberland Channel (Harmac) 1979	106
30	PISCES Dive Tracks, Woodfibre (1979)	109
31	PISCES Dive Track, Powell River Pulpmill (1980)	111
32	PISCES Dive Track, Nanaimo (Harmac) 1980	113
33	PISCES Dive Track, Crofton Pulpmill (1980)	115
34	PISCES Dive Tracks, Port Mellon (1981)	120
35	Dive Tracks and Fibre Bed Extent (Harmac, 25, 26 February, 1981)	125
36	Location of Coastal Mining Sites	126
37	PISCES Dive Tracks, Quatsino Sound (1975)	136
38	PISCES Dive Tracks, Howe Sound 1976	152
39	PISCES Dive Tracks, Bute Inlet (1976)	159

Figure

.

40	PISCES Dive Track, off Texada Mine (1976)	160
41	PISCES IV Dive Tracks, Kitimat Smelter (1976)	163
42	PISCES Dive Tracks - Alice Arm, Hastings Arm, and Observatory Inlet (1976)	179
43	PISCES Dive Tracks, Howe Sound (1978)	184
44	PISCES Dive Track, Howe Sound (Porteau Cove) 1978	187
45	PISCES Dive Track, Howe Sound (1978)	191
46	PISCES Dive Tracks, Howe Sound (1978)	192
47	PISCES IV Submarine Dive Sites - Alice Arm and Hastings Arm - July 1982	210
48	Location of Ocean Dumpsites	211
49	PISCES Dive Tracks at Point Grey Dumpsite (1976 and 1978)	215
50	PISCES Dive Tracks, Port Mellon Dumpsite (1976)	217
51	PISCES Dive Track, Port Mellon Dumpsite (1976)	219
52	PISCES Dive Track, Malaspina Strait (1976) Proposed dumpsite	223
53	PISCES Dive Track, North of Powell River (1976)	225
54	PISCES Dive Track, Strait of Georgia (off Nanaimo Harbour) 1976	228
55	PISCES Dive Tracks, Ocean Dumpsite off Porlier Pass (1976)	230
56	PISCES Dive Track, Ocean Dumpsite off Porlier Pass (1976)	233
57	PISCES Dive Track, Stuart Channel Dumpsite (1976)	236

Figure

58	PISCES Dive Track, Stuart Channel (Osborn Bay) Dumpsite (1976)	237
59	PISCES Dive Track, Saanich Inlet off Mill Bay (1977). Potential dumpsite	239
60	PISCES Dive Track, Alberni Inlet Dumpsite (1977)	242
61	PISCES Dive Track, Zeballos Inlet Dumpsite (1977)	249
62	PISCES Dive Track, Zeballos Inlet Dumpsite (1977)	252
63	PISCES Dive Track, Quatsino Sound Ocean Dumpsite (1977)	256
64	PISCES Dive Track, Nanaimo Dumpsite (1978)	260
65	PISCES Dive Track, Quarantine Buoy (Pre 1977 Dumpsite) 1979	283
66	PISCES Dive Track, Victoria (Quarantine Buoy 1977 Dumpsite) 1979	287
67	PISCES Dive Track, Victoria (off Quarantine Buoy Dumpsite) 1979	289
68	PISCES Dive Track, Quarantine Buoy (1978 Dumpsite) 1979	291
69	PISCES Dive Track, Victoria (off Quarantine Buoy Dumpsite) 1979	293
70	PISCES Dive Track, Victoria (Constance Bank) 1979	295
71	PISCES Dive Track, Malaspina Strait (1980) Proposed dumpsite	298
72	PISCES Dive Track, Johnstone Strait (1980) Proposed dumpsite	301
73	PISCES Dive Track, Kelsey Bay (1980)	304
74	PISCES Dive Track, Ccean Dumpsite off Porlier Pass (1980)	307

Page

- viii -

LIST OF APPENDICES

		Page
Appendix I	Reference table of PISCES IV Dives 1973-1982	309
Appendix II	Representative Photographs from PISCES IV Dives	315

1. Introduction

The coastal waters of British Columbia receive effluents from several industrial sectors, the largest contributors being pulpmills, mines, and municipal sewage plants. Certain locations along the coast have been designated as ocean dumpsites under the Ocean Dumping Control Act, and receive materials such as dredge spoil, woodwastes, etc.

The PISCES IV three man submersible has been employed by the Environmental Protection Service since 1973 to visually inspect the benthic impact in affected areas. In most cases the PISCES provides a more complete picture of the nature of benthic impact which cannot be obtained by surface deployed samplers alone (Pomeroy 1982). In various pulpmill survey dives it has been shown that "the surface of the deposits are so unconsolidated that they are not effectively sampled by grabs, etc." (Pomeroy 1982:2)

During most of the PISCES survey dives observations as well as photographs and 16 mm films have been taken and will be documented in this report as they apply to each industry sector under study. The PISCES is capable of specific sampling; ie. obtaining small core samples of the benthos and collecting hard objects such as rocks, shells, and clams for closer observation; as well as performing depth checks of fine benthic sediments. To date, however, such sampling procedures have only been employed in pulpmill related studies to determine the components of the deposit surfaces and will therefore not be presented in this report.

The PISCES IV is a qualitative assessment tool which has been found to be a valuable supplement to quantitative sampling methods. Often observations of relative abundances of various species noted with the PISCES IV correspond closely to otter trawl data. With the PISCES IV the zone of impact associated with various industrial activities can be determined with a minimal amount of time and effort.

2. Methods

The PISCES IV, a three man submersible operated by the Department of Fisheries and Oceans, was used to visually assess the physical condition of the benthos in areas of industrial activity on the B.C. coast. Where possible, written records of substrate type, degree of impact, and relative abundances of macrofauna were made. On all dives, photographs were taken with a Bolex 16 mm movie camera (Tungsten Ektachrome EP 7242, ASA 125 film) and a Hasselblad 70 mm still camera (Kodak Aerocolour Negative 2445 film). Reference film files were prepared following each survey to provide ready access for future reference.¹

¹ For available films please contact N. Holman

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3.1 MUNICIPAL DISCHARGE

.



Location:	Five Fing	er Island		Date:	January 1976
Dive No.:	382 (tra	ck 1 & 2) (Fig	. 2)		
Observers:	N. Holman	, G. Packman			
Position:		Start	Tur	<u>n</u>	Finish
	track 1	49 ⁰ 13.60'N	49 ⁰ 14	.08'N	49 ⁰ 14.25'N
		124 ⁰ 56.30'W	124 ⁰ 56	.72'W	124 ⁰ 56.04'W
	track 2	49 ⁰ 14.70'N 123 ⁰ 56.30'W	49 ⁰ 14.18'N 123 ⁰ 56.46'W	49 ⁰ 14.2'N 123 ⁰ 56.2'W	49 ⁰ 14.23'N 123 ⁰ 55.48'W

Depth: 160m

<u>Note</u> : No report available.

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Location:	Five Fing	er Island	
Dive No.:	382 (trad	ck3) (Fig. 2)	
Observer:	V. Bradsha	aw	
Position:		Start	Finish
		49 ⁰ 14.2 'N	49 ⁰ 14.05'N
		123 ⁰ 55.48'W	123 ⁰ 55.03'W

- Depth: 160m
- Note: No report available.





- 7 -

Location:	Cape Lazo		Date
Dive No.:	472 (Fig.3)		
Observer:	V. Bradshaw		
Position:	<u>Start</u>	Finish	
	49 ⁰ 43.05'	N 49 ⁰ 43.25'N	
	124 ⁰ 48.0 '	W 124 ⁰ 46.8 'W	

Depth: 220m

Note: No report available.

Date: 31 August 1976



Location:	Strait of Ge (off Five Fi	orgia nger Island)	Date:	1 September 1976
Dive No.:	474 (Track	5) (Fig. 4)		
Observer:	V. Bradshaw			
Position:		<u>Start</u>	Turn	<u>Finish</u>
		49 ⁰ 14.24'N	49 ⁰ 14.31'N	49 ⁰ 14.52'N
	1	23 ⁰ 53.68'W	123 ⁰ 53.40'W	123 ⁰ 53.53'W
Depth: 25	Om			
Visibility	: 6 - 10m			

Bottom Characteristics: hard packed clay, a rock face dropping 20m was discovered.

Current: approximately 0.9 km/hr - 1.0 km/hr

Benthic Fauna

The benthic fauna may be divided into 2 discrete groups associated to the differing bottom characteristics (i.e., mud bottom and rock face).

Mud Bottom

On the mud bottom were observed calcareous sponges (<u>Aphrocallistes</u>, sp. and <u>Rhabdocallistes</u> sp.), burrowing sea anemones (<u>Pachycerianthus</u> sp.), brittle starfish (<u>Ophuira</u> sp., <u>Ophiopholus</u> sp.) in concentrations of approximately 20 per square meter, starfish (<u>Pseudarchaster parelii alascensis</u>), bathypelagic shrimp (<u>Pasiphea pacifica</u>), prawns (<u>Pandalus platyceros</u>), pink shrimp (<u>P</u>. <u>borealis</u>), a number of Cyclopteridae and a couple of Pacific ocean perch (<u>Sebastes alutus</u>).

Rock Face

The rock face was characterized by reddish branching sponges, bryozoans, cup corals and scattered squat lobsters (<u>Munida quadraspina</u>).

Summary

On the whole this area may be described as typical of the Strait of Georgia with observations concurrent with those of previous PISCES work and drawling and benthic grab activities.



- 10 -

- 11 -PISCES IV DIVE RECORD

Location:	Five Finger Island			13 April 1978		
Dive No.:	648 (Fig. 5)					
Observers:	G. Packman, N. Ho	lman				
Position:	<u>Start</u>	Turn	Turn	<u>Finish</u>		
	49 ⁰ 14.24'N 123 ⁰ 56 69'W	49 ⁰ 14.17'N 123 ⁰ 56 63'W	49 ⁰ 14.23'N 123 ⁰ 56 25'W	49 ⁰ 14.38'N 123 ⁰ 56.05'W		
	123 JU.03 W	123 JU.US W	123 30.23 W	123 30.03 W		

Depth: 142m

Watercolumn

Both descending and ascending through the watercolumn revealed very little phytoplankton or zooplankton above 80m. The photic zone was observed to extend at least as far down as 80m. The number of euphausids increased markedly below the photic zone and continued to increase, being joined by copepods, amphipods, and chaetagnaths as the bottom was approached. In the vicinity of the bottom, dense concentrations of bathypelagic amphipods were apparent. While sitting on the bottom, thousands of amphipods congregated in the light pool from Pisces's main lights.

Throughout the water column there was no evidence of turbidity at all. Light from the surface was observed to extend to the bottom at the diffuser. There was no visually apparent increase in turbidity of plankton concentration during the ascent from the diffuser as compared with the initial descent.

CTD Data

	Temperature	<u>Conductivity</u>	Dissolved Oxygen
Surface	13.00 ^Ô C	31.18m mhos/cm	8.86 mg/l
Bottom (on descent)	8.07 ⁰ C	33.50m mhos/cm	8.97 mg/1
Bottom (at diffuser)	9.70 ⁰ C	32.30m mhos/cm	8.03 mg/1

Bottom Characteristics

At the position of initial descent to the bottom it was observed to be gravelly and rocky with a covering of detritus. The depth at this point was 142m. These characteristics are felt to be typical of the entire area of discharge pipe and persisted throughout the dive. A cliff was, however, discovered while proceeding from the drop location to the outfall pipe. The cliff was approximately 7 - 10m in height and composed of rock. The depth at the top of the cliff was 112m with the substrate being very rocky and having no overlying sediment layer.

The substrate in the immediate vicinity of the sewage diffuser varied between sand and gravel. There was no apparent accumulation of organic material opposite the ports.

Biological Observations

Upon initial arrival at the bottom, a dogfish (<u>Squalus canthisa</u>), a number of ratfish (<u>Hydrologus colliei</u>) and a starfish (<u>Henricia sp.</u>), were observed. Also observed along the flat bottom were living and dead sponges (<u>Aphrocallistes</u> sp.), squat lobsters (<u>Munida quadrispina</u>), prawns (<u>Pandulus platyceros</u>), shrimp (Pandalus sp.), hermit crabs (Pagurus sp.), Brachiopoda, and sculpins (Cottidae).

After running along the bottom for a short period of time a rocky cliff was encountered. Fauna inhabiting this rocky area included a large number of siliceous sponges (<u>Aphrocallistes</u> sp. and <u>Chonelasma calyx</u>), sea anemones (<u>Metridium senile</u> and <u>Stomphia</u> sp.), an unidentified starfish (Asteroidae), calcareous tubiculous polychaetes and a decorator crab (<u>Oregonia gracilis</u>).

After ascending the cliff the bottom composition changed again to what it had been at the commencement of the dive. Shortly thereafter the pipe was located. A variety of fauna was observed in the vicinity of the pipe. These forms included sea anemones (<u>Stomphia</u> sp.), starfish (<u>Ceramaster patagonicus</u>), skillfish (Erilepis zonifer), and lemon sole (Parophrys vetulus).

The number of fish increased as the diffuser was approached with lingcod, rockfish and pricklebacks being the dominant types. At any given time, up to ten or more lingcod were visible at the outer edge of the pool of light from the PISCES IV.

The Effluent Diffuser

The effluent diffuser is constructed in a Y share. Dams were apparent on each arm and on an extension of the main pipe. These would require a diver to open and close them. A large concrete block was observed directly out from the end of the main diffuser pipe and this was assumed to have been the base from which the pipe was pulled out from shore. It was noted that there was no effluent being discharged from the last eleven ports on each arm.

Diffuser Impact

The most notable observation made in connection with the diffuser was the apparent lack of accumulation of organic material on the bottom adjacent to the ports. There was also very little in the way of non-degradable material around the ports. Some non-degradable material had collected around the end of the centre pipe. This had presumably been deposited before primary treatment had begun.

The effluent was observed to be a grey suspension which rose straight up from ports, diffusing rapidly to the point where it could no longer be seen. In a number of cases sea anemones were observed attached on the upper side of the ports just out of the effluent stream. Fish (lingcod, rockfish and pricklebacks) were also observed in great numbers around the diffuser, staying just out of the effluent stream.

The fauna in the vicinity of the diffuser appeared healthy and was the most abundant that we have ever seen from Pisces IV in terms of fish. It would be advisable, however, to monitor these fish for heavy metal and PCB contamination which may stem from the discharge. This may best be accomplished by means of hand-lining for fish and prawn trapping for invertebrates.



- 15 -PISCES IV DIVE RECORD

Location:	French Creek		Date:	16	April	1978
Dive No.:	652 (Fig. 6)					
Observers:	G. Packman, N. Holman, D. H	Brothers				
Position:	Start	<u>Finish</u>				
	49 ⁰ 21.2'N	49 ⁰ 22.0'N				
	124°20.2'W	124°21.2'W				

Depth: 55m

Watercolumn

The watercolumn was fairly clear throughout with little or no phytoplankton, zooplankton or detritus present. The only notable zooplankton group present was pelagic amphipods. The visibility on the bottom at 55m was approximately 12 metres.

Bottom Characteristics

The bottom was firm being composed of sand and mud. As the pipe was approached some gravelly patches were observed as well as some hummocks near the French Creek marina breakwater. The bottom at the diffuser end was sandy and firm.

Bottom Fauna

The most notable feature of the bottom fauna was the uniform distribution of small sea whips.

The remaining fauna was also evenly distributed and included those outlined in the following table.

	- 16 -		
PHYLUM	TAXON	COMMON NAME	RELATIVE ABUNDANCE (1-10)
Cnidaria	<u>Ptilosarcus</u> gurneyi	Sea pen Sea whip	1 10
	<u>Pachycerianthus</u> fimbriatus	Burrowing sea anemone	Beginning of Dive - 1
			Just before pipe located 10(1-2/m ²)
Mollusca	Archidoris ohdneri	Nudibranch	1
	Dirona albolineata		2
	Gastropod eggs		1 sighting
	<u>Octopus</u> sp.		2 sighted (large)
Polychaeta	Sabellidae		9
	Unidentified burrowing tubiculous polychaetes		10
	Calcareous tubiculous polychaetes		8
Arthropoda	Pagurus sp	Hermit crab	7
	Lopholithodes sp.	Box crab	2 (just after pipe found)
	Oregonia gracilis	Decorator crab	2
Echinodermata	Luidia foliolata		1
	Pisaster brevispinus		1
	Solaster endeca		2
	Pycnopodia helianthoides		1
	Orthasterias koehleri		2
	Unidentified Asteroidea		2
	Parastichopus californicus		1
Pisces	Zoarcidae	Eelpouts	6
	<u>Sebastes</u> sp	Rockcod	3
	<u>Ophiodon</u> <u>elongatus</u>	Lingcod	2
	Agonidae	Poacher	3
	Pleuronectidae	Sole	4
	Stichaeidae	Prickleback	3
	Cottidae	Sculpin	1
	Porichthys notatus	Plainfin Midshipman	2
	<u>Erilepis</u> zonifer (?)	Skilfish (?)	1 possible sighting

Diffuser Description

The effluent pipe appeared to be approximately 40cm - 60cm in diameter and was suspended approximately 30cm above the bottom by the concrete stabilizing blocks. The diffuser was fabricated of stainless steel with the ports located on the northern side and a cover on the open end. Only a trickle of fresh water was coming out at the time.

Conclusions

At the time of the dive there appeared to be little or no effect on the bottom fauna stemming from the diffuser, however full operation had not as yet commenced. Small patches of organic material were apparent adjacent to the diffuser ports but these were not felt to be problematic as yet. Although no effects were observed on this dive the dive was a useful "before operation" view of the site and should be repeated in approximately two years to see what changes have occurred.



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Location:	Comox, Cape Lazo	Date:	1 December 1978
Dive No.:	719 (track 1) (Fig. 7)		
Observers:	G. Packman, N. Holman		
Position:	Start	Turn	<u>Finish</u>
	49 ⁰ 42.12'N	49 ⁰ 42.47'N	49 ⁰ 42.53'N
	124 ⁰ 48.87'W	124°49.12'W	124 ⁰ 50.27'W

Depth: 63m

Water Column

The water column was very clear, with good visibility throughout most of the descent. Some detritus and zooplankton were encountered between 40 metres and the bottom (63 metres). The readings observed on the CTD unit are presented in Table 1.

TABLE 1

CTD READINGS

Depth	Temperature(⁰ C)	<u>Conductivity</u>	Dissolved Oxygen (mg/l)
Om	8.50	31.34	9.40
15m	8.55	31.36	7.40
27m	8.57	33.40	8.70
45m	8.80	32.00	7.85
63m (bottom)	9.00	32.50	6.40
53m (bottom)	8.85	32.19	7.30
43m (bottom)	8.80	32.14	7.00
20m (bottom)	8.50	31.36	8.00
16m (bottom)	8.50	31.36	7.50

- 19 -

Bottom Characteristics

Throughout the course of the dive the substrate was sandy in nature, with the grain size being smaller in the deeper portion of the dive. The substrate looked excellent for construction purposes with the slope not being a problem for a pipeline. The substrate was coarse enough that divers would not have a visibility problem arising from stirred up sediment. At the 20 metre depth rippling was apparent in the sandy substrate, presumably arising from wave surge.

Holes in the bottom arising from infaunal burrowers were not abundant at any time during the dive. Worm castings were noted on the surface of the sediment in the deeper portion of the dive.

Bottom Fauna

A summary of the benthic and bathypelagic epifauna noted during this dive is presented in Table 2. The fauna observed was typical of a sandy bottom community and changed with depth as the shore was approached. In the deeper area covered at the beginning of the dive the dominant faunal forms included small unidentified shrimp, thin white sea pens and Dover or lemon sole. Throughout the dive a diverse representation of starfish was noted. A band of different faunal forms was encountered between 30 and 25 metres of depth. In this area there occurred an abundance of burrowing anemones (<u>Pachycerianthus</u> sp.) scallops and small octopii. The dominant fish type throughout the dive was sole.

TABLE	2
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		TAXON	ABUNDANCE
Sponge	-	unidentified	1 noted
Polychaeta	-	Serpulida and/or Sabellide	Evenly spaced and fairly abundant below 40 metres
Anthozoa	-	<u>Ptilosarcus gurneyi</u>	Approximately 3 noted
	-	unidentified thin white sea pen	Approximately 29 noted in deeper portion of dive site
Actinaria	-	<u>Metridium senile</u>	3 noted
	-	Pachycerianthus sp.	Noted occasionally in deeper water. Between 30-25 metres there were 3-4 per square metre
	-	unidentified Anemone	Noted occasionally
Gastropoda	÷	Nudibranchia (unidentified)	Occasionally noted
	-	<u>Dirona</u> sp.	Occasionally noted
	-	<u>Armina</u> sp.	Occasionally noted
	-	Gastropteron pacificum	1 noted
Bilvalvia	-	unidentified scallop	Abundant - approximately one per square metre at the 28 met depth
Cephalopoda	-	<u>Octopus</u> sp.	Fairly common at 25 metres
	-	unidentified Squid	Noted occasionally
Crustacea	-	Pandalus platyceros	1 noted
	-	unidentified pink shrimp	Noted occasionally
		unidentified small pink shrimp	Lots at beginning of dive - approx- imately 5 per square metre. Numbers declined as depth decreased.
	-	Pagurus sp.	Noted occasionally
	-	Pugettia producta	2 noted
Asteroidea	-	<u>Solaster</u> sp.	Noted occasionally
	-	<u>Mediaster</u> sp.	Noted occasionally
	-	<u>Pycnopodia</u> sp.	Noted occasionally
	-	<u>Evasterias</u> sp.	Fairly common

TABLE 2 (continued)

		TAXON	ABUNDANCE
Asteroidea (continued)	-	<u>Luidia</u> sp.	Noted occasionally
	-	<u>Pteraster</u> sp.	Noted occasionally
	-	<u>Pisaster brevispinus</u>	Fairly common
	-	<u>Dermasterias imbricata</u>	Noted occasionally
	-	<u>Orthasterias</u> koehleri	Noted occasionally
	-	Unknown Asteroidea	Noted occasionally
Echinoidea	-	<u>Strongylocentrotus</u> droebachiensis	1 noted
Ascidiacea	-	<u>Ascidia paratropa</u>	Fairly common around the 28 metre depth
Pisces	-	Skate	3 noted
	-	Clupeidae	1 noted
	-	Embiotocidae (surf perch)	A school followed the boat around
	-	Stichaeidae	Noted occasionally
	-	<u>Ophiodon</u> elongatus	3 noted
	-	Cottidae	Noted occasionally
	-	<u>Scorpaenichthys</u> marmoratus	1 noted
	-	Agonidae	Noted occasionally
	-	Sole (Lemon or Dover)	Fairly abundant
	-	<u>Psettichthys</u> <u>melanostictus</u> (Sand Sole)	Noted occasionally

Conclusions

The bottom throughout this dive was composed of compacted sand. As a result, the epifauna, although being quite diverse, was not particularly abundant. The dominant fish type was sole. The bottom slope and material appeared to be ideal for the construction of a deep marine outfall.

Location:	Comox		Date: 1	l December 1978
Dive No.:	719 (track 2) (fig. 7)			
Observers:	G. Packman, N. Holman			
Position:	Start	Turn	Turn	Finish
	49 ⁰ 40.45'N	49 ⁰ 40.17'N	49 ⁰ 40.58'N	49 ⁰ 41.00'N
×	124 ⁰ 50.53'W	124 ⁰ 50.43'W	124 ⁰ 50.23'W	124 ⁰ 50.37'W

Depth: 78m

Water Column

Visibility was good throughout the water column with not too much detritus or zooplankton being present. A fair number of scyphozoans were observed in the upper reaches of the water column. Scyphozoans were also observed at greater depths but their numbers were decreased. Some siphonophores were noted at approximately 60 metres. The data obtained with the CTD probes are presented in Table 1.

TABLE 1

CTD READINGS

Depth	Temperature(^O C)	<u>Conductivity</u>	Dissolved Oxygen (mg/l)
40m	8.90	32.00	8.8
60m	9.20	32.50	7.3
78m (bottom)	9.30	32.90	6.4
70m (bottom)	9.18	32.50	6.5
43m (bottom)	9.12	32.39	6.6
23m (bottom)	9.00	33.20	7.2

Bottom Characteristics

The sediment type was markedly different from that observed on the Track 1 dive, that is, a soft clay mud substrate with a thin overlay of very light sediment. The visibility at or close to the bottom was very much reduced compared to the Track 1 dive location also, the sediment was much more readily disturbed and re-suspended by the submersible, hence further reducing visibility.

Bottom Fauna

A list of the fauna observed during the course of this track is presented in Table 2. During the first half of the dive the dominant epifaunal form was the thin white sea pen. There were also 5-10 infaunal holes per square metre and 1-2 pink shrimp per square metre.

During the second half of the dive, where the depth was shallower and the sediment coarser, the number of animals was reduced markedly. However, in this area very few sea pens and pink shrimp were apparent. There was still a stable, diverse and productive community present.

		TAXON	ABUNDANCE
Actinaria	-	<u>Metridium</u> sp.	Noted occasionally
	-	Pachycerianthus sp.	Fairly common
	-	Unknown	Noted occasionally
	-	Thin white sea pens	5-10 per square metre during deeper portion of the dive; after ascending slope the numbers dropped off markedly
Gastropoda	-	<u>Dirona</u> sp.	Quite abundant on coarser sediment in shallower water
	-	Nudibranchia	Noted occasionally
Cephalopoda	-	<u>Octopus</u> sp. (small)	1 noted
	-	squid	1 noted
Crustacea	-	pink shrimp	1-2 per square metre at the be- ginning of dive declining to very few in shallower portion of dive.
	-	<u>Pagurus</u> sp.	Noted occasionally - more frequently in shallower, sandy area.
Asteroidea	-	<u>Mediaster</u> sp.	Fairly common
	-	<u>Pisaster</u> brevispinus	Noted occasionally
	-	<u>Evasterias</u> sp.	Noted occasionally
	-	<u>Pycnopodia</u> sp.	Noted occasionally
	-	Unidentified	Noted occasionally
Pisces	-	<u>Squalus</u> acanthias	1 noted
	-	<u>Hydrolagus colliei</u>	1 noted
	-	Gadus macrocephalus	2 noted
	-	Zoarcidae	Fairly common
	-	Embiotocidae (surf perch)	2 schools noted
	-	<u>Sebastes</u> sp.	2 noted
	-	<u>Ophiodon elongatus</u>	1 noted
	-	Cottidae	Noted occasionally

TABLE 2 (continued)

TAXON	ABUNDANCE	
Pisces (continued) - Agonidae	Common during first half of dive - predominant fish species during second half of dive	
- Pleuronectidae	Noted occasionally	
- Psettichthys melanostrictus	Noted occasionally	

Conclusions

The bottom sediments in the deeper portion of this dive track were very fine indicating that currents were minimal. The bottom fauna, both epifauna and infauna, was quite abundant. Fauna could be adversely affected by the discharge of sewage, with specific reference to the accumulation of organic material in the sediments.

The fine sediment in this area would easily be stirred up by divers involved in submarine construction, reducing visibility and thereby increasing construction time and expense.


FIG. 7 PISCES DIVE TRACKS, CAPE LAZO (1978)

Location:	Macaulay Point Sewage Out	fall	Date:	7 May 1979
Dive No.:	755 (track 1) (Fig. 8)			
Observers:	G. Packman, B. Kay			
Position:	Start	<u>Finish</u>		
	48 ⁰ 23.80'N 123 ⁰ 24 68'W	48 ⁰ 25.06'N 123 ⁰ 24 35'W		
	200 21100 1	100 2.1.00 M		

Depth: 80m

Water Column Characteristics

Visibility was generally good during the descent through the water column. In the surface waters a fair bit of phytoplankton was apparent. At approximately 25 metres the amount of phytoplankton in the water column increased such that visibility decreased somewhat. At 55 metres the amount of detritus in the water increased however there was no corresponding increase in zooplankton numbers. At 55 metres detritus such as toilet paper was noted in the water column which apparently originated with the sewage discharge. A fair bit of sewage related debris was noted suspended in the water just above the bottom throughout the dive. The depth throughout the dive was 80 metres.

Bottom Characteristics

Approach to Pipe

Upon initial arrival on the bottom the substrate was observed to consist of soft mud and sand, and did not appear to have been contaminated by sewage debris. During the approach to the pipe the substrate composition varied from silt and sand, to gravel and occasionally to rock. Initially natural organic debris such as drifting detached algae was observed on the bottom. As the pipe was approached however various bits of typical sewage debris were noted.

Tracking Along The Pipe

A track was run along the eastern side of the sewage outfall to the discharge point. The substrate along the eastern side of the outfall pipe consisted of silt and shell debris which had piled up against the pipe. This varied occasionally to a sandy substrate and a substrate composed of gravel and shells. As the end of the outfall was approached the quantity of anthropogenic debris increased. The physical appearance consisted of scouring in the immediate vicinity of the discharge point and the accumulation of a mound of black organic material beyond that. The scoured area directly opposite the discharge was gravelly in nature with some but not a great deal of sewage debris present. A great deal of plastic and other debris including a credit card and an identification card from Gorge Road hospital was present along with the organic ooze. On a course run out directly from the end of the pipe the debris was observed to thin out at approximately 20 metres from the pipe end. Approximately 40 metres from the discharge point the bottom was composed of broken scallop shells, fine organic material and bits of plastic and tin foil. Therefore it was felt that considerable impact was still being effected at that point.

The diffuser at the end of the sewage outfall was broken off approximately half way along its length. Small accumulations of debris and organics were apparent opposite the operating ports. The sewage effluent was discharging at an extremely high rate when the Pisces initially arrived at the discharge point. However while we were observing the pipe pumping was shut down and the discharge cased.

Fauna

A summary of the fauna noted on the approach to the outfall pipe is contained in Table 1. It may be seen from this table that the fauna, while being diverse was not exceptionally abundant and was mainly epifaunal.

The fauna observed during the run down the pipe is summarized in Table 2. Scallops were one of the dominant faunal forms beside the pipe, while sea anemones (<u>Metridium</u> sp.) were abundant on the pipe. Sea urchins (<u>Strongylo</u>centrotus sp.) were abundant in concentrated groupings on and beside the pipe.

At the discharge point in the direct discharge stream no benthic infauna or epifauna were present. Large numbers of rock cod (<u>Sebastes</u> sp.) and ratfish (<u>Hydrolagus colliei</u>) were observed swimming around the effluent stream. Off to the sides, away from the direct impact of the sewage discharge, hermit crabs (Pagurus sp.) were the dominant faunal form and were present in large numbers.

Conclusion

The areas away from the impact of the sewage discharge were typically compacted mud, sand and gravel with a predominantly epifaunal community. The fauna in these areas, although not particularly rich appeared to constitute a diverse, stable epifaunal community. The bottom directly opposite the broken end of the diffuser where the main discharge occured consisted of a black organic accumulation devoid of an epifaunal community. The bottom along the sides of the diffuser was composed of a black, reduced sediment. Large numbers of hermit crabs (<u>Pagurus</u> sp.) were present in this area which may indicate an increase in biomass but as the community diversity is very low this represents a classic pollution situation.

Faunal Form	Abundance
<u>Metridium</u> sp.	12 noted attached to rocks and other solid substrata
Anemones - unidentified	12 noted
Calcareous Tubiculous Polychaetes	noted on ricky substrata
Scallops	noted occasionally
<u>Fusitriton</u> sp.	10 noted
<u>Neptunea</u> sp.	1 noted on a piece of wood
<u>Octopus</u> sp.	1 small individual noted
Nudibranch	1 noted
<u>Pagurus</u> sp.	approximately 10 were noted during the first five minutes of the dive after that 8 were noted during the remaining approach to the pipe
Parastichopus californicus	1 noted
<u>Cucumaria</u> sp.	1 noted
Strongylocentrotus sp.	1 noted
<u>Solaster</u> <u>stimpsoni</u>	5 noted
<u>Luidia</u> sp.	5 noted
<u>Henricia</u> sp.	2 noted
Ophiuroidea	noted occasionally throughout approach
<u>Hydrolagus coliei</u>	1 noted
Gadus macrocephalus	1 noted
Zoarcidae	1 noted
Stichaeidae	2 noted
<u>Ophiodon elongatus</u>	3 small individuals noted

TABLE 1 FAUNA NOTED DURING APPROACH TO PIPE

.

TABLE 1 (continued)

Faunal Form	Abundance
Agonidae	3 noted
Pleuronectidae	4 noted
Ascidia peritropa	noted infrequently
Ascidians unidentified	noted infrequently

FAUNA NOTED ALONG PIPE

Faunal Form	Abundance
<u>Metridium</u> sp.	many on pipe, along its length and at end
Unidentified anemone	1 noted
Calcareous tubiculous polychaetes	a few on pipe end
Scallops	generally 2-3/m ² except for a bed where 20-30/m ² were observed the numbers diminished in the immedi- ate area of the discharge but were approximately 10/m ² at approximately 25m from the outfall end.
Fusitriton sp.	3 noted
Lopholithodes sp.	2 noted
<u>Pagurus</u> sp	many around the outfall end, dominant faunal form in that area
<u>Florometra</u> <u>serratissima</u>	noted occasionally along pipe
<u>Gorgonocephalus</u> sp.	1 noted
Strongylocentrotus sp.	noted in piles along pipe
<u>Solaster</u> <u>stimpsoni</u>	5 noted along pipe a few noted around and on pipe end
<u>Dermasterias imbricata</u>	one noted
<u>Luidia</u> sp.	one noted
<u>Hydrolagus</u> colliei	a few noted around pipe end
<u>Sebastes</u> sp.	a school of juveniles was noted while running down the pipe.
	many (approx. 50) large rockfish were noted in the effluent.
Ophiodon elongatus	one noted along pipe
	one noted at pipe end



PISCES DIVE TRACK, MACAULAY POINT SEWAGE OUTFALL (1979). FIG. 8

10 May 1979

Location:	Sechelt - Trail Bay		Date:
Dive No.:	763 (track 1) (Fig. 9)		
Observers:	G. Packman, N. Holman		
Position:	Start	Finish	
	49 ⁰ 26.72'N	49 ⁰ 26.58'N	
	123 ⁰ 47.82'W	123 ⁰ 46.00'W	

Depth: 100m

Water Column

In the surface waters large numbers of copepods were observed. These were noted to extend down through the water column to approximately 50 metres. Zooplankton and detritus were observed to extend to a depth of approximately 75 metres. Between the 100 metre depth and the bottom ctenophores, siphonophores, scyphozoans and euphausids were noted. Pelagic amphipods and shrimp (Pasiphea pacifica) were also noted in the waters just above the bottom.

Bottom Characteristics

The bottom throughout most of the dive was a very soft silty mud substrate indicating very little current in the area. What little current there was was flowing from the south east at the time of observation. Infaunal holes in the bottom numbered approximately $1-2/m^2$. Towards the end of the dive a mud slope was encountered, which gradually steepened whereupon the bottom changed to a mixed cobble and silt substrate. At the end of the dive the bottom levelled off with the substrate returning to fine silt.

Bottom Fauna

A list of the fauna noted throughout the dive is presented in Table 1. The most common faunal form throughout the dive was the pink shrimp (<u>Pandalus</u> sp.) which averaged approximately $1/m^2$. Sidestripe shrimp (<u>Pandalopsis dispar</u>) became almost as common as pink shrimp during the second half of the dive. Infaunal holes in the mud sediment averaged less than 1 per square metre. Generally speaking the bottom fauna was fairly sparse, typical of a soft mud substrate.

Faunal Type	Abundance
<u>Aphrocallistes</u> sp. (Glass sponge)	- 1 specimen noted attached to a boulder
Nemertea	 10 noted specifically, however they were noted occasionally throughout the dive.
Pachycerianthus sp. (burrowing anemones)	- 23 noted throughout dive.
Unidentified Anemone	- 2 noted during dive.
<u>Neptunea</u> sp.	- 2 noted on open substrate.
	 a large number were observed on the only log noted during the dive.
Octopus sp.	- 1 noted
Rossia pacifica	- 1 noted
Polychaeta - calcareous tubes - soft tubes	 noted infrequently on rocks. numbers increased markedly during last half of dive.
Pink Shrimp	- most frequent faunal form noted.
	- $1-2/m^2$ throughout the dive.
<u>Pandalus platyceros</u> (prawn)	- 4 noted on open substrate.
	 a number of prawns were noted around the only log observed on the dive.
<u>Pandalopsis</u> <u>dispar</u>	 noted infrequently during first half of dive but increased markedly in numbers towards the end (approx. 2.5/m²)
<u>Crangon</u> sp.	 noted infrequently
<u>Munida quadrispina</u>	- 1 noted
Lopholithodes sp. (box crab)	- 1 noted
<u>Cancer magister (</u> dungeness crab)	- 2 noted
Hermit crab	- 2 noted
<u>Squalus</u> <u>acanthias</u> (dogfish)	- 2 noted

TABLE 1 (continued)

Faunal Type	Abundance
Rajidae (skates)	- 3 noted
<u>Hydrolagus</u> <u>colliei</u> (ratfish)	- 4 noted
<u>Gadus macrocephalus</u> (grey cod)	- 3 noted
Zoarcidae	- 7 noted
Bathymasteridae	- 8 noted
<u>Sebastes</u> sp.	- 4 noted
<u>Sebastolobus alascanus</u>	- 1 noted
Cottidae	- 1 noted
Agonidae	- 10 noted
<u>Glyptocephalus zachirus</u> (Rex sole)	- 1 noted
Pleuronectidae - adult (sole) juvenile (sole)	11 noted6 noted

Conclusions

The bottom throughout the dive was a fine, soft sediment with few infaunal holes. The bottom fauna was fairly sparse with no forms typical of strong current locations being present. The currents at the time of the dive were flowing from the southeast but were extremely weak. The general conclusion from these observations is that bottom water circulation is limited in this area.

Location:	Sechelt - east of Trail Islands		12 May 1979
Dive No.:	765 (track 2) (Fig. 9)		
Observers:	H. Nelson, N. Holman		
Position:	<u>Start</u> <u>Finish</u>		
	49 ⁰ 27.10'N 49 ⁰ 27.90'N 123 ⁰ 46.30'W 123 ⁰ 45.00'W		

Depth: 100m

The dive commenced in approximately 100 metres of water just east of the Trail Islands. The submersible proceeded shoreward heading close to magnetic north into an area proposed as a possible discharge site for domestic sewage. The sewage, originating in the Sechelt area, would be processed in a secondary treatment plant prior to discharge. The submersible continued shoreward in the general direction of Selma Park Marina until reaching a depth of 50 metres at which point it reversed course and headed south into deeper water to begin the ascent. The northward track of the dive ended about 180 metres from shore. Readings taken on the Plessey C.T.D. probe during the dive are presented following the observations.

OBSERVATIONS

SURFACE	- water clear, few plankton.
DESCENDING	- visibility good, a few Ctenophores.
BOTTOM	- at 103 metres, visibility 4 to 6 metres.
	- the bottom substrate was composed of a thin layer of soft brown
	mud overlying at least several inches of grey soft sediment.
	The substrate appeared natural with no characteristics of a
	reducing sediment. A slight bottom current, estimated at
	.5 km/hr, was moving in a westerly direction.
	- benthos observed on landing consisted of a school of 50 to 60
	juvenile hake (<u>Merluccius productus</u>), several ratfish (<u>Hydrolagus</u>
	<u>colliei</u>) and a few glass sponge, burrowing anemones (<u>Pach</u> -
	ycerianthus sp.), pricklebacks, squat lobsters (Munida quadrispina),
	and orange starfish (Mediaster aequalis).

- 70m the Pisces headed shoreward up a slight incline past over an area with a few large rocks and cobbles. This area was characterized by tube polycheates, Serpulids, growing on the rocks, a few green stripe rockfish (Sebastes elongatus) and a single quillback rockfish (Sebastes moliger) and snail (Neptunea sp.).
- 65m the slightly inclined, flat soft bottom continued to a depth of 65 metre when the Pisces began moving into deeper water down a slight decline. This decline continued to a depth of approximately 100 metres where the bottom flattened out. For about 30 minutes the Pisces traversed the soft mud bottom with little change in depth.
 - during the travel into deeper water the benthos observed in addition to those previously mentioned included sole, ling cod (<u>Ophiodon elongatus</u>), large pink anemones, and prawns (<u>Pandalus</u> <u>platyceros</u>). The prawns were occupying craters from 10 to 30 centimetres in diameter.
- during the first part of the deeper portion of the track a large number of squat lobsters (<u>Munida quadrispina</u>) were observed associated with an increase in wood debris. During this period a few prawns, one skate (<u>Raja sp.</u>) and no shrimp were observed. Later in the track with no appreciable change in substrate or depth small pink shrimp appeared in large numbers (6 to 8/m²), several prawns were observed and the number of squat lobsters decreased significantly. The Dungeness crab (<u>Cancer magister</u>) also appeared later in the track.
 - the Pisces proceeded from the 100 metre depth up a slight incline to 50 metres depth where the northward progress ended.
 Benthos during this portion included a few small octopus (Octopus sp.), several sea whips, large white and orange anemones (Metridium sp.), several flounders, a single sea pen (Ptilosarcus gurneyi) and a single sea cucumber (Parastichopus californicus).
 - at 50 metres depth the Pisces reversed course and headed south into 77 metres of water and surfaced completing the dive.

<u>Depth (m)</u>	<u>D.O.</u>	Conductivity	Temp. (^O C)
Surface (1.9)	10.7	25.5	11.9
Descending 8.0	11.5	29.0	11.4
" 20.0	8.5	31.5	7.7
" 40.0	7.3	31.5	7.4
" 70.0	7.7	31.7	7.5
" 90.0	7.9	31.7	7.5
*Bottom (103)	7.6	31.7	7.5
Bottom (50)	7.0	31.5	7.5
Bottom (70)	9.1	31.6	7.5
Ascending 50	8.0	31.5	7.5
" 30	8.8	31.5	7.0
" 10	10.9	31.6	7.0
Surface (2)	12.5	23.5	12.2

PLESSEY READINGS

* throughout the deeper portion of the dive the readings remained relatively constant.

SUMMARY

The dive area had a natural mud substrate with occasional rock and cobble. The bottom is relatively flat with only slight gradients encountered and a large flat area at a depth of 100 metres. More benthos seemed to inhabit the flat area than at depths from 50 to 80 metres. These were predominately squat lobsters, shrimp, and prawns.



White 😽

2 .5 3 0 Scale in Kilometres

FIG. 9 PISCES DIVE TRACKS, SECHELT (1979),

Location:	French Creek		Date:	17 Mar	ch 1980
Dive No.:	832 (Fig. 10)				
Observers:	G. Packman, N. Holman				
Position:	<u>Start</u>	Turn	<u>Finis</u>	<u>h</u>	
	49 ⁰ 21.5'N 124 ⁰ 21.0'W	49 ⁰ 21.53'N 124 ⁰ 21.39'W	49 ⁰ 21. 124 ⁰ 21.	65'N 30'W	

Depth: 65m

Note: No report available



OUTFALL (1980). SEWAGE CREEK FRENCH TRACK , DIVE PISCES FIG. 10

Location:	Five Finger Island (Outfal	1 Inspection) Date:	18 March 1980
Dive No.:	833 (fig 5)			
Observers:	N. Holman, G. Packman			
Position:	Start	Turn	Turn	Finish
	49 ⁰ 14.08'N	49 ⁰ 14.15'N	49 ⁰ 14.23'N	49 ⁰ 14.41'N
	123 ⁰ 56.46'W	123 ⁰ 56.49'W	123 ⁰ 56.25'W	123 ⁰ 56.09'W

Depth:

<u>Note</u>: No report available

PISCES IV RECORD

Location:	Victoria (Macaulay Point)		Date:	20 March 1980
Dive No.:	836 (Fig 11)			
Observers:	G. Packman, Rogers			
Position:	<u>Start</u>	Turn	<u>Finish</u>	
	48 ⁰ 24.33'N 123 ⁰ 23.98'W	48 ⁰ 24.36'N 123 ⁰ 24.46'W	48 ⁰ 23.7 123 ⁰ 24.6	0'N 2'W

Depth: 50m

.

Note: No report available





Locatio	n: Victoria (Macaulay Point)	Date:	20	March	1980	
Dive No	: 837					
Observe	rs: G. Packman, Klassen					
Positio	n: <u>Start</u> <u>Finish</u>					
Depth:	50m •					
Note:	spection of outfall.					
	Currents quite strong.					
	Dive in vicinity of pipe - can't plot track.					

Location	n: Victoria	(Clover Point)		Date:	21	March	1980
Dive No.	: 838 (Fig	. 12)					
Observer	rs: N. Holmar	, Klassen					
Positior	n:	Start	<u>Finish</u>				
		48 ⁰ 23.57'N	48 ⁰ 23.58'N				
		123 ⁰ 21.30'W	123 ⁰ 20.05'W				
Depth:	87m	•					
Note:	Outfall area	inspection	the last and				

pipe does not extend far so just looked at scour area
 strong current.





3.2 PULP MILLS

~

Location:	Howe Sound (W	latts Point)		Date:	25 August 1976
Dive No.:	463 (track 1	.) (Fig. 14)			
Observers:	D. Sullivan,	D. Goyette			
Position:		<u>Start</u>	<u>Turn</u>	<u>Finis</u>	<u>h</u>
	track 1 49 123	⁰ 40.0 ⁷ N 8 ⁰ 12.92'W	49 [°] 40.12'N 123 [°] 12.65'W	49°40.0 123 ⁰ 12.0	66'N 62'W
	track 2 49 123	9 ⁰ 39.78'N 8 ⁰ 12.18'W		49 ⁰ 39.1 123 ⁰ 11.8	52'N 85'W
Depth: 200	n				
DESCENT :	d a - B - V - C - b - f - 1 B E S B D S L B - v - 1 S - a - a 1 d a	letritial mater bundant plank ottom: 200 m fis; 5m; quick course; 050 ⁰ ottom very si few shrimp, bo 115 hours ottom remains ottom remains ottom remains othrocara asycottus lender sole emon sole (?) rown cat shar is requires a ifted off bot hore pproached cli lmost vertica ayer of silt epressions he reas somewhat	erial to 70 metre stonic life; few metres ly reduced to 1. Ity, uneven surf ottom covered wit 175 metres the same; speci the same; speci	s; below lantern 09: 5 - 2m face h mud ca v es noted face cov th silt	w this depth fish noted. 35 hours astings of worms is: 60 cm d eded north towards vered with fine , life in these

- <u>Munida quadraspina</u> and prawns very abundant dominant species
- Cancer and tanner crabs common
- Cloud sponge, starfish, scallops (?) anemones very abundant after 50 metres on ascent
- Small shrimp very abundant after 40 metres Munida still abundant
- Followed rock surface on slow ascent to 5 metres
- Surfaced 1236 hours.



FIG.14 PISCES DIVE TRACKS, SQUAMISH HARBOUR (1976).

Location:	Northumberland Channel (off Harmac Pulp Mill)		Date:	1 September 19	976
Dive No.:	476 (track 7) (Fig. 15))			
Observer:	D. DeMill				
Position:	Start	<u>Finish</u>			
	49 ⁰ 08.73'N 123 ⁰ 50.94'W	49 ⁰ 09.55'N 123 ⁰ 52.13'W			

Depth: 80m

Water Column

The water column both at the beginning and end of the dive was quite discoloured (brown) between 60-80 metres.

Speculation was made as to whether this was pulp mill effluent moving up channel from Harmac Pulp Mill, in the opposite direction from which it is supposed to flow.

Bottom Characteristics

Initially the bottom was composed of mud, however rock piles were encountered which because of their rock composition and spatial concentration appeared to have been dumped into the channel.

A few scattered rocks and logs were discovered on the mud bottom.

Benthic Fauna

Mud Bottom

A considerable amount of life was observed both on top of the mud and in it. The predominant infaunal lifeforms appeared to be bamboo worms (<u>Maldanidae</u>), burrowing anemones (<u>Pachycerianthis</u> sp.) burrowing holothurians (possibly <u>Leptosynapta</u> but this is only speculation) and what appeared to be <u>Terebellidae</u> dwelling in holes in the mud. The epifauna observed consisted of nemerteans, a sea pen (<u>Stylatula elongata</u>), sunstars (<u>Pycnopodia helianthoides</u>), polychaete worms (<u>Polynoidae</u>), pink shrimp (<u>Pandalus borealis</u>), prawns (P. <u>platyceros</u>), squat lobsters (<u>Munida</u> <u>quadraspina</u>), crangon, Dungeness crabs (<u>Cancer magister</u>), unidentified Brachyurans, eelpouts (<u>Zoarcidae</u>), grey cod (<u>Gadus macrocephalus</u>), rockfish (<u>Sebastes</u> sp.) and small sole (<u>Pleuronectidae</u>).

Rocky Ledge

Fauna in the rocky area was basically epifauna as would be expected.

The fauna present included siliceous sponges (<u>Aphrocallistes</u> sp. and <u>Rhabdocallistes</u> sp.), a variety of sea anemones including <u>Metridium senile</u> in great abundance squat lobsters (<u>Munida quadraspina</u>), prawns (<u>Pandalus</u> <u>platyceros</u>) which were less abundant than on the mud bottom.

Summary

The most startling observation on this dive was the presence of what appeared to be pulp mill effluent in the midwater in the northwestern end of Northumberland Channel. According to calculations made prior to pulp mill expansion all of this effluent should have moved down through Dodd Narrows. On the whole a great amount of life was observed on this dive, probably owing to the constant movement of water through Dodd Narrows.



- 56 -

Location:	Cousins Inle	t (Ocean Fall	s)	Date: 2	0 October 197	6
Dive No.:	512 (track	1) (Fig. 16)				
Observers:	N. Holman, R	. Hoos				
Position:	5 12	<u>Start</u> 2 ⁰ 21.08'N 7 ⁰ 42.34'W	<u>Turn</u> 52 ⁰ 21.18'N 127 ⁰ 42.85'W	<u>Finish</u> 52 ⁰ 21.05 127 ⁰ 42.90	' N ' W	
Depth: 60	n.					
Location: Dive No.:	Cousins Inle 513 (track	t (Oceans Fal 2) (Fig. 17)	1s)	Date: 2	0 October 197	6
UDSERVERS: Position:	N. Holman, G <u>Start</u> 52 ⁰ 19.90'N 127 ⁰ 44.43'W	. Packman <u>Turn</u> 52 ⁰ 19.92'N 127 ⁰ 44.28'W	<u>Turn</u> 52 ⁰ 19.97'N 127 ⁰ 44.45'W	<u>Turn</u> 52 ⁰ 20.00'N 127 ⁰ 44.50'W	<u>Turn</u> 52 ⁰ 20.08'N 127 ⁰ 44.65'W	<u>Finish</u> 52 ⁰ 20.10'N 127 ⁰ 44.71'W

Depth: 70m

Track 1

The first dive was located just off the mill as indicated in Figure 1. On descent, a layer heavily laden with fibre was found to exist in the top two metres of the water column. Below this the water cleared somewhat, still however remaining heavily laden with fibre. The only planktonic forms apparent in the water column were ctenophores. Just above the fibre mat, the water had a milky appearance reducing visibility to the order of 1.5m.

The fibre bed was initially white and had the appearance of a field of snow, undulating, with an occasional log projected (Plate 1). It was apparent that the mat was not greatly compacted, as shock waves would ripple through it if disburbed. As the dive progressed, grey and black patches became apparent on the surface of the fibre bed where the underlying anaerobic decomposition had for some reason been exposed. No life was initially apparent on the fibre bed itself, however sea anemones (<u>Metridium senile</u>) and ascidians (<u>Ascidia peritropa</u>) were present on logs projecting from the bed. In the area where grey and black patches were observed, tube dwelling polychaetes (<u>Capitella sp.</u>) were observed, extending above the surface of the fibre, in the black patches. A few paochers (Agonidae) and a tomcod (Microgadus proximus) were also observed.

As the dive progressed up a cliff face off Coolidge Point, more life became apparent. The life forms observed here included coon-stripped shrimp (<u>Pandalus</u> <u>danae</u>) and <u>Cancer productus</u>. However, throughout the dive there was an obvious absence of such typical faunal forms as squat lobsters (<u>Munida quadraspina</u>), ratfish (Hydrolagus colliei), dogfish (Squalus acanthias) and rockfish (Sebastes sp.).

Track 2

A second dive was completed on 20 October at a location further down the inlet from the first. On descent, the water column was again observed to be of a milky nature from the presence of fibre particles in the water, however this was not as apparent as in the previous dive. The only zooplanktonic forms observed were again ctenophores.

The bottom at the point of descent appeared to be composed of mud and detritus which may have been covering remnants of the old fibre bed, presumed to have been layed down when the old sulphite mill was in operation. Upon moving off from this point, branches and logs were observed protruding from the bottom. The bottom was observed to change to one in which patches of black hydrogen sulphide ooze (covered in part by a white bacterial slime) appeared in the detrital mud bottom. Extensive patches of small wood chips were also observed. A cliff was encountered on the west side of the inlet. This was climbed, the terrain at the top being composed of rocks and small boulders interspersed with woodships.

Benthic fauna was abundant throughout the dive. The most abundant form throughout the first portion was a small, thin, white sea pen which reached concentrations of up to 50/metre². This lifeform was observed on all bottom types except the rocky terrain. Other major lifeforms observed on the "recolonized fibre bed" were poachers (Agonidae), ronquils (Bathymasteridea), pricklebacks (Stichaeidae), pink shrimp (<u>Pandalus borealis</u>), burrowing anemones (<u>Pachycerianthus sp.</u>), and sedentary polychaetes such as <u>Cirratula</u> sp.

The rockface was heavily populated with sea anemones (<u>Metridium senile</u>), sea urchins (<u>Strongylocentrotus droebachiensis</u>), squat lobsters (<u>Munida</u> <u>quadraspina</u>), hermit crabs (<u>Pagurus</u> sp.) and spider crabs. Many burrowing holothurians, very similar in appearance to <u>Chirodota</u> sp. were observed in the sediments at the summit of the rockface.

Conclusions

It was the general concensus of the observers present (N. Holman, R. Hoos, G. Packman) that the vicinity of the second dive (Track 2, Figure 17) would be unsuitable for ocean dumping due to the apparent recolonization in this area. It was felt that the area surrounding Track 1 would be suitable for this purpose however, as the bottom was completely covered with fibre, life subsequently being non-existent. This condition will probably remain as it is at present as long as the mill is in operation with the same degree of fibre loss.



FIG. 16 PISCES DIVE TRACK, COUSINS INLET (1976).



FIG. 17 PISCES DIVE TRACK, OCEAN FALLS (1976).
Location:	Prince Rupert (Chatham	Sound)	Date:	22	October	1976
Dive No.:	516 (Fig. 18)					
Observers:	N. Holman, G. Packman					
Position:	Start	Finish				
	54 ⁰ 11.47'N	54 ⁰ 11.49'N				
	130°23.22'W	130 ⁰ 23.88'W				

Depth: 115m

× .

Note: No report available



C H A T H A M

SOUND



FIG. 18 PISCES DIVE TRACK, CHATHAM SOUND (1976).

Location:	Prince Ru	pert (Chatham S	iound)	Date: 2	2 October	1976
Dive No.:	517 (Fig	. 19)				
Observers:	N. Holman	, G. Packman				
Position:		Start	Turn	<u>Finish</u>		
		54 ⁰ 14.42'N 130 ⁰ 28.05'W	54 ⁰ 14.48'N 130 ⁰ 28.49'W	54 ⁰ 14.45' 130 ⁰ 29.10 '	N W	
Depth: 70m						

•

Note: No report available.



Location:	Sate	ellite	Channe1		Date:	8 March 1977
Dive No.:	591	(Fig	. 20)			
Observers:	R. 1	loos,	G. Packman			
Position:			Start	Finish		
			48 ⁰ 42.55'N 123 ⁰ 29.80'W	48 ⁰ 42.88'N 123 ⁰ 30.05'W		
Depth: 65m						
Observations	5:		Descending			
			- at 25 metres	. Group of small	salmon r	oted.
			- Plankton clou at 75m.	ud including Eupha	usids ar	d Chaetognaths
			- Soft silty bo Visibility <u>ca</u> 1.85 km/hr.	ottom. 8-12 cm he <u>a</u> . 3m. Current fr	rring mc om 090 ⁰	oving about. at approximately
			- Bottom at 65r Island. Bott minutes. Br [.]	n. Moving off on to the second s	course C <u>ossia</u> no Herring	930 ⁰ to Saltspring Hed in 1st few H seen regularly.
			- a few large <u>M</u> flat sandy bo	Mediaster and a la	rge <u>Luid</u> or prawn	l <u>ia</u> noted on the Is seen at this time.
			- Occasional Mo in water colu	oonsnail. Visibil umn.	ity 2-3m	n. Fine sediment
			- Grab sample ı	using Eckman sampl	er penet	trated 12 cm.
			- Climbing slop	pe at 65m. Some <u>N</u>	eptunea	noted.
			- Pricklebacks observed.	(approx. 20 cm. 1	ong) and	la few small sole
			- 1 Skate, 2 cc	od, 2 prickleback	observed	in 11 cm ² .
			- 50 metres. (Visibility in brittlestars, quite a bit (Considerably more nproved. 72 cm. s , <u>Mediaster</u> , sea a of algae and bryoz	life at lope. <u>S</u> nemones, oan life	this depth. <u>olaster</u> , numerous pricklebacks, noted.

Observations:- 35m. Orange sea pen, great variety of starfish including(cont.)Pycnopodia, Dermasterias, Solastar, Evasterias, Orthasterias,
Mediaster, Crossaster. Noted.

- Algae found from 35m to surface.



FIG. 20 PISCES DIVE TRACK, SATELLITE CHANNEL (CHEMAINUS). 1977

,

location: Alberni	Inlet Date: 11 March 1077
Dive No.: 593 (Fig	g. 21)
Observers: R. Hoos,	G. Packman
Position:	<u>Start</u> <u>Finish</u>
	49 ⁰ 02.75'N 49 ⁰ 03.00'N
	124 ⁰ 50.90'W 124 ⁰ 50.70'W
Depth: 300m	
Observations:	Descending
	 Brown surface water, possibly attributable to the pulp mill complex at Alberni.
	- Visibility poor at 20m.
	- A few euphausids at 60m.
	- Euphausid layer cases by 90m. Ctenophores, copepods present.
	- <u>Pasiphaea pacifica</u> concentrated at 175m. A few very large ctenophores and lantern fish in the background.
	- Greater concentration of lantern fish (Myctophidae) at 225m.
	Bottom
	- Bottom at 270m. Ratfish, some shrimp. Dropped into a school of hake. The hake stirred up dust. Took about 15 minutes of manoeuvring to get away from the poor visibility created.
	- Sediment very fine and soft. Visibility 3 - 3.5m. A few smelt, <u>Crangon</u> present.
	 Ratfish, hake, dogfish, sole, red snapper, eel pouts seen from time to time.
	- 295m. Visiblity approx. 3m. Sole and turbot seen. Several "PMT" type prawns noted.

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Observations: - Position fixed at 300m - 49⁰3.0'N, 124⁰50.7'N (continued) - Ascent from 300m to surface.

1

1



FIG. 21 PISCES DIVE TRACK, ALBERNI INLET (1977).

Location:	Muchalat] (off Gold	nlet River Pulp Mill))	Date:	12	March	1977
Dive No.:	595 (Fig.	22)					
Observers:	H. Nelson,	G. Packman					
Position:		Start	Finish				
		49 ⁰ 40.25'N 126 ⁰ 06.70'W	49 ⁰ 40.60'N 126 ⁰ 80.31'W				
Depth: 360r	n						
Observations	5:						
Descending 50m		 much detritus, pelagic amphip decrease in su siphonophores. 	white particles oods, ctenophores uspended matter euphausids	in stan	ds	in sus	pension.
175m		 many pelagic a <u>Pasiphaea paci</u> milky turbid w 	amphipods <u>fica</u> water layer just o	off bott	tom		
Bottom							
310m		 visibility app flat bottom, s particles. bottom epibent course 270⁰, g little or no c several logs a with fine sedi (white in colo 	proximately 2 metro ubstrate dark fin thic area inhabita gradually sloping current and branches burie ment. No benthic pur)	res he sedim ated by bottom ed to va c life e	mar mar uryi	t, fine ny amph ing deg ept amp	wood wipods grees whipods
325m		 after covering no life observ no obvious sig heading 325⁰, often pass clu feeding on pie heading 020⁰to 	approximately . yed other than amp ns of dumping act towards diffuser mps of amphipods eces of detritus. wards diffuser	5km of ohipods. tivity (10 to	bot 50)	tom, presu	ımably

360m	- no change
	 large clumps of light coloured suspended matter just off bottom.
340m	- base of steep rock cliff with clumps of fine fibres
	accumulating in the crevices
	- rock face devoid of life
	- water becoming murky, visibility decreased, fibre
	suspended in water column.
265m	- observed first <u>Munida guadrispina</u>
	- white slime (bacterial) in pockets or crevices
	- clumps of fibre rolling down rock face
250m	- anemone
	- tube polychaetes, squat lobster
225m	- many zooplankters, amphipods and copepods
	- small shrimp
	- amphipods very abundant in fibre mat and water column
125m	- many polychaete tubes
100m	 visibility improved to approximately 10 metres
95m	- several <u>Metridium</u> sp., nudibranch, cup coral
85m	- <u>Pandalus platyceros</u> (prawn), <u>Hydrolagus colliei</u> (rat
	fish)
50m	- rat fish
45m	- visibility decreasing
	 large pieces of fibre on shelves of cliff
40m	 rat fish, <u>Metridium</u> sp., tube polychaetes
35m	- visibility poor
	 schools of rock fish around diffuser pipe
	- pipe <u>open ended</u> , covered with <u>Metridium</u> sp., as are
	supporting cables
	 visibility above the pipe quite good
20m	- begin ascent from end of pipe
	- surfaced approximately 50m south of shore sewer box
SUMMARY:	A marked lack of benthic life in this area, with the
	exception of amphipods which seem to thrive. Since the
	bottom is covered by a mat of fibre the natural de-
	composition of this organic matter may have contributed

to the anoxic bottom environment. This anoxia was revealed by results of the dissolved oxygen survey done in the area after completion of the dive. The unusual absence of life on the steep rock face below the diffuser pipe may indicate the direct environmental impact of the effluent discharge. During the dive, stressed rock fish, <u>Sebastes</u> <u>entomelas</u> were collected from the diffuser area by cree off the ship.

SUMMARY (continued)



Location:	Tahsis Inlet
Dive No.:	597 (track 14) (Fig. 23)
Observers:	G. Packman, D. Sullivan
Position:	<u>Start</u> <u>Finish</u>
	49 ⁰ 51.48'N 49 ⁰ 51.60'N
	126°39.42'W 126°40.20'W

Depth: 140m

OCEANOGRAPHIC CHARACTERISTICS

Depth	Temperature	Salinity	<u>D.O.</u>	<u>% Saturation</u>
0	7.25	14.31	11.5	107.21
2	7.76	22.51	10.0	99.33
5	8.45	28.07	9.3	97.40
10	8.60	29.33	8.5	90.07
25	8.67	30.1	7.7	82.16
175	8.38	31.92	1.25	13.41

Watercolumn

A freshwater mixing layer extending to a depth of 15 metres was observed, below which the watercolumn was very clear with little detritus present. At 100 metres siphonophores and euphausids were observed while at 125 metres pelagic amphipods were present. Zooplankton concentrations increased as the bottom was approached, with <u>Pasiphea pacifica</u>, Copepoda and Pteropoda being present. On the bottom the visibility was of the order of 35m.

Bottom

The bottom consisted of a mud substrate appearing to contain a fair quantity of woodwastes. As the dive progressed the concentration of woodwastes increased and patches of black hydrogen sulphide ooze covered in a white bacterial slime were observed. Towards the end of the dive a typical rock cliff was climbed.

Date: 13 March 1977

Fauna

The fauna observed on the bottom was reasonably typical of a B.C. inlet. Animals observed included <u>Munida quadrispina</u>, Crangonidae, eelpouts, small Pleuronectidae, Agonidae, <u>Hydrolagus colliei</u> and small shrimp. The one outstanding feature of the faunal composition was the presence of a large number of empty shells of the bivalve Solemya johnsonii.

The cliff face climbed towards the end of the dive was typical in its faunal composition. The animals observed included the cloud sponge (<u>Aphrocallistes</u> sp.), burrowing anemones (<u>Pachycerianthus</u> sp. on small mud filled plateaus), sea anemones (<u>Metridium senile</u>), cup corals, calcareous tuberculous polychaetes, a scale worm (Polynoidae, at base of cliff), jingle shells (<u>Pododesmus cepio</u>), various types of starfish including <u>Pseudarcaster</u> sp., squat lobsters (<u>Munida</u> <u>quadrispina</u>), prawns (<u>Pandalus platyceros</u>), coon-striped shrimp (<u>Pandalus danae</u>), various unidentified shrimp, <u>Psolus chitinoides</u>, sole (Pleuronectidae), rock-fish (Scorpaenidae), poachers (Agonidae) and solitary ascidians.

Comments

Evidence of past dumping activity was observed in the form of wood debris mixed into the sediments and patches of hydrogen sulphide ooze covered in a white bacterial slime on the surface. Damage to the benthic epifauna appeared limited, however there was little evidence of benthic infauna.



FIG. 23 PISCES DIVE TRACK, TAHSIS INLET (1977).

Location: Tahsis Inlet Dive No.: 598 (track 15) (Fig. 24) Observers: G. Packman, H. Nelson Position: Start

49 ⁰ 53.00'N	49 ⁰ 52.92'N
126 ⁰ 39.60'W	126 ⁰ 39.98'W

Depth: 140m

OCEANOGRAPHIC CHARACTERISTICS

Depth	Temperature	Salinity	<u>D.O.</u>	<u>% Saturation</u>
0	7.25	20.69	10.3	99.89
2	7.53	20.39	10.2	99.41
5	7.35	26.37	9.0	90.75
10	8.48	28.8	8.5	89.50
25	6.65	29.77	7.5	76.01
50	9.02	30.78	4.35	47.01
200	8.87	31.5	2.65	28.68

Watercolumn

On descent a halocline was apparent at approximately the 20 metre depth. Light penetration was found to extend to a depth of approximately 85 metres below which a zooplankton layer was evident. Zooplankton became thick again just off the bottom at 135 metres.

Visibility on the bottom at 140 metres was approximately 7 metres.

Bottom

The bottom upon descent was primarily mud with some woodwastes mixed into the substrate. After a period of time running along the bottom, patches of black ooze were apparent showing through the mud surface. Heavy concentrations of woodwastes were soon observed as well as a piece of machinery (possible part of a car) and bits of rubble. This area appeared to be the site where dumping had taken place.

Towards the end of the dive a typical rock cliff was climbed.

Finish

Date: 13 March 1977

<u>Fauna</u>

Upon arrival at the bottom a number of squat lobsters (<u>Munida quadrispina</u>) and Crangonidae as well as three grey cod (<u>Gadus macrocephalus</u>) were observed. The numbers of decapod crustacea were not as great however as those observed on the previous (No. 597) dive in Tahsis Inlet. Other fauna observed on the bottom included scale worms (Polynoidae) a number of polychaete tubes protruding from the mud, prawns (<u>Pandalus platyceros</u>), various unidentified shrimp. poachers (Agonidae) and eelpouts (Zoarcidae). In the areas where dumped material was concentrated there was a significant reduction in the numbers of epifaunal and infaunal lifeforms.

The fauna found on the cliff climbed at the end of the dive was typical for the area. Included were calcareous tubiculous polychaetes, <u>Rossia pacifica</u>, prawns (<u>Pandalus platyceros</u>), eelpouts (Zoarcidae), pricklebacks (Stichaeidae), poachers (Agonidae), sole (Pleuronectidae), and the solitary ascidian <u>Ascidia</u> <u>peritropa</u>.

Comments

Two patches of heavy concentrations of woodwaste were located. In both of these areas epifauna and infauna had been entirely eliminated. The destruction was however quite localized and it would be of interest to continue investigation of the area to plot the course of recolonization.



FIG. 24 PISCES DIVE TRACK, TAHSIS INLET (1977).

Location:	Stuart C	nannel (Crofton	pulp mill)	Date:	12 April	1978
Dive No.:	647 (tra	acks 1 & 2) (F [.]	ig. 25)			
Observers:	N. Holman G. Packma	n, H. Nelson (ti an (track 2)	rack 1)			
Position:	track 1	<u>Start</u> 49 ⁰ 53.85'N 123 ⁰ 37.65'W	<u>Finish</u> 49 ⁰ 53.55'N 123 ⁰ 38.10'W			
	track 2	49 ⁰ 54.10'N 123 ⁰ 37.70'W	49 ⁰ 54.00'N 123 ⁰ 38.00'W			

Depth: 140m

The start of the dive corresponded with the beginning of a flood tide. It was commenced at a depth of 140 metres (78 fathoms) in Stuart Channel. The Pisces proceeded at a course of 215° mag. towards the Crofton diffuser outfall pipes situated at a depth of 18 metres (south sewer) and 27 metres (north sewer). See attached figure for position of track.

OBSERVATIONS:

Surface	 water murky, fine wood fibres in suspension, few plankters (siphonophores). 			
Descending				
15m	 clumps of wood fibre in suspension, these persisted to the bottom and were most noticeable, i.e., larger clumps, from a depth of 70 metres to the bottom. Visibility was variable throughout the water column. 			
50m	 more zooplankters, mostly euphausids 			
70m	- several pelagic shrimp (<u>Pasiphaea pacifica</u>)			
100m	- more euphasids, several pelagic amphipods			
Bottom	 at 140 metres depth. Bottom was relatively flat with a slight incline and very few potholes. Substrate was a thin layer of soft mud overlying small rocks and mud. A weak bottom current (1 km/hr to 2 km/hr) was present, coming from a direction of 90⁰ mag. Recordings made on the STD probe were as follows: 			

- 82 -

- conductivity 32.093
- temperature 8.074°C
- depth 143.15m
- the dissolved oxygen reading on the STD probe fluctuated between 6 and 8.5 ppm.
- there was much indication of burrowing activity however very few large potholes.
- benthos consisted of brittle stars, "sidestrip shrimp" (<u>Pandalopsis dispar</u>) and spirontocarid shrimp, eel pouts, burrowing sea cucumbers, burrowing anemones (<u>Pachycerianthus sp.</u>), and red rockfish.
- the Pisces headed off on a course of 215^omagnetic.
 After approximately 1 hour of travel the bottom had not changed appreciably. Additional benthos observed included "pink" shrimp (Pandalus borealis, identification not definite), a few skate, many tanner crabs, a few <u>Cancer magister</u>, a few ratfish, two prickleback fish, a single dogfish, and a single perch-like fish. The Pisces passed over a depression in the bottom containing 8-10 prawns (P. platyceros); no other prawns were observed on the dive. The depth after 1 hour of travel was 130 metres and the weak bottom current was still present and persisted throughout the dive.
- 105m a white slime appeared in patches on the substrate indicating decomposition of organic material possibly fibre, although fibre deposits were not evident.
 - shrimp present in great abundance, most appeared to be juvenile "pink" shrimp (identification not definite).
 - the bottom incline had increased slightly.
 - trenches along the bottom possibly indicative of commercial trawling activities.

100m - steep incline encountered with a rock face and associated benthos change, i.e., large anemones (<u>Metridium</u> sp. and an unknown pink species).

90m - another change in bottom topography to a rocky substrate and an incline of approximately 35°. The clumps of suspended fibre were increasing. Many worm castings observed and small potholes (3-6 cm diameter) approximately 6/square metre.
78m - return to soft substrate with increasing slime patches and a noticeable decrease in benthos (only a few shrimp present).
60m - another steep rock face encountered, many Metridium sp., worm castings, and small gastropods present on rock faces. Rock face followed by reduced incline and soft

50m - another rock face encountered followed by soft fibrous substrate. The fibre deposits appeared to be old.

40m - many sole (15-35 cm length) were present on the soft substrate; however, other benthic life had virtually disappeared with the exception of a few shrimp. Large fibre particles were present suspended above the bottom.

35m - no shrimp present, many sole on what appeared to be old fibre deposits.

25m - Pisces moving up an incline of approximately 20⁰ over soft fibrous substrate.

17m - no benthic organisms observed, water became very murky, no surface light was penetrating the water column.

- began ascent at 1700 hours.

13m

substrate.

Surface - STD probe recordings - dissolved oxygen - 14 ppm - conductivity - 31.59 - temperature - 9.78^oC - depth - 2m

- the Pisces surfaced approximately 100 metres north west of the vent tower for the north outfall.

SUMMARY

The dive was characterized by an abundance of shrimp at depths of about 100 metres with a soft mud substrate. In the area between 100 metres depth and 60 metres depth steep rocky slopes were encountered interspersed with areas of reduced incline and soft substrate (step-like configuration). The rock faces were from 3 to 10 metres in height and were inhabited by large anemones and some gastropods.

From 50 metres depth to 25 metres depth the dominant benthic organisms were sole with a gradual decrease in the numbers of shrimp. At these depths the bottom topography was also step-like with the soft substrate between rock slopes becoming more fibrous in nature as the Pisces proceeded shoreward.

From the 25 metre depth until the Pisces surfaced from 13 metres depth, the bottom was inclined about 20⁰ and was characterized by a soft fibrous substrate. No life was observed on the bottom from the 17 metre depth to the completion of the dive.



Location:	Northumberland Channel (Ha	armac diffuser)	Date:	14 April 1978
Dive No.:	649 (track 1) (Fig. 26)			
Observers:	N. Holman, G. Packman			
Position:	Start	<u>Finish</u>		
	49 ⁰ 08.7'N	49 ⁰ 09.00'N		
	123 ⁰ 51.7'W	123 ⁰ 51.45'W		

Depth: 109m

Watercolumn

Very little phytoplankton or zooplankton was apparent in the watercolumn. However, a layer of copepods and detritus was observed at a depth of 40-43 metres. At 72 metres amphipods, euphausids and a siphonophore were observed while at 80 metres a relatively dense layer of euphausids was observed. A ctenophore was also observed at 80m. The dissolved oxygen reading on the CTD probe was 8.5 - 8.6 mg/l throughout the descent. The depth at the point of descent was 85m.

Oceanographic Data (as collected with N.I.O. bottles)

Depth	Temperature	Salinity	Dissolved Divygen	% Saturation
0	8.93	27.86	8.85	93.59
2	8.93	28.07	8.70	92.15
5				
10	8.65	28.46	8.20	86.50
25	8.45	28.72	7.85	82.57
50	8.08	29.30	6.60	69.06
90	8.15	29.61	5.90	61.98
	Depth 0 2 5 10 25 50 90	DepthTemperature08.9328.935	DepthTemperatureSalinity08.9327.8628.9328.075	DepthTemperatureSalinityDissolved 0xygen08.9327.868.8528.9328.078.705108.6528.468.20258.4528.727.85508.0829.306.60908.1529.615.90

<u>Station</u>	Depth	<u>Nitrate</u>	<u>Nitrite</u>	Ammonia	lotal <u>Phosphate</u>
NC-13	0	0.266	<0.0050	0.0055	0.0670
	2	0.289	<0.0050	0.0080	0.0695
	5	0.289	<0.0050	0.0080	0.0665
	10	0.308	<0.0050	0.0105	0.0698
	25	0.330	<0.0050	0.0130	0.1600
	50	0.355	<0.0050	0.0100	0.0733
	90	0.390	0.0023	0.0050	0.0825

Bottom Characteristics

The bottom throughout the dive was observed to be a soft mud bottom with an occasional rock or log protruding. The substrate did however change markedly in the vicinity of the pipe end. The soft silt had been blown away from that area and woodchips, gravel and non-degradable metal and plastic items were apparent. A thin white film was apparent over the substrate. Further away from the diffuser where silt was present, woodchips appeared to lie under the silty layer.

Bottom Fauna

The bottom fauna in the portion of the dive where the diffuser was approached was fairly uniform, typical of a soft mud bottom. The fauna observed on the track leading up to the pipe included; sea anemones (Metridium senile), large snails (Neptunea sp.), small sea cucumbers (probably Chirodota sp.), crangon, prawns (Pandalus platyceros), squat lobsters (Munida quadrispina), Dungeness crabs (Cancer magister), dogfish (Squalus acanthias), ratfish (Hydrolagos colliei), whitebarred prickleback (Poroclinus rothrocki), unidentified pricklebacks (Stichaeidae), tomcod (Microgadus proximus), grey cod (Gadus macrocephalus), rockfish (Sebastes sp.), lemon sole (Parophrys vetulus), unidentified sole (Pleuronectidae) and eelpouts (Zoarcidae). The bottom had holes in it which varied in size and density (from a few to many in a given area) throughout the dive. These holes are indicative of density in the benthic community. Also the numbers of Chirodota sp. varied from as few as <1/m² to as many as $20 - 30/m^2$.

While running down the pipe towards the diffuser the fauna was observed to be similar in nature and composition to that observed while attempting to locate the pipe. There were however a number of epifaunal forms utilizing the pipe both as protective cover and as a substrate. These forms included sea anemones (<u>Metridium senile</u>) using the effluent pipe as a substrate. The fauna using the pipe as protective cover included increased members of crangon, prawns (<u>Pandalus</u> <u>platyceros</u>), Dungeness crabs (<u>Cancer magister</u>) and rockfish (quillback rockfish, Sebastes maliger; yelloweye rockfish, Sebastes ruberimus).

In the degraded area around the end of the diffuser very little benthic infauna was observed. There were however a number of prawns (<u>Pandalus platyceros</u>), a crab (<u>Cancer productus</u>) and a large grey cod (<u>Gadus macrocephalus</u>).

Pipe and Diffuser

Where the pipe was initially contacted it was observed to be approximately 60 - 90 cm. in diameter and partially sunk into the substrate. Shortly before the diffuser was reached the pipe diameter increased to 1m - 1.3m. A good view of the diffuser itself was not available on this dive.

Summary and Conclusions

The diffuser was not operating at the time of this dive and as a result no discolouration was apparent in the watercolumn and no observations could be made on the behaviour of the effluent at the point of discharge. There appeared to be a degraded area at the end of the diffuser pipe. Material such as woodchips and debris had collected there eliminating the benthic infauna. There was however epibenthic and bathypelagic fauna in this area indicating that water quality had not been permanently impaired.



CHANNEL (HARMAC) 1978. DIVE TRACK, NORTHUMBERLAND PISCES FIG. 26

Location: Northumberland Channel (Harmac diffuser) Date: 15 April 1978 Dive No.: 651 (track 2) (Fig. 27) Observers: G. Packman, N. Holman Position: <u>Start Finish</u> 49^C08.84'N 123^O51.83'W

Depth: 95m

Watercolumn

On descending through the watercolumn between the surface and 36m small particulates and detritus were noted in the watercolumn as well as a brown colour presumably from the Harmac effluent stream. At 39 metres the brown colour cleared slightly and at 42 metres extended agglomerations of detritus were observed. A Chaetognath was noted at 46 metres while from 64 metres to 70 metres increasing numbers of amphipods were noted. The turbidity increased slightly as the bottom was approached. Generally speaking there was little in the way of phytoplankton and zooplankton in the watercolumn. The depth at the initial point of descent was 94 metres.

Bottom Characteristics

The bottom on the approach to the pipe was a flat mud bottom with an occasional log or rock on the surface. The number of holes from benthic infauna varied over the approach to the pipe but was noted at 2 - 5 holes/metre² shortly after the start of the run. Just before encountering the pipe loose clumps of clay were noted.

The bottom characteristics changed dramatically at the end of the diffuser. A thin white coating was noted on the surface of the sediment which could have been either fibre or a bacterial slime or a combination of the two. The bottom was also covered with wood waste debris and bits of non-degradable material. The bottom conditions were surveyed on a course of 340° M directly out from the end of the pipe. On this line the fibre or bacterial slime extended approximately 30 - 40 metres from the pipe end. There was still lots of woody debris apparent at the end of this line.

Bottom Fauna

On the approach to the pipe the fauna observed was typical of a soft mud substrate. The types noted included sea anemones (<u>Metridium senile</u>), <u>Gastropteron</u> <u>pacificum</u>, an octopus, a gastropod (<u>Neptunea</u> sp.) euphasids just above the bottom, prawns (<u>Pandalus platyceros</u>), pink shrimp (<u>Pandalus sp.</u>) crangon, squat lobsters (<u>Munida quadrispina</u>) hermit crabs (<u>Pagurus sp.</u>), Dungeness crabs (<u>Cancer magister</u>), sea cucumbers (<u>Chirodota sp.</u>), a skate (Rajidae), catfish (<u>Hydralogos colliei</u>), grey cod (<u>Gadus macrocephalus</u>), tomcod (<u>Microgadus proximus</u>), eelpouts (Zoarcidae), pricklebacks (Stichaeidae), rockfish (<u>Sebastes sp.</u>) and sole (Pleuronectidae).

The numbers of <u>Chirodota</u> sp. varied from as low as 2 - 5 individuals per square metre to $20 - 30/m^2$ but were apparent throughout the dive.

The fauna observed while running along the pipe was similar to that observed on the approach. However in addition to those types lingcod (<u>Ophiodon elongatus</u>) were also observed. Sea anemones (<u>Metridium senile</u>) were noted clinging to the pipe. Prawns (<u>Pandalus platyceros</u>) and pink shrimp (<u>Pandalus sp.</u>) were noted in considerable numbers utilizing the sheltered habitat under the curve of the pipe. Also a number of rockfish (Sebastes sp.) were observed around the pipe.

Little or no benthic infauna was observed in the degraded area at the end of the diffuser. A considerable number of epifaunal and bathypelagic forms were however noted in this area. These forms included polychaetes (Polynoidae), crangon, Dungeness crabs (<u>Cancer magister</u>), dogfish (<u>Squalus acanthias</u>), plainfin midshipman (<u>Porichthys notatus</u>), grey cod (<u>Gadus macrocephalus</u>), and rockfish (<u>Sebastes sp.</u>).

Description of Diffuser

The diffuser appeared to be approximately one metre in height with the ports located on the top. The end was open and there was a small, upturned lip on the bottom, presumably to deflect debris up and clear of the end. Some reference numbers were noted on the pipe and photographed for future reference. A small pipe was noted running along the top of the effluent pipe. It was difficult to observe the effluent coming out of the pipe as it came out with a considerable pressure, catching Pisces and carrying the boat up with it. The effluent was however observed to stream straight up from the diffuser ports.

Summary and Conclusions

The observed area of benthic disruption appeared limited in area extending 30 - 40m from the open end of the diffuser. In this area, directly adjacent to the pipe the silt had been blown away and some woodwaste, gravel and nondegradable material was present. Further out from the pipe the substrate was coated with a layer of bacterial slime or fibre or a combination of both, indicative of an adverse affect stemming from the release of suspended solids from the pulpmill. The disruption at the present time did not appear to be too extensive. However this should be monitored over time by means of a sediment coring program conducted by the mill to avoid the development of a serious problem.

On this dive the effluent was visible in the watercolumn.



CHANNEL (HARMAC) 1978. DIVE TRACK, NORTHUMBERLAND PISCES FIG. 27

Powell River, Malaspina Strait Location: Date: 30 November 1978 (proposed pulp mill diffuser location) Dive No.: 719 (Track 1) (Fig. 28) Observers: R. Hoos, H. Nelson Position: Start Finish 49⁰52.05'N 49⁰52,20'N 124⁰34.60'W 124⁰33.80'W

Depth: 100m

The dive commenced in 100 metres of water approximately 200 metres seaward of the estimated termination point for a diffuser proposed for the Powell River pulp mill. The diffuser and pipe are to extend approximately 800 metres from shore with the diffuser portion constituting about 330 metres at the The downstream end of the diffuser will be at about 72m depth and the end. upstream end at about 55m depth. Upon reaching the bottom the Pisces proceeded on a course intended to cover the area into which the diffuser would discharge. As shown on the Figure the course varied slightly from the intended track, however, bottom characteristics should not be significantly different.

OBSERVATIONS:

Surface	- water clear, few plankton observed.
	Descending
20m	 visibility good, surface light, one pelagic polychaete observed, very little suspended material.
30m	- surface light was still evident.
40m	- loss of surface light.
45m .	 many pelagic amphipods (white colouration) observed from this depth to the bottom.
75m	- school of herring, 5 - 10 centimetres in length observed.

- 96 -

Bottom

- at 100 metres
- bottom substrate a fine grey-brown sediment underlying a thin layer of wood particles i.e. not a reducing substrate. Small craters about 5 cms in diameter and larger depressions about 30 cms in diameter
- Bottom visibility 5 to 7 metres and no noticeable current was present
- benthos consisted of small shrimp with white legs (approximately 2 or 3 per square metre), eel pouts (Lycodes sp.), flat fish, pelagic polychaetes and amphipods, and dungeness crabs (Cancer magister).
- moved towards shore at a bearing of approximately 060⁰ magnetic up a slight incline. More wood debris encountered, a few large boulders (50 to 100 cms in diameter), a few large pieces of wood debris and logs. Several greenstriped rockfish (<u>Sebastes elongatus</u>) and orange anemones (<u>Metridium senile</u>) associated with boulders and large wood debris.
- Course change to 040⁰ magnetic. Continued toward shore up a slight incline, substrate became more fibrous in nature and patches of white bacterial slime began to appear. Water became murky briefly. Benthos remained unchanged with the addition of squat lobsters (<u>Munida quadrispina</u>) and a few prawns (<u>Pandalus platyceros</u>). The numbers of small shrimp increased to 10 to 15 per square metre. Another school of small herring containing several hundred individuals was observed.
 - encountered several pieces of large wood debris and a few boulders. Benthos associated with this area included organisms mentioned previously and also rat fish (<u>Hydrolagus colliei</u>), lingcod (<u>Ophiodon elongatus</u>), quillback rockfish (<u>Sebastes maliger</u>) and <u>Neptunea</u> sp. Another school of herring was observed (or possibly the same school reported earlier). Pieces of rusted pipe

87m

and stainless steel wire were observed.
- patches of white bacterial slime were more prevalent
 substrate more fibrous in nature with very fine fibres loosely compacted. Less shrimp observed than previously.
- observed a large skate (<u>Raja</u> sp.)
- The surface tender boat estimated our position to be approximately 3/4 of the way along the intended track and approximately 500 metres from shore.
 natural substrate in this area appeared to be gravel which had been covered by a fine fibre mat 10 to 30 cms in thickness; wherever a boulder or log had been deposited the fine fibre was displaced beneath the object thereby exposing the gravelly substrate. Many small lingcod (1 to 2 kgs) were noted in the area.
- 1 sea cucumber (<u>Parastichopus</u> sp.) - more rusted pipe and wire observed
 water became murky again. The small shrimp, present since the beginning of the dive, have disappeared. CTD Probe recordings - D.O. 5.7 Mg/l Temp. 9.2°C few small sould observed and several flatfish
- patches of white stringy material (bacterial growth?)
- (12:30 Hours); patches of bacterial slime increased
 visibility improved, wood debris becoming coarser and appears to be of more recent origin.
 began moving up steep incline, fibre became progress- ively more coarse. Visibility increased to 10 to 15 metres with surface light. Many small pieces of white paper were lying on the fibre mat, presumably from the newsprint operation.

10m - bottom levelled off and Pisces began ascent.
Surfaced

- 12:40 hours, tender boat estimated the Pisces surfaced approximately 100 metres from boom sticks at the mouth of the tailrace.

Summary

At the beginning of the dive the bottom substrate was characterized by soft sediment (mud) underlying a thin layer of wood particles. It did not appear to be a reducing sediment. As the Pisces moved shoreward the natural substrate appeared to become gravelly (65m) however it was covered by a progressively thicker layer of fine fibrous wood debris. As the shallower depths were approached (35m) the wood debris became coarser in nature and seemed to be more recently deposited. The only steep incline was encountered at 30m and appeared to be composed of fibrous wood debris. The incline continued to a depth of 10m when the bottom levelled off.

Benthos encountered during the dive were predominately small shrimp, demersal and pelagic fish. Above the depth of 50m no shrimp were observed and the dominant fish were demersal flounders or sole.



FIG 28 PISCES DIVE TRACK, POWELL RIVER (1978).

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Location:	Harmac (diffuser)		Date:	10 M	lay	1979
Dive No.:	761 & 762 (Fig. 29)					
Observers:	G. Packman, D. Goyette					
Position:	<u>Start</u> 48 ⁰ 08.75'N 123 ⁰ 51.98'W	<u>Turn</u> 48 ⁰ 08.82'N 123 ⁰ 51.47'W	<u>Finis</u> 48 ⁰ 08.9 123 ⁰ 51.4	<u>sh</u> 97'N 15'W		

Depth:

Note: Two dives were conducted to inspect the Harmac diffuser due to problems with the Pisces on the first dive. The reports from both dives have been combined into one report.

Water Column

Effluent was observed in the surface water down to a depth of 10-15 metres at both the dive and surfacing locations. At approximately 15 metres the visibility became quite clear. At 25 metres strings of detrital material became apparent in the water and the occasional pelagic amphipod was noted. At the 40-45 metre depth zooplankton began to appear with some ctenophores, scyphozoans, amphipods and euphausids being noted. The zooplankton and detritus concentrations became thicker as the bottom was approached at approximately 80 metres. No further layers of effluent other than the surface layer were noted.

Bottom Characteristics

The bottom on descent during both dives was soft mud without many large holes. The holes in the substrate numbered approximately $1-2/m^2$. These characteristics did not vary greatly throughout the approach to the outfall pipe. Initially however pockets of white bacterial slime were noted in depressions in the bottom. Also the bottom was disturbed in one area where construction rubble or material from Nanaimo's mines had been disposed of.

During the run down the outfall pipe the bottom was predominantly soft mud with approximately 1 large hole per square metre. Silt was noted to have built up around the lower 1/3 of the pipe. Many crab tracks in the soft sediment

were noted running parallel to the pipe. No fibre was apparent on the bottom along the pipe however some bacterial slime was noted along the base. One log was observed lying beside the pipe.

Soft mud remained the predominant substrate at the proximal end of the diffuser. Below the first port of the diffuser some scouring was apparent. The sediment was slightly black indicating that some wood waste must have been deposited and was undergoing reduction. On the eastern side of the diffuser some scouring had occurred. Wood wastes were present in the sediment in this area but not as much as on the western side of the diffuser. As the end of the diffuser was approached more wood debris became apparent.

At the open end of the diffuser scouring was apparent while a significant quantity of wood splinters and chips had been deposited. A course was run directly out from the diffuser end in order to determine whether or not fibre was accumulating and the extent of any accumulation. Extending to a distance of approximately 20 metres from the diffuser end the bottom was composed mainly of splinters, knots and other debris. At about 20 metres from the diffuser end more sediment became mixed in with the wood wastes giving the substrate an appearance similar to that noted in most of the Point Grey ocean disposal site. This course was continued for approximately 60 metres from the outfall where some wood wastes were still noted mixed in with the natural sediments.

A course was also run west from the diffuser. On this course splinters of wood and debris were noted mixed in with fine sediments, extending for a distance of approximately 20 metres. The sediments and wood wastes did not appear to be reduced.

An easterly course was run from the end of the diffuser to delineate the extent of deposition in that direction. The characteristics of the sediment remained the same as on the other two transects with the accumulation of wood debris extending approximately 40 metres.

No real signs of fibre were apparent anywhere, however wood chips, splinters and debris were quite prevalent.

Fauna

The fauna noted during the approach to the outfall pipe was similar to that noted on previous Pisces dives in the area and typical for a soft mud bottom.

The predominant faunal forms included <u>Chirodota</u> sp burrowing in the substrate, small shrimp and crangon, eelpouts (Zoarcidae) and pricklebacks (Stichaeidae). During the run down the pipe sea anemones (<u>Metridium</u> sp.) were noted on the pipe, as well as squat lobsters (<u>Munida quadrispina</u>). Dungeness crabs (<u>Cancer</u> <u>magister</u>) and prawns (<u>Pandalus platyceros</u>) were noted seeking cover along the bottom of the pipe. In the vicinity of the diffuser some fish and crustaceans were noted. Quite a few squat lobsters (<u>Munida quadrispina</u>) were noted amongst the wood wastes near the diffuser end. Also 2 ratfish (<u>Hydrolagus colliei</u>), a rockfish (<u>Sebastes</u> sp.) and 2 lingcod were noted in close proximity to the effluent stream.

The discharge appeared to be exerting a definite impact upon the benthic receiving environment in the form of wood waste deposition. Wood wastes appeared to have covered the benthic infaunal community. Also eelpouts (Zoarcidae) and pricklebacks (Stichaeidae) were not present in the zone of influence of the diffuser. Squat lobsters (<u>Munida quadrispina</u>), ratfish (<u>Hydrolagus colliei</u>) and lingcod (<u>Ophiodon elongatus</u>) were noted in the immediate vicinity of the discharge.

Conclusions

The bottom observed on the approach to the pipe was a soft mud bottom as noted on previous dives. An accumulation of wood wastes in the form of knots, splinters and industrial debris was noted in the vicinity of the diffuser end. No accumulation of fibre, as such, was noted on this dive. Pisces dives should be continued in the future to monitor the diffuser impact.

- 102 -

Track 1

Faunal Form	Abundance
<u>Metridium</u> sp.	 4 noted during approach to pipe many noted on top of pipe.
<u>Rossia</u> sp.	- 1 noted.
<u>Chirodota</u> sp.	 noted occasionally during first portion of dive along pipe approximately 20/m² were noted.
<u>Pycnopodia</u> sp.	- 1 noted
<u>Munida quadrispina</u>	 some on rocky rise lots adjacent to airpipe along top of outfall pipe
<u>Pandalus</u> platyceros	 approximately 15 noted on approach to pipe quite a few noted along pipe using pipe for cover
Small Pink Shrimp (unidentified)	- noted occasionally on bottom
<u>Crangon</u> sp.	 noted occasionally during approach and along pipe
<u>Cancer</u> <u>magister</u>	 noted occasionally during approach to pipe. 1 noted approximately every 10m along pipe.
<u>Pagurus</u> sp.	- 1 noted
<u>Hydrolagus colliei</u>	 5 noted occasionally quite a few juveniles around boat
Porichthys notatus	- 1 noted
Gadus macrocephalus	- 2 noted
Merluccius productus	 school noted upon initial arrival on bottom

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Track 1 (continued)

Faunal Form	Abundance
Zoarcidae	- 6 noted
Stichaeidae	- 9 noted
<u>Sebastes</u> maliger	- 4 noted
<u>Sebastes</u> sp.	- 5 noted
<u>Ophiodon</u> <u>elongatus</u>	- 4 noted - two near effluent
Pleuronectidae	- 12 noted

Track 2

Faunal Forms	Abundance
· · · · · · · · · · · · · · · · · · ·	
Metridium	- a few noted on diffuser
<u>Octopus</u> sp.	- 1 noted near diffuser
<u>Chirodota</u> sp.	- quite a few noted in sediment as woodwastes thinned
Pandalus platyceros	- 3 noted under diffuser - 2 noted away from diffuser
Small Unidentified Shrimp	- noted occasionally
Munida quadrispina	- quite a few noted amongst woodwastes
Tanner crab	- 3 noted approximately 20m from diffuser
Hydrolagus colliei	 approximately 7 noted in vicinity of outfall, 2 right under effluent stream
<u>Sebastes</u> maliger	- 2 noted
<u>Ophiodon elongatus</u>	- 5 noted
Pleuronectidae	- 3 noted



Location:	Woodfibre			Date: 1	May 1979
Dive No.:	764 (track	1) (Fig. 30)			
Observers:	D. Goyette,	H. Nelson			
Position:	Start	Turn	Turn	Turn	Finish
	49 ⁰ 39.60'N 123 ⁰ 14.80'W	49 ⁰ 39.83'N 123 ⁰ 14.89'W	49 ⁰ 39.92'N 123 ⁰ 14.95'W	49 ⁰ 39.57'N 123 ⁰ 15.04'W	49 ⁰ 39.18'N 123 ⁰ 14.61'W

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- Depth: 250m
- Note: No report available.

- 108 -

PISCES IV DIVE RECORD

 Location:
 Woodfibre
 Date:
 11 May 1979

 Dive No.:
 764 (track 2) (Fig. 30)
 Date:
 11 May 1979

 Observers:
 D. Goyette, H. Nelson
 Position:
 Start
 Finish

 $49^{0}39.69'N$ $49^{0}40.05'N$ $123^{0}15.24'W$ $123^{0}14.63'W$

Depth:

Note: No report available.



FIG. 30 PISCES DIVE TRACKS, WOODFIBRE (1979).

Location:	Powell River	· (pulp mill)		Date: 1	11 March 1980
Dive No.:	827 (Fig. 3	1)			
Observers:	H. Nelson, M	hr. Beaton			
Position:	Start	Turn	Turn	Turn	Finish
	49 ⁰ 52.29'N 124 ⁰ 34.29'W	49 ⁰ 52.21'N 124 ⁰ 34.12'W	49 ⁰ 52.07'N 124 ⁰ 34.40'W	49 [°] 52.12'N 124 [°] 34.35'W	49 ⁰ 52.23'N 124 ⁰ 34.08'W

- Depth: 75m
- Note: No report available.



Location:	Nanaimo (Harmac)			18	March	1980
Dive No.:	834 (Fig. 32)					
Observers:	G. Packman, N. Holman					
Position:	Start	Turn	Fini	sh		
	49 ⁰ 08.53'N	49 ⁰ 08.53'N	49 ⁰ 08.	98'1	N	
	123 ⁰ 51.18'W	123 ⁰ 51.46'W	123 ⁰ 51.	43'	N	

Depth: 100m

Note: No report available.



- 114 -

1980

PISCES IV DIVE RECORD

Location:	Crofton		Date:	19 March
Dive No.:	835 (Fig. 33)			
Observers:	G. Packman, N. Holman			
Position:	<u>Start</u>	Finish		
	48 ⁰ 54.06'N 123 ⁰ 37.38'W	48 ⁰ 53.61'N 123 ⁰ 37.98'W		

Depth: 170m

Note: No report available.



TRACK, CROFTON PULPMILL (1980) DIVE PISCES FIG. 33

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Location:	Thornbrough Channel (proposed diffuser location off Port Mellon Pulp Mill)		Date:	19 March 1981	
Dive No.:	1012 (t	rack 1 and 2)	(Fig. 34)		
Observers:	H. Nelso	n, D. DeMill			
Position:		Start	Finish		
	Track 1	49 ⁰ 31.17'N 123 ⁰ 28.66'W	49 ⁰ 31.3'N 123 ⁰ 28.8'W		
	Track 2	49 ⁰ 31.21'N 123 ⁰ 28.60'W	49 ⁰ 31.3'N 123 ⁰ 28.8'W		

Depth:

Track 1

Summary

The dive began in 197 metres of water approximately 600 metres southeast of the mouth of the Rainy River. The Pisces proceeded on a course of 324° which would take it along the line proposed for the new effluent diffuser. The new diffuser will extend about 300 metres from shore to a depth of approximately 120 metres.

At the beginning of the dive the bottom was comprised of a thin layer of silt, brown sediment and pockets of wood debris overlying a sand substrate. Rocks and boulders appeared in patches along the course of the dive. The majority of the rocks observed were 10 to 30 cm. in diameter with a few to about 80 cm. in diameter. Several pieces of scrap metal, plastic, rubber and old planks were scattered along the bottom.

Various organisms were observed during the dive as noted in the attached species list. Prawns were present in the greatest numbers with several hundred juveniles observed during the latter stages of the dive.

The bottom was relatively flat until the Pisces reached the 155 metre depth when it began moving up a slope inclined at approximately 20° - 25° . The incline in-

creased gradually as Pisces proceeded towards shore with a 35° - 45° angle at 70 metres depth, a 45° angle at 40 metres, and a 60° angle at 13 metres depth. There was no evidence of sloughing, however a small trough was encountered at the 100 metres depth.

OBSERVATIONS:

Bottom	 197 metres, good visibility (approx. 6m), no current. soft brown sediment and patches of wood debris overlying sand substrate.
	- little indication of burrowing activity. - proceeding towards shore on a course of 324 ⁰ (mag.).
175m	- patches of rocks and boulders, scrap metal.
155m	- incline of approximately 20 ⁰ - 25 ⁰ , bottom relatively flat with rocks and boulders protruding.
135m	 area traversed with no rocks visible, approximately 20 metres.
100m	 trough observed approximately 6 metres across with sides 1 and 2 metres high.
90m	 continuing up incline, industrial debris decreased slightly otherwise bottom unchanged.
70m	- incline of slope increased to 35 ⁰ - 45 ⁰ .
53m	- the numbers of rocks and boulders have decreased.
40m	- slope increased to 45 ⁰ incline, still fewer rocks and boulders than earlier in dive.
30m	- still fewer rocks and boulders.
21m	 incline of slope increasing, more wood debris encountered extending to at least 10 centimetres in depth. patches of white bacterial slime observed.
13m	 very steep slope (60⁰) of wood debris with black (reducing) sediments below the surface layer. dive terminated.

Track 2

Summary

The dive began in 158 metres of water approximately 450 metres from shore. The Pisces proceeded toward shore on a course of 298° (mag.) following a proposed diffuser line presented as an alternate to that followed in Track 1. At the beginning of the dive the bottom consisted of fine brown sediment, wood debris, scrap metal, leaves and small rocks overlying sand. The Pisces proceeded up a slope which rose off to the right of the Track and was inclined approximately 15° . The angle of the slope increased throughout the dive ie. 30° at 136 metres, 35° at 86 metres, to a maximum of 55° to 60° at the end of the dive at 17 metres.

As with Track 1 the bottom was relatively smooth with rocks and boulders occurring in patches. There appeared to be more small rocks and gravel on Track 2 and a fewer number of the larger boulders. Marine life was the same as the previous track with a predominance of prawns.

At a depth of 70 metres the amount of wood debris on the bottom increased with a subsequent increase in the number of juvenile prawns. At 36 metres depth an area of sloughing was observed where the sloughed material was mainly wood waste ie. wood chips and bark fragments. From this depth to the end of the dive at 17 metres the slope was very steep and appeared to be comprised of wood wastes.

OBSERVATIONS:

Bottom	- 158m, good visibility, no discernable current.
136m	 slope increased to 30⁰ incline, no large boulders, no evidence of sloughing.
124m	 pockets of wood debris with increased numbers of squat lobsters.
114m	- very few rocks in this area, some wood debris and scrap metal.
97m	- bottom substrate changed to small rocks and gravel.
86m	- slope incline increased to 35 ⁰ .
70m	 more wood debris encountered and an increase in numbers of juvenile prawns.

55m	- size of rocks increased.
36m	 evidence of sloughing from a slope of predominately wood waste.
28m	- steep slope of wood debris.
23m	- slope very steep (55 ⁰ to 60 ⁰), wood wastes and patches of white bacterial slime.
17m	- end of dive on steep slope of wood wastes.

Pisces IV Dive 1021 - Species List

dogfish	-	<u>Squalus acantheas</u>
ratfish	-	<u>Hydrolagus colliei</u>
pollock	-	<u>Theragra</u> chalcogramma
hake	-	Merluccius productus
midshipman	-	<u>Porichthys</u> notatus
sidestrip shrimp	-	<u>Pandalopsis dispar</u>
Pelagic shrimp	-	<u>Paciphaea</u> <u>pacifica</u>
Pink shrimp	-	<u>Pandalus</u> borealis
burrowing anemone	-	Pachycerianthus sp.
anemone	-	<u>Metridium senile</u>
squat lobster	-	<u>Munida quadrispina</u>
Dungeness crab	-	Cancer magister
prawn	-	<u>Pandalus</u> platyceros
octopus	-	<u>Octopus</u> sp.
snail	-	<u>Colus</u> sp.

rockfish, anemones, eel pouts, small shrimp, plankters.

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- other organisms observed but not identified to species included:



FIG. 34 PISCES DIVE TRACKS, PORT MELLON (1981).

Location: Northumberland Channel (Harmac) Date: 25 & 26 February 1981 991 (track 2), 992 (track 1), 993 (track 3) (Fig. 35) Dive No.: Observers: M. Pomeroy Position: Start Turn Finish 48⁰08.68'N 48⁰08,68'N 48⁰09,15'N track 2 122⁰51.13'W 122⁰51.47'W 122⁰51.37'W 48⁰09.25'N 48⁰09.27'N track 1 122⁰52.13'W 122⁰51.35'W 48⁰08.55'N 48⁰08.80'N 48⁰08.97'N track 3 122⁰50.13'W 122⁰50.57'W 122⁰51.23'W Depth: 90m (track 2) 114m (track 1) 97m (track 3)

Clumps of material varying in size from tennis balls to several cubic feet have been reported by shrimp trawlers over a considerable portion of Northumberland Channel during the past two years. The material has been described as strong smelling (H_2S) and of unusual appearance (aggregates of sand, shell, wood debris and wood fibres). Some of the material received from the district fisheries officer was prepared by EPS and sent to Dr. H. Rogers (DFO) for subsequent analysis. A tetrahydropimaric acid and a diterpene hydrocarbon, both uncommon in wood extracts, and a number of wood sterols were identified. Dr. Rogers considers the sample to have contained resin acids probably originating in mill effluents, which had undergone substantial bacterial breakdown under anaerobic conditions making them difficult to identify.

Bioassays performed by Ron Watts (EPS) indicated the material to be highly toxic to fish. 96 hr. LT_{50} : 20 to 24 hrs. at 4.2% by volume of unextracted sample.

Based on the above findings, a Pisces dive was requested to investigate bottom conditions in the area.

Track 2 (1st Dive):

Approaching the outfall pipe on the first leg of the track, the substrate consisted of silt overlying firmer sediments. Prawns (<u>Pandalus platyceros</u>), shrimp (<u>Pandalus sp.</u>), and crab (<u>Cancer magister</u>) were abundant along with large sea anemones (<u>Metridium sp., Stomphia sp.</u>) and sea pens. Ratfish (<u>Hydrologus colliei</u>), rockfish, ling cod and sole were most abundant around the pipe itself.

The effect of current action was evident along the pipe. On acquisition, it was setting on the surface, but further from shore it was variously covered by sediment to 1/3 to 2/3 of its height. In places the pipe was undercut to <u>ca</u>. 0.5m for a distance of up to 10m. Current at the bottom (approximately 90m) was S.E. at .5 km./hr.

Visibility in the water column was about 4 to 5m on reaching the bottom and decreased slightly closer to the outfall pipe. This distance decreased to 2 to 3m as the diffuser was reached. At the termination of the dive, visibility was 1 to 2m. A mixture of zooplankton and fibre material existed throughout the column, increasing in concentration below 20m.

Small isolated patches of white material about 0.25m in diameter were encountered along both legs of the track. These were reported in past Pisces dives at this location and were considered to be a mixture of fungal/bacterial growth responding to wood fibre-debris deposition. Most of the white patches appear in small depressions in the sediment where material collects.

The gravelly substrate immediately at the end of the diffuser graded into an area of gravel and wood debris (chips and bark) extending out 10 to 20m. Crabs, prawns, shrimp and rockfish were still abundant in the region. The white patches were becoming more prevalent and at about 40 - 45m from the diffuser became heavy covering the bottom with a thin layer. Species diversity and abundance began to decrease at this point. At a depth of 98m at an estimated distance of 70m from the diffuser a heavy fibre bed was located. The bottom was very unconsolidated and 'jelly-like' in nature and was easily disturbed to reveal black reducing sediments which rapidly mixed and surrounded the Pisces. The bed appeared to be at least one metre deep. This condition extended cross-channel to a rock outcropping where the dive terminated. The only benthic fauna in the area of the fibre bed were a few shrimp and prawns in its surface and small anemones on protruding rocks.

Track 1 (2nd Dive):

Results of the second dive further north in Northumberland Channel were similar to the first. On first reaching the bottom at 114m visibility was about 2 to 4m. Crabs, prawns, shrimp, anemones, ratfish, rockfish and sole were present but in lower abundance compared to the first dive. At 109m about one quarter way along the track, isolated white patches were located on an unevenly rolling bottom. The distribution of white material became greater and by 101m (half way along the track) the fibre bed had been located. It was again soft and reducing, the submersible sinking to its ports (ca. 1m) in the material. Little life was evident on the mat aside from a few shrimp and prawns on the surface and anemones on protruding rocks and logs. The fibre bed was followed cross-channel to the rock outcropping at Gabriola Island. At 62m, below the booming grounds near the island, the fibre mat became somewhat less prominent with considerable amounts of wood debris present.

Track 3 (3rd Dive):

This dive was made south of the diffuser to locate the southern extent of the fibre bed. At point of descent, the bottom at 41m had a soft silty surface layer (\underline{ca} . 15 - 20 cm) with a firm layer below. Numerous rocks and boulders dotted an irregular bottom. Ratfish, cod, rockfish, crab, shrimp, prawns and anemones were present in moderate numbers. Visibility was between 2 - 3m with considerable particulate matter in the water drifting southeast. These conditions prevailed out into the channel along the first leg of the dive to a depth of 73m. Brittle stars, squat lobsters and sole were noted at this point.

Having not encountered any white fibre material to this point, a 90° turn to the north was made towards the diffuser. The bottom was rocky and irregular with crab, shrimp and ratfish abundant. At 83m, about 2/3 along the second leg, the white deposit was discovered, forming a mat at 97m <u>ca</u>. 3/4 along the second leg of this track. The physical appearance of the bed was as reported for the past two dives, the only difference being the presence of a few crabs on its surface.

<u>Conclusion</u>:

An unconsolidated fibre bed at least 1m deep in places exists below 97m on the Gabriola Island side of Northumberland Channel. We were able to locate its southern extent but a further dive is needed to delineate the northern limit. The approximate known extent is shown on Figure 35 and covers an area \underline{ca} . .5 km wide by 1.6 - 2.0 km long. From the three dives, coverage varies from light to heavy but appears fairly complete.

The effect on benthic fauna was obvious with diversity and abundance dropping rapidly as the fibre bed was reached. Crabs and shrimp occurred on the surface of the bed. Anemones were present on rocks protruding from the surface of the bed. Rockfish and ratfish swimming over the bed were infrequently noted. No clumps of material resembling those reported in the past were seen during the dive. The presence of the large fibre mat with adjacent natural sediment in the area where shrimpers operate suggest a possible source of the 'pitchball' material. The snowballing effect of fibre and natural substrate in the net may be forming articifical aggregates.

3.3 MINES, SMELTERS, AND QUARRIES

X





MINING

Location:	Holberg In	nlet (off Pot Roc	:k)	Date:	11 February 1975
Dive No.:	294 (Fig.	. 37)			
Observer:	D. Goyette	5			
Position:		Start	<u>Finish</u>		
		50 ⁰ 35.0'N	50 ⁰ 35.0'N		
		127 ⁰ 39.4'W	127 ⁰ 39.1'W		
Depth: 115m	n				
OBSERVATIONS	<u>S</u> :				
30m		- Water murky, v orange claw). uishable.	isibility approxi Individual suspe	mately ended pa	1.8 metres (end of orticles disting-
50m		- Few chaetognat	hs appearing.		
65m		- Visibility app	proximately 1.8 me	etres.	
75m		- Increase in pa significant nu	rticulate matter, mbers.	zoopla	nkton not in
100m		- Visibility red	uced due to large	e partic	les in suspension.
115m		- On bottom, vis tailings, nume observed. Fis ratfish.	ibility 0.6 metre rous craters, few h observed were h	es, bott / shrimp nake, ee	com covered in (Pandalid) lpout, sole,
80m		- Moved to new p improved but i a few shrimp o	osition, tailings nsufficient for a bserved.	preser Idequate	t, visibility observations,
50m		- Visibility mod no tailings ob (<u>Pseudarcaster</u>	erate, rocky bott served, few rockf sp.), and shrimp	com, lig Tish, st o observ	ht brown sediment, arfish ed.
40m		- Substrate smal	l rocks, visibili	ty appr	oximately 3 metres.
20m		- Returned to su	rface.		

REMARKS:

Visibility was very poor at 115 metres and improved slightly above 50 metres. Observations were limited and Pisces operations difficult. The reduced visibility was due to a high concentration of brown coloured particles suspended in the water. No definite layering of either turbidity or zooplankton was observed. Tailings (from the distinct grey colour) were evident up to a depth of 80 metres and not seen at 50 metres.

Location:	Rupert Inlet Date: 11 February 197 (centre channel, abeam of Red Island)	5
Dive No.:	295 (Fig. 37)	
Observer:	D. Goyette	
Position:	<u>Start</u> <u>Finish</u>	
	50 ⁰ 35.25'N 50 ⁰ 35.25'N 127 ⁰ 27.40'W 127 ⁰ 27.40'W	
Depth: 90m		
OBSERVATIONS	:	
10m	 Fine particles suspended in the water producing a milky grey appearance. 	
25m	- Halocline observed.	
60m	- No zooplankton observed to this depth.	
85m ·	 A few euphausids and hyperid amphipods appearing. Size of suspended particles increasing. 	
90m	 On bottom. Bottom not visible due to high turbidity, appearance of water similar to a very dense fog. Distance - viewport to bottom approximately 0.7 metre Returned to the surface. 	-

REMARKS:

Entire water column extremely turbid with visibility ranging between 1.8 metres at the surface to less than 0.3 metre below a depth of 60 metres. Appearance of the water column, surface to the bottom, similar to a dense fog. Visibility decreased gradually with no distinct layering. Fine suspended particles throughout the water column giving it a definite grey colour. Lack of visibility prevented observations and photography. Unable to see the bottom, approximately 0.7 metre from viewpoint. Particles extremely fine, unable to distinguish individual particles until near the bottom. Increase in particle size possibly due to flocculation.

Location: Rupert Inlet (centre channel, abeam of Red Island)

Date: 12 February 1975

Dive No.: 297 (Fig. 37)

Observers: D. Goyette and C. Pelletier

Position:	Start	<u>Finish</u>
	50 ⁰ 35.35'N	50 ⁰ 35.35'N
	127 ⁰ 26.70'W	127 ⁰ 26.70'W

Depth: 75m

OBSERVATIONS:

Transmissometer readings were recorded during the descent:

Surface	-	18%	
15m	-	26%	
30m	-	12%	
35m	-	9%	
50m	-	5%	
70m	-	4%	
75m	-	3%	(bottom)

Little change in visibility over Dive No. 295 in the same area. Dense grey fog throughout water column. Size of many of the suspended particles appeared to increase near the bottom. Contact with the bottom at 75 metres.

REMARKS:

Unable to observe the bottom. Dive was terminated soon after colliding with an underwater object.

Location: Holberg Inlet (west of Straggling Islands) Date: 13 February 1975 Dive No.: 298 (Fig. 37) Observer: H. Nelson

Position: <u>Start</u> <u>Finish</u> 50⁰36.00'N 50⁰35.10'N 127⁰43.90'W 127⁰44.00'W

Depth: 90m

OBSERVATIONS:

Transmissometer readings on descent:

Surface - 51% transmissibility 25m - 36% 50m - 26% 90m - 7% on bottom

Visibility poor, worse than Dive No. 294 (Pot Rock). Particle size larger than that observed in Rupert Inlet. Ascended to 50 metres depth for better visibility and headed to north shore. Contacted bottom again at 65m. Transmissibility at 65m was 22%, substrate soft mud, no evidence of tailings on the bottom. Numerous craters, few shrimp. Plankton (chaetognaths, amphipods, small euphausids) fairly abundant during descent.

- 132 -

PISCES IV DIVE RECORD

Location:	Near head of Holberg In	let	13 February 1975
Dive No.:	299 (Fig. 37)		
Observer:	H. Nelson		
Position:	Start	Finish	
	50 [°] 37.9'N	50 ⁰ 38.15'N	
	127 ⁰ 54.9'W	127 ⁰ 54.70'W	
	_		

Depth: 55m

OBSERVATIONS:

Transmissometer readings on descent and ascent:

Surface	-	60 - 70% transmissibility
5 Om	-	40%
55m	-	50% on bottom
45m	-	30% "
40m	-	26% "

Many plankters observed during descent. Contacted bottom at 55m, visibility 2.4 to 3.0m and murky. Substrate soft, brown mud; numerous craters up to 10 cm. in diameter. Amphipods and euphausids abundant during descent. Several flat fish observed. Size of suspended particles smaller than those seen on Dive No. 298. At 45m moving towards shore, little change in substrate, few shrimp, occasional eelpout. Visibility descreased towards shore, increase in marine life, eg., pandalid shrimp, eelpouts, flatfish (15 to 20 cm. long) frequently observed. At 40m water murky; a few anemones, number of large empty clam shells, many zooplankters (mostly euphausids) observed. At 20m, ascended to surface.
Location: Quatsino S	ound, West of Drake Island Date: 14 February 1975
Dive No.: 300 (Fig	37)
Observer: D. Goyett	e
Position:	<u>Start</u> 50 ⁰ 29.09'N 127 ⁰ 44.65'W 127 ⁰ 45.35'W
Depth: 125m	
OBSERVATIONS:	
Surface	- Visibility very good, clear.
25m	- Water colour dark blue, increase in suspended particles compared with the surface but water clarity remained extremely clear.
35m	 Increase in size and concentration of suspended particles, no sign of zooplankton, suspended particles appear as brown to whitish coloured matter, short (20.3 mm) strings to small spheres (presumably diatom).
50m	- Few chaetognaths appearing; odd, small euphausid
65m	- Number of small euphausid increasing.
75m	- Concentration of suspended particles remaining re- latively uniform, chaetognaths and euphausids the dominant plankton.
100m	- Holding at 100m to attach more line to surface buoy, number of white flecks observed, similar in size and shape to herring scales.
120m	- On the bottom, visibility very good, approximately 4.5m; light brown to slightly grey colour to sediment, no sign of tailings; mud very soft, vibrates ahead of sub when skids touch; number of shrimp present; substantial numbers of chaetognaths (most dominant plankton); number of large (5.0 to 7.6 cm.) shrimp observed;

increase in the number of Hyperid amphipods, 40 to 50 chaetognaths observed at any given time; several small (2.5 cm.) orange coloured pelagic polychaetes; one pteropod (pelagic mollusc); bottom smooth with numberous large craters; large numbers of Pandalid shrimp (Pandalopsis dispar); a number of flatfish, eelpouts, ratfish, hake, small orange-banded rockfish; several clumps of cloud sponge 0.3 to 0.6m in diameter. 105m - Steep mud incline. 100m - Bottom changed to coarser sediment, rock cod, sea urchin; large number of shrimp observed. 75m - Crossaster sp., Pseudarcaster sp. 70m - Clump of cloud sponge. - Large numbers of Psolus (creeping cucumber) on small 65m rocks; large numbers of squat lobsters and Munida sp. Substrate type has a definite relationship to the species observed. 60m - Sea anemone; number of boot sponge (Hexactinellida) similar to those commonly seen in Saanich Inlet; bottom consisted of rock and coarse sediment; several large schools of rockfish; noticeable increase in variety of marine life over that observed at 120m. 50m - Area of large boulders; further increase in amount of marine life; large schools of rockfish, Parastichopus sp; bottom changing to coarse gravel and sand; decrease in the number of shrimp; large skate; pink and white banded rockfish; water slightly murky 30m - Gravel bottom, occasional boulder; wood debris (natural). 25m - Left bottom; steep cliff; visibility 5.5 to 6.0m.

REMARKS:

Visibility excellent, making Pisces operation easier than previous dives. No evidence of the grey coloured suspension which was noted in Rupert Inlet.

Although the concentration of suspended particles was relatively high, the water between the particles was clear, giving excellent visibility (to the maximum penetration of the submersible's lights). Plankton abundant below 65m with very large concentrations of chaetognaths. Area extremely rich in marine life with a variety of fish and invertebrates. Pandalid shrimp very abundant up to 50 metres. Numbers and presence of shrimp appear to be associated with mud bottom. Increase in numbers of rockfish associated with boulders or rocky areas. Numerous craters observed in the mud bottom. Craters have been seen frequently in Alberni Inlet, Indian Arm, and Howe Sound. Craters appear to be formed by an unidentified organism. Craters end in a well-defined and maintained hole approximately 3.0 to 7.6 cm in diameter which frequently leads off at right angles to the base of the crater. No tailings observed at any depth.



Location:	Howe	Sound			Date:	23 August 1976
Dive No.:	460	(Fig.	38)			
Observer:	D. Bi	rother	S			
Position:			<u>Start</u>	Turn	<u>Finis</u>	<u>sh</u>
			49 ⁹ 29.70'N	49 ⁰ 29.50'N	49 ⁰ 29.8	35'N
			123°17.15'W	123°17.15'W	123017.7	75'W
Depth: 240	m					
OBSERVATION	<u>s</u> :					
Surface			- Visibility 1.5	5m. Turbid fres	h water 1	layer down to
			approximately	8 metres.		
			- Increased Visi	IDIIITY DELOW TR	esn water	r layer 3m - 4m.
8-100m			- White particul (detritus?); f	late suspended m few ctenophores;	atter in some zoo	water column oplankton.
100-240m			- Abundance of z	zooplankton and	detritus.	
200-240m			- Highest concer	ntration of zoop	lankton.	Many small
			fish (soft eel	lpout, lantern f	ish, othe	er unidentified).
Bottom			- 240m, bottom a	appears to be bro	ownish ma	aterial sediment.
			- Proceeding sou	ith along bottom	240m - 2	200m visibility
			2-3m, biota ob	oserved: - <u>Spiro</u>	ntocaris	sp many
				- "Foot	ball" ane	emone - 4 or 5
				– Mud s	tars - 2	<u>Ctenodisous</u> sp.
				- <u>Panda</u>	lus borea	alis - some
				- Panda	<u>lopsis</u> di	<u>ispar</u> - few
				- Eelpo	uts, blac	ckfins, pricklebacks
				- Ratfi	sh - 2 or	• 3
				- Squid	- 1 (40	cm. approximately)
				- Short	spined t	cnornynead - many
				- Burrol	wing anem	ione (dark prown) lontungy on a many two-ka
				- Carge	white cr	oppe 7-10 cm
				- Sinall	a quadric	nina - vorv fow
				- Two f	latfish ((unidentified)

- Proceeding course 270[°]; up incline 200m 100m;
 visibility 3m 4m. Biota observed:
 - Blackfin and/or eelpout
 - <u>Chinonoecetes bairdi</u> tanner crabs at a definite depth
 - Flatfish
 - Prawns Pandulus danae
 - Drastic increase in members of shrimp (all three species mentioned above)
 - Rockfish
 - Few matridium
 - (rock cutcroppings now appearing)
 - Pseudarchaster sp.
 - Pycnopodia sp.
 - Munida very abundant
- Proceeding up incline 100m 10m (rock outcropping more frequent)
 - Abundance of sponge display, Munida, and Metridium sp.
 - More prawns, fewer shrimp (Cobble-type rocks in this area)
 - Nudibranch
 - Decorator crabs
 - Parastichopus sp.
 - (20m 10m)
 - Increasing numbers of Metridium sp. to "forests".
 - Incredible sponge displays
 - Many rockfish (predominantly same spieces)
 - Mediaster eaqualis
 - Evasterios troschelli (?)

.

Location:	Howe	Sound			Date:	23 August 1976
Dive No.:	461	(Fia.	38)			
Observer:	D. Go	oyette				
Position:			<u>Start</u>	Finish		
		12 12	49 ⁰ 35.30'N 23 ⁰ 14.75'W	49 ⁰ 33.40'N 123 ⁰ 15.40'W		
Depth: 285r	n					
OBSERVATIONS	<u>S</u> :					
Surface		-	 murky 1.3m, c surface layer water clear b suspended thr Zooplankton d Numbers incre Lantern fish 	law barely visible freshwater, appre elow surface, num oughout watercolum ominantly amphipo asing at a depth observed at 175m.	e oximate erous wl mn. ds. of 150m	ly 10m hite particles
Bottom - 285	ōm	-	visibility po	or, approximately	.36	5m.
Sediment		-	light brown s disturbed by	urface layer with burrowing animals	patches	s of grey in areas
		-	Few eelpouts observed. Vi west for clea near the bott	(black belly), so sibility poor. Le rer water. Suspe om in the central	le, and eft bott nded sed areas d	pandalid shrimp tom and headed diment concentrated of Howe Sound.
		-	Contacted bot improved. Ba	tom again at 285m se of steep cliff	(inshon at 285r	re). Visibility n.
		-	Large numbers	of prawns, pink s	shrimp,	and <u>Munida</u> observed.
			Rock face cov (tailings). analysis. Fe on ascent. O burrowing ane	ered with thick la Sampled from skids w rock fish, scul ccasional <u>Cancer i</u> mones in soft sed	ayer of s by sum pin, and <u>magistem</u> iment a [°]	grey sediment rface dives for d dogfish observed <u>r</u> at 50m. Numerous long the ledges.

- Fewer numbers of shrimp at 50 metres. Very little evidence of wood debris.

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SUMMARY

Visibility very poor near centre channel. Visibility improved at 80m depth in inshore areas. Few eelpouts and shrimp observed, no pelagic fish observed near centre channel.

<u>Munida</u> and prawns very numerous at 100m. Fewer in shallower regions. Shoreline - steep rocky slope covered by sediment similar to tailings. Burrowing anemones common.

Marine life less abundant than dive 460 (pilot observation). More sediment covering cliff face than dive No. 460.

Location:	Howe Sound	d (Britannia	Mine)	Date:	24 August 197	6
Dive No.:	462 (Trad	ck 2) (Fig.	38)			
Observer:	D. Sulliva	an				
Position:		Start	<u>Finish</u>			
		48 ⁰ 37.56'N 123 ⁰ 13.29'W	48 ⁰ 37.57 123 ⁰ 12.47	N W		
Depth: 235	m					
Descent:		- detrital m abundant p	naterial to 75 Dlanktonic life	metres; below ; Lantern fis	this depth h common	
Bottom (235	m.)	 Visibility bottom ver noted; eel proceeded tailing ri few rock bottom lif visibility cancer and few shrimp bottom ver surface, g tailing ri Dive ends 	 2.5 - 3m; sli y silty, soft; pouts common east toward Br idges encounter outcroppings n fe similar but reduced to 1m tanner crabs , eelpouts, so y silty in thi grey to black u idges continue 70 metre depth 	ghtly murky sole, tanner itannia Mine ed at 175 met oted; manoeuv reduced i. noted le, <u>Colus</u> sp. s area, flat, nderneath	crabs, shrimp res; very stee erability diff , sculpin (Das beige colour	p; icult ycottus) on

Location:	Howe Sound (north of	Britannia Min	ie)	Date:	24 August 19	976
Dive No.:	462 (Trac	k 3) (Fig. 3	8)			
Observer:	D. Goyette					
Position:		<u>Start</u> 49 ⁰ 37.95'N 123 ⁰ 13.07'W	<u>Finish</u> 49 ⁰ 38.1'N 123 ⁰ 12.9'W			
Depth: 235	n					
OBSERVATIONS	<u>S</u> :					
Visibility - Upper 50m - No macro-zoo Amphipods ap 100m - same - occas No change in shrimp and 1 Copepods abu On the botto Catshark (1) Contacted bo colour cover	- 3 - 3.5m mostly det oplankton of opearing at abundance of ional sipho ional sipho visibility antern fish undant near om at 235m - o, ratfish ottom on a s red with a f	below surface ritus, sparse bserved to 70 75m of zooplankto onophore, no y and plankto h observed. bottom. - visibility steep slope, thin brown su	layer phytoplankton a m n euphausids obser n abundance to 1 lowered to 2.5 - heading towards rface layer.	ved, largel 75m, occast 3m (murky) shore. Sec	<ton y amphipods ional pelagic) diment - grey</ton 	c y in
Several tadp	ole snail f	fish (<u>Nectoly</u>	saris pelagicus)	observed r	near the bott	tom.
Numerous sma	ll pandalio	d shrimp (<u>Spi</u>	rontocaris, few	Cancer magi	ister)	
Considerable	evidence o	of burrowing				
Headed towar the shore.	ds shore a Ridge exter	long a narrow nded to base	tailings ridge of a cliff to a	running per depth of 60	^pendicular f)m.	from
Bottom simil	ar to dive	462 (2)				
Cancer magis	ster - numen	rous around a	depth of 75m, f	ew tanner d	rab	

Rock ledges covered by tailings - few surpulid polychaetes, solitary corals on bare rock. Upper 15m - free from sediment, barnacles, many slipper shell (<u>Crepidula</u>), occasional rock fish.

- 142 -

Location: Howe Sound (east shore north of Watts Point)

463 (Track 2) (Fig. 38)

Date: 25 August 1976

Observer: D. Govette

Position:	<u>Start</u>	Finish
	49 ⁰ 39.78'N	49 ⁰ 39.52'N
	123 ⁰ 12.18'W	123 ⁰ 11.85'W

Depth: 170m

Dive No.:

OBSERVATIONS:

Surface visibility approximately 30 cm. Fresh water evident to 10m. Visibility increased below 10m - clear. Few amphipods, mostly detritus. Numbers of amphipod increase - at 80m. Several small white coloured squid. No. euphausids or fish observed during descent. Bottom at 200m - visibility approximately 2.3m. Few eelpouts, ratfish, hake, numerous holes in sediment. Sedminet soft and light brown in colour. Headed toward east shore - bottom contour - series of ridges running perpendicular from shore - encountered several ledges above 70m which ran parallel to the shoreline - lemon sole (1), sidestripe (1) 170m - visibility lowered to 1.2m - few snails (Colus?), occasional shrimp (pandalid), few small ratfish, black belly eelpouts (few) - several Chirodota seen lying on surface 150m - slope increasing 120m - few prawn appearing - starry flounder (1) 100m - numbers of pandalid shrimp increased (pink shrimp and

	<u>Spirontocaris</u>) - occasional larger shrimp, presumably sidestripes
75m	- wood debris
50m	 visibility decreasing still following ridge more evidence of sediment along east shore compared to west shore (dive 463 (1)) <u>Cancer magister</u> becoming very numerous, 10-15 seen at a time estimated 100-200 crabs within a small area light coloured pandalid shrimp appearing fewer number of fish over other dives numbers of <u>Munida</u> concentrating around wood debris sedge ball observed numerous burrows occasional flatfish, <u>Munida</u> not present in areas of soft sediment occasional blackbelly eelpout, prawn
25m	- sea pens
15m	 terminated dive sediment present observed to a depth of 15m.

Most dominant species during dive was the pandalid shrimp and, at 50-70m, <u>Cancer magister</u>. Marine life in deeper depth not overly abundant and very little diversity.

Location:	Howe Soun (Thornbro	d ugh Channel, off	McNab Creek)	Date: 26 August 1976	
Dive No.:	464 (Fig	. 38)			
Observer:	H. Nelson				
Position:		Start	Turn	Finish	
		49 ⁰ 32.88'N	49 ⁰ 33.12'N	49 ⁰ 33.55'N	
		123 ⁰ 23.28'W	123 ⁰ 22.80'W	123 ⁰ 22.52'W	
Depth: 230	n				
OBSERVATIONS	<u>S</u> :				
		Good surface vi particles with	sibility. On des a few plankters.	scent, large inert	
100m		- the number of	large particles	decreased, number of	
		zoopl ankters	increased. Visil	oility good.	
200m		 many pelagic few fish appr 	amphipods, sever	al Ctenophores and a	a
				iong. Visibility decreasing	9.
230m		- on the bottom sediment over	fine grey sedime	Substrate a skiff of brown ent.	
		Moving over the	mud bottom, anim	nals observed were:	
		- several shrim	p (<u>Spirontocaris</u>	sp. and sidestripes,	
		<u>Pandolopsis</u> d	ispar.)		
		- a few large a	nemones (footbal	l) and <u>Metridium</u> sp.	
		- several eel p	outs.		
		- large Gastrop	ods		
		- a few orange	starfish (<u>Pseuda</u>)	<u>rcaster</u>).	
		- many large si	destripes and squ	lat lobsters (<u>Munida</u> sp.)	
		- single spider	crab, single <u>Lar</u>	<u>ncer magister</u>	
		- single rock t	isn (red snapper,	, single skate	
		four buittle	perayic snrimp		
		- JEW DEILLIE S	the better life	has not observed encourtely.	
		- at 1050 Hours	w colo have here	nas not changed apprectably	1.
		no ribunders i	or sole nave beer	I UDSELVEU.	

	 at 1035 hours more wood, bark, and leaves cover the bottom. a few flounder and sole have been seen jelly babies (<u>Chiridota laevis</u>) large brittle stars single octopus, single Squalus sp., single hake
190m	 another substrate change to sand, boulders, and leaves several prawns very abundant <u>Munida</u> sp.
100m	 ling cod, <u>C. magister</u> passed over a ridge of fine sediment, presumably originating from McNab Creek
70m	 begin moving up cliff face, visibility good, approximately 10m many sponge; <u>C. magister</u>, anemones, tube worms, clam shells, starfish in clear sphere?

SUMMARY

Three substrate types encountered each with a corresponding change in benthic communities, both qualitative, and quantitative as noted. Habitat very important in structuring bottom communities. These are enhanced by introduction of wood debris (logs, bark, chips, leaves).

Location:	Howe So (Thornb Pit)	und rough Channel of	f Hillside Gravel	Date:	26 August 1976	
Dive No.:	465 (F	ig. 38)				
Observer:	H. Nels	on				
Position:		<u>Start</u> 49 ⁰ 30.35'N 123 ⁰ 28.82'W	<u>Finish</u> 49 ⁰ 30.21'N 123 ⁰ 29.47'W			
Depth: 220r	m					
OBSERVATIONS	<u>s</u> :					
		Surface visib Descending, 1	ility fair arge inert particl	es (whit	e) in suspension	
100m		- siphonophor megalops	es, amphipods, cte	nophores	, cumaceans,	
150m		- inert parti ctenophores	cles smaller, pela , small fish	gic shri	mp, large lobed	
220m (bottor	n)	 soft substra many zoopla several sea anemones <u>Spirontocar</u> gastropods single red 	ate, mud. Visibil nkters, mainly cop pens (sea whip), <u>is</u> sp., <u>Munida</u> sp. (<u>Neptunia</u> sp.) on snapper, single Ta	ity 3.5m epods eel pout , severa logs nner cra	s, burrowing prawns, large	
145m		 moving towa encountering increasing (very abundation single red at 	rds Hillside Grave g wood debris, log numbers of prawns, ant and large), sn snapper	l Plant s and ba <u>Metridi</u> ails	rk <u>um</u> sp., <u>Munida</u> sp).
50m		- logs and <u>Me</u> - moving out bottom.	<u>tridium</u> sp. from under log boo	ms and h	eading south off	

.

SUMMARY

Benthic communities in this area were quite similar to those encountered off McNab Creek (Dive No. 464). However, no flounder or sole were seen and prawns were present in greater numbers. The <u>Munida</u> sp. off Hillside, present in large numbers around the wood debris, seemed to be larger. Very large <u>Metridium</u> sp. on the logs.

- Location: Thornbrough Channel Date: 27 August 1976 (Centre Channel east to Woolridge Island)
- Dive No.: 466 (Fig. 38)
- Observer: D. Goyette

Position:	<u>Start</u>	Turn	Turn	<u>Finish</u>
	49 ⁰ 30.40'N	49 ⁰ 30.60'N	49 ⁰ 30.58'N	49 ⁰ 30.55'N
	123 ⁰ 28.45'W	123 ⁰ 28.36'W	123 ⁰ 28.10'W	123 ⁰ 27.95'W

Depth: 225m

OBSERVATIONS:

	Surface layer of freshwater to 10m Visibility - clear Few amphipods appearing at 50m Larval fish at 75m
	Few ctenophores, zooplankton not very abundant, some detritus.
	Increasing numbers of zooplankton below 75m - largely amphipod, siphonophores, and occasional ctenophore, no euphausids.
	Large ctenophores (Bolinopsis?) appearing at 100m. These normally seen at this depth.
125m	 increasing numbers of various jellyfish, no euphausids observed (similar to previous dives)
210m	- lantern fish common - larger concentration of copepod
225m	 on the bottom, visibility approximately 3.5m sediment - light brown on the surface light grey colour in disturbed areas Munida very abundant, Mediastes shrimp (pandalid),
	<u>Colus</u> - common.

	Few sidestripe, burrowing anemones - abundant, occasional sea whip.
	Colus? very abundant along logs. Bottom - relatively free of wood debris, only occasional log and cedar bark.
	<u>Munida</u> very abundant around wood debris. A number of red snappers? seen by pilot. Few eelpouts.
	Slope increasing at 225m - base of cliff - numbers of burrowing anemones increased, increase in bark and wood deposits, large amount of sponge debris at base of cliff. <u>Munida</u> , anemones very numerous. Large white anemones concentrated along logs.
200m	 light film of sediment over rocks, considerably less than Howe Sound area large numbers of "horn" sponges growing on rock face, cloud sponge also present.
185m	 continued along cliff "horn" sponge very abundant, many <u>Munida</u> inside and around clusters of sponges
	Occasionally <u>Munida</u> seen swimming away from rock face. Cliff face also covered with numberous brachiopods and a small white either solitary coral or anemone. Ascending to 130m and again ran parallel to cliff - heading south along rock face - <u>Munida</u> and sponges - still very numerous
60m	 numerous sponges, occasional glass sponge (tubular) occasional - yellow banded rockfish, few prawns (not as numerous as dive 465), cloud sponge - abundant
SUMMARY	

- 150 -

Bottom conditions basically similar to dive 465 with exception of less wood debris inshore. Fewer fish observed than Howe Sound dives. Shrimp not as abundant as Howe Sound. Most abundant animals in deeper areas were <u>Colus</u>, <u>Munida</u>, and burrowing anemones. "Horn" sponge and <u>Munida</u> most abundant form along rock cliff off Woolridge Island. Fewer prawn than opposite shore (dive 465). Very little sediment deposition along shoreline, rock cliff heavily encrusted with sponges.

- 151 -

PISCES IV DIVE RECORD

Location:	Centre of (off Manni	Thornbrough on Creek)	Channel	Date	: 27	August	1976
Dive No.:	467 (Fig.	38)					
Observer:	D. DeMill						
Position:		<u>Start</u>	<u>Finis</u>	<u>1</u>			
Depth: 175m	n	49 ⁰ 27.90'N 123 ⁰ 27.60'W	49 ⁰ 27.63 123 ⁰ 27.45	3'N 5'W			
OBSERVATIONS	5:						
Surface laye	- er of fresh	water to arc	und 10m.				
Some amphip	ods, detrit	us, a few sm	all squid in	water column	•		
Bottom - vis	sibility 5m	decreasing	to 2.5m durir	ng the dive.			
Sediment - g	gray, "tail	ings-like" c	overed with 1	ight brown s	kiff.		
ordinary-loc rockfish; fl headed (with Shrimp - com up into wate	bking eelpo lounders/so bumps) sc nmon - incl er). More	low numbers uts; long, t le; sandab (ulpin. uding; sides sidestripesm	<pre>hin eelpouts; ?); hake (?), tripes; small near end of c</pre>	small, pale red and whi transparent live.	fish te ro ones	; small, ckfish; (fright	, red round- tened
<u>Munida</u> - num	ierous.						
Burrows - ma	iny small c	lam-like, a	few larger -	3 cm.			
Cucumbers - burrows when	many small frightene	(approximat d).	ely 2 ~ 5 cm)	white (pull	ed ba	ck into	
Beer cans -	one.						
Crabs - a fe	w small de	corator crab	s and one "ta	nner" crab.		· .	
Anemones - s	ome burrow	ing anemones	•				
Sea pen - sm	all white,	rigid-stalk	ed - a few.				
Snails - clu	isters of \underline{T}	<u>hais</u> -like sn	ails on logs	and wood chu	nks.		
Octopus - 1	small.						
Starfish - f	lat, thick	, armed, bro	wn.				



Location:	Bute Inl	et (Littleton P	oint)	Date:	28 August 1976
Dive No.:	468 (Fi	g. 39)			
Observer:	D. Goyet	te			
Position:		Start	Turn	Turn	<u>Finish</u>
		50 ⁰ 49.85'N 124 ⁰ 54.10'W	50 ⁰ 50.15'N 124 ⁰ 53.95'W	50 ⁰ 50.40'N 124 ⁰ 54.30'W	50 ⁰ 50.40'N 124 ⁰ 54.50'W

Depth: 380m

OBSERVATIONS:

Surface water milky green colour. Visibility approximately 5 cm. Completely submerged - visibility increased to approximately 60 cm.

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5m	 visibility approximately 1.2m, white flocc in surface water.
25m	 mostly detritus, water between particles clear giving good visibility, greater than 3.5m.
50m	- occasional amphipod - few small euphausids (<u>E. pacifica</u>) - dogfish (1), few tenophores - mostly detritus
100m	- claw clearly visible - squid (3)
150m	- occasional fish - smelt?
175m	- occasional lantern fish, smelt
200m	- large squid - pelagic shrimp - large ctenophore (Bolinopsis)
250m	- numerous small fish (deëpsea smelt?) - occasional ctenophore - large squid (1) - several small squid (opaque)

300m	- visibility - murky
380m	 Bottom - sediment soft and very light colour occasional burrows - fewer than Howe Sound. Numerous pandalid shrimp, snail? tracks - no animals observed, ratfish, no burrowing anemones or flatfish observed, occasional black belly eelpouts. visibility - murky, approximately 2.3m <u>Metridium</u> (1) Bottom smooth, relatively undisturbed, little evidence of wood debris Eelpouts and pandalid shrimp - by far the most species, with occasional hake, ratfish, dogfish, Mediaster (starfish). Based on size shrimps are a mixture of <u>Spirontocaris</u> and pink shrimp.
350m	 little change no flatfish observed headed inshore at 330⁰ 1 - heart urchin, ratfish (1), mediaster, hake, small polynices (1), numberous shrimp, hermit crab, only 2 burrowing anemones starry flounder (1) visibility increasing - murky 3.5m
330m	 numbers of crangon shrimps appearing, 30 pandalid shrimp at approximately 1.85 km/hr visible area estimated at 3.5m x 2.6m 15 shrimp, 1 eelpout, 2 mediaster, 1 large pink anemone 27 shrimp, 2 eelpout, 1 mediaster.
325m	 15 shrimp, 1 eelpout contact with shoreline - red snapper? bark, mostly shrimp and numerous <u>Munida</u> (none seen earlier in this dive) occasional sidestripe - sidestripe more abundant closer to shoreline
280m	 steep slope - almost vertical rock covered by thick layer of sediment, occasional rock outcripping free of sediment.

•

	 bare surface covered with brachiopods and few "horn" sponges and pink anemones sediment covering rock face - mostly shrimp and <u>Munida</u> occasional eelpout (juvenile) depth of 180m, seen floating at the bottom - coiled
150m	- few pink sea urchins, e.g., <u>S. drobachiensis</u>
7 5m	- little change from base of cliff
65m	 several pink sea urchins "horn" sponge - numbers considerably less than Thorn- brough Channel occasional prawn
50m	 numbers of white pandalid shrimp, legs and viscera also white colour
0-25m	 marine life not very abundant few rock crab, 3 lithodes crabs (Rhinolithodes), <u>Psolus</u>

Very little change in marine life and sediment from base of cliff to a depth of 70m.

Location:	Mouth of Bute Inlet (opposite Fawn Point)		Date:	28 August 1976
Dive No.:	469 (Fig. 39)			
Observer:	D. DeMill			
Position:	Start	<u>Finish</u>		
	50 ⁰ 29.50'N	50 ⁰ 29.50'N		
	125 ⁰ 05.50'N	125 ⁰ 06.30'W		

Depth: 400m

OBSERVATIONS:

Surface water greenish but visibility good. Large flocculated clumps in water.

Zooplankton - rich. Large amount of detritus, some euphausids, several large 2-tailed barrel-shaped tunicates (?), several large ctenophores, some amphipods. Several small and a few larger squid, several herring, one ratfish.

Bottom - met cliff at 400m.

At first steep sediment-covered slope. Sediment of grey tailings-like, many <u>Munida</u>. Steeper slopes to overhangs - smooth granite faces. At 300m some large rocks, coarse sand and/or shell fragments.

Biota - deeper, some rockfish, brachiopods (?), some mostly sediment covered sponges, Munida everywhere, many shrimp (some sidestripes), 1 or 2 prawns.

Shallower - large cloud sponges (esp. 150 - 75 cm), some small-cushion stars, 1 decorator crab, 1 large yellow cush. star, several poster-type and similar anemones, abundant Munida, Mysid(?), swarms, some <u>Stylasterias</u> forreri, pink rockfish, 1 red snapper-like (copper-red) long-jawed rockfish, some pink pricklebacks, many shrimps, some prawns.

Location:	Strait of Georgia (off Texada Mine)		Date:	31 August 1976
Dive No.:	473 (Track 3) (Fig. 39)			
Observer:	G. Packman			
Position:	<u>Start</u> 49 ⁰ 41.28'N 124 ⁰ 33.92'W 1	<u>Finish</u> 49 ⁰ 41.33'N 24 ⁰ 32.72'W		

Depth: 200m

Watercolumn

- Thick phytoplankton and below that zooplankton, visibility clearing somewhat at approximately 150m.
- The water column was clouded in tailings from 85m to the bottom at the inshore end of the dives

Bottom Characteristics

- Mud bottom with 4m visibility
- Lots of infaunal holes
- At the upper end of the track tailings began to be noticed in the sediment
- The beginning point of this was imperceptible and observations of the extent of tailings deposition close to the mine was precluded by the almost total loss of visibility from tailings in the water.

Faunal Description

- The fauna encountered was typical of the Strait of Georgia.
- On the soft mud bottom numerous infaunal holes were observed, from the burrowing activities of Polychaetes, Bivalves, Holothurians, Echiurans and Sipunculids.
- Pink shrimp (<u>Pandalus borealis</u>) and prawns (<u>Pandalus platyceros</u>) were present although not in great numbers.
- Four Gadiformes (probably <u>Theragra chalcogramma</u>), a few sole (<u>Pleuronectidae</u>) of varying types and an eelpout (Zoarcidae) were observed.

- Scattered rocks were discovered providing habitats for calcareous, tubiculous polychaetes, sea anemones (<u>Metridium senile</u>) and various types of rockfish (Scorpaenidae) including the quillback rockfish (<u>Sebastes maliger</u>) and Pacific Ocean Perch (Sebastes alutus).
- the ratfish <u>Hydrolagos colliei</u> was observed a number of times throughout the dive
- frequent small bathypelagic fish (possibly of the family Bathylagidea) as well as the bathypelagic shrimp Pasiphea pacifica were observed.

SUMMARY

The beginning point of tailings buildup was difficult to differentiate however at the upper end of the dive tailings deposition was very apparent as a coarse grey sediment. Animals such as <u>Pandalus borealis</u> and <u>P. platyceros</u> we're still apparent when the dive was terminated due to lack of visibility. However it would seem that these animals could not extend much further inshore in the face of the tailings being discharged.



FIG. 39 PISCES DIVE TRACKS, BUTE INLET (1976).



FIG. 40 PISCES DIVE TRACK, OFF TEXADA MINE (1976).

- 160 -

Location: Kitimat Arm (near smelter) Date: 21 October 1976 Dive No.: 514 (Track 1) (Fig. 41) Observers: G. Packman, N. Holman, R. Hoos Position: <u>Start Turn Finish</u> 53⁰57.60'N 53⁰57.76'N 53⁰58.05'N 128⁰41.30'W 128⁰41.02'W 128⁰41.88'W

Depth: 180m

Note: No report available.

- 162 -

PISCES IV DIVE RECORD

Location:Kitimat Arm (near smelter)Date:21 October 1976Dive No.:515 (Track 2) (Fig. 41)Observers:Position:StartTurnTurnTurnFinish

53⁰59.25'N 53⁰59.35'N 53⁰59.27'N 53⁰59.22'N 53⁰59.28'N 53⁰59.19'N 128⁰41.25'W 128⁰41.05'W 128⁰40.81'W 128⁰40.61'W 128⁰40.62'W 128⁰40.70'W

Depth: 128m

Note: No report available.



FIG. 41 PISCES IV - DIVE TRACKS, KITIMAT SMELTER (1976)

Location:	Hast	ings A	rm		Date:	23 October	1976
Dive No.:	518	(Fig.	42)				
Observers:	D. Go	oyette	, H. Nelson				
Position:			<u>Start</u> 55 ⁰ 29.45'N 129 ⁰ 45.70'N	<u>Turn</u> 55 ⁰ 29.13'N 129 ⁰ 45.23'W	<u>Fini</u> 55 ⁰ 23. 123 ⁰ 44.	<u>sh</u> 09'N 70'W	
Depth: 300r	ח						
OBSERVATIONS	<u>S</u> :						
Surface			- visibility - - White susper zooplankton	- beyond range of nded particles the in upper 60m.	the ligh roughout	ts water colum	n. No
60m			- Small euphau - Ctenophore (usids (<u>E. pacifica</u> (occasional).	<u>a</u> ?) - few		
100m			- Appearance o - Zooplankton (hyperid).	of <u>Bolinopsis</u> (cto increasing; eupha	enophore) ausids, o	ccasional a	mphipod
125m		-	- Siphonaphore	2			
150m			- Smelt (few) - Amphipod (fe	ew)			
175m		-	- Smelt (numbe - Occasional p	ers increasing) belagic shrimp (<u>Pa</u>	asiphaea	sp.)	
200m		-	 Numbers of a Ctenophores 	amphipods increasi abundant - <u>Boroë</u>	ing. and <u>Boli</u> i	nopsis.	
260m		-	 Bottom (0915 Visibility of Sediment sof surface dark Tidal currer small fish (tain positio 	5). greater than 4m. Ft, light brown co K, bluish grey col hts present, veloc <u>Nectoliparis</u> sp.) on on the bottom.	olour. So our. ty suff to swim	ediment ben icient to re actively to	eath equire o main-

- Course heading 160° against flood tide.
- Burrows (numerous).

Dominant organisms - large hermit crabs occupying <u>Neptunea</u> shells, small hermit crabs, and shrimps, sidestripe (<u>Pandalopsis dispar</u>) very abundant, pink shrimp (<u>P. borealis</u>) - very common.

- Occasional pollock (<u>Theragra chalcogramma</u>).
- Eelpout (few).
- Small white sea pens (numerous).
- Unidentified (leech like) worm; dorso-ventrally flattened pointed anterior, dark brown - swims in undulations (common).
- Small octopus (7).
- Fish less abundant than previous dives, mostly eelpouts, occasional pollock, one sole, occasional sturgeon poacher (<u>Agonus acipenserinus</u>), no ratfish or dogfish observed. These were commonly seen during submersible dives in other areas.
- Nectoliparis very common.
- Shrimp appear to occur in groups and in considerable numbers compared to Knight Inlet (pilot observation) and Howe Sound. Bottom free of wood debris.
- 290m Alaska king crab (2) <u>Paralithodes</u> sp.
- 300m (1018) Altered course to 060° toward shore - Alaska king crab (1).
- 265m @ 1035.
 - sloping, mud bottom.
- 250m Alaska king crab (3).
- 240m Numbers of pink shrimps increasing.
 - Side stripes still abundant. Shrimps approximately 8-10/m² occurring in groups.
- 225m (1035) Numerous eelpouts.

200m	 (1100 hrs.) Base of steep cliff, rock face very smooth, covered by thin layer of sediment. Surface covered with brachiopods, occasional pink sea urchin (S. <u>paligus</u>) sea cucumber (similar to <u>Parastichopus</u>) common - spines long and fleshy.
160m	- <u>Munida</u> (few).
150m	 -(1116) Marine life on rock cliff largely brachiopods, few <u>Neptunea</u>, sidestripe (no prawns observed), few basketstars (<u>Gorgonocephalus</u>). Numbers <u>Munida</u> increasing.
125m	- (1126) Occasional crinoid - <u>Florometra</u> , cushion star <u>Pteraster</u> , fewer shrimps, few rock fish.
40m	 - (1152) Brachiopids continue dominance. - Entering zone of calcarious tube worms, occasional <u>Psolus</u> (creeping cucumber). - Visibility with ambient light in excess of 18m.
25m	- (1156) Encrusting algae. - Occasional cloud sponge.

SUMMARY

Dominant macroinvertebrate species - larger hermit crab and pandalid shrimp (<u>Pandalopsis dispar</u>)

Six Alaska king crab observed between 250 and 300m.

Very few fish observed - mostly eelpouts. No dogfish or ratfish, (commonly observed during other dives), seen in Hastings Arm.

Few rock fish inshore, 1 sole.

Dominant invertebrate on rock face - brachiopods - similar to most dives. Very little change in marine life on rock face between 50 and 200m.

Location:	Hastings Arm	Date: 23 October 1976
Dive No.:	519 (Fig. 42)	
Observers:	D. Goyette, D. Sullivan	
Position:	<u>Start</u> <u>Finish</u>	
	55 ⁰ 34.00'N 55 ⁰ 34.01'N 123 ⁰ 47.57'W 123 ⁰ 47.13'W	
Depth: 270m	1	
OBSERVATIONS	<u>}</u> :	
	- Visibility similar to 518. - Plankton absent 0-50m. Numbers	s increased below 100m.
100m	- Amphipod, ctenophore.	
170m	- Smelt.	
225m	- Eelpout course OEO ^O .	
270m	 (1335) Bottom, course 020^C. See Grey coloured sediment beneath observed. Burrows more numerous than 518. Eelpout more numerous than 518. Fewer shrimp than dive 518, spathered sediment of the set of the se	ediment similar to 518. surface seen at 518 not but not abundant. arse, occasional sidestripes. toward shore, bottom
250m	- (1417) - Hermit crab (few). - Sidestripe (occasional). - Tanner crab (1).	
200m	- (1455) - Numbers of sidestripe increasi - Numerous burrows.	ng and larger size.

	 Numerous tadpole-like fish - light brown, transparent outer covering, larger head. Numbers of pink shrimps increasing. Alaska king crab (1).
	- Visibility - beyond range of lights.
150m	 Shrimp more abundant than 270m. 3-4 sidestripe and pink shrimp /m².
125m	 - (1455) Contact with rock cliff, marine life similar to 518. Occasional <u>Munida</u>, rockfish, pink sea urchin, pectin, flounder.
100m	- (1505) Dive terminated due to leak in ballast system.

SUMMARY

Generally similar to dive 518 except fewer shrimps and slightly greater numbers of fish (eelpouts). Numbers of shrimps (sidestripe, pinks) increased slightly inshore. No dogfish or ratfish and only few flatfish observed compared to Howe Sound, Bute Inlet etc. Two Alaska king crab observed. Fewer hermit crab burrowing anemones normally seen in areas not observed.
Location:	Alice Arm (head)		Date: 2	4 October 1976
Dive No.:	520 (Trackś	1 and 2) (F	ig. 42)		
Observers:	D. Goyette,	J. Littlepage			
Position:	Start	Turn	Turn	Turn	<u>Finish</u>
Track l	55 ⁰ 27.10'N 129 ⁰ 29.80'W	55 ⁰ 27.10'N 129 ⁰ 29.71'W	55 ⁰ 27.12'N 129 ⁰ 29.58'W	55 ⁰ 27.12'N 129 ⁰ 29.32'W	55 ⁰ 27.24'N 129 ⁰ 29.16'W
Track 2	55 ⁰ 27.85'N 129 ⁰ 29.35'W				55 ⁰ 28.05'N 129 ⁰ 29.40'W

Depth: 150m

OBSERVATIONS:

Greater number of zooplankton (75m) than Hastings Arm. Visibility similar except near the bottom. Greater number of jellyfish beginning at 95m. <u>Bolinopsis</u>, <u>Boroe^{^L</u>} (ctenophore) also abundant.</u>

150m	 (0916) Visibility - 3m, sediment light brown surface, lighter sediment beneath surface. Soft and silty, easily disturbed, course heading 070⁰. Small Alaska king crab (1). Fewer shrimps observed than 518 and 519. (<u>Pandulus borealis</u>). No sidestripes observed (start of dive).
150m	 (0930) Numerous basket stars (<u>Gorgonocephalus</u>). Clumps of Fucus sp. common throughout dive. Anemones (occasional) white base, pink tentacles. Fewer burrows than 518. Tanner crab (occasional).
	 Tadpole snail fish (brown) numerous. Sea whips (occasional) - 5 cm. diameter, 2m in length, white.
	 Eelpout (grey, mottled colour similar to a ling cod colouration).

- 169 -

		- Small skate (1). - Alaska king crab (1). - Occasional shrimps, few sidestripes.
1	125m	 (0946) Continued on course 070⁰. Bottom gradual upward slope. Sole (occasional). Large sea ships very numerous. Basket stars (very common). Contact with tailings delta - surface colour similar to earlier portion of dive, obvious reduction in burrowing activity, surface smooth and compact, slope steeper.
1	LOOm	 - (0957) Contact with rock cliff. - Many basket stars. - Numerous sea whips. - Cloud sponge (numerous). - Boot sponge (few). - Eelpouts (occasional). - No shrimps or hermit crabs observed.
	90m .	- (1011) Changed course to 030 ⁰ .
	70m -	- (1019) Changed course to 070 ⁰ . - Flat fish more abundant than 518.
	60m -	- (1022) Changed course to 170 ⁰ . - Continue to follow tailings delta. - Obvious reduction in marine life. - Shrimp absent. - Large pink/white sea anemone - numerous.
	30m -	 (1035) Shrimps absent. Visibility greater than 4m. Sea whips (occasional). Sediment grey in colour around burrows. <u>Cancer magister</u> (1) - 1st sighting since start of dives Course 020⁰.
	20m ·	- (1046) Surfaced.

DIVE	520 (Track 2)
	 1105 hrs. Sediment characteristics similar to early portion of 520 (1). Fewer burrows than Hastings Arm. Tanner crab (numerous). Small pandelid shrimp (few) - pink and humpback, hermit crab, <u>Hyas</u> (occasional). Flat fish (common). Nudibranch (few). Current and sediment dispersion - negligible.
100m	- (1149) End of dive.

SUMMARY

Bottom sediment with exception of tailings delta similar to Hastings Arm. Fewer burrows, fewer shrimps - mostly pinks, fewer larger hermit crabs.

Greater number of flat fish compared to Hastings Arm.

Basket stars, larger sea whips, Tanners crab (<u>Chionoecetes</u>) - very common. Tailings delta-noticeable reduction in burrowing activity. Surface smooth and compact.

Bottom currents minimal during dives in Alice Arm.

Location: Alice	Arm (centre)		Date: 24 October	1976
Dive No.: 521	(Fig. 42)			
Observers: D. Go	yette, J. Littlepa	ġe		
Position:	Start	Turn	<u>Finish</u>	
	55 ⁰ 27.08'N	55 ⁰ 27.08'N	55 ⁰ 26.80'N	
	129 ⁰ 35.78'W	129 ⁰ 35.78'W	129 ⁰ 36.18'W	
Depth: 380m				
000501471010				
UBSERVALIONS:				
Descent similar t	o dive 520 - fewer	numbers of small	l jelly fish. <u>Boroë</u> ve	ery
common below 125m	•			
380m	- (1520) Botto	om, course 070 ⁰ .		
	- Sediment lig	ht brown, soft.	Sediment surrounding	burrows
	light brown	colour compared	to light grey observed	j at
	head of inle	et.		
	- Visibility n	urky,		
	- Small hermit	crabs (occasion	nal).	
	- Alaska king	crab (2).		
	- Shrimp (most	ly pinks, few si	idestripe), considerab	ly fewer
	than Hasting	is Arm but more a	bundant than head of <i>l</i>	Alice Arm.
	- Prawn (occas	ional).		
	- Eelpouts - c	common.		
	- Small skate.			
	- POILOCK (CON	mon).	coon in other regions	notico
	- burrowing an	also matfish ar	d doafish absont	notre-
	ably absent,		o	
380m	- (1540) Chang	ed course to 180	ο.	
	- Gradual upwa	rd slope.		2.
	- Shrimp occur	ring in groups i	n large numbers (20/m [*]	-)
	(pinks and s	idestripe) other	r areas shrimp are span	rse.
	- Tanner crab	(occasional).		

340m	 - (1620) Mud slope. - Contact with slide area covered by rock fragments, boulders, shell (cockle) debris - steep slope.
315m	 (1630) Contact base of rock cliff. Brachiopod (many). Rock covered with thin layer of sediment. Hermit crab, pectins, pink sea urchins (<u>S. paligus</u>) (few). Pteraster (occasional). Fan coral (<u>Paragorgia</u> sp.) few.
250m	- (1639) Large Alaska king crab - observed on rock ledge.
200m	 - (1645) Crinoid (<u>Florometra</u>) few. - <u>Pteraster</u> - common. - <u>Munida</u> - absent. - Shrimp (<u>pandalid</u>) numerous on rock ledges covered with sediment.
150m	- (1658)
135m	 - (1700) <u>Munida</u> (occasional). - Cloud sponges. - Larger prawns (few) - prawns do not appear to be very abundant in either Alice Arm or Hastings Arm. - Sea anemones (pink/white) common.
75m	- (1705)
25m	- (1710) Surfaced.

SUMMARY

Shrimp fewer than Hastings Arm but greater than head of Alice Arm. Eelpouts very common.

Three Alaska king crab.

Rock face - greater variety of marine life than Hastings Arm - fan coral pink urchin, <u>Pteraster</u> (cushion star), shrimps common on ledges covered by sediment. Cloud sponge common, occasional solaster, numerous brachiopods. Type of marine life varied little between 30 and 280m.

Visibility - lower than dives in Alice and Hastings Arm.

<u>Cancer</u> magister sparse.

Location:	Alice Arm (m	outh)		Date: 2	5 October 1976
Dive No.:	522 (Fig. 4	2)			
Observers:	D. Goyette,	H. Nelson			
Position:	<u>Start</u> 55 ⁰ 24.71'N 129 ⁰ 40.76'W	<u>Turn</u> 55 ⁰ 24.64'N 129 ⁰ 40.60'W	<u>Turn</u> 55 ⁰ 24.88'N 129 ⁰ 40.65'W	<u>Turn</u> 55 ⁰ 25.14'N 129 ⁰ 40.95'W	<u>Finish</u> 55 ⁰ 25.30'N 129 ⁰ 40.72'W
Depth: 85m					
OBSERVATIONS	<u>S</u> :				
visibility - Detritus, no	- clear. D zooplankton	observed unt	il reaching b	ottom.	
85m	- (-) - (-) - [-] -] -] -] -] -] -] -] -] -]	(0903) Bottom Currents negl Macroinverteb Similar to Ha Basket stars Often surroun <u>Crossaster</u> - Hermit crabs Fanner crab (Larger sea wh Flounder (com Shrimp - few Humpback shri Skate (1).	visibility 4 igible. rates numerou stings Arm. (<u>Gorgonocepha</u> ded by numero few. (large) - abu numerous). ips (common). mon), Pollock pinks, no sid mp (common com	.5m. s and diverse <u>lus</u>) very num us juveniles. ndant. (common). estripes. mpared to oth	er dives).
75m	- (W	(0930) Increa with few side groups.	se in number stripes and h	of shrimp - m umpbacks - sh	ostly <u>P. borealis</u> rimp occurring in
60m	- (- E - 1 k	(0935) Alaska Basket stars, LG Alaska kin King crab.	king crab (4 sea whips - g g crab - grou). common. Ded tøgether,	captured smaller

·

	 Carapacewidth 19.05 cm, legs 1.31m tip to tip <u>Parasticopus</u> - like sea cucumber common. Flatfish, eelpout - numerous. One approx. 2 kg. salmon observed.
60m	 (1005) Course - due north 75m. - (1026) Slope, bottom changing to gravel. - Numerous small white sea urchins associated with gravel bottom.
	- Tanner crab. - Solitary corals (on rocky areas). - Humpback shrimps - numerous. - <u>Parastichopus</u> - like sea cucumber - common. - Flounder, sculpin - few. - No shrimps seen on gravel.
60m	 (1035) Contact with rock cliff. Few brachiopod. many shrimp - on rock face and ledges. <u>Pteraster</u>, <u>Crossaster</u>, <u>Patria</u> (orange), <u>Henricia</u>, <u>Mediaster</u> starfish - common. Cloud sponge. Rock relatively sediment free.
10m	- (1048) Forced to surface due to strong lateral current.

- 175 -

SUMMARY

Compared to other dives - area showed a greater diversity of macroinvertebrates - greatest abundance of Alaska king crab.

Location:	Observatory	Inlet		Date: 2	25 October 1976
Dive No.:	523 (Fig. 42	2)			
Observers:	D. Goyette, I). Sullivan			
Position:	<u>Start</u> 55 ⁰ 21.60'N 129 ⁰ 45.76'W	<u>Turn</u> 55 ⁰ 21.65'N 129 ⁰ 45.00'W	<u>Turn</u> 55 ⁰ 21.68'N 129 ⁰ 44.80'W	<u>Turn</u> 55 ⁰ 21.48'N 129 ⁰ 44.66'W	<u>Finish</u> 55 ⁰ 21.51'N 129 ⁰ 44.46'W
Depth: 210	m				
OBSERVATION	<u>S</u> :				
Surface vis	ibility - clea	ur. Detritus	concentratio	n similar to	previous dives.
90m	- A - (oppearance of Occasional eu	ctenophores phausid small	<u>Bolinopsis</u> . fish, chaeto	ognaths.
125m	- N - N	lumbers of cto lumerous hype lumerous cteno	enophores inc rid amphipods ophores.	reased.	
150m	- N	lumerous smel	t.		
200m	- \	'isibility de	creasing.		
210m	- (- a - V - C - N P - S - N - F	1320) Bottom pproximately isibility app course 100 ⁰ . umerous domes ink, white to mall sea pens umerous small ew sidestripe	- soft brown 1.5m ² light prox. 3m. shaped anemone o deep red. s (white) com l shrimp (<u>P. 1</u>	mud, occasio grey undernea es observed - mon. borealis).	onal burrow. hth. colours varied,
	- S - E - T - S	elpouts (few) anner crab (f mall squid (8). few). 3).		
	- F - H	lounder (few) yas - common).		

	- (1413) Changed course to 120 ⁰ .
200m	 (1429) Changed course to 150⁰. Bottom sloping towards shore. Shrimps 6-8/m² occurring in groups. Conc. of shrimp similar to Alice Arm occasionally clustered in groups of 15-20. Numerous burrows. Brittle stars - exceptionally numerous, covered the entire bottom, arm to arm throughout most of the dive area.
200m	- (1425) Bottom becoming steeper (about 45 ⁰). - Brittle stars - dominant. - Shrimp (<u>P. borealis</u>) - numerous. - Occasional sidestripe.
180m ·	- (1435) Rock outcroping.
175m -	 Return to mud bottom. Larger numbers brittle stars, <u>P. borealis</u>, (common). Small octopus. <u>Pteraster</u>.
145M ·	- (1455)
125m-	 (1500) Bottom covered by brittle stars. Shrimp (occasional). Tanner crab. Parasite seen on king crab observed free living on bottom debris. <u>Munida</u> (occasional). Humpback shrimp (few). Tubeworms. Cabazon.
100m -	- (1507) Gravel bottom, occasional boulder. - Crinoid (few) - <u>Florometra</u> .
95m ·	- (1510) Contact with base of cliff. - Brachiopod, brittle stars, <u>Parasticopus</u> - like sea cucumber.

- Light cover of sediment over rocks.
- Crinoids, <u>Pteraster</u> common.
- Pycnopodia (few).
- Bottom varied from silt to rock and coarse sand to solid rock.
- Cloud sponge, crinoids. <u>Munida</u>, and tubeworms common on rock face, occasional flounder.

20m

- Rock surface free from sediment.

- Left bottom at 1530.

SUMMARY

Shrimp abundant similar to Alice Arm - mostly pinks with the occasional sidestripe and humpback. Brittle stars - most dominant species throughout dive. Eelpout, flatfish, pollock - common. Flatfish less abundant than head of Alice Arm. Bottom ranged from fine silt to gravel/silt to coarse sand/boulder to clean rock from centre channel to shoreline.



FIG. 42 PISCES DIVE TRACKS - ALICE ARM, HASTINGS ARM, AND OBSERVATORY INLET (1976).

Location: Howe Sound (Daisy Creek, Track 1) Date: 20 April 1978 (North of Britannia Mine Track 2) Dive No.: 653 (Tracks 1 and 2) (Fig. 43) Observers: D. Goyette, D. Brothers Position: Start Finish 49⁰36.50'N 49⁰36.36'N Track 1 123⁰13.48'W 123⁰12.98'W 49⁰38.06'N 49⁰38,13'N Track 2 123⁰12.78'W 123⁰13.29'W Depth: 272m (Track 1) 242m (Track 2) Track 1 Surface - murky. - floccs and strings of diatoms abundant - strings up to 3.Om 6.6.m 15 cm long. 20m - few zooplankton. 52m - detritus, little zooplankton. 80m - slight increase in zooplankton, occasional euphausids. - smelt 100m - occasional Hyperid (amphipod). 115m - occasional smelt, one ctenophore (very few seen). 160m - increase in smelt 180m - pelagic shrimp 190m - smelt 202m 272m - on bottom - smooth, thin layers of silt over gray clay. - some spirontocarid shrimp. - few Hake like fish - silver lateral line, gray colour, mottled, thin body, no sign of dorsal fin. - occasional Munida sp.

	 course 020⁰ mostly spirontocarid shrimp. occasional eelpout absence of craters commonly seen on the bottom occasional Hake like fish, ratfish, eel pouts.
250m	 smooth bottom occasional <u>Munida</u> sp. no other pandalid shrimp seen to this point except for 2 sidestripe shrimp. eelpouts, light brown, black fins.
225m and up	 occasional <u>Colus</u> sp. steep ridge, vertical face, no sign of rock very rough bottom lumps, ridges course in shore 120⁰ steep slope, rough bottom
180m	 followed steep ridge perpendicular to shore, flat top width of Pisces - fell off sharply on either side - face almost vertical
157m	- several prawns - lost ridges at pinnacle - several small cuttlefish - <u>Spirontocaris</u> sp. and Pandalid shrimp
140m	 ridge ratfish, Colus a number of large craters, increase in numbers of Pandalid shrimp
129m	- occasional Munida
120m	- Prawn, pin anemones (small)
102m	 rock cliff, silted occasional exposed rock - areas generally covered by brachiopods, small anemones - sponges not present if slight layer of silt. Large Metridium, appear to tolerate thicker layers of silt.

	 numerous small Munida burrowing anemones on silt ledges.
87m	- steep, smooth rock face covered with sediment - num e rous Perch (small) - one Tanner crab
58m	 barren sediment numerous sessile invertebrates on sediment free areas regardless of how small the area generally sponges, small anemones and brachiopods small sea whips headed for surface
Track 2	
2.4m	- surface visibility - murky
15m - 22m	- diatom strings
72m	- decreasing visibility, murky layers
80m	- increasing visibility
242m	 bottom numerous small <u>Munida</u> sp. bottom similar in appearance to that of Track 1. visibility 4.5m numerous spirontocarid shrimp, <u>Munida</u> very numerous, flatfish, eelpouts flat bottom, no evidence of large craters, occasional log and wood debris. Munida very numerous few gastropods - <u>Colus</u>? - on wood debris occasional eelpouts, mostly Munida (small) and <u>Spirontocaris</u> sp.
243m	 no starfish seen on both Track 1 (morning) and Track 2 (evening) dives ratfish level bottom
293m	- base of cliff - covered with thick layer of silt

	 worm castings, eelpouts increasing number of burrows contacted another ridge
196m	- mostly spirontocarid shrimp - occasional pink shrimp - occasional side stripe - Tanner crab - sturgeon Poacher
133m	- increasing numbers of prickleback and eelpouts
128m	- visibility decreasing - few Pandalids - cancer crab - large craters
89m	- still turbid - Pandalids common
100m	- side stripe
87m	- visibility 60 cm. - Tanner crab - Lemon sole
68m	- bare rock heavily silted, not as smooth as Track 1 dive - poor visibility
40m	- rock fish
15m	 leaving bottom large no. of <u>Cancer magister</u> near end of dive

SUMMARY

- bottom similar on both dives
- gray beneath thin layer of brown sediment
- few burrows
- fewer fish than previous dives
- mostly eelpouts and pricklebacks
- occasional sole, ratfish, dogfish
- mostly spirontoca is shrimp with numbers of Pandalids increasing inshore
- pinks and occasional sidestripe
- bottom topography consisted of a series of terraces lying parallel to the shore line and sharp ridges running perpendicular to shore.



FIG. 43 PISCES DIVE TRACKS, HOWE SOUND (1978).

Location:	Howe Sound	Howe Sound Date: 21 April 1978					
Dive No.:	654 (Fig.	44)					
Observers:	D. Goyette,	P. Christie					
Position:	Start	Turn	Turn	Turn	Turn	<u>Finish</u>	
	49 ⁰ 34.08'N 123 ⁰ 15.50'W	49 ⁰ 34.02'N 123 ⁰ 15.85'W	49 ⁰ 33.75'N 123 ⁰ 15.92'W	49 ⁰ 33.58'N 123 ⁰ 16.00'W	49 ⁰ 33.34'N 123 ⁰ 16.10'W	49 ⁰ 33.16'N 123 ⁰ 16.22'W	
Depth: 25	Om						
250m	-	bottom visibility 9 muddy bottom	'm - 12m				
270m	-	sloping mud change cours	bottom e 180 ⁰ to top	of sill			
154m	-	bottom steep	mud slope				
45m	-	forest of sea slope up was on course 18	a pens not steep, t O ^O	herefore carr	y on down slo	pe	
100m	-	skiing down	slope				
135m	- -	flat bottom batteries fl headed for s	at urface.				

Species noted

Ambrocallistes sp many on slope	<u>Stylatuľa elongata</u> – many
squat lobster - few	<u>Neptunea</u> sp few on logs
starfish - few	Rockfish - occasional
<u>Cancer magister</u> (6)	Ratfish - few
spider crabs - occasional	Sole - occasional
Eelpout - many	<u>Pandalus platyceros</u> - numerous
<u>Pachycerianthus</u> sp many	<u>Pandalus borealis</u> - few

- 185 -

<u>Also:</u>

Metridium senile
 Ptilosarcus gurneyi
 Colus sp.
 Pacifaea pacifica
 Hermit crabs
 Henricia sp.
 Hake
 Pollock
 Quillback Rockfish
 Dogfish



SOUND (PORTEAU COVE) 1978. DIVE TRACK, HOWE PISCES FIG. 44

Location: How	e Sound	Da	ate: 21	April 1978
Dive No.: 655	(Fig. 45)			
Observers: D. (Goyette, D. Sullivar	1		
Position:	Start	Finish		
	49 ⁰ 29,60'N	49 ⁰ 29,35'N		
	123 ⁰ 15.55'W	123 ⁰ 14.95'W		
Depth: 233m				
OBSERVATIONS:				
233m	- on bottom			
-	- mud bottom			
	- visibility	3m - 4m		
	- shrimp, and	emones, and starfish		
	- course 150 [°])		
	- change to C	170 ⁰ towards shore		
235m	- base slopin	ıg		
	- mud bottom			
	- now bottom	is a jungle of rocks		
200m	- coming up s	teep, broken rock face	2	
	- headed for	surface		
Species noted:				
Aphrocallistes s	sp.	Bryozoa		Tanner Crab
Rhabdocallistes	sp.	Terebratula		Pseudarcaster
Soft sponges		<u>Solaster</u> sp.		Chiridota
<u>Metridium</u> <u>senile</u>	2	solitary Ascidian		Tunicates
Pachycerianthus	sp.	Eelpout		
Pandalus boreali	is_	Pollock		
<u>Pandalus</u> platyce	eros	Rockfish		
Pacifaea pacific	<u>ca</u>	Ratfish		
Squat lobster		Dogfish		
Crangon		Sole		

Location:	Howe Sound Date: 22 April 1978
Dive No.:	656 (Tracks 1 and 2) (Fig. 46)
Observers:	D. Goyette, R. Kussat (Track 1) R. Hoos, M. Ito (Track 2)
Position:	<u>Start</u> Track 1 49 ⁰ 25.38'N 49 ⁰ 24.68'N 123 ⁰ 14 80'W 123 ⁰ 14 50'W
	Track 2 $49^{\circ}27.00'N$ $49^{\circ}27.15'N$ 123 [°] 18.00'W 123 [°] 18.85'W
Depth: 235 244	m (Track 1) m (Track 2)
<u>Track 1</u>	
235m	- on bottom - moving off on course 150 ⁰
234m	- heading on course of 120 ⁰ - bottom is basically mud - visibility 3m - 4m - lots of hills and valleys
211m	- coming up steep mud slope - not a lot of fish
180m	- still on mud slope
148m	- coming up a rock bluff
101m	 coming up a mud and rock bluff headed for surface
Track 2	
244m	- on bottom - moving off on course 255 ⁰ .
206m	- coming up slight mud slope
175m	- coming up a rock bluff
85m	- on a plateau

- still on plateau

.

- headed for surface

86m



FIG. 45 PISCES DIVE TRACK, HOWE SOUND (1978).



Location:	Alice Arm	ı (near Pearson f	Point)	Date: 8 J	July 1982
Dive No.:	1102 (Fi	g. 47)			
Observers:	D. Goyett	e, R. Hinder			
Position:		<u>Start</u> 55 ⁰ 26.96'N 129 ⁰ 30.63'W	<u>Turn</u> 55 ⁰ 27.30'N 129 ⁰ 29.61'W	<u>Turn</u> 55 ⁰ 27.30'N 129 ⁰ 29.43'W	<u>Finish</u> 55 ⁰ 27.19'N 129 ⁰ 29.19'W
Depth: 107	m				
OBSERVATION	<u>s</u> :				
		- turbid at sur	face		
8.5m		- halocline - f	fine particles	in suspension.	
to 60m		- fine particle a few euphaus	es, ctenophore sids.	s, chaetognaths	, <u>Cyanea</u> ,
60m		- more ctenopho	ores seen.		
89m 100m		- grey haze, vi - very murky	sibility 1.2	- 1.4m	
102m		- extremely mur	·ky.		
107m		- reached botto in water colu	om – steep slo Imn.	pe - fresh tail	ing, amphipods
90m		- course 060 ⁰ - surface.	• sea whip in •	fresh tailing -	ripples on
61m _		- some small sh shore).	arimp – altere	d course to 090) ⁰ (toward north
97m		- sub frame cle	arly visible	- water murky g	irey.
75m		- recontacted b	ottom.		
90m		- again contact	ed bottom, vi	sibility 2.3m.	
75m		 bottom - old brown, some b <u>Chinocetes ba</u> and <u>Pandalus</u> 	tailing or na ourrows and an <u>irdi, Lithode</u> <u>borealis</u> .	tural sediment imal tracks. <u>s aequispina</u> , <u>P</u>	- surface light Pandalus hypsinotus

Location:	Alice Arm	l (off Pearson Po	oint)	Date: 8 July 1982	
Dive No.:	1103 (Fi	g. 47)			
Observers:	D. Goyett	e, D. DeMill			
Position:		Start	Turn	<u>Finish</u>	
		55 ⁰ 26.92'N	55 ⁰ 26.85'N	55 ⁰ 26.92'N	
		129 ⁰ 29.56'W	129 ⁰ 29.63'W	129 ⁰ 29.56'W	
Depth: 38m					
OBSERVATIONS	<u>S</u> :				
		- surface water	`murky.		
38m		- bottom - visi	bility good.		
		- eelpout, <u>Hyas</u>	<u>lyratus</u> , <u>Lithod</u>	es aequispina, Chionc	<u>ocetes</u>
		<u>bairdi</u> , panda	lid shrimp.		
		- sediments - n	atural in appear	ance - burrows, ligh	t brown
		layer on surf	ace.		
		- Ran west para	llel to shore, f	ound 14 cm pipe (cen	tre of
		small bay wes	t of outfall).		
		- Returned east	to find outfall	pipe at 35m, edge o	f
		turbidity clo	ud encountered w	ith billowing clouds	•
		- Dive cancelle	ed due to potenti	al hazard from ropes	attached
		to the pipe a	nchors.		

.

Location:	Alice Arm	Date: 9 July 1982
Dive No.:	1104 (Fig	. 47)
Observers:	D. Goyette	, F. Hickey
Position:		<u>Start</u> <u>Finish</u> 55 ⁰ 26.70'N 55 ⁰ 26.77'N 129 ⁰ 31.85'W 129 ⁰ 31.58'W
Depth: 274	m	
OBSERVATION	<u>S</u> :	
		- water murky at surface.
13m		- water clear - fine suspended particles.
86m		- greyish-white appearance to water column, larger particles same as shallower.
104m		- strands in water.
155m		- large numbers of strands and particles, visibility about 3m, no further evidence of turbidity field.
250m		- murky.
272m		- occasional smelt-like fish, hyperid amphipods.
274m		 bottom - fresh tailings, surface rippled, featureless, no burrows, occasional chunks of clay. some <u>Pandalus borealis</u>, one prickleback, coiled brown/black nemertean worms on surface. visibility about 2m left bottom.
269m		- becoming murky.
higher		- extremely murky - visibility nil.

Location:	Alice Arm (o	ff Pearson Po	int)	Date: 9	July 1982
Dive No.:	1105 (Fig.	47)			
Observers:	R. Hinder, L	McLeod			
Position:	Start	Turn	Turn	Turn	<u>Finish</u>
	55 ⁰ 27.55'N 129 ⁰ 29.52'W	55 ⁰ 27.65'N 129 ⁰ 29.36'W	55 ⁰ 27.63'N 129 ⁰ 29.26'W	55 ⁰ 27.73'N 129 ⁰ 29.26'W	55 ⁰ 27.49'N 129 ⁰ 29.52'W
Depth: 99m					
OBSERVATIONS	<u>5</u> :				
	- 1	murky at surf	ace.		
11m	- 1	halocline.			
40m	-	larger white	particles beg	in showing up	•
70m	- (odd ctenophor	e, particles	as at 40m.	
99m	-	bottom - cour	se set at 040	•	
	- 1	numerous burr	ows and track	s, similar to	dive 1102,
		grey sediment	with brown c	oating, sea w	hips (small).
	- (ctenophores i	n water.		
	[*]	visibility ab	out 1.4m.		
97m	- -	some small lo	gs and branch	es, loose <u>Fuc</u>	<u>us</u> .
	- 1	very few shri	mp, some <u>Chio</u>	nocetes baird	i, and eelpouts.
94m	-	king crab, se	a whips very	common, visib	ility 2m.
	÷.	larger burrow	s, more shrim	p (mostly <u>Pan</u>	dalopsis dispar,
	9	some <u>Pandalus</u>	<u>hypsinotus</u> ,	Pandalus bore	alis, and others).
78m	- (changed cours	e to 120 ⁰ .		
later	- (changed cours	e to O ^O .		
	- (chaetognaths	and euphausid	s in water.	
79m	- 2	2 Theragra ch	alcogramma.		
	- 1	visibility im	proving.		
92m	· (changed cours	e to 245 ⁰ .		
	- 9	sea whips den	se, several <u>P</u>	andalopsis di	spar.

- encountered humps about 1m high and 6m apart.

- no shrimp, fewer sea whips than earlier.

98m

- 199 -

Location:	Alice	Arm (of	f Hans Point	.)	Date: 10	July 1982
Dive No.:	1106	(Fig. 4	7)			
Observers:	D. Goy	ette, D	DeMill			
Position:			<u>Start</u>	Turn	Turn	Finish
		55 129	0 ⁰ 25.71'N 1 ⁰ 40.23'W	55 ⁰ 25.42.N 129 ⁰ 40.13'W	55 ⁰ 25.13'N 129 ⁰ 40.14'W	55 ⁰ 25.08'N 129 ⁰ 40.45'W
Depth: 232r	n					
OBSERVATIONS	<u>S</u> :					
		- s	ome surface	turbidity.		
8m		– h	alocline.			
lower		- f	ine particle	s, strands (m	ore than at hea	d of inlet).
186m		- m	any suspende	d particles.		
232m		- b s - s - c	ottom - visi ilt. mall urchins ourse 170 ⁰ .	bility about 4	5m, cobbles cov	vered with fine
		- 1 n w <u>P</u>	ight brown s umerous smal hite <u>Henrici</u> andalopsis d	ilt. <u>Chionoco</u> 1 shrimp and <u>a</u> -like starfis <u>ispar</u> , <u>Lithod</u>	<u>etes bairdi, Pa</u> hermit crabs, s sh, <u>Parastichop</u> es aequispina.	ndalus borealis, kate, eelpouts, pus, a few
186m		- 1 <u>d</u>	arger rocks, ispar, <u>Litho</u>	occasional <u>Pa</u> des <u>aequispina</u>	andalus boreali a.	<u>s</u> and <u>Pandalopsis</u>
70m		- c <u>T</u> <u>m</u> - v - P	obbles, boul <u>heragra chal</u> <u>iniata</u> , crin ery few shri teraster, Mu	ders, small <u>Pa</u> <u>cogramma, Cros</u> oids. mp, clean bot <u>nida</u> , cup cora	aragorgia - whi ssaster papposu tom. als, many small	te and pink, <u>s, Cucumaria</u> <u>Paragorgia</u> .

42m	 <u>Strongylocentrotus pallidus</u>, <u>Crossaster</u>, few crustaceans, crinoids dominant, basket stars, a few sole. outer slope of sill, fine gravel. slightly lower visibility.
52m	 gravel - hermit crabs, basket stars, sculpins, sole, Parastichopus, Colus.
58m	- cup coral, snails, hermit crab, occasional starfish.
64m	 mud, sea whips, sea cucumbers, sea urchins. No king crab on outer side of sill thus far.
67m	 visibility lowered to 1.2 - 1.7m. Soft, light brown, smooth mud, a few burrows and animal tracks, small <u>Paralithodes</u>, very few shrimp, eelpouts, basket stars, large sculpin, <u>Chionocetes bairdi</u>.

•

Location:	Alice	Arm		Date: 10 July 19	82
Dive No.:	1107	(Fig. 47)			
Observers:	D. Goy	yette, D. DeMill			
Position:		Start	Turn	<u>Finish</u>	
		55 ⁰ 26.70'N 129 ⁰ 32.49'h	55 ⁰ 26.70'N 129 ⁰ 32.04'W	55 ⁰ 26.98'N 129 ⁰ 31.86'W	
Depth: 342r	n				
OBSERVATIONS	<u>}</u> :				
		(A pre-dive trubidity 80-110m)	transmissometer p at around 100 metre	rofile revealed maxim es, elevated levels f	um rom
100m		- water mil	ky.		
143m		- still mur	ky and entering and	other layer.	
342m		- bottom - light bro	natural appearing r wn layer - course (nud, craters, burrows 090 ⁰ .	,
		- <u>Ctenodisc</u> cucumbers eelpout, <u>dispar</u> , 2	<u>us, Chionocetes ba</u> protruding from bo a few <u>Pandalus bore</u> <u>Lithodes aequisp</u>	irdi, numerous small ottom (<u>Chiridota</u> ?), o ealis, a few <u>Pandalop</u> oina, hermit crab.	sea ccasional <u>sis</u>
322m		- silty app	earance, entering t	fringe of tailing dep	osit.
324m		- bottom sm	oother, <u>Lithodes</u> .		
317m		- smoother - bottom ap ridges an - clay lump - "moonscap	bottom, fewer burro pears striated due d brown material in s, smooth bottom - e" - barren and smo	ows, few shrimp. to ripples with ligh n troughs. fresh tailing. ooth, some animal trad	t grey cks.
318m		- <u>Molpadia</u> , - ridges ru	very few shrimp. n N-S, about 1½ cm.	high.	

313m	- evidence of slumping, clay lumps.
317m	- turning to shore - course 030 ⁰ .
307m	- silt, clay chunks, numbers of shrimp increasing.
290m	- steep slope.
269m	- poor visibility.
237m	 still poor visibility - soft mud, craters reappearing, sea urchins, occasional sea anemone (pink/white), <u>Ctenodiscus, Crangon communis</u> - common, <u>Solaster</u>, small fish.
212m	 silty, visibility poor. Natural sediments, steep mud slope.
171m	 <u>Pandalus borealis</u> - numbers increasing. Very few fish seen this dive, no sole, the odd skate, several <u>Theragra chalcogramma</u>, <u>Chionocetes</u>. bottom conditions similar to beginning of dive.
143m	- steep mud slope.
94m	- few flatfish.
67m	- visibility increasing, silty bottom.
	 rock with cloud sponge, brachiopods, numerous anemones (pink/white), shrimp.

Location:	Alice	Arm	(across	from Ha	ns Point)	Dat	e: 11	July	1982
Dive No.:	1108	(Fig	47)						
Observers: D. DeMill,			F. Hickey						
Position:			Start		Turn	<u>Fi</u>	<u>nish</u>		
			55 ⁰ 26.6	8'N	55 ⁰ 26.27'N	55 ⁰ 2	6.48'N	l	
			129 ⁰ 39.0	5'W	129 ⁰ 39.52'W	129 ⁰ 4	0.23'W	l	
Depth: 306n	n								
OBSERVATIONS:									
78m			- large	particl	es in water	1 - 2 cm.	apart.		
			- inters	titial	water clear.				
			- ctenop	nores,	amphipods, co	opepods.			
100m			- long s	trands	begin to appe	ear.			
142m			- herrin	g, eelp	out-like fisl	h.			
200m			- chaeto	gnaths,	<u>Cyanea</u> .				
306m			- bottom	- visi	bility 3m, s	oft mud bo	ttom.		
			- course	2350.					
			- prickl cucumb	eback, ers	Pandalopsis (<u>dispar</u> , sm	all pi	nk sea	1
			- bottom	soft m	ud with many	tiny tube	s prot	ruding	, no
			burrow	s.					
			- white	small <u>H</u>	<u>enricia</u> -like	starfish,	a few	smal]	shrimp,
			small (elpout	s, white sea	urchins.			
			- a few	burrows	now.				
			- bottom	finely	dusted with	light bro	wn sed	iment	and
			organi	c debri	s (bark, brai	nches).			
		• •	- Lithod	es aequ	ispina, Thera	agra chalc	ogramm	<u>a, Chi</u>	onocetes
			bairdi	, small	<u>Colus</u> , smal	l burrowin	g anem	ones.	
		•	- occasi	onal sm	all burrows,	many smal	1 tube	s.	
266m			- <u>Munida</u> and pro	, hermi otrudin	t crabs, tube g further fro	es a littl om the bot	e larg tom.	er in	diameter

	 getting into coarser sediment - appearance of rippled beach sand, firmer - the sub doesn't plough in as deep no tubes. 				
253m	- smooth river stones up to 30 cm or more in diameter.				
later	 tubes reappear, anemones. softer sediment with burrows. small hermit crab, small shrimp, small tubes, one <u>Marsipobdella sacculata</u> (leech) on own - others on <u>Lithodes</u>. small eelpout. sediment light grey with brown organic coating. A lot of organic debris. <u>Pandalopsis dispar</u>, small sculpin, <u>Theragra chalcogramma</u>. 				
216m	 new heading 270⁰. pink anemone, <u>Strongylocetrotus pallidus</u>, <u>Lithodes</u> <u>aequispina</u>, several small shrimp, sponge, brittle star. tubes still plentiful, occasional shallow burrow. many small sea cucumbers. 				
later	 have reached station U64, still heading 270⁰. shallow burrows, cucumber castings, large snail. visibility 3-5 metres. 				
216m	 slope rising. sediment light grey beneath brown coating. small hermit crab, small shrimp, eelpout, scale worms. large rock. steep rock cliff - hermit crab, brachiopods, anemones, brittle stars, large Primnoa, starfish, anemones in tubes, small white Paragorgia. brown sediment on rock, brachiopods, tube worms, anemones in tubes, white <u>Cucumaria</u>, white <u>Henricia</u>-like starfish. seawhip, sponge, large sculpin, many <u>Strongylocentrotus pallidus</u>. smooth sediment covering part of slope, with a few burrows, small shrimp, small eelpouts, <u>Munida</u>, cup corals. 				
70m	- rock cliff again - brachiopods, cup corals, shrimp.				
Location:	Alice Arr	n		Date: 11 July 198	2
-------------	------------	--	--	---	-----------------------
Dive No.:	1109 (F	ig. 47)			
Observers:	R. Hinder	r, L. McLeod			
Position:		<u>Start</u> 55 ⁰ 27.10'N 129 ⁰ 36.07'W	<u>Turn</u> 55 ⁰ 26.98'N 129 ⁰ 35.48'W	<u>Finish</u> 55 ⁰ 27.27'N 129 ⁰ 35.40'W	
Depth: 362	m				
OBSERVATION	<u>s</u> :				
		- long mucous	strands, eelpout	-like fish.	
362m		- visibility 2 - sediment gra - large and sm	2/3 metre. ay with light bro mall burrows, som	own dusting. ne animal trails, a fe	w shrimp.
355m		- Lithodes aeq	uispina.		
340m		 visibility 1 2 shrimp event <u>dispar</u>, some several eelp 	m. ery second, at or Pandalus boreal pouts and prickle	e knot speed. Mostly <u>is</u> , and others. backs.	<u>Pandalopsis</u>
299m		- rock face, s	ea cucumbers.		
287m		- equal amount (abouth6 in	s <u>Pandalopsis</u> di view at one time	<u>spar</u> and <u>Pandalus</u> bor).	<u>ealis</u> ,
225m		 visibility 3 more <u>Pandalu</u> more <u>abundan</u> some grey pa from the sub 	-4m. <u>s borealis</u> than t overall (10-15 tches where the strate.	<u>Pandalopsis dispar</u> an in view at one time) brown coating has bee	d shrimp n cleared
210m		- some large b	urrows - up to 1	5 cm. across.	
175m		- sea anemone.			
169m		- smaller burr <u>Pandalus</u> bor	ows. Even numbe ealis plus small	ers of <u>Pandalopsis</u> <u>dis</u> er shrimp.	par and
surfaced		- many long mu	cous-like strand	s in water column.	

Location:	Hastings Arm (Grenby Bay)	Date:	12 July	1982
Dive No.:	1110 (Fig. 47)			
Observers:	D. Goyette, D. DeMill			
Position:	<u>Start</u> 55 ⁰ 24.18'N 129 ⁰ 49.30'W 129 ⁰ 48.90'W			
Depth: 90m				
OBSERVATION	<u>5</u> :			
	- turbid at surface.			
90m	 at bottom - fairly smooth, oc surface sediment brownish. visibility 1m. very many shrimp - mainly <u>Pan</u> <u>Pandalopsis</u> dispar. 	casional dalus bon	burrows. realis, s	ome
later	- visibility improved to 1½m.			

Location:	Alice Arm			Date: 1	.3 July 1982
Dive No.:	1111 (Fig.	47)			
Observers:	D. Goyette,	R. Hinder			
Position:	Start	Turn	Turn	Turn	Finish
	55 ⁰ 26.70'N 129 ⁰ 31.13'W	55 ⁰ 26.76'N 129 ⁰ 31.04'W	55 ⁰ 26.80'N 129 ⁰ 31.04'W	55 ⁰ 26.87'N 129 ⁰ 30.97'W	55 ⁰ 26.84'N 129 ⁰ 30.89'W
Depth: 240m	1				
OBSERVATIONS	<u>.</u> :				
	(C	onsists solel	y of transmis	sometry in mi	d-water).
229m	-	getting fairl 045 ⁰ .	y turbid - st	arting horizo	ntal run-course
	-	(bottom 240m)	•		
general	-	a few <u>Cyanea</u>	(jellyfish) h	ave been seen	•
218m	-	changed cours	e to 000 ⁰ .		
145m	-	fairly turbid	•		
118m	-	still turbid. changed cours	e to 030 ⁰ .		
119m	-	changed cours very turbid. at first, the	e to 120 ⁰ . As course co n cleared som	ntinued turbi ewhat.	dity increase

Location:	Hastings Ar	m (off Carr P	oint)	Date:	13 July 1982
Dive No.:	1112 (Fig.	47)			
Observers:	D. Goyette,	D. DeMill			
Position:		<u>Start</u>	Turn	<u>Fini</u>	<u>sh</u>
	1	55 ⁰ 28.82'N 29 ⁰ 45.32'W	55 ⁰ 29.00'N 129 ⁰ 45.46'W	55 ⁰ 29. 129 ⁰ 44.	12'N 92'W
Depth: 296	М				
OBSERVATION	<u>S</u> :				
24m	-	many particl little zoopl	es, interstitial ankton.	water cl	ear.
later	-	less large w occasional s	hite particles n melt-like fish.	ear the b Fish not	ottom. common.
296m		bottom - sil many small b <u>Ctenodiscus</u> <u>borealis</u> , on <u>Pandalopsis</u> visibility 1 shrimp space octopus. sediment aro shrimp distr very few eel	ty, surface ligh urrows and crate <u>crispatus</u> freque e <u>Theragra chalc</u> <u>dispar</u> , animal t -2m, fine suspen d about 1m - apa und burrows grey ibution patchy - pouts, no flatfi	t brown, rs. nt, occas <u>ogramma</u> , racks. ded parti rt. some are sh, one <u>P</u>	mounds greyish. ional <u>Pandalus</u> triton (snail), cles. as none. <u>andalopsis dispar</u> .
283m	- - - -	large crater <u>Ctenodiscus</u> occasional b shrimp do no prickleback. no hermit cra	s common, no rip <u>crispatus</u> freque urrowing anemone t seem as abunda abs.	pling. nt - some s, <u>Pandal</u> nt as in	buried. opsis <u>dispar</u> . 1976 dives.

270m	- steep rock face.
	- brachiopod shells at base.
	 rock face covered in brachiopods.
	- anemones, white <u>Henricia</u> -like starfish, <u>Balanus nubilis</u> ,
	one <u>Lithodes</u> <u>aequispina</u> .
241m	- occasional pandalid shrimp - fair distance between
	individuals.
216m	- gradual incline.
	- occasional eelpout, one <u>Anoplopoma</u> fimbria (sablefish).
	- a few small shrimp, poacher, snailfish.
200m	- shrimp a little more abundant - <u>Pandalopsis</u> <u>dispar</u> ,
	pandalids, a few spirontocarids.
	- <u>Ctenodiscus, Chionocetes bairdi,</u> another <u>Anoplopoma</u>
	<u>fimbria</u> .
183m	- steep muddy slope - uneven surface, some burrows.
	- many shrimp.
136m	- base of cliff, nearly vertical.
	- light dusting of silt on ledges.
	- brachiopods, cloud sponges, small white <u>Henricia</u> -like
,	starfish.
138m	- some <u>Parastichopus</u> , a triton, occasional <u>Munida</u> and
	Stronglocentrotus pallidus, some sea cucumbers.
100m	- very few shrimp.
	- surfaced.

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FIG. 47

PISCES IV SUBMARINE DIVE SITES - ALICE ARM AND HASTINGS ARM - July, 1982



8

Location:	Point Gre	зy		Date:	23 January	1976
Dive No.:	(Tr	acks 1, 2, 3,	3A, 4, and 5)	(Fig. 49)		
Observers:	N. Holman	, R. Hoos, G.	Packman			
Position:		Start	<u>Finish</u>			
	Track 1	49 ⁰ 16.70'N 123 ⁰ 22.04'W	49 ⁰ 16.09'N 123 ⁰ 21.97'W			
	Track 2	49 ⁰ 15.76'N 123 ⁰ 21.04'W	49 ⁰ 15.93'N 123 ⁰ 20.12'W			
	Track 3	49 ⁰ 16.66'N 123 ⁰ 19.83'W	49 ⁰ 17.17'N 123 ⁰ 20.72'W			
•••				Date:	24 January	1976
	Track 3A	49 ⁰ 16.97'N 123 ⁰ 19.76'W	49 ⁰ 16.72'N 123 ⁰ 20.73'W			
	Track 4	49 ⁰ 17.55'N 123 ⁰ 20.19'W	49 ⁰ 18.13'N 123 ⁰ 20.19'W			
	Track 5	49 ⁰ 15.42'N 123 ⁰ 22.43'W	49 ⁰ 15.42'N 123 ⁰ 23.58'W			

Depth: <u>ca</u> 250m

Submersible Observations and Photography Point Grey 1976

(Tracks 1, 2, 3, 3a, 4, 5)

During the course of the "PISCES" dives, approximately eight hours of videotape, two hours of 16mm film, and 350 still photographs were generated, as well as many visual impressions not recorded by any of the aforementioned media. This information is presently being examined and edited, to be retained as a permanent photographic record of conditions as they existed in 1976. In many ways the "PISCES" dives confirmed the insights gained from examination of the material collected by the beam trawl and benthic grab surveys. Relatively little dumped material was found within the dump site boundary, and virtually none occurred in the southern and western hemispheres. Epibenthic life and demersal fish were scarce in these areas. The benthos of all transects was deduced to be primarily infaunal owing to the abundant burrows and castings occurring on the mud surface.

Most of the debris noted had been deposited in the northern and eastern sections of the study area, with considerably more occurring outside, than inside, the limits of the designated dump site. Within the boundary, the most common materials found were lumps of hardpan clay and some wood debris, including a few deadheads. Outside the dump site, particularly along tracks 3, 3a, and 4, there were large quantities of construction rubble (including concrete pillars, reinforcing rods and cables), dredged material, and wood wastes. In some areas, regular mounds up to 2 metres high were found. These larger deposits were presumably the result of dumping by bottom-dump barges, the only likely mechanism whereby mounds of this scale could be generated. As would be expected, the deposits were randomly distributed, although more were present along transects 3, 3a, and 4.

With regard to the biological communities inhabiting the areas of concentrated debris, exposed objects such as deadheads, concrete blocks, scrap iron, etc., were attractive to many of the epibenthic macrofauna, including anemones, shrimp, and prawns, as well as to various species of fish. Apparently, the nooks and crannies provided niches with a measure of protection from predators, as well as firm substrates for the attachment of certain sessile organisms. This is a typical phenomenon experienced in the construction of artificial reefs in shallow waters and around shipwrecks. Many of the deadheads encountered were in an advanced state of decay, primarily due to heavy shipworm (<u>Bankia sp.</u>) infestations. Several were also covered in unidentified fungal and/or bacterial growths. In two instances, hundreds of large snails (<u>Neptunea</u> sp.) were found on logs covered with this growth. It is not yet clear whether the snails were feeding on the fungal and/or bacterial matter, or whether they were simply exhibiting a swarming behaviour for mating purposes.

The numerous holes and castings indicative of infaunal populations of polychaetes, holothurians, echinoids, and crustacea prevailed throughout the study area, inlcuding those sites where concentrated dumping has occurred. In fact, they were even found over all the large mounds described earlier, suggesting that infaunal recolonization of smothered areas was taking place.

- 213 -

The relatively shallower depths and the presence of noticeable bottom currents (as opposed to the negligible water movements typical of the dump site) along tracks 3, 3a, and 4, have apparently provided optimum conditions for ophiurioids. A dense population was found covering the bottom, including the areas of deposition, along the entire length of these transects.

In summary, "the PISCES dives" confirmed that the majority of the material dumped off Point Grey was, in fact, not found at the designated site, but rather to the northeast, toward the City of Vancouver. Many of the areas surveyed with "PISCES" were impossible to sample with trawling gear due to the variety of debris on the bottom. However, this debris did not appear to be adversely affecting the epibenthic macrofauna and served to attract to these areas many of the major life forms found. Nevertheless, these conclusions should not be considered a sanction for ocean disposal in sites other than those officially designated. In many locations, including the Point Grey area, a valuable trawl fishery exists in the more productive near-shore regions. Should such areas be littered with debris, fishermen would find it impossible to trawl their nets over the bottom.



FIG. 49

PISCES DIVE TRACKS AT POINT GREY DUMPSITE (1976 and 1978)

- 215 -

Port Mellon (Thornbrough Channel) Location: Date: 26 January 1976 Dive No.: 380 (Tracks 1 and 2) (Fig. 50) Observers: N. Holman (Track 1), J. Landucci (Track 2) Position: Start Finish 49⁰31.86'N 49⁰31.52'N Track 1 123⁰27.20'W 123⁰26.32'W 49⁰31.24'N 49⁰30.95'N Track 2 123⁰28.10'W 123⁰28.13'W

i

Depth: 130m

Note: No dive report available.



FIG. 50 PISCES DIVE TRACKS, PORT MELLON DUMPSITE (1976).

Location: Port Mellon

Dive No.: 381 (Fig. 51)

Observer: R. Hoos

Position: <u>Start</u> <u>Finish</u> 49⁰30.71'N 49⁰30.98'N 123⁰28.44'W 123⁰28.90'W

Depth: 130m

Note: No dive report available.

Date: 26 January 1976



FIG. 51 PISCES DIVE TRACK, PORT MELLON DUMPSITE (1976).

Location: Malaspina Strait (off Beaver Island) Date: 30 August 1976 Dive No.: 470 (Track 1) (Fig. 52) Observer: R. Hoos Position: Start Turn Turn Finish Turn Turn Turn 49⁰36.90'N 49⁰36.93'N 49⁰36.91'N 49⁰37.25'N 49⁰37.28'N 49⁰36,60'N 49⁰37.42'N

124⁰05.50'W 124⁰05.60'W 124⁰04.86'W 124⁰04.70'W 124⁰04.40'W 124⁰04.46'W 124⁰04.56'W

Depth: 215m

Water Column

- The surface water was characterized by a pea soup green colour, heavily laden with what appeared to be organic detritus, probably primarily planktonic algae.
- Natural light penetration (visible light) extended to a depth of 20 metres.
- Organic detritus continued to the bottom (215m) with the heaviest concentration occurring in the top 50m.
- Considerable zooplankton activity encountered
 Juvenile euphausids at 65m
 Adult euphausids from 75m 100m
 Gammarid amphipods, including <u>Cyphocaris</u> several species of small medusae
 (Aglantha, Aegina, Aeguorea), ctenophores (Pleurobrachia, Beroe) at 100-125m.
- Occasional squid observed from 160m to bottom 215m.

- At and near bottom observed considerable numbers of decapod crustacea (<u>Pasiphaea</u>), hyperiid amphipods, and polychaetes (<u>Tomopteris</u>).

Benthic Fauna

- Once on the bottom (215m) PISCES covered a transect heading generally northeast and terminating at a depth of 20 metres. - During the dive several rock "steps" were encountered, separated by relatively flat mud plains.

The following is a general summary of observations. The first 20 minutes of the track was on a flat silt/sand bottom at a depth of 215-190 metres. Some exposed <u>Chiridota</u> sp. were seen as well as several cod, hake, eelpouts, pink shrimp (<u>P. borealis</u>), numerous <u>Munida</u> and large burrows. We then proceeded to climb a series of steps terminating the dive at 20 metres.

The mud "plains" in between the ledges were all similar except that prawns became more common (approx. $1-2/m^2$) at between 150m and 75m. Shallower than 50m, prawns and shrimp became scarce. <u>Munida</u> remained common throughout but were generally large above 100m. They were particularly abundant on the rock ledges as were glass sponges (<u>Aphrocallistes</u> and unidentified cylindrical species). A variety of species of rockfish concentrated around the ledges. These included harlequin (<u>Sebastes variegatus</u>), stripetail (<u>S. saxicola</u>), redstripe (<u>S. proriger</u>), tiger (<u>S. nigrocinetus</u>), quillback (<u>S. maliger</u>), and Pacific Ocean perch (<u>S. alutus</u>).

Some soil, flounders, grey cod and hake were found on all flat muddy substrates with higher numbers encountered between 125 and 50 metres. Ratfish and some dogfish were observed regularly at all depths.

Between 35m and 20m life forms typical to the shallow littoral zone were observed (<u>Parastichopus</u>, <u>Leioptilus</u>, <u>Mytilus</u>, <u>Pisaster</u>, <u>Henricia</u>, <u>Cancer</u>, Strongylocentrotus, Chlamys, etc.).

In terms of debris, through the course of the dive, only 4 deadheads, one tire, a few beer/pop bottles, a tangle of fishing line and an old newspaper were encountered.

In comparing this area to similar sites at Point Grey and Port Mellon, I feel that the Malaspina Strait site harbours a considerably greater variety as well as numbers of pelagic fish and epibenthic macrofauna. The dive observations indicated that the largest standing crop of epifaunal organisms occurred within the 150-50 metre zone and that they concentrated around rock ledges and hard objects.

Note: no page 222; 223 next



FIG. 52 PISCES DIVE TRACK, MALASPINA STRAIT (1976). (PROPOSED DUMPSITE)

Location:	North of Powell Riv (between Harwood Is	er . and the mainland)	Date:	31 August 1976
Dive No.:	471 (Track 2) (Fi	g. 53)		
Observer:	N. Holman			
Position:	Start	Finish		
	49 ⁰ 52.30	'N 49 ⁰ 52.92'N		
	124 ⁰ 35.60	'W 124 ⁰ 35.65'W		
Donth 1/16	m			

Depth: 145m

Note: No dive report available.



FIG. 53 PISCES DIVE TRACK, NORTH OF POWELL RIVER (1976).

Location:	Strait of Georgia (off Nanaimo Harbour)	Date: 1 September 1976
Dive No.:	475 (Track 6) (Fig. 54)	
Observers:		
Position:	<u>Start</u> <u>Fin</u>	<u>ish</u>
	49 ⁰ 12.35'N 49 ⁰ 10 123 ⁰ 53.40'W 123 ⁰ 53	.31'N .58'W

Depth: 120m

Observations of the water column during descent showed considerable suspended detritus.

Touched bottom at 1600 hours at 120m. Visibility 1.5m. The bottom was noted to be a typical mud/silt bottom and first observations were of small hake, red snapper and later, numerous red snapper. Shrimp were in evidence. At approximately one-third of the way along the track, a long (5m) log was noted and shortly after several iron bars or rods were seen protruding from the bottom. Small sole and hermit crabs were seen. Occasional rocks and boulders were noted with squat lobsters and burrowing anemones in the vicinity. The bottom gently sloping upwards became rockier with an overlying layer of silt. Small white sponges (Aphrocallistes) and starfish (Mediaster) were evident in this area. An old discarded tire was found to contain an octopus (60 cm. extended). Brown and white banded rockfish (Scorpaenidae) were observed and later a random distribution of iron rods and rusting debris; remains of a fish net in the area might indicate that the debris caused the loss of this net. Another small octopus was sighted; small white seapens (1.2m), ratfish, yellow starfish (Pteraster), and a very large new log (stripped of bark). More cable or twisted steel rod was noted. The bottom terrain became more undulating in a depth of approximately 80m and two large mounds were seen. The area appeared to be covered in many more boulders. Brittle stars were prevalent and one large white seapen was seen. At 75m there appeared to be many crabs (Cancer magister). The terrain changed to mounds of small stones or crushed rock covered with a thin layer of silt, numerous squat lobsters were noted. Several eelpouts were also in evidence in this area and an abundance of crabs (Cancer magister).

The dive terminated in 70m at 1730 hours. As a general comment, it would appear that the several mounds noted in this area appeared to show evidence of past-dumped material or at least dumped material was in evidence in the general area of those mounds. However, it was also true that the most abundant marine life was observed in the latter part of the surveyed track.



 Location:
 Porlier Pass
 Date: 2 September 1976

 Dive No.:
 477 (Track 8) (Fig. 55)
 0bservers:
 V. Bradshaw, G. Packman

 Position:
 Start
 Turn
 Turn
 Finish

 49°01.64'N
 49°01.93'N
 49°01.61'N
 49°01.83'N
 49°01.61'N

 123°33.51'W
 123°33.31'W
 123°33.05'W
 123°32.90'W
 123°33.05'W

 Depth:
 178m

Current - approximately 1.85 km/hr from 110⁰T

Bottom Characteristics

The bottom was a typical mud bottom characterized by an exceptionally large number of holes and burrows.

Benthic Fauna

The major visible lifeforms were brittle stars (<u>Ophuira sarsi</u>) and eelpouts (Zoarcidae). The brittle stars were as abundant in this location as the ones observed off Point Grey.

Other epifauna observed included sponges, nemerteans, burrowing anemones (<u>Pachycerianthus</u> sp.), starfish (possibly <u>Dipsacaster</u> sp. or <u>Pseudochaster</u> sp.), hermit crabs (<u>Paguridae</u>), pink shrimp (<u>Pandalus borealis</u>), squat lobsters (<u>Munida quadraspina</u>), crangon and juvenile ratfish (<u>Hydrolagos colliei</u>).

Speculation on the infauna was that it contained representatives of Leptosynapta and Maldanidae. Speculation was made after a hole was dug up with the small manipulator arm of PISCES. A sample of mud was placed in the sample box. This was later found to contain species of <u>Rhabdamina</u> sp., (a "stock like" member of the Order Foraminifera), and the polychaeta families Nephtydae and Maldanidae.

Summary

The lack of visibility and strong currents had the effect of curtailing the distance which could be covered with PISCES. However what was seen indicated active and prolific populations of both epi- and infaunal organisms.



Location: Porlier Pass Date: 2 September 1976 Dive No.: 478A (Track 9) (Fig. 56) Observers: N. Holman, G. Packman Position: Start Finish 49⁰01.30'N 49⁰01.14'N 123⁰30.29'W 123⁰29.80'W Depth: 250m Location: Porlier Pass Date: 3 September 1976 Dive No.: 478B (Track 10) (Fig. 57) Observers: Position: Start Finish 48⁰59.48'N 48⁰59.37'N 123⁰28.86'W 123⁰29.02'W

Depth: 250m

Visibility - approximately 1.2m.

Current - approximately 1.85 km/hr from 0° T

Bottom Characteristics

Initially the bottom was exactly the same as the previous dive off Porlier Pass. That is, it was a mud bottom characterized by extensive epi-and infaunal populations. The bottom began sloping however and the mud bottom gave way to a bottom of rock under a light covering of mud. About halfway through the dive a rock cliff was found which was densely populated with epifauna. The cliff ran $030^{\circ} - 040^{\circ}T$ and was approximately 9-14m in height.

Benthic Fauna

Mud Bottom

The mud bottom was characterized by holes indicating an extensive infauna and an epifauna including crangon, pink shrimp (Pandalus borealis), nemerteans, an

unidentified gastropod, an unidentified asteroid, and a sole (Pleuronectidae).

Transition Zone (Mud to Rock)

This zone was characterized by an increased epifauna including bryozoans, increased numbers of gastropods, brittle stars (<u>Ophinra</u> sp.), squat lobsters (<u>Munida quadraspina</u>), crangon, cup corals, unidentified asteroid and sponges, burrowing anemones (Pachycerianthus sp.) and solitary tunicates (Ascidiacea).

Rock_Cliff

The rock cliff was densely populated thus making it almost impossible to detail every life form present. The films obtained should be consulted in order to properly list the species present. Some that were listed included, a variety of unidentified sea anemones, <u>Terebratula</u> sp., white bryozoans, solitary ascidians, a white asteroid (possibly <u>Dipsacaster</u> sp. or <u>Pseudarchaster</u> sp.), a yellow starfish (<u>Pteraster tesselatus arcuatus</u>) as well as numerous ratfish (Hydrolagos colliei) and one skate.

Summary

This area appeared to be quite productive, probably due to the variety in substrate and the relatively strong current which is prevalent. Again current and lack of visibility hampered operations.



Location: Stuart Channel (Ladysmith Harbour) Date: 3 September 1976 Dive No.: 479 (Track 11) (Fig. 57) Observers: G. Packman, N. Holman Position: Start Turn Finish 48⁰57.98'N 48⁰58.02'N 48⁰57.96'N 123⁰43.20'W 123⁰43.75'W 123⁰43.65'W Depth: 84m Location: Stuart Channel (Osborn Bay) Date: 3 September 1976 Dive No.: 480 (Track 12) (Fig. 58) Observers: N. Holman, V. Bradshaw Position: Start Turn Turn Finish 48^o52.38'N 48^o52.38'N 48^o52.65'N 48^o52.39'N 123^o35.85'W 123^o36.10'W 123^o35.38'W 123^o35.30'W Depth: 205m

Visibility - 1.2m

Bottom Characteristics

The bottom was a typical mud bottom however a rock face was located with the side scan sonar and inspected. A bacterial slime over the mud was noted in some areas.

Benthic Fauna

The water column just above the bottom was extremely densely populated with Euphausids throughout the dive.

Mud Bottom

The actual benthic fauna appeared to be mainly epibenthic as few holes or burrows in the mud were observed. However burrowing anemones (<u>Pachycerianthus</u> sp) were apparent, but sparse.

The epifauna observed included crangon, pink shrimp (<u>Pandalus borealis</u>), Dungeness crabs (<u>Cancer magister</u>), eelpouts (Zoarcidae), sole (Pleuronectidae), grey cod (<u>Gadus macrocephalus</u>) and pricklebacks (<u>Stichaeidae</u>).

Rock Face

The rock face was heavily populated with fish as well as sedentary invertebrates. Some groups represented included sea anemones of a variety of species including <u>Metriduim senile</u>, sea cucumbers (<u>Parastichopus californicus</u>), starfish such as <u>Mediaster aequalis and Pycnopodia helianthoides</u>, prawns (<u>Pandalus platyceros</u>), squat lobsters (<u>Munida quadraspina</u>), spider crabs (<u>Oregonia gracilis</u>), a number of rock fish (<u>Sebastes alutus and Sebastes maliger</u>) and lingcod (<u>Ophiodon</u> <u>elogatus</u>).

Summary

The major aspects of this area worth noting were the relatively heavy populations of bathypelagic euphausids throughout and the fish populations especially rock fish and lingcod in the vicinity of the rocky area.



PISCES DIVE TRACK, STUART CHANNEL DUMPSITE (1976). FIG. 57



TRACK, STUART CHANNEL (OSBORN BAY) DUMPSITE (1976). DIVE PISCES FIG. 58

Location:	Saanich Inlet (centre Channel between Mill Bay and Patricia Bay)	Date: 8 March 1977
Dive No.:	592 (Fig. 59)	
Observers:	R. Hoos, V. Bradshaw	
Position:	<u>Start</u> <u>Finish</u> 48 ⁰ 39.00'N 48 ⁰ 39.25'N 123 ⁰ 30.90'W 123 ⁰ 31.00'W	
Depth: 175m	n	
OBSERVATIONS	<u>S</u> :	
Descending 75m	- 55 metres juvenile euphausids amphipods - <u>Cyphocaris, Parath</u> - Dense plankton layer	emisto
120m	- Detritus and Orchomenella only	' in water column
170m	- On bottom	
Bottom	 settled into bottom. Visibili feeding on greeny gray surface Sank 1m into soft substrate. Some rippling of bottom upon 1 as at Ocean Falls. 1.0 to.5 k <u>Orchomonella</u> feeding on detrit appearance. Grey-green colour Maple Leaf in fall colour seen Surface at 1720 hours. 	ty good. Amphipods sediment. Black underneath. Claw burried anding. But not as soft m/hr current from west us. Bottom uniform in . A few depressions. . One 30 - 40 cm cod seen.


of concentrated dumping. While stationary, smelt were attracted to lights.

- Ran PISCES into tree trunk with complete root system.
 Bottom littered with wood debris. Eelpouts, a few smelt and a few small sole present.
- 1 brittlestar. No sign of shrimp, but only few were present on "unaffected" bottom.
- Near southern extremity of dumpsite, ran into large number of large logs, probably constituting fall-out from log booming area above. Bundle straps noted.
- F. Chambers quote "Dangerous area, there are a great many huge logs standing up and lying down, and I do not like this area whatsoever".
- Course changed to get away from this area. PISCES surfaced at 1617.



.FIG. 60 PISCES DIVE TRACK, ALBERNI INLET DUMPSITE (1977).

Location:	Muchalat Inlet (off Gold River pulp mill))	Date:	12 March	1977
Dive No.:	595 (Fig. 22)				
Observers:	G. Packman, H. Nelson				
Position:	<u>Start</u> 49 ⁰ 40.25'N 126 ⁰ 06.70'W	<u>Finish</u> 49 ⁰ 40.60'N 126 ⁰ 80.31'W			

Depth: 340m

OCEANOGRAPHIC CHARACTERISTICS

<u>Depth</u>	Temperature	<u>Salinity %</u>	Dissolved Oxygen (mg/l)	% Saturation
(m)	(°C)		,	(⁰ 2)
0	5.3	4.1	11.6	97.1
2	8.0	27.0	7.8	80.3
6	8.6	28.7	7.3	77.1
10	8.6	29.3	8.4	89.0
20	8.7	29.7	8.0	85.2
50	9.0	31.2	5.5	59.6
350	7.7	32.8	0.1	1.1

OBSERVATIONS:

Water Column - Initially the water column was quite brown in colour, presumably from the presence of pulp mill effluent. This discolouration extended to a depth of 10m whereupon layers of clear and discoloured water were traversed until final clearing occurred at 15 metres. Large quantities of detritus (possibly part or all fibre) were observed in the upper 25m of the water column. As the bottom was approached the water became quite milky and on the bottom the visibility was approximately 2m.

Bottom - Where the PISCES landed, the bottom was observed to consist of a flat dark brown substrate which was presumed a mixture of sediment and fibre. Beneath the dark brown surface layer a black ooze was observed which probably contained hydrogen sulphide. Some branches and logs were observed throughout the dive. They protruded from under a thick covering of detritus and probably originated as dumped material which was then rapidly covered over. The only fauna observed on the actual floor of the inlet consisted of amphipods. The amphipods disappeared as the PISCES moved closer to the mill outfall and fibre deposition became more intense.

Close to the side of the inlet in the vicinity of the outfall the bottom began to slope steeply and then became a rocky cliff at a depth of about 340 metres. Fibre was observed to have piled up considerably at the base of the rock cliff. Initially no life at all was observed on the rock, however, squat lobsters (<u>Munida quadrispina</u>) were soon found and at a depth of 250 metres a sea anemone (<u>Metridium senile</u>) was observed. Life continued to increase in abundance as the cliff was ascended, with calcareous tubiculous polychaetes and Crangonidae being added to the fauna already observed. Chitons were observed on the rocks at 220 metres. With continually decreasing depth polychaetes on the undersides of the rocks became more numerous and a grey cod (<u>Gadus</u> <u>macrocephalus</u>) was observed. At 65 metres sea anemones (<u>Metridium senile</u>), a nudibranch, and a ratfish (<u>Hydrolagos colliei</u>) were observed, while at 50 metres cup corals were present.

The diffuser from the Tahsis Gold River pulp mill was located at 20 metres. It was found to lie diagonally across the cliff face being supported by steel cables. It was constructed of steel, with ports along its length, however the end was open and most of the effluent was flowing out of that aperture.

An abundance of rockfish, ratfish and sea anemones were observed in the vicinity of the diffuser, presumably being attracted to the area by the warm effluent. A number of dying rockfish were found on the surface by the PISCES crew. These appeared to have been caught in the effluent stream and succumbed either to the toxic properties of the effluent or were suffering from ruptured gas bladders resulting from their rapid ascent in the effluent stream. Visibility in the area was limited due to the presence of effluent in the water.

<u>Comments</u> - The bottom in this area seemed suitable for Ocean Dumping activities as little life existed and the rapid fibre deposition appears to cover over any dumped material.

Location:	Muchalat Inlet (West of Gold River Pulp Mill)	Date:	12	March	1977
Dive No.:	596 (Fig. 22)				
Observers:	H. Nelson, D. Sullivan				
Position:	<u>Start</u> <u>Finish</u> 49 ⁰ 38.90'N 49 ⁰ 39.10'N				
Depth: 225m	126 ⁰ 16.20'W 126 ⁰ 16.20'W				
OBSERVATIONS	<u>S</u> :				
Decending	- small white particles in suspe	nsion			
75m	- few plankters, some pelagic am	phipods	and	sipho	onophores
115m	- white suspension still present Pasiphaea pacifica (pelagic sh	, few pl rimp)	lank	ters,	one
175m	 several copepods, <u>P. pacifica</u> on previous dive near pulp mili strands of particles and fine this dive.) 	(less pl 1 (595) fibres (lank). (woo	ton th Also t d) not	an noted :he : seen in
200m	- squid				
Bottom					
225m	 rock face with many <u>Munida quad</u> many brachiopods 	irispina	<u>a</u> (s	quat 1	obster),
	- <u>Spirontocaris</u> sp., rockfish, so - <u>Lophaster</u> sp. (spiny starfish)	luid, sc , anemor	ole, ne,	spong spider	je. • crab
200m	 Pandalus platyceros (prawn), ha polychaetes (considerably more 595). 	airy tri life th	iton 1an 1	, tube noted	e on Dive

135m	 many Gorgonian corals, prawns, one box crab, hermit crabs, tunicates, rockfish.
100m	 tunicates, brachiopods, cloud sponges, urichins, many tube polychaetes. shelves on rock face have substrate of sand and shell fragments
75m	 <u>Pachycerianthus</u> sp. (burrowing anemone) abundant brachiopods and tube polychaetes covering rock faces
50m	- several burrowing anemones
20m	- begin ascent.

SUMMARY

Differences noted from dive (595) off the Gold River pulp mill include less fibre and fewer strands of particulate matter in water column. Plankton in water column less abundant however benthic life significantly more abundant. Of particular interest, the large gorgonian corals at 135 metres.

- 247 -

PISCES IV DIVE RECORD

Location:	Zeballos Inlet		Date;	14	March	1977
Dive No.:	599 (Track 16) (Fig. 61)					
Observers:	D. Sullivan, G. Packman					
Position:	<u>Start</u> 49 ⁰ 55.30'N 126 ⁰ 50.09'W	<u>Finish</u> 49 ⁰ 55.30.N 126 ⁰ 50.07'W				

Depth 110m

OCEANOGRAPHIC CHARACTERISTICS

Depth	Temperature	Salinity	<u>D.O.</u>	<u>% Saturation</u>
0	7.68	15.94	10.55	100.4
2	8.55	26.9	8.85	92.19
5	8.68	28.61	8.85	93.50
10	8.68	29.24	8.25	87.55
25	9.27	29.88	6.4	69.15
105	8.86	30.5	1.2	12.90

OBSERVATIONS:

Watercolumn

The watercolumn was generally very clean with little in the way of phytoplankton, zooplankton or detritus. Light was observed to extend to a depth of approximately 50m. A zooplankton layer composed mainly of pelagic amphipods and copepods was found just above the bottom at 105m.

Bottom

The bottom in the immediate area of descent was composed of a soft mud substrate penetrated by a number of deep holes. Many polychaete castings were also observed on the surface of the sediments. As the dive progressed some wood debris was observed as well as an area of gravel and rock debris. This debris appeared to have been the result of dumping activities and extended for a distance of 45-90m. Towards the end of the dive a rocky cliff was ascended.

Fauna

A rich faunal composition was observed throughout the dive. The fauna observed on the mud substrate included squat lobsters (<u>Munida quadrispina</u>) in concentrations of 2-3/m², some prawns (<u>Pandalus platyceros</u>), pink shrimp, grey cod (<u>Gadus macrocephalus</u>), poachers (Agonidae), pricklebacks (Stichaeidae), eelpouts (Zoarcidae), catfish (<u>Hydrolagus colliei</u>), and numerous small sole (Pleuronectidae). The composition of the community changed somewhat in the area where gravel had been deposited on the bottom. In these areas there was a definite lack of infaunal animals, however the concentration of epifauna such as pink shrimp and squat lobsters were not greatly reduced.

Towards the end of the dive, a steep mud slope and rock cliff were ascended. Fauna observed in these areas included burrowing sea anemones (<u>Pachycerianthus</u> sp.), prawns (<u>Pandalus platyceros</u>) and rockfish (Scorpaenidae). There appeared to be no effect resulting from dumping activities in this area.

Comments

The effects of ocean dumping observed on this dive were limited to the deposition of gravel and rock debris in a concentrated area in the middle of the inlet. It appeared as though the infaunal communities were destroyed in this area, however the epifaunal communities were not greatly affected. With the deposition of sediment in the future, infaunal communities should return to the area.



FIG.61 PISCES DIVE TRACK, ZEBALLOS INLET DUMPSITE (1977).

Location:	Zeballos Inlet Date: 14 March 1977	
Dive No.:	600 (Track 17) (Fig. 62)	
Observers:	D. Sullivan, H. Nelson	
Position:	<u>Start</u> <u>Finish</u>	
	$49^{\circ}57.20$ 'N $49^{\circ}56.97$ 'N	
	127 ⁰ 49.96'W 127 ⁰ 49.92'W	
Depth: 165m	n	
OBSERVATIONS	<u>S</u> :	
Descending		
25m	- visibility good, small particles, no plankton	
50m	- no plankton	
75m	- few copepods	
90m	 several zooplankters including euphausids, amphipods, copepods 	
125m	 siphonophores, pelagic ampipods <u>Pasiphaed pacifica</u>, copepods 	
150m	- <u>Pasiphaea</u> pacifica	
Bottom		
165m	- bottom topography, - rolling mounds	
	 substrate fine soft sediment pocked with craters with 	
	diameters 2.5 cm to several cm.	
	- several <u>Bolinopsis</u> sp. just off bottom	
	- few <u>Munida quadrispina</u>	
	- slight current from 210°	
	- many small copepous just off bottom	
	- small sole, shrimp, eel pout, <u>Bollhopsis</u> sp., prickleback ratfish rock fish	,
	- very little wood debris	

	- white legged shrimp
165m	- begin up mud slope, no indication of dumping activity - bottom current increased, now from 300 ⁰
	- close to shore, turned and headed back out into inlet
	- few Munida and shrimp
	- Metridium sp. on log, prawn Pandalus platyceros
	- up slope on south shore - prickleback, sturgeon poacher,
	Pachycerianthes sp. (burrowing anemone)
	- more wood debris
	- large logs, small rockfish (school)
40m	- much surface light
Ascent	

SUMMARY

Despite the fact that we were supposedly diving in an ocean dumping area the logs and wood debris encountered on the south shore appeared to be of natural origin. Visibility was very good in the area and benthic life observed would be expected in an unpolluted area of similar substrate type.

- 251 -



FIG.62 PISCES DIVE TRACK, ZEBALLOS INLET DUMPSITE (1977).

Location:	Quatsino Sound Date: 15 March 1977 (East of Koskimo Island)
Dive No.:	601 (Fig. 63)
Observers:	D. Sullivan, H. Nelson
Position:	<u>Start</u> 50 ⁰ 28.5'N 127 ⁰ 50.0'W 127 ⁰ 50.2'W
Depth: 190r	n
OBSERVATIONS	<u>S</u> :
Descending	- surface visibility fair - no plankters in water column
100m	- euphausids, <u>Pasiphaea pacifica</u> , pelagic amphipods - fairly large particles in suspension, visibility good - no significant increase in plankton
Bottom	
150m	 soft mud, a few craters but not as numerous as the dive off Zeballos bottom covered with Ophiuroids, single <u>Pandalus</u> <u>platylceros</u>, 1 <u>Hydrolagus colliei</u> several mud casts, pink shrimp, white banded legs, sole
165m	 neading off on course due north dipping in hole, <u>Pseudarcaster</u> sp., number of Ophiuroids increasing, so abundant their arms are overlapping side-stripe <u>Pandalopsus dispar</u>
180m	 sea whip (30 cm.), large sole, hairy triton <u>Fusitritoin</u> sp. hermit crab
190m	 substrate unchanged, bottom still covered with brittle stars prawn, several small rat fish

185m	 approximately mid channel, sponge visibility decreased to approximately 3m, water murky number of craters decreasing, sea urchin, side-stripe, large sole, sponge, <u>Pseudarcaster</u> sp., many small shrimp substrate becoming more rocky, many small bivalves, believed to be juvenile scallops nudibranch, cushion star, anemone 170m several rat fish
165m	 many scallops, polychaete tubes sediment soft with surface layer of coarse sand or gravel, several <u>Pseudarcaster</u> sp.
150m	 working up north slope, most dominant organism still the brittle star, with many small bivalves yellow encrusting sponge, tunicates slope increasing, clump of <u>Metridium</u> sp., large boulders several <u>Parasticopus</u> sp. and <u>Strongylocentrotus</u> sp. large halibut (14-20 kgs)
155m	- number of Ophiuroids decreased
150m	- back to soft mud substrate with a few rocks - large sole
165m	- heading up incline again, shrimp, larger brittle stars
140m	- not many organisms on mud slope
130m	- eel pout, few brittle stars, spiny pinks
125m	- large shark (1-1.25m)
115m	- many zooplankters, mostly euphausiids
100m	- 1st <u>Munida</u> sp.
75m	- large rocks and boulders, cloud sponge
50m	- begin ascent

SUMMARY

As a control site, there appeared to be more sediment than was expected. The entire bottom surface was covered with brownish sediment. The visibility was correspondingly reduced. The location was nowhere as productive as expected. Dive aborted - damage to port thruster.

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SOUND OCEAN DUMPSITE (1977). PISCES DIVE TRACK , QUATSINO FIG. 63

Location:	Five Finger Island Site (Nanaimo Ocean Dumpsite)		Date:	14 April	1978
Dive No.:	650 (Fig. 64)				
Observers:	D. Sullivan, D. Brothers				
Position:	Start	<u>Finish</u>			
	49 ⁰ 14.4'N	49 ⁰ 15.25'N			
	124°53.9'W	124 ⁰ 53.30'W			

Depth: 260m

WATERCOLUMN

Water clarity during descent was estimated at between 5-7 metres visibility. Visual light penetration extended to approximately 80 metres. Suspended detrital material was present throughout the watercolumn in concentrations considered "normal". Bottom was reached at 260 metres depth; water clarity remained the same.

Zooplankton concentrations were sparce to 80 metres, heavy from 80-100 metres (predominantly euphausids), and moderate from 100 metres to the bottom. Zooplankton observed included ctenophores (heaviest at 170 metres), amphipods, free swimming polychaetes, and decapod larvae. Two hake (<u>Merluccius productus</u>) were observed at 220 metres depth and many <u>Pasiphaea pacifica</u> were noted near the bottom.

Bottom Characteristics & Dive Track

After reaching bottom, "PISCES" proceeded on a slightly descending grade on course 010° magnetic at 1436 hours P.S.T. During this portion of the track, the bottom was predominantly sediment with some rock outcroppings. The sediment consisted of a fine brownish layer overlying a grey clay-like substrate. A .5 km/hr to 1.0 km/hr current was setting against "PISCES" during this portion of the track.

At 1457 hours P.S.T. and 270 metre depth, a rock cliff was encountered. "PISCES" ascended the cliff face to 223 metres. The sediment encountered at this point was similar to that at the cliff bottom, but with a notable amount of cobble. The current at this point had increased to an estimated 1.5 km/hr. At 1503 hours proceeding on course 010° magnetic, "PISCES" ascended a gradual incline to 207 metres and descended a gradual decline to 280 metres, at which point the bottom became level.

At 1628 hours, "PISCES" began ascent and surfaced. No dumped material was encountered during the dive.

Biota Observed

Epifauna and infauna was sparce on the sediments, but quite prolific on and in the vicinity of rock faces. Burrowing activity was limited; about one burrow per square metre at most.

Table 1 gives the relative abundance of the biota observed during the dive.

Table 1

TAXON

HYALOSPONGIA	Aphrocallistes sp.	many
	Rhabdocalyptus sp.	many
ANTHOZOA	Pachycerianthus sp.	many
	Paragorgia arborea	few
CRUSTACEA	Pasiphaea pacifica	many
	<u>Pandalopsis</u> <u>dispar</u>	many
	Pandalus spp.	many
	P. platyceros	common
	<u>Munida quadrispina</u>	few
	Paguridae	few
	Lithodidae	noted
BRYOZOA		many
BRACHIOPODA	· · · · · · · · · · · · · · · · · · ·	many
OPHIUROIDEA		many
ASTEROIDEA	Ctenodiscus chispatus	many
	Asteroidea (unidentified)	

Table 1 (continued)

PISCES

<u>Squalus</u> acanthia	5	few
Hydrolagus colli	ei	common
<u>H. colliei</u> (egg	cases)	noted
Gadus macrocepha	lus	noted
<u>Sebastolobus</u> alas	scanus	common
Lycodopsis pacif	ica	noted
Pleuronectidae		common
Agonidae		noted

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FIG.64 PISCES DIVE TRACK, NANAIMO DUMPSITE (1978).

- 260 -

Location: Point Grey Dive No.: 714 (Track 1) (Fig. 49) Observers: G. Packman, N. Holman Position: <u>Start Finish</u> 49⁰16.11'N 49⁰16.19'N 123⁰21.03'W 123⁰21.48'W

Depth: 240m

Water Column

On descent the water column was fairly clear with good visibility down to a depth of approximately 60 metres. Between 70 metres and 80 metres a zooplankton layer was encountered. The predominant zooplankters in this layer were pelagic amphipods and euphausids. At approximately 80m this layer cleared somewhat while the concentration of detrital material increased. From 80m to the bottom at 240m the concentration of detrital material continued to increase while the concentration of zooplankton remained minimal. At 120m a number of chaetognaths were encountered. As well a few pelagic fish resembling smelt were observed during the descent. Near the bottom the visibility dropped markedly due to the presence of detrital material, which may have been stirred up from the bottom by the relatively strong bottom currents in the Point Grey area. Pelagic Shrimp (Pasiphaea pacifica) were observed near the bottom. The characteristics of the water column were similar on ascent.

Table 1 below depicts the readings obtained from the CTD probes on the exterior of the boat. Although the values obtained by the CTD had not at that time been compared with values obtained by more traditional methods, they were stable and of the same order of magnitude as would be expected. Therefore, it has been assumed that these values are reasonably accurate, especially in light of the fact that the instrument had just been serviced by the manufacturer.

Date: 27 November 1978

TABLE 1

CTD READINGS

<u>Depth</u>	Temperature (^O C)	Conductivity (m mhos/cm)	Dissolved Oxygen (mg/l)
140m	8.4	32.65	7.88
186m	8.58	32.92	7.73
227m	8.7	33.25	7.0
239m (bottom)	8.65	33.25	6.13
240m (bottom)	8.6	33.23	6.3
167m	8.4	32.72	7.1
157m	8.4	32.69	7.26

Bottom Characteristics

The bottom characteristics were fairly constant throughout the dive with the dominant characteristic being a layer of woodwaste intermingled with and lying on top of the normally soft Point Grey sediments. Clumps or piles of bark and wood debris were observed regularly as though they had remained intact through the water column after being dumped off the barge. Also apparent in some locations were patches containing various combinations of broken granite, gravel and hardpan clay. In some areas the bottom felt quite solid under the PISCES and little sediment was stirred up by the boat. This was felt to be due to the packing down of wood debris over the normally fine Strait of Georgia sediments. Numerous logs were observed on the bottom as well as other anthropogenic items, such as pieces of steel cable, a piece of sheet metal and a plastic container. The number of holes in the bottom, from benthic infaunal burrowing, was felt to have been reduced from what would be termed "normal" in the Strait of Georgia. In general it was felt that the bottom was significantly disturbed from the natural situation.

Bottom Fauna

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A list of the fauna observed as well as an indication of abundance is presented in Table 2. The dominant impression of the dive was that the bottom dwelling animals were not very abundant. A concerted attempt was made to count every animal in the field of view with the exception of the Nemerteans, which were too abundant. Therefore, although some animals may have been missed in the counting process, the numbers in the "abundance" column are fairly accurate and give an indication of the low level of abundance.

Woodwastes appeared to have covered the bottom and this might be correlated with the small number of holes in the bottom from benthic infauna. It should be pointed out, however, that the abundant orange nemerteans were associated with woodwastes approximately 70% of the time. The anemones observed were associated with logs etc., exclusively, while the shrimp and rock fish (<u>Sebastolobus alascanus</u>) were often found near logs and clumps of debris. The gastropod <u>Neptunea</u> sp. was found almost exclusively on sunken logs.

TABLE 2	FAUNAL LIST
Taxon	Abundance
Nemertea	One of the most numerous faunal forms, often located on a piece of wood pro- truding from the bottom
Actinaria	
Unidentified	2 - throughout dive
Unidentified:	
(orange with white	
spots on column)	3 - throughout dive
Pachycerianthus sp.	3 - throughout dive
Gastropoda	
Unidentified	1 - throughout dive
Nudibranch (unidentified)	1 - throughout dive
<u>Neptunea</u> sp.	13- throughout dive; mainly on logs
Echinoidea	
Unidentified	2

- 264 -

Abundance

Ateroidea			
<u>Ctenodiscus</u>	sp.	4	
<u>Mediaster</u> sp.		3	
Crustacea			
<u>Pasiphaea</u> pac	<u>cifica</u>	present in water column just above botto	m
Pandalopsis d	lispar	29 - throughout dive	
(side stripe	shrimp)		
Pandalus plat	tyceros	3 - throughout dive	
Unidentified	pink shrimp	19 - throughout dive	
<u>Munida</u> quadri	ispina	2 - throughout dive	
Spider crab	(unidentified)	1 - throughout dive	
Pisces			
<u>Squalus</u> acant	<u>chias</u>	4 - throughout dive	
(juvenile dog	jfish)		
Hydrolagus co	olliei	3 - throughout dive	
(ratfish)		-	
Microgradus p	proximus	1 - throughout dive	
(tomcodi)			
Zoarcidae		3 - throughout dive	
Sebastolobus	alascanus	9 - throughout dive	
(short spine	thornyhead)		
Pleuronecti	dae	2 - throughout dive	

Conclusions

Taxon

Evidence of dumped material was apparent throughout the dive. The most surprising observation made in the course of the dive was that wood and bark debris had travelled through the water column and landed on the bottom in remarkably large clumps and aggregations. It has previously been assumed that this type of material would disperse before it hit the bottom. The general impression derived from the dive was that the benthic epifauna and infauna had been reduced somewhat by the presence of dumped wood debris, however, this was only a qualitative impression.

715 (Track 2) (Fig. 49) Dive No.: Observers: G. Packman, D. Brothers Position: Start Finish 49⁰15.25'N 49⁰16.03'N 123⁰21.03'W 123⁰21.60'W

Depth: 246m

Water Column

On descent the water column was fairly clear with good visibility down to a depth of approximately 80 metres. Between 90 metres and 130 metres a zooplankton layer was encountered. Zooplankton observed in this layer included ctenophores, pelagic amphipods, euphausids, some decapod larvae and the occasional smelt-like fish. Slightly below the defined zooplankton layer, at about 150 metres, some Chaetognaths and Siphonophores were observed. Below the zooplankton layer the concentration of detrital material became thicker to the point where visibility was reduced to approximately 2.3m near the bottom. The depth at the bottom was 240 metres. On ascent surface light was first observed at approximately the 100 metre depth.

Table 1 presents the observations of depth, temperature, conductivity and dissolved oxygen obtained with the CTD probes outside the PISCES.

Date: 28 November 1978

Point Grey Location:

TABLE 1

CTD READINGS

Depth	Temperature (^O C)	Conductivity (m_mhos/cm)	Dissolved Oxygen (mg/l)
Om	6.6	26.62	11.1
84m	8.6	32.5	8.1
133m	8.5	32.6	8.2
200m	8.5	33.0	7.9
240m (bottom)	8.55	33.17	6.4
246m (bottom)	8.5	33.18	6.43
244m (bottom)	8.5	33.2	6.6
221m	8.5	33.1	6.4
194m	8.5	33.1	6.4
115m	8.9	33.1	6.6
100m	8.5	⁻ 32.5	6.8
65m	9.2	33.0	6.2
29m	9.4	32.8	5.1
18m	9.3	31.9	5.8

Bottom Characteristics

The bottom characteristics were observed to be a light mud with a fair bit of wood waste and construction material mixed in. Patches of gravel, logs and clumps of wood debris were observed at intervals through the dive. The clumps or piles of wood debris increased in frequency towards the end of the track. This was not surprising as the end of Track 2 was in close proximity to the end of Track 1 where these were observed. On occasion the bottom felt very firm under the skids of the PISCES, indicating that the normally soft sediments may have been strengthened with dumped material. Two unusual items observed during the dive were a piece of chain with a rope attached and a piece of scrap metal,

It generally appeared as though there were few holes in the bottom from infaunal burrowing. The presence of infaunal burrowers may have been reduced by dumping activities. The bottom fauna was generally sparse, having a fairly uniform composition throughout the dive. A list of the fauna noted is presented in Table 2. The dominant feature noted in the dive was the apparent lack of infaunal burrowing organisms. This was assumed to be associated with the changed bottom sediments stemming from ocean dumping activities. Organisms such as <u>Neptunea</u> sp., the unidentified orange anemone with white spots on the trunk, pink shrimp and <u>Sebastolobus alascanus</u> (short spine thornyhead) were often observed in association with logs or wood debris which appeared to have been there for a period of time.

It should be noted that, although there existed a fair proportion of wood waste in the sediments, there was no corresponding reduction in dissolved oxygen concentration as measured by the CTD unit on the exterior of the PISCES.

Conclusions

The bottom characteristics noted in Track 2 were very similar to those noted in Track 1, which was not surprising as they were located very close to each other. Dumped material was quite evident throughout the dive. Towards the end of the dive wood wastes were noted in piles as though they had remained intact throughout the water column after being dumped from the barge. The benthic infauna appeared to be relatively sparse. Shrimp were often found in association with sunken logs but not exclusively. Dumped material appeared to be having a qualitative impact upon the bottom characteristics.

Taxon		Relative abundance	e on a scale 1-10
Nemertea		10	
Actinaria - -	<u>Pachycerianthus</u> sp. unidentified - orange with	5	
	white spots on trunk	7	
~	unidentified	2	
Gastropoda-	<u>Neptunea</u> sp.	5	abundant on logs
-	unidentified	1	

TABLE 2

FAUNAL LIST

Relative abundance on a scale 1-10

Asteroidea	- <u>Mediaster</u> sp.	4
	- <u>Ctenodiscus</u> sp.	4
Crus tacea	- <u>Pasiphea pacifica</u>	3
	- <u>Pandalopsis dispar</u>	7
	- unidentified pink shrimp	5
	- <u>Munida quadrispina</u>	1
	- <u>Crangon</u> sp.	1
Pisces	- <u>Hydrolagus colliei</u>	3
	- <u>Squalus acanthias</u> (juvenile)	1
	- Herring type	1
	- Zoarcidae	1
	- <u>Sebastolobus</u> <u>alascanus</u>	5
	- Pleuronectidae	2

Taxon

Location:	Point Grey		Date: 2	8 November	1978
Dive No.:	716 (Track 3) (Fig. 49)				
Observers:	G. Packman, D. Brothers				
Position:	Start	Turn	Finish		
	49 ⁰ 14.64'N 123 ⁰ 22.28'W	49 ⁰ 14.80'N 123 ⁰ 22.35'W	49 ⁰ 15.10 123 ⁰ 22.20	'N 'W	

Depth: 250m

Water Column

From the surface to a depth of approximately 85 metres the water column was fairly clear with not much plankton and not much detritus. At 85 metres a zooplankton layer began, being composed mainly of pelagic amphipods, chaetognaths and euphausids. This zooplankton layer extended to approximately 130 metres. At 100 metres six dogfish (<u>Squalus acanthias</u>) were observed swimming around the boat, while at 120 metres a fish, which appeared to be a smelt, was observed. At 140 metres and 200 metres some small smelt-like fish, a few decapod larvae, some juvenile squid and siphonophores were observed.

As the bottom was approached the amount of detritus in the water column increased such that at the bottom (250 metres) the visibility was in the order of 1.7m. A current at a rate of approximately 1 km/hr was present on the bottom.

TABLE 1

CTD OBSERVATIONS

Depth	Temperature (^O C)	Conductivity (m_mhos/cm)	Dissolved Oxygen (mg/l)
25m	9.1	32.16	9.9 (may be
			suspect)
90m	8.9	32.8	7.8
123m	8,6	32.8	8.1
.140m	8.7	32.9	7.9
175m	8.6	33.0	7.8
250m (bottom)	8.4	33.0	7.0
248m (bottom	6.85	33.16	6.85

Bottom Characteristics

The bottom throughout Track 3 was a soft mud bottom typical of the Strait of Georgia. The occasional bit of woodwaste and hardpan clay was observed but not in nearly the same quantities as observed on Tracks 1 and 2. Logs were also noted intermittently, some of which were covered with sediment. Throughout the dive the number of infaunal holes in the sediment was approximately 5 per square metre. One of the prime reasons for diving at this location was to attempt to observe a number of concrete pipes which had been dumped two years previously. One of these pipes was located and inspected. It was protruding from the mud at approximately a 20 degree angle and buried in the mud for approximately 2/3 of its length. It was covered with a light dusting of silt and detritus.

Bottom Fauna

The bottom fauna observed on Track 3 was felt to be typical of a soft mud bottom in the Strait of Georgia. The taxa noted on this track are listed in Table 2. The fauna was evenly distributed throughout the dive with the number of holes from benthic infauna being of the order of 5 per square metre. The predominant epifaunal forms were nemerteans, burrowing anemones (<u>Pachycerianthus</u> sp.) unidentified orange anemones with white spots on the column, <u>Mediaster</u> sp., sidestripe shrimp (<u>Pandalopsis dispar</u>), unidentified pink shrimp and the short-spine thornyhead rockfish (Sebastolobus alascanus).

Very little fauna was noted associated with the concrete pipe. The total life associated with the pipe was an unidentified orange anemone with white spots on the trunk, two <u>Neptunea</u> sp., one <u>Neptunea</u> sp. egg mass, one <u>Munida</u> <u>quadrispina</u>, two unidentified pink shrimp, one <u>Sebastolobus</u> <u>alasacanus</u> and a grey cod (Gadus macrocephalus).

Conclusions

The bottom throughout the dive was relatively unaffected by dumped material, indicating that this portion of the dumpsite is not used very frequently. The concrete pipes had not been extensively colonized since their deposition two years ago. Generally speaking, there did not appear to be a high degree of biological productivity in the form of epifauna in this area.

		•		
TABLE 2		FAUNAL	LIS	<u>ST</u>
Taxon			<u>AI</u>	bundance
Nemertea			-	fairly common throughout dive
Actinaria	-	unidentified- orange with trunk with white spots	-	fairly common throughout dive - mainly on logs, some of soft sediment
	-	Pachycerianthus sp.	-	fairly common throughout dive
Gastropoda	-	<u>Neptunea</u> sp.	-	present on most logs and occasionally on soft substrate
	-	Nudibranchia	-	2 noted during dive
Asteroidea	-	<u>Mediaster</u> sp.	-	fairly common throughout dive
Crustacea	-	<u>Pasiphea</u> pacifica	-	occasionally noted
		<u>Pandalopsis</u> <u>dispar</u>	-	most common animal
		Pandalus platyceros	-	1 noted
		unidentified pink		
		shrimp	~	second most common faunal form
		<u>Crangon</u> sp.	-	fairly common throughout dive
		<u>Pagurus</u> sp.	-	2 noted
		Tanner Crab	-	1 noted
Pisces	-	<u>Hydrolagus colliei</u>	-	l noted
		<u>Squalus acanthias</u>	-	1 noted
		<u>Gadus</u> macrocephalus	-	2 noted
		Zoarcidae	-	3 noted
		Sebastolobus alascanus	-	3 noted
		Anoplopoma fimbria	-	1 noted
		Pleuronectidae	-	2 noted

- 271 -

- 272 -

 Location:
 Point Grey
 Date:
 29 November
 1978

 Dive No.:
 718 (Track 4) (Fig. 49)
 Doservers:
 G. Packman, N. Holman

 Position:
 Start
 Finish

 $49^{0}16.50'N$ $49^{0}17.18'N$
 $123^{0}19.38'W$ $123^{0}20.47'W$

Depth: 160m

Water Column

TABLE 1

On descent through the water column the visibility was good to a depth of about 80 metres. Up to that depth very little zooplankton or detritus was apparent other than a few copepods noted at 50 metres. A fish approximately 24 cm. in length, which was presumed to be a smelt, was noted at approximately 60 metres.

At 90 metres a zooplankton layer was encountered which contained pelagic amphipods, euphausids, the occasional decapod larva, as well as a few smelts. At 130 metres the zooplankton layer was noted to have thinned out considerably while the concentration of detritus increased and continued to increase until the bottom was reached. Pelagic shrimp (<u>Pasiphaea pacifica</u>) were observed from 150 metres down to the bottom at 160 metres.

CTD OBSERVATIONS

Depth	Temperature (^O C)	Conductivity (m_mhos/cm)	Dissolved Oxygen (mg/l)
Surface	7.5	28.7	11.6
10m	8.2	30.47	11.38
40m	9.6	33.1	7.2
57m	9.6	33.2	6.8
90m	8.5	33.5	8.4
150m	8.5	32.9	8.0
160m (bottom)	8.46	32.9	7.7
158m (bottom)	8.46	32.9	7.7

Bottom Characteristics

The substrate at Track 4 was generally a sandy material with a considerable quantity of woodwaste mixed in. The woodwastes occasionally occurred in piles as though dumped from a barge, remaining intact through the water column. Other material observed on the bottom included an occasional log, pieces of cable, a tire and pieces of concrete. Very few infaunal holes were observed in the substrate.

Bottom Fauna

Brittle stars (Ophiuroidea) were the dominant member of the benthic community at this location with 30-50 individuals being present in a square metre. The community was basically epifaunal due to the compact nature of the sandy substrate. An outline of the fauna noted is presented in Table 2. The presence of woodwastes did not appear to be exerting a terribly significant impact on the benthic community as it appears as if the community was already epifaunal in nature. Faunal forms other than brittle stars were quite limited in number.

<u>Neptunea</u> sp. were noted in abundance on certain logs (16 on one log) and occasionally on the sandy substrate.

- TABLE 2FAUNAL LISTTaxonAbundanceActinaria- Metridium senile- noted occasionally
- NeethannaNeethannaPachycerianthussp.Pachycerianthussp.Unidentified (orange
with white spots)- noted occasionallyGastropoda Neptuneasp.Gastropoda Neptuneasp.- 16 observed on one log; Seen occasionally
out on sand but mainly on logsCrustacea -- Pandalopsis dispar- Second most abundant form found after

- 273 -

Abundance

Crustacea (d	continued)	
	Unidentified pink	- Most abundant form found after
	shrimp	Ophiuroidea
	Unidentified	
	Decorator Crab	- 1 noted
	Unidentified	
	Hermit Crab	- 1 noted
Ophiuroidea		- 30-50 individuals per square metre
Pisces -	<u>Hydrolagus</u> colliei	- 3 noted
	Gadus macrocephalus	- 1 noted
	Theragra chalcogramma	- 1 noted
		1
	Uphion elongatus	- 1 noted
	<u>Ophion elongatus</u> Sebastolobus alascanus	- 1 noted - 1 noted

Conclusions

Taxon

The substrate at Track 4 was sandy in nature resulting in the fact that the community was basically epifaunal. Brittle stars (Ophiuroidea) were the dominant faunal form, with approximately 30-50 individuals being present in a square metre. Some woodwastes were noted indicating that dumping is occurring before the barges reach the designated dumpsite. The dissolved oxygen concentration, as measured by the CTD unit, was not depressed as a result of the presence of woodwastes. There appeared to be an impact on the bottom community at this site, however it was not as dramatic as at other dive sites around the dumpsite.

Location:	Point Grey		Date: 2	29 November 1978
Dive No.:	717 (Track 5) (Fig. 49)		
Observers:	G. Packman, N. Holman			
Position:	Start	Turn	Turn	Finish
	49 ⁰ 15.13'N	49 ⁰ 15.33'N	49 ⁰ 15.87'N	49 ⁰ 16.12'N
	123 ⁰ 19.18'W	123 ⁰ 19.38'W	123 ⁰ 19.06'W	123 ⁰ 19.27'W

Depth:

Water Column

The water column on descent was clear of detritus and zooplankton to a depth of approximately 80 metres. A zooplankton layer was present extending from 80m - 110m. The dominant zooplankters in this layer were pelagic amphipods and euphausids. At 110m the defined zooplankton layer cleared leaving the water fairly clear as little detritus was present. At 122 metres a siphonophore, decapod larvae and chaetognaths were noted. A siphonphore was also noted at 170 metres. At 160 metres the concentration of detritus increased and kept increasing until the bottom was reached, where the visibility was poor.

The water column characteristics as determined by the CTD are presented in Table 1. These data indicate that the dissolved oxygen near the bottom was not depleted.

CTD OBSERVATIONS

Depth	Temperature (^O C)	Conductivity (m_mbos/cm)	Dissolved Oxygen (mg/l)
			("
Om	7.3	28.5	11.5
30m	9.5	32.4	8.6
65m	9.35	33.1	7.2
168m	8.48	32.8	8.1
190m	8.5	32.9	7.1
195m (bottom)	8.46	32.99	6.8
194m (bottom)	8.46	32.95	6.9
190m (bottom)	8.45	32.9	7.6
189m (bottom)	8.46	32.9	7.9
187m (bottom)	8.46	32.93	7.32
182m	8.0	32.9	6.6

Bottom Characteristics

At the beginning of the dive, the bottom consisted of a fairly clean soft sediment with a small amount of woodwaste and some hardpan mixed in. Occasional logs were also encountered. There were approximately 5-10 holes per square metre and some worm casting on the sediment. These conditions extended along the first leg of the dive.

At approximately the first bed in Track 5 the wood debris began to occur in small concentrations and steel bands from bundle booming were encountered. In one instance a considerable pile of steel bands was observed, indicating that the woody material in the nearby sediments had probably orginated from log pond dredging. At a point 0.4 km north of the dive site, the sediment became lighter in consistency and darker in colour, indicating a reducing type of sediment. The number of holes in the sediment was significantly reduced here and the bottom was noted as being quite degraded.

During the final stages of Track 5, the proportion of woody debris increased again. In this area a lot of shell debris was mixed in with dredged material with not much of a silt cover. Infaunal burrows here were virtually non-existent. Logs were also common in this area.
Bottom Fauna

Table 2 presents a list of the fauna observed during Track 5. At the beginning of the dive a fairly "normal" soft bottom community was observed. The dominant animals in this community include side-stripe shrimp (<u>Pandalopsis dispar</u>), unidentified pink shrimp and small shrimp which were either juvenile pinks or a small shrimp species. The large gastropod, <u>Neptunea</u> sp., was noted in abundance on sunken logs, presumably feeding on the white bacterial slime on these logs. During the last 1/3 of the dive the number of infaunal holes decreased rapidly to the point where there were virtually none. This was observed to be concurrent with the increasing concentration of woodwastes in the sediments and their more reducing nature. Mixed in with these degraded sediments were a fair number of broken bivalve shells which may have been killed in situ but were more likely deposited with the dredged material. In general, faunal colonization in the area of these degraded sediments was decreased markedly.

<u>Conclusions</u>

During the last 1/3 of Track 5, in the area on a line between the North Arm of the Fraser and the dumpsite, the sediments were observed to be quite degraded, having a high concentration of woodwaste in them and having the appearance of reducing sediments.

The dissolved oxygen in the bottom water adjacent to these sediments was not depressed, however, according to the reading of the CTD unit. Biological activity was much reduced where the sediments were degraded, with infaunal burrows being almost non-existent.

TABLE 2	FAUNAL LIST
Taxon	Abundance
Nemertea	- fairly common
Actinaria - <u>Pachycerianthus</u> sp - Unidentified orang anemone with white	e fairly common le
spots on trunk	- fairly common

TABLE 2	FAUNAL LI	<u>ST</u>
Taxon		Abundance
Nemertea		- fairly common
Actinaria	 Pachycerianthus sp. Unidentified orange anemone with white 	- fairly common
	spots on trunk	- fairly common
Gastropoda	- <u>Neptunea</u> sp. - <u>Fusitriton</u> sp.	on logs and in open - eggs on some logs1 noted
Holothuroid	iea	
	- <u>Chirodota</u> sp.	- The present of Chirodota sp. was noted but abundance not obtained due to its infaunal nature
Asteroidea	- <u>Ctenodiscus</u> sp	- fairly common
	- <u>Mediaster</u> sp.	- 1 noted
Echinoidea		- 1 noted
Crustacea	- Pandalopsis platyceros	- 10 noted
	 Pandalopsis dispar Unidentified pink 	- common
	shrimp	- common
	- Unidentified juvenile	- 1-2 individuals per square metre except
	shrimp (or smaller species)	in extremely degraded area
	- Unidentifed Crangon sp	- present but no indication of abundance
	- <u>Munida quadrispina</u>	- fairly common
	- <u>Pagurus</u> sp.	- fairly common
	- Tanner crab	- 8 noted

- 279 -

Taxon		Abundance
Pisces	- <u>Squalus</u> acanthias (juvenile)	- 9 noted
	- <u>Squalus acanthias</u> (adult)	- 1 noted
	- <u>Hydrolagus colliei</u> - <u>Microgadus proximus</u> - Stichaeidae	- 4 noted - 3 noted - 1 noted
	 <u>Sebastes</u> sp. <u>Sebastolobus</u> alascanus Pleuronectidae 	- 1 noted - 14 noted - 12 noted

Location:	Victoria (Quarantine Buoy Pre 1977 Dumpsite)		Date:	9 May 1979
Dive No.:	759 (Track 4) (Fig. 65)			
Observers:	G. Packman, B. Kay			
Position:	Start	Turn	Turn	Finish
	48 ⁰ 22.08'N 123 ⁰ 25.97'W	48 ⁰ 22.23'N 123 ⁰ 25.80'W	48 ⁰ 22.12'N 123 ⁰ 25.75'W	48 ⁰ 22.17'N 123 ⁰ 25.33'W

Depth: 80m

Water Column

Generally visibility was good throughout the descent through the water column. A fair bit of phytoplankton was apparent in the surface water. At 25 metres a lesser quantity of phytoplankton and some detritus was observed. At 50 metres more detritus and zooplankton including scyphozoans and some copepods were noted. The depth at the bottom was 80 metres and this remained constant throughout the dive.

Bottom Characteristics

Upon initial arrival at the bottom the substrate was observed to be sandier and siltier than the gravel substrate on the 1977 Quarantine Buoy dumpsite dive. Quite a few ridges were noted in the sand, presumably from the currents in the area. In this area the only evidence of dumped material was the occasional clump of hardpan clay.

As the dive progressed the substrate became more gravelly with broken shells mixed in. After a short period of time evidence of dumping activity became more apparent in the form of pieces of iron, wire cable, large rocks, bricks, construction rubble and pieces of machinery.

Bottom Fauna

A summary of the bottom fauna noted during the dive is contained in Table 1. The faunal forms noted were predominantly epifaunal due to the naturally coarse, compacted nature of the bottom. The community was well diversified but not exceptionally prolific.

Conclusions

TABLE 1

Ocean dumping did not appear to have had a severe impact upon the benthic community in this area. The natural substrate consisted of gravel and sand such that the dumped material did not effect a gross change in that parameter. The finer fractions and woodwastes were not apparent in the disposal area, presumably having been carried away by strong currents. These fractions may turn up in unexpected areas of the shoreline. The benthic community was predominantly epifaunal in both affected and unaffected areas therefore it did not appear as though benthic productivity was being severly impacted although some impact is inevitable. The physical presence of the dumped construction material would impede commercial trawling in the area.

FAUNA NOTED THROUGHOUT DIVE

Faunal Form	Abundance
Ptilosarcus gurneyi	1
Sea whip	1
Anemone unidentified	6
Nudibranch	1
<u>Modiolus</u> sp.	clumps noted throughout dive
Scallops	no scallops were noted initially but
	some where noted occasionally during the
	last 2/3 of the dive.
Parastichopus californicus	6
Asteroidea unidentified	2
<u>Henricia</u> sp.	3
<u>Gorgonocephalus</u> sp.	1
Ophiuroidea	1
Strongylocentrotus	5
<u>Pagurus</u> sp.	7

TABLE 1 (continued)

Faunal Form	Abundance
Spider Crab	2
<u>Hydrolagus colliei</u>	1
Gadus macrocephalus	2
Agonidae	6
<u>Glyptocephalus</u> zachirus	1
Pleuronectidae	4



Location:	Victoria, (Quarantine Buoy 1977 Dumpsite)	/	Date:	9 May 1979
Dive No.:	758 (Track 3) (Fig. 66)			
Observers:	G. Packman, B. Kay			
Position:	Start	<u>Finish</u>		
	48 ⁰ 22.20'N	48 ⁰ 22.23'N		
	123 ⁰ 23.68'W	123 ⁰ 23.20'W		

Depth: 60m

Water Column Characteristics

Visibility throughout the water column was very good. On the surface a fair concentration of phytoplankton was apparent while at 27m some zooplankton began to appear.

At approximately 60 metres strings of detritus were noted in the water column. The occasional scyphozoan was noted in the deeper waters.

Bottom Characteristics

The bottom throughout the dive was gravelly in nature with the fine sediment fraction apparently scoured away by strong currents. The current was consistently strong during the dive having a velocity of approximately 1.0 km/hr. to 2 km/hr. Dumped material was apparent on the bottom during most of the dive in the form of construction rubble. This included broken concrete, hardpan clay, scrap metal and ceramic tiles. Somes pieces of concrete had yellow paint on them such that they resembled roadside curbs. A manhole cover and some rope were also noted.

The natural substrate appeared to consist of gravel with a thin layer of silt over top. Towards the end of the dive shell debris was observed mixed in with the gravel and fine silt. Occasionally patches of silt were noted. In the latter portion of the dive long undulating ridges, approximately 1.3 km in height were noted. It was difficult to assess the cause of these ridges, however scouring is a possibility. Generally speaking it was difficult to pin point an effect of dumping on the bottom as bottom material appeared to be very naturally course.

Bottom Fauna

The bottom fauna observed during the course of this dive is presented in Table 1. The dominant faunal forms throughout most of the dive were scallops which were approximately 5 cm in diameter. These were observed in numbers of 5-10 individuals per square metre. Approximately 2/3 of the way through the dive a fairly dense concentration of starfish which were possibly <u>Orthasterias</u> <u>koehleri</u> was noted. This increased concentration of starfish extended for some distance over the bottom.

Generally speaking the bottom dwelling organisms were epifaunal in nature. There were virtually no holes, from infaunal organisms, in the substrate. Therefore the dumping of construction type material should not have a great impact upon the benthic community as a whole and this in fact, appeared to be the case.

TABLE 1

Faunal Forms	Abundance
Porifera	- noted occasionally
Anemone-unidentified	- 1
Serpulidae	 noted occasionally on rocks
Scallops	- dominant faunal form throughout the dive
	 numbers varied but ranged up to approx. 5-10/m²
Modiolus sp.	- found in clumps in soft substrate areas
Fusitriton sp.	- 1
Parastichopus californicus	- 2
Psolus chitinoides	- 2
<u>Cucumaria</u> sp. (?)	- 4
Echinoidea	 noted occasionally throughout dive
<u>Solaster stimpsoni</u>	- 3
Henricia	- 5

TABLE 1 (continued)

Faunal Forms	Abundance
<u>Mediaster</u> sp.	- 1
<u>Pycnopodia</u> sp.	- 1
<u>Orthasterias</u> koehleri	- dominant faunal form in the area $2/3$
	of the way through the dive
Asteroidea (unidentified)	- 1
<u>Gorgonocephalus</u> sp.	- 7
<u>Pagurus</u> sp.	- 1
<u>Hydrolagus colliei</u>	- 5
Microgadus proximus	- 1
<u>Ophiodon elongatus</u>	- 1
<u>Glyptocephalus</u> zachirus	- 1
Pleuronectidae	- 2

Conclusions

Dumped material was apparent on the bottom throughout most of the dive. The natural substrate was mainly gravel with a thin layer of sediment over it. Generally speaking the bottom fauna was predominantly epi-faunal with scallops being the dominant form. Ocean dumping did not appear to have had a drastic impact upon the substrate or bottom community as the bottom was already composed of gravel and the community epifaunal.



PISCES FIG. 66

Location: Off Quarantine Buoy dumpsite Date: 8 May 1979 Dive No.: (Fig. 67) Observer: D. Goyette Position: Start Finish

48 ⁰ 22.13'N	48 ⁰ 22.03'N
123 ⁰ 22.93'W	123 ⁰ 22.72'W

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Depth:

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Note: No dive report available. No photographs.



PISCES DIVE TRACK, VICTORIA (OFF QUARANTINE BUOY DUMPSITE) 1979. FIG. 67

Location:	(Victoria) Quarantine (1978 dumpsite)	Buoy	Date: 8 May	1979
Dive No.:	(Fig. 68)			
Observers:	D. Goyette, N. Holman			
Position:	Start	Turn	Finish	
	48 ⁰ 22.50'N 123 ⁰ 22.08'W	48 ⁰ 22.70' N 123 ⁰ 21.90'W	48 ⁰ 22.60'N 123 ⁰ 21.59'W	

Depth:

Note: No dive report available.



Location: off Quarantine Buoy dumpsite Date: 9 May 1979 Dive No.: (Fig. 69) Observer: D. Goyette Position: <u>Start Turn Finish</u>

48 ⁰ 22.40'N	48 ⁰ 22.43'N	48 ⁰ 22.65'N
123 ⁰ 21.00'W	123 ⁰ 20.44'W	123 ⁰ 19.88'W

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Depth:

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Note: No dive report available. No photographs.



Location:	Constance Bank (off Vic	toria)	Date: 9	9 May 1979
Dive No.:	(Fig. 70)			
Observers:	D. Goyette, N. Homan			
Position:	Start	Turn	Turn	Finish
	48 ⁰ 19.75'N 123 ⁰ 21.52'W	48 ⁰ 19.77'N 123 ⁰ 20.57'W	48 ⁰ 20.24'N 123 ⁰ 20.01'W	48 ⁰ 28.30'N 123 ⁰ 19.68'W

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Depth:

Note: No dive report available.



Location:	Malaspina Strait (propos Dump Site East of Grief	sed Ocean Pt.)	Date:	10 March 1980
Dive No.:	826 (Fig. 71)			
Observers:	H. Nelson, D. Brothers			
Position:	Start	<u>Finish</u>		
	49 ⁰ 45.3'N	49 ⁰ 44.6'N		
	124 ⁰ 28.0'W	124 ⁰ 27.3'W		

Depth: 322m

SUMMARY:

The dive commenced in 322 metres of water at a position approximately 1000 metres north-west of the proposed dump site. Visibility on the bottom was approximately 6 metres. Bottom substrate consisted of a thin layer of light-brown sediment overlying soft clay-like material light grey in colour. The occasional piece of wood debris observed had trenches at the base indicative of relatively strong current. There was considerable evidence of burrowing (some of which was in progress). The submersible moved off at a course of 120° to-wards a "pinger" which had been placed at the dumpsite location. The submersible reached the "pinger" and continued on for approximately 200 metres before changing to a course of 200° and heading towards Texada Island. This course was followed for approximately 500 metres where the dive was terminated. The bottom remained relatively flat throughout the dive and the benthos was fairly diverse although not abundant. Dominant organisms were the side stripe shrimp and the Dover sole. The only uncommon life observed were two brown cat-sharks at 30-60 cm in length.

OBSERVATIONS:	Descending
0- 70m	 visibility good, considerable suspended material (detritus) however few plankters.
70-200m	 siphonophores and pelagic amphipods. Many euphausiids at 100m
200-300m	 one hake (<u>Merluccius productus</u>), one spiny dogfish (Squalus acanthias)

322m

- Fishes observed included several Hake, ratfish
 (Hydrolagus colliei), Pacific cod (Gadus macrocephalus),
 Dover sole (Microstoma pacificus), brown cat sharks
 (Apristurus brunneus) poachers and eel pouts.
- other organisms observed on the bottom included: squat lobsters, burrowing anemones, octopus (single), nemerteans, sea pens (small), pelagic polychaetes, mud stars, Tanner crabs, heart urchins, whelks, and large anemones.



Location:	10 km West of Kelsey Bay (Johnstone Strait south)		Date:	12 March 1980
Dive No.:	828 (Track 3) (Fig. 72)			
Observers:	H. Nelson, D. Brothers			
Position:	Start	Finish		
	50 ⁰ 27.8'N	50 ⁰ 27.3'N		
	126 ⁰ 04.7'W	126 ⁰ 05.0'W		

Depth: 290m

SUMMARY:

The dive commenced in 290 metres of water. Bottom substrate was soft sediment approximately 10 cm thick interspersed with rocks and gravel. Visibility on the bottom was approximately 6 metres. The bottom was occupied by a diverse community with the most notable members being several species of starfish and many ophiuroids on the soft substrate and numerous anemones, corals, and sponges on the rocks. The PISCES headed on a course of $270^{\circ} - 280^{\circ}$ against a current of approximately 1 km/hr. This track was followed for 800 metres without appreciable change in depth, substrate or biota. The exact ocean dump site was estimated to be approximately 300 metres along this track. After 800 metres the PISCES turned to Port (heading south-east) for approximately 500 metres and then turned towards Texada Island for another 500 metres. During the shoreward run more rock and gravel were encountered and a considerable amount of wood debris scattered over the bottom. The Dive was terminated at 270 metres depth approximately 300 metres from shore.

OBSERVATIONS:

Descending

0	-	70m	-	fine	detritus	in	water	colu	umn	with	very	few	plankters.
70	₩.	290m	-	a fev very	w pelagic scarce.	amŗ	phipod	s, a	sin	gle	euphai	usid',	plankton

Bottom

- fishes observed during the Dive included ratfish

(<u>Hydrolagus colliei</u>), dog fish (<u>Squalus acanthius</u>), pollock (<u>Theragra chalcogramma</u>), skate (<u>Raja sp.</u>), lemon sole (<u>Parophrys vetulus</u>), Dover sole (<u>Microstoma</u> pacificus), lumpfish (<u>Cydopteridae</u>).

 other biota included brittle stars, hermit crabs (<u>Pagurus</u> sp.), sidestripe shrimp (<u>Pandalopsis</u> <u>dispar</u>), brachiopods, urchins, scallops, sponges, nudibranchs, crinoids, corals, nemerteans, anemones, and juvenile crabs (possibly box crabs).

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FIG. 72 PISCES DIVE TRACK, JOHNSTONE STRAIT (1980). PROPOSED DUMPSITE

Location:	Kelsey Bay	Date:	12 March 1980
Dive No.:	829 (Fig. 73)		
Observers:	H. Nelson, D. Brothers		
Position:			
	50 ⁰ 26.10'N 50 ⁰ 26.50'N 126 ⁰ 00.50'W 126 ⁰ 00.40'W		
Depth: 250r	m		
<u>Water Colum</u>	<u>n</u>		
0 - 40m	- very clear, no plankton		
40 - 100m	- fine detritus, a few plankters	i	
100 - 175m	- more detritus, larger particle	S	
bottom 200m	 sandy, good visibility <u>ca</u>. 8m many scallop shells sand with ripples sand ridge then gravel, shells 	, rocks	
travel 600m	 sand mounds picket of wood fragments on do heading on course 210⁰ barren compared to previous di 2 or 3 dogfish colonial bryophytes most numerous animal is sea ur S. <u>paladus</u>, S. <u>purpatus</u> hermit crabs rocks quite clean, probably du nemerteans, ratfish, large bar pink corals, very few small fi (3 species) 	wn curre ve chin e to sau nacles, sh, aner	ent side nd action basket star, mone, starfish

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- absence of sponges
- 3 or 4 flatfish
- skates (juvenile)
- spider crab
- much evidence of strong currents

SUMMARY

Everything from large boulders with pink coral in short stalked clumps to fine beach sand and gravel with pockets of wood fragments.



NEAR KELSEY BAY (1980). DUMPSITE OCEAN PROPOSED FIG. 73

Location:	Ocean Dump Site off Porl	ier Pass	Date:	14 March 1980
Dive No.:	831 (Track 5) (Fig. 74	.)		
Observers:	H. Nelson, R. Kussat			
Position:	Start	Finish		
	49 ⁰ 00.2'N	49 ⁰ 00.8'N		
	123 ⁰ 29.8'W	123 ⁰ 29.8'W		

Depth: 208m

SUMMARY

The bottom substrate was a thin layer of soft light brown sediment overlying greyish fine sediment. It did not appear to be a reducing sediment. In several locations large pieces of clay were observed over the natural sediment indicative of dumping activity. Large pieces of wood debris and logs were also observed as were metal bands used to bundle logs. There was a current of approximately 1 km/hr from 150° . Evidence of burrowing activity was considerable and the dominant organism seemed to be sidestripe shrimp; many pelagic shrimp were swimming just off the bottom. Although ocean disposal of forest product wastes had occurred in the area no deleterious effects were noted. Several species of fish were noted however they were not abundant. The bottom remained relatively flat throughout the dive.

OBSERVATIONS:

	Descend	ing
0 - 301	m - visib	ility good, little detritus, no plankters.
30 - 70	m - few a	rrow worms and siphonophores.
100m	- few e	uphasids.
130m	- pelag	ic amphipods, pelagic shrimp.
175 - 19	5m - severa be not	al plankters observed and small fish believed to rthern smooth tongue.

Bottom

- 208 m fishes observed during the dive included skate (<u>Raja</u> sp.), dog fish (<u>Squalus acanthius</u>), brown cat shark (<u>Apristurus</u> <u>brunneus</u>), rat fish (<u>Hydrolagus colliei</u>), flatfish (species unknown), rockfish (species unknown).
 - commercial species of shrimp included the sidestripe (Pandalopsis dispar) which was very abundant.
 - other benthic organisms included; 2 small octopus, pelagic shrimp, nemerteans, burrowing anemone, large anemone, tanner crabs.



References

Pomeroy, W. M. 1982 Environmental Impacts of Bottom Deposits Originating From B.C. Coastal Pulpmills: A General Summary. Prepared for 49th Annual PNPCA Meeting and 1982 Annual BCWWA Conference.

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Appendix I

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Reference table of PISCES IV Dives 1973 - 1982

DIVE NO.	LOCATION	OA TE					
-			INUUSIKIAL SELIUK INVULVED	FIGURE NO.	REPORT AVAILABLE	16 mm FILM	PHOT OGRAPHS
						(approximate length) (minutes)	
	Howe Sound	1973	control				
294	Holberg Inlet	11 February 1975	mine (control dive)	37	EPS 5-PR-77-11		
295	Rupert Inl <i>e</i> t	11 February 1975	mine (Island Copper)	37	EPS 5-PR-77-11		
297	Rupert Inlet	12 February 1975	mine (Island Copper)	37	EPS 5-PR-77-11		
298	Holberg Inlet	13 February 1975	mine (control dive)	37	EPS 5-PR-77-11		
299	Holberg Inlet (head)	13 February 1975	control	37	EPS 5-PR-77-11		
300	Quatsino Sound	14 February 1975	mine (Island Copper)	37	EPS 5-PR-77-11		
460	Howe Sound	23 August 1976	mine (control)	38			
461	Howe Sound	23 August 1976	mine (Anaconda) pulpmill (Woodfibre)	38			
462 (track 2)	Howe Sound (Britannia)	24 August 1976	mine (Anaconda) pulpmill (Woodfibre)	38			
4 62 (track 3)	Howe Sound (North of Britannia)	24 August 1976	mine (Anaconda) pulpmill (Woodfibre)	38			
463 (track 2)	Howe Sound (North of Watts Point)	25 August 1976	pulpmill (Woodfibre)	38			
464	Howe Sound (Thornbrough Channel)	26 August 1976	mine (Anaconda) pulpmill (Port Mellon)	38	79-2		
465 -	Howe Sound (Thornbrough Channel off Hillside Gravel Pit)	26 August 1976	pulpmill (Port Mellon) gravel pit (Hillside)	38	79-2		
466	Howe Sound (Thornbrough Channel, east of Woodridge Is.)	27 August 1976	pulpmill (Port Mellon) [·] gravel pit (Hillside)	38	79-2		
467	Howe Sound (Thornbrough Channel off Mannion Creek)	27 August 1976	control	38			
468	Bute Inlet (Littleton Point)	28 August 1976	control	39			
469	Bute Inlet (Mouth)	28 August 1976	control	39			
4 73 (track 2)	Strait of Georgia (off Texada Mine)	31 August 1976	mine (Texada)	40	QL	5	

DIVE NO	I OCATION	OATE	INDUCTOTAL CECTOD TANDI VED	10101	OCOUNT ALLEY AND		
					KEPUKI AVAILABLE	16 mm FILM	PHOTOGRAPHS
				-0 <u>-</u>		(approximate length)	
						/cannuul	
514	Kitimat Arm (head)	21 October 1976	smelter (Kitimat)	41	EPS 5-PR-11-1	11	
(track 1)						•) es
515							
(track 2)							
518	Hastings Arm	23 October 1976	control	42	19-17		
519							
520	Alice Arm (head)	24 October 1976	mine (AMAX/Kitsault)	42	79-17		
521	Alice Arm (centre)	24 October 1976	mine (AMAX/Kitsault)	42	79-17		
522	Alice Arm (mouth)	25 October 1976	<pre>mine (AMAX/Kitsault)</pre>	42	79-17		
523	Observatory Inlet	25 October 1976	mine (control)	42	79-17		
653	Howe Sound (near Britannia	20 April 1978	mine (Anaconda)	43		:	
(tracks 1 & 2)	Beach)	-		2	2	9	
654	Howe Sound (off Porteau Cove)	21 April 1978	mine (Anaconda)	44	Q	90	
655	Howe Sound	21 April 1978	mine (Anaconda)	45	01	05	
656	Howe Sound	22 April 1978	mine (Anaconda)	46	Q	·	
(tracks 1 & 2)					•		
1102 1103	Alice Arm (near Pearson Point)	8 July 1982	mine (AMAX/Kitsault)	47	83-05		
1104	Alice Arma	9 July 1982	mine (AMAX/Kitsault)	47	83-05		
1105	Alice Arm (off Pearson Point)	9 July 1982	mine (AMAX/Kitsault)	47	83-05		
1106	Alice Arm (off Hans Point)	10 July 1982	mine (AMAX/Kitsault)	47	83-05		
1107	Alice Arma	10 July 1982	mine (AMAX/Kitsault)	47	. 83-05		
1108	Alice Arm (across from Hans Pt.)	11 July 1982	mine (AMAX/Kitsault)	47	83-05		
1109	Alitce Arm	11 July 1982	mine (AMAX/Kitsault)	47	83-05		
0111	Hastings Arm (Grenby Bay)	12 July 1982	control	47	83~05		
1111	Alice Arm	13 July 1982	<pre>mine (AMAX/Kitsault)</pre>	47	83-05		
1112	Hastings Arm (off Carr Point)	13 July 1982	control	47	83-05		
463	Howe Sound (Matts Point)	25 August 1976	pulpmill (Woodfibre)	14			
(track 1)							
476	Northumberland Channel (off Harmac)	1 September 1976	pulpmill (Harmac)	15	79-8	80	

DIVE NO.	LOCATION	DATE	INDUSTRIAL SECTOR INVOLVED	FIGURE	REPORT AVAILABLE	16 mm FIIM	PHOTOCPA PHS
		•		NO.		(approximate length)	
						(minutes)	
512 513	Cousins Inlet (Ocean Falls)	20 October 1976	pulpmili (Ocean Falls) suitable for ocean dumpsite	16,17	9-67	22	yes
516 517	Prince Rupert (Chatham Sound)	22 October 1976	pulpmill (Prince Rupert ocean dumpsite	18,19		8	
165	Satellite Channel (Cape Keppel)	8 March 1977	pulpmill (Chemainus) ocean dumpsite	20		5	yes
593	Alberni Inlet (south of ten mile point)	11 March 1977	pulpmill (Port Alberni)	21	11-62	03	yes
594	Alberni Inlet (Stamp Narrows)	11 March 1977	pulpmill (Port Alberni) ocean dumpsite (Stamp Marrows)	56	11-62	05	yes
595	Muchalat Inlet (off Gold River)	12 March 1977	pulpmill (Tahsís/Gold Ríver) ocean dumping	22	79-10	01	
597 (track 14)	Tahsis inlet (Mozino Point)	13 March 1977	pulpmill (Tahsis/Gold River) old ocean dumpsite	23		90	- 21 sey
598 (track 15)	Tahsis Inlet	13 March 1977	pulpmill (Tahsis/Gold River) old ocean dumpsite	24		8	.1 -
647 (tracks 1 & 2)	Stuart Channel (off Crofton pulpmill)	12 April 1978	pulpmill (Crofton)	25	79-5	11	
649 (track 1)	Northumberland Channel (off Harmac diffuser)	14 April 1978	pulpmill (Harmac)	26	79-8	13	
651 (track 2)	Northumberland Channel (off Harmac diffuser)	15 April 1978	pulpmill (Harmac)	27	79-8	13	
719	Malaspina Strait (Powell River)	30 November 1978	pulpmill (proposed diffuser location Powell River)	28	79-14	8	
761 762	Northumberland Channel (Harmac)	10 May 1979	pulpmill (Harmac diffuser)	29		16	
764 (tracks 1 & 2)	Wood fibre	11 May 1979	pulpmill (Woodfibre)	30		11	
827	Powell River	11 March 1980	pulpmill (Powell River)	31		03	
834	Northumberland Channel (Harmac)	18 March 1980	pulpmill (Harmac)	32	OU	05	
835	Stuart Channel (off Crofton)	19 March 1980	pulpmill (Crofton)	33	OL	05	
1012 (tracks 1 & 2)	Thornbrough Channel (off Port Mellon)	19 March 1981	pulpmill (proposed diffuser location off Port Mellon)	34			

211

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DIVE ID.	IDCATION	MTF	INDUSTRIAL SECTOR INVOLVED				
			INDO IN THE SECTOR INTOLICO	r Judike	REPORT AVAILABLE	16 mm FILM	PHOTOGRAPHS
				QN		(approximate length)	
						(minutes)	
166	Northumberland Channel 25	4 26 February 1981	pulpmill (Harmac)	35	ç	2	
(track 2)	(Harmac)		•	:	2	9	
266							
(track 1)							
£66							
(track 3)							
382	five Finger Island	January 1976	municipal discharge (Nanaimo)	2	EPS 5-PR-77-3	Q.	g
(tracks 2 & 3)					5	3	eaf
472	Cape Lazo	31 August 1976	municipal discharge (Comox)	3	OL	05	
474	Strait of Ge orgia (off Five Finger Island)	l September 1976	municipal discharge	•	EPS 5-PR-77-3	3	
648	Fige Finger Island	13 April 1978	municipal discharge (Nanaimo)	5	81-4	13	
652	French Creek	16 April 1978	municipal discharge (Qualicum/ Parksville)	Q	82-12	10	
719	Commox (Cape Lazo)	1 December 1978	municipal discharge (Cape Lazo)	,	81-1		
(tracks 1 & 2)					•	:	
755	Victoria (Macaulay Point)	7 May 1979	municipal discharge	8		n	
763	Sechelt (Trail Bay)	10 May 1979	municipal discharge	6		13	
765	Sechelt (Trail Bay)	12 May 1979	municipal discharge	6		13	
832	French Creek	17 March 1980	municipal discharge (Qualicum/ Parksville)	10	82-12	12	
833	Five Finger Island	18 March 1980	municipal discharge	5	81-4	10	
836	Victoria (Macaulay Point)	20 March 1980	municipal discharge	11	Ч	3	
837	Victoria (Macaulay Point)	20 March 1980	municipal discharge	:	QU	8	
838	Victoria (Clover Point)	21 March 1980	municipal discharge	12	90	8	
	French Creek	1961	municipal discharge (Qualicum/ Parksville)	:	82-12		
(track 1)	Point Grey	23 January 1976	ocean dumpsite	49	EPS 5-PR-77-2	8	yes
(track 2)	Point Grey	23 January 1976	ocean dumpsite	61	EPS 5-PR-77-2	8	yes

Continued...

DIVE NO.	LOCATION	DATE	INDUSTRIAL SECTOR INVOLVED	F IGURE NO.	REPORT AVAILABLE	l6 mm FILM (approximate length) (minutes)	PH0T0GRAPHS
(track 3)	Point Grey	23 January 1976	ocean dumpsite	49	EPS 5-PR-77-2	30	yes
(track 3A)	Point Grey	24 January 1976	ocean dumpsite	49	EPS 5-PR-77-2	30	yes
(track 4)	Point Grey	24 January 1976	ocean dumpsite	49	EPS 5-PR-77-2	30	yes
(track 5)	Point Grey	24 January 1976	ocean dumpsite	49	EPS 5-PR-77-2	30	yes
380 (tracks 1 Å 2)	Thornbrough Channel (Port Mellon)	26 January 1976	ocean dumpsite	50	Ou	30	
381	Thornbrough Channel (Port Mellon)	26 January 1976	ocean dumpsite	51	2	30	yes
470 (track 1)	Malaspina Strait (off Beaver Island)	30 August 1976	proposed ocean dumpsite (Pender Harbour)	52	2	07	
471 (track 2)	Morth of Powell River	31 August 1976	ocean dumpsite information	53	Q	10	
475 (track 6)	Strait of Georgia (off Nanaimo Harbour)	1 September 1976	ocean dumpsite	54	EPS 5-PR-17-3	05	
477 (track 8)	Strait of Georgia (off Porlier Pass)	2 September 1976	ocean dumpsite	55		11	
478A (track 9) 4788 (track 10)	Strait of Georgia (off Porlier Pass)	2 September 1976	ocean dumpsite	55, 56		11	
479 (track 11)	Stuart Channel (Ladysmith Harbour)	3 September 1976	ocean dumpsite pulpmill	57		11	
480 (track 12)	Stuart Channel (Osborn Bay)	3 September 1976	ocean dumpsite pulpmill (Crofton)	58	79-10	11	
592	Saanich Inlet (centre Channel between Mill Bay & Patricia Bay)	8 March 1977	potential ocean dumpsite	59	79-10	02	yes
595	Muchalat Inlet (Gold River)	12 March 1977	pulpmill (Tahsis/Gold River) ocean dumpsite	22		03	
596	Muchalat Inlet (west of Gold River)	12 March 1977	ocean dumpsite pulpmill (Tahsis/Gold River)	22		07	

- 313 -

Continued...

DIVE NO.	LOCATION	DATE	INDUSTRIAL SECTOR INVOLVED	FIGURE	REPORT AVAILABLE	16 mm FILM	PH0T0GRAPHS
				ND.		(approximate length)	
						(minutes)	
599 (track 16)	Zeballos Inlet	14 March 1977	ocean dumpsite pulpmill	61		10	yes
600 (track 17)	Zeballos Inlet	14 March 1977	ocean dumpsite pulpmill	62		10	yes
601	Quatsino Sound (east of Koskimo Island)	15 March 1977	ocean dumpsite	63		10	yes
650	off Five Finger Island (Nanaimo ocean dumpsite)	14 April 1978	ocean dumpsite (Nanaimo)	64		02	
714 (track 1)	Point Grey	27 November 1978	ocean dumpsite	49	80-3	30	
715 (track 2)	Point Grey	28 November 1978	ocean dumpsite	49	80-3	90	
716 (track 3)	Point Grey	28 November 1978	ocean dumpsite	49	80-3	30	
717 (track 4)	Point Grey	29 November 1978	ocean dumpsite	49	80-3	30	
718 (track 5)	Point Grey	29 November 1978	ocean dumpsite	49	80-3	30	
759 (track 4)	Victoria (Quarantine Buoy)	9 May 1979	pre 1977 ocean dumpsite	65		11	
758 (track 3)	Victoria (Quarantine Buoy)	9 May 1979	1977 ocean dumpsite	66		II	
	Victoria (off Quarantine Buoy)	8 May 1979	ocean dumpsite	67	00	II	
	Victoria (Quarantine Buoy)	8 May 1979	ocean dumpsite	68	ОП	п	
	Victoria (off Quarantine Buoy)	9 May 1979	ocean dumpsite	69	ОП	11	
	Victoria (Constance Bank)	9 May 1979	ocean dumpsite	70	UO	8	
826	Malaspina Strait (SE of Grief Point)	10 March 1980	proposed ocean dumpsite	ц		03	
828 (track 3)	Johnstone Strait South (west of Kelsey Bay)	12 March 1980	proposed ocean dumpsite	72		8	
829	Kelsey Bay	12 March 1980	proposed ocean dumpsite	73		05	
831 (track 5)	Strait of Georgia (off Porlier Pass)	14 March 1980	ocean dumpsite	74		8	

- 314 -

Appendix II

Representative Photographs From PISCES IV Dives



PLATE 1 Appearance of typical fibre deposit -Northumberland Channel off Harmac pulpmill

PLATE 2 Wood debris and development of white bacterial slime found under sorting and storage areas - Alberni Inlet in vicinity of Port Alberni pulpmill





PLATE 3 Marine mine trailing deposits forming ridge -Howe Sound near Britannia mine



PLATE 4 Marine mine trailing deposits on flat bottom showing Prickleback fish - Alice Arm



PLATE 5 Leak in pipe at connecting flange of effluent discharge pipe with Quillback Rockfish and Sea Anemone - Five Finger Island off Nanaimo

PLATE 6 Diffuser port of effluent discharge pipe - Five Finger Island



PLATE 7 Dredge spoil consisting of hard pan clay material and concretion with prawns, brittle stars, shrimps, and Neptunea species - Point Grey ocean dumpsite



PLATE 8 Metal banding material - Point Grey ocean dumpsite