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Marine Bivalve Data from a Site Contaminated with Copper Mine Tailings, and a Reference Site in Notre Dame Bay, Newfoundland

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Canadian Data Report of
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MARINE BIVALVE DATA FROM A SITE CONTAMINATED WITH COPPER MINE TAILINGS, AND A REFERENCE SITE IN NOTRE DAME BAY, NEWFOUNDLAND

by

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CONTENTS

ABSTRACT

Meade, J.D., D. Hamoutene, F.M. Power, L.L. Fancey and J.F. Payne. 2000. Marine Bivalve Data from a Site Contaminated with Copper Mine Tailings, and a Reference Site in Notre Dame Bay, Newfoundland. Can. Data Rep. Fish. Aquat. Sci. No. 1062: v + 21 p.

Presently, in Atlantic Canada and British Columbia, sub-marine tailings disposal is being considered as a safe option for the discharge of mining effluents. Nonetheless, the effluent leaching process under saline vs. fresh water, the effect of the pH buffering capacity of sea water and the biological impacts in the marine environment are so poorly known that no operating permits are now in effect.

Data are presented here for a study conducted on a reference site and a site contaminated with copper mine tailings in Notre Dame Bay, Newfoundland. Soft shelled clams (*Mya arenaria*) and blue mussels (*Mytilus sp.*) were collected from both sites and used for a biological and biochemical assessment. Several shell measurements, cavity volumes, and condition indices were determined for the collected mussels. Sex was determined for clams and mussels from both sites and oxidative metabolism was assessed in the hepatopancreas and gills of the specimens. The amount of Thiobarbituric Acid Reactive Species (TBARS) was used to indicate the free radicals produced in the animals' tissues (hepatopancreas and gills). Catalase and NADPH cytochrome c reductase activities, two enzymes involved in the peroxidation process, were also measured in both organs.

Key words : copper, tailings, mussels, clams, peroxidation, oxidative metabolism

RÉSUMÉ

Meade, J.D., D. Hamoutene, F.M. Power, L.L. Fancey and J.F. Payne. 2000. Marine Bivalve Data from a Site Contaminated with Copper Mine Tailings, and a Reference Site in Notre Dame Bay, Newfoundland. Can. Data Rep. Fish. Aquat. Sci. No. 1062: v + 21 p.

Les provinces Atlantiques ainsi que la Colombie Britannique ont opte ces dernières années pour un rejet en mer des résidus miniers. Cette option ne semblait pas, jusqu'à présent, représenter un danger pour l'environnement. Néanmoins, la méconnaissance des phénomènes de lessivage en mer, de l'effet du pH salin sur ces effluents, de leur impact biologique réel ont fait qu'aucun permis officiel n'existe encore à ce jour.

Les données présentées ici concernent des prélèvements effectués dans deux sites de la côte Terre Neuvienne, l'un de reference et l'autre contaminé par les rejets d'une mine de cuivre. Des moules (*Mytilus sp.*) et des myes (*Mya arenaria*) ont été collectées et utilisées pour des mesures biologiques et des tests biochimiques. La longueur, la largeur, le volume de la coquille, le poids sec et humide ainsi que le facteur de condition ont été mesurés et calculés pour les moules. Les myes ont été utilisées uniquement pour les dosages biochimiques. Les Thiobarbituric Acid Reactive Species ont été mesurées au niveau de l'hépatopancréas et des branchies des moules et myes. C'est un indice du degré de peroxidation des tissus utile pour l'évaluation d'un éventuel effet de polluants sur le métabolisme oxydatif. Les activités enzymatiques de la catalase et de la cytochrome c réductase ont été également mesurées. Ce sont deux activités impliquées dans le métabolisme oxydatif.

Mots Clés : cuivre, mine, moules, myes, peroxydation, métabolisme oxydatif

INTRODUCTION

Mining is a major component of the Canadian economy, nationally and internationally. There are 3000 mining companies operating in the world and 1500 of them are Canadian. The processing of ore at these mines generates large amounts of solid wastes (tailings) which contain residual concentrations of all metals originally present in the ore. Any mining effluent or tailings disposal which is free of confounding effects from other major sources of pollution provides ideal conditions for evaluating the biological impact of complex mixtures of metals. Two sites in Newfoundland provide such an opportunity and Little Bay is one of them. The mining history of this site goes back to the late 1800's and ceases in 1969.

During mining operations in the 1960's, a tailings impoundment area was created by constructing a 8 - 10 m high dam across the mouth of a shallow mixed marine/ freshwater bay known as Shoal Bay. Small freshwater streams flowing into the southwest end of Shoal Bay and from the higher ground to the northwest combined with mine process water provided a shallow water cover for the tailings. Approximately 1.8 million tonnes of tailings were generated during this phase of mining, and the tailings pond covered an area approximately 1 km long by 135 m wide and to a depth of up to 16m, but averaging 7 m (Collins and LeGrow, 1986). In 1974, the tailings dam was breached and the tailings now form a deltaic beach below the dam extending into the waters of Little Bay Arm.

As part of a study to investigate the impacts of mining effluents, bivalves were collected from two sites in Notre Dame Bay, Newfoundland; a site contaminated with copper mine tailings, Little Bay, and a reference site, Smith's Harbour (Fig. 1). Bivalves which filter considerable levels of metal laden particulate from the water column are prototype examples of chronic exposure of considerable toxicological interest. Studying chronic toxicity is especially important for investigating the effects of metal complexes which have little acute toxicity potential. Biological effects were estimated by calculating condition indices of mussels. Oxidative stress was evaluated in both mussels and clams using three biochemical tests.

One of the mechanisms of metal toxicity is the oxidative damage to DNA and other molecules (Davies, 1995). It has been clearly established that the health of aquatic organisms exposed to different pollutants may be dramatically compromised by disorders associated with oxidative stress (Di Giulio *et al.*, 1989). One expression of oxidative stress is the production of free radicals and its consequence: lipid peroxidation. The thiobarbituric acid assay (TBA) is the most frequently used method for determining the extent of membrane lipid peroxidation (Buege and Aust, 1970). TBA reactive species (TBARS; mostly malondialdehyde) were measured in hepatopancreas and gills of bivalves. Free radicals are not only produced by nonenzymatic systems but also by enzymatic ones (Mukhopadhyay and Chatterjee, 1994). One of the physiologically relevant enzymatic systems is the NADPH cytochrome c reductase measured in this study. Catalase activity measurements were also performed to determine if this key enzyme involved in antioxidant processes (Livingstone *et al.*, 1992) was affected by mining effluents.

MATERIALS AND METHODS

1. SITE LOCATIONS

Mussels (*Mytilus sp.*) and clams (*Mya arenaria*) were collected from two locations in the western portion of Notre Dame Bay, Newfoundland in October 1999. At Little Bay, mussels were collected along the northern shore adjacent to the breached dam and clams were sampled from within the tailings delta also on the northern side. At Smith's Harbour, mussels were collected along the western shore of the cove and clams were taken throughout the length of the beach. Samples were held in coolers in seaweed from each site and transported to the lab where they were placed in a separate aquarium within 72 hours. Tissue samples for biochemical analysis were taken within 48 hours of arrival at the laboratory.

2. CONDITION INDICES

Measurements of length, width, depth, wet weight, dry weight, shell weight and cavity volume were taken to determine the condition of mussels from each site. Length, width and depth were each measured as the maximum distance obtained using the unaltered (intact) organism. Wet weight was obtained by shucking each mussel and scraping all tissue into a weight boat, draining excess water and recording mass. Dry weight was the mass of the tissue recorded after 48 hours of drying at room temperature in a fume hood. Similarly, shell weight was recorded as the mass after 48 hours of drying at room temperature in a fume hood. The cavity volume was obtained using the displacement method of Penney and Hart (1999). Condition Indices were measured as a percentage of the tissue weight (wet and dry) versus shell weight with higher condition index values indicating healthier mussels (Grout *et al.*, 1999). Condition Indices were determined using 5 mm size classes of the mussels, which ranged from 30-35 mm to 90-95 mm.

3. SEX DETERMINATION

The method used for sex determination involved heating biopsy samples with a thiobarbituric acid (TBA) reagent (Jabbar and Davies, 1987). A piece of the mantle, 50-200 mg wet wt, was placed in a tube containing 20% (w/v) trichloroacetic acid solution (2 ml) and anti-bumping granules. After adding freshly prepared 0.75% (w/v) TBA solution (0.5 ml), the tube was capped and placed in a boiling water-bath for 20 min. The presence of a yellow or pink colour, as determined visually, was used to identify male and female animals, respectively.

Previously, this technique was used only with mussels. In the present study, the protocol was also used for clams using bigger pieces of the mantle (200-800 mg wet wt). Gonad observation was performed to confirm sex of clams. The TBA technique gave exactly the same results as slide observation proving that it can be applied to sex determination for clams as well.

Individual mussels used for this test and the following oxidative stress tests ranged in size from 40-60 mm while the clams had a size ranging from 50-80 mm.

4. S9 PREPARATION

Gills and hepatopancreas of both clams and mussels were used to prepare S9 for biochemical analysis. Organs were sampled and weighed. A 25% (w/v) liver homogenate in 0.1 M phosphate buffer, pH 7.4, was prepared using a Potter-Elvehjem homogenizer. The homogenate was centrifuged at 10,000 g for 10 min and the supernatant (S9) was stored at -70°C prior to use.

5. TBARS TEST

Lipid peroxidation in the gills and hepatopancreas samples was determined by measuring TBARS as described by Uchiyama and Mihara (1978). In a 10 ml test tube, 0.5 ml of S9 was mixed with 3 ml of 1% H_3PO_4 to keep the pH of the medium at about 2.0. One ml of 0.6% aqueous TBA was then added and the mixture was heated at 100°C for 45 min. After cooling, 4 ml of 1-butanol was added and the mixture was shaken vigorously. The butanol phase was separated by centrifugation and its absorbance at 535 and 520 nm was measured. The difference in absorbance at these two wavelengths was taken to avoid interference due to the protein. Tetramethoxypropane was used as an external standard. The level of TBARS is expressed as nmol/mg protein.

6. ENZYME ASSAYS

Enzyme activities were measured using S9 samples of both gills and hepatopancreas of clams and mussels. The activity of NADPH cytochrome c reductase (CYT RED) was determined by monitoring the increase in absorbency at 550 nm using an extinction coefficient of 21 $mM^{-1}\cdot cm^{-1}$ for reduced cytochrome c (Masters *et al.*, 1967). The activity is expressed in nmol/min/mg protein. Catalase activity (CATALASE) was measured according to Greenwald (1985) and expressed as μmol/min/mg. Protein concentration was determined according to Lowry *et al.* (1951).

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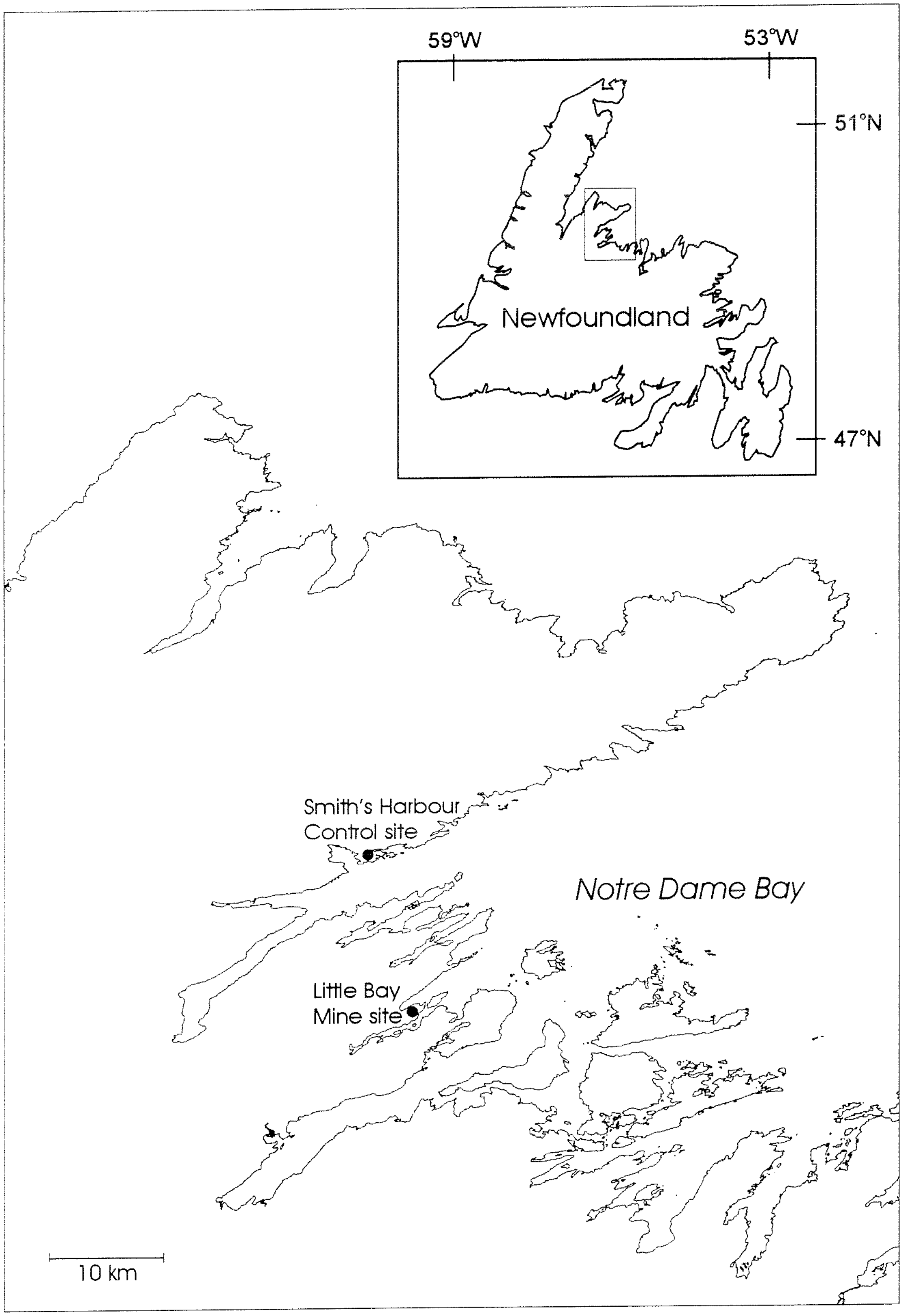

Figure 1. Study site locations

Table 1.1. Shell measurements of individual mussels collected from the Little Bay site.

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
LB1	56.86	30.34	21.76	3.4984	0.5676	11.1384	10.2
LB2	55.64	30.68	23.46	5.353	1.1124	13.8384	11.8
LB3	58.29	30.04	22.38	4.3158	0.8282	12.0978	11.2
LB4	54.66	29.13	23.91	4.9093	1.0941	11.5678	11
LB5	54.59	27.75	23.56	4.4145	0.8737	13.4173	9.6
LB6	53.2	25.95	22.52	3.4533	0.4954	8.8276	9.2
LB7	50.04	25.17	21.71	3.7202	0.6867	9.0972	7.8
LB8	52.91	28.58	20.35	4.0347	0.7131	9.6097	9.6
LB9	56.41	29.35	22.88	4.1607	0.7527	9.8114	11
LB10	55.07	28.62	20.29	3.7084	0.6902	8.9308	8.6
LB11	50.49	27.55	23.87	3.5142	0.6093	13.5163	9.8
LB12	52.05	26.66	23.03	3.5949	0.7546	10.1985	9.8
LB13	52.66	29.59	24.62	4.0241	0.6865	13.3925	11.2
LB14	54.29	28.69	22.31	4.3654	0.7874	9.7188	11
LB15	57.75	27.8	23.86	5.4683	0.71	10.0463	11.2
LB16	55.78	28.32	24.02	5.1391	0.9218	12.3982	11
LB17	52.03	28.65	24.39	4.4002	0.7295	12.2228	9
LB18	53.01	28.23	26.22	5.2321	0.8754	12.3501	11.8
LB19	51.46	27.8	19.18	2.9252	0.4506	6.8994	8.8
LB20	49.5	29.68	20.64	2.9621	0.4606	9.6205	8.2
LB21	55.69	29.43	22.25	4.2312	0.6694	10.1741	10.8
LB22	50.47	27.49	22.35	4.1939	0.5788	9.208	8.2
LB23	51.56	26.16	23.24	3.1367	0.4926	10.2799	8.6
LB24	57.12	29.25	26.04	4.4275	0.8007	12.9207	10.6
LB25	60.23	34.9	23.19	5.1041	0.8292	12.2798	14.6
LB26	58.56	29.35	23.32	4.9464	0.7758	12.202	9.6
LB27	57.06	29.2	26.01	5.1777	0.9363	12.7187	11.6
LB28	55.17	28.33	21.75	3.7872	0.6961	10.6321	10
LB29	50.72	27.6	22.36	4.0861	0.7454	11.0031	9.4
LB30	50.16	26.28	22.65	3.5488	0.5941	11.2264	7.6
LB31	53.62	26.26	23.17	3.2983	0.5613	11.8106	7.8
LB32	48.76	25.17	20.53	3.0923	0.4776	7.6645	7.4
LB33	53.32	27.42	21.71	3.1918	0.4772	10.1438	10.4
LB34	50.72	25.96	23.67	3.3501	0.5582	11.3785	10
LB35	49.47	26.92	22.34	3.5619	0.5886	10.1799	8.6
LB36	51.03	24.44	21.68	3.2243	0.4872	4.8716	9.6
LB37	50.97	24.62	21.96	3.0446	0.4274	7.7091	9.6
LB38	55.54	27.59	21.65	3.4328	0.5765	9.2198	9.4
LB39	48.9	23.83	22.97	3.5822	0.5761	8.7886	8.8
LB40	49.17	22.73	21.89	3.0192	0.4024	7.3665	7.8
LB41	55.17	28.18	24.2	3.3425	0.4528	12.4155	10.8
LB42	48.33	23.62	22.41	3.6642	0.7031	10.663	8.4
LB43	45.24	25.82	21.03	3.159	0.6617	8.389	7.6
LB44	52.53	28.97	22.41	3.0643	0.9334	10.5474	10.2

Table 1.1. (continued)

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
LB45	50.31	26.37	24.17	3.186	0.5196	11.2771	9.4
LB46	54.96	28.86	22.57	3.6551	0.5029	11.4694	10.6
LB47	54.07	27.44	22.07	3.7056	0.6369	11.3477	8.8
LB48	51.87	28.39	19.95	3.4669	0.5566	9.8322	8.4
LB49	52.56	26.87	25.74	3.823	0.7301	11.2391	11
LB50	54.78	29.69	21.79	4.1469	0.6758	9.7643	10.6
LB51	50.16	27.83	21.48	3.0467	0.5061	8.0668	9
LB52	52.41	23.43	22.06	3.6313	0.486	7.7619	9
LB53	53.41	29.94	22.01	3.2865	0.497	11.0702	10
LB54	53.16	27.09	23.24	4.4157	0.9974	12.3254	8.8
LB55	51.85	28.89	21.46	4.3057	0.758	9.3606	9
LB56	50.59	25.9	20.86	3.2197	0.545	9.2323	8.6
LB57	59.01	30.21	22.76	4.2661	0.6913	10.4739	12.2
LB58	51.48	25.54	23.34	3.4274	0.5224	9.0284	10
LB59	47.93	23.67	23.19	2.7531	0.4754	11.7032	7.6
LB60	49.29	28.6	20.98	3.3785	0.5452	9.8804	9.4
LB61	53.56	28.49	21.68	3.4263	0.585	9.3122	10.2
LB62	55.27	29.2	24.16	5.0463	1.0333	12.7343	12.2
LB63	51.8	27.79	22.7	3.6662	0.6416	10.4417	9
LB64	48.33	24.86	20.14	3.527	0.5902	7.6692	7
LB65	47.78	25.07	18.64	1.8516	0.3023	7.0966	7
LB66	47.67	22.23	20.94	2.6687	0.3311	5.7772	8
LB67	48.47	24.94	20.12	2.7262	0.5083	8.0096	7.4
LB68	46.39	22.13	21.34	2.4892	0.3615	6.3596	7.4
LB69	42.02	18.84	25.01	2.2509	0.2668	6.1861	7.2
LB70	43.79	23.54	18.78	2.304	0.4213	6.5321	5.8
LB71	40.79	19.46	19.86	2.3913	0.286	5.8176	5.4
LB72	37.43	19.73	15.96	1.5379	0.212	4.3771	3.8
LB73	56.39	27.95	20.14	3.9692	0.592	8.9133	10.2
LB74	46.43	24.94	19.72	2.7658	0.3977	6.7981	7.4
LB75	54.68	27.23	21.16	3.5352	0.4889	6.5235	10.4
LB76	49.53	28.72	21.27	4.378	0.714	8.2384	9.2
LB77	58.43	29.32	23.27	4.9015	0.7437	12.8045	11.4
LB78	51.52	26.25	20.92	3.642	0.6042	10.0889	7.8
LB79	45.12	20.56	21.19	2.4414	0.3401	6.7341	6.8
LB80	48.16	25.61	18.72	2.6372	0.3818	7.3862	5.9
LB81	44.57	24.06	19.19	2.9726	0.523	5.5281	6
LB82	46.57	24.68	19.35	2.6363	0.3571	7.7862	6
LB83	45.44	21.59	18.91	2.4796	0.3314	4.6462	6.6
LB84	50.89	26.22	22.67	2.8426	0.4057	9.2652	8.6
LB85	44.39	25.54	21.91	2.5831	0.3675	7.8341	7.6
LB86	47.82	22.63	20.33	2.8291	0.4436	8.8696	6.2
LB87	48.09	25.16	18.63	2.6384	0.3614	5.9715	6.6
LB88	46.83	24.43	18.79	2.6701	0.3759	5.0098	6.8

Table 1.1. (continued)

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
LB89	46.05	24.41	20.39	2.8155	0.392	8.8886	5.9
LB90	43.41	18.23	22.24	2.6739	0.3582	5.8773	6
LB91	42.33	21.26	19.64	1.988	0.2868	5.6585	5.2
LB92	45.94	21.63	20.59	2.4882	0.3127	6.8197	6.8
LB93	49.98	26.53	19.21	3.1577	0.4149	7.757	8.4
LB94	45.71	25.73	17.61	2.6091	0.3602	6.2499	6.2
LB95	39.31	17.69	20.73	2.1153	0.2721	4.6684	5.2
LB96	49.1	25.6	19.55	2.7785	0.3787	6.4367	7.2
LB97	50.86	27.19	21.73	3.1671	0.4845	9.1215	9
LB98	52.87	29.75	20.72	3.7798	0.4928	8.7594	10
LB99	50.35	26.81	21.48	3.8263	0.5522	10.0891	8.2
LB100	46.85	23.39	20.24	3.2565	0.4597	7.0016	6.6
LB101	43.5	21.23	20.49	2.569	0.3626	7.3185	6.1
LB102	44.11	22.87	19.14	2.0785	0.2559	5.1598	5.8
LB103	43.59	20.47	18.65	2.053	0.2844	3.7708	5.4
LB104	46.92	24.47	19.21	2.2053	0.3318	7.6474	6.2
LB105	44.51	23.25	19.27	2.7693	0.4191	6.1724	6.4
LB106	43.59	22.51	17.83	2.3381	0.2844	4.6134	6
LB107	38.42	19.13	16.65	1.6378	0.2364	2.6306	4.1
LB108	37.92	17.08	18.89	1.6411	0.1816	3.7162	4.4
LB109	35.61	17.33	16.36	1.1381	0.1231	2.3474	3.4
MEAN	50.12	25.913	21.5	3.362	0.547	8.897	8.514
STD. DEV.	5.043	3.332	2.057	0.092	0.204	2.633	2.084

Table 1.2. Shell measurements of individual mussels collected from the Smith's Harbour site.

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
SH1	91.18	51.96	40.23	13.0502	1.7958	69.4343	48.4
SH2	60.95	30.22	23.88	3.1066	0.4347	10.5544	13.4
SH3	65.39	32.85	28.2	9.6794	1.0275	19.0935	18.4
SH4	87.32	46.38	35.89	11.0894	2.1169	40.7857	47
SH5	61.64	31.6	27.28	2.3698	0.2616	17.6475	15.2
SH6	73.13	36.84	25.84	6.3089	1.0852	27.5951	24.8
SH7	55.83	29.1	24.04	3.5694	0.5676	12.9187	13.2
SH8	70.18	38.04	36.36	7.3831	1.3092	45.2244	23.6
SH9	78.17	42.43	29.84	9.0051	1.225	29.1536	26
SH10	50.14	25.86	23.23	2.1316	0.3354	6.8587	8.8
SH11	72.39	38.3	31.58	8.5876	1.3663	32.4035	26.8
SH12	58.26	31.35	28.15	3.7682	0.4859	11.5586	16
SH13	40.69	24.84	16.23	1.3571	0.1808	4.2762	5.6
SH14	57.17	30.32	21.93	2.8362	0.3366	11.1897	12
SH15	78.54	38.08	30.44	7.0183	1.0604	33.6323	29.2
SH16	68.83	34.71	29.69	5.8933	1.0124	16.9973	21.6
SH17	79.11	43.22	33.89	10.7505	1.7309	34.9099	35.2
SH18	79.24	39.25	33.96	9.4125	1.1506	28.2959	32.4
SH19	79.39	37.63	32.35	8.2278	1.2577	30.1568	29.8
SH20	59.54	33.07	24.08	4.7743	0.6882	14.9318	13
SH21	34.14	18.88	14.97	0.9152	0.1083	2.0864	3
SH22	82.23	47.23	35.27	14.2386	2.2737	40.1724	45.2
SH23	57.2	32.1	26.49	5.7282	0.8851	13.4271	15.6
SH24	78.65	41.44	34.87	7.6676	1.0244	40.1771	34.4
SH25	69.24	40.99	26.92	6.6073	1.1314	23.0401	22
SH26	58.75	31.54	23.43	3.5607	0.5155	10.8145	15.2
SH27	76.26	41.58	32.56	10.8662	1.4803	38.1365	31
SH28	46.71	23.1	19.18	2.3371	0.3092	4.794	7
SH29	39.76	22.96	14.04	1.188	0.1688	3.1008	4.2
SH30	53.49	28.81	22.55	3.1595	0.3768	9.3389	10.8
SH31	45.63	26.38	19.49	2.0386	0.3223	6.6689	6.2
SH32	64.88	32.52	27.54	5.5455	0.9132	22.1866	18
SH33	44.98	24.17	20.19	1.6531	0.1711	5.6527	7.2
SH34	47.1	26.26	18.44	1.7636	0.1991	4.6154	7.6
SH35	74.54	38.32	35.3	7.3373	1.2542	24.8031	29.4
SH36	72.97	41.43	27.57	6.6525	0.7088	19.0916	27.2
SH37	73.71	38.78	33.18	5.4021	0.6087	23.9083	30.4
SH38	69.74	34.78	27.36	5.5796	0.7994	23.6703	21.8
SH39	76.24	36.72	30.47	6.825	1.1792	23.6046	27.8
SH40	73.04	37.66	30.39	6.6547	0.9469	30.1256	25.6
SH41	75.22	38.39	28.5	7.7708	1.1837	26.2322	22.8
SH42	69	37.2	32.51	6.9823	1.134	26.9121	24.4
SH43	70.34	36.28	29.77	8.8452	1.2557	24.3634	25.2
SH44	69.15	37.7	30.07	5.5092	0.6043	23.8517	23.4

Table 1.2. (continued)

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
SH45	67.34	34.27	28.54	4.9423	0.6233	24.4259	19.8
SH46	64.76	34.71	29.93	5.9034	1.1603	19.4475	20.4
SH47	70.58	28.22	28.25	6.3539	0.9467	19.7031	23.6
SH48	64.59	38.03	29.97	7.533	1.0984	22.7252	23.6
SH49	62.06	34.93	23.79	4.1936	0.653	13.2139	15.4
SH50	62.65	34.51	25.19	3.2442	0.428	14.0385	17.8
SH51	77.23	39.67	34.99	9.7392	2.6024	31.8688	31.6
SH52	72.86	38.3	30.02	5.8851	0.9296	21.1968	28.8
SH53	64.26	34.31	28.67	5.2936	1.0306	16.955	19.8
SH54	70.31	35.45	31.81	7.3075	1.4619	25.5045	24
SH55	74.15	39.98	30.72	6.2942	1.1599	29.776	28.4
SH56	67.63	33.46	35.54	6.9302	1.0594	25.9921	26
SH57	69.55	36.78	29.81	7.0957	1.2261	20.5253	23.6
SH58	71.51	40.41	29.3	7.7145	1.5012	22.6964	23.2
SH59	73.78	40.94	30.48	5.6486	0.9891	36.9314	26.8
SH60	65.47	37.91	24.64	5.4793	0.9284	15.7371	19
SH61	68.88	37.47	30.34	4.6973	0.6044	22.2574	22.6
SH62	70.61	35.52	31.97	8.0249	1.2707	26.6672	26
SH63	74.67	37.33	37.77	9.4126	1.4592	29.9754	35.6
SH64	72.03	40.61	32.36	5.4084	0.7478	31.729	27.2
SH65	67.13	35.41	29.29	5.9063	0.8746	21.4478	23.4
SH66	65.09	35.21	27.09	4.1534	0.6381	17.8034	19.2
SH67	70.42	37.81	30.32	8.9948	1.711	19.1864	23.8
SH68	74.73	36.38	34.45	10.1686	1.9881	31.4758	30
SH69	64.22	33.52	31.88	5.1909	0.8683	24.5748	23.4
SH70	78.39	35.1	35.42	8.8507	2.0592	27.5873	29.2
SH71	68.74	36.21	35.96	11.6079	2.9078	41.5583	26.8
SH72	69.71	34.89	29.82	4.5297	0.5507	19.1801	22.6
SH73	69.48	34.86	30.01	6.7691	1.2615	18.3827	22.8
SH74	65.43	34.33	28.72	5.0697	0.711	21.5503	20.4
SH75	76.78	43.42	33.62	6.7766	1.6178	42.3335	30.8
SH76	75.36	38.78	31.89	5.7123	1.0402	42.9124	26.8
SH77	79.81	44.23	36.91	9.3779	2.4706	46.8238	40.6
SH78	77.29	36.64	34.01	11.6091	2.7428	33.0969	29.4
SH79	51.8	24.79	21.85	1.2846	0.1178	5.0882	9.6
SH80	60.97	35.14	25.37	4.3866	0.5462	12.3286	17
SH81	60.15	32.11	26.37	5.1896	0.732	15.5506	17.2
SH82	60.82	33.43	27.6	4.2086	0.5194	14.762	17.6
SH83	53.88	29.57	23.44	2.663	0.3497	7.7224	11.2
SH84	58.72	28.7	22.76	3.7319	0.5158	13.2868	11.8
SH85	52.47	29.38	22.01	3.6464	0.4451	10.1169	10.6
SH86	56.6	30.47	26.15	2.5986	0.3245	16.5347	12.8
SH87	49.96	26.59	20.2	1.8332	0.1942	5.9538	9
SH88	59.15	33.24	27.34	6.0594	0.9734	23.191	15.6

Table 1.2. (continued)

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
SH89	54.47	28.51	28.58	4.1929	0.5727	14.9759	14.2
SH90	60.14	32.64	25.28	4.7575	0.7647	17.4754	14.2
SH91	55.42	32.36	23.37	3.8106	0.4782	11.3157	13.2
SH92	57.52	32.39	24.28	4.3402	0.7061	12.9698	13
SH93	53.93	30.21	21.11	2.7034	0.3118	9.374	10.4
SH94	54.51	28.02	21.96	4.2527	0.6813	10.7617	10.8
SH95	56.24	29.92	25.74	4.1472	0.6072	11.0301	14
SH96	56.21	28.62	24.87	3.803	0.5206	15.1931	12
SH97	55.62	30.16	23.34	3.7283	0.5517	10.2813	12
SH98	54.82	28.53	22.93	2.3422	0.2453	10.0859	11.6
SH99	53.58	27.74	21.61	2.9016	0.4319	8.4783	10.6
SH100	51.62	27.13	22.58	2.7531	0.4145	9.3186	9.6
SH101	58.72	35.42	23.92	4.6329	0.6787	12.6345	11.8
SH102	53.65	28.96	24.25	3.4049	0.5267	9.2889	11.2
SH103	92.47	44.36	39.87	11.0863	1.6002	58.8163	44.6
SH104	88.64	46.32	37.23	10.4221	1.6534	50.2849	41.2
SH105	93.18	42.33	37.89	8.5561	1.3244	51.6197	39.8
SH106	56.21	30.07	29.93	2.9455	0.2863	10.9708	12.8
SH107	87.36	40.17	35.39	10.1706	1.5682	38.8508	38.2
SH108	52.77	27.89	20.68	2.8125	0.3742	7.8168	9
SH109	47.55	25.86	17.42	1.9399	0.2388	4.6208	6.6
SH110	48.4	25.34	20.17	2.248	0.2971	6.4228	7.6
SH111	45.25	25.83	18.56	2.2901	0.318	6.1526	6
SH112	40.92	20.66	18.21	1.7188	0.12	4.3766	6
SH113	40.51	22.26	17.65	1.2624	0.139	3.9654	4.6
SH114	39.59	20.55	15.97	1.0634	0.1274	3.607	4.2
SH115	40.43	22.39	18.17	1.7416	0.2269	5.5412	4.8
SH116	37.07	19.85	17.11	1.1179	0.0993	2.9365	4.4
SH117	41.18	21.39	17.66	1.4281	0.1578	2.584	5.1
SH118	34.42	19.77	15.49	0.8211	0.0642	2.0855	3.6
SH119	34.85	17.33	14.34	0.8119	0.0958	1.989	2.9
SH120	82.62	44.21	36.39	15.9664	2.7945	46.5898	38.2
SH121	82.73	39.85	33.31	10.9131	1.7342	34.3779	34.8
SH122	48.98	28.24	20.16	2.4652	0.3013	7.8048	9.2
SH123	44.64	25.52	20.41	1.8881	0.1874	7.0343	7.2
SH124	47.92	26.73	18.61	2.9425	0.4074	6.0793	7.2
SH125	46.5	25.71	18.91	2.1815	0.2917	5.5177	6.9
SH126	42.39	21.74	17.21	1.4718	0.1106	2.5152	5.2
SH127	43.88	23.52	18.74	2.0809	0.2795	5.9884	6.4
SH128	41.9	25.37	18.61	1.6953	0.2085	5.0023	5.6
SH129	42.23	22.01	16.35	2.2198	0.2935	3.6271	5.4
SH130	45.84	23.86	21.37	1.6259	0.1628	7.4261	8
SH131	42.17	21.2	18.79	1.9167	0.1946	4.6501	5.5
SH132	42.39	22.07	17.93	1.5559	0.1652	3.2832	5.4

Table 1.2. (continued)

Sample Number	Length (mm)	Width (mm)	Depth (mm)	Wet Weight (g)	Dry Weight (g)	Shell Weight (g)	Cavity Volume (ml)
SH133	42.29	20.87	17.46	2.3121	0.2464	4.4468	4.8
SH134	42.11	21.35	19.72	1.9037	0.1535	4.9359	5.2
SH135	42.24	20.37	17.13	1.6872	0.1194	3.6837	4.8
SH136	33.38	19.01	14.42	0.8246	0.095	2.3735	3
SH137	31.95	15.14	13.51	0.7132	0.0798	1.467	2.2
SH138	33.77	17.83	13.24	0.6512	0.0433	1.5764	2.8
SH139	37.51	19.89	17.01	1.0592	0.1072	3.3272	3.8
SH140	41.96	20.94	18.29	1.5123	0.1914	3.7832	4.4
SH141	38.19	21.35	16.47	1.1017	0.101	2.6836	4.6
SH142	37.56	20.45	21.09	1.3861	0.1079	3.9729	4.8
SH143	38.52	21.04	17.93	1.4224	0.161	3.4821	4.8
SH144	40.37	21.31	16.78	1.4205	0.1089	3.0289	4.8
MEAN	60.093	31.714	25.834	4.942	0.777	17.894	17.608
STD. DEV.	14.904	7.605	6.683	3.259	0.637	13.666	11.195

Table 2.1. Condition Index (C.I.) as calculated using wet tissue weight versus shell weight for mussels from both sites.

	Smith's Harbour			Little Bay		
Size Range (mm)	Number of Individuals	Mean C.I. (%)	Standard Error	Number of Individuals	Mean C.I. (%)	Standard Error
30-35	6	41.5	1.89	0	0	0
35-40	7	36.4	1.68	5	47.1	4.4
40-45	18	41.4	2.45	12	42.1	2.21
45-50	11	36.7	2.41	30	38.7	1.38
50-55	13	32.1	1.34	43	37.3	1.15
55-60	16	30.8	1.61	18	39.2	1.35
60-65	13	27.9	1.68	1	41.6	0
65-70	17	28.6	1.86	0	0	0
70-75	19	27.8	1.81	0	0	0
75-80	15	26.4	1.74	0	0	0
80-85	3	33.8	1.09	0	0	0
85-90	3	24.7	2.01	0	0	0
90-95	3	18.1	0.749	0	0	0

Table 2.2. Condition Index (C.I.) as calculated using dry tissue weight versus shell weight for mussels from both sites.

	Smith's Harbour			Little Bay		
Size Range (mm)	Number of Individuals	Mean C.I. (%)	Standard Error	Number of Individuals	Mean C.I. (%)	Standard Error
30-35	6	4.21	0.458	0	0	0
35-40	7	3.81	0.35	5	5.96	0.77
40-45	18	4.3	0.318	12	5.95	0.426
45-50	11	4.71	0.394	30	5.82	0.211
50-55	13	4.31	0.32	43	6.24	0.21
55-60	16	4.35	0.300	18	6.67	0.257
60-65	13	4.24	0.335	1	6.75	0
65-70	17	4.43	0.366	0	0	0
70-75	19	4.53	0.372	0	0	0
75-80	15	4.8	0.475	0	0	0
80-85	3	5.57	0.483	0	0	0
85-90	3	4.17	0.553	0	0	0
90-95	3	2.62	0.486	0	0	0

Table 3. Sex Determination of individual mussels and clams used for the oxidative stress tests.

MUSSELS				CLAMS			
LITTLE BAY		SMITH'S HR.		LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	SEX	SAMPLE I.D.	SEX	SAMPLE I.D.	SEX	SAMPLE I.D.	SEX
LBM1	M	SHM1	M	LBC1	N.D.*	SHC1	N.D.
LBM2	F	SHM2	F	LBC2	N.D.	SHC2	N.D.
LBM3	M	SHM3	F	LBC3	M	SHC3	M
LBM4	M	SHM4	M	LBC4	M	SHC4	F
LBM5	M	SHM5	F	LBC5	F	SHC5	F
LBM6	F	SHM6	F	LBC6	F	SHC6	F
LBM7	F	SHM7	F	LBC7	M	SHC7	M
LBM8	M	SHM8	F	LBC8	M	SHC8	M
LBM9	F	SHM9	F	LBC9	F	SHC9	F
LBM10	F	SHM10	F	LBC10	M	SHC10	M
LBM11	F	SHM11	M	LBC11	M	SHC11	M
LBM12	M	SHM12	F	LBC12	M	SHC12	M
LBM13	F	SHM13	F	LBC13	M	SHC13	F
LBM14	M	SHM14	F	LBC14	F	SHC14	M
LBM15	F	SHM15	F	LBC15	F	SHC15	M
LBM16	M	SHM16	F	LBC16	M	SHC16	M
LBM17	M	SHM17	M	LBC17	F	SHC17	M
LBM18	M	SHM18	M	LBC18	M	SHC18	M
LBM19	M	SHM19	M	LBC19	M	SHC19	M
LBM20	F	SHM20	F	LBC20	F	SHC20	M
		SHM21	M			SHC21	M
		SHM22	M			SHC22	M
		SHM23	M			SHC23	F
		SHM24	M			SHC24	F

N.D.*: sex not determined

Table 4.1. Level of TBARS in the hepatopancreas of mussels and clams from both sites (nmol/mg protein).

MUSSELS				CLAMS			
LITTLE BAY		SMITH'S HR.		LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	TBARS-H	SAMPLE I.D.	TBARS-H	SAMPLE I.D.	TBARS-H	SAMPLE I.D.	TBARS-H
LBM1	1.58	SHM1	2.03	LBC1	0.8	SHC1	0.15
LBM2	1.02	SHM2	2.07	LBC2	2.08	SHC2	0.18
LBM3	0.93	SHM3	2.54	LBC3	0.45	SHC3	0.08
LBM4	1.45	SHM4	2.74	LBC4	0.52	SHC4	0.44
LBM5	0.97	SHM5	0.3	LBC5	1.1	SHC5	0.38
LBM6	0	SHM6	1.58	LBC6	1.43	SHC6	0.45
LBM7	0.11	SHM7	1.24	LBC7	0.46	SHC7	0.29
LBM8	1.44	SHM8	0.81	LBC8	0.5	SHC8	0.25
LBM9	1.86	SHM9	1.02	LBC9	0.58	SHC9	0.4
LBM10	0.66	SHM10	1.45	LBC10	0.59	SHC10	0.22
LBM11	1.13	SHM11	2.12	LBC11	0.52	SHC11	0.33
LBM12	3.67	SHM12	2.63	LBC12	0.35	SHC12	0.16
LBM13	0.99	SHM13	0.55	LBC13	0.51	SHC13	0.42
LBM14	2.55	SHM14	0.81	LBC14	0.47	SHC14	0.27
LBM15	0.63	SHM15	0.48	LBC15	0.54	SHC15	0.31
LBM16	1.1	SHM16	0.48	LBC16	0.7	SHC16	0.34
LBM17	1.72	SHM17	0.45	LBC17	0.99	SHC17	0.2
LBM18	0.94	SHM18	0.37	LBC18	0	SHC18	0.21
LBM19	0.11	SHM19	0.82	LBC19	0.35	SHC19	0.2
LBM20	1.63	SHM20	1.09	LBC20	0.58	SHC20	0.1
		SHM21	0.54			SHC21	0.08
		SHM22	0.79			SHC22	0.08
		SHM23	0.76			SHC23	0.05
		SHM24	1.89			SHC24	0.11
MEAN	1.224	MEAN	1.232	MEAN	0.676	MEAN	0.237
STD. DEV.	0.852	STD. DEV.	0.780	STD. DEV.	0.447	STD. DEV.	0.125

Table 4.2. Level of TBARS in the gills of mussels and clams from both sites (nmol/mg protein).

MUSSELS				CLAMS			
LITTLE BAY		SMITH'S HR.		LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	TBARS-G	SAMPLE I.D.	TBARS-G	SAMPLE I.D.	TBARS-G	SAMPLE I.D.	TBARS-G
LBM1	2.68	SHM1	2.82	LBC1	0.34	SHC1	0.14
LBM2	1.74	SHM2	4.44	LBC2	0.74	SHC2	0.2
LBM3	0.3	SHM3	2.53	LBC3	0.25	SHC3	0.07
LBM4	4.78	SHM4	1.97	LBC4	0.64	SHC4	0.08
LBM5	1.17	SHM5	3.13	LBC5	0.31	SHC5	0.14
LBM6	0	SHM6	3.35	LBC6	0.55	SHC6	0.22
LBM7	1.33	SHM7	3.17	LBC7	0.29	SHC7	0.06
LBM8	3.09	SHM8	1.33	LBC8	0.35	SHC8	0.14
LBM9	1.3	SHM9	2.81	LBC9	1.64	SHC9	0.06
LBM10	1.58	SHM10	3.33	LBC10	0.42	SHC10	0.03
LBM11	1.33	SHM11	1.55	LBC11	0.26	SHC11	0.13
LBM12	1.57	SHM12	2.4	LBC12	0.53	SHC12	0.08
LBM13	1.81	SHM13	1.77	LBC13	2.84	SHC13	0.1
LBM14	1.6	SHM14	1.16	LBC14	0.33	SHC14	0.05
LBM15	2.12	SHM15	1.66	LBC15	0.52	SHC15	0.15
LBM16	0.86	SHM16	0.88	LBC16	0.18	SHC16	0.16
LBM17	2.16	SHM17	1.56	LBC17	0	SHC17	0.06
LBM18	0	SHM18	2.93	LBC18	0	SHC18	0.15
LBM19	3.09	SHM19	2.53	LBC19	0	SHC19	0
LBM20	2.91	SHM20	1.13	LBC20	0	SHC20	0.13
		SHM21	1.7			SHC21	0.11
		SHM22	2.17			SHC22	0.2
		SHM23	0.88			SHC23	0.3
		SHM24	3.9			SHC24	0.1
MEAN	1.771	MEAN	2.296	MEAN	0.509	MEAN	0.119
STD. DEV.	1.153	STD. DEV.	0.972	STD. DEV.	0.659	STD. DEV.	0.0675

Table 5.1. Level of cytochrome-c reductase in the hepatopancreas of mussels and clams from both sites (nmol/min/mg protein).

MUSSELS				CLAMS			
LITTLE BAY		SMITH'S HR.		LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	CR-H	SAMPLE I.D.	CR-H	SAMPLE I.D.	CR-H	SAMPLE I.D.	CR-H
LBM1	0.4	SHM1	2.67	LBC1	2.41	SHC1	8.37
LBM2	0.62	SHM2	2.73	LBC2	0.95	SHC2	10.32
LBM3	0.92	SHM3	4.67	LBC3	2.86	SHC3	7.76
LBM4	0.75	SHM4	3.61	LBC4	2.15	SHC4	8.16
LBM5	0.62	SHM5	4.59	LBC5	4.47	SHC5	7.98
LBM6	1.67	SHM6	3.15	LBC6	3.3	SHC6	11.37
LBM7	1.49	SHM7	2.69	LBC7	1.93	SHC7	10.48
LBM8	1.17	SHM8	8.81	LBC8	3.4	SHC8	9.8
LBM9	0	SHM9	7.92	LBC9	5.03	SHC9	10.99
LBM10	1	SHM10	4.99	LBC10	4.17	SHC10	8.44
LBM11	2.58	SHM11	2.52	LBC11	4.32	SHC11	12.64
LBM12	1.2	SHM12	3.27	LBC12	0	SHC12	7.47
LBM13	0.79	SHM13	2.95	LBC13	2.31	SHC13	14.34
LBM14	0.56	SHM14	2.09	LBC14	1.58	SHC14	12.52
LBM15	0.8	SHM15	3.28	LBC15	3.77	SHC15	13.76
LBM16	0	SHM16	4.32	LBC16	4.37	SHC16	10.82
LBM17	3.01	SHM17	5.36	LBC17	7.63	SHC17	8.6
LBM18	4.66	SHM18	5.6	LBC18	8.38	SHC18	13.03
LBM19	1.23	SHM19	2.03	LBC19	2.97	SHC19	9.17
LBM20	2.06	SHM20	5.37	LBC20	1.46	SHC20	8.19
		SHM21	7.55			SHC21	9.66
		SHM22	4.51			SHC22	10.73
		SHM23	3.69			SHC23	9.51
		SHM24	3.51			SHC24	12.85
MEAN	1.277	MEAN	4.245	MEAN	3.373	MEAN	10.290
STD. DEV.	1.108	STD. DEV.	1.821	STD. DEV.	2.052	STD. DEV.	2.046

Table 5.2. Level of cytochrome-c reductase in the gills of mussels and clams from both sites (nmol/min/mg protein).

MUSSELS				CLAMS			
LITTLE BAY		SMITH'S HR.		LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	CR-G	SAMPLE I.D.	CR-G	SAMPLE I.D.	CR-G	SAMPLE I.D.	CR-G
LBM1	0.9	SHM1	1.29	LBC1	11.9	SHC1	2.88
LBM2	2.3	SHM2	2.1	LBC2	5.58	SHC2	6.23
LBM3	4.11	SHM3	2.46	LBC3	5.11	SHC3	4.85
LBM4	0.82	SHM4	5	LBC4	5.34	SHC4	2.06
LBM5	0.92	SHM5	3.15	LBC5	4	SHC5	2.3
LBM6	0.82	SHM6	2.38	LBC6	6.38	SHC6	3.16
LBM7	1.48	SHM7	0	LBC7	4.78	SHC7	10.82
LBM8	2.28	SHM8	1.72	LBC8	3.64	SHC8	6.85
LBM9	3.25	SHM9	4.93	LBC9	4.54	SHC9	1.8
LBM10	1.46	SHM10	1.78	LBC10	5.71	SHC10	1.84
LBM11	1.83	SHM11	2.38	LBC11	6.64	SHC11	1.64
LBM12	1.44	SHM12	1.94	LBC12	14.03	SHC12	3.34
LBM13	2.08	SHM13	2.02	LBC13	7.58	SHC13	2.71
LBM14	3	SHM14	4.49	LBC14	8.45	SHC14	3.13
LBM15	0.79	SHM15	6.51	LBC15	6.36	SHC15	1.93
LBM16	1.01	SHM16	5.67	LBC16	3.58	SHC16	1.49
LBM17	0.98	SHM17	4.6	LBC17	7.05	SHC17	2.92
LBM18	0	SHM18	4.02	LBC18	6.27	SHC18	2.76
LBM19	0.73	SHM19	3	LBC19	5.97	SHC19	5.29
LBM20	0.99	SHM20	4.33	LBC20	7.49	SHC20	2.92
		SHM21	4.88			SHC21	8.66
		SHM22	2.4			SHC22	11.17
		SHM23	3.97			SHC23	11.16
		SHM24	3.6			SHC24	11.32
MEAN	1.560	MEAN	3.276	MEAN	6.520	MEAN	4.718
STD. DEV.	1.013	STD. DEV.	1.576	STD. DEV.	2.585	STD. DEV.	3.417

Table 6.1. Level of catalase in the hepatopancreas of mussels and clams from both sites (µmol/min/mg protein).

MUSSELS				CLAMS			
LITTLE BAY		SMITH'S HR.		LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	CAT-H	SAMPLE I.D.	CAT-H	SAMPLE I.D.	CAT-H	SAMPLE I.D.	CAT-H
LBM1	45.2	SHM1	20.43	LBC1	32.14	SHC1	37.74
LBM2	38.66	SHM2	32.98	LBC2	37.95	SHC2	32.52
LBM3	38.46	SHM3	18.3	LBC3	35.96	SHC3	53.07
LBM4	26.07	SHM4	28.81	LBC4	36.82	SHC4	35.98
LBM5	35.02	SHM5	29.8	LBC5	33.06	SHC5	49.59
LBM6	30.44	SHM6	26.28	LBC6	25.22	SHC6	34.75
LBM7	51.37	SHM7	20.12	LBC7	23.44	SHC7	56.83
LBM8	41.93	SHM8	33.7	LBC8	38.33	SHC8	49.54
LBM9	17.35	SHM9	28.51	LBC9	30.63	SHC9	40.54
LBM10	37.6	SHM10	32.5	LBC10	47.01	SHC10	55.59
LBM11	26.66	SHM11	28.26	LBC11	48.89	SHC11	71.39
LBM12	33.5	SHM12	24.88	LBC12	9.76	SHC12	30.09
LBM13	28.96	SHM13	16.4	LBC13	32.46	SHC13	46.84
LBM14	34.16	SHM14	38.34	LBC14	40.68	SHC14	50.82
LBM15	13.34	SHM15	38.47	LBC15	34.11	SHC15	46.83
LBM16	50.55	SHM16	17.38	LBC16	32.68	SHC16	28.21
LBM17	29.8	SHM17	32.73	LBC17	43.87	SHC17	44.78
LBM18	131	SHM18	25.09	LBC18	37.68	SHC18	69.76
LBM19	41.03	SHM19	17.31	LBC19	22.51	SHC19	25.27
LBM20	17.59	SHM20	25.08	LBC20	18.72	SHC20	29.21
		SHM21	14.94			SHC21	52.78
		SHM22	40.07			SHC22	25.26
		SHM23	25.21			SHC23	26.53
		SHM24	24.57			SHC24	65.91
MEAN	38.435	MEAN	26.673	MEAN	33.096	MEAN	44.160
STD. DEV.	24.095	STD. DEV.	7.280	STD. DEV.	9.564	STD. DEV.	13.954

Table 6.2. Level of catalase in the gills of clams from both sites (µmol/min/mg protein).

CLAMS			
LITTLE BAY		SMITH'S HR.	
SAMPLE I.D.	CAT-G	SAMPLE I.D.	CAT-G
LBC1	5.63	SHC1	7.63
LBC2	13.87	SHC2	4.68
LBC3	4.02	SHC3	11.07
LBC4	16.14	SHC4	3.89
LBC5	11.13	SHC5	9.35
LBC6	38.8	SHC6	14.38
LBC7	11.81	SHC7	13.9
LBC8	8.75	SHC8	9.09
LBC9	25.71	SHC9	17.95
LBC10	7.75	SHC10	26.16
LBC11	10.08	SHC11	15.33
LBC12	23.1	SHC12	12.22
LBC13	15.79	SHC13	10.01
LBC14	23.82	SHC14	12.71
LBC15	22.7	SHC15	13.34
LBC16	23.87	SHC16	22.81
LBC17	11.76	SHC17	10.29
LBC18	17.63	SHC18	16.09
LBC19	15.46	SHC19	38.33
LBC20	17.83	SHC20	2.94
		SHC21	15.9
		SHC22	16.85
		SHC23	15.36
		SHC24	6.07
MEAN	16.282	MEAN	13.598
STD. DEV.	8.296	STD. DEV.	7.670

Note: Catalase levels in the gills of mussels from both sites were too low to be determined.