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# **CHARACTERISTICS OF FISH PLANT WASTES IN NOVA SCOTIA AND THEIR EFFECTS ON COASTAL BAYS III: TOXICITY STUDIES**

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**Environmental Impact and Assessment  
Report EPS-8-AR-75-4  
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CHARACTERISTICS OF FISH PLANT WASTES IN NOVA SCOTIA  
AND  
THEIR EFFECTS ON COASTAL BAYS III: TOXICITY STUDIES

P.G. WELLS AND J.R. SCHNEIDER

TOXICITY EVALUATION SECTION  
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FOREWORD

This report is the third of a five part series entitled "Characteristics of Fish Plant Wastes in Nova Scotia and Their Effects on Coastal Bays". Other reports in the series are:

- Vol. I        Summary and General Conclusions.  
              EPS-8-AR-75-2.
- Vol. II       Waste Water Characterization.  
              EPS-8-AR-75-3.
- Vol. IV       Bacteriological Characteristics.  
              EPS-8-AR-75-5.
- Vol. V        Nearshore Effects.    EPS-8-AR-75-6.

FOREWORD

This report is the third of a four part series entitled Characteristics of Fish Plant Wastes in Nova Scotia and Their Effects on Coastal Bays. Other reports in the series are:

Vol. I Summary and General Conclusions. EPS-8-AR-75-2.

Vol. II Waste Water Characterization. EPS-8-AR-75-3.

Vol. IV Nearshore Effects. EPS-8-AR-75-5.

ABSTRACT

Most effluents from the three processing plants were non-lethal to fingerling rainbow trout, salt-water adjusted rainbow trout and mummichogs. One effluent of high BOD, collected from a fish unloading facility, was acutely toxic to rainbow trout. Different rates of aeration and filtration did not change acute toxicities of any effluent. There was insufficient data on production and effluent characteristics to generalize on the non-lethality of specific fish plant effluents. However, it is apparent that effluents of the fish plants, sampled while varied species of fish were being processed, were generally non-lethal to test organisms, and in this sense potentially much less damaging than effluents from several other types of processing facilities in the Maritime provinces.

RESUME

La majorité des effluents des trois usines du traitement du poisson n'était pas mortelles pour les jeunes truites arc-en-ciel, les truites arc-en-ciel acclimatées à l'eau salée et aux choquemorts. Un effluent avec une DOB élevée, recueilli auprès d'une installation de débarquement du poisson, était toxique envers la truite arc-en-ciel. Des taux différents d'aération et de filtration n'ont pas changés la toxicité aigue des effluents. Les données sur la production des usines et les caractéristiques des effluents étaient insuffisantes pour faire une conclusion générale sur la toxicité des effluents d'usines du traitement de poisson. Cependant, il ressort que les effluents des usines du traitement de poisson échantillonnés lorsqu'on traitait des espèces variées de poissons, n'étaient pas mortelles envers les organismes examinés. Dans ce sens, ces effluents sont potentiellement moins dangereux pour l'environnement que plusieurs autres dans les provinces maritimes.

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1 INTRODUCTION

In 1974, a study of fish processing plant wastewaters was undertaken by three groups of the Environmental Protection Service, Atlantic Region. The study centered on three processing plants in Nova Scotia: National Sea Products, Louisburg; National Sea Products, Lockport; Swim Brothers, Lockeport. A study of the production techniques and effluent quality within each plant was conducted by the engineering section. A survey on species diversity and water and sediment quality in the waters receiving the fish wastes was conducted by field ecologists. Samples of specific effluents from each plant were collected for the evaluation of their acute toxicity using standard bioassay procedures.

Although many studies have been conducted on treatment systems and effluent characteristics of fish processing plants (Dazai et al, 1968; Bachanek, 1970; Pearson et al, 1970; Soderquist et al, 1970; Claggett, 1973; Riddle and Shikaze, 1973; Claggett and Wong, 1974) , a literature search revealed no studies on the acute toxicity of final fish processing plant effluents at the pipe. Information from such toxicity studies is a necessary stage in the assessment of the potential impact of such effluent discharges on receiving waters and their biota. Pollutants from fish processing plants include particles of fish, oil, blood and slimes, often forming a highly-enriched liquid waste or "stickwater" (Claggett, 1973; Waldichuk, 1974).

High levels of suspended and total solids and a high BOD<sub>5</sub> characterize the effluents. However, their physico-chemical composition is complex and varies considerably depending upon the age and species of fish being processed, processing techniques employed and water usage (Bachanek, 1970; Riddle and Shikaze, 1973). Except in situations where chemicals are used in the processing procedure, such as chlorides in tuna plants (Pearson et al, 1970), any toxicity of the final effluents is likely related to their BOD or content of suspended solids.

This paper presents results of 4-day toxicity bioassays conducted with fingerling rainbow trout, Salmo gairdneri Richardson and mummichogs, Fundulus heteroclitus Linnaeus, and various effluent samples from the three Nova Scotia fish plants. Specific objectives of these bioassays were:

- (a) to determine acute toxicities of full-strength effluents from different processing procedures at the three plants;
- (b) to determine effects of screening and aeration on the toxicity of the effluents;
- (c) to relate the presence or absence of acute toxicity to known physico-chemical parameters of each fish plant effluent.

2           METHODS AND MATERIALS

All samples of effluent were collected in 5 Imperial gallon carboys and transported to the laboratory at ambient temperatures. They were then cooled to 15C, after which the tests were started.

Four-day static bioassays were conducted with two treatments - 100% effluent, which was either in fresh or salt water, and control water, fresh dechlorinated or salt. The fresh dechlorinated water was from the Dartmouth municipal supply (Appendix Table I) and salt water was from Bedford Basin. All test volumes were 20ℓ with no replacement over 4 days. Treatments were either unfiltered or filtered with 4 layers of cheese-cloth (variable pore size). They were either lightly (2ℓ/min) or vigorously (6-8ℓ/min) aerated. The pH of the effluents was not adjusted. Fingerling rainbow trout (Salmo gairdneri) were selected from batch 74-5. Mummichogs (Fundulus heteroclitus), collected from Lawrencetown, N.S., in late May, 1974, and held at 15C, were also used. Five fish were tested in each tank. Fish weights and ratios of water volume per gram of fish per day are presented in Appendix Table II. Initial and final temperatures, pH, oxygen levels and salinities of all test solutions are presented in Appendix Tables IIIA and IIIB.

Other bioassay procedures used throughout the tests followed Sprague (1973) as closely as possible. Acute toxicities were expressed as LT50's (median lethal times), derived as in Litchfield (1949). Because of limited partial mortalities, LT50's in hours are presented as ranges of time within which mortality occurred.

3 RESULTS

All results of bioassays are presented in Tables 1A & 1B. Production data and characteristics of the effluents of the fish plants are shown in Appendix Tables IV & V.

3.1 National Sea Products, Louisburg

The effluent collected at the fish unloading facility was acutely toxic to rainbow trout. Median lethal times (LT50's) were 1-17 hr and 2-18 hr for two samples (Table 1A). This effluent had a high BOD (Appendix Table V) as shown by the rapid drop in oxygen over 17 hr (Appendix Table IIIA).

Samples from the filletting plant (sewer 1 and final effluents) were not acutely toxic to trout.

Samples from the fish meal plant (sewer 2) caused no mortalities to fish, except where heavy aeration was used with June 13 effluent and "salinity-acclimated" rainbow trout. Controls were free of mortalities except for one fish in the June 15 test of the filletting plant (sewer 1) effluent.

The bioassays were conducted at 14-16C (Appendix Table III). Dissolved oxygen concentrations ranged from 0.2-7.0 mg/l, 8.2-9.3 mg/l and 8.6-9.4 mg/l in the fish unloading facility, filletting plant and fish meal plant effluents, respectively. pH values were near neutrality, and initial salinities ranged from 0.0-0.3‰, 0.2-1.8‰ and 16.6-31.5‰.

TABLE 1A SUMMARY OF TOXICITY TESTING ON EFFLUENTS FROM THREE FISH PROCESSING PLANTS IN NOVA SCOTIA. ALL WERE 96-HOUR STATIC BIOASSAYS, RUN AT 15°±1°C.

FISH PLANT	SOURCE OF EFFLUENT	DATE EFFLUENT SAMPLED	DATE TEST STARTED	FILTERED (+) OR UNFILTERED (x)	RATE OF AERATION	SPECIES TESTED	MORT. %	LT50 * HR.
National Sea Products, Louisburg	Fish Unloading Facility	24 July	25 July	+	light	S. gairdneri	100	1-17
		24 July	25 July	+	heavy	S. gairdneri	100	1-17
		24 July	25 July	x	light	S. gairdneri	100	1-17
		24 July	25 July	x	heavy	S. gairdneri	100	17-26
		7 Aug.	8 Aug.	x	light	S. gairdneri	100	2-18
		7 Aug.	8 Aug.	x	heavy	S. gairdneri	100	2-18
		7 Aug.	8 Aug.	+	light	S. gairdneri	100	2-18
		7 Aug.	8 Aug.	+	heavy	S. gairdneri	100	2-18
		7 Aug.	8 Aug.	+	heavy	S. gairdneri	100	2-18
Filletting (fish) Plant (sewer 1)		13 June	15 June	x	light	S. gairdneri	0	>96
		13 June	15 June	x	heavy	S. gairdneri	0	>96
		13 June	15 June	+	light	S. gairdneri	0	>96
		13 June	15 June	+	heavy	S. gairdneri	0	>96
		7 Aug.	8 Aug.	x	moderate	S. gairdneri	0	>96
Filletting (fish) Plant (final)		6 June	7 June	x	light	S. gairdneri	0	>96
		6 June	7 June	x	heavy	S. gairdneri	0	>96
		6 June	7 June	+	light	S. gairdneri	0	>96
		6 June	7 June	+	heavy	S. gairdneri	0	>96
Fish Meal Plant (sewer 2)		13 June	15 June	x	light	S. gairdneri**	0	>96
		13 June	15 June	x	heavy	S. gairdneri	60	72-96
		13 June	15 June	+	light	S. gairdneri	40	>96
		13 June	15 June	+	heavy	S. gairdneri	80	51-72

(Continued)

TABLE 1A (Continued)

FISH PLANT	SOURCE OF EFFLUENT	DATE EFFLUENT SAMPLED	DATE TEST STARTED	FILTERED (+) OR UNFILTERED (x)	RATE OF AERATION	SPECIES TESTED	MORT. %	LT50 * HR.
	Fish Meal Plant (sewer 2)	7 Aug.	8 Aug.	-	heavy	S. gairdneri**	0	>96
		7 Aug.	8 Aug.	x	light	F. heteroclitus	0	>96
		7 Aug.	8 Aug.	x	heavy	F. heteroclitus	0	>96
		7 Aug.	8 Aug.	+	light	F. heteroclitus	0	>96
		7 Aug.	8 Aug.	+	heavy	F. heteroclitus	0	>96
National Sea Products, Lockeport	Filletting (fish) Plant	22 Aug.	24 Aug.	x	light	F. heteroclitus	0	>96
		22 Aug.	24 Aug.	x	heavy	F. heteroclitus	0	>96
		22 Aug.	24 Aug.	+	light	F. heteroclitus	0	>96
		22 Aug.	24 Aug.	+	heavy	F. heteroclitus	0	>96
	Fish Meal Plant	2 Aug.	2 Aug.	x	light	F. heteroclitus	20	>96
		2 Aug.	2 Aug.	x	heavy	F. heteroclitus	20	>96
		20 Aug.	22 Aug.	x	light	F. heteroclitus	0	>96
		20 Aug.	22 Aug.	x	heavy	F. heteroclitus	0	>96
		20 Aug.	22 Aug.	+	light	F. heteroclitus	0	>96
		20 Aug.	22 Aug.	+	heavy	F. heteroclitus	0	>96
Swim Brothers, Lockeport	Filletting (fish) Plant	2 Aug.	2 Aug.	x	light	F. heteroclitus	0	>96
		2 Aug.	2 Aug.	x	heavy	F. heteroclitus	0	>96
		2 Aug.	2 Aug.	+	light	F. heteroclitus	0	>96
		2 Aug.	2 Aug.	+	heavy	F. heteroclitus	0	>96
		20 Aug.	23 Aug.	x	light	F. heteroclitus	0	>96
		20 Aug.	23 Aug.	x	heavy	F. heteroclitus	0	>96
		20 Aug.	23 Aug.	+	light	F. heteroclitus	0	>96
		20 Aug.	23 Aug.	+	heavy	F. heteroclitus	20	>96

\* All tests 100% effluent.

\*\* Acclimated to seawater (salinity of 29-31‰).



TABLE 1B CONTROL MORTALITY DURING 96-HOUR STATIC BIOASSAYS WITH EFFLUENTS FROM  
THREE FISH PROCESSING PLANTS IN NOVA SCOTIA.

FISH PLANT	SOURCE OF EFFLUENT	DATE OF TEST	RATE OF AERATION	SPECIES TESTED	MORT. %	LT50 HR.
National Sea Products, Louisburg	Fish Unloading Facility	25 July	light	S. gairdneri	0	>96
		8 Aug.	moderate	S. gairdneri	0	>96
	Filletting (fish) Plant	15 June	light	S. gairdneri*	20	>96
		8 Aug.	moderate	S. gairdneri	0	>96
		7 June	light	S. gairdneri	0	>96
	Fish Meal Plant (sewer 2)	15 June	light	S. gairdneri*	0	>96
8 Aug.		moderate	F. heteroclitus	0	>96	
National Sea Products, Lockeport	Filletting (fish) Plant	24 Aug.	moderate	F. heteroclitus	0	>96
		2 Aug.	light	F. heteroclitus	0	>96
	Fish Meal Plant	23 Aug.	moderate	F. heteroclitus	0	>96
Swim Brothers, Lockeport	Filletting (fish) Plant	2 Aug.	light	F. heteroclitus	0	>96
		23 Aug.	moderate	F. heteroclitus	0	>96

\* "Acclimated" to seawater.

in the fish unloading facility, filletting plant and fish meal plant effluents, respectively (Appendix Table III).

3.2 National Sea Products, Lockeport

Effluent from the filletting plant was not acutely toxic to mummichogs (Table 1A).

Samples from the fish meal plant (August 2) were non-toxic or slightly toxic to mummichogs (Table 1A). All controls survived.

The bioassays were conducted at 14-17C. Dissolved oxygen concentrations ranged from 6.7-8.5 mg/l and 8.8-10.1 mg/l in the filletting plant and fish meal plant effluents, respectively. The pH values were 7.7-8.1. Initial salinities were 27.4‰ to 31.5‰ (Appendix Table III).

3.3 Swim Brothers, Lockeport

Effluent collected from the filletting plant was not acutely toxic to mummichogs (Table 1A). All controls survived.

The bioassays were conducted at 14-17C. Dissolved oxygen concentrations ranged from 5.2-8.1 mg/l and 8.1-8.8 mg/l. pH values ranged from 7.2-8.2 and initial salinities were 27.4‰ and 30.9‰ (Appendix Table III).

4 DISCUSSION AND CONCLUSIONS

In general, most effluents from the fish processing plants were non-acutely toxic as determined by 4-day tests with fingerling rainbow trout, salt-water adjusted rainbow trout and mummichogs. Filtration and aeration had no observable effect on this lack of toxicity.

However, the effluent from the fish unloading facility (National Sea Products, Louisburg) was acutely toxic to rainbow trout. This effluent had a high BOD, as indicated by the rapidly depleted oxygen supply. Oxygen levels could not be maintained above a non-lethal level. In addition, there was an acutely toxic level of unionized ammonia in the effluent at source (Appendix Table V; Anon, 1973), which may have existed in the bioassay test solutions. Different rates of aeration and straining did not reduce the toxicity of this effluent.

One sample of fish meal plant effluent from National Sea Products, Louisburg, was also acutely toxic to salt-water adjusted trout, but only under conditions of heavy aeration; these data should be interpreted cautiously as the "acclimation" of the trout (weight 6-7 g) to sea-water was not demonstrated, nor was it considered complete.

There was insufficient data on production and effluent characteristics to generalize on the non-lethality of

specific fish plant effluents. However, it was apparent that over the period of sampling, with varied species of fish being processed, most of the effluents of the fish plants were non-acutely toxic and in this sense potentially much less damaging than effluents from several other types of processing facilities in the Maritime provinces.

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APPENDICES



APPENDIX TYPICAL WATER QUALITY CHARACTERISTICS FOR DECHLORINATED FRESH WATER  
(TABLE I) AT B.I.O.

WATER QUALITY PARAMETERS

PARAMETER	UNITS	JANUARY			FEBRUARY		
		$\bar{x}$ <sup>1</sup>	$\sigma$ <sup>2</sup>	RANGE	$\bar{x}$	$\sigma$	RANGE
Acidity (titrimetric method [Ammanval])	mg/l CaCO <sub>3</sub>	5.37 (4)	0.84	4.49-6.48	4.39 (2)	0.14	4.29-4.49
Alkalinity (CaCO <sub>3</sub> )	ppm	- (4)	-	<1-3.1	4.0 (3)	0.06	3.9-4
Chlorine	ppb	<10 (3)	0	<10			
Copper	mg/l	- (3)	-	<.001-.003	- (3)	-	<.001-.005
Hardness, Scale From (CaX2.5) + (MgX4.1)	mg/l	13.42 (4)	1.21	12.13-14.72	14.99 (2)	0.31	14.77-15.21
Humic Acids	ppm	- (3)	-	<1-2.6	- (3)	-	<1-2.7
Inorganic Carbon	ppm	<1 (4)	0	<1	<1 (3)	0	<1
Iron	mg/l	0.11 (4)	0.08	0.003-0.18	0.119 (3)	0.016	.101-0.13
Lead	mg/l	- (3)	-	<.001-.002	- (3)	-	<.001-0.02
Nitrogen: Nitrite	ppm	<.005 (4)	0	<.005	<.005 (3)	0	<.005
Nitrate	ppm	0.028 (4)	0.016	.005-.038	0.057 (3)	0.007	0.05-0.064
Nitrite & Nitrate	ppm	-	-	-	-	-	-
Oxygen (Tank 1)	mg/l	9.48 (4)	0.60	8.7-10.0	8.95 (2)	1.34	8.0-9.9
pH		6.32 (4)	0.22	6.12-6.6	6.55 (2)	0	6.54-6.55
Phosphate (total)	ppm	<.005 (4)	0	<.005	<.005 (3)	0	<.005
Total Carbon	ppm	- (4)	-	<1-2.5	<1 (3)	0	<1
Total Dissolved Solids	mg/l	41 (3)	10.2	30-50	60.7 (3)	7.4	55-69
Turbidity	jtv	0.50 (4)	0.14	.4-.7	0.67 (3)	0.46	0.32-1.2
Zinc	mg/l	-	-	<.001-.003	- (3)	-	<.001-.004

<sup>1</sup>  $\bar{x}$  - Mean.

<sup>2</sup>  $\sigma$  - Standard deviation of mean.

APPENDIX      WEIGHTS OF FISH AND RATIO OF LITRES OF TESTWATER PER GRAM OF FISH PER DAY FOR  
 (TABLE II)      CONTROL AND TOXICITY TESTS ON FISH PROCESSING PLANT EFFLUENTS.

FISH PLANT	SOURCE OF EFFLUENT	DATE TEST STARTED	SPECIES*	MEAN FISH WEIGHT ( $\pm$ S.E.)	SAMPLE SIZE	l/gm/DAY
N.S.P. Louisburg	Fish Unloading Facility	25 July	S. g.	9.96 $\pm$ 0.90	25	0.1
		8 Aug.	S. g.	1.11 $\pm$ 0.08	25	0.9
	Filleting (fish) Plant (sewer 1) (final)	15 June	S. g.	6.30 $\pm$ 0.55	25	0.16
		8 Aug.	S. g.	0.94 $\pm$ 0.09	10	1.06
		7 June	S. g.	5.96 $\pm$ 0.44	25	0.17
	Fish Méal Plant (sewer 2)	15 June	S. g.	6.64 $\pm$ 0.69	25	0.15
		8 Aug.	F. h.	5.07 $\pm$ 1.03	35	0.19
N.S.P. Lockeport	Filleting (fish) Plant	24 Aug.	F. h.	2.14 $\pm$ 0.25	25	0.47
		2 Aug.	F. h.	2.37 $\pm$ 0.29	15	0.42
	Fish Meal Plant	22 Aug.	F. h.	2.28 $\pm$ 0.20	25	0.44
Swim Brothers, Lockeport	Filleting (fish) Plant	2 Aug.	F. h.	2.58 $\pm$ 0.44	25	0.39
		23 Aug.	F. h.	1.98 $\pm$ 0.17	25	0.50

\* S. g. - Salmo gairdneri; F. h. - Fundulus heteroclitus.

APPENDIX MEANS ( $\pm$ S.E.) OF PHYSICO-CHEMICAL PARAMETERS OF TEST SOLUTIONS FROM THREE FISH PROCESSING PLANTS  
(TABLE IIIA) IN NOVA SCOTIA.

FISH PLANT	SOURCE OF EFFLUENT	DATE TEST STARTED	TEMP. ( $^{\circ}$ C)		pH		D.O. (mg/l)		INITIAL S $^{\circ}$ /‰ <sup>1</sup>	SAMPLE SIZE
			INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL		
National Sea Products, Louisburg	Fish Unloading Facility	25 July	14.0 $\pm$ 0.0	14.1 $\pm$ 0.0	6.8 $\pm$ 0.0	6.3 $\pm$ 0.1	7.0 $\pm$ 0.0	1.2 $\pm$ 0.3	0.0	4
		8 Aug.	16.0 $\pm$ 0.0	14.6 $\pm$ 0.1	6.5 $\pm$ 0.0	6.6 $\pm$ 0.1	6.7 $\pm$ 0.1	0.2 $\pm$ 0.0	0.3	4
	Filletting Plant (sewer 1) (final)	15 June	14.5 $\pm$ 0.0	15.0 $\pm$ 0.0	7.3 $\pm$ 0.1	7.4 $\pm$ 0.0	9.3 $\pm$ 0.3	9.3 $\pm$ 0.5	1.3	4
		8 Aug.	16.0	15.0	6.6	7.3	7.3	8.8	0.2	1
		7 June	15.5 $\pm$ 0.0	16.0 $\pm$ 0.0	6.7 $\pm$ 0.1	7.2 $\pm$ 0.1	7.8 $\pm$ 0.7	8.2 $\pm$ 0.6	1.8	4
	Fish Meal Plant (sewer 2)	15 June	15.0 $\pm$ 0.0	15.5 $\pm$ 0.0	7.6 $\pm$ 0.1	7.7 $\pm$ 0.1	9.4 $\pm$ 0.2	8.6 $\pm$ 0.7	31.5	4
		8 Aug.	16.0 $\pm$ 0.0	14.8 $\pm$ 0.1	6.7 $\pm$ 0.0	7.6 $\pm$ 0.1	7.5 $\pm$ 0.3	8.8 $\pm$ 0.4	16.6	4
	National Sea Products, Lockeport	Filletting Plant	24 Aug.	16.1 $\pm$ 0.2	14.0 $\pm$ 0.0	7.7 $\pm$ 0.0	8.1 $\pm$ 0.1	6.7 $\pm$ 0.5	8.5 $\pm$ 1.0	31.5
Fish Meal Plant			2 Aug.	17.0 $\pm$ 0.0	14.0 $\pm$ 0.0	7.8 $\pm$ 0.0	8.1 $\pm$ 0.1	8.8 $\pm$ 0.0	9.3 $\pm$ 0.4	27.4
		23 Aug.	15.0 $\pm$ 0.0	14.0 $\pm$ 0.0	7.9 $\pm$ 0.1	8.0 $\pm$ 0.1	9.3 $\pm$ 0.1	10.1 $\pm$ 0.1	31.2	4
Swim Brothers, Lockeport	Filletting Plant	2 Aug.	17.0 $\pm$ 0.0	14.0 $\pm$ 0.0	7.2 $\pm$ 0.0	7.9 $\pm$ 0.2	5.2 $\pm$ 0.1	8.1 $\pm$ 0.9	27.4	4
		23 Aug.	16.0 $\pm$ 0.0	14.0 $\pm$ 0.0	7.7 $\pm$ 0.1	8.2 $\pm$ 0.2	8.8 $\pm$ 0.3	8.1 $\pm$ 1.1	30.9	4

<sup>1</sup> Meter read low during tests - readings were multiplied by 1.406, derived assuming salinity of full strength sea water was 30‰ and meter reading for same sea water was 21.3‰.

APPENDIX SUMMARY OF PHYSICO-CHEMICAL PARAMETERS FOR CONTROL TESTS OF BIOASSAYS RUN ON THREE FISH  
(TABLE IIIB) PROCESSING PLANTS IN NOVA SCOTIA.

FISH PLANT	SOURCE OF EFFLUENT	DATE TEST STARTED	TEMP. (°C)		pH		D.O. (mg/l)		INITIAL S°/oo
			INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	
National Sea Products, Louisburg	Fish Unloading Facility	25 July	17.0	14.0	6.8	6.9	8.6	9.4	0.0
		8 Aug.	15.0	15.0	7.0	7.4	9.8	10.0	0.0
	Filletting Plant (sewer 1) (final)	15 June	17.0	15.0	6.8	7.5	10.2	7.9	0.0
		8 Aug.	15.0	15.0	7.0	7.4	9.8	10.0	0.0
		7 June	15.5	16.0	7.2	7.0	9.7	9.4	0.0
	Fish Meal Plant	15 June	15.5	15.0	7.2	7.7	10.4	9.3	32.6
8 Aug.		15.0	15.0	7.6	7.7	9.8	9.2	16.7	
National Sea Products, Lockeport	Filletting Plant	24 Aug.	16.5	14.0	7.8	8.2	9.5	9.9	30.2
	Fish Meal Plant	2 Aug.	15.0	14.0	7.8	8.0	8.9	8.6	28.1
		23 Aug.	17.0	14.0	8.0	8.1	9.3	10.0	28.8
Swim Brothers, Lockeport	Filletting Plant	2 Aug.	15.0	14.0	7.8	8.0	8.1	8.6	28.1
		23 Aug.	15.5	14.0	6.6	7.8	9.3	10.2	29.8

APPENDIX PRODUCTION DATA FOR THREE FISH PROCESSING PLANTS IN NOVA SCOTIA ON DAYS OF SAMPLING. N.S.P.  
 (TABLE IV) LOUISBURG AND LOCKEPORT EXPRESSED IN TERMS OF ROUND FISH (LBS.) AND SWIM BROTHERS, LOCKEPORT,  
 IN TERMS OF FINISHED PRODUCT (LBS.).

FISH PLANT	DATE SAMPLED	COD	TURBOT	FLOUNDER	REDFISH	HADDOCK	CATFISH	POLLOCK	TOTAL
N.S.P., Louisburg	13 June	19,225	--	6,975	70,280	60	--	--	96,540
	7 Aug.	--	140	--	68,670	--	35	--	68,845
N.S.P., Lockeport Filleting Plant (fish)	20 Aug.	--	--	--	--	--	--	--	--
	22 Aug.	--	--	--	--	--	--	--	56,995
Fish Meal Plant	20 Aug.	--	--	--	--	--	--	--	5,900
	22 Aug.	--	--	--	--	--	--	--	3,400
Swim Brothers, Lockeport	20 Aug.	--	--	--	--	--	--	18,058	18,058

APPENDIX AVERAGE VALUES FOR LIQUID EFFLUENT CHARACTERISTICS (mg/l) OF THREE FISH PROCESSING PLANTS ON  
(TABLE V) DATES SAMPLED.

FISH PLANT	SOURCE OF EFFLUENT	DATE SAMPLED	pH	TEMP. (C)	BOD	COD	SS	TS	TVS <sup>1</sup>	VSS <sup>2</sup>
N.S.P., Louisburg	Fish Unloading Facility	6 Aug.	7.0	18.3	686	1,125	210	566	412	-
		25 July	7.6	13.5	830	1,596	173	994	644	-
	Filleting (fish) Plant	13 June	7.3	13.8	142	194	77	1,897	303	-
		7 Aug.	6.7	21.2	348	448	107	1,336	390	107
	Fish Meal Plant	13 June	8.7	14.2	236	315	136	31,027	3,802	-
		7 Aug.	7.5	23.6	1,104	2,454	757	31,337	4,620	739
N.S.P., Lockeport	Filleting (fish) Plant	22 Aug.	-	-	288	410	192	34,813	-	-
	Fish Meal Plant	20 Aug.	-	-	25	143	28	32,095	-	-
Swim Brothers, Lockeport	Filleting (fish) Plant	20 Aug.	-	-	1.2	1,530	363	36,145	-	-

(Continued)

APPENDIX (TABLE V) (Continued)

FISH PLANT	SOURCE OF EFFLUENT	TOTAL INORGANIC PO <sub>4</sub>	ORGANIC PO <sub>4</sub>	AMMONIA (UNIONIZED)	NO <sub>3</sub> -N	NO <sub>2</sub> -N
N.S.P., Louisburg	Fish Unloading Facility	- 32.4	- 3.5	- 1.5	- 0.15	- 0.01
	Filletting (fish) Plant	- -	- -	- -	0.71 -	- -
	Fish Meal Plant	- -	- -	- -	- -	- -
N.S.P., Lockeport	Filletting (fish) Plant	-	-	-	<0.005	<0.005
	Fish Meal Plant	-	-	-	-	-
Swim Brothers, Lockeport	Filletting (fish) Plant	-	-	-	-	-

<sup>1</sup> Total volatile solids.

<sup>2</sup> Volatile suspended solids.