POLLUTANT LEVELS IN BIVALVES

A DATA BIBLIOGRAPHY

Compiled by Gayle M. Kidder
Scripps Institution of Oceanography
under the Mussel Watch Program, 1977
(EPA Contract No. R-80421501)

INTRODUCTION

This volume attempts to present a compendium of the data presently available on levels of four major pollutants in bivalves, to provide baseline data for present and future studies. It was compiled at Scripps Institution of Oceanography under the Mussel Watch Program sponsored by the U.S. Environmental Protection Agency (EPA Contract No. R-80421501).

The four major categories of pollutants investigated are metals, pesticides and halogenated hydrocarbons, radionuclides, and petroleum hydrocarbons. Entries herein are divided according to pollutant category, with a special section for papers dealing with analyses of two or more categories. Entries are arranged alphabetically by author in each section.

Analytical data presented has been confined primarily to that concerning the class Pelecypoda (= Lamellibranchia, = Bivalvia), even though many other organisms may have been included in particular papers. Biological species names are those used by the individual authors, and no attempt has been made to standardize the taxonomy. Our systematic sources in deciding which organisms to include have been Vokes (1967) and Keen and Coan (1974), and we would recommend reference to these for taxonomic difficulties.

As far as possible we have tried to present all research data relevant to a comparison of results from different laboratories, using different techniques, and often for different purposes. When discernible we have included a note as to whether the quantities expressed are on a wet or dry weight basis, and if dry, at what temperature the specimens were dried, so that allowances can be made for these variables.

A library of the literature is being maintained at Scripps Institution of Oceanography. The material will hopefully be computerized in the near future to provide even readier access to the data. We hope that this compilation will help solve some of the great problems encountered in garnishing of relevant information in the proliferation of scientific publications today, at least in this one small area.

Gayle M. Kidder, editor
Scripps Institution of Oceanography
La Jolla, California USA

October 1977

Vokes, H. E. 1967. Genera of the Bivalvia: A systematic and bibliographic catalogue. Bulls. Amer. Paleont., vol. 51, no. 232:101-394.

Keen, M. K. & E. Coan. 1974. Marine Molluscan Genera of Western North America: An Illustrated Key, 2nd ed., 208p. Stanford Univ. Press, California.

METALS

REF. NO.: 76 - A - 1

SUBSTANCES: Ag, Zn, Pb, Cu, Cr, Ni

Reference: Alexander, G. V. & D. R. Young. 1976. Trace metals in Southern California mussels. Mar. Pollut. Bull. 7:7-9.

Organisms: Mytilus californianus

Date of Sample Collection: 1971

Location:
Southern California

Analytical Technique:
Optical emission spectrometry

Analytical Data: (dry wt, freeze-dried)

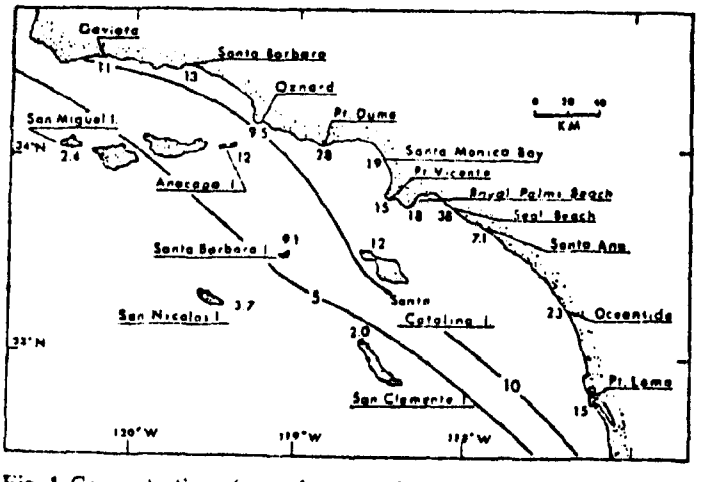


Fig. 1 Concentrations (ppm dry wt) of lead in digestive gland tissue of *Mytilus californianus*, 1971.

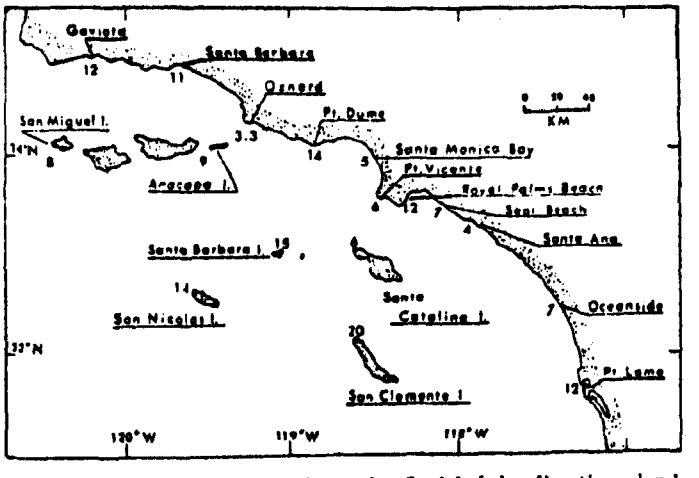


Fig. 6 Concentrations (ppm dry wt) of nickel in digestive gland tissue of *Mytilus californianus*, 1971.

Alexander, G. V. & D. R. Young. 1976.

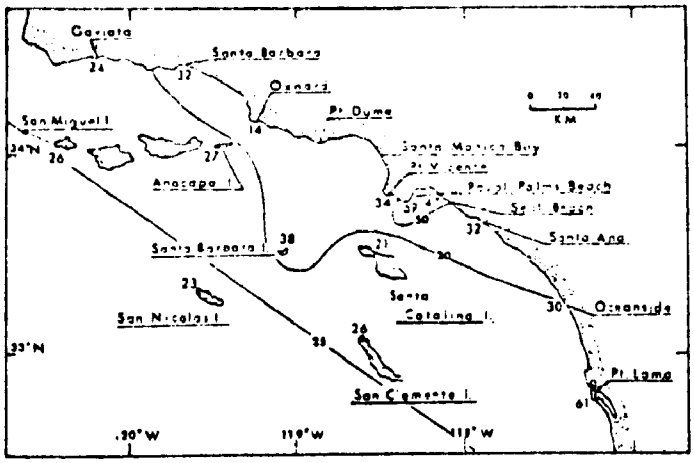


Fig. 2 Concentrations (ppm dry wt) of copper in digestive gland tissue of *Mytilus californianus*, 1971.

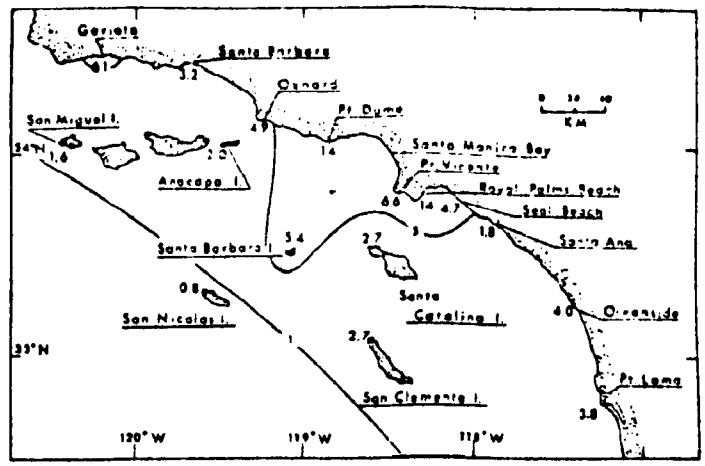


Fig. 3 Concentrations (ppm dry wt) of chromium in digestive gland tissue of *Mytilus californianus*, 1971.

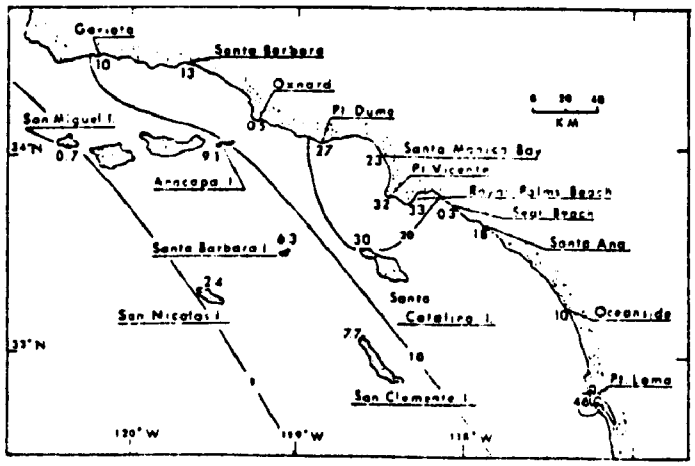


Fig. 4 Concentrations (ppm dry wt) of silver in digestive gland tissue of *Mytilus californianus*, 1971.

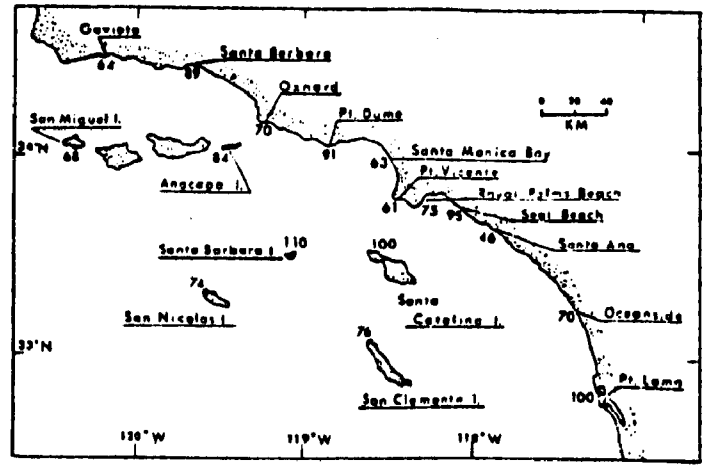


Fig. 5 Concentrations (ppm dry wt) of zinc in digestive gland tissue of *Mytilus californianus*, 1971.

REF. NO.: 73 - A - 1

SUBSTANCES: Hg, Cu, Zn, Cd, Pb

Reference: Andersen, A. T. 1973. Tungmetaller og andre forurensninger i Oslofjorden og kystfarvann - innvirkning av disse pa marine organismer. Vann (Norsk Foren. Vass. vann. Oslo) 8:84-88.

Organisms: Mytilus edulis

Date of Sample Collection: 1973?

Location: Oslofjord

Analytical Technique:

Analytical Data:

Tabell 1. Tungmetallinnholdet (angitt i µg/g våtvekt) i noen marine organismer fanget i Nordsjøen.

Land	Hg	Cu	Zn	Pb	Cd	
Frankrike	0.03	1.1	10.2	0.4	0.05	
England	0.04	1.2	15.0	1.1	0.10	
Skottland	0.02	1.0	7.2	0.5	0.03	*Sild*
Sverige	0.04	0.9	5.0	4.5	0.60	
Norge	0.05	2.5	9.3	0.9	0.11	
Frankrike	0.07	1.1	2.6	0.5	0.08	
England	0.18	0.3	4.0	0.5	0.13	
Skottland	0.08	0.3	3.4	0.2	0.03	*Torsk*
Sverige	0.08	0.4	3.4	2.6	0.40	
Norge	0.20	1.0	4.0	0.2	0.05	
Frankrike	0.12	3.6	5.8	0.7	0.10	
England	0.10	0.5	5.5	0.5	0.50	
Skottland	0.08	0.4	4.0	0.2	0.10	*Rødspette*
Sverige	0.05	0.5	4.3	1.6	0.50	
Norge	0.07	1.5	3.2	1.0	0.10	
Nederland	0.09	12.5	25.0	5.0		
Frankrike	0.05	12.4	21.1	3.4	0.50	*Strandreke*
England		22.0	35.0	4.5	0.70	
Norge	0.08	18.8	16.1	0.9	0.10	
Nederland	0.60	4.4	23.5			
Frankrike	0.05	6.0	15.0	1.5	0.30	
England		4.0	40.0	3.5	0.30	*Blåskjell*
Skottland		1.5	20.0	1.5	0.20	
Norge	0.12	3.8	23.9	4.3	0.40	

Andersen, A. T. 1973.

Tabell 2. Konsentrasjoner av Hg, Cu, Zn, Cd og Pb i blåskjell, Mytilus edulis fra forskjellige lokaliteter i Oslofjorden.

Lokalitet	Lengde mm	Konsentrasjon i µg/g tørrvekt Hg	Cu	Zn	Cd	Pb
Bekkensten	63.4	0.08	8.0	140	2.4	8.8
Hellvik	61.8	0.22	7.6	120	2.4	2.8
Langøya	65.1	0.26	11.2	140	3.6	1.2
Nakkholmen	66.5		8.8	160	3.2	15.8
Gjeltholmen	62.0	0.24	12.0	208	3.6	6.8
Torvøya	66.0	0.24	11.5	175	2.0	7.9
Steilene	64.0	0.24	7.2	100	3.6	6.0
Spro	64.6	0.26	6.4	140	2.4	4.0
Nordliløkka	63.8	0.20	8.0	160	3.2	4.8
Storskjær	61.4	0.44	8.8	80	3.6	7.6
Mølen	66.7	0.24	7.0	155	2.1	9.2
Rauer	65.9	0.34	5.3	100	2.1	0.5
O-skjell:		0.66	72.0	1680	15.6	32.4

Tabell 3. Konsentrasjoner av Cu, Zn, Cd og Pb i vev av blåskjell.

Vev	Konsentrasjon i µg/g tørrvekt Cu	Zn	Cd	Pb
Fot	4.4	60	1.2	8.8
Gjeller	14.8	200	3.6	12.0
Kappe	9.6	88	2.0	6.8
Lukkemuskel	2.8	140	1.6	4.0
Leppe	8.0	68	3.6	6.0
Innvoller	12.8	292	7.2	8.8
Total dyr	12.0	220	4.4	7.6

REF. NO.: 74 - A - 1 **SUBSTANCES:** Hg

Reference: Andersen, A. T. & B. B. Neelakantan. 1974. Mercury in some marine organisms from the Oslofjord. Norwegian J. Zool. 22:231-235.

Organisms:
Mytilus edulis
Cardium edule
Mya arenaria
Modiolus modiolus

Date of Sample Collection: 1972

Location: Oslofjord, Norway

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt.)

Table I. The concentration of mercury in some marine organisms collected from the Oslofjord

Species	Sampling locality	No. of animals in the analysed samples	Size (group) in mm	% water content	Concentration of mercury in µg/g dry weight
Molluscans					
Cardium edule	Drøbak	10	34.9	80.7	0.40
Cyprina icelandica	Drøbak	10	103.0	82.8	0.55
Mya arenaria	Drøbak	10	76.9	81.7	0.29
Mytilus edulis	Drøbak	10	61.5	83.7	0.30
Modiolus modiolus	Drøbak	10	130.0	86.4	0.84

Table II. The concentration of mercury in different tissues of the common mussel, *Mytilus edulis*, from Drøbak. The values are based on pooled samples of tissues from 20 individuals

Tissue	% water content	Concentration of Hg in µg/g dry weight
Gills	89.4	0.54
Mantle	87.1	0.12
Adductor muscle	76.4	0.12
Visceral mass	79.2	0.35
Total soft parts	84.0	0.27

Table III. Concentration of mercury in *Mytilus edulis* from different localities in the Oslofjord. 10 individuals of *M. edulis* were pooled together to give one sample

Place of collection	Average length (mm)	% water content	Concentration of mercury in µg/g dry material
Bekkenstein	63.4	85.0	0.08
Hellvik	61.6	82.4	0.22
Nakkholmen	66.5	77.7	0.16
Geitholmen	62.0	80.8	0.14
Borøya	63.3	81.0	0.24
Steilene	64.0	84.1	0.14
Spro	64.6	80.0	0.33
Langåra	65.1	77.8	0.31
Nordilokka	63.8	83.0	0.20
Storskjær	61.4	85.8	0.57
Drøbak	61.5	83.7	0.30
Molen	66.7	80.6	0.20
Rauøy	65.9	80.3	0.55
Average			0.26

LIBRARY
Environmental Protection Agency
Environmental Research Lab.
W 35th Street
Corvallis Oregon 97330

REF. NO.: 75 - A - 2 **SUBSTANCES:** Hg

Reference: Aubert, M. 1975. Le problème du mercure en Méditerranée. Rev. Intern. Océanogr. Méd. 37-38:215-231.

Organisms: Mussel sp. (unspecified)

Date of Sample Collection: 1969

Location: French Mediterranean coast

Analytical Technique:

Analytical Data: 2.58 ppm

REF. NO.: 74 - A - 2

SUBSTANCES: Cd, Cu, Zn, Pb, Cr

Reference: Ayling, G. M. 1974. Uptake of cadmium, zinc, copper, lead and chromium in the Pacific oyster, Crassostrea gigas, grown in the Tamar River, Tasmania. Water Res. 8:729-738.

Organisms: Crassostrea gigas

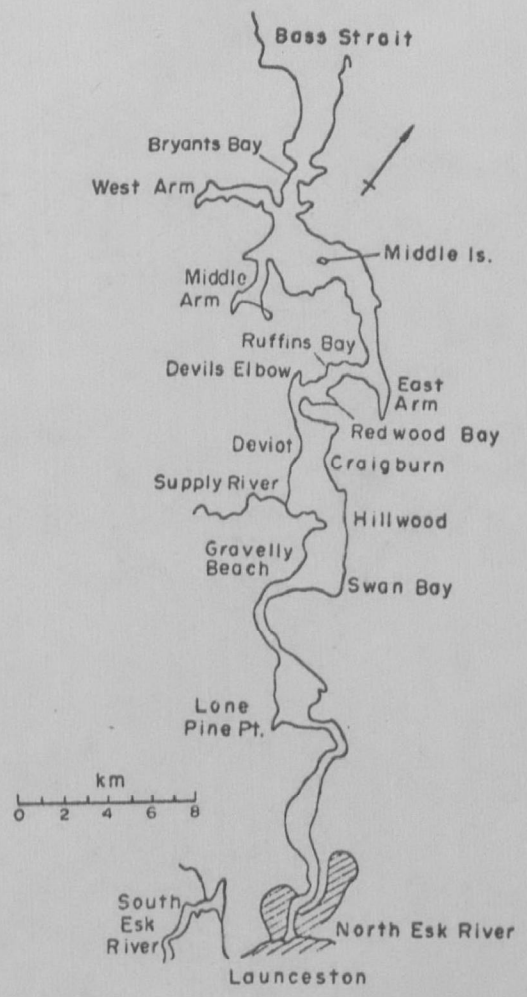
Date of Sample Collection: 1973

Location: Tamar River, Tasmania

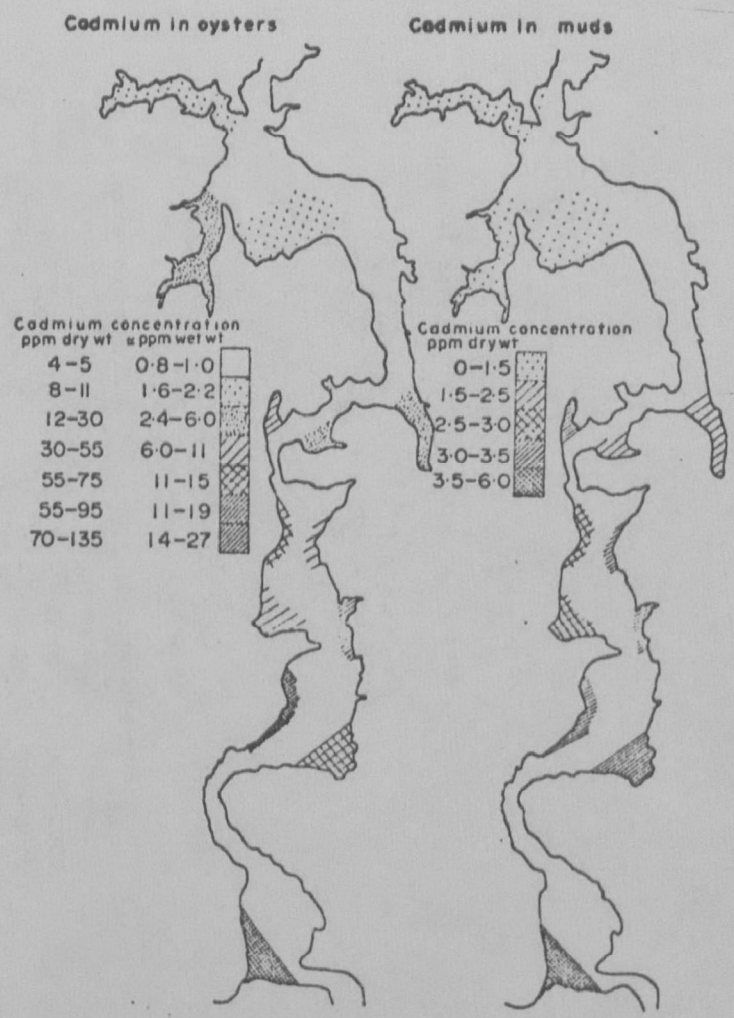
Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

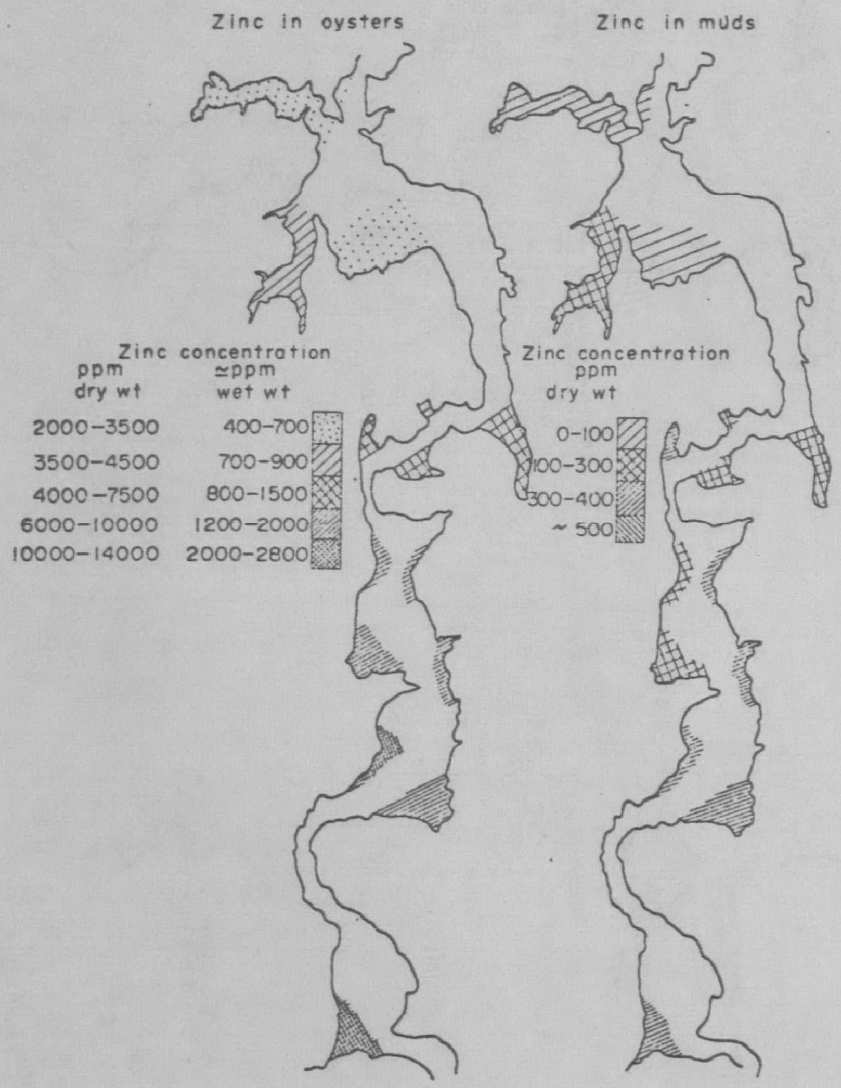
(dry wt., dried at 105°C)



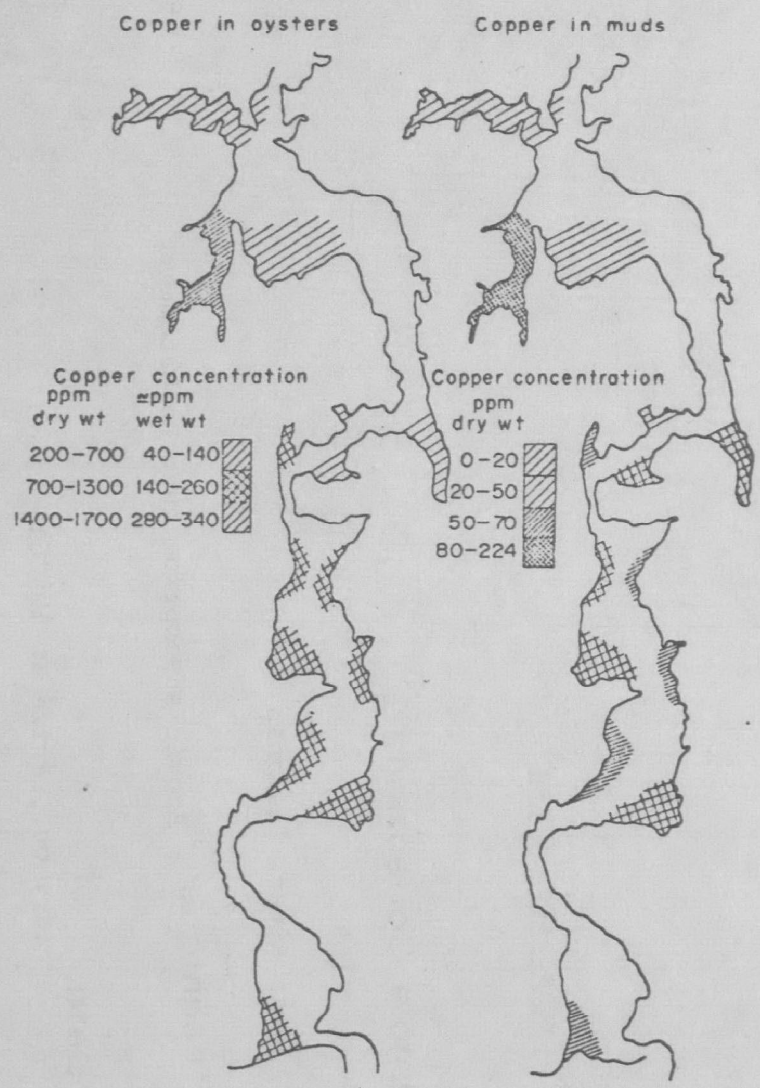
Map 2. The 15 oyster bed sites studied along the Tamar River.



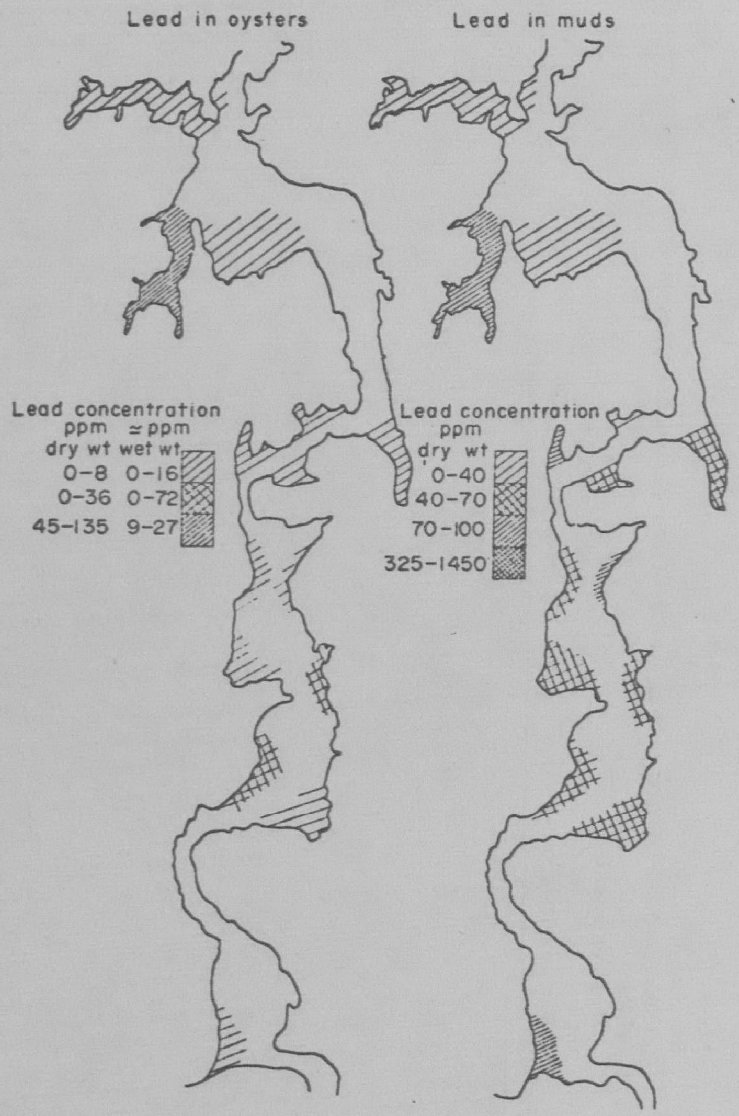
Map 3.


Zinc in oysters
Zinc in muds
Zinc concentration
ppm dry wt
≈ppm wet wt
2000–3500 400–700
3500–4500 700–900
4000–7500 800–1500
6000–10000 1200–2000
10000–14000 2000–2800
Zinc concentration
ppm dry wt
0–100
100–300
300–400
~ 500

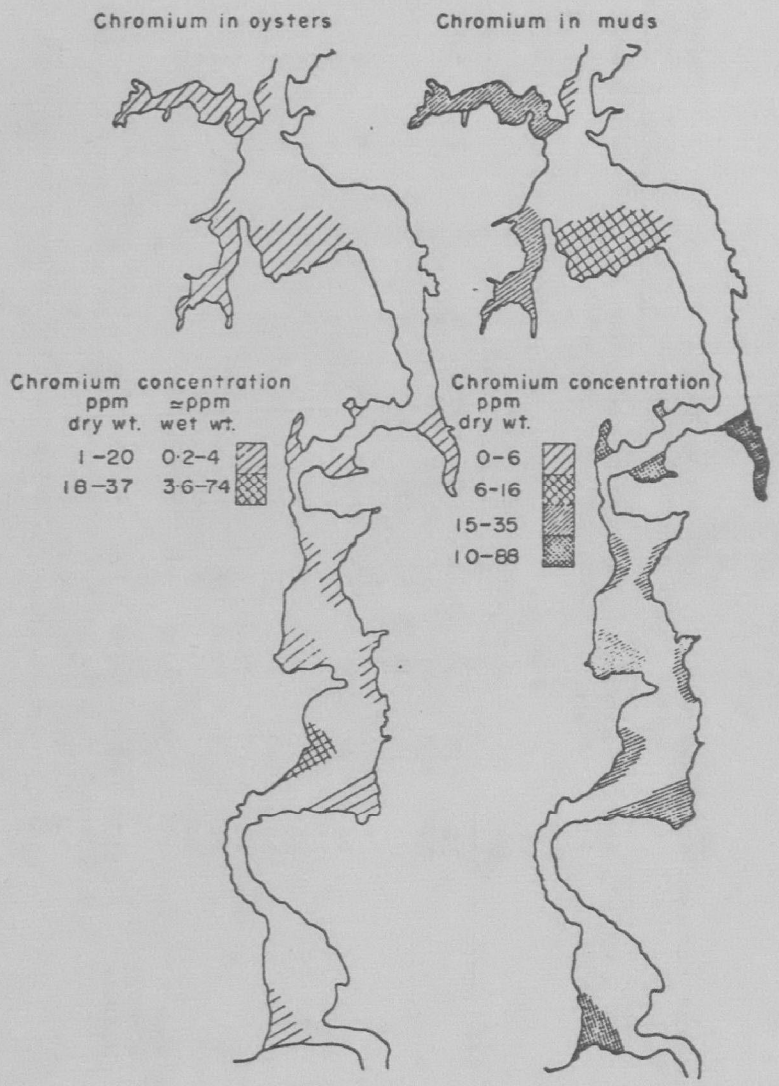
Map 4.


Copper in oysters
Copper in muds
Copper concentration
ppm dry wt
≈ppm wet wt
200–700 40–140
700–1300 140–260
1400–1700 280–340
Copper concentration
ppm dry wt
0–20
20–50
50–70
80–224

Map 5.


Lead in oysters
Lead in muds
Lead concentration
ppm ≃ ppm
dry wt wet wt
0–8 0–16
0–36 0–72
45–135 9–27
Lead concentration
ppm
dry wt
0–40
40–70
70–100
325–1450

Map 6.


Chromium in oysters
Chromium in muds
Chromium concentration
ppm ≃ ppm
dry wt. wet wt.
1–20 0·2–4
18–37 3·6–74
Chromium concentration
ppm
dry wt.
0–6
6–16
15–35
10–88

Map 7.

Ayling, G. M. 1974.

Table 1. Variations in concentrations of heavy metals in oysters and muds at a single site, with a comparison of variations attributable to the analytical method

(a) Means and standard deviations for 11 individual oysters (Feb. collection; > 5-yr-old) from Devils Elbow
Metal concentrations ppm [wet wt basis (w), dry wt basis (d)]

	Dry wt (g)	Wet wt (g)	Cadmium d	Cadmium w	Copper d	Copper w	Lead d	Lead w	Chromium d	Chromium w	Zinc d	Zinc w
	2·8	13·3	27	5	519	91	0	0	9	2	7100	1300
	2·7	14·0	45	8	1527	269	0	0	14	2	14,700	2600
	0·4	2·4	33	6	594	105	0	0	36	6	4100	700
	3·4	15·3	33	6	1469	259	4	1	10	2	11,900	2100
	2·4	10·7	24	4	493	87	0	0	9	2	3200	600
	1·3	10·2	22	4	372	65	2	0	10	2	2200	400
	3·0	13·8	26	5	436	77	0	0	10	2	5700	1000
	2·9	19·2	41	7	335	59	3	1	9	2	4900	900
	4·8	31·8	39	7	824	145	0	0	11	2	10,300	1800
	3·4	24·6	40	7	426	75	0	0	10	2	5000	900
	5·4	31·7	35	6	613	108	0	0	9	2	10,400	1800
Mean:	2·95	17·00	33·18	5·91	691·6	121·8	0·82	0·18	12·45	2·36	7227	1282
Standard deviation:	±1·39	±9·12	±7·64	±1·30	±420·7	±74·2	±1·47	±0·40	±7·94	±1·20	±4010	±670
(b) Separate analysis of a further 12 pooled oysters from the same collection as (a) (averages)												
	2·42	17·33	33	6	833	147	1	0	11	2	8400	1500
(c) Means and standard deviations for 5 mud samples from the same collection as (a)												
			3·4		53		91		81		373	
			4·0		70		93		88		351	
			3·5		73		91		91		364	
			3·5		69		86		93		372	
			3·6		66		90		86		380	
Mean:			3·60		66·2		90·2		87·8		368·0	
Standard deviation			±0·23		±7·8		±2·6		±4·7		±11·1	
(d) Means and standard deviations for analyses of each of 2 pooled oyster samples containing different levels of heavy metals												
(i) Mean:			9·00	2·00	634·2	152·8	3·17	0·83	8·67	2·17	1950	483
Standard deviation:			±0·63	±0·00	±26·8	±6·5	±1·72	±0·41	±0·82	±0·41	±138	±40·8
(ii)			19·50	4·83	1930	459·2	93·83	22·50	9·67	2·17	5517	1300
Standard deviation:			±0·55	±0·41	±98·9	±23·4	±4·75	±1·05	±0·82	±0·41	±240	±63·3

REF. NO.: 72 - B - 2

SUBSTANCES: Hg, Zn, Cu, Cd

Reference: Bender, M. E., R. J. Huggett & H. D. Slone. 1972. Heavy metals -- an inventory of existing conditions. J. Wash. Acad. Sci. 62:144-153.

Organisms: oysters (unspecified)

Date of Sample Collection: 1970-71

Location: Virginia (rivers)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

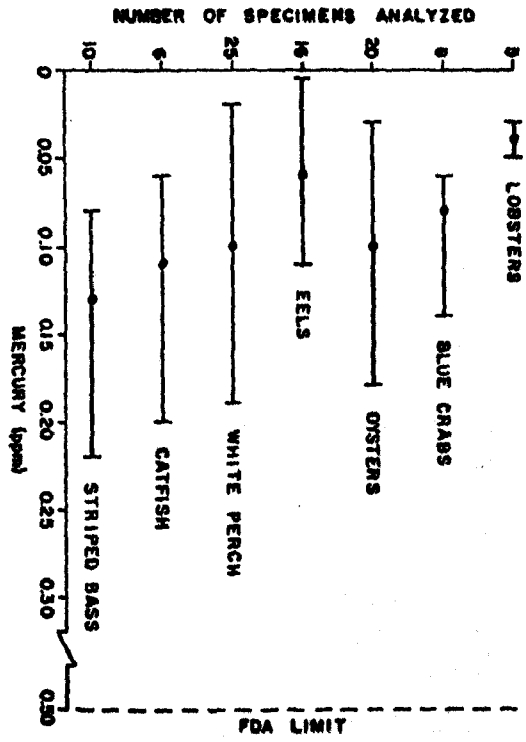


Fig. 3.—Mercury levels in selected animals.

REF. NO.: 72 - B - 1

SUBSTANCES: Fe, Co, Sb, Zn, Sc, Se, Ag, Cr, Hg

Reference: Bertine, K. K. & E. D. Goldberg. 1972. Trace elements in clams, mussels, and shrimp. Limnol. Oceanogr. 17:877-884.

Organisms:

Ensis ensis	*Mytilus edulis*
Ensis arcuatus	*Mytilus afer*
Ensis siligua	*Mytilus galloprovincialis*
Ensis vagsina	

Date of Sample Collection: Museum and recent specimens from 1896 to 1971

Location: Atlantic and Mediterranean, Europe

Analytical Technique: Neutron activation

Analytical Data:

Bertine, K. K. & E. D. Goldberg. 1972.

TABLE 1. *Trace element concentrations in clam shells (values in ppm). All shells were aragonitic. Anomalous values are in parentheses. Unless indicated all organisms were taken from the Belgian coast*

Location and Year	Fe	Co	Sb	Zn	Sc	Se	Ag	Cr	Hg
				ENSIS ENSIS					
Britain 1909	7.5	0.028	0.014	0.27	0.003	0.03		0.04	0.04
Atlantic 1922	11	0.105	0.004	0.66	0.002	0.04	0.011	0.05	0.42
				ENSIS ARCUATUS					
1896	100	0.029	0.042	1.56	0.004	0.060	0.023	0.18	0.26
1909	58	0.064	0.030	2.25	0.007	0.034	0.010	0.15	0.38
1922	74	0.027	0.040	1.34	0.008	0.054	0.016	0.23	0.16
1927	26	0.018	0.052	1.67	0.005	0.039	0.028	0.11	0.16
1936	183	0.041	0.011	0.90	0.004	0.035	0.015	0.088	0.014
1939	15	0.034	0.011	0.84	0.004	0.094	0.010	0.084	0.020
1947	50	0.036	0.017	2.10	0.004	0.087	0.029	0.12	0.063
1949	66	0.034	(1.96)	1.61	0.005	0.091	0.045	0.14	0.028
1950	25	0.034	0.054	1.67	0.005	0.104	(0.402)	0.14	0.070
1964	37	0.066	0.026	1.17	0.006	0.047	0.029	0.15	0.14
1967a	108	0.028	0.015	0.88	0.006	0.042	0.014	0.17	0.055
1967b	87	0.022	0.022	0.70	0.005	0.063	0.015	0.15	0.029
1967c	45	0.023	0.022	1.28	0.006	0.076	0.023	0.19	0.064
1967d	48	0.034	0.037	1.64	0.006	0.049	0.021	0.12	0.029
1971	42	0.025	0.012	1.49	0.005	0.031	0.025	0.092	0.15
Average	66	0.034	0.028	1.40	0.005	0.060	0.022	0.14	0.11
				ENSIS SILICUA					
1927	60	0.019	0.018	0.94	0.003	0.019	0.020	0.13	0.069
1949	80	0.022	0.011	0.35	0.003	0.047	0.020	0.13	0.012
1950	105	0.024	0.009	(2.33)	0.004	0.039	0.018	0.15	(10.6)
1963	18	0.022	0.013	0.47	0.005	0.034	0.016	0.078	0.11
1964	158	0.029	0.018	0.86	0.002	0.062	0.023	0.11	0.37
1967a	53	0.034	0.008	0.98	0.014	0.026	0.016	0.21	0.21
1967b	36	0.023	0.010	0.49	0.004	0.033	0.009	0.08	0.035
1967c	38	0.056	0.012	0.68	0.006	0.023	0.006	0.078	n.d.
1967d	183	0.079	0.018	0.82	0.005	0.023	0.013	0.13	0.025
1971	50	0.020	0.007	0.55	0.004	0.036	0.020	0.077	0.02
1909 (Monaco)	43	0.056	0.028	0.80	0.016	0.030	0.022	0.26	0.13
Average	75	0.035	0.014	0.84	0.008	0.033	0.017	0.13	0.10
				ENSIS VAGSINA					
1912 (Mediterranean)	87	0.096	0.015	0.79	0.002	0.03	0.029	0.09	0.39

Bertine, K. K. & E. D. Goldberg. 1972.

TABLE 2. *Trace element concentrations in mussels (values in ppm). Unless otherwise indicated the materials were preserved in a dry state. Numbers in parentheses were not included in average*

Location and Year	Fe	Co	Sb	Zn	Sc	Se	Ag	Cr	Hg	% Aragonite
					MYTILUS EDULIS SHELL					
1971 Liverpool	12	0.046	0.004	(39)	n.d.	0.14	0.011	0.10	0.16	33
1915 Adriatic	10	0.031	0.051	0.28	0.005	n.d.	0.016	0.09	0.04	12
1909 Britain	20	0.045	0.027	0.85	0.004	0.06	0.020	0.12	0.07	29, 29
1968 Bizerte	8.6	0.090	0.008	0.84	0.013	0.10	0.006	0.11	0.03	21, 25
1870 Belgium	49	0.041	0.033	1.51	0.004	0.06	0.071	0.21	2.28	32
1897 Belgium	35	0.066	0.064	1.99	0.010	0.04	0.070	0.17	0.61	30
1908 Belgium	13	0.016	0.015	1.49	0.002	0.05	0.005	0.57	0.16	
1971a	8.7	0.023		1.6	0.003	0.043	0.005	0.06	0.38	32
1971b	10.1	0.030	0.007	0.35	0.003	0.044	0.003	0.05	0.24	22
1971c	10.7	0.039	0.005	0.52	0.005	0.054	0.004	0.09	0.36	31
1971d	6.6	0.033	0.008	0.78	0.011	0.044	0.010	0.38	0.39	27
1971e	9.5	0.032	0.003	0.39	0.003	0.047	0.005	0.06	0.49	29, 33
1971f	8.3	0.019	0.003	0.32	0.002	0.039	0.004	0.04	0.24	20, 20
1971g	9.3	0.038	0.011	0.32	0.002	0.064	0.004	0.04	0.20	27, 33
1971h	9.4	0.022	0.012	0.32	0.003	0.044	0.006	0.09	1.24	28
1971i	6.4	0.026	0.09	0.56	0.002	0.060	0.007	0.05		36
1971j	10.1	0.026	0.009	0.74	0.003	0.023	0.009	0.12		24
Average	8.9	0.029	0.022	0.59	0.004	0.046	0.006	0.10	0.49	
					MYTILUS AFER. SHELL					
Algeria 1912	15	0.093	0.020	1.39	0.004	0.02	0.0022	0.05	0.20	100
Algeria 1909	11	0.153	0.071	1.69	0.003			0.04		100
					MYTILUS GALLOPROVINCIALIS SHELL					
Atlantic 1922	13	0.089	0.015	1.26	0.002	0.06	0.049	0.05	0.19	20, 22
Cote d'Azur 1909	25	0.105	0.014	0.34	0.008		0.011			30
					MYTILUS EDULIS FRESH SOFT PARTS (Dry Weight)					
Nieuport, Belgium										
1971a	423	1.53	0.07	29	0.07	5.0	0.18	0.61	1.55	
1971b	410	1.21	0.05	35	0.08	4.9	0.16	0.56	0.70	
1971c	1408	2.14	0.14	38	0.34	3.5	0.16	1.85	0.97	
1971d	1211	2.23	0.13	57	0.28	5.6	0.15	1.51	0.98	
1971e	1261	2.15	0.19	51	0.27	4.7	0.10	1.20	0.77	
1971f	724	1.74	0.10	38	0.17	3.8	0.24	0.83	1.22	
1971g	788	1.79	0.07	52	0.17	4.0	0.09	1.19	0.89	
1971h	903	1.67	0.09	34	0.20	4.5	0.10	1.34	1.20	
1971i*	632	1.22	(0.71)	29	0.16	4.9	0.17	2.00	0.47	
Average	776	1.74	0.11	40	0.19	4.5	0.15	1.23		

* In oven at 60C for 4 hr.

Bertine, K. K. & E. D. Goldberg. 1972.

TABLE 2. Continued

Location and Year	Fe	Co	Sb	Zn	Sc	Se	Ag	Cr	Hg
Holland									
1971a'	639	2.27	0.18	95	0.09	10.6	0.21	6.60	2.27
	MYTILUS EDULIS ALCOHOL-PRESERVED SOFT PARTS (Dry Weight)								
1904	3100	2.70	4.5	1400	0.62	15	3.3	3.9	4.4
1912	5600	6.0	5.5	450	1.7	17	7.5	10	5.4
1938	1100	5.2	2.7	250	0.17	19	8.3	2.5	1.5
1949	12,000	7.0	1.4	150	3.0	4.8	0.84	16	0.75
1966	3200	3.9	1.6	260	0.18	27	1.7	2.9	1.4
	MYTILUS EDULIS ALCOHOL-PRESERVED SHELL								
1904	4	0.22	0.64	210	n.d.	0.08	n.d.	0.09	-
1912	17	0.20	0.40	32	n.d.	-	n.d.	-	-
1938	16	0.20	0.16	9.5	n.d.	0.09	n.d.	0.09	-
1949	26	0.15	0.14	8.4	0.005	0.08	n.d.	0.03	
1966	120	0.07	0.10	11	0.003	0.06	n.d.	0.06	-

REF. NO.: 20 - B - 1

SUBSTANCES: Zn

Reference: Bodansky, M. 1920. Biochemical studies on marine organisms. II. The occurrence of zinc. J. Biol. Chem. 44:399-407.

Organisms: oysters, clams (unspecified)

Date of Sample Collection: 1920?

Location: ?

Analytical Technique: turbidometric procedure

Analytical Data: (wet wt)

Bodansky, M. 1920.

TABLE III.

Distribution of Zinc in Oysters, Hardened in 10 Per cent Formaldehyde for 24 Hrs. Previous to Dissection.

Fraction.	Weight.	Zinc.	
		Found in sample.	In 1,000 gm. tissue.
	gm.	*mg.*	*mg.*
Digestive glands	80.0	19.00	237.50
Mantles	141.7	37.84	267.00
Muscle	70.3	11.25	160.00
"Residue"	206.0	55.50	269.40
Formaldehyde extract		6.50	
Total	498.0*	130.09†	

* 525 gm. of oysters were dissected. The difference of 27 gm. represents the water which passed into the formaldehyde and that which was lost during the dissection.

† Calculated on the basis of 525 gm., this is equivalent to 247.8 mg. of zinc per kilo.

TABLE IV.

Distribution of Zinc in Oysters, Dissected without Previous Formaldehyde Treatment.

Fraction.	Weight.	Zinc.	
		Found in sample.	In 1,000 gm. tissue.
	gm.	*mg.*	*mg.*
Digestive glands	56.7	11.10	196.00
Mantles	84.0	18.38	218.80
Muscle	38.5	2.94	76.40
"Residue"	102.0	19.50	191.20
Total	281.2*	51.92†	

* 300 gm. of oysters were dissected. The difference of 18.8 gm. represents the water which was lost during the dissection.

† Calculated on the basis of 300 gm., this is equivalent to 173.1 mg. of zinc per kilo.

Zinc Content of Marine Animals.

No. of analysis.	Animal.	Amount taken for analysis.	Zinc.		Remarks.
			Found in sample.	In 1,000 gm. of fresh substance.	
		gm.	*mg.*	*mg.*	
	Cœlenterata.				
9	Jellyfish.	200.0	2.50	12.50	Entire animal ground.
42	Portuguese man-of-war.	271.5	1.22	4.50	One animal entire.
44	" "	81.0	1.30	16.05	Two small individuals.
	Pelecypoda.				
2	Oysters.	100.0	18.85	188.50	Shucked.
4	"	100.0	34.10	341.00	
31	"	100.0	27.50	275.00	
32	"	100.0	24.38	243.80	
37	"	100.0	25.11	251.10	
39	Clams.	76.6	5.90	77.00	

REF. NO.: 75 - B - 1

SUBSTANCES: As

Reference: Bohn, A. 1975. Arsenic in marine organisms from West Greenland. Mar. Pollut. Bull. 6:87-89.

Organisms: Mytilus edulis

Date of Sample Collection: 1972-73

Location: West Greenland

Analytical Technique:

Analytical Data: (dry wt)

TABLE 2
Background concentration of arsenic in marine invertebrates and rockweed from Marmorilik, West Greenland.

Species	No. of individuals in sample	Avg. wt of individuals in sample (g)	As (ppm dry wt)
Deep sea prawn	34	4.7	80.2
(P. borealis)	35	3.1	62.9
	>50	–	66.2
Blue mussel	18	0.8	16.7
(M. edulis)	11	1.5	14.1
	15	1.2	14.3
Zooplankton – predominantly copepods	>500	–	6.0
Rockweed	2	–	35.8
(F. vesiculosus)	3	–	35.2

REF. NO.: 76 - B - 1

SUBSTANCES: Hg

Reference: Bourget, E. & D. Cossa. 1976. Mercury content of mussels from the St. Lawrence estuary and northwestern Gulf of St. Lawrence, Canada. Mar. Pollut. Bull. 7:237-239.

Organisms: Mytilus edulis

Date of Sample Collection: 1976

Location: St. Lawrence estuary and Gulf of St. Lawrence, Canada

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

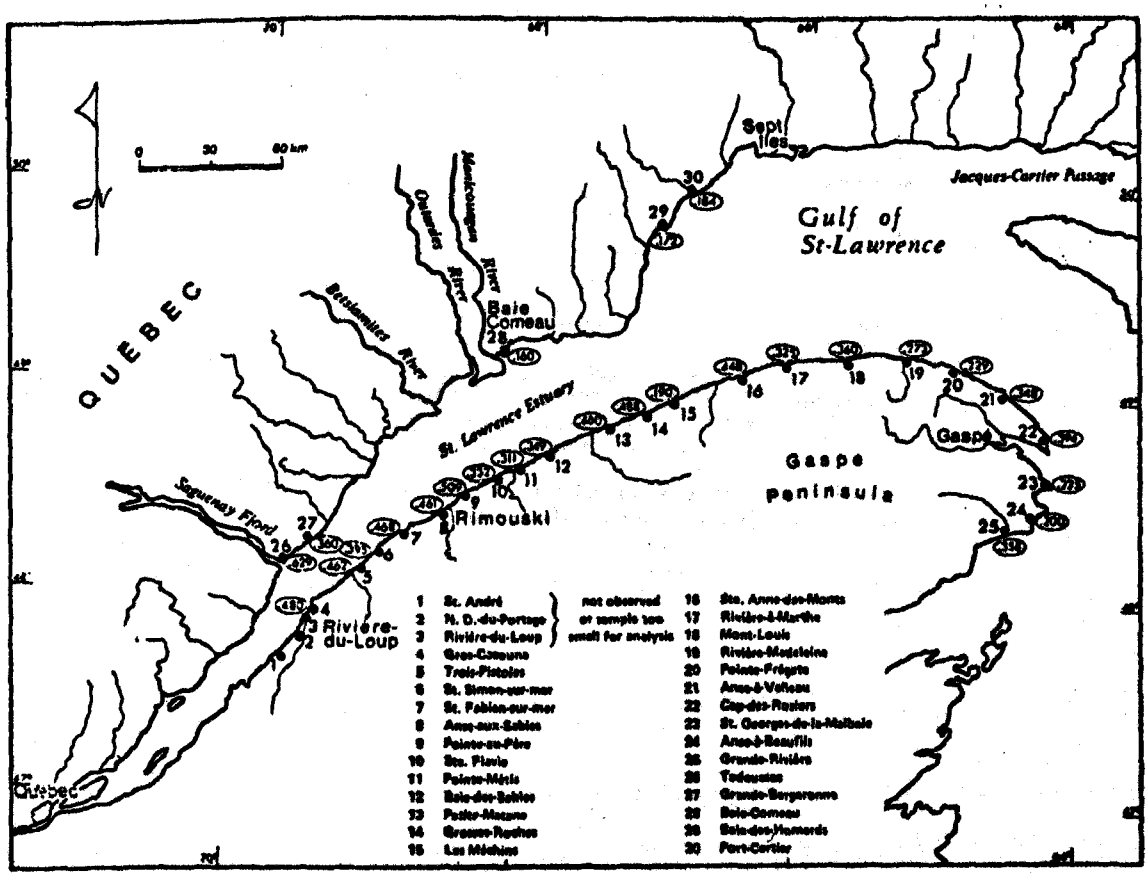


Fig. 1 Mean mercury content in the soft parts of intertidal *Mytilus edulis* (ppm, dry weight) along the coast of the Lower St. Lawrence Estuary and Northwest Gulf of St. Lawrence. Values represent the mean of three determinations.

Bourget, E. & D. Cossa. 1976.

TABLE 1
Comparison of results of analyses of fractions of two homogenized samples of whole *Mytilus edulis*.
Mean of determinations in ppm (dry wt).

Laboratories	Number of determinations	Sample A mean	Sample A s.d.	Sample B mean	Sample B s.d.
Environment Canada Research and Development (Halifax Laboratory)	3	0.290	0.017	0.020	0.006
Institut Scientifique et technique des Pêches Maritimes, (France)	2	0.265	0.007	0.020	0.000
Laboratoire océanographique de Rimouski (Québec, Canada)	3	0.280	0.033	0.015	0.008

TABLE 2
Variation in the mercury content (ppm, dry wt) of the soft parts of *Mytilus edulis* from different shore levels, substratum and localities (F significant at $p < 0.001$).

Source of variation	Degrees of freedom	Sum of squares	Mean square	F ratio
Between groups from different localities shore levels and substratum	34	15.3171	0.4505	60.10
Between determinations within each group	70	0.5247	0.0075	
Total	104	15.8418		

TABLE 3
Influence of the level of collection and substratum on the mercury content (ppm, dry wt) of *Mytilus edulis* collected at Pointe-Métis (F not significant at $p < 0.10$).

Source of variation	Degrees of freedom	Sum of squares	Mean square	F ratio
Between shore levels	2	0.0376	0.0188	1.59
Between substrata	1	0.0013	0.0013	0.072
Interaction	2	0.0070	0.0035	0.297
Error	12	0.1417	0.0118	
Total	17	0.0187		

		Rocky	Muddy
Mean values	*E(L)HWN	0.438 ppm	0.383 ppm
	MTL	0.311 ppm	0.295 ppm
	MLWN	0.375 ppm	0.395 ppm

*E(L)HWN: extreme (lowest) high water of neap tides; MTL: mean tide level; MLWN: mean low water of neap tides.

REF. NO.: 30 - B - 1

SUBSTANCES: Mn

Reference: Boycott, A. E. & G. R. Cameron. 1930. Manganese in foodstuffs. Lancet 219:959.

Organisms:

Cardium edule
Ostrea edulis
Mytilus edulis
Pecten opercularis
Pecten maximus

Date of Sample Collection: 1930?

Location: England

Analytical Technique: Colorimetry

Analytical Data:

	Manganese mg. in 100 g. dried.
Winkle (*Littorina littorea*) ..	Tr. to 16
Whelk (*Buccinum undatum*)	Nil
Purpura lapillus	Nil
Trochus cinerarius	Nil
Limpet (*Patella vulgata*) ..	Tr. or nil
Crepidula fornicata	10 to 17
Cockle (*Cardium edule*) ..	Nil
Oyster (*Ostrea edulis*) ..	4
Mussel (*Mytilus edulis*) ..	Nil to 4
Scallop (*Pecten opercularis*)	Tr. to 40
" (*P. maximus*) ..	5
Shrimp (bottled)	Nil to 4
Prawn (bottled)	Nil

Tr. = trace.

	Manganese mg. in 100 g. dried.
Tea	27 to 43
Coffee	Tr. or nil
Cocoa	Tr.
Mixed spice ..	14
Cinnamon ..	2
Ginger	4 to 12
Coriander ..	10
Cloves	48 to 50
Vinegar ..	1
Curry powder ..	4
Olives (flesh) ..	6
Pepper	10 to 20
Cayenne pepper	2 or less

REF. NO.: 74 - B - 2

SUBSTANCES: Cd, Cu, Fe, Ni, Pb, Zn

Reference: Boyden, C. R. 1974. Trace element content and body size in molluscs. Nature 251:311-314.

Organisms: Mytilus edulis
Mercenaria mercenaria
Venerupis decussata
Cerastoderma edule

Date of Sample Collection: 1974?

Location: Severn Estuary and River Helford, Cornwall, England

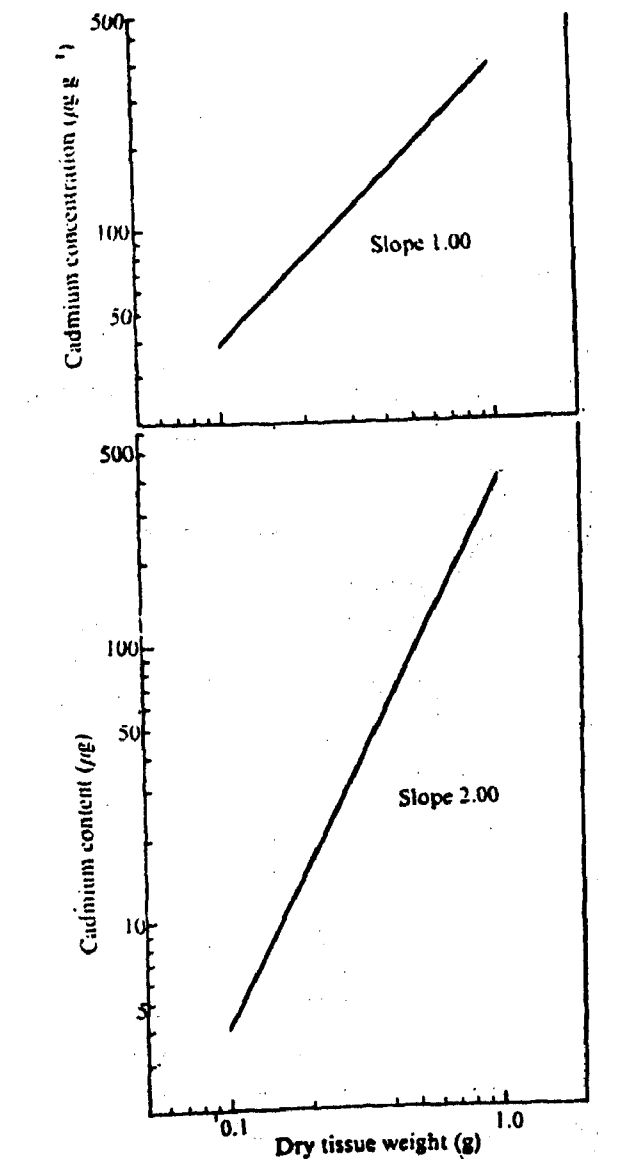
Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt)

Table 1 Distribution of the three types of regression coefficients relating element content (μg) to dry body weight (g) within six species of mollusc

Regression coefficient	Cadmium	Copper	Iron	Nickel	Lead	Zinc
≃ 0.75	*C. edule* *M. mercenaria* *V. decussata*	*P. vulgata* *P. intermedia* *C. edule* *M. edulis* *M. mercenaria* *V. decussata*	*P. vulgata* *P. intermedia* *M. edulis* *M. mercenaria*		*P. vulgata* *P. intermedia* *C. edule* *M. edulis* *V. decussata*	*P. vulgata* *P. intermedia* *C. edule* *M. edulis*
≃ 1.00	*M. edulis*		*C. edule* *V. decussata*	*M. edulis* *C. edule* *V. decussata* *M. mercenaria*	*M. mercenaria*	*V. decussata* *M. mercenaria*
≃ 2.00	*P. vulgata*					

Boyden, C. R. 1974.



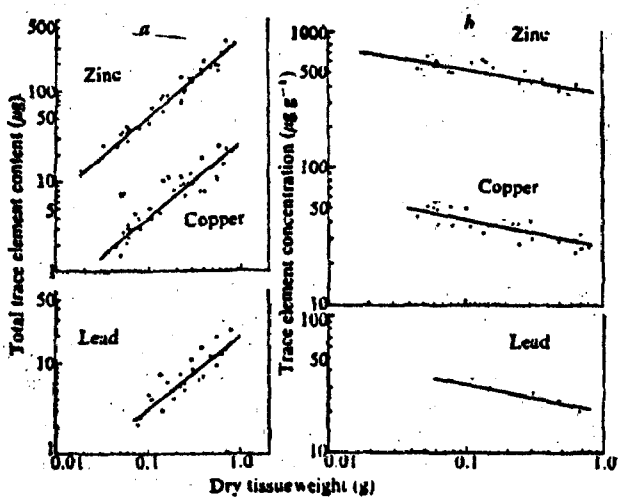


Fig. 1 Relationship of *a*, element content (μg) and, *b*, element concentration (μg g^{-1}) to body weight (g) for copper, lead and zinc in the limpet *Patella vulgata* collected on August 3, 1973

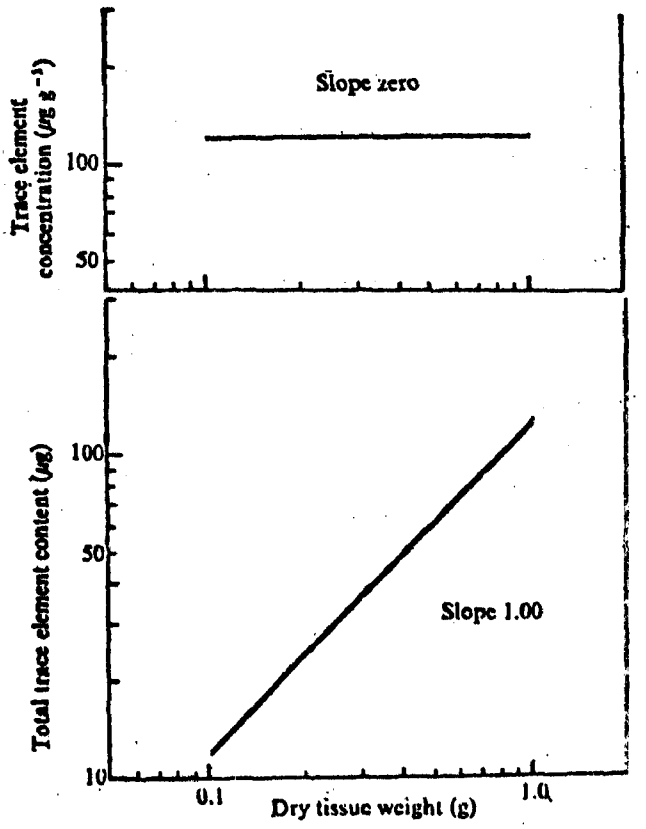


Fig. 3 Element content directly related to body size; weight-specific concentration independent of size. This example relates to nickel in the cockle *C. edule*.

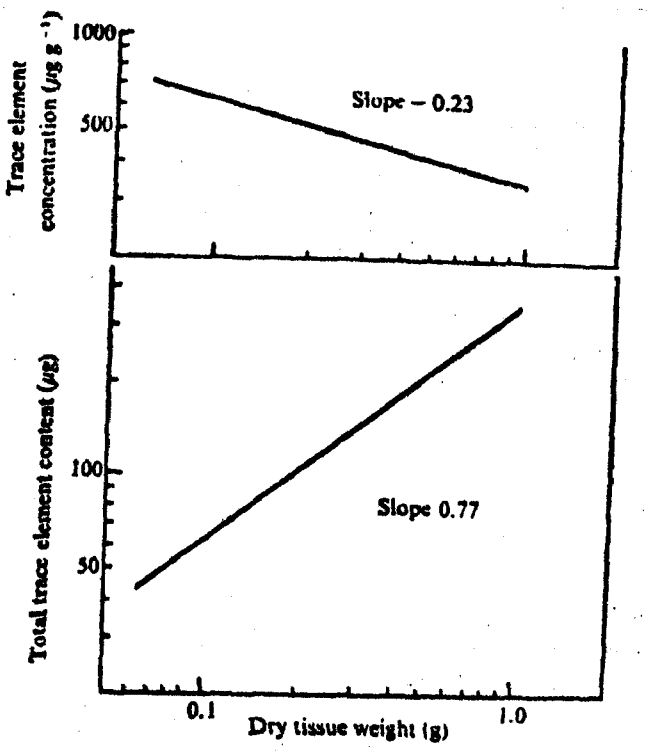


Fig. 2 Relationship of element content (and concentration) to body weight where element content related to 0.77 power of body weight. The data shown pertains to zinc in *P. vulgata* collected from Portishead, Severn Estuary.

REF. NO.: 75 - B - 3

SUBSTANCES: Cd, Cu, Fe, Mn, Ni, Pb, Zn

Reference: Boyden, C. R. 1975. Distribution of some trace metals in Poole Harbour, Dorset. Mar. Pollut. Bull. 6:180-187.

Organisms: Ostrea edulis
Crassostrea gigas
Cerastoderma edule
Mytilus edulis

Date of Sample Collection: 1973-74

Location: Poole Harbour, U. K.

Analytical Technique: Atomic absorption

Analytical Data: (dry wt)

TABLE 7
Trace element concentrations in shellfish collected from various locations in Poole Harbour.

Sample location	Species	Date of sample	Sample size	Mean individual weight (g)		Trace element concentration (µg/g) Cadmium	Copper	Iron	Manganese	Nickel	Lead	Zinc
Oysters												
Holes Bay – locality C (≙ station 6)	*Ostrea edulis*	1.6.73	5	2.0328	M	53.7	451	240	9	5	5	339[illegible]
					SD	5.9	54	41	1.5	1.2	1.2	89[illegible]
Stokes Buoy-locality B (≙ station 12)	*Ostrea edulis*	10.4.73	5	1.2978	M	9.0	285	172	6	2	5	197[illegible]
					SD	0.8	72	43	1.1	0.4	1.8	58[illegible]
Oyster Company lay, locality A	*Ostrea edulis*	10.4.73	7	1.2693	M	5.9	86	394	7	3	8	196[illegible]
					SD	2.8	25	298	1.3	0.9	6.4	47[illegible]
(as above)	*Crassostrea gigas*	10.4.73	6	2.0257	M	4.6	200	228	18	3	6	176[illegible]
					SD	0.4	45	85	3.0	0.6	0.7	49[illegible]
Cockles (*Cerastoderma edule*)												
Holes Bay, locality a (≙ station 3)		10.9.73	8	0.3521	M	16.9	9	502	5	174	14	27[illegible]
					SD	4.5	2.3	114	2.4	39.5	3.2	8[illegible]
Sandbanks – locality b		10.8.73	5	0.8717	M	1.6	4	172	3	35	7	11
					SD	0.4	1.2	27	0.5	11.1	2.2	4
South of Brownsea Island, locality c		10.8.73	8	0.7764	M	1.5	4	185	3	51	5	11
					SD	0.3	1.2	48	0.9	12.7	1.1	4[illegible]
Mussels (*Mytilus edulis*)												
Lift Bridge (≙ station 10)		22.2.74	10	1.1063	M	65.4	11	154	5	12	19	16
					SD	13.1	1.3	41	2.4	2.7	4.9	6
North of Brownsea island, locality d		22.2.74	10	1.5529	M	3.7	7	87	3	5	7	9
					SD	0.5	1.8	11	2.1	0.7	1.3	3

M = mean concentration; SD = standard deviation.

Boyden, C. R. 1975.

TABLE 8

Concentration of trace elements accumulated by the oysters *Ostrea edulis* and *Crassostrea gigas* over a 5 month period at the oyster hatchery intake.

					Trace element concentration (μg/g)											
					Whole animal						Gill tissue					
SPECIES	Data sample	Sample size	Mean individual weight (g)		Cd	Cu	Fe	Ni	Pb	Zn	Cd	Cu	Fe	Ni	Pb	Zn
Ostrea edulis (stock from Menai Straits)	10.4.73	10	0.3296	M	6.0	363	389	13	10	3090	6	554	443	8	12	4290
				SD	1.0	156	166	5.5	4.2	626						
	5.5.73	8	0.6205	M	32.7	334	278	4	9	2200	39	380	174	4	11	2915
				SD	7.6	94	103	0.7	3.5	647						
	23.6.73	5	0.7260	M	61.9	373	172	4	5	2180	75	572	234	6	10	2862
				SD	8.4	98	34	1.5	1.0	713						
	10.8.73	6	1.0087	M	103.8	465	164	3	8	2630	123	694	187	4	9	3930
				SD	8.3	138	35	0.6	1.0	834						
	10.9.73	7	1.2975	M	92.5	597	193	5	5	2430	114	1420	283	16	16	7940
				SD	15.7	131	91	0.5	1.0	270						
Crassostrea gigas (Menai stock)	10.4.73	11	0.5765	M	6.4	337	269	6	10	3720	8	513	476	12	12	6763
				SD	1.1	89	43	1.9	1.8	843						
	5.5.73	6	0.8886	M	51.7	589	422	5	16	4690	48	1054	344	5	8	6412
				SD	12.7	143	184	2.3	7.2	1531						
	23.6.73	5	1.3266	M	45.1	359	146	3	5	2620	68	761	282	6	8	5261
				SD	8.4	77	23	0.4	0.8	483						
	10.8.73	5	0.5010	M	136.2	853	314	6	8	6060	138	1276	334	12	14	9067
				SD	13.8	377	46	1.0	1.4	2158						
	10.9.73	7	0.6641	M	111.6	836	423	8	12	4860	102	1655	454	7	13	6943
				SD	13.7	416	132	1.8	3.7	2439						

M = mean concentration;
SD = standard deviation.

REF. NO.: 74 - B - 1

SUBSTANCES: Cd, Co, Fe, Mn, Ni, Pb, Zn, Cu

Reference: Boyden, C. R. & M. G. Romeril. 1974. A trace metal problem in pond oyster culture. Mar. Pollut. Bull. 5:74-78.

Organisms: Crassostrea gigas

Date of Sample Collection: 1972-73

Location: Hinckley Point power station, Somerset, U.K.

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 85°C)

TABLE 1

Metal concentrations recorded in the oyster, *Crassostrea gigas*, during the early stages of this investigation.

Sample location and date	Mean dry weight (g)† and number of animals sampled	Metal concentration (µg/g dry weight) Cd	Co	Cu	Fe	Mn	Ni	Pb	Zn
Hinkley, September, 1972	0·2980(6)	40	2·2	6480	392	20	6·5	15	9,860
Hinkley, October, 1972	0·5878(9)	–	–	4770	–	–	–	–	19,220
Hinkley, November, 1972	0·5855(6)	43	–	2530	214	46	–	16	13,940
Hinkley, January, 1973	0·6675(6)	17	–	2770	–	–	–	–	34,220
Hinkley, April, 1973	0·4720(7)	27	3·5	1760	422	16	3·8	17	35,120
Menai Straits Sept., 1972	0·7316(38)	4	2	200	800	36	5	12	1,830
Menai Straits April, 1973	1·3983(5)	6	1	340	158	28	2	7	2,750
Washington Coast*	–	5·7	0·2	95·5	186	28·2	0·2	0·2	1,130
Washington Coast*	–	–	–	–	–	–	–	–	500

* From Pringle *et al.*, 1968 (converted from wet weight data × 5).
** From Naidu & Seymour, 1969 (converted from wet weight data × 5).
† Number of animals sampled in parentheses.

TABLE 2

Metal concentrations in the intake and outfall water at Hinkley power station.

Sample date and location	Silt load (mg/l)	Metal concentrations (µg/l) Particulate associated metal Cd	Cu	Fe	Mn	Pb	Zn	Soluble metal Cd	Cu	Fe	Mn	Pb	Zn
November 25, 1972													
Intake	304·9	0·5	9·5	2380	210	59	147	1·3	7	30	5	1	52
Outlet	131·1	0·4	3	980	68	23	8	1·2	6	20	12	2	49
January 22, 1973													
Intake	1090·8	6·5	35	8750	835	237	292	1·0	8	250	20	<2	28
Outlet	650·0	3·0	20	4250	442	144	255	1·0	6	250	28	<2	30

TABLE 6

Metal concentrations in a subsequent stock of the oyster *Crassostrea gigas*, established in August, 1972, after the removal of the recirculation pump, but with zinc trays irregularly employed.

Date	Mean dry weight (g)*	Metal concentration (µg/g dry weight) Cd	Co	Cu	Fe	Mn	Ni	Pb	Zn
May, 1973	0·1858(6)	4·0	3·2	104	610	14	4·8	18	24,020
August, 1973	0·2124(6)	18·2	4·1	142	300	13	6·2	11	9,720

* Number of animals sampled in parentheses.

REF. NO.: 65 - B - 1

SUBSTANCES: Mn, Pb, Cr, Mo, V, Cu, Ag, Cd, Zn, Ni, Fe, Sb

Reference: Brooks, R. R. & M. G. Rumsby. 1965. The biogeochemistry of trace element uptake by some New Zealand bivalves. Limnol. Oceanogr. 10:521-527.

Organisms: Ostrea sinuata
Pecten novae-zelandiae
Mytilus edulis aoteanus

Date of Sample Collection: 1965?

Location: Tasman Bay, New Zealand

Analytical Technique: emission spectography

Analytical Data: (dry wt, dried at 110°C)

TABLE 1. *Concentrations of trace elements in the soft portions of whole shellfish (all concentrations in ppm on material dried at 110C)*

Description	Mn	Pb	Cr	Mo	V	Cu	Ag	Cd	Zn	Ni	Fe
Scallop	161	23	23	2.3	14	12	2.3	299	368	17	6,900
	98	13	4	0.8	7	7	0.5	256	288	4	3,200
	63	12	8	0.6	6	7	0.5	225	293	2	1,950
	28	10	3	1.1	8	14	0.2	210	195	2	1,140
	12	14	7	0.5	5	7	0.2	216	288	4	1,242
	306	23	12	0.1	11	2	0.3	272	268	5	3,060
Oyster	10	6	6	0.3	2	53	6.3	43	1,500	3	630
	11	6	5	0.3	2	49	7.3	43	1,050	3	700
	1	7	4	0.1	2	49	6.3	38	1,204	2	688
	9	13	2*	0.4	3	32	4.8	10*	850	1*	646
	8	12	2*	0.1	3	39	4.6	42	1,040	1*	676
	8	14	6	0.3	4	21	4.5	34	975	1*	750
Mussel	18	18	9	1.0	4	5	0.1*	<10	50*	5	1,610
	34	25	18	0.6	6	10	0.1*	<10	50*	17	2,520
	38	12	14	0.5	5	10	0.1*	<10	168	13	2,640
	30	8	17	0.1*	8	11	0.1*	<10	50*	3	2,430
	28	6	11	1.0	2	8	0.3	<10	180	5	1,600
	12	3*	24	0.1*	3	9	0.1*	<10	50*	1*	960
Avg. scallop	111	16	10	0.9	9	9	0.7	249	283	6	2,915
Avg. oyster	8	10	3	0.3	3	41	5.6	35	1,103	2	682
Avg. mussel	27	12	16	0.6	5	9	0.1	<10	91	7	1,960

* Below spectrographic detection limit, estimated value based on 50% of detection limit.

Brooks, R. R. & M. G. Rumsby. 1965.

Table 3. *Concentrations of trace elements in individual organs of shellfish (all concentrations in ppm on material dried at 110C)*

Sample	% of whole animal	Mn	Pb	Cr	Mo	V	Cu	Ag	Cd	Zn	Ni	Fe	Sb
Scallop													
Mantle	13	45	<5	<3	1.8	7	15	0.2	<20	<100	<2	1,540	<30
Gills	10	353	52	145	3.1	3	36	1.0	<20	<100	68	21,600	<30
Muscle	24	2	<5	<3	<0.1	<2	1	<0.1	<20	108	<2	34	<30
Visceral mass*	17	24	8	8	2.0	30	24	1.8	2,000	400	2	2,200	<30
Intestine*	1	435	28	24	3.6	16	131	2.9	<20	392	52	6,090	<30
Kidney	1	2,660	137	17	3.4	4	78	4.8	<20	2,630	106	2,470	<30
Foot	1	27	14	8	0.4	4	17	1.1	<20	210	22	2,380	<30
Gonads	20	5	78	<3	<0.1	32	9	0.2	<20	256	<2	228	<30
Shell		1	<5	<3	<0.1	130	2	<0.1	<20	<100	<2	2,000	<30
Oyster													
Mantle	7	4	<5	<3	<0.1	12	34	4.8	207	4,760	<2	840	<30
Gills	10	11	<5	<3	0.4	3	100	4.6	<20	3,300	<2	620	<30
Muscle	7	2	<5	<3	<0.1	<2	23	1.8	<20	400	8	274	80
Striated Muscle	20	1	<5	<3	<0.1	4	6	0.5	97	369	<2	2,880	<30
Visceral mass*	33	2	<5	<3	0.5	<2	49	68	61	1,122	12	1,156	<30
Kidney	4	2	<5	<3	<0.1	4	22	1.0	118	1,248	<2	384	<30
Heart	1	2	15	9	1.3	4	59	48	154	2,090	2	247	<30
Shell		1	<5	<3	<0.1	49	<1	<0.1	<20	<100	<2	570	<30
Mussel													
Mantle	15	2	<5	<3	<0.1	3	11	0.4	<20	192	<2	180	<30
Gills	14	28	36	10	0.6	5	20	1.0	<20	336	8	2,940	<30
Muscle	18	<1	<5	<3	<0.1	2	1	<0.1	<20	<100	<2	82	<30
Visceral mass*	14	105	26	29	1.9	23	19	0.2	<20	525	32	13,650	<30
Intestine*	2	65	69	<3	<0.1	25	15	0.3	<20	<100	42	570	<30
Foot	15	<1	<5	<3	<0.1	44	13	<0.1	<20	<100	<2	<10	<30
Gonads	6	6	7	<3	0.1	<2	6	0.1	<20	260	5	93	<30
Shell		<1	<5	<3	11	110	3	<0.1	<20	<100	<2	<10	<30
Sediment		693	<5	307	1.5	84	102	<0.1	<20	<100	219	73,000	<30
Seawater† (ppb)		2	3	0.05	10	2	3	0.3	0.11	10	0.5	10	0.5

* Includes the gut content.

† Data of Goldberg (1957).

REF. NO.: 73 - B - 1

SUBSTANCES: Ag, Co, Cr, Cu, Mn, Ni, Pb, Zn, Al, Cd, Fe

Reference: Bryan, G. W. 1973. The occurrence and seasonal variation of trace metals in the scallops Pecten maximus (L.) and Chlamys opercularis (L.). J. mar. biol. Ass. U.K. 53:145-166.

Organisms: Pecten maximus
Chlamys opercularis

Date of Sample Collection: 1973?

Location: English Channel

Analytical Technique: Atomic absorption spectrometry; gamma scintillation

Analytical Data: (dry wt, dried at 105°C)

TABLE 1. MEAN CONCENTRATIONS OF METALS IN THE WHOLE BODY AND TISSUES OF *CHLAMYS OPERCULARIS* ON A DRY WEIGHT BASIS

(The samples, consisting of one whole animal or tissues pooled from six animals, were collected at different times of year.)

Metal	No. of whole animals analysed	Whole body (soft parts)		No. of tissue samples	Body fluid		Mantle		Gills		Digestive gland		Adductor muscles: Striated		Adductor muscles: Unstriated		Gonad and foot		Kidneys	
		μg/g	S.D.		μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.
Co	11	0·33	0·08	11–13	0·20	0·10	0·20	0·13	0·45	0·07	1·03	0·42	0·03	0·01	—		0·20	0·08	15·1	6·1
Cu	11	15·4	5·7	16–17	5·6	2·0	5·6	1·3	16·7	5·9	36·7	11·4	1·3	0·4	3·13	0·99	9·7	3·0	1285	591
Fe	11	113	30	16–17	32·1	23·3	67·1	26·2	134	45	853	221	10·7	3·2	16·6	3·3	132	42	330	68
Mn	11	158	67	16–20	2·0	1·7	18·6	7·6	105	41	29·7	13·7	4·00	0·76	4·36	2·20	12·5	6·4	17300	4570
Ni	11	1·56	0·40	10–11	0·88	0·49	0·60	0·23	1·57	0·65	4·25	0·78	0·17	0·13	—		0·63	0·52	78·2	28·4
Pb	11	12·0	5·2	8–9	1·05	1·49	1·02	0·65	2·12	1·8	10·2	7·3	0·55	0·14	—		2·47	2·18	827	236
Zn	11	462	122	15–19	45·1	17·2	152	34	384	115	132	26	61·7	6·3	111	19	117	31	40800	7290
Dry weight of tissue as % of wet weight	11	13·7	3·3	16–18	4·08	0·17	12·6	1·0	11·0	0·5	28·0	2·4	22·4	2·8	22·2	1·0	19·1	5·5	19·5	1·3
Contribution of each organ or tissue to the wet weight of soft parts (%)	—	100 (51·3 % of total including the shell)		—	43·82		14·38		9·49		3·72		20·9		1·16		6·02		0·51	

Bryan, G. W. 1973.

TABLE 2. MEAN CONCENTRATIONS OF METALS IN THE WHOLE BODY AND TISSUES OF *PECTEN MAXIMUS* ON A DRY WEIGHT BASIS

(The samples, consisting of one whole animal or tissues pooled from six animals, were collected at different times of year.)

Metal	No. of whole animals analysed	Whole body (soft parts)		No. of tissue samples	Body fluid		Mantle		Gills		Digestive gland		Adductor muscles: Striated		Adductor muscles: Unstriated		Gonad and foot		Kidneys	
		μg/g	S.D.		μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.	μg/g	S.D.
Co	11	0·25	0·09	11–13	0·07	0·05	0·14	0·03	0·23	0·05	1·28*	0·46	0·009	0·004	—		0·10	0·03	9·05	3·07
Cu	11	8·9	4·5	16–17	2·5	1·7	2·7	0·6	6·7	1·5	57·9*	27·4	0·78	0·27	1·63	0·27	17·4*	5·6	20·8	10·3
Fe	11	196*	83	16–17	26·4	16·6	86·4*	32·8	137*	41	1295*	361	13·1*	3·0	17·7*	3·2	143*	40	149	71
Mn	11	107	60	17–22	1·0	1·7	8·8	7·6	45·5	26·3	15·6	7·0	1·75	0·72	0·85	0·31	9·9	5·7	15300	4100
Ni	11	0·73	0·25	10–11	0·65	0·43	0·40	0·11	0·74	0·12	3·55	0·67	0·04	0·02	—		0·26	0·12	22·9	6·3
Pb	11	2·0	0·6	9	0·85	1·16	0·71	0·79	0·84	1·34	3·90	1·44	0·21	0·12	—		1·68	0·88	159	38
Zn	11	273	95	17–23	30·1	9·5	59·4	12·6	100	37	407*	123	69·9*	6·7	94·2	19·7	196*	48	19300	4800
Dry weight of tissue as % of wet weight	11	12·4	1·3	18–22	3·98	0·13	10·3	1·0	11·0	1·8	28·5	2·6	22·3	1·6	22·4	1·2	17·8	2·3	17·2	1·1
Contribution of each organ or tissue to the wet weight of soft parts (%)	—	100 (45·8% of total including shell)		—	40·22		15·99		7·3		3·77		23·62		2·4		6·28		0·42	

* Concentration in *Pecten* > *Chlamys*.

TABLE 3. CONCENTRATIONS OF OTHER METALS IN *PECTEN* AND *CHLAMYS* ON A DRY WEIGHT BASIS

(Mean concentrations from two sets of samples, each consisting of three whole animals or tissues pooled from six animals.)

Metal	*Pecten*: Soft parts of whole animal including fluid (μg/g)	*Pecten*: Kidneys (μg/g)	*Pecten*: Digestive gland (μg/g)	*Pecten*: Remaining soft parts including fluid (μg/g)	*Chlamys*: Soft parts of whole animal including fluid (μg/g)	*Chlamys*: Kidneys (μg/g)	*Chlamys*: Digestive gland (μg/g)
Ag	2·7	4·3	13·6	0·43	10·4	35	77
Al	55	53·5	173	24·5	49	58	43
Cd	32·5	79	321	2·2	5·5	41	27
Cr	1·3	3·9	8·1	0·65	2·2	6·6	4·7
Fe	133	109	907	55·3	120	273	510
Zn	183	20000	375	78	631	54700	228
Dry weight of tissue as % of wet weight	12·5	19·4	28·5	15·1	11·7	22·8	26·6

TABLE 4. RELATIVE IMPORTANCE OF METALS IN DIFFERENT TISSUES

(Quantity of metal in each tissue as a percentage of the total in the soft parts including fluid.)

Metal	*Pecten*: Gills	*Pecten*: Mantle	*Pecten*: Digestive gland	*Pecten*: Kidneys	*Chlamys*: Gills	*Chlamys*: Mantle	*Chlamys*: Digestive gland	*Chlamys*: Kidneys
Ag	—	—	63·7	1·5	—	—	62·4	3·4
Al	—	—	33·9	0·7	—	—	7·4	0·8
Cd	—	—	89·9	1·7	—	—	41·5	7·5
Co	6·7	8·8	50·3	23·9	11·5	8·7	26·0	36·2
Cr	—	—	46·9	1·7	—	—	18·1	3·0
Cu	5·3	4·4	60·9	1·5	7·9	4·6	17·3	57·6
Fe	5·7	7·4	71·9	0·6	9·7	8·4	61·4	2·3
Mn	3·1	1·2	1·4	92·5	5·7	1·7	1·6	89
Ni	7·2	7·9	45·9	20·0	9·1	6·1	24·5	43
Pb	3·1	5·4	19·0	52·3	2·1	1·8	10·2	78·8
Zn	3·0	3·6	16·2	51·8	7·4	5·1	2·6	75·1

REF. NO.: 75 - C - 1

SUBSTANCES: Cd, Fe, Mn, Mb, Co, Th, Ni

Reference: Castagna, A. & F. Sarro. 1975. Primi dati sulla presenza di alcuni elementi metallici in Mytilus galloprovincialis, Lam. della costa orientale sicula, svelati con spettrofotometria per assorbimento atomico. Soc. Ital. Biol. Sper., Boll. 51:477-483.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1974?

Location: Catania, Priolo and Bay of Ognina, Sicily

Analytical Technique: atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 110°C)

TABELLA I - Concentrazioni dei vari metalli espresse in ppm sul tessuto secco di esemplari raccolti nelle località indicate.

Metalli pesanti	Porto di Catania	Priolo	Baia di Ognina
Cadmio	0,78	3,15	0,92
Rame	8,35	15,00	10,62
Manganese	6,99	4,52	6,14
Molibdeno	21,00	20,40	24,00
Cobalto	3,75	3,96	4,46
Tallio	2,09	2,00	1,60
Nichelio	39,50	40,16	37,33

REF. NO.: 27 - C - 1

SUBSTANCES: Pb, Cu

Reference: Chapman, A. C. & H. Linden. 1927. On the presence of lead and other metallic impurities in marine crustaceans and shell fish. Analyst 51: 563-564.

Organisms: mussels, cockles (unspecified)

Date of Sample Collection: 1927?

Location:

Analytical Technique:

Analytical Data: Specimens of the following crustaceans and shell fish were examined:—

	Parts per million.	
	Copper.	Lead.
Lobster	167	6·2
"	—	25·6
Prawns	—	7·5
Crab	130	17
Mussels	—	20
"	—	10
Cockles	—	9·7
"	—	1·3
Periwinkles	—	18
"	—	7·2
Whelks	—	6·9
"	—	5
"	115	17·1

The above numbers are expressed on the dry material, but it may be taken that, in all cases, the amounts of copper and lead present in the wet edible portions would be approximately one-fourth.

In the case of native oysters, lead was found to be present in the three samples examined, each of which represented about one dozen specimens. The results, ~~expressed~~ on the dried edible portions, were 12 parts, 20 parts, and 400 parts per million, respectively.

Five samples of Portuguese oysters were similarly examined, and found to contain the following amounts of lead, expressed in parts per million on the dry edible substance: No. 1, 21; No. 2, 10; No. 3, 25; No. 4, 307; and No. 5, 27.

It was not thought necessary to examine any of the oysters for zinc and copper, as this has been done by several workers, and numbers are recorded in the literature showing the presence of quantities of copper varying from 4 to 3300, and of zinc varying from 70 to 2100 parts per million. The highest numbers we have seen, both for copper and for zinc, are contained in the Report issued by the Ministry of Agriculture and Fisheries entitled *Fishery Investigations* (Series 2, Vol. VI, No. 4, 1924), and were obtained in the Government Laboratory.

REF. NO.: 76 - C - 2 **SUBSTANCES:** Pb

Reference: Chow, T. J., H. G. Snyder & C. B. Snyder. 1976. Mussels (Mytilus sp.) as an indicator of lead pollution. Sci. Total Envir. 6:55-63.

Organisms: Mytilus californianus
Mytilus edulis

Date of Sample Collection: 1972-73

Location: Southern California and Baja

Analytical Technique: Mass spectrometry

Analytical Data: (dry wt, dried at 110°C)

TABLE 1

LEAD CONTENTS IN WHOLE SOFT PARTS OF *Mytilus* sp.

Location	Date collected	Species	Length (mm)	Pb (p.p.m.) Wet wt.	Pb (p.p.m.) Dry wt.
Piedras Blancas South of lighthouse	10/21/72	*M. californianus*	50, 80	0.094	0.556
			58	0.150	0.824
			54, 72	0.174	0.958
			49	0.179	1.057
Cayucos, 6 km north of village	10/22/72	*M. californianus*	39, 43	0.135	0.683
			45, 47	0.147	0.738
			42, 50	0.153	0.815
			37, 47	0.194	0.993
Cayucos, 0.6 km north of village	09/14/73	*M. californianus*	78	0.104	0.386
			80	0.125	0.507
			76	0.170	0.688
Cayucos, 3 km south of village Pier	09/14/73	*M. californianus*	103	0.065	0.265
			74	0.082	0.325
			89	0.086	0.339
			107	0.094	0.342
Gaviota State Beach	10/23/72	*M. californianus*	95	0.118	0.568
			86	0.159	0.808
			84	0.170	0.859
Goleta Point	10/24/72	*M. californianus*	85	0.131	0.664
			87	0.199	1.054
			80	0.235	1.150
			77	0.252	1.355
Santa Barbara Harbor Marina	10/24/72	*M. edulis*	77	0.586	2.471
			95	0.630	3.500
			77	1.086	4.395
Santa Barbara Harbor Marina	09/13/73	*M. edulis*	77	0.651	4.752
			78	1.746	11.54
			80	2.062	18.87

Chow, T. J. et al. 1976.

TABLE 1 (*Continued*)

Location	Date collected	Species	Length (mm)	Pb (p.p.m.) Wet wt.	Pb (p.p.m.) Dry wt.
Rincon Point	10/25/72	*M. californianus*	87	0.124	0.596
			100	0.202	0.968
			97	0.276	1.312
			95	0.426	2.341
Long Beach Harbor Marina	04/11/73	*M. edulis*	78	1.422	8.11
			68, 70	1 696	9.48
			69	2.311	19.81
			85	3.051	24.92
			79	4.012	24.46
Anaheim Bay Gasoline station fueling dock	04/11/73	*M. edulis*	78	3.222	24.62
			73	3.360	30.53
			57, 61	3.669	31.63
			70	4.083	41.97
			68, 73	4.162	36.32
San Clemente Pier	04/13/73	*M. californianus* (20 juveniles)	20-25	0.520	3.393
Oceanside Harbor Marina	04/11/73	*M. edulis*	60, 62	0.338	4.878
			55, 57, 65	0.498	5.150
			50, 70, 75	0.619	5.669
			70	0.700	6.917
			72	0.898	9.963
San Diego La Jolla SIO Pier	04/12/73	*M. californianus*	92	0.817	6.276
			100	0.884	6.542
			110	0.922	7.617
			104	0.952	8.334
			97	1.400	11.03
San Diego Pacific Beach Pier	05/24/73	*M. californianus*	106	0.681	4.489
			96	0.966	6.487
			82	1.291	7.737
			97	1.302	9.679
			97	1.462	9.210
		M. edulis	42, 42, 48, 54	0.312	1.870
			45, 46, 48, 50	0.334	1.954
			42, 42, 44, 51	0.354	2.128
			40, 41, 47, 48	0.419	2.440
San Diego Quivera Basin	05/24/73	*M. edulis*	55, 68	0.229	1.455
			59, 64	0.520	2.847
			66, 74	0.536	4.394
			63, 64	0.955	4.917
			50, 75	1.533	9.622
San Diego Shelter Island	05/24/73	*M. edulis*	69	0.657	3.486
			98	0.957	5.487
			71	1.892	12.89
			75	1.750	12.89
La Salina, Baja California	05/09/73	*M. californianus*	118	0.177	1.136
			111	0.207	1.403
			124	0.254	2.329
			135	0.466	4.179
Ensenada, Baja California Harbor Marina	05/08/73	*M. edulis*	60, 73	0.179	1.172
			66, 68	0.504	3.639
			60, 73	0.643	4.519
			62, 65	0.833	5.723
Punta Banda, Baja California	05/08/73	*M. californianus*	61, 65	0.335	2.188
			66, 76	0.322	2.451
			75, 77	0.390	3.090
			66, 85	0.588	4.327

Chow, T. J. et al. 1976.

TABLE 2

LEAD CONTENTS IN VARIOUS ORGANS OF *Mytilus* sp.

	Muscle		*Gill*		*Stomach*		*Gonad*		*Umbo shell*		*Posterior shell*	
	Pb (p.p.m.)		*Pb (p.p.m.)*		*Pb (p.p.m.)*		*Pb (p.p.m.)*		*Pb (p.p.m.)*		*Pb (p.p.m.)*	
Location	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*	*Wet*	*Dry*
Mytilus californianus												
Gaviota State Beach	0.144	0.662	0.520	3.280	0.315	1.671	0.103	0.542	0.526	0.544	0.275	0.286
	0.082	0.414	0.234	1.824	0.102	0.627	0.081	0.483	0.311	0.337	0.344	0.366
San Diego	0.971	6.098	2.356	20.13	0.653	4.029	0.572	4.311	1.182	1.265	1.666	1.748
LaJolla, Scripps Pier	0.544	3.401	1.105	9.093	0.179	1.469	0.312	2.251	1.252	1.351	1.341	1.404
La Salina	0.262	1.550	0.886	7.971	0.230	1.470	0.319	2.103	0.264	0.280	0.320	0.341
Baja California	0.375	2.302	0.856	6.212	0.070	0.554	0.108	0.707	0.280	0.298	0.436	0.458
*	0.432	2.443	0.793	8.140	0.265	1.738	0.179	1.408	—	—	0.291	0.304
Punta Banda	0.198	1.017	0.441	3.554	0.222	1.318	0.222	1.483	0.394	0.420	0.476	0.490
Baja California	0.196	1.007	0.450	3.556	0.076	0.465	0.260	1.987	0.579	0.602	0.805	0.833
Mytilus edulis												
Santa Barbara	0.494	2.310	3.455	22.96	0.876	4.862	0.699	3.387	1.973	2.157	2.658	2.737**
Harbor Marina	0.451	2.248	2.059	14.64	0.962	5.412	0.253	1.322	1.652	1.770	1.699	1.850
Long Beach	1.782	9.358	3.952	31.04	1.060	7.864	0.739	4.792	3.897	4.139	7.863	8.529
Harbor Marina	1.599	9.253	3.602	31.44	1.069	7.914	1.236	8.076	3.977	4.439	6.113	6.797
San Diego	0.359	1.737	0.923	6.063	0.968	4.717	0.478	2.493	2.102	2.205	1.759	1.879
Shelter Island	0.962	4.789	1.832	15.33	0.334	2.105	0.290	1.821	1.969	2.094	2.172	2.328

* One large specimen.
** One whole valve.

TABLE 3

ISOTOPE RATIOS OF LEAD IN *Mytilus* sp.

Location	*Species*	*Date collected*	*Material*	$^{206}Pb/^{204}Pb$	$^{206}Pb/^{207}Pb$	$^{206}Pb/^{208}Pb$
Piedras Blancas South of lighthouse	*M. californianus*	10/21/72	soft parts	18.79	1.193	0.4859
Gaviota State Beach	*M. californianus*	10/23/72	soft parts	—	1.191	0.4839
Santa Barbara Harbor Marina	*M. edulis*	10/24/72	soft parts	18.54	1.183	0.4845
			shell	18.47	1.182	0.4841
Long Beach Harbor Marina	*M. edulis*	04/11/73	soft parts	18.68	1.187	0.4842
			shell	18.56	1.187	0.4869
Oceanside Harbor Marina	*M. edulis*	04/11/73	soft parts	18.59	1.184	0.4855
San Diego La Jolla Scripps Pier and Pacific Beach Pier	*M. californianus*	04/12/73	soft parts	18.60	1.185	0.4843
		05/24/73	shell	18.38	1.178	0.4746
Punta Banda and La Salina Baja California	*M. californianus*	05/08/73 05/09/73	soft parts	18.37	1.176	0.4790

REF. NO.: 76 - C - 3

SUBSTANCES: Pb

Reference: Chow, T. J., C. B. Snyder, H. G. Snyder & J. L. Earl. 1976. Lead content of some marine organisms. J. Environ. Sci. Health, Environ. Sci. Eng. A11:33-44.

Organisms: *Hinnites multirugosus* *Chione* sp.
Crassostrea gigas
Protothaca staminea
Tivela stulforum

Date of Sample Collection: 1971-73

Location: Southern California and Baja California, Mexico

Analytical Technique: Mass spectrometry

Analytical Data:

Chow, T. J. et al. 1976.

APPENDIX 3. Lead Contents of Some Marine Invertebrates.

Specimen	Location	Year	Material	Pb, p.p.m. Wet. Wt.	Pb, p.p.m. Dry Wt.
Hinnites multirugosus (Rock Scallop)	La Jolla	1971 Nov.	Muscle	0.042	0.18
				0.057	0.26
				0.077	0.35
				0.11	0.49
			Shell	--	0.32
				0.60	0.65
Grassostrea gigas (Oyster)	Morro Bay	1972 Oct.	Muscle	0.056	0.28
				0.086	0.39
				0.11	0.52
			Viscera	0.049	0.30
				0.057	0.25
				0.070	0.37
			Whole Tissue	0.045	0.27
				0.081	0.41
				0.089	0.45
			Shell	0.14	0.15
Protothaca staminea (Cockle)	Rincon Point	1972 Oct.	Tissue	0.027	0.16
				0.027	0.19
				0.074	0.43
				0.077	0.47
				0.10	0.78
			Shell	0.21	0.22
	Anaheim Bay	1973 April	Tissue	0.35	2.90
				0.39	3.12
				0.43	3.34
				0.55	3.92
				2.05	14.5
			Shell	1.06	1.10
				1.72	1.78
Tivela stulforum (Pismo Clam)	Morro Bay	1972 Oct.	Muscle	0.011	0.046
				0.014	0.056
				0.024	0.103
			Stomach	0.014	0.072
				0.024	0.12
				0.027	0.15
			Foot	0.008	0.045
				0.029	0.16
				0.050	0.30
			Shell	0.084	0.088
Chione sp. (Cockle)	Bahia de Todos Santos	1973 May	Tissue	0.020	0.18
				0.027	0.25
				0.038	0.36
				0.057	0.60
			Shell	0.11	0.12

REF. NO.: 76 - C - 4

SUBSTANCES: Pb

Reference: Clarke, J. H., A. N. Clarke, D. J. Wilson & J. J. Friauf. 1976. Lead levels in fresh water mollusk shells. J. Environ. Sci. Health, Environ. Sci. Eng. A11:65-78.

Organisms:
Corbicula manillensis
Anodonta grandis
Alasmidonta calceolus
Anodonta imbecillis
Lasmigona costata

Date of Sample Collection: 1976?

Location: Harpeth River and J. Percy Priest Reservoir, near Nashville, Tennessee

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Clarke, J. H. et al. 1976.

TABLE 1

Lead Concentrations (ppm) of Various Fresh Water Mollusk Shells

Species	Site	Weight Group	Lead Concentration Mean	Lead Concentration Range	Number of Samples
Corbicula Manillensis	#2 McDaniel Road	I[a]	1.9	0.0-3.6	36
	#3 Highway 100	I[a]	1.6	0.4-7.9	53
		II[b]	23.4	11.0-67.7	15
	#4 J. Percy Priest (island)	I[a]	0.6	0.1-1.3	20
	#5 J. Percy Priest (marina)	I[a]	1.2	0.1-3.4	18
		II[b]	39.0	4.2-190	21
Anodonta Grandis	#1 Highway 41	I[a]	0.4	0.1-0.8	22
	#2 McDaniel Road	I[a]	0.4	0.0-0.7	6
Alasmidonta Calceolus	#2 McDaniel Road	I[a]	1.1	0.1-4.0	7
Anodonta Imbecillis	#1 Highway 41	I[a]	0.15	0.1-0.2	2
	#4 J. Percy Priest (island)	I[a]	0.3	0.0-1.2	15
Lasmigona Costata	#1 Highway 41	I[a]	1.0	0.4-1.6	4
	#3 Highway 100	I[a]	0.8	0.0-1.8	3

[a]Group I shells weigh more than 0.2 grams per valve (half-shell).

[b]Group II shells weigh less than 0.2 grams per valve (half-shell).

REF. NO.: 72 - C - 2

SUBSTANCES: Zn, Cu, Na, K, Ca, Mg

Reference: Coombs, T. L. 1972. The distribution of zinc in the oyster *Ostrea edulis* and its relation to enzymic activity and to other metals. Mar. Biol. 12: 170-178.

Organisms: *Ostrea edulis*

Date of Sample Collection: 1971?

Location: Conway, North Wales, U.K. (fishery-raised)

Analytical Technique: Atomic absorption spectroscopy; flame emission spectroscopy

Analytical Data:

Coombs, T. L. 1972.

Table 1. *Ostrea edulis. Metal content of whole individuals and separated oyster tissues*

Material		Zn				Cu			
		μg/g protein	μg/g wet wt.	mmol/g protein	mmol/g wet wt.	μg/g protein	μg/g wet wt.	mmol/g protein	mmol/g wet wt.
Whole oyster (Conway)	No. 1	20,800	800	0.32	0.012	1,620	65	0.025	0.0010
	No. 2	12,650	550	0.19	0.009	980	42	0.015	0.0007
	No. 3	11,850	395	0.18	0.006	2,040	67	0.032	0.0011
	No. 4	19,700	560	0.30	0.009	1,605	45	0.025	0.0007
	No. 5	27,500	940	0.42	0.014	1,510	52	0.024	0.0008
	No. 6	26,000	1050	0.40	0.016	1,190	48	0.019	0.0008
	No. 6 (Dialysed)	1,340	54	0.02 (5%)	0.001	675	27	0.011 (57%)	0.0004
Whole oyster (Loch Ewe)	No. 1	8,490	465	0.13	0.007	713	39	0.011	0.0006
	No. 2	47,120	725	0.72	0.011	1,407	47	0.022	0.0007
Oyster (Conway)	Muscle	8,400		0.13		237		0.004	
	Palps	52,500		0.81		3,710		0.056	
	Gills	17,000		0.26		9,700		0.152	
	Mantle	49,000		0.75		2,300		0.036	
	Digest	32,700		0.50		2,450		0.038	
	Fluid	20,000		0.31		704		0.011	

Material		Na		K		Ca		Mg		PO_4	
		mmol/g protein	mmol/g wet wt.	mmol/g protein	mmol/g wet wt.	mmol/g protein	mmol/g wet wt.	mmol/g protein	mmol/g wet wt.	mmol/g protein	mmol/g wet wt
Whole oyster (Conway)	No. 1	71	0.28	0.93	0.037	0.31	0.013	1.01	0.041	0.81	0.032
	No. 2	56	0.24	0.98	0.043	0.23	0.010	0.83	0.037	0.94	0.042
	No. 3	66	0.22	1.18	0.039	1.35	0.045	1.06	0.035	1.24	0.041
	No. 4	89	0.25	1.97	0.055	0.52	0.015	1.30	0.037	1.10	0.031
	No. 5	80	0.27	0.98	0.034	0.56	0.019	1.24	0.043	0.79	0.027
	No. 6	57	0.23	1.51	0.061	0.33	0.013	0.90	0.036	1.01	0.040
	No. 6 (Dialysed)	N.D. (0%)	N.D.	N.D. (0%)	N.D.	0.02 (6%)	0.001	0.01 (1%)	0.004	0.12 (12%)	0.005
Whole oyster (Loch Ewe)	No. 1										
	No. 2										
Oyster (Conway)	Muscle	0.93		0.5		0.06		0.16		0.32	
	Palps	6.0		2.1		0.80		0.94		1.26	
	Gills	21.7		3.2		0.60		2.49		2.88	
	Mantle	10.0		1.3		0.70		1.28		0.95	
	Digest	5.0		1.6		0.30		0.64		1.22	
	Fluid	137.0		3.7		2.8		16.20		0.16	

REF. NO.: 57 - C - 2

SUBSTANCES: Pb

Reference: Costa, R. L. & L. R. Molins. 1957. Determinacion colorimetrica del plomo en el mejillon (Mytilus edulis) y en el agua de mar de la Ria de Vigo. Bol. Inst. Esp. Oceanogr. 84:1-13.

Organisms: Mytilus edulis

Date of Sample Collection: 1955

Location: Ria de Vigo, Spain

Analytical Technique: Colorimetry

Analytical Data:

RESULTADOS OBTENIDOS

Operac. núm.	Procedencia	Fecha	Agua mar. capturada a tres metros de profundidad Pb mgr./m³	Contenido en Pb del mejill. mgrs /kg. sobre M. seca	M.ª fresca	Factor de enriquecimiento del mejillón frente al agua del mar
1	Ríos	5- 2-55	9,10	0,150	0,011	17
2	Ribera del Berbés	15- 2-55	7,00	0,250	0,020	35
3	Domayo	1- 3-55	9,25	0,156	0,031	16
4	Louredal	11- 3-55	5,50	0,230	0,044	42
5	St XX	15- 3-55	6,50	—	—	—
6	Coya	25- 3-55	4,00	0,240	0,060	60
7	San Adrián	5- 4-55	6,35	—	—	—
8	Raude	12- 4-55	9,75	0,283	0,066	29
9	Dársena Náutico.	3- 5-55	7,50	0,269	0,055	36
10	Coya	10- 5-55	6,75	0,321	0,072	48
11	Meira	24- 5-55	6,75	0,267	0,060	40
12	Ribera del Berbés	7- 6-55	6,75	0,286	0,057	42
13	Domayo	14- 6-55	6,62	0,187	0,045	28
14	Dársena W. Pto. Pesquero	28- 6-55	7,00	0,314	0,067	44
15	Pto. Bayona... ...	15- 7-55	6,25	0,359	0,075	57
16	Canabal	18- 8-55	6,25	—	—	—
17	Rande...	20- 9-55	5,75	0,260	0,071	45
18	Rande...	23- 9-55	—	0,232	0,065	—

Factor medio de enriquecimiento = 38,5

REF. NO.: 67 - C - 2

SUBSTANCES: Pb, Cu, Hg

Reference: Craig, S. 1967. Toxic ions in bivalves. J. Amer. Osteopath. Ass. 66:1000-1002.

Organisms: *Venus mercenaria*
Spisula sp.

Date of Sample Collection: 1967?

Location: Delaware Bay and Woods Hole, Mass.

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Craig, S. 1967.

TABLE 1. CONCENTRATIONS OF LEAD, COPPER, AND MERCURY IN VENUS MERCENARIA

Delaware Bay					Woods Hole				
No. of clams per batch	Total weight per batch (grams)	Average concentration in ppm of each batch			No. of clams per batch	Total weight per batch (grams)	Average concentration in ppm of each batch		
		Pb	Cu	Hg			Pb	Cu	Hg
5	105.5	1.29	1.52	1.35	3	97.2	1.12	18.03	1.20
2	66.4	0.72	0.50	0.57	4	120.8	1.30	19.20	1.30
11	126.39	1.87	1.32	1.39	5	165.0	2.90	18.71	2.90
4	54.00	0.51	0.31	1.24	3	92.7	2.01	16.51	1.54
					6	148.32	4.42	27.50	7.44
					3	93.6	1.10	15.42	1.89
22	352.29	4.39	3.65	4.55	24	717.62	12.85	115.37	16.77
Average weight per clam	16.01					29.92			
Average concentration for each clam		1.09	0.91	1.11			2.57	19.23	2.71

TABLE 2. CONCENTRATIONS OF LEAD, COPPER, AND MERCURY IN SPISULA SP.

Delaware Bay					Woods Hole				
No. of clams per batch	Total weight per batch (grams)	Average concentration in ppm of each batch			No. of clams per batch	Total weight per batch (grams)	Average concentration in ppm of each batch		
		Pb	Cu	Hg			Pb	Cu	Hg
5	789.60	5.10	0.87	1.10	4	640.30	1.59	0.83	0.99
4	619.24	7.20	1.57	0.87	4	671.00	1.40	0.64	0.95
5	810.95	8.05	1.99	0.56	5	760.50	3.40	0.70	0.83
3	664.70	9.18	0.69	0.91	4	636.16	1.84	0.71	0.81
4	630.00	8.40	1.19	0.61	5	806.10	2.34	1.03	0.87
3	492.21	6.30	0.42	0.86	2	319.80	0.19	0.46	0.56
24	4006.50	44.23	6.67	4.91	24	3833.86	10.26	2.37	5.01
Average weight per clam	166.93					159.74			
Average concentration for each clam		7.37	1.11	0.82			1.17	0.73	0.835

TABLE 3. COMPARATIVE SUMMARY OF THE DATA OF TABLES 1 AND 2

	Delaware Bay			Woods Hole		
	Venus mercenaria	Spisula sp.	Sea water	Venus mercenaria	Spisula sp.	Sea water
Average weight (grams)	16.0	166.93		29.48	159.74	
Concentration (ppm)						
Pb	1.09	2.37	0.4	2.57	1.71	42.02
Cu	0.91	1.11	5.0	19.23	0.73	1.32
Hg	1.11	0.82	10.5	2.32	0.835	0.1199

REF. NO.: 72 - C - 3

SUBSTANCES: Mn, Fe, Cu, Zn

Reference:

Cross, F. A., J. M. Lewis, L. H. Hardy & N. Y. Jones. 1972. Partitioning of Me, Fe, Cu and Zn among four species of filter-feeding bivalve molluscs. Atlantic Estuarine Fisheries Center, Ecology Division, Ann. Rep. to AEC, 1972, p. 33-51.

Organisms:

Mercenaria mercenaria
Tagelus plebius
Chione cancellata
Argopecten irradians
Venus japonica
Aequipecten irradians

Date of Sample Collection: 1970-71

Location: Newport River estuary and Bogue Sound, North Carolina

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 2.--Concentrations of Fe, Mn, Zn, and Cu in four species of molluscs. These values are expressed as the mean ± two S.E., the median, the concentration at the mean log values ± two S.E., and the 10th-90th percentile range.

Expression of concentration[A]	Hard clams (133)[B] (Mercenaria mercenaria)				Razor clams (141)[B] (Tagelus plebius)				Dog clams (74)[B] (Chione cancellata)				Scallops (61)[B] (Argopecten irradians)			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Mean conc. ±2 S.E.	270 ±24	15 ±2.2	79 ±4.1	13 ±0.8	1200 ±120	25 ±1.7	95 ±4.8	81 ±8.2	440 ±74	47 ±15	45 ±3.2	33 ±8.0	510 ±100	440 ±98	180 ±17	20 ±8.0
Median value	240*	13	74*	13	1000*	24	93	76	340*	16*	40*	24*	380*	380**	170	12
Conc. at mean log value ±2 S.E.	240 (+20) (-18)	11 (+1.9) (-1.2)	76 (+0.5) (-3.0)	13 (+0.2) (-1.3)	1100	23 (+2.3) (-2.3)	91 (+6.0) (-6.0)	67 (+8.5) (-7.9)	370 (+55) (-49)	22 (+7.7) (-5.7)	43 (+2.7) (-2.5)	25 (+4.4) (-3.6)	400 (+73) (-58)	270 (+85) (-68)	170 (+15) (-12)	13 (+3.3) (-2.5)
10th-90th Percentile range	130 - 460	3.5 - 31	56 - 110	8.9 - 17	580 - 1800	13 - 37	61 - 130	28 - 150	200 - 720	5.9 - 160	33 - 60	11 - 45	180 - 900	49 - 860	130 - 240	6.4 - 32

[A]µg/g dry wt.

[B]Number of individuals analyzed

*More than two standard errors from the arithmetic mean

**More than two standard errors from the log mean value

Table 3.—Comparison of published concentrations of trace metals in hard clams or in closely related species.

Investigator	Organism	Collection sites	Sample size (individuals)	Fe[A]	Mn[A]	Cu[A]	Zn[A]
Pringle et al. (1968)	*Mercenaria mercenaria*	Maine through North Carolina	U[B]	30 (9.0-83)	5.6 (0.7-30)	2.6 (1.0-16.5)	20.6 (11.5-40.2)
Segar et al. (1971)	*Mercenaria mercenaria*	Irish Sea	U[B]	1100[C]	3.6[C]	5[C]	19[C]
Shimizer (1967)	*Venus japonica*	Eastern coast of Japan	U[B]	48[D] (2.9-138)	NA	1.8[D]	NA
Schelske et al. (in press)	*Mercenaria mercenaria*	Beaufort, North Carolina	U[B]	62	1.8	NA	NA
Cross et al. (this study)	*Mercenaria mercenaria*	Beaufort, North Carolina	133	28 (7.6-82)	1.6 (0.14-7.2)	1.4 (0.16-2.5)	8.2 (4.6-24)

[A]Mean and range (if known) in μg/g wet weight

[B]Number of individuals analyzed not known

[C]Published dry weight values were converted to wet weight

[D]Values drom two sampling areas averaged

NA-not analyzed in sample

Table 4.--Comparison of published concentrations of trace metals in bay scallops or in closely related species.

Investigator	Organism	Collection sites	Sample size (individuals)	Fe[A]	Mn[A]	Cu[A]	Zn
Segar et al. (1971)	*Pecten maximus*	Irish Sea	NK	48	40	0.93	65
Schelske et al. (In press)	*Aquipecten irradians*	Beaufort, N. C.	NK	70	55	NA	NA
Cross et al. (this study)	*Aquipecten irradians*	Beaufort, N. C.	61	84 (15-400)	72 (6.3-320)	3.4 (0.86-36)	30 (16-70)

[A]Mean and range (if known) in µg/g wet weight

NK-number of individuals analyzed not known

NA-not analyzed in samples

Cross, F. A. et al. 1972.

REF. NO.: 75 - C - 2

SUBSTANCES: Cu, Pb, Zn, Cd, Mn, Cr, Hg

Reference: Crowley, M. & C. Murphy. 1975. Heavy metals in mussels and in seawater from Irish coastal waters. ICES C.M. Papers & Reports, C.M. 1975/E:29, 10p.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1975?

Location: Irish Sea

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table IV

Comparison of chromium concentrations in Dungarvan with those for the rest of the country.

Water		Mussels	
Mean Value for Country	Value for Dungarvan	Mean Value for Country	Value for Dungarvan
0.04 p.p.m.	0.130 p.p.m.	0.61 p.p.m.	6.40 p.p.m.

Crowley, M. & C. Murphy. 1975.

TABLE II: Concentrations of Cu, Pb, Zn, Cd, Mn, Cr, in Mythilus edulis p.p.m. (wet weight).

Location	Cu	Pb	Zn	Cd	Mn	Cr
Carlingford Lough	1.07	0.35	6.75	0.97	1.33	1.60
Dundalk	0.08	3.12	8.80	0.60	0.87	0.17
Mornington	0.35	0.41	23.00	-	3.27	2.10
Malahide	0.55	0.47	22.00	-	1.92	2.10
Arklow	-	-	-	-	-	-
Wexford	1.38	0.01	29.00	-	3.35	2.21
Waterford	4.00	2.30	10.80	-	2.33	0.31
Dungarvan	0.83	1.20	29.00	-	2.70	6.40
Youghal	0.52	N.D	9.90	0.28	1.30	N.D
Cork	0.35	N.D	23.30	0.23	1.40	N.D
Oysterhaven	0.43	N.D	7.56	0.03	0.54	0.02
Kinsale	0.34	0.02	1.22	-	-	0.41
Courtmacsherry	1.25	N.D	8.33	0.31	0.89	N.D
Clonakilty	1.10	N.D	10.40	0.31	0.98	0.26
Rosscarberry	0.66	N.D	8.60	0.28	1.80	N.D
Glandore	0.75	0.08	8.20	0.23	1.00	N.D
Roaringwater Bay	0.90	0.11	5.20	0.96	2.40	0.04
Bantry Bay	0.14	N.D	9.60	0.34	0.65	N.D
Castletownbere	0.34	0.07	10.40	0.08	2.00	N.D
Dingle	-	-	-	-	-	-
Shannon Estuary	0.60	N.D	7.70	0.20	2.10	N.D
Clarecastle	-	-	-	-	-	-
Ballyvaughan	0.09	0.30	15.60	0.20	1.03	0.02
Galway	0.80	0.14	10.04	0.29	1.60	0.13
Killary	1.00	0.09	5.30	0.07	1.40	N.D
Killala	0.65	0.01	7.00	0.23	1.20	N.D
Sligo	0.60	0.08	12.00	0.45	1.20	N.D
Donegal	0.13	0.03	10.01	0.24	1.60	0.11
Killybegs	0.24	0.01	19.00	0.20	1.20	0.08
Mean	00.75	0.34	12.26	0.31	1.60	0.61

"-" = Not examined.

"N.D."= Not detected.

Crowley, M. & C. Murphy. 1975.

TABLE III: Heavy metals concentrations in Irish coastal waters. Parts per million

Location	Cd	Mn	Cr	Hg
Carlingford Lough	0.003	0.005	0.010	0.001
Dundalk	0.001	0.008	0.010	0.001
Drogheda	0.002	0.002	0.010	0.001
Skerries	0.008	0.002	0.001	0.001
Malahide	0.002	0.003	0.010	0.001
Arklow	0.001	0.020	0.010	0.001
Wexford	0.001	0.006	0.010	0.002
Waterford	0.002	0.040	0.006	0.001
Dungarvan	0.005	0.008	0.130	0.002
Youghal	0.001	0.011	0.012	0.002
Cork	0.002	0.020	0.006	0.001
Kinsale	0.002	0.020	0.006	0.003
Courtmacsherry	0.001	0.009	0.003	0.001
Clonakilty	0.003	0.002	0.010	0.003
Rosscarbery	0.001	0.001	0.012	0.002
Glandore	0.002	0.006	0.028	0.004
Roaringwater Bay	0.002	0.080	0.012	0.001
Bantry Bay	0.001	0.013	0.012	0.001
Castletownbere	0.003	0.001	0.028	0.004
Dingle	0.001	0.005	0.012	0.001
Shannon Estuary	0.002	0.008	0.018	0.001
Clarecastle	0.001	0.028	0.029	0.001
Ballyvaughan	0.001	0.001	0.008	0.001
Galway	0.001	0.012	0.006	0.001
Killary	0.001	0.005	0.008	0.001
Killala	0.001	0.008	0.005	0.001
Sligo	0.001	0.007	0.005	0.001
Donegal	0.001	0.015	0.001	0.001
Killybegs	0.001	0.006	0.010	0.001
Mean	0.002	0.012	0.014	0.001

REF. NO.: 58 - C - 2

SUBSTANCES: Ga, Cu, Al, Fe

Reference: Culkin, F. & J. P. Riley. 1958. The occurrence of gallium in marine organisms. J. mar. biol. Ass. U.K. 37:607-615.

Organisms: Mytilus edulis
Pecten maximus
Chlamys opercularis

Date of Sample Collection: 1958?

Location: Irish Sea and Isle of Man

Analytical Technique: spectrophotometry

Analytical Data: (dry wt, dried at 110°C)

TABLE 2. OCCURRENCE OF GALLIUM, ALUMINIUM, IRON AND COPPER IN MARINE ANIMALS

Organism	Ash (%)	Ga (μg/g)	Cu (μg/g)	Al (μg/g)	Fe (μg/g)	Ga/Al × 10⁴	Ga/Fe × 10⁴	Ga in ash (μg/g)
PROTOZOA								
Foraminifera								
Ramulina sp.	116	0·18	111	973	1148	1·9	1·6	0·2
PORIFERA								
Halichondria panicea	88·7	0·93	59·5	3700	4040	2·5	2·3	1·1
COELENTERATA								
Alcyonium digitatum	69·0	0·05	61·5	435	438	1·2	1·1	0·1
CRUSTACEA								
Cirripedia								
Balanus balanoides	120	0·07	28·7	240	146	2·9	4·8	0·05
Decapoda								
Cancer pagurus	79·0	0·03	35·0	166	157	1·8	1·9	0·04
Corystes cassivelaunus	71·6	0·36	—	1041	1045	3·5	3·4	0·5
MOLLUSCA (Shells only)								
Lamellibranchia								
Mytilus edulis	—	0·010	2·1	38	41	2·6	2·4	0·01
Pecten maximus	—	0·008	6·0	81	118	1·0	0·7	0·01
Chlamys opercularis	—	0·069	3·8	174	239	4·0	2·8	0·07
Gastropoda								
Buccinum undatum	—	0·036	1·6	76	85	4·7	4·2	0·04
Littorina littorea	—	0·011	5·2	32	45	3·4	2·4	0·01
Gibbula umbilicalis	—	0·014	7·9	48	51	2·9	2·7	0·01
MOLLUSCA (Soft parts)								
Lamellibranchia								
Mytilus edulis	15·8	0·16	53·7	465	325	3·4	4·9	1·0
Pecten maximus				See Table VI.				
Chlamys opercularis	15·7	0·05	37·1	186	1093	2·7	0·5	0·3
Gastropoda								
Buccinum undatum	8·8	0·007	53·5	198	86	0·35	0·8	[illegible]
Littorina littorea	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Culkin, F. & J. P. Riley. 1958.

TABLE 3. DISTRIBUTION OF GALLIUM, ALUMINIUM, IRON AND COPPER IN *CHLAMYS OPERCULARIS*

Organ	Ash (%)	Ga (μg/g)	Cu (μg/g)	Al (μg/g)	Fe (μg/g)	Ga/Al × 10⁴	Ga/Fe × 10⁴	Ga in ash (μg/g)
Shell	—	0·07	3·8	174	239	4·0	2·9	0·07
Muscle	6·5	0·06	47·9	773	52·8	0·8	1·1	1·0
Gonad	10·4	0·06	—	—	—	—	—	0·6
Mantle and viscera	21·6	0·55	1150	3420	2720	1·6	2·0	2·5

TABLE 6. DISTRIBUTION OF GALLIUM, ALUMINIUM, IRON AND COPPER IN *PECTEN MAXIMUS*

Unpurged	Full gonad	Spent gonad	Striped muscle	Unstriped muscle	Mantle	Digestive gland	Gonad + gut	Mantle gut + digestive gland
Sulphated ash (%)	10·7	3·2	6·0	4·7	13·3	7·2	12·6	13·9
Ga (μg/g)	<0·01	0·009	<0·01	<0·01	<0·01	0·79	0·29	0·3[illegible]
Al (μg/g)	—	—	86·6	—	161	454	833	842
Fe (μg/g)	—	—	167	—	189	841	1552	766
Cu (μg/g)	—	25·2	4·0	—	—	153	—	50·8
Ga in ash (μg/g)	<0·1	0·28	<0·2	<0·2	<0·1	11·0	2·3	2·2

Purged	Gills	Male gonad	Female gonad	Striped muscle	Gut + digestive gland	Mantle
Sulphated ash (%)	25·0	3·0	10·2	12·7	10·9	9·4
Ga (μg/g)	0·14	0·034	<0·01	<0·01	0·011	0·01
Cu (μg/g)	6·3	11·3	26·6	7·5	70·9	10·2
Ga in ash (μg/g)	0·56	1·1	<0·1	<0·1	1·0	<0·1

REF. NO.: 75 - D - 4 **SUBSTANCES:** Cd

Reference: Darracott, A. & H. Watling. 1975. The use of molluscs to monitor cadmium levels in estuaries and coastal marine environments. Trans. Roy. Soc. S. Africa 41:325-338

Organisms:
Crassostrea gigas
Crassostrea virginica
Ostrea sinuata
Ostrea edulis
Modiolus modiolus
Mytilus edulis
Mytilus edulis aoteanus
Glycymeris glycymeris
Mercenaria mercenaria
Mya arenaria
Cardium edule
Pecten maximus
Pecten nova-zelandiae

Date of Sample Collection:

Location: U.S., U.K., New Zealand

Analytical Technique: ?

Analytical Data:

TABLE 2

Reported cadmium concentration in molluscs from polluted and unpolluted environment—unpolluted.

Mollusc (entire soft parts)	Cadmium dry tissue (µg/g)	Cadmium wet tissue (µg/g)	Location	Source
Lamellibranchia				
F. Ostreidae				
Crassostrea gigas	1,8	0,2	4 month Helford River,	
	2,2	0,2	8 month Cornwall, U.K.	This paper
	1,6	0,3	12 month	
	5		Menai Straits, U.K.	Boyden & Romeri 1974
Ostrea edulis	3,2	0,5	Carrick Roads, Falmouth, Cornwall, U.K.	Darracott, unpublished data
F. Mytilidae				
Mytilus edulis	3,2		Port Erin, Isle of Man, U.K.	Mullin & Riley 1956
	5,1		Solent, U.K.	Segar *et al.* 1971
Modiolus modiolus	5,8		Port Erin, Isle of Man, U.K.	Segar *et al.* 1971
Other Bivalvia				
Glycymeris glycymeris	3,3		Port Erin, Isle of Man, U.K.	Segar *et al.* 1971
Mercenaria mercenaria	2,1		Solent, U.K.	Segar *et al.* 1971
		0,19	Atlantic coast, U.S.A.	Pringle *et al.* 1968
Mya arenaria		0,27	Atlantic coast, U.S.A.	Pringle *et al.* 1968
Cardium edule	1,5		Solent, U.K.	Segar *et al.* 1971
Pecten maximus	13		Port Erin, Isle of Man, U.K.	Segar *et al.* 1971
Gastropoda				
Carnivores/scavengers				
Nucella lapillus	36		Beer, Dorset, U.K.	Stenner & Nickless 1974
	73		Port Erin, Isle of Man, U.K.	Segar *et al.* 1971
	38		Port Erin, Isle of Man, U.K.	Mullin & Riley 1956
Buccinum undatum	2,2		Solent, U.K.	Segar *et al.* 1971
	31,8		Port Erin, Isle of Man, U.K.	Mullin & Riley 1956
Herbivores				
Patella vulgata	16,4		Port Erin, Isle of Man, U.K.	Mullin & Riley 1956
	31		Port Erin, Isle of Man, U.K.	Segar *et al.* 1971
Patella sp.	9			Nickless *et al.* 1972
		0,9–2,3	South Devon, U.K.	Peden *et al.* 1973
	4,4		North Sea shoreline, U.K.	Dutton *et al.* 1973
	11		Beer, Dorset, U.K.	Stenner & Nickless 1974

Darracott, A. & H. Watling. 1975.

TABLE 2

Reported cadmium concentration in molluscs from polluted and unpolluted environments—polluted.

Mollusc (entire soft parts)	Cadmium dry tissue (μg/g)	Cadmium wet tissue (μg/g)	Location	Source
Lamellibranchia				
F. Ostreidae				
Crassostrea gigas . . .	14,1	1,8	4 month Poole Harbour,	This paper
	26,1	3,8	8 month Dorset, U.K.	
	32		Hinkley Point Power Station pond, Somerset, U.K.	Boyden & Romeril 1974
Gastropoda				
Carnivores/scavengers				
Nucella lapillus . . .	620		St Andrews Head, Somerset, U.K.	Stenner & Nickless 1974
Herbivores				
Patella sp.		118,5	Portishead, Somerset, U.K.	Peden *et al.* 1973
		107	Weston super Mare, U.K.	
		85	Watchet, U.K.	
Patella sp.	500		Bristol Channel, U.K.	Nickless *et al.* 1972
	265		Bristol Channel, U.K.	
	100		Mumbles, Swansea, U.K.	
	68		Gower, Swansea, U.K.	
Patella sp.	220		St Andrews Head, Somerset, U.K.	Stenner & Nickless 1974

TABLE 2

Reported cadmium concentration in molluscs from polluted and unpolluted environment—possibly polluted

Mollusc (entire soft parts)	Cadmium dry tissue (μg/g)	Cadmium wet tissue (μg/g)	Location	Source
Lamellibranchia				
F. Ostreidae				
Crassostrea gigas . . .		1,14	Pacific coast, U.S.A.	Pringle *et al.* 1968[1]
'Oysters, unspecified' .		0,2–2,1	Pacific coast, U.S.A.	Pringle *et al.* 1968[1]
Crassostrea virginica . .		3,1	Atlantic coast, U.S.A.	Pringle *et al.* 1968[1]
'Oysters, unspecified' .		0,1–7,8	Atlantic coast, U.S.A.	Pringle *et al.* 1968[1]
Ostrea sinuata. . . .	35		Tasman Bay, N.Z.	Brooks & Rumsby 1965[2]
F. Mytilidae				
Mytilus edulis aotearoa .	< 10		Tasman Bay, N.Z.	Brooks & Rumsby 1965[2]
Other Bivalvia				
Perna nesa-zelandica. .	249		Tasman Bay, N.Z.	Brooks & Rumsby 1965[2]

[1] Sampling stations were selected 'without regard to possible chemical pollution'.
[2] High concentrations may be due to the method of analysis (spectrographic as opposed to spectrophotometric).

TABLE 5

Cadmium concentrations in the gills, mantle and whole animal of *Crassostrea gigas* placed in Poole Harbour and Helford River.

(Trace metal concentrations as μg/g.)

Sample	Initial sample Helford	Initial sample Poole	4-month Helford	4-month Poole	8-month Helford	8-month Poole	12-month Helford
WET TISSUE							
Cd gills	1,7	1,3	0,27	2,3	0,32	3,9	0,5
Cd mantle . . .	1,6	0,8	0,2	1,9	0,23	2,7	0,3
Cd whole oyster .	0,8	0,8	0,2	1,8	0,2	3,8	0,8
Zn whole oyster .	256	255	213	230	247	380	421
Cu whole oyster .	43	33	32	33	63	56	85
Mean wet weight of individual oysters (g)	0,32	0,48	2,02	2,0	3,43	4,62	6,73
DRY TISSUE							
Cd gills	15,0	10,8	2,5	19,0	3,8	29,4	3,6
Cd mantle . . .	15,0	6,0	2,4	16,0	2,8	25,8	2,0
Cd whole oyster .	6,0	4,0	1,8	14,1	2,2	26,7	1,6
Mean dry weight of individual oysters (g)	0,05	0,09	0,26	0,26	0,55	0,65	1,19

Note: A 12-month sample was not obtained from Poole Harbour.

REF. NO.: 75 - D - 5

SUBSTANCES: Hg

Reference: D'Aubert, S., P. Renon & A. Corrado. 1975. Contaminazione da mercurio in alcuni frutti di mare del Mediterraneo. Arch. Vet. Ital. 26(5-6): 153-155.

Organisms:

Mytilus galloprovincialis
Venus gallina
Pecten jacobaeus
Glycymeris violacescens
Cardium tuberculatum
Amygdalum decussata
Ostrea edulis

Date of Sample Collection: 1975?

Location: Mediterranean Sea

Analytical Technique:

Analytical Data:

TABELLA n. 1.

Fonte	N. campioni	Tipo	Origine	Concentr. Hg ppm
Kittamura	15	Lamellibranchi	Giappone	0,007-4,81
Newberne	1	Ostriche	Canadà	0,068
Newberne	2	Pecten jacobaeus	Canadà	0,009-0,012
Newberne	1	Pecten opercularis	U.S.A.	0,004
Newberne	1	Pecten jacobaeus	U.S.A.	0,03
Bligh & Armstrong	—	Ostriche	Canadà	0,02 -0,14
Bligh & Armstrong	—	Pecten opercularis	Canadà	0,02 -0,11
Ministry of Agriculture Fisheris and food	—	Ostriche	Inghilterra Tamigi	0,03 -0,20
Fisheris and food	—	Mitili	Tamigi	0,02 -0,65
Aubert	10	Ostriche	Mediterraneo	0,19
Simpson e coll.	—	Lamellibranchi Mitili Pecten opercularis	Massachussets	0,3 -4

RISULTATI

I risultati sono riportati nella Tab. n. 2.

TABELLA n. 2 - *Concentrazioni in Hg (ppm) in alcuni frutti di mare.*

Tipo	Provenienza	Concentrazione di Hg ppm (valori medi)
Mitilus Galloprovincialis	La Spezia	0,02-0,03
Mitilus Galloprovincialis	Chioggia	0,03-0,04
Mitilus Galloprovincialis	Spagna	0,01-0,02
Venus Gallina	Chioggia	0,03-0,04
Venus Gallina	Cattolica	0,03-0,05
Pecten jacobaeus	Chioggia	0,02-0,05
Murex trunculus	Chioggia	0,17-0,28
Amigdala decussata	Chioggia	0,48-0,57
Ostrea edulis	Chioggia	0,14-0,27
Glicimeris violacesens	Chioggia	0,06-0,08
Cardium tuberculatum	Chioggia	0,08-0,10
Massa mutabilis	Cattolica	0,06-0,08

SUBSTANCES: Cu

REF. NO.: 75 - D - 1

Reference: Delhaye, W. & D. Cornet. 1975. Contribution to the study of the effect of copper on *Mytilus edulis* during reproductive period. Comp. Biochem. Physiol. 50A:511-518.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1972-73

Location: Knokke, Belgium and Morgat, France

Analytical Technique: atomic absorption

Analytical Data:

Table 1. Copper contents of mussels

	Knokke	Morgat
	($\mu g\ Cu^{2+}/g$ dry weight)	
Whole mussels	11·5	8·37
Gills	10·77	6·91
Foot	7·2	4·21
Mantle	5·85	5·4
Kidney	8·72	7·4
Digestive gland	6·87	7·02
Muscles	2·74	3·72

REF. NO.: 75 - D - 3 **SUBSTANCES:** Hg

Reference: De Wolf, P. 1975. Mercury content of mussels from West European coasts. Mar. Pollut. Bull. 6:61-63.

Organisms: *Mytilus edulis*
Mytilus galloprovincialis

Date of Sample Collection: 1971-72

Location: West European coast, from Arcachon, France, to Cape Skagen, Denmark; East coast of Jutland, Denmark; Land's End to Edinburgh, Great Britain

Analytical Technique: atomic absorption spectrometry

Analytical Data:

TABLE 1
Mean mercury content of fresh soft parts of intertidal mussels in ppb, calculated from the contents of a number of samples of 100 mussels each, collected from different sites in the areas indicated.

	No. of samples	1971						1972		
		March	May	July	Sept	Nov	Dec	Jan	Feb	Mar
Western Scheldt	10	132	141	154	112	130		180		120
Eastern Scheldt	7	147	110	166	97	110		121		136
West coast of Holland	5	177	148	140	98	130		175		186
Western Wadden Sea	10	171	122	157	96	133		137	176	218
Eastern Wadden Sea	5	118	95	101	89	92		92	117	140
Eems Dollard Estuary	3	488	237	312	305–259	300	261	311	288	613

TABLE 2
Mercury content (ppb, fresh weight) of subtidal and intertidal mussels of comparable sites and dates.

Area	Period	Subtidal	Intertidal
Eastern Scheldt	Nov.	88	110
Eastern Scheldt	Jan	95	121
West coast of Holland	March	157	186
Western Wadden Sea	March	137	218
Eastern Wadden Sea	Dec	106	135
Eems Dollard Estuary	Nov	146	300

TABLE 4
Mercury content (ppb, fresh weight) of intertidal mussels at large distances from the Netherlands coast.

Baye de St. Michel, fish market	6 [illegible]
Coutainville, from culture bed	3 [illegible]
St. Vaast La Hougue, fish market	9 [illegible]
Yerseke, from owner	14 [illegible]
Øland (German–Danish frontier), from fisherman	19 [illegible]
Arcachon, market	17 [illegible]
La Rochelle, from Bretagne, small mussels	6 [illegible]
La Rochelle, from Bretagne, large mussels	15 [illegible]
Carnac, market	12 [illegible]
Donarnenez, market	19 [illegible]
Burnham Overy Staithe, on musselbed	12 [illegible]

TABLE 5
Mercury content (ppb, fresh weight) of intertidal mussels of different size classes, from three different locations.

Size class (cm)	Pointe de Grave (France)	Nieuwstad (Netherlands)	Balgzand (Netherlands)
2.5–3.0	160	500	150
3.0–3.5	150	560	130
3.5–4.0	180	530	230
4.0–4.5	120	480	280
4.5–5.0		420	200
5.0–5.5		460	320
>5.5			330

TABLE 3
Mercury content (ppb, fresh weight) commercial mussels for consumption, collected as indicated, in March 1972.

Central North Sea (from buoy)	25–34
Hebrides	32–38
Dublin	20

REF. NO.: 74 - D - 2 **SUBSTANCES:** Cu, Zn

Reference: Drifmeyer, J. E. 1974. Zn and Cu levels in the eastern oyster, Crassostrea virginica, from the lower James River. J. Wash. Acad. Sci. 64:292-295.

Organisms: Crassostrea virginica

Date of Sample Collection: 1973

Location: lower James River, Virginia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt., dried at 105°C)

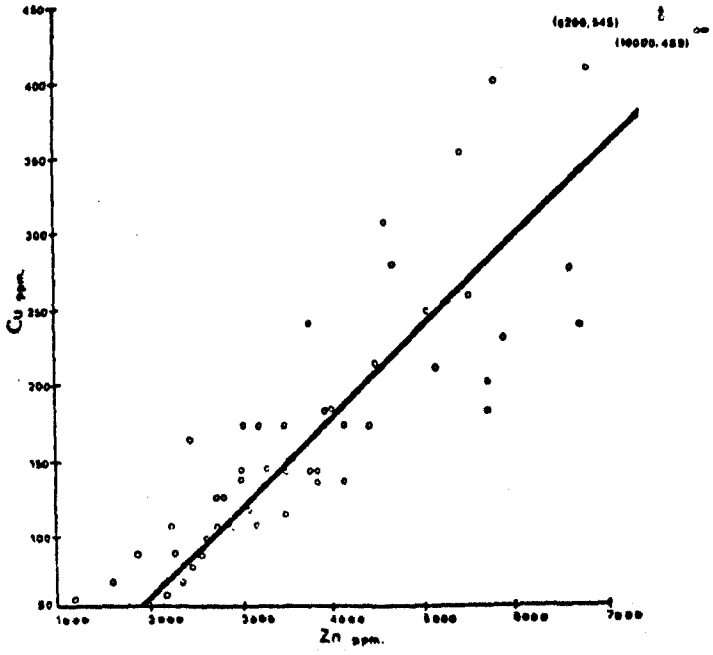


Fig. 2. Relationship between zinc and copper in oysters from the lower James River.

REF. NO.: 76 - E - 3

SUBSTANCES: Hg

Reference: Eganhouse, R. P. & D. R. Young. 1976. Mercury in tissues of mussel off Southern California. Mar. Pollut. Bull. 7:145-147.

Organisms: *Mytilus californianus*

Date of Sample Collection: 1974

Location: Southern California Bight

Analytical Technique: Flameless atomic absorption

Analytical Data:

TABLE 1
Mercury content (mg/kg wet wt) in tissues of mussels from Emma Woods State Beach (Stn. 4).

Tissue	No. of samples	Total mercury Mean	Std. deviation	Range
Digestive gland	7	0.022	0.005	0.017–0.032
Adductor muscle	9	0.012	0.005	0.008–0.021
Gonads	8	0.005	0.002	0.002–0.010

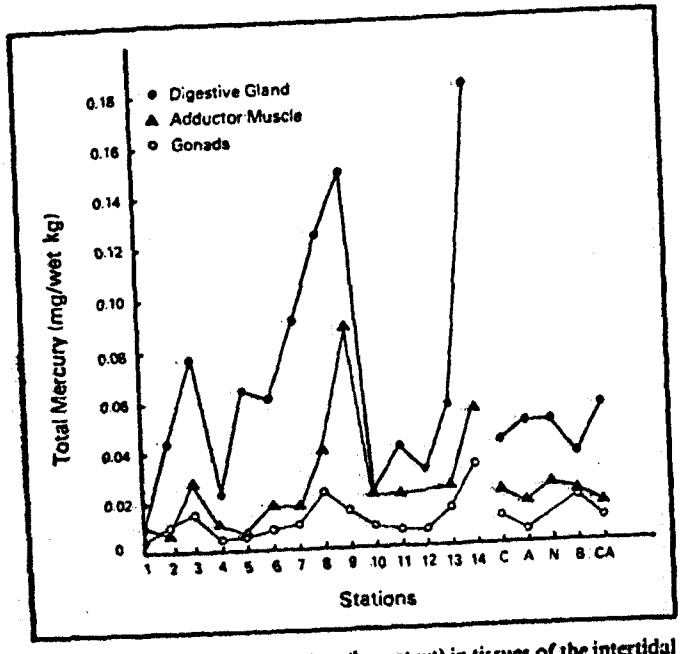


Fig. 2 Total mercury content (mg/kg wet wt) in tissues of the intertidal mussel, *M. californianus*, at various coastal and island stations, 1974.

REF. NO.: 76 - E - 1

SUBSTANCES: Hg

Reference: Eganhouse, R. P. Jr. & D. R. Young. 1976. Mercury in mussels. Southern California Coastal Water Research Project Annual Report, June 1976, p. 105-109.

Organisms: Mytilus californianus

Date of Sample Collection: 1974

Location: Southern California Bight

Analytical Technique: Flameless atomic absorption

Analytical Data:

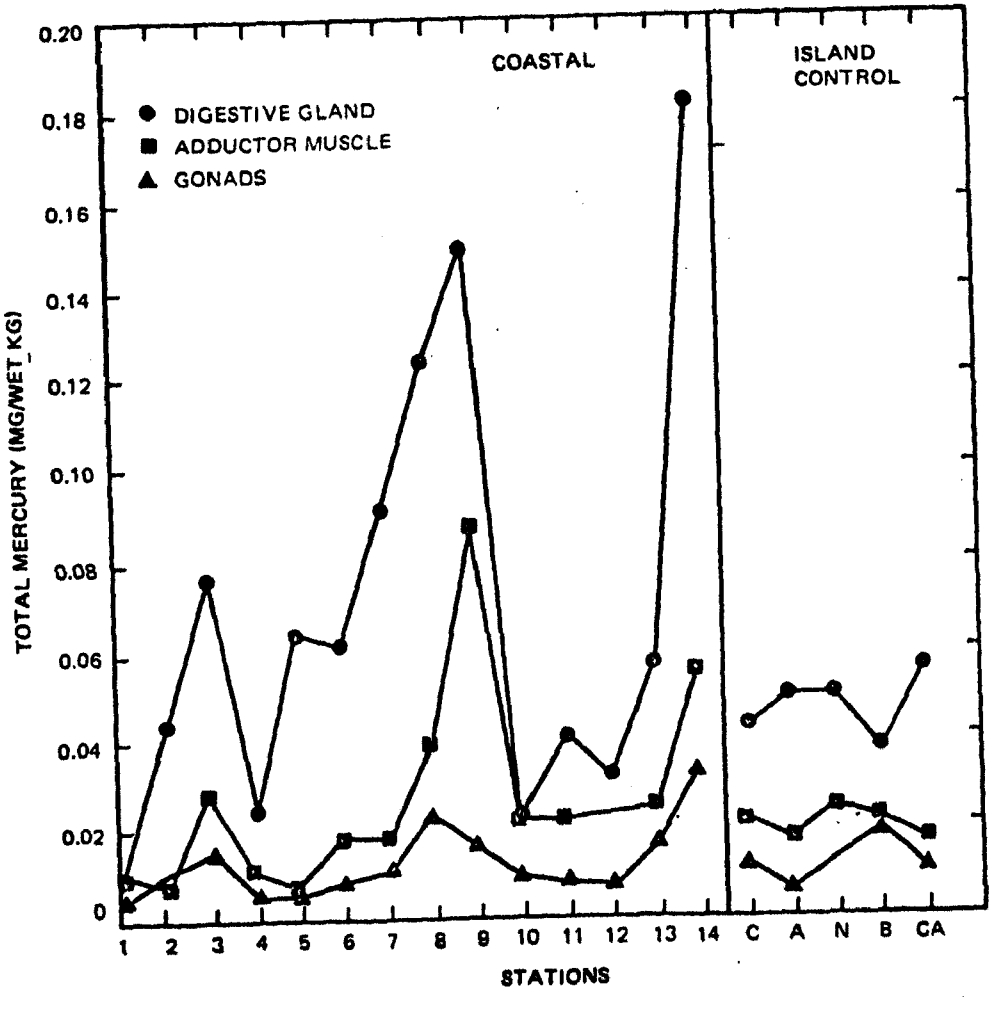


Figure 2. Total mercury content (mg/wet kg) in tissues of the intertidal mussel, *M. californianus*, at various coastal and island stations, 1974.

Eganhouse, R. P. Jr. & D. R. Young. 1976.

Table 1. Mercury content in tissues of mussels from Emma Woods State Beach (Station 4)

Tissue	No. of Samples	Mean (mg/wet kg)	Total Mercury Standard Deviation	Range (mg/wet kg)
Digestive gland	7	0.022	0.005	0.017–0.032
Adductor muscle	9	0.012	0.005	0.008–0.021
Gonads	8	0.005	0.002	0.002–0.010

Table 2. Total mercury (μg/wet kg) in tissues of *Mytilus californianus* from Point Sal, San Clemente Island, and Royal Palms, 1976

Station	Digestive Gland	Adductor Muscle	Gonad
Point Sal	26.7	20.6	5.1
	26.4	19.3	4.5
	26.1	28.3	5.8
San Clemente Island	23.0	21.5	6.4
Royal Palms	62.8	61.8	14.2

REF. NO.: 75 - E - 3

SUBSTANCES: Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn

Reference: Emerson, R. R., D. F. Soule & M. Oguri. 1975. Heavy metal concentrations in marine organisms and sediments collected near an industrial waste outfall. Proc. International Conference on Environmental Sensing and Assessment, Sept. 14-19, 1975, Las Vegas, Nev., v. 1, sect. 6-7, 5p.

Organisms: Macoma nasuta

Date of Sample Collection: 1975?

Location: Los Angeles Harbor, California

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt., dried at 103°C)

Table 2. Concentrations of heavy metals in invertebrates from five benthic stations

Station	Species	Element concentration# in ppm (dry wt)							
		Cd	Cr	Cu	Fe	Mn	Ni	Pb	Zn
2	Pelecypod (internal org.)	1.0	4.1	315.9	217.1	21.7	2.2	0.5	65.0
3	*Macoma nasuta*	1.0	19.1	140.7	266.1	34.3	6.5	2.0	75.9
3	Pelecypod (internal org.)	2.6	26.3	81.9	289.0	15.1	4.5	0.9	114.9
4	*Macoma nasuta*	0.9	22.2	79.8	249.4	15.3	19.2	1.3	99.5

Analyses are means of duplicate determinations.

REF. NO.: 68 - E - 1

SUBSTANCES: Cu, Fe, Mn, Zn

Reference: Establier, R. & M. Gurierrez. 1968. Distribucion anatomica de cobre, cinc, hierro y manganeso en el ostion, Crassostrea angulata (Lmk) y ostra, Ostrea edulis (L.). Inv. Pesq. 34:191-202.

Organisms: Crassostrea angulata
Ostrea edulis

Date of Sample Collection: 1968

Location: Cadiz, Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA I

Resultados de los análisis de Cu, Fe, Mn y Zn efectuados sobre las distintas partes anatómicas del Ostion *(C. angulata)* y de la Ostra *(O. edulis)*.

Especie	Procedencia	Fecha	Órgano	Cu mg/100 g		Fe mg/100 g		Mn mg/100 g		Zn mg/100 g	
				Fresco	Seco	Fresco	Seco	Fresco	Seco	Fresco	Seco
O. edulis	Ría de Arosa	6-3-68	M. Visceral	3,64	15,07	5,67	23,47	0,19	0,79	61,78	255,65
»	»	6-3-68	Manto	2,72	22,11	4,64	37,72	1,10	8,93	48,41	393,28
»	»	6-3-68	Branquias	1,38	11,06	2,66	21,60	0,90	7,17	57,61	460,91
»	»	6-3-68	M. Aductor T.	0,26	1,26	1,55	7,59	0,06	0,30	6,79	33,14
»	»	6-3-68	M. Ad. blanco	0,37	2,05	1,65	9,21	0,08	0,43	8,24	45,92
»	»	6-3-68	Palpos	1,83	10,17	4,00	22,22	0,59	3,28	72,63	403,75
»	»	6-3-68	Corazón	3,03	16,34	25,52	137,66	—	—	57,78	311,66
C. angulata	Sanlúcar de Bde.	29-3-68	M. Aductor T.	5,15	22,83	1,25	5,54	0,06	0,26	24,57	108,95
»	(Corral de Montijo)	29-3-68	M. Ad. Blanco	6,84	36,67	3,31	17,14	0,13	0,69	28,47	152,65
»	»	29-3-68	Palpos	53,27	257,46	3,07	14,84	0,66	3,18	219,36	1060,22
»	»	29-3-68	Manto	43,51	284,56	4,30	28,12	0,63	4,11	174,05	1138,25
»	»	29-3-68	Branquias	45,16	305,74	4,19	28,28	1,33	9,03	180,65	1222,99
»	»	29-3-68	M. Visceral	33,87	167,50	10,67	52,78	0,50	2,47	129,33	639,56
»	Sancti-Petri	22-4-68	Manto	8,24	38,07	3,73	17,24	0,72	3,33	126,27	583,50
»	»	22-4-68	Branquias	7,04	39,82	3,41	19,28	2,01	12,28	97,89	553,67
»	»	22-4-68	M. Aductor T.	1,12	4,63	1,18	4,88	0,10	0,41	21,74	89,98
»	»	22-4-68	M. Ad. blanco	1,98	9,79	1,82	9,00	0,25	1,23	36,82	182,09
»	»	22-4-68	M. Visceral	5,37	19,96	8,61	32,00	0,41	1,52	83,21	309,33
»	»	22-4-68	Palpos	3,52	11,97	2,31	7,86	0,70	2,38	68,26	232,16
»	»	22-4-68	Gónadas ♂	1,06	4,22	3,42	13,65	0,10	0,40	17,71	70,67
»	»	22-4-68	Gónadas ♀	2,63	10,15	3,34	12,90	2,21	8,53	37,67	145,38
»	»	22-4-68	Corazón	15,87	73,03	20,97	96,54	—	—	242,79	1117,81
C. angulata	Sanlúcar de Bda.	29-5-68	Branquias	68,15	351,46	4,78	24,65	1,40	7,22	288,76	1489,22
»	(Banco de Juan Pul)	29-5-68	Manto	60,91	333,71	4,46	22,24	0,47	2,34	241,34	1203,69
»	»	29-5-68	M. Visceral	67,07	250,72	10,00	37,38	0,57	2,13	302,84	1132,11
»	»	29-5-68	Palpos	70,35	264,37	4,75	17,85	0,51	1,92	276,94	1040,73
»	»	29-5-68	M. Aductor T.	12,12	49,48	1,47	6,00	0,08	0,33	52,05	212,53
»	»	29-5-68	M. Ad. blanco	17,30	86,54	3,45	17,25	0,29	1,45	72,31	361,73
»	»	29-5-68	Corazón	127,15	604,03	28,73	136,48	—	—	502,80	2388,59
O. edulis	Ría de Arosa	24-11-68	Manto	2,82	18,24	3,11	20,11	0,27	1,74	38,80	251,55
»	»	24-1168	Branquias	2,90	19,88	2,46	16,86	0,26	1,78	55,50	383,02
»	»	24-11-68	M. Visceral	1,62	5,90	4,70	17,87	0,11	0,41	30,07	111,16
»	»	24-1168	Palpos	1,36	5,57	2,20	9,08	0,10	0,41	33,40	136,88
»	»	24-11-68	M. Aductor T.	0,54	2,32	1,36	5,86	0,04	0,18	7,87	33,62
»	»	24-11-68	M. Ad. blanco	1,30	6,42	2,05	9,69	0,06	0,24	11,84	70,02
»	»	24-11-68	Corazón	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]

REF. NO.: 69 - E - 1 **SUBSTANCES:** Cu, Fe, Mn, Zn

Reference: Establier, R. 1969. Contenido en cobre, hierro, manganeso y cinc de los ostiones (Crassostrea angulata) de las costas de Cádiz. Inv. Pesq. 33:335-345.

Organisms: Crassostrea angulata

Date of Sample Collection: 1967-68

Location: Cádiz, Spain (Atlantic)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA I

Resultados de los análisis de Cu, Zn, Mn y Fe efectuados en ostiones de distintos lugares de las costas de Cádiz.

Procedencia	Fecha	Cu mg/100 gr		Zn mg/100 gr		Mn mg/100 gr		Fe mg/100 gr	
		Fresco	Seco	Fresco	Seco	Fresco	Seco	Fresco	Seco
Sanlúcar de Bda. . .	20-11-67	32,32	224,60	138,20	960,39	0,82	5,70	5,08	34,05
Zona Franca	24-11-67	6,80	38,79	73,72	420,54	0,94	5,36	6,65	37,93
Pto. Sta. María . . .	20-11-67	9,32	57,64	81,13	501,78	0,78	4,82	6,56	40,57
Zona Franca . . .	15- 2-68	6,05	33,76	105,30	587,61	1,08	6,03	5,47	30,52
Rota	18- 2-68	26,54	170,56	163,32	1105,27	0,35	2,37	6,53	44,18
Sanlúcar de Bda. . .	18- 2-68	23,56	157,27	100,96	673,96	0,50	3,34	4,84	32,31
Chipiona	18- 2-68	26,95	191,67	136,42	970,27	0,46	3,27	5,06	35,99
Río San Pedro . . .	28- 2-68	6,03	32,45	45,09	242,68	1,07	5,76	5,41	29,15
Zona Franca	28- 2-68	6,60	40,80	99,95	610,26	0,83	5,14	5,22	32,34
Sanlúcar de Bda. . .	29- 2-68	46,32	327,58	172,04	1216,69	0,50	3,54	5,58	39,46
Barbate	3- 3-68	3,65	25,12	51,53	354,05	0,69	4,75	4,11	28,29
Sancti-Petri	5- 3-68	3,42	15,87	62,36	289,37	0,71	3,29	4,87	22,60
Sanlúcar de Bda. . .	10- 3-68	21,82	150,20	104,64	720,66	0,60	4,13	4,21	28,99
Zona Franca	14- 3-68	8,93	49,44	74,86	414,50	1,25	6,92	5,68	31,45
Zona Franca	28- 3-68	13,21	61,24	145,04	672,41	1,12	5,19	5,56	25,77
Sanlúcar de Bda. . .	29- 3-68	21,06	117,98	89,19	499,66	0,72	4,03	5,27	29,52
Chipiona	29- 3-68	35,14	210,04	199,19	1190,82	0,60	3,58	5,39	32,21
Zona Franca	17- 4-68	9,98	49,88	126,41	622,70	1,12	5,54	4,97	24,56
Sanlúcar de Bda. . .	17- 4-68	21,04	106,58	97,27	492,75	0,96	4,86	5,51	27,91
Sancti-Petri	22- 4-68	3,81	18,15	71,71	341,63	0,54	2,57	5,12	24,39
Río San Pedro . . .	30- 4-68	5,31	21,57	53,08	215,47	1,16	4,71	4,37	17,76

69 - E - 1

Establier, R. 1969.

TABLA II

Valores medios de los contenidos en Cu, Zn, Mu y Fe de las determinaciones efectuadas en ostiones de distintos lugares de las costas de Cádiz.

Localidad	Cu mg/100 gr		Zn mg/100 gr		Mn mg/100 gr		Fe mg/100 gr		N.º de muestras analizadas
	Fresco	Seco	Fresco	Seco	Fresco	Seco	Fresco	Seco	
Sanlúcar de Bda. . . .	27,68	180,70	117,05	760,68	0,68	4,27	5,12	32,19	6
Chipiona	31,05	200,86	168,31	1053,55	0,53	3,43	5,23	34,10	2
Rota	26,54	179,56	163,32	1105,27	0,35	2,37	6,53	44,18	1
Pto. Sta. María . . .	9,32	57,64	81,13	501,73	0,78	4,82	6,56	40,57	1
Río San Pedro . . .	5,67	29,01	49,07	229,08	1,12	5,24	4,98	23,46	2
Zona Franca	8,60	45,58	104,21	556,17	1,06	5,70	5,59	30,43	6
Sancti-Petri	3,62	17,01	67,54	315,50	0,63	2,93	5,00	23,50	2
Barbate	3,65	25,12	51,53	354,65	0,69	4,75	4,11	28,29	1

TABLA III

Resultados de los análisis efectuados el 29-5-68 en ostiones procedentes de la estación A (Corral de Montijo), B (Lagunaza de Montijo) y C (Bajos de Juan Pul).

Estación	Talla	Cu mg/100 gr		Fe mg/100 gr		Mn mg/100 gr		Zn mg/100 gr	
		Fresco	Seco	Fresco	Seco	Fresco	Seco	Fresco	Seco
A	75-85	18,02	82,47	5,95	27,23	1,10	5,03	79,88	365,58
B	85-95	39,00	213,11	7,29	39,83	0,80	4,37	158,39	865,51
C	80-85	41,25	225,40	5,70	31,14	0,40	2,18	135,00	737,70

REF. NO.: 69 - E - 2 **SUBSTANCES:** Cu

Reference: Establier, R. 1969. Estudios del contenido en cobre del agua de mar y ostiones (Crassostrea angulata) de las costas de Cádiz. Inv. Pesq. 33:69-86.

Organisms: Crassostrea angulata

Date of Sample Collection: 1966-67

Location: Cádiz, Spain (Atlantic

Analytical Technique: Colorimetry, spectrophotometry

Analytical Data:

TABLA I

Temperatura, salinidad, contenido en cobre del agua de mar y de los ostiones de la Zona Franca (Bahía de Cádiz).

Fecha	Hora	Temp. aire °C	Temp. agua °C	S ‰	Cu en agua µ gr/l	Cu en ostiones mgr/100 gr P. Húmedo	Cu en ostiones mgr/100 gr P. Seco
21- 3-66	—	—	—	—	—	9.89	—
20- 4-66	10,45	16,5	18,00	34,50	5.74	9.14	48,21
5- 5-66	10,30	21,1	19,50	35,52	2,98	5.86	22,66
23- 5-66	10,30	22.0	21.50	36.20	7,40	6.53	30,37
3- 6-66	10,00	24,0	22,10	34,45	2,58	3,85	17,14
4- 7-66	9,45	21.1	22.00	36,40	5,74	5,01	20,88
19- 7-66	10,00	23.5	22,20	36,70	5,48	5,27	24,62
1- 8-66	10,00	24.5	23,50	36,02	2,66	6,90	31,35
13- 8-66	8,30	23,0	24,00	36,00	4.68	8,09	40,53
16- 9-66	9,45	22.2	23.50	35,80	3,23	5.32	28,42
4-10-66	10,45	20,1	21,00	35,50	—	4,60	20,07
17-10-66	11.00	18,3	20,90	35,45	—	5.45	28,31
3-11-66	11,00	13.5	15,00	35,50	3,02	6.10	29,24
29-11-66	10,40	11.1	12.50	35.30	2.65	5.34	29,73
13-12-66	10,30	11,0	13.70	35.15	3,15	6,17	28,19
27- 1-67	10,15	13,1	13,90	35.80	4,57	11.38	54,09
11- 2-67	11,30	12,6	12.50	36.10	5,80	10,60	51.41
25- 2-67	10,10	14,1	14:50	35,80	7,45	11,37	68,80
10- 3-67	10,00	16.8	15,40	35,85	3.40	10,70	50,64
3- 4-67	10,30	17,1	17,00	37,10	4,14	13,27	68,43
28- 4-67	11,35	19,8	16,90	37,15	6.70	7,55	37,75
9- 5-67	10,00	—	19,50	37,70	8,19	6,94	21.20
24- 5-67	10,15	20,5	19,50	36,30	6,38	5,35	22.83
8- 6-67	9,30	19,1	21,10	37,10	6,08	6,00	25.52
7- 7-67	9,00	23,5	24.50	37,33	5,63	6,59	29,34
21- 7-67	9,30	25,0	25,90	37,15	5,32	5,14	23,76
8- 8-67	9,30	22,0	25,30	37,65	4,15	5,95	26,35
4- 9-67	10,00	20,0	22,50	36,95	7,07	4,88	26,74
28- 9-67	10,45	22,0	22,10	36,67	—	7,15	38.55
18-10-67	9,30	18.0	20.50	—	—	5,99	34.28
4-11-67	10,30	20,0	18.00	35,98	—	5.12	24,72
24-11-67	13,30	19,1	16,00	34,30	3,95	6,80	38,79

69 - E - 2

Establier, R. 1969.

TABLA II

Resultados de los análisis de salinidad, contenido en cobre del agua de mar y de los ostiones *(Crassostrea angulata)* de Montijo (Sanlucar de Barrameda) y Chipiona.

Fecha	Montijo (Sanlúcar de Barrameda)					Chipiona				
	Talla mm.	S ‰	µgr Cu/L agua	mgr Cu/100 gr P. Húmedo	mgr Cu/100 gr P. Seco	Talla mm.	S ‰	µgr Cu/L agua	mgr Cu/100 gr P. Húmedo	mgr Cu/100 gr P. Seco
13- 6-66	60-75	33,45	5,43	23,84	107,34	70-80	35,52	7,98	25,66	131,05
14- 7-66	65-75	35,80	5,00	18,81	83,36	65-70	36,25	5,96	29,95	142,89
18- 8-66	75-80	35,41	3,12	20,93	101,95	60-70	36,01	3,76	30,80	181,71
13- 9-66	70-85	34,65	7,55	28,89	162,21	75-85	35,25	8,62	27,46	160,12
19-10-66	60-70	—	—	33,84	204,84	70-75	—	—	17,61	112,52
16-11-66	70-80	34,30	5,53	30,82	205,47	50-55	33,80	4,46	23,04	152,09
14-12-66	65-75	31,55	4,35	20,83	133,95	60-70	30,85	4,20	34,55	216,34
26- 1-67	65-90	32,40	3,17	34,49	222,51	60-65	35-15	3,40	31,63	201,97
16- 3-67	75-80	32,85	7,12	37,26	232,72	70-80	34,55	5,53	27,67	165,58
25- 4-67	75-80	34,50	4,20	35,09	210,87	65,70	35,80	7,87	28,96	149,97
14- 6-67	65-70	36,00	5,00	24,88	114,91	60-65	35,15	6,38	28,87	159,50
19- 7-67	65-70	33,45	7,77	22,72	119,39	65-70	35,70	5,95	22,44	118,10
14- 8-67	65-70	33,50	3,95	31,30	157,96	65-70	35,85	4,15	24,49	199,62
18- 9-67	55-60	34,45	8,51	25,16	157,05	60-65	34,70	8,62	20,74	198,53
19-10-67	60-65	34,75	—	32,78	194,30	50-55	32,60	—	28,33	148,71
20-11-67	70-75	34,60	—	32,04	222,65	55-60	35,28	—	33,45	217,63

TABLA III

Contenido en cobre del agua de mar superficial y de los ostiones *(Crassostrea angulata)* del río San Pedro.

Agua de mar				Ostiones			
Fecha	Temp. °C	S ‰	Cu µg/L	Fecha	Talla	mg Cu/100 gr P. Húmedo	mg Cu/100 gr P. Seco
18- 4-66	—	—	5,21	18- 4-66	60-75	4,10	—
20- 6-66	—	37,92	6,67	20- 6-66	65-75	3,30	16,11
12- 7-66	—	38,50	8,73	13- 7-66	75-85	5,06	25,84
30- 9-66	—	36,70	6,17	14- 9-66	70-80	6,46	35,46
22-11-66	12,9	36,15	4,36	30- 9-66	65-75	6,21	33,10
9-12-66	10,9	36,25	2,47	27-10-66	60-65	4,82	22,42
26- 1-67	12,7	35,80	4,14	28- 1-67	75-80	5,03	21,07
25- 2-67	16,8	34,15	5,21	25- 2-67	75-85	5,67	22,95
15- 3-67	15,0	34,55	6,17	15- 3-67	70-80	4,08	16,12
11- 4-67	16,4	37,80	4,60	14- 4-67	70-80	6,95	26,88
21- 4-67	18,1	37,40	6,38	12- 6-67	60-65	5,60	28,35
12- 6-67	24,1	39,50	7,66	29- 7-67	80-85	5,50	24,07
29- 7-67	—	38,70	5,53	18- 9-67	70-85	5,03	20,65
1-10-67	23,5	38,45	5,74	20-11-67	65-70	3,27	15,48
20-11-67	16,2	21,35	—				

Establier, R. 1969.

TABLA VI

Ensayos realizados sobre la disminución del contenido en cobre de los ostiones *(Crassostrea angulata)* «cobreados», procedentes de la zona Sanlúcar-Chipiona, al ser colocados en el río San Pedro (Bahía de Cádiz)

Ensayo n.º	Fecha	Talla mm	mgr Cu/100 gr P. Húmedo	mgr Cu/100 gr P. Seco	N.º de días	Disminución Contenido en Cu mgr/100 gr (P. Húmedo)
1	18- 4-66	50-60	36,00	187,50		
	6- 5-66	55-60	33,75			
	20- 6-66	65-75	15,89	74,78		
	13- 7-66	70-80	18,37	93,06		
	14- 9-66	75-85	10,73	64,21	149	25,27
2	27-10-66	70-75	28,90	165,62		
	17-11-66	75-80	17,42	109,49		
	14-12-66	75-85	18-65	91,02		
	28- 1-67	75-85	15,51	82,72	93	13,49
3	26- 1-67	75-85	35,25	197,25		
	25- 2-67	75-85	25,58	141,05		
	15- 3-67	80-85	19.71	98,69		
	14- 4-67	80-85	19,73	82,83		
	12- 6-67	80-90	13,50	61,36	187	21,75
4	26- 1-67	50-60	22,23	141,14		
	25- 2-67	50-60	20,67	125,27		
	15- 3-67	55-60	18.95	99,21		
	14- 4-67	55-65	17,65	75,65		
	12- 6-67	60-70	9,11	39,31	187	13,12

TABLA IV

Análisis de cobre efectuados en ostiones *(Crassostrea angulata)* de diversos lugares de las costas de Cádiz.

Procedencia	Fecha	mgr Cu/100 gr P. Húmedo	mgr Cu/100 gr P. Seco
Matagorda	5- 4-66	9,07	43,10
Sancti-Petri	18- 4-66	4.86	.23,34
Sancti-Petri	25- 5-66	4,25	21,57
Sancti-Petri	31- 5-66	5,16	26,50
Sancti-Petri	22- 6-66	7,73	37,47
Barbate	4- 8-66	3,74	16,67
Sancti-Petri	9- 8-66	7,21	39,88
Sancti-Petri	29-10-66	4,55	27,97
Rota	17- 3-67	20,70	136,99
Pto. de Santa María (Río Guadalete)	17- 3-67	10,32	51,22
Pto. de Santa María (Río Guadalete)	30-11-67	9,28	57,08

TABLA V

Valores medios de los contenidos en cobre de los ostiones *(Crassostrea angulata)* de todos los lugares estudiados de la costa de Cádiz.

Procedencia		N.º de lotes analizados	mgr Cu/100 gr P. Húmedo	mgr Cu/100 gr P. Seco
Sanlúcar de Barrameda		16	28,36	164,43
Chipiona		16	27,80	162,32
Rota		1	20,70	136,99
Río Guadalete	Bahía de Cádiz	2	9,78	54,15
Río San Pedro	Bahía de Cádiz	14	5,03	23,73
Matagorda	Bahía de Cádiz	1	9,07	43,10
Zona Franca (Cádiz)	Bahía de Cádiz	32	7,01	33,16
Sancti-Petri		6	5,83	29,46
Barbate		1	3,74	16,67

REF. NO.: 71 - E - 1

SUBSTANCES: Cu

Reference: Establier, R. 1971. Estudios sobre la acumulacion del cobre en el ostion, Crassostrea angulata (Lmk). Pub. Tecn. Dir. Gen. Pesca Marit., no. 9:231-236.

Organisms: Crassostrea angulata

Date of Sample Collection: 1966-69

Location: Coast of Cadiz, Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA I

VALORES MEDIOS DE LOS CONTENIDOS EN COBRE DE LOS OSTIONES (*CRASSOSTREA ANGULATA*) DE TODOS LOS LUGARES ESTUDIADOS DE LA COSTA DE CADIZ

PROCEDENCIA		Número de lotes analizados	Mgr. Cu/100 gr.	
			P. húmedo	P. seco
Sanlúcar de Barrameda		16	28,36	164,43
Chipiona		16	27,80	162,32
Rota		1	20,70	136,99
Bahía de Cádiz	Río Guadalete	2	9,78	54,15
	Río San Pedro	14	5,03	23,73
	Matagorda	1	9,07	43,10
	Zona Franca (Cádiz)	32	7,01	33,16
Sancti-Petri		6	5,63	29,46
Barbate		1	3,74	16,67

Establier, R. 1971.

TABLA II

ENSAYOS REALIZADOS SOBRE LA DISMINUCION DEL CONTENIDO EN COBRE DE LOS OSTIONES (*CRASSOSTREA ANGULATA*) «COBREADOS», PROCEDENTES DE LA ZONA SANLUCAR-CHIPIONA, AL SER COLOCADOS EN EL RIO SAN PEDRO (BAHIA DE CADIZ)

Ensayo número	Fecha	Talla — *Milímetros*	MG. CU/100 GR.		Número de días	Disminución Cont. Cu mg./100 gr. (P. humedo)
			P. húmedo	P. seco		
1	18- 4-66	50-60	36,00	187,50	—	—
	6- 5-66	55-60	33,75	—	—	—
	20- 6-66	65-75	15,89	74,78	—	—
	13- 7-66	70-80	18,37	93,06	—	—
	14- 9-66	75-85	10,73	64,21	149	25,27
2	27-10-66	70-75	28,90	165,62	—	—
	17-11-66	75-80	17,42	109,49	—	—
	14-12-66	75-85	18,63	91,02	—	—
	28- 1-67	75-85	15,51	82,72	93	13,49
3	26- 1-67	75-85	35,25	197,25	—	—
	25- 2-67	75-85	25,58	141,05	—	—
	15- 3-67	80-85	19,71	98,69	—	—
	14- 4-67	80-85	19,73	82,83	—	—
	12- 6-67	80-90	13,50	61,36	137	21,75
4	26- 1-67	50-60	22,23	141,14	—	—
	25- 2-67	50-60	20,67	125,27	—	—
	15- 3-67	55-60	18,95	99,21	—	—
	14- 4-67	55-65	17,65	75,65	—	—
	12- 6-67	60-70	9,11	39,31	137	13,12
5	25-11-68	115-130	45,50	356,02	—	—
	9-12-68	115-130	46,64	314,07	—	—
	27- 1-69	115-130	20,00	85,17	—	—
	1- 3-69	115-130	15,03	70,06	—	—
	29- 4-69	115-130	13,76	54,53	155	31,74

REF. NO.: 72 - E - 2

SUBSTANCES: Cu

Reference: Establier, R. 1972. Nota sobre el contenido en cobre de los ostiones (Crassostrea angulata) de las costas de Huelva. Inv. Pesq. 36:293-296.

Organisms: Crassostrea angulata

Date of Sample Collection: 1966-70

Location: Gulf of Cádiz, Spain (Atlantic)

Analytical Technique: Spectrophotometry

Analytical Data:

TABLA I

Contenido en cobre de los ostiones de Huelva

Fecha	Lugar	Talla mm	mg Cu/100 g	
			Fresco	Seco
30-6-66	Río Piedras (El Terrón)	75-85	20.27	84.63
18-8-66	Isla Cristina	75-80	4.85	26.44
3-5-68	Río Piedras (El Terrón)	70-75	17,32	74.46
25-8-68	Ría Huelva	70-80	124.06	529.94
24-6-70	Ayamonte	70-75	8.59	42.86
24-6-70	Isla Cristina (La Mojarra)	70-80	8.22	34.98
24-6-70	Río Piedras (El Rompido)	70-80	16.98	87.80
24-6-70	Río Piedras (El Terrón)	70-80	16.79	68.25
24-6-70	Punta Umbría	70-75	165.78	652.65

REF. NO.: 72 - E - 1 **SUBSTANCES:** Hg

Reference: Establier, R. 1972. Concentración de mercurio en los tejidos de algunos peces, moluscos y crustáceos del golfo de Cádiz y caladeros del noroeste africano. Inv. Pesq. 36:355-364.

Organisms: Crassostrea angulata, Tapes decussatus, Tapes rhomboides, Venus gallina, Cardium edulis, Mactra glauca, Solen marginatus

Date of Sample Collection: 1971

Location: Gulf of Cádiz, Spain (Atlantic)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA II

Contenido en mercurio de moluscos y crustáceos del Golfo de Cádiz

Fecha	Nombre vulgar	Nombre científico	Zona procedencia	Talla cm	Hg. p. p. m. Peso húmedo	Hg. p. p. m. Peso seco
		MOLUSCOS *(Bivalvos)*				
23-4-71	Ostión	*Crassostrea angulata*	Bahía de Cádiz	5-5-6,0	0,16	0,74
26-4-71	»	» »	Sanlúcar de Barrameda (Cádiz)	6.5-7,0	0,23	0,98
24-4-71	»	» »	Bahía de Cádiz	11,0	0,07	—
28-4-71	»	» »	Sancti-Petri (Cádiz)	5,5-6,0	0,07	—
19-11-71	»	» »	Río Piedras (Huelva)	7,0-7,5	0,11	0,65
26-6-71	Almeja	*Tapes decussatus*	Sanlúcar de Barrameda (Cádiz)	2,7-3,2	0,06	0,29
1-9-71	»	» »	Isla Cristina (Huelva)	3,0-3,5	0,05	0,24
19-11-71	»	*Tapes rhomboides*	Río Piedras (Huelva)	3,0-3,2	0,12	0,60
4-5-71	Chirla	*Venus gallina*	Costas Huelva		0,04	—
23-6-71	»	» »	Punta Umbría (Huelva)	2,5-2,6	0,17	0,77
23-6-71	»	» »	Punta Umbría (Huelva)	2,4-2,6	0,16	0,72
23-6-71	»	» »	Punta Umbría (Huelva)	2,5-2,7	0,26	1,18
1-9-71	»	» »	Ayamonte (Huelva)	2,6-2,8	0,05	0,23
1-9-71	»	» »	Ayamonte (Huelva)	2,5-2,7	0,08	0,36
1-9-71	»	» »	Ayamonte (Huelva)	2,4-2,6	0,05	0,22
1-9-71	»	» »	Isla Cristina (Huelva)	2,8-3,2	0,05	0,23
1-9-71	Verdigón	*Cardium edulis*	Ayamonte (Huelva)	2,8-3,0	0,04	0,19
19-11-71	»	» »	Río Piedras (Huelva)	2,6-2,7	0,05	0,27
1-9-71	Clica	*Mactra glauca*	Ayamonte (Huelva)	3,0-3,3	0,15	0,75
19-11-71	Muergo o Longeiron	*Solen marginatus*	Río Piedras (Huelva)		0,11	0,48
		MOLUSCOS *(Cefalópodos)*				
1-9-71	Choco	*Sepia officinalis*	Ayamonte (Huelva)		0,09	0,29
		CRUSTACEOS				
25-6-71	Langostino	*Penaeus kerathurus*	Punta Umbría (Huelva)	13,5	0,13	0,57
25-6-71	»	» »	Punta Umbría (Huelva)	12,5	0,11	--
23-7-71	»	» »	Sanlúcar de Barrameda (Cádiz)	13,0	0,21	0,88
23-7-71	»	» »	Sanlúcar de Barrameda (Cádiz)	14,0	0,16	—
6-8-71	»	» »	Sanlúcar de Barrameda (Cádiz)	15,0	0,23	—
1-9-71	»	» »	Ayamonte (Huelva)	15,0	0,17	0,76
1-9-71	»	» »	Ayamonte (Huelva)	12,5	0,10	0,41
1-9-71	»	» »	Ayamonte (Huelva)	18,0	0,26	—

REF. NO.: 73 - E - 2

SUBSTANCES: Hg

Reference: Establier, R. 1973. Estudio del contenido en mercurio de las conservas de pescados y moluscos españolas. Inf. Tec. Inst. Invest. Pesq. 11:11p.

Organisms: Cardium edule, Mytilus edulis, Cardium tuberculatum, Chlamys varia, Solen sp., Tapes sp.

Date of Sample Collection: 1973? (canned specimens)

Location: Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA 3

Valores máximos, mínimos y medios de los contenidos en mercurio, expresados en partes por millón (ppm), de las conservas de pescado y moluscos de fabricación nacional

Especie envasada	*N.º muestras analizadas*	*Concentración de mercurio (ppm)*		
		Máxima	*Mínima*	*Media*
Sardinas	16	0,10	0,03	0,07
Anchoas	9	0,26	0,11	0,20
Relanzón	2	0,26	0,19	0,23
Caballas	10	0,20	0,04	0,11
Atún	17	0,95	0,15	0,36
Albacora (Bonito del Norte)	8	0,31	0,18	0,26
Melva	2	0,38	0,25	0,31
Berberechos	9	0,38	0,15	0,25
Mejillones	11	0,20	0,07	0,11
Langostillos	2	0,16	0,09	0,13
Zamburiñas	3	0,25	0,05	0,15
Navajas	3	0,24	0,09	0,18
Almejas	3	0,18	0,09	0,14
Calamares	8	0,18	0,04	0,11
Pulpos	6	0,14	0,04	0,09

Establier, R. 1973.

TABLA 2

Contenido en mercurio, expresado en partes por millón (ppm), de las conservas de moluscos de fabricación nacional

Muestra número	*Producto envasado*	*Tipo de envase*	*Año fabric. (troqueles)*	*Mercurio (ppm)*
65	Berberechos al natural	OV-120	1970 (J)	0,29
66	Berberechos al natural	OV-120	1972 (L)	0,17
67	Berberechos al natural	OV-120	1972 (L)	0,30
68	Berberechos a la cazuela	OV-120	1972 (L)	0,35
69	Berberechos al natural	OV-120	1971 (K)	0,20
70	Berberechos al natural	OV-120	—	0,38
71	Berberechos al natural	OV-120	1972 —	0,22
72	Berberechos al natural	OV-120	1973 (M)	0,21
73	Berberechos al natural	OV-120	1972 (L)	0,15
74	Mejillones en escabeche	RO-300	1972 (L)	0,07
75	Mejillones en escabeche	OV-120	1972 (L)	0,07
76	Mejillones en escabeche	OV-120	1972 (L)	0,10
77	Mejillones en escabeche	OV-120	1972 (L)	0,08
78	Mejillones en escabeche	OV-120	1971 (K)	0,13
79	Mejillones en escabeche	OV-120	1972 (L)	0,09
80	Mejillones en escabeche	OV-120	1972 (L)	0,08
81	Mejillones al natural	OV-120	—	0,20
82	Mejillones al natural	OV-120	1972 (L)	0,11
83	Mejillones en escabeche	OV-120	1973 —	0,13
84	Mejillones en escabeche	OV-120	1973 (M)	0,11
85	Langostillos al natural	OV-120	1972 (L)	0,09
86	Langostillos al natural	OV-120	1972 (L)	0,16
87	Zamburiñas en salsa marinera	OV-120	1972 (L)	0,25
88	Zamburiñas en salsa vieira	OV-120	1971 —	0,15
89	Zamburiñas en salsa vieira	OV-120	1972 (L)	0,05
90	Navajas al natural	OV-120	1972 (L)	0,21
91	Navajas al natural	OV-120	—	0,24
92	Navajas al natural	OV-120	1972 (K)	0,09
93	Almejas al natural	OV-120	1972 (L)	0,14
94	Almejas al natural	OV-120	1972 (L)	0,18
95	Almejas rubias al natural	OV-120	1972 (L)	0,09
96	Calamares en su tinta.	OV-120	1972 —	0,13
97	Calamares en su tinta	OV-120	1972 (L)	0,09
98	Chipirones enteros en su tinta	OV-120	1972 (L)	0,11
99	Calamares, trozos en su tinta	OV-120	1972 (L)	0,11
100	Calamares rellenos en aceite de oliva	OV-120	1970 (L)	0,11
101	Calamares, trozos en su tinta	OV-120	1973 (M)	0,18
102	Calamares, trozos en su tinta	OV-120	1972 (L)	0,14
103	Calamares, trozos en su tinta	OV-120	1973 (M)	0,04
104	Pulpo a la marinera	OV-120	1972 (L)	0,09
105	Pulpo al ajillo	OV-120	1972 (L)	0,08
106	Pulpo en aceite de oliva	OV-120	1972 (L)	0,14
107	Pulpo en aceite	OV-120	1972 (L)	0,09
108	Pulpo a la marinera	OV-120	1973 (M)	0,04
109	Pulpo a la marinera	OV-120	—	0,10

NOTA: Los nombres científicos de las especies citadas en esta tabla son los siguientes, según la Nomenclatura Oficial Española (1965): Berberecho: *Cardium edule*; Mejillón: *Mytilus edulis*; Langostillo: pie del *Cardium tuberculatun*; Zamburiñas: *Chlamys varia*; Navaja: *Solen Sp.*; Almeja: *Tapes Sp.*; Calamares y Chipirones: *Loligo Sp.*; Pulpo: *Octopus vulgaris*.

REF. NO.: 73 - E - 3

SUBSTANCES: Hg

Reference: Establier, R. 1973. Contenido en mercurio de los mejillones (*Mytilus edulis*) silvestres y cultivados de la zona noroeste española. Inv. Pesq. 37:101-106.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1972

Location: Vigo, Pontevedra, Arosa, Muros and Noya Rivers, Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Contenido en mercurio de los mejillones cultivados y silvestres de algunos lugares de las Rías Gallegas.

Fecha	Localidad	Tipo de mejillones	N.º ejemplares analizados	Talla mm.	Hg. ppm. Peso húmedo	Hg. ppm. Peso seco
		Ría de Vigo				
7-2-72	Rande	Cultivados	11	75-95	0,10	0,56
7-2-72	Moaña	»	9	60-80	0,08	0,41
7-2-72	Bayona	»	8	76-94	0,09	0,43
7-2-72	Puerto de Vigo	Silvestres	9	58-78	0,25	1,23
14-4-72	Bayona	»	10	64-74	0,11	0,67
		Ría de Pontevedra				
2-3-72	Marín	Cultivados	10	68-78	0,28	1,82
14-4-72	Marín	»	10	47-59	0,24	1,45
2-3-72	Bueu	»	10	75-94	0,14	0,87
14-4-72	Bueu	»	10	76-94	0,11	0,62
2-3-72	Aldán	»	10	78-90	0,09	0,56
14-4-72	Aldán	»	8	72-100	0,09	0,55
2-3-72	Marín	Silvestres	10	59-75	0,38	2,57
14-4-72	Marín	»	10	61-69	0,46	2,71
2-3-72	Aldán	»	10	47-57	0,38	2,59
14-4-72	Aldán	»	10	47-59	0,50	2,81
		Ría de Arosa				
17-3-72	Villagarcía	Cultivados	10	65-90	0,06	0,35
17-3-72	El Grove	»	12	74-100	0,11	0,59
17-5-72	Puebla Caramiñal	»	11	90-103	0,06	0,31
17-3-72	Villajuan	Silvestres	11	47-58	0,14	0,89
17-3-72	La Toja	»	12	54-66	0,18	1,20
17-5-72	Puebla Caramiñal	»	14	68-75	0,09	0,45
17-5-72	Aguino	»	12	52-64	0,08	0,41
		Rías de Muros y Noya				
22-3-72	Muros	Cultivados	10	84-105	0,10	0,56
22-3-72	Esteiro (Noya)	»	10	91-104	0,11	0,58

REF. NO.: 74 - E - 1 **SUBSTANCES:** Cu, Zn, Fe, Mn

Reference: Establier, R. & E. Pasqual. 1974. Estudios del cobre, hierro, manganeso y cinc en ostiones (Crassostrea angulata) del golfo de Cádiz. Inv. Pesq. 38:371-384.

Organisms: Crassostrea angulata

Date of Sample Collection: 1968-69

Location: Gulf of Cádiz, Spain (Atlantic)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA I

Resultados de los análisis de Cu, Fe, Mn y Zn, efectuados sobre los ostiones *(Crassostrea angulata)* procedentes de Sanlúcar de Barrameda (Cádiz)

Fecha	*Cu mg/100 gr.*		*Fe mg/100 gr.*		*Mn mg/100 gr.*		*Zn mg/100 gr.*	
	Fresco	*Seco*	*Fresco*	*Seco*	*Fresco*	*Seco*	*Fresco*	*Seco*
18- 2-68	23,56	157,27	4,84	32,31	0,50	3,34	100,96	673,96
10- 3-68	21,82	150,20	4,21	28,99	0,60	4,13	104,64	720,66
29- 3-68	21,06	117,98	5,27	29,52	0,72	4,03	89,19	499,66
17- 4-68	21,04	106,58	5,51	27,91	0,96	4,86	97,27	492,75
14- 5-68	16,72	81,72	5,43	26,53	0,94	4,59	71,07	347,36
29- 5-68	18,02	82,47	5,95	27,23	1,10	5,03	79,88	365,58
26- 6-68	17,04	73,70	3,77	16,31	1,08	4,67	73,80	319,20
29- 7-68	33,00	151,93	6,82	31,39	1,05	4,83	128,02	589,41
14- 8-68	23,07	99,87	3,87	16,75	1,04	4,50	100,48	434,97
9- 9-68	22,17	114,08	4,63	23,81	1,10	5,65	99,74	513,06
25- 9-68	28,55	195,54	3,53	24,17	0,93	6,36	119,46	818,21
25-10-68	14,84	95,49	4,25	27,34	1,14	7,33	80,99	521,17
22-11-68	21,57	139,97	5,82	37,76	1,09	7,07	109,80	712,52
9-12-68	18,68	128,03	7,17	40,43	1,04	5,86	75,94	520,49
27- 1-69	21,49	162,18	7,42	56,00	0,88	6,64	85,29	643,39
1- 3-69	26,20	201,53	4,90	37,69	0,56	4,31	123,32	950,80

TABLA II

Resultados de los análisis de Cu, Fe, Mn y Zn, efectuados sobre los ostiones *(Crassostrea angulata)* procedentes de la Bahía de Cádiz.

Fecha	*Cu mg/100 gr.*		*Fe mg/100 gr.*		*Mn mg/100 gr.*		*Zn mg/100 gr.*	
	Fresco	*Seco*	*Fresco*	*Seco*	*Fresco*	*Seco*	*Fresco*	*Seco*
24-11-67	6,80	38,79	6,65	37,93	0,94	5,36	73,72	420,54
15- 2-68	6,05	33,76	5,47	30,52	1,08	6,03	105,30	587,61
28- 2-68	6,60	40,89	5,22	32,34	0,83	5,14	99,95	619,26
14- 3-68	8,93	49,44	5,68	31,45	1,25	6,92	74,86	414,50
28- 3-68	13,21	61,24	5,56	25,77	1,12	5,19	145,04	672,41
17- 4-68	9,98	49,33	4,97	24,56	1,12	5,54	126,41	622,70
6- 5-68	12,60	62,56	4,32	21,45	1,25	6,20	129,41	642,55
28- 5-68	3,98	19,56	4,05	19,90	0,80	3,93	43,95	215,97
24- 6-68	6,94	31,76	4,47	20,46	1,04	4,76	71,32	326,40
10- 7-68	3,91	18,46	3,73	17,61	0,90	4,24	54,65	258,02
26- 7-68	6,35	29,91	4,12	19,40	0,86	4,05	66,10	311,35
8- 8-68	5,41	24,40	4,56	20,56	0,93	4,19	63,22	285,16
16- 9-68	5,71	35,68	3,98	24,87	1,03	6,43	66,01	412,53
8-10-68	4,92	24,51	5,02	25,01	1,17	5,82	70,36	350,57
22-10-68	6,98	41,35	4,47	26,48	0,76	4,50	91,62	542,77
8-11-68	5,86	33,56	4,97	28,46	0,87	4,98	98,60	564,71
9-12-68	6,62	40,29	3,46	21,05	1,20	7,31	69,50	423,00
18- 1-69	2,75	22,19	3,69	29,78	0,87	7,02	36,09	291,28
17- 2-69	6,45	34,34	3,84	20,44	0,47	2,50	49,19	261,92
18- 3-69	8,46	47,52	3,56	20,00	0,60	3,37	92,66	520,56
19- 4-69	5,43	24,57	4,42	19,98	1,06	4,79	51,64	233,45
5- 5-69	5,18	20,56	4,04	16,03	1,20	4,76	55,79	221,47

REF. NO.: 75 - E - 2 **SUBSTANCES:** Cd, Pb

Reference: Establier, R. 1975. Estudio del contenido en cadmio y plomo de las conservas de pescados y moluscos españolas. Inf. Técn. Inst. Inv. Pesq. 29:1-14.

Organisms: *Cardium edule*, *Mytilus edulis*, *Cardium tuberculatum*, *Chlamys varia*, *Solen* sp., *Tapes* sp.

Date of Sample Collection: 1973-74

Location: Canned specimens from local markets in Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

CUADRO 3

Valores máximos, mínimos y medios de los contenidos en plomo y cadmio, expresados en partes por millón (ppm), de las conservas de pescado y moluscos de fabricación española

Especie envasada	Número de muestras analizadas	Concentración de cadmio (ppm)			Concentración de plomo (ppm)		
		Máxima	Mínima	Media	Máxima	Mínima	Media
Sardinas	8	0,11	< 0,02	—	2,00	0,46	1,07
Caballas	11	0,12	< 0,02	—	1,15	0,12	0,43
Atún	10	0,07	< 0,02	—	0,88	0,13	0,45
Atún Blanco (Bonito del Norte)	7	0,09	< 0,02	—	1,51	0,28	0,79
Anchoas	8	0,08	< 0,02	—	2,15	0,43	0,93
Relanzón	1	0,10	0,10	0,10	0,50	0,50	0,50
Sardinas (anchoiz)	2	0,26	0,09	0,18	2,05	1,20	1,62
Berberechos	12	0,20	< 0,02	—	2,36	0,73	1,55
Mejillones	11	0,66	0,21	0,34	2,49	0,83	1,67
Langostillos	1	0,03	0,03	0,03	2,41	2,41	2,41
Zamburias	3	1,63	0,52	1,06	2,34	1,86	2,13
Navajas	4	0,25	< 0,02	—	2,61	0,65	1,36
Almejas	2	0,32	0,25	0,28	2,54	1,85	2,19
Calamares	12	0,92	0,18	0,44	2,67	0,37	1,44
Pulpo	3	0,08	< 0,02	—	1,80	0,37	1,03

Establier, R. 1975.

CUADRO 2

Contenido en plomo y cadmio, expresado en partes por millón (ppm), de las conservas de moluscos de fabricación española

Muestra núm.	*Producto envasado*	*Tipo de envase*	*Año fabricación (troqueles)*	*Cadmio (ppm)*	*Plomo (ppm)*
48	Berberechos, al natural	OV - 120	1973 (M)	0,18	1,83
49	Berberechos, al natural	OV - 120	1973 (M)	0,20	2,36
50	Berberechos, al natural	OV - 120	1973 (M)	0,06	1,73
51	Berberechos, al natural	OV - 120	1973 (M)	0,06	1,10
52	Berberechos, al natural	OV - 120	1973 (M)	0,03	1,53
53	Berberechos, al natural	OV - 120	1973 (M)	0,04	1,60
54	Berberechos, al natural	OV - 120	1973 (M)	0,04	1,49
55	Berberechos, al natural	OV - 120	1973 (M)	0,05	1,85
56	Berberechos, al natural	OV - 120	1973 (M)	< 0,02	0,73
57	Berberechos, al natural	OV - 120	1973 (M)	< 0,02	2,08
58	Berberechos, al natural	OV - 120	1973 (M)	0,04	1,63
59	Berberechos, al natural	OV - 120	1973 (M)	0,11	0,78
60	Mejillones, en escabeche	OV - 245	1973 (M)	0,46	0,89
61	Mejillones, al natural	OV - 120	1973 (M)	0,24	0,83
62	Mejillones, en escabeche	OV - 120	1973 (M)	0,25	2,45
63	Mejillones, en escabeche	OV - 120	1973 (M)	0,35	2,49
64	Mejillones, en escabeche	OV - 120	1973 (M)	0,66	0,88
65	Mejillones, en escabeche	OV - 120	1973 —	0,35	2,44
66	Mejillones, en escabeche	RO - 1.150	1973 (M)	0,35	0,93
67	Mejillones, en escabeche	OV - 120	1973 (M)	0,24	1,66
68	Mejillones, en escabeche	OV - 120	1973 (M)	0,40	1,32
69	Mejillones, en escabeche	OV - 120	1973 (M)	0,21	2,20
70	Mejillones, en escabeche	OV - 120	1973 (M)	0,24	2,30
71	Langostillos, al natural	OV - 120	1973 (M)	0,03	2,41
72	Zamburiñas, a la americana	OV - 120	1973 (M)	0,83	2,34
73	Zamburiñas, en salsa picante	OV - 120	1973 (M)	0,52	2,21
74	Zamburiñas, en salsa vieira	OV - 120	1973 —	1,83	1,86
75	Navajas, al natural	OV - 120	1973 —	0,25	2,61
76	Navajas, al natural	OV - 120	1973 (M)	0,03	0,65
77	Navajas, al natural	OV - 120	—	< 0,02	0,88
78	Navajas, al natural	OV - 120	1974 (N)	0,05	1,30
79	Almejas, al natural (Rubias)	OV - 120	1973 (M)	0,32	1,85
80	Almejas, al natural	OV - 120	—	0,25	2,54
81	Calamares, en su tinta trozos	OV - 120	1973 (M)	0,25	0,37
82	Chipirones, enteros en su tinta	OV - 120	1973 (M)	0,45	2,67
83	Calamares, en salsa americana	OV - 120	1973 (M)	0,31	1,52
84	Calamares, trozos en su tinta	OV - 120	1973 (M)	0,64	0,53
85	Calamares, trozos en aceite	OV - 120	1973 (M)	0,35	0,71
86	Calamares, trozos en tinta	OV - 120	1973 (M)	0,92	1,25
87	Calamares, rellenos en su tinta	OV - 120	1973 (M)	0,58	1,20
88	Calamares, rellenos en su tinta	OV - 120	1973 (M)	0,18	1,70
89	Calamares, en su tinta	OV - 120	1974 (N)	0,28	1,72
90	Calamares, en salsa americana	OV - 120	1974 (N)	0,32	1,40
91	Calamares, rellenos en aceite (Chipirones)	OV - 120	1974 (N)	0,42	2,65
92	Calamares en su tinta (trozos)	OV - 120	1974 (N)	0,67	1,61
93	Pulpo, de las rías gallegas, a la marinera	OV - 120	1973 (M)	0,02	1,80
94	Pulpo, a la marinera	OV - 120	1973 (M)	0,08	0,92
95	Pulpo, en aceite	OV - 120	1974 (N)	< 0,02	0,37

NOTA: Los nombres científicos de las especies citadas en este cuadro son los siguientes, según la Nomenclatura Oficial *Española* (1965): Berberecho: *Cardium edule;* Mejillón: *Mytilus edulis;* Langostillo, pie del: *Cardium tuberculatum;* Zamburiñas: *Chlamys varia:* Navaja: *Solen Sp.;* Almeja: *Tapes Sp.;* Calamares y Chipirones: *Loligo Sp.;* Pulpo: *Octopus vulgaris.*

REF. NO.: 75 - E - 4

SUBSTANCES: Cd

Reference:

Establier, R. 1975. Concentración de cadmio en organismos marinos de la costa sudatlántica española. Inf. Tecn. Inst. Inv. Pesq. 26: 1-8.

Organisms: Crassostrea angulata, Tapes decussatus, Mactra stultorum, Eastonia rugosa, Scrobicularia plana, Pecten maximus

Date of Sample Collection: 1972-74

Location: Coast of Cadiz, Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

CUADRO III

Concentraciones máximas, mínimas y medias de cadmio encontradas en las lapas *(Patella Sp.)* y ostión *(Crassostrea angulata)* procedentes de cinco zonas de las costas de Cádiz

Localidad	*Molusco*	*Talla mm*	*Cd p.p.m.* Peso húmedo *máx.*	*min.*	*medio*	Peso seco *máx.*	*min.*	*medio*
Sanlúcar de Barrameda	Lapas	26-40	2,137	2,032	2,084	10,531	10,049	10,285
	Ostión	74-90	1,935	1,065	1,406	11,214	7,773	9,333
Bahía de Cádiz	Lapas	36-45	0,747	0,236	0,504	3,112	0,925	2,025
	Ostión	63-85	0,611	0,292	0,425	2,882	1,460	2,114
Cádiz	Lapas	30-40	0,185	0,150	0,167	0,872	0,675	0,773
Sancti-Petri	Lapas	33-39	1,497	0,874	1,185	6,767	4,122	5,444
	Ostión	70-76	0,353	0,353	0,353	1,802	1,802	1,802
Barbate	Lapas	31-45	1,508	1,508	1,508	6,244	6,244	6,244
	Ostión	52-72	0,453	0,453	0,453	2,626	2,626	2,626

Establier, R. 1975.

CUADRO I

Contenido en cadmio de algunos moluscos de las costas de Cádiz

Muestra n.º	*Zona de procedencia*	*Nombre vulgar*	*Nombre científico*	*Fecha*	*N.º de ejemp. analiz.*	*Talla mm*	*Cd (p.p.m.)*	
							p. húmedo	*p. seco*
1	Sanlúcar de Barrameda	Ostión	*Crassostrea angulata*	22-11-72	5	60-92	1,065	7,773
2	Sanlúcar de Barrameda	Ostión	*Crassostrea angulata*	7-12-72	4	74-76	1,570	11,214
3	Sanlúcar de Barrameda	Ostión	*Crassostrea angulata*	12-12-73	6	75-78	1,126	8,159
4	Sanlúcar de Barrameda	Ostión	*Crassostrea angulata*	22-12-73	4	76-91	1,333	10,390
5	Sanlúcar de Barrameda	Ostión	*Crassostrea angulata*	5- 7-74	6	70-101	1,935	9,127
6	Río San Pedro (Bahía de Cádiz)	Ostión	*Crassostrea angulata*	13-11-72	5	80-85	0,368	2,203
7	Río San Pedro (Bahía de Cádiz)	Ostión	*Crassostrea angulata*	26- 7-74	6	70-78	0,292	1,460
8	Bahía de Cádiz	Ostión	*Crassostrea angulata*	18- 4-73	4	75-82	0,420	1,909
9	Bahía de Cádiz	Ostión	*Crassostrea angulata*	16- 5-73	5	63-76	0,611	2,882
10	Sancti-Petri	Ostión	*Crassostrea angulata*	4- 4-73	6	70-76	0,353	1,802
11	Barbate	Ostión	*Crassostrea angulata*	5- 4-73	6	52-73	0,453	2,626
12	Sanlúcar de Barrameda	Lapas	*Patella sp.*	22-11-72	20	31-40	2,137	10,531
13	Sanlúcar de Barrameda	Lapas	*Patella sp.*	22-12-73	15	26-37	2,032	10,049
14	Bahía de Cádiz	Lapas	*Patella sp.*	5-12-72	20	35-45	0,660	— 2,170
15	Bahía de Cádiz	Lapas	*Patella sp.*	16- 3-73	14	36-40	0,270	1,247
16	Bahía de Cádiz	Lapas	*Patella sp.*	23- 3-73	12	41-43	0,236	0,928
17	Bahía de Cádiz	Lapas	*Patella sp.*	18- 4-73	10	36-41	0,606	2,669
18	Bahía de Cádiz	Lapas	*Patella sp.*	30- 4-73	11	36-41	0,747	3,212
19	Cádiz	Lapas	*Patella sp.*	26-11-72	12	30-34	0,150	0,675
20	Cádiz	Lapas	*Patella sp.*	13- 3-73	14	37-40	0,185	0,872
21	Sancti-Petri	Lapas	*Patella sp.*	16- 3-73	10	34-39	0,814	4,122
22	Sancti-Petri	Lapas	*Patella sp.*	4- 4-73	13	33-38	1,497	6,767
23	Conil	Lapas	*Patella sp.*	22- 4-74	15	35-39	0,750	2,840
24	Barbate	Lapas	*Patella sp.*	5- 4-73	14	31-45	1,508	6,244
25	Barbate	Lapas	*Patella sp.*	8- 9-74	16	32-40	1,225	6,080
26	Sanlúcar de Barrameda	Almeja fina	*Tapes decussatus*	22-11-72	25	19-31	0,210	1,173
27	Sanlúcar de Barrameda	Almeja fina	*Tapes decussatus*	10-11-73	19	28-32	0,272	1,570
28	Barbate	Almeja fina	*Tapes decussatus*	5- 4-73	35	30-32	0,103	0,525
29	Sanlúcar de Barrameda	Almeja	*Mactra stultorum*	22-11-72	45	20-24	0,237	1,895
30	Sanlúcar de Barrameda	Almejón	*Eastonia rugosa*	22-11-72	6	28-42	0,178	0,895
31	Bahía de Cádiz	Coquina	*Scrobicularia plana*	17-11-72	40	29-33	0,180	1,107
32	Conil	Vieiras	*Pecten maximus*	23- 4-74	8	70-78	0,660	3.905
33	Golfo de Cádiz	Calamar	*Loligo vulgaris*	15- 4-74	1	560 g	0,042	0,201
34	Golfo de Cádiz	Choco	*Sepia officinalis*	17- 5-74	1	370 g	0,020	—
35	Golfo de Cádiz	Choco	*Sepia officinalis*	11- 6-74	3	230-250 g	0,020	—

REF. NO.: 74 - E - 2 **SUBSTANCES:** Zn, Cd, Cu, Mn

Reference: Eustace, I. J. 1974. Zinc, cadmium, copper and manganese in species of finfish and shellfish caught in the Derwent Estuary, Tasmania. Aust. J. Mar. Freshwat. Res. 25:209-220.

Organisms: Ostrea angasi
Mytilus edulis

Date of Sample Collection: 1972-73

Location: Derwent Estuary, Tasmania

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 100°C)

Table 2. Zinc, cadmium, copper and manganese in fish, shellfish and other species from the Derwent Estuary
N/A, not available

Class and family	Species	Common name	No. of individuals analysed	Fork length (cm)	Dry matter content (%)	Metal concentration (ppm wet weight) Zinc	Cadmium	Copper	Manganese
Elasmobranchii									
Hexanchidae	*Notohynchus cepedianus*	Seven-gilled shark	1	120·0	19·8	4·4	<0·05	<0·25	<0·5
Pristiophoridae	*Pristiophorus cirratus*	Common saw shark	1	107·0	24·7	4·1	<0·05	0·3	<0·5
Dasyatidae	*Dasyatis brevicaudatus*	Stingray	1	80·0	27·2	9·2	<0·05	1·0	0·7
Rajidae			1		22·0	9·6	<0·05	0·7	1·6
Teleostomi									
Leptocephalidae	*Leptocephalus wilsoni*	Conger eel	1	N/A	33·1	19·6	0·3	9·0	<0·25
Macruridae	*Macruronus novaezelandiae*	New Zealand whiptail	1[A]	N/A	22·6	19·4	<0·05	1·7	0·8
Macrorhamphosidae	*Hippocampus* sp.	Seahorse	1		23·5	34·5	<0·05	0·7	15·0
Dinolestidae	*Dinolestes lewini*	Long-finned pike	1	28·5	24·7	5·8	<0·05	0·7	<0·5
Sparidae	*Acanthopagrus butcheri*	Black bream	1	28·0	23·0	7·8	<0·05	<0·25	<0·5
Cheilodactylidae	*Dactylopagrus carponemus*	Sea carp	1	40·5	20·9	28·8	<0·05	0·3	<0·5
Salmonidae	*Salmo trutta*	Brown trout	1	30·0	26·4	5·2	<0·05	0·9	<0·5
Diodontidae	*Atopomycterus nichthemerus*	Porcupine fish	12		25·2	129·2	0·15	3·2	3·7
Ostraciontidae	*Aracana aurita*	Striped cow-fish	1		34·0	146·7	0·14	1·9	3·3
	Gymnapastes marmoratus	Soldier fish	1[A]		24·7	21·3	<0·05	6·3	0·7
		Devil fish	1		21·7	19·9	<0·05	1·6	4·4
	Ostrea angasi Sowerby	Native oyster	7[B]		20·4	5657·0	10·7	57·9	2·5
	Mytilus edulis	Common mussel	2		15·7	45·8	5·5	3·1	2·5
	Notodarius gouldi	Squid	2		20·0	18·5	<0·05	5·3	<0·5
	Octopus sp.	Octopus	1		17·3	18·5	<0·05	7·0	0·6
	Clibanarius strigimanus	Stridulating hermit crab	2		27·2	74·3	<0·05	15·8	0·8
	Patiriella regularis	Mud starfish	4		41·8	245·0	0·7	31·4	51·7
	Coscinasterias calamaria	Red starfish	1		26·3	40·6	0·6	10·4	6·9
	Ascidiacea sp.	Tunicate	1		8·3	64·0	0·2	8·3	112·6

[A] Specimens not filleted prior to homogenization. [B] Each sample contained six to ten individual oysters.

REF. NO.: 76 - F - 4

SUBSTANCES: Cd, Cu, Pb, Fe, Mn, Zn

Reference: Fabris, G. J., F. A. Tawfic & J. Harris. 1976. Concentrations of heavy metals in selected invertebrates from Port Phillip Bay and Westernport. Interim Report to Environmental Studies Section, Ministry for Conservation, Victoria, Australia (Pub. no. 164), Section 6: 17p.

Organisms: *Mytilus edulis planulatus*
Ostrea angasi
Anadara trapezia
Mytilus edulis

Date of Sample Collection: 1974-76

Location: Westernport and Port Phillip Bay, Australia

Analytical Technique: Atomic absorption apectrophotometry; anodic stripping voltammetry

Analytical Data:

Table 6-2 Port Phillip Bay Survey 1
Concentration of heavy metals (µg/g dry weight) in *Mytilus edulis* from Port Phillip Bay
(Average values of five composite samples consisting of five mussels each)

LOCATION	DATE COLLECTED	Wet/Dry Ratio	(1σ)	Zn	±S.D. (1σ)	Cd	±S.D. (1σ)	Pb	±S.D. (1σ)	Cu	±S.D. (1σ)	Mn	±S.D. (1σ)	Fe	±S.D. (1σ)
Blairgowrie	20-10-75	7.3±	0.2	135±	29	1.72±	0.63	4.5±	1.7	4.4±	0.6	5.5±	1.2	197±	19
Rosebud	"	6.5	0.2	112	11	1.91	0.14	4.2	0.4	3.9	0.2	5.8	1.0	179	32
Dromana	"	6.4	0.2	142	18	1.62	0.16	2.1	0.5	4.7	0.7	5.6	0.4	320	44
Mornington	"	7.2	0.2	242	21	3.78	0.24	4.5	1.1	5.5	0.3	33.3	21.8	238	30
Frankston	"	6.8	0.5	143	28	2.67	1.06	7.5	2.1	6.1	0.9	8.2	1.9	451	77
Mordialloc	14-10-75	5.7	0.1	237	17	5.13	1.60	16.6	6.9	8.9	1.5	6.7	0.9	346	47
Ricketts Point	"	6.6	1.0	192	59	4.91	1.66	11.6	2.5	4.7	0.9	9.0	0.8	535	61
Black Rock	"	8.0	0.9	247	46	5.21	0.72	7.2	2.7	4.2	1.1	6.6	0.8	329	63
Sandringham	"	8.6	1.5	250	86	5.85	1.78	11.8	3.6	4.3	1.6	5.7	1.0	262	76
Brighton	"	6.2	0.3	282	27	7.67	2.33	21.7	7.6	6.0	0.8	18.6	12.3	344	116
St. Kilda (1)	"	5.7	0.1	230	55	5.31	0.35	24.1	3.5	7.2	2.6	9.5	0.9	389	104
(2)	"	6.5	0.3	345	195	6.28	1.22	38.9	17.5	12.3	2.2	10.7	1.6	496	58
Rippleside Pier	19-10-75	6.9	0.3	178	9	29.2	2.4	18.3	2.8	5.6	0.7	7.6	1.4	484	79
Stony Pier	"	7.1	0.5	200	6	18.6	2.4	34.0	4.3	7.6	0.5	10.4	0.5	759	58
Portarlington	"	6.7	0.3	108	25	4.37	0.68	3.6	0.7	4.6	0.8	7.2	1.3	375	62
St. Leonards	"	6.9	0.3	100	7	2.72	0.26	4.1	1.9	6.8	2.1	6.5	0.8	601	18
Swan Bay	"	9.6	0.9	157	22	2.00	0.16	1.0	0.3	5.8	0.8	7.5	1.4	570	43

(1) Seaward end of jetty

(2) Rocks at foot of jetty

Table 6-3 Port Phillip Bay Survey 2
(Average values of 10 individuals) (µg/g dry weight)

LOCATION	DATE COLLECTED	Wet/Dry Ratio	(1σ)	Zn	S.D. (1σ)	Cd	S.D. (1σ)	Pb	S.D. (1σ)	Cu	S.D. (1σ)	Mn	S.D. (1σ)	Fe	S.D. (1σ)	Length (mm ±1σ)	
Brighton	24-3-76	6.4±	0.8	362±	175	4.36±	1.10	20.4±	7.6	4.3±	1.4	11.3±	2.4	211±	89	51±	3
St. Kilda	"	5.0	0.3	96	44	1.07	0.40	5.7	1.6	4.8	0.8	14.3	2.5	296	71	53	2
Kerford St.	"	5.3	2.1	77	20	1.44	0.92	7.1	3.8	5.4	2.8	12.5	8.6	163	76	53	2
Station Pier	"	4.7	0.5	118	53	1.69	0.60	2.9	1.2	4.2	0.4	7.1	2.6	75	42	51	4
Princess Pier	"	5.1	0.5	107	34	2.1	1.0	5.1	3.6	4.7	1.0	8.1	2.8	102	54	56	4
Beacon (200 m off Princess Pier)	9-4-76	5.8	0.8	123	63	2.9	1.4	3.5	1.4	4.2	1.1	4.7	1.9	70	46	64	6
Ann St. (Will'tn)	24-3-76	5.2	0.3	132	51	1.04	0.38	9.9	8.8	7.1	1.9	14.5	2.5	505	203	41	3
Breakwater Pier (Williamstown)	"	6.3	0.9	193	86	4.74	1.80	2.8	1.5	5.0	1.5	7.2	2.9	204	106	52	3
Duncans Rd. (Werribee)	25-3-76	7.2	1.0	103	50	3.2	1.2	4.2	1.9	4.9	1.1	7.0	2.3	402	84	63	3
Shell Ref.	"	7.7	1.2	418	147	18.2	6.0	6.9	3.3	4.1	1.8	5.1	2.1	481	245	59	7
Moorpangal Park (Geelong)	"	7.2	2.0	158	110	30.3	15.4	3.2	1.9	3.3	0.5	5.2	0.8	157	55	94	5
		6.8	0.7	242	104	13.0	1.9	4.7	2.4	4.4	1.5	9.6	1.8	232	99	56	2
Rippleside Park	"	5.0	0.7	111	53	14.3	4.2	6.5	3.3	5.3	0.9	9.3	1.9	280	73	50	4
Stony Pier	"	5.2	0.3	237	144	12.7	3.9	36.3	17.5	7.0	1.5	10.9	2.0	249	60	55	4
Parkside	"	5.6	0.5	143	81	12.7	2.7	5.0	2.8	4.9	0.9	7.1	2.2	209	58	59	4
Portarlington	"	5.6	0.5	118	39	3.66	0.63	0.6	0.3	4.8	1.4	7.4	1.8	184	69	57	3
St. Leonards	"	7.4	0.8	185	83	3.14	0.71	0.8	0.6	5.9	0.9	6.2	2.3	207	93	54	4
Swan Bay	"	5.6	0.3	135	52	1.24	0.35	0.7	0.3	5.0	1.4	5.9	2.0	170	23	56	3

Table 6-4 Concentration of metals (µg/g dry weight) in *Mytilus edulis* collected monthly from rocks at end of Brighton Jetty

DATE COLLECTED	Wet/Dry Ratio	S.D. (1σ)	Zn	S.D. (1σ)	Cd	S.D. (1σ)	Pb	S.D. (1σ)	Cu	S.D. (1σ)	Mn	S.D. (1σ)	Fe	S.D. (1σ)	No Ind.	No Com.
14-10-75	6.2	0.3	282	27	7.67	2.33	21.7	7.6	6.0	0.8	18.6	1.2	344	116		5
2-11-75	8.1	1.0	323	158	5.29	1.71	26.7	14.8	5.7	1.0	6.7	2.7	350	168	10	
19-12-75	7.0	0.9	145	48	4.58	1.99	21.6	11.5	3.3	0.8	7.0	3.4	273	118	10	
21-01-76	6.2	0.8	188	46	3.61	1.20	7.9	3.7	3.7	0.5	6.7	1.2	266	70	10	
16-02-76	7.7	1.2	304	166	4.68	1.60	17.8	11.0	3.4	0.8	5.7	1.3	168	50	10	
17-03-76	7.2	1.0	257	112	4.78	2.01	13.3	7.2	3.6	1.2	9.5	4.2	185	96	10	
15-04-76	8.3	2.0	239	147	6.8	4.4	14.3	8.5	3.7	0.7	8.2	2.2	200	56	10	
18-05-76	8.9	1.0	466	217	7.05	1.59	21.2	17.2	6.2	0.9	13.5	3.8	508	195	10	
17-06-76	9.3	1.2	282	247	8.81	3.60	18.7	21.1	4.7	0.9	6.2	1.7	259	108	10	
20-07-76	8.7	1.4	322	240	7.93	2.72	22.8	10.4	6.0	0.9	10.0	2.9	428	200	10	
18-08-76	9.0	0.9	369	176	6.52	1.80	21.4	8.4	5.2	0.5	7.3	2.0	360	160	10	
15-09-76	8.6	0.7	345	189	5.95	1.97	29.4	14.5	6.5	0.8	6.7	1.2	215	46	10	
19-10-76	6.6	0.7	194	154	3.0	0.6	19.2	6.7	5.4	0.8	5.2	1.1	279	61	10	

Table 6-5. Concentration of metals (μg/g dry wt) in *Mytilus edulis* from Corio Bay

Location	Date	Wet/Dry ratio ± iσ	length mm ± iσ	Zn±iσ	Cd ± iσ	Pb ± iσ	Cu ± iσ	Mn ± iσ	Fe ± iσ	Comments
Rippleside Pier	29.10.75	6.9±0.3		178± 9	29.2± 2.4	18.3± 2.8	5.6±0.7	7.6±1.4	484± 79	5 composite samples of 5 individuals
" "	5.12.75	6.0±0.4		129± 52	19.2± 3.6	11.6± 8.6	6.3±1.2	10.5±2.0	343± 93	30 individuals
" "	25. 3.76	5.0±0.7	50±4	111± 53	14.3± 4.2	6.5± 3.3	5.3±0.9	9.3±1.9	280± 73	10 indivi uals
" "	16. 7.76	8.1±0.6	62±3	181± 63	31.5± 8.1	14.2± 3.1	5.6±1.1	7.1±1.8	493±160	10 individuals
" "	26.10.76	8.0±1.0	73±5	271±110	36.7±10.8	25.8±12.2	5.7±1.6	8.2±1.6	416±107	10 individuals
" Street Drain	5.12.75	6.1±0.2		215± 88	60.6±13.6	39.9±20.3	6.8±1.2	7.4±1.3	629±118	9 individuals
"	16. 7.76	9.0±0.5	57±2	392±147	88 ±37	60.3±32.9	6.8±1.2	8.0±2.4	1226±399	10 individuals
" Main Drain	26.10.76	9.3±1.5	53±2	487±236	127 ±34	101 ±55	8.9±1.7	10.8±2.6	1383±278	10 individuals
Parkside Baths	5.12.75	5.9±0.6		140± 45	19.9± 5.1	6.2± 1.6	5.8±1.2	9.2±1.3	203± 38	10 individuals
" "	23. 3.76	5.6±0.5	59±4	143± 81	12.7± 2.7	5.0± 2.8	4.9±0.9	7.1±2.2	209± 58	10 individuals
" "	16. 7.76	8.1±1.2	51±5	213±105	21.7± 5.6	5.0± 2.1	5.4±1.1	9.0±1.8	475±173	10 individuals
Moorpangal Park	16. 7.76	8.8±0.3	16±4	330± 31	22.0± 1.2	10.8± 1.7	10.0±1.0	14.9±2.7	1056± 61	5 composite samples of 10 individuals
" "	"	8.3±1.1	44±3	386±170	26.7± 5.8	7.3± 3.2	3.0±1.5	8.1±3.3	352±118	10 individuals
" "	"	8.2±1.1	61±4	443±127	28.7± 5.4	4.4± 1.5	7.8±1.2	6.8±1.9	301±109	10 individuals
" "	"	9.3±1.2	72±4	352±125	39.9±18.4	10.1± 3.8	4.0±1.3	6.8±1.4	220± 73	10 individuals
" "	"	10.4±1.1	89±6	390±232	72 ±21	8.3± 3.1	4.5±0.8	6.8±1.1	353±134	10 individuals

Table 6-6 Concentration of metals (µg/g dry weight) in *Mytilus edulis* from Westernport Bay
Average concentration ± Standard Deviation (1σ)

LOCATION	DATE COLLECTED	Wet/Dry Ratio		Zn ± S.D.		Cd ± S.D.		Pb ± S.D.		CU ± S.D.		Mn ± S.D.		Fe ± S.D.		No. Ind.	No. Com.
B.P. Jetty	17-02-75	8.6		238		0.89		4.5		6.4							
	4-07-75	7.1	0.2	212	46	0.66	0.14	<5		5.8	0.5	6.2	1.1	465	61		5
Cobb's Bluff	28-07-75	8.7	1.1	192	71	1.60	0.60	1		4.1	1.5			888	426	47	7
Corinella	16-04-75	5.9	0.7	165	70	1.20	0.68	1		4.6	2.1	8.6	8.2	468	332	35	2
	22-10-75	9.7	1.2	250	48	1.74	0.10	0.5	0.3	5.1	1.8	8.9	0.4	858	113	10	
Crawfish Rock	12-06-75	7.0	0.6	214	86	1.30	0.40	1		8.0	5.0	5.4	2.0	467	131	56	10
	15-10-75	7.5	0.9	154	15	0.63	0.07	1.5	1.0	3.8	0.6	3.5	0.9	382	75		5
	5-02-76	8.2		255	132	1.01	0.55	1.7	2.0	3.1	1.4	5.7	1.6	247	46	10	
Elizabeth Is.	[1] 7-08-75	7.2	1.2	148	55	0.91	0.44	1.8	1.0	3.9	1.0	6.7	2.8	703	241	26	
	[2] "	7.1	0.9	156	56	0.96	0.44	1.9	1.7	5.1	1.5	11.4	11.2	800	168		7
	[2] 15-10-75	8.5	0.3	170	50	0.98	0.10	0.3	0.2	3.6	0.4	5.7	0.6	574	85	10	
	[2] 4-02-76	6.5	0.9	141	60	0.59	0.24	<5		2.7	1.3	3.9	0.7	312	84	10	
Esso Jetty	3-07-75	7.9	0.5	302	48	0.63	0.10	0.4	0.3	8.2	2.3	5.1	0.9	650	61		5
Grossard Pt.	23-04-74	8.1		204		0.35		3.2		7.3							1
	17-04-75	7.5	0.7	156	22	1.40	0.50	1.5	0.5	4.7	0.9	6.0	2.3	376	86	50	7
Lysaght Jetty	17-02-75	7.9		185		0.87		1.7		3.2							1
	16-10-75	8.9	0.5	331	51	0.60	0.10	1.1	0.4	4.8	1.1	8.8	1.7	538	90		5
Newhaven	17-04-75	6.3	0.7	167	35	1.00	0.30	1		4.0	2.0	4.4	2.5	438	75	30	1
	22-10-75	9.5	0.5	204	63	1.14	0.14	0.4	0.3	4.8	0.8	6.1	0.8	562	118	10	
San Remo	24-07-74	8.6		207		0.29		11.6		10.3							
	22-10-75	7.65	1.25	233	123	1.17	0.54			3.6	0.9	4.1	1.7	477	169	40	
	12-02-76	7.4	1.5	204	167	3.08	1.66	0.4	0.2	3.3	0.5	5.1	1.4	413	127	10	1

Table 6-6 (Cont'd)

LOCATION	DATE COLLECTED	Wet/Dry Ratio		Zn	S.D.	Cd	S.D.	Pb	S.D.	Cu	S.D.	Mn	S.D.	Fe	S.D.	No. Ind.	No. Com.
Soldier's Road	10-09-75	6.7	0.4	215	60	1.79	1.03	1.6	0.9	4.6	1.5			625	107	1	5
Station 706	7-08-75	6.8	0.4	180	40	0.66	0.39	1		6.5	2.6	7.0	2.5	799	296		11
	15-10-75	7.7	0.3	199	50	0.76	0.23	<5		5.7	1.2	5.5	0.6	459	52	10	
	4-02-75	8.9	1.3	193	58	1.10	0.42	1.3	0.9	3.6	0.9	4.3	0.8	456	152	10	
Station 741	15-10-75	7.2	0.2	196	18	0.63	0.07	0.8	0.5	5.1	1.3	5.6	1.4	444	88	10	
	6-02-76	5.2	0.8	128	63	0.40	0.08	<5		3.3	3.1	3.8	0.6	244	39	10	
Stony Point	30-7-74	6.8		215		0.11		1.7		3.0							1
	15-10-75	8.2	0.1	282	75	0.86	0.01	0.9	0.5	4.7	0.5	6.3	0.7	658	116	10	
	16-10-75	8.1		189	67	0.56	0.13	0.35	0.04	4.4	0.6	5.8	1.8	536	136		5
Tankerton	30-04-75	7.5	0.6	177	77	0.90	0.20	1		5.9	1.7	8.4	3.8			24	1
	15-10-75	9.7	0.7	217	47	0.89	0.17	0.6	0.3	3.7	0.4	3.5	0.4	470	75		5
	4-01-76	7.0	1.2	181	88	0.62	0.18	<5		2.2	0.8	4.0	1.4	266	53	10	
Tooradin	8-05-74	7.8		251		4.41		4.2		1.7							

[1] on the island

[2] 200 m west of island on old jetty

Table 6 - 7: Concentrations of Heavy Metals (μg/g dry weight) in other invertebrates.

Location	Collection Date	Wet/Dry Ratio	Zn	±S.D. (1σ)	Cd	±S.D. (1σ)	Pb	±S.D. (1σ)	Cu	±S.D. (1σ)	Mn	±S.D. (1σ)	Fe	±S.D. (1σ)	No. of Individ. Analysed	No. of Composits.
Oyster, Ostrea Angasi.																
Corinella	16. 4.75	8.2±1.6	1609	790	1.64	0.96	<1		90.0	30.0	10.4	3.1	687	173	28	
	22.10.75	7.1±0.8			1.68	0.75	<1		104	22	12.7	6.5	612	149	10	
	12. 2.76	7.2±1.6	2473	1499	1.58	0.45	<1		103	41	9.8	3.0	1266	905	10	
Soldiers Rd.	10. 9.76	5.2±0.4	1016	156	1.25	0.43	<1		56.1	9.9	16.7	4.3	648	200		8
Crawfish Rock	12. 6.75	7.7±0.8	2098	947	1.38	0.32	<1		38.9	22.3	11.2	2.8	685	382	17	
Cobb's Bluff	28.7. 75	7.8±1.0	878	705	1.75	0.61	<1		74.1	28.5	15.3	6.8	842	479	19	
San Remo	12. 2.76	6.6±1.5	3051	1860	2.64	0.88	1.9	1.6	57.6	33.6	7.8	1.6	1227	592	10	
Churchill Isl.	12. 2.76	7.9±1.0	1430	652	0.97	0.37	<1		75.6	23.0	14.5	11.1	2585	1086	14	
Mud Ark, Andara Trapezia																
Corinella	16. 4.75	5.7±0.5	45.3	7.8	4.03	1.45	1.1	0.5	3.2	2.5	9.1	6.6	1285	361	8	1
	22.10.75	5.9±0.5	56	4	3.35	1.51	0.5	0.3	2.2	0.5	4.2	2.1			15	
Soldiers Rd.	10. 9.75	7.6±0.8	58.3	6.1	2.5	0.17	0.6	0.2	1.7	0.9	8.7	3.8	931	110		5
Cobb's Bluff	28. 7.75	7.7±0.5	57	12	1.86	0.86	1.4	1.4	4.1	2.2	6.6	2.6			15	
Limpet, Cellana Tramosrica																
Grossards Pt.	10. 9.75	4.2±0.6	170	36	2.63	0.64	1.2	1.0	8.6	3.2	191	142	6505	1000	10	

Table 6-8: Levels of metals in soft tissue of oysters from various locations.

Location and species	Metal Content µg/g (dry weight)						Reference
	Zn	Cd	Pb	Cn	Mn	Fe	
Georgia, U.S.A. (Crassostera virginica)	3600-1200			261-48	51-24	738-233	Windom and Smit 1972
Conneticut, U. S. A. (C. virginica)	10460-8300	28.1-15.6	7.1-4.2	2208-1260			Greig et al., 1975
New South Wales[a] (C. commercialis)	544-4522	0.68-6.8	2.0-8.8	326-20			Mackay et al., 1975
Tasmania, Aust.[b] (O. angasi)	17719	52.4		284	12.3		Eustace, 1975
This study (O. angasi)	3051-878	2.64-0.97	1.9-0.5	103-39	15.3-7.8	2585-612	

a. a value of 14.6% of wet wt. used to convert values to dry weight.

b a value of 20.4% of wet wt. used to convert values to dry weight.

Table 6-9. TRACE METAL CONCENTRATIONS IN SOFT PARTS OF MYTILUS FROM VARIOUS GEOGRAPHICAL AREAS

Species	Location	Reference	Metal Content µg/g (dry wt)											
			Zinc		Cadmium		Lead		Copper		Manganese		Iron	
			mean ± 1σ	range	mean ± 1σ	range	mean ± 1σ	range	mean ± 1σ	range	mean ± 1σ	range	mean ± 1σ	range
Mytilus edulis	Scotland (Clyde Sea)	Topping 1972*		618-94	7	7-06		41- 2		38-4				
" "	S.W. Spain & Portugal	Stenner & Nickless, 1975		370-190		3.6-1.7		15-2		14-6.5				
" "	England (Poole Hbr. Dorset)	Boyden, 1975		162-94		65.4-3.7		19-1.3		11-1.8		5-3		154-87
" "	Tasmania (Derwent Estuary)	Eustace, 1974	292		35				19.7		15.9			
" "	New Zealand (Tasman Bay)	Brooks & Rumsby, 1965		180-50		10		25-3		11-5		38-12		2640-960
" "	Australia (Port Phillip Bay)	Talbot et al, 1976				83-2.8								
" "	" (" " ")	Hansard, 2 Oct., 1975*		728-123		136-3.6		75-5.3		10.9-3.0				
" "	" (Westernport Bay)	" , 1974*		330-165		30-2.3		3.8		3				
" "	" (Port Phillip Bay)	This study (1975-76)	173 ±77	345-77	3.40 ±1.8	5.85-1.07	8.4 ±8.9	38.9-0.6	5.5 ±1.8	12.3-3.9	9.4 ±5.9	33.3-4.7	302 ±154	601-70
" "	" (Corio Bay)	" " (")	253 ±111	487-111	32 ±22	127-12.7	18 ±16	101-5.0	6.0 ±1.7	10.0- 3.0	8.5 ±2.1	14.9-6.8	477 ±304	1383-157
" "	" (Westernport Bay)	" " (")	202 ±45	331-128	1.00 ±0.80	4.40-0.11	1.8 ±2.1	11.6-0.3	4.7 ±1.8	10.3-1.7	6.1 ±2.0	11.4-3.5	522 ±179	888-247
Mytilus galloprovincialis	N.W. Mediterranean	Fowler & Oregioni, 1976	209	644-97	1.9	5.9-0.4	21.5	117-2.7	18.0	154-2.4	21.1	69.8-3.3	443	2220-149
"	Italy (Gulf of Trieste)	Favretto & Tunis, 1970	129.4						5.4		6.5		175.3	

* a value of 7.5 wet wt./dry wt. ratio was used to convert results.

REF. NO.: 74 - F - 2 **SUBSTANCES:** Pb

Reference: Favretto, L. & F. Tunis. 1974. Typical level of lead in Mytilus galloprovincialis LMK from the Gulf of Trieste. Rev. Intern. Oceanogr. Med. 33:67-74.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1974?

Location: Gulf of Trieste

Analytical Technique: Atomic absorption spectroscopy

Analytical Data: (dry wt, dried at 105°C)

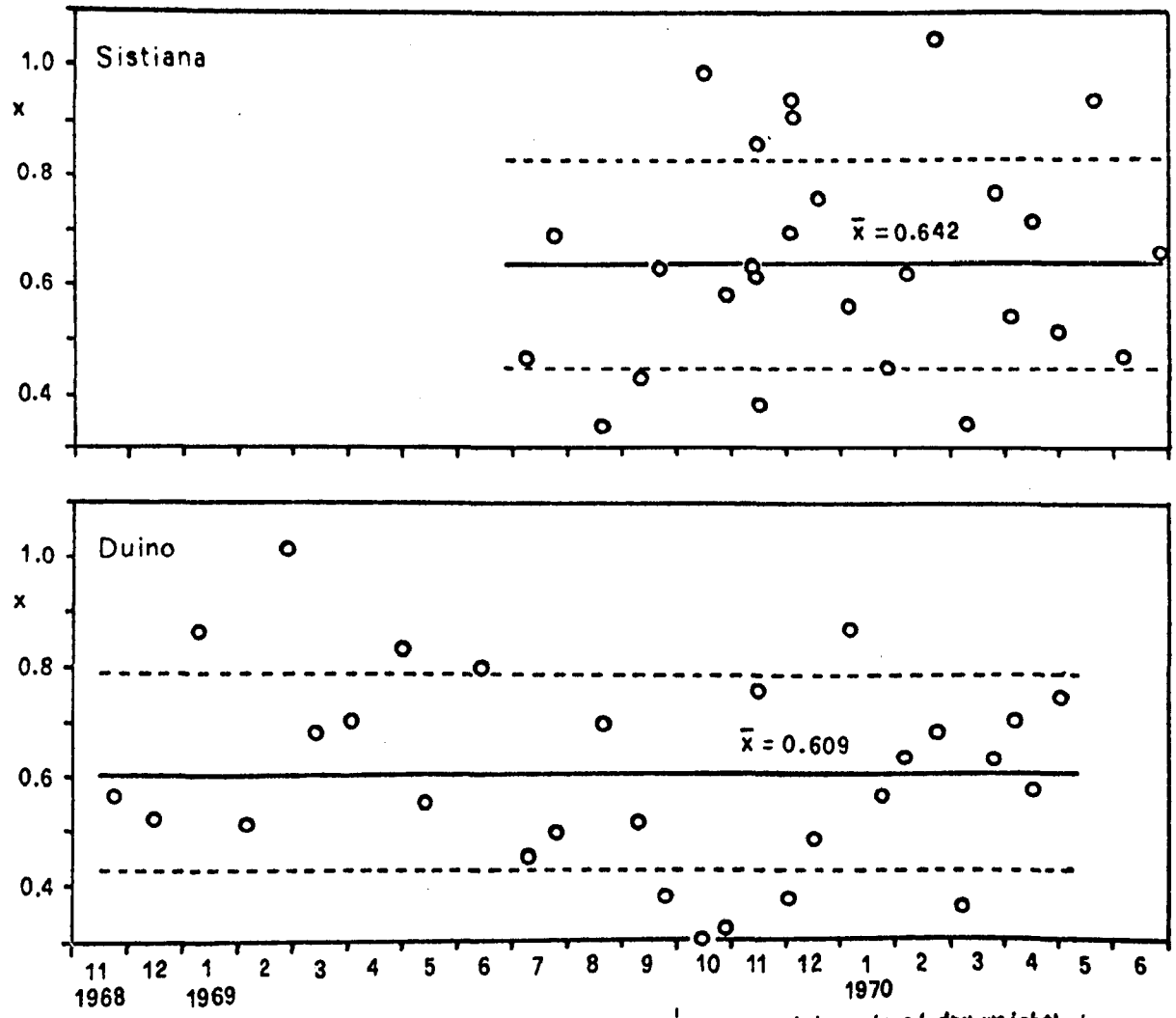


Fig. n° 2 : lead content ($x = \log_{10} c_{Pb}$, where c_{Pb} is expressed in µg/g of dry weight) in mussels from the Gulf of Trieste. Sampling date is indicated in abscissa. The root mean square deviation of x values around their mean ($\bar{x}$) is indicated by interrupted lines.

REF. NO.: 73 - F - 2

SUBSTANCES: Cr, Co, Cu, Mn, Ni, Cd, Pb, Zn, Hg

Reference: Feng, S. Y. & G. M. Ruddy. 1973. Trace elements in oysters from Connecticut waters. In A Determination of Budgets of Heavy Metal Wastes in Long Island Sound, 1st Ann. Rep., p. B1-B5. Univ. of Connecticut, Marine Sciences Institute.

Organisms: *Crassostrea virginica*

Date of Sample Collection: 1972-73

Location: Connecticut coast

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (lyophilized wt)

TABLE I. Average Trace Element Concentrations (in ppm of lyophilized weight) of Oyster Samples Collected from July, 1972 to May, 1973*.

	Cr	Co	Cu	Mn	Ni	Cd	Pb	Zn	Hg
Base Sample June 1972	nd**	nd	374 (51)	23.5 (4.4)	1.3 (1.4)	9.2 (1.2)	nd	4,425 (620)	0.265 (0.043)
Norwalk	nd	nd	520 (183)	20.3 (4.7)	17.2 (20.1)	11.5 (4.2)	nd	5,974 (1,819)	0.284 (0.055)
Bridgeport	6.1	nd	2,093 (707)	15.8 (5.8)	41.1 (29.2	46.7 (19.6)	nd	9,790 (2,540)	0.290 (0.146)
Housatonic	14.5	nd	1,815 (923)	28.0 (6.5)	30.7 (17.7)	50.0 (23.1)	nd	10,917 (4,550)	0.375 (0.116)
New Haven	nd	nd	280 (63)	13.6 (4.8)	15.8 (16.2)	6.6 (2.1)	nd	5,458 (939)	0.452 (0.092)
New London	nd	nd	388 (87)	11.5 (5.3)	14.4 (16.0)	7.3 (1.9)	nd	8,280 (1,728)	0.357 (0.089)
Noank	nd	nd	346 (90)	12.0 (5.9)	12.9 (16.6)	6.4 (1.6)	nd	5,902 (1,176)	0.643 (0.134)

* Standard deviation is given in parentheses

** Not detected

REF. NO.: 74 - F - 6

SUBSTANCES: Zn, Cu, Cd, Mn, Hg

Reference:

Feng, S. Y. & G. M. Ruddy. 1974. Zn, Cu, Cd, Mn, and Hg in oysters along the Connecticut coast. In Investigations on Concentrations, Distributions, and Fates of Heavy Metal Wastes in Parts of Long Island Sound, p. 132-159. University of Connecticut, Marine Sciences Institute.

Organisms: *Crassostrea virginica*

Date of Sample Collection: 1972-74

Location: Connecticut coast

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (lyophilized wt)

Table 2. Mercury concentrations* in Crassostrea virginica maintained in trays at Norwalk Harbor, Bridgeport, Housatonic River, New Haven Harbor, New London Harbor, and Noank, Connecticut (June 1972 to March 1974).

Date	Norwalk Harbor	Bridgeport	Housatonic River	New Haven Harbor	New London Harbor	Noank
June 72	0.265±0.043					
July-Sept.	0.293±0.063	0.388±0.220	0.472±0.079	0.532±0.065	0.448±0.046	0.562±0.069
Oct.-Dec.	0.236±0.033	0.220±0.130	0.289±0.118	0.382±0.094	0.258±0.050	0.708±0.198
Jan.-Mar. 73	0.299±0.111	0.234±0.034	0.359±0.079	0.413±0.066	0.377±0.050	0.662±0.109
Apr.-June	0.336±0.035	0.256±0.023	0.365±0.058	0.518±0.037	0.373±0.063	0.658±0.078
July-Sept.	0.284±0.056	0.241±0.056		0.510±0.088	0.434±0.071	0.795±0.189
Oct.-Dec.	0.209±0.057	0.152±0.048			0.303±0.076	0.628±0.069
Jan.-Mar. 74	0.286±0.014	0.174±0.055				

*Expressed as mean ug Hg/gm ± 1 S. D.

Table 3. Cadmium concentrations* in *Crassostrea virginica* maintained in trays at Norwalk Harbor, Bridgeport, Housatonic River, New Haven Harbor, New London Harbor, and Noank, Connecticut (June, 1972 to March, 1974).

Date	Norwalk Harbor	Bridgeport	Housatonic River	New Haven Harbor	New London Harbor	Noank
June 72	9.24±1.19					
July-Sept.	7.24±2.36	25.30± 8.28	23.06±14.13	7.20±2.15	6.30±1.43	5.93±1.34
Oct.-Dec.	12.01±1.74	44.00± 6.40	49.20± 3.42	5.30±0.66	6.40±1.64	6.80±2.93
Jan.-Mar. 73	10.67±1.66	53.20± 5.60	61.65± 6.97	4.60±1.27	7.60±2.56	5.27±1.44
Apr.-June	16.94±2.07	77.70± 4.16	84.01±18.33	8.51±1.97	8.81±2.89	8.00±2.13
July-Sept.	11.91±3.37	106.80±13.54		7.90±0.73	11.33±2.15	11.10±2.88
Oct.-Dec.	11.74±2.12	88.24±14.98			10.75±2.72	11.36±2.65
Jan.-Mar. 74	9.06±3.74	93.49± 9.98				

*Expressed as mean ug Cd/gm ± 1 S. D.

Table 4. Manganese concentrations* in *Crassostrea virginica* maintained in trays at Norwalk Harbor, Bridgeport, Housatonic River, New Haven Harbor, New London Harbor, and Noank, Connecticut (June 1972 to March 1974).

June 72	23.48±4.42					
July-Sept.	16.57±4.17	17.92±5.73	23.90±11.93	12.76±7.12	10.45±5.31	13.18±7.11
Oct.-Dec.	25.62±5.98	19.07±4.23	28.20± 9.34	17.30±3.22	14.75±1.59	15.22±3.13
Jan.-Mar. 73	19.51±3.85	13.73±1.79	29.60± 9.39	13.40±1.44	14.21±1.58	13.02±1.50
Apr.-June	22.87±9.04	10.90±7.06	24.39±19.96	10.04±5.21	4.16±3.46	4.10±2.46
July-Sept.	21.33±6.59	28.30±5.02		23.32±6.64	9.20±3.12	13.80±4.25
Oct.-Dec.	13.98±2.22	12.02±3.00			9.67±1.92	14.40±1.80
Jan.-Mar. 74	8.22±1.54	7.00±1.84				

*Expressed as mean ug Mn/gm ± 1 S. D.

Table 5. Copper concentrations* in *Crassostrea virginica* maintained in trays at Norwalk Harbor, Bridgeport, Housatonic River, New Haven Harbor, New London Harbor, and Noank, Connecticut June 1972 to March 1974).

Date	Norwalk Harbor	Bridgeport	Housatonic River	New Haven Harbor	New London Harbor	Noank
June 72	374± 50					
July-Sept.	305± 83	1388± 355	743±370	282± 65	341± 71	243± 86
Oct.-Dec.	514± 95	1886± 300	1536±168	214± 37	380±117	361± 76
Jan.-Mar. 73	715±113	2603± 432	2418±485	288± 26	392± 88	450±145
Apr.-June	693± 89	3135± 603	3028±309	404±103	494±129	452±145
July-Sept.	520±147	4304± 886		475± 52	657± 96	613±141
Oct.-Dec.	373± 50	3399± 874		497±117	586±136	592±174
Jan-Mar. 74	495±103	4001±1102		551±143	527± 85	475± 58

*Expressed as mean ug Cu/gm ± 1 S. D.

Table 6. Zinc concentrations* in *Crassostrea virginica* maintained in trays at Norwalk Harbor, Bridgeport, Housatonic River, New Haven Harbor, New London Harbor, and Noank, Connecticut (June 1972 to March 1974).

Date	Norwalk Harbor	Bridgeport	Housatonic River	New Haven Harbor	New London Harbor	Noank
June 72	4425± 620					
July-Sept.	3895± 496	6341± 941	5540±2084	4835± 783	6212±1148	4593± 873
Oct.-Dec.	5653±1093	8515±1289	10986±1145	4742± 547	8677±1474	6208±1388
Jan-Mar. 73	7864± 825	11198±1145	15948±3154	6240± 635	9458±1620	6635±1284
Apr.-June	7657±1262	12229±1782	13495±2483	6705±1206	9679±1533	7019±1072
July-Sept.	5608±1368	14045±2050		7106± 413	11652±1932	8751±1360
Oct.-Dec.	4247± 538	10524± 779		7654±1161	12521±1909	9451±2676
Jan-Mar.74	4926± 746	10698±1136		7441± 893		

*Expressed as mean ug Zn/gm ± 1 S. D.

Table 7. Multiple comparisons among means of Zn, Cu, Mn, Cd and Hg from oysters maintained at Norwalk Harbor (Hw.), Bridgeport (Bd.), Housatonic River (Ho.), New Haven Harbor (N. H.), New London (N. L.) and Noank (No.) from June 1972 to March 1974, using the Student-Newman-Keuls Test.

	Station					
	Nw.	N.H.	No.	N.L	Bd.	No.
Zn	5550±1543*	5894±1027	7183±1897	9702±2300	10493±2483	10922±4115
Cu	335±100	463±156	480±130	504±157	1830±895	3013±1119
	N	No.	N.L.	Nw.	Ho.	Bd.
Mn	10±4	12±5	15±8	16±6	20±9	27±6
	N.L.	No.	Bd.	N.H.	Nw.	Ho.
Cd	7±2	8±3	9±2	11±4	55±26	72±28
	Bd.	Nw.	Ho.	N.L.	N.H.	No.
Hg	0.240±0.108	0.275±0.052	0.367±0.104	0.367±0.084	0.475±0.084	0.676±0.133

*Expressed as ug/gm freeze-dried tissues.
Underline denotes those ranges which are found to be not significant; ranges which are not underlined, are significant at $P<0.05$.

TABLE 15. Comparison of heavy metal concentration in oysters from the Atlantic Coast, Long Island Sound, Georgia Coast, and Mobile Bay, Alabama (ppm wet weight).

Element	Mobile Bay[1]	Georgia Coast[2]	Long Island[3] Sound	Atlantic[4] Coast
Zinc	665	2580	1036	1426
Copper	19.5	97.3	139	91.5
Cadmium	0.62	----	3.38	3.10
Manganese	----	34.7	2.10	4.30

[1] from Kopfler and Mayer (1973).
[2] from Windom and Smith (1972).
[3] from the present study
[4] from Pringle et al. (1968), Maine to North Carolina.

TABLE 16. Comparison of median concentrations of manganese, copper and zinc in oysters taken from central Long Island Sound during 1933-1935 and 1972-1974.

	1933-1935*		1972-1974**	
Element	Median	Range	Median	Range
Manganese	15***	8-50	23	5-44
Copper	1,000	400-3,000	1,500	200-5,000
Zinc	6,200	3500-14,000	11,000	3,500-19,000

* Data from Galtsoff (1964);

** Data from the present study;

*** Expressed as ug/gm dry weight.

REF. NO.: 73 - F - 3

SUBSTANCES: Pb, Hg, Cd, Zn
Cu, Cr

Reference: Ferrell, R. E., T. E. Carville & J. D. Martinez. 1973. Trace metals in oyster shells. Environmental Letters 4:311-316.

Organisms: Crassostrea virginica

Date of Sample Collection: 1973?

Location: Timbalier Bay and Euhlan Bay, Louisiana, and Chesapeake Bay, Maryland

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table I. Heavy Metal Concentration in Oyster Shells and Sea Water

	No. of Shells	No. of Sol'ns	LEAD	MERCURY	CADMIUM	ZINC	COPPER	CHROMIUM
Timbalier Bay oyster shells Analyzed EPA lab, Baton Rouge, La. (Standards prepared in 1000 ppm Ca^{++})	6	22	39.55* (5.20)**	0.089 (0.037)	7.95 (3.39)	9.12 (1.58)		1.82 (2.85)
Timbalier Bay oyster shells Analyzed LSU Geochemistry lab (aqueous standard solutions)	6	22			10.86 (3.67)	5.20 (1.31)		7.26 (2.79)
Timbalier Bay oyster shells Analyzed LSU Geochemistry lab (HCl (1/4) and water in standards)	4	5	35.90 (1.46)					
Chesapeake Bay oyster shells Analyzed LSU Geochemistry lab (aqueous standard solutions)	4	8	40.88 (2.18)		10.00 (2.33)	7.50 (3.29)	42.69 (3.94)	2.31 (0.81)
Euhlan Bay oyster shells Analyzed LSU Geochemistry lab (aqueous standard solutions)	2	4	38.00 (2.18)		10.38 (1.13)		69.75 (4.58)	4.38 (0.36)
Sea Water (Mason, 1966) Metal Concentration in ppb			.03†	.03	0.11	10.	3.0	0.05

* Average Concentration of Metal in ppm
** Standard(Deviation
† Concentrations in ppb

REF. NO.: 73 - F - 5

SUBSTANCES: Hg

Reference: Fouassin, A., A. Fontaine & A. Noirfalise. 1973. Le mercure dans les poissons et crustaces consommes en Belgique. Arch. Belg. Med. Soc. Hyg. Med. Trav. Med. Leg. 31:145-152.

Organisms: mussels (unspecified)

Date of Sample Collection: 1971-72

Location: Belgium, retail market

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

	range	0.00-0.10	0.11-0.20 ppm
fresh (6 specimens)	0.09 - 0.12	17.3%	82.7%
preserved (1 specimen)	0.03	100%	

REF. NO.: 74 - F - 4

SUBSTANCES: Ag, Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn

Reference: Fowler, S. W., B. Oregioni, J. LaRosa & W. C. Renfro. 1974. Trace element concentrations in mussels of the Ligurian Sea. In Activities of the International Laboratory of Marine Radioactivity, 1974 Report, Monaco, p. 119-125. Tech. Rep., IAEA, Vienna (IAEA-163).

Organisms: *Mytilus galloprovincialis*

Date of Sample Collection: 1973

Location: Ligurian Sea

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 60°C)

Table 37. Trace metal content (µg/g dry) of *Mytilus galloprovincialis* soft parts collected in the Ligurian Sea, 19-22 June 1973. Values represent mean and 1σ of six replicates.

Station No.	Location	Ratio wet/dry	ppm dry								
			Ag	Cd	Co	Cr	Cu	Mn	Ni	Pb	Zn
1	Sète (etang)	5.66	0.10±0.01	3.64±0.44	3.1±0.5	1.0±0.1	7.2±0.2	10.1±0.7	1.0±0.1	7.3±0.8	107± 3
2	Grau de Roi	6.09	0.10±0.01	1.72±0.34	2.6±0.2	2.7±0.3	7.3±0.6	25.7±0.6	1.5±0.1	9.4±0.6	122± 5
3	Port St.Louis	5.84	0.19±0.01	2.13±0.10	3.1±0.3	2.8±0.3	8.2±0.3	45.5±1.6	2.2±0.3	18.1±0.6	181± 4
4	Marseille	5.50	0.45±0.01	1.93±0.28	2.7±0.3	2.2±0.3	10.0±0.2	5.0±0.2	2.9±0.2	20.8±1.7	209± 6
5	Cap de l'Aigle	5.82	0.48±0.02	2.01±0.25	1.7±0.3	5.0±0.1	9.5±0.3	12.6±0.7	3.3±0.2	15.7±1.3	125± 2
6	Cap Sicie	5.89	0.46±0.02	3.38±0.24	1.1±0.2	1.6±0.3	7.1±0.6	14.7±0.4	12.0±0.6	15.1±1.1	98± 3
7	Toulon	5.72	0.21±0.02	1.45±0.05	1.0±0.0	1.3±0.2	7.6±0.3	5.9±0.6	1.6±0.2	5.0±0.5	156± 2
8	Cap Camarat	6.72	0.39±0.02	1.72±0.21	0.5±0.0	1.1±0.2	5.8±0.4	4.3±0.4	1.1±0.2	3.0±0.4	130± 2
9	St. Tropez	6.34	0.49±0.02	1.74±0.20	0.5±0.0	1.6±0.2	7.3±0.2	3.9±0.4	3.6±0.4	2.7±0.2	170± 5
10	St.Raphaël	5.57	0.48±0.02	2.19±0.28	1.0±0.0	0.5±0.0	11.4±0.4	10.3±0.9	4.3±0.4	5.0±0.3	134± 4
11	Monaco	7.38	0.48±0.02	1.83±0.27	1.0±0.0	0.5±0.0	7.7±0.4	9.1±0.7	1.6±0.2	10.5±0.7	112± 2
12	San Remo	7.15	0.49±0.01	1.93±0.01	2.4±0.0	2.3±0.3	8.1±0.4	26.4±0.7	2.6±0.3	15.1±0.5	131± 1
13	Savona	6.88	0.41±0.02	3.43±0.21	3.2±0.4	5.4±0.3	8.2±0.2	39.5±0.5	4.3±0.1	29.6±1.6	184± 3
14	Genoa	5.09	0.40±0.01	2.75±0.16	2.1±0.3	5.0±0.3	11.0±0.3	35.4±2.6	8.5±0.6	16.7±0.2	197± 4
	Grand $\bar{X}$ ± 1σ		0.37±0.15	2.28±0.72	1.9±1.0	2.4±1.7	8.3±1.6	17.7±14.1	3.6±3.1	12.4±7.7	147±36

Standard deviations of ± 0.0 represents calculated standard deviations of less than 0.05

Table 38. Trace metal concentrations (µg/g dry weight) in the soft parts of *Mytilus galloprovincialis*. Mean values are listed followed by ranges (in parentheses) when available. N = number of samples. Dash indicates sample not analyzed for this metal.

Location	N	Drying Temp °C	Analytical method	ppm dry Ag	Cd	Co	Cr
Ligurian Sea (present study)	14	60	AAS	0.37(0.10-0.49)	2.28(1.45-3.64)	1.9 (0.5-3.2)	2.4 (0.5-5.4)
California[42]	24	110	AAS	1 (<1-1.3)	5 (3-7)	-	4 (<2-8)
New Zealand[41]	6	110	S	0.1 (0.1-1.3)	<10 (<10)	-	16 (9-24)
Irish Sea,[43]	-	60	AAS	0.03	5.1	1.6	1.5
Nieuport, Belgium[22]	10	≈20	NA	0.15(0.09-0.24)	-	1.74(1.21-2.23)	1.23(0.56-2.00)
The Netherlands[22]	1	≈20	NA	0.02	-	2.27	6.6
Bristol Channel, U.K.[44]	-	105	AAS	-	18 (4-60)	-	-
*Clyde Sea, Scotland[45]	6	100	AAS	-	1.8(0.6-3.5)	-	-
**Bay of Naples, Italy[49]	-	-	AAS	-	-	-	-
Grand X				0.28	7.0	1.9	5.3

AAS = atomic absorption spectrophotometry
NA = neutron activation
S = spectrographic analysis
* = dry weight/wet weight ratio of 0.165 used to convert values to ppm dry weight
** = assumed values are ppm dry weight

Table 38 (Cont.)

Location	N	Drying Temp °C	Analytical method	ppm dry Cu	Mn	Ni	Pb	Zn
Ligurian Sea (present study)	14	60	AAS	8.3(5.8-11.4)	17.7(3.9-45.5)	3.6(1.1-12.0)	12.4(2.7-29.6)	147(98-209)
California[42]	24	110	AAS	7 (5-11)	16 (6-28)	-	5 (2-8)	284(204-341)
New Zealand[41]	6	110	S	9 (8-11)	27 (12-38)	7 (1-17)	12 (3-25)	91(50-180)
Irish Sea,[43]	-	60	AAS	9.6	3.5	3.7	9.1	91
Nieuport, Belgium[22]	10	≈20	NA	-	-	-	-	40(29-57)
The Netherlands[22]	1	≈20	NA	-	-	-	-	95
Bristol Channel,UK[44]	-	105	AAS	-	-	-	10.7(1-30)	147(62-250)
*Clyde Sea,Scotland[45]	6	100	AAS	12.5(5.7-30.0)	-	-	15.7(6.0-33.0)	155(79-259)
**Bay of Naples, Italy[49]	-	-	AAS	8.0	43.4	6.6	56.7	227
Grand X				9.1	21.5	5.2	17.4	142

REF. NO.: 74 - F - 7

SUBSTANCES: Ag, Cd, Co, Cr, Mn, Ni, Pb, Zn, Fe

Reference: Fowler, S. & B. Oregioni. 1974. Heavy metals in mussels from the north western Mediterranean Sea. Iles Journées Étud. Pollutions, p. 179-180. Monaco, C.I.E.S.M.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1973-74

Location: North-western Mediterranean Sea

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Maximum values: (dry wt.)

Pb (Marseille)	117ppm
Cu (Toulon)	154ppm

(partial data--data in full to be reported later)

REF. NO.: 76 - F - 1

SUBSTANCES: Ag, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn

Reference: Fowler, S. W. & B. Oregioni. 1976. Trace metals in mussels from the N.W. Mediterranean. Mar. Pollut. Bull. 7:26-29.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1973-74

Location: N.W. Mediterranean (France and Italy)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 60°C)

TABLE 3

Trace metal concentrations (μg/g dry) in soft parts of *Mytilus* from different geographical areas. Mean values and ranges are listed when available.

Location	Reference	Ag	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
Mediterranean Sea											
N.W. coast	Present study	0.76 (0.10–1.89)	1.9 (0.4–5.9)	2.8 (0.5–7.4)	7.5 (0.5–28.8)	18.0 (2.4–154)	443 (149–2220)	21.1 (3.3–69.8)	4.3 (0.9–14.1)	21.5 (2.7–117)	209 (97–644)
Naples Bay, Italy	Sheppard & Bellamy, 1974					8.0		43.4	6.6	56.7	227
*Rovinj, Yugoslavia	Lulic & Strohal, 1974			12			667				8485
S.W. Spain and Portugal	Stenner & Nickless, 1975		2.7 (1.7–3.6)			10.9 (6.5–14)				6.8 (2–15)	265 (190–370)
California, USA	Graham, 1972	1 (<1–1.3)	5 (3–7)		4 (<2–8)	7 (5–11)		16 (6–28)		5 (2–8)	284 (204–341)
New Zealand	Brooks & Rumsby, 1965	0.1 (<0.1–1.3)	<10 (<10)		16 (9–24)	9 (8–11)	1960 (960–2640)	27 (12–38)	7 (1–17)	12 (3–25)	91 (50–180)
Derwent Estuary, Tasmania	Eustace, 1974		35			19.7		15.9			292
Irish Sea, UK	Segar *et al.*, 1971	0.03	5.1	1.6	1.5	9.6	1700	3.5	3.7	9.1	91
Bristol Channel, UK	Nickless *et al.*, 1972		18 (4–60)							10.7 (1–30)	147 (62–250)
*Clyde Sea, Scotland	Topping, 1972		1.8 (0.6–3.5)			12.5 (5.7–30)				15.7 (6–33)	155 (79–259)
Nieuport, Belgium	Bertine & Goldberg, 1972	0.15 (0.09–0.24)		1.74 (1.21–2.23)	1.23 (0.56–2.00)		854 (410–1408)				40 (29–57)
The Netherlands	Bertine & Goldberg, 1972	0.2		2.27	6.6		639				95
	ICES, 1974										
*North Sea			2.2 (2–2.7)			17 (10.3–20)				20 (15–27)	194 (164–242)
UK			1.0			15				4.8	85
France			1.8			24					109
The Netherlands						79	776	17.6			127
Germany						23				44	194
Norway			3.0								

* 0.165 Dry/wet ratio used to convert values.

Fowler, S. W. & B. Oregioni. 1976. TABLE 2

Trace metal content (μg/g dry) of *Mytilus galloprovincialis* soft parts from the northwestern Mediterranean Sea. Values represent mean and 1σ of replicates.

Station	*Date	Ag	Cd	Co	Cr	Cu	Fe	Mn	Ni	Pb	Zn
1 Sète (étang)	6–73	0.10 ± 0.01	3.6 ± 0.4	3.1 ± 0.5	1.0 ± 0.1	7.2 ± 0.2	–	10.1 ± 0.7	1.0 ± 0.1	7.3 ± 0.8	107 ± 3
	3–74	0.52 ± 0.02	4.0 ± 0.2	3.8 ± 0.5	5.9 ± 0.4	12.0 ± 0.4	388 ± 6	7.7 ± 0.3	3.0 ± 0.2	12.3 ± 1.0	180 ± 4
	6–74	0.25 ± 0.03	2.0 ± 0.1	2.9 ± 0.1	5.7 ± 0.1	6.0 ± 0.1	314 ± 6	6.0 ± 0.5	1.5 ± 0.1	7.1 ± 0.3	233 ± 9
	9–74	0.36 ± 0.01	1.8 ± 0.0	0.7 ± 0.0	5.7 ± 0.1	7.0 ± 0.1	269 ± 5	10.6 ± 0.2	2.5 ± 0.1	2.7 ± 0.1	173 ± 4
	12–74	0.37 ± 0.01	2.4 ± 0.2	2.7 ± 0.1	2.8 ± 0.2	9.8 ± 0.2	260 ± 4	8.1 ± 0.4	3.7 ± 0.1	8.0 ± 0.6	179 ± 5
2 Grau du Roi	6–73	0.10 ± 0.01	1.7 ± 0.3	2.6 ± 0.2	2.7 ± 0.3	7.3 ± 0.6	–	25.7 ± 0.6	1.5 ± 0.1	9.4 ± 0.6	122 ± 5
	3–74	0.78 ± 0.03	2.2 ± 0.3	7.4 ± 0.5	28.8 ± 1.8	14.9 ± 0.9	676 ± 21	41.1 ± 3.9	9.8 ± 0.5	10.9 ± 1.1	237 ± 5
	6–74	0.22 ± 0.01	0.4 ± 0.0	3.7 ± 0.1	7.8 ± 0.2	7.7 ± 0.2	339 ± 7	43.3 ± 0.7	7.0 ± 0.2	8.6 ± 0.4	139 ± 4
	9–74	0.69 ± 0.01	1.2 ± 0.2	2.1 ± 0.1	9.2 ± 0.5	9.0 ± 0.5	473 ± 4	52.5 ± 0.4	8.7 ± 0.1	7.9 ± 0.5	137 ± 9
	12–74	0.37 ± 0.01	2.1 ± 0.1	2.6 ± 0.1	3.4 ± 0.2	8.3 ± 0.5	256 ± 8	14.9 ± 0.2	5.1 ± 0.1	8.3 ± 0.2	174 ± 3
3 Port St. Louis	6–73	0.19 ± 0.01	2.1 ± 0.1	3.1 ± 0.3	2.8 ± 0.3	8.2 ± 0.3	–	45.5 ± 1.6	2.2 ± 0.3	18.1 ± 0.6	181 ± 4
	3–74	0.52 ± 0.02	5.9 ± 0.3	5.6 ± 0.3	15.6 ± 0.7	12.0 ± 0.4	800 ± 24	67.2 ± 4.1	6.7 ± 0.2	7.7 ± 0.3	343 ± 6
	6–74	0.21 ± 0.02	2.6 ± 0.1	2.9 ± 0.1	7.5 ± 0.4	7.3 ± 0.1	274 ± 9	31.2 ± 2.8	2.8 ± 0.3	6.4 ± 0.2	222 ± 8
	9–74	0.71 ± 0.01	1.9 ± 0.1	1.1 ± 0.0	5.8 ± 0.1	5.5 ± 0.2	191 ± 4	21.8 ± 0.3	3.2 ± 0.1	7.1 ± 0.2	145 ± 3
	12–74	0.37 ± 0.01	2.4 ± 0.2	2.8 ± 0.1	4.0 ± 0.1	7.6 ± 0.2	261 ± 7	16.6 ± 0.2	3.2 ± 0.2	6.9 ± 0.4	184 ± 12
4 Marseille	6–73	0.45 ± 0.01	1.9 ± 0.3	2.7 ± 0.3	2.2 ± 0.3	10.0 ± 0.2	–	5.0 ± 0.2	2.9 ± 0.2	20.8 ± 1.7	209 ± 6
	3–74	0.72 ± 0.04	3.0 ± 0.1	6.2 ± 0.6	8.7 ± 0.2	95.0 ± 6.5	356 ± 5	30.6 ± 2.0	6.2 ± 0.1	117 ± 2.0	644 ± 7
	6–74	0.41 ± 0.01	1.3 ± 0.1	1.9 ± 0.2	7.3 ± 0.3	38.3 ± 0.2	220 ± 6	11.7 ± 0.4	2.5 ± 0.2	53.5 ± 1.7	265 ± 7
	9–74	0.70 ± 0.01	1.5 ± 0.1	1.1 ± 0.0	5.0 ± 0.0	47.0 ± 0.6	192 ± 4	11.2 ± 0.2	2.5 ± 0.1	52.5 ± 1.1	355 ± 6
	12–74	0.55 ± 0.01	2.1 ± 0.1	2.7 ± 0.3	5.2 ± 0.2	79.4 ± 1.0	226 ± 7	14.9 ± 0.3	2.8 ± 0.1	56.4 ± 0.8	337 ± 6
5 Cap de l'Aigle	6–73	0.48 ± 0.02	2.0 ± 0.3	1.7 ± 0.3	5.0 ± 0.1	9.5 ± 0.3	–	12.6 ± 0.7	3.3 ± 0.2	15.7 ± 1.3	125 ± 2
	3–74	0.85 ± 0.06	1.5 ± 0.2	1.5 ± 0.2	5.6 ± 0.3	9.9 ± 0.1	770 ± 10	16.9 ± 0.4	6.0 ± 0.2	12.9 ± 1.5	198 ± 3
	6–74	0.42 ± 0.04	0.4 ± 0.0	1.2 ± 0.1	8.5 ± 0.5	5.8 ± 0.1	190 ± 7	4.6 ± 0.4	3.6 ± 0.1	8.5 ± 0.4	159 ± 3
6 Cap Sicié	6–73	0.46 ± 0.02	3.4 ± 0.2	1.1 ± 0.2	1.6 ± 0.3	7.1 ± 0.6	–	14.7 ± 0.4	12.0 ± 0.6	15.1 ± 1.1	98 ± 3
	6–74	0.42 ± 0.01	1.7 ± 0.1	2.2 ± 0.1	13.2 ± 0.5	5.1 ± 0.2	197 ± 6	5.5 ± 0.3	5.9 ± 0.2	6.3 ± 0.1	97 ± 3
7 Toulon	6–73	0.21 ± 0.02	1.5 ± 0.1	1.0 ± 0.0	1.3 ± 0.2	7.6 ± 0.3	–	5.9 ± 0.6	1.6 ± 0.2	5.0 ± 0.5	156 ± 2
	3–74	1.22 ± 0.05	2.8 ± 0.1	1.4 ± 0.2	11.9 ± 0.9	77.4 ± 7.1	645 ± 19	27.8 ± 2.5	2.8 ± 0.2	110 ± 2.0	391 ± 8
	6–74	0.64 ± 0.03	2.2 ± 0.1	1.3 ± 0.1	2.5 ± 0.2	21.9 ± 1.3	242 ± 13	9.2 ± 0.6	1.4 ± 0.2	58.1 ± 1.3	243 ± 9
	9–74	0.70 ± 0.01	2.9 ± 0.1	1.8 ± 0.0	6.7 ± 0.1	154 ± 6.0	206 ± 5	26.4 ± 1.4	3.5 ± 0.1	71.2 ± 1.5	349 ± 13
	12–74	1.08 ± 0.01	4.7 ± 0.0	3.1 ± 0.2	3.9 ± 0.0	126 ± 3.0	322 ± 3	14.3 ± 0.3	4.0 ± 0.1	88.7 ± 1.6	543 ± 3
8 Cap Camarat	6–73	0.39 ± 0.02	1.7 ± 0.2	0.5 ± 0.0	1.1 ± 0.2	5.8 ± 0.4	–	4.3 ± 0.4	1.1 ± 0.2	3.0 ± 0.4	130 ± 2
	6–74	0.44 ± 0.01	0.4 ± 0.0	1.3 ± 0.1	6.6 ± 0.4	2.4 ± 0.4	171 ± 7	11.7 ± 0.7	2.6 ± 0.2	8.9 ± 0.2	118 ± 5
	9–74	0.72 ± 0.01	1.5 ± 0.0	2.2 ± 0.1	7.6 ± 0.1	5.1 ± 0.0	149 ± 4	11.7 ± 0.2	3.9 ± 0.1	5.9 ± 0.2	136 ± 5
	12–74	0.70 ± 0.05	2.0 ± 0.1	1.9 ± 0.1	4.7 ± 0.1	8.4 ± 0.2	163 ± 6	12.9 ± 0.3	3.9 ± 0.1	5.9 ± 0.2	155 ± 3
9 St. Tropez	6–73	0.49 ± 0.02	1.7 ± 0.2	0.5 ± 0.0	1.6 ± 0.2	7.3 ± 0.2	–	3.9 ± 0.4	3.6 ± 0.4	2.7 ± 0.2	170 ± 5
	3–74	1.39 ± 0.08	1.2 ± 0.2	4.0 ± 0.4	4.4 ± 0.3	12.6 ± 0.6	626 ± 8	19.8 ± 0.9	2.7 ± 0.3	9.8 ± 0.3	223 ± 3
	6–74	0.84 ± 0.05	0.4 ± 0.0	0.8 ± 0.1	7.2 ± 0.2	5.7 ± 0.2	271 ± 4	9.3 ± 0.2	2.7 ± 0.1	8.7 ± 0.1	146 ± 4
	9–74	1.74 ± 0.02	1.1 ± 0.1	2.4 ± 0.1	5.6 ± 0.1	7.0 ± 0.1	239 ± 10	18.0 ± 0.3	3.6 ± 0.1	7.7 ± 0.4	162 ± 5
	12–74	1.08 ± 0.02	1.8 ± 0.1	2.0 ± 0.2	4.3 ± 0.1	8.5 ± 0.3	244 ± 6	12.4 ± 0.1	4.3 ± 0.1	8.3 ± 0.2	165 ± 7
10 St. Raphaël	6–73	0.48 ± 0.02	2.2 ± 0.3	1.0 ± 0.0	0.5 ± 0.0	11.4 ± 0.4	–	10.3 ± 0.9	4.3 ± 0.4	5.0 ± 0.3	134 ± 4
	3–74	1.02 ± 0.04	1.0 ± 0.0	5.3 ± 0.7	18.0 ± 1.2	17.6 ± 0.2	523 ± 14	59.6 ± 5.4	5.7 ± 0.3	24.7 ± 1.3	195 ± 2
	6–74	1.42 ± 0.08	0.9 ± 0.1	1.7 ± 0.0	11.5 ± 0.4	7.6 ± 0.5	387 ± 7	12.8 ± 0.3	3.5 ± 0.1	10.6 ± 0.7	97 ± 2
	9–74	1.05 ± 0.02	1.1 ± 0.0	2.4 ± 0.1	7.1 ± 0.1	5.8 ± 0.1	180 ± 6	11.2 ± 0.2	3.3 ± 0.1	7.2 ± 0.2	117 ± 3
	12–74	1.86 ± 0.05	1.8 ± 0.0	2.4 ± 0.2	5.9 ± 0.3	8.3 ± 0.2	300 ± 11	13.3 ± 0.2	5.0 ± 0.1	9.8 ± 0.3	160 ± 7
11 Cannes	3–74	1.89 ± 0.09	1.0 ± 0.0	3.9 ± 0.2	16.9 ± 0.3	11.3 ± 0.1	624 ± 12	13.8 ± 0.7	4.6 ± 0.2	40.9 ± 2.1	277 ± 5
	6–74	1.04 ± 0.04	0.4 ± 0.0	1.6 ± 0.1	5.3 ± 0.4	8.3 ± 0.3	312 ± 10	8.4 ± 0.1	1.3 ± 0.1	31.2 ± 1.2	224 ± 4
	9–74	1.05 ± 0.02	2.5 ± 0.1	1.4 ± 0.1	7.5 ± 0.1	13.9 ± 0.8	818 ± 6	18.4 ± 0.8	4.3 ± 0.1	58.5 ± 1.4	259 ± 4
	12–74	1.14 ± 0.06	2.1 ± 0.2	3.9 ± 0.2	4.7 ± 0.1	13.0 ± 0.8	776 ± 31	12.9 ± 0.5	4.1 ± 0.0	69.7 ± 1.4	267 ± 4
12 Monaco	6–73	0.48 ± 0.02	1.8 ± 0.3	1.0 ± 0.0	0.5 ± 0.0	7.7 ± 0.4	–	9.1 ± 0.7	1.6 ± 0.2	10.5 ± 0.7	112 ± 2
	3–74	1.24 ± 0.05	1.6 ± 0.1	2.0 ± 0.2	8.8 ± 0.1	16.7 ± 0.2	523 ± 13	13.3 ± 1.8	1.0 ± 0.1	35.6 ± 1.7	237 ± 4
	6–74	0.87 ± 0.02	0.4 ± 0.0	0.9 ± 0.0	3.7 ± 0.2	7.1 ± 0.2	179 ± 2	3.3 ± 0.5	0.9 ± 0.0	15.7 ± 0.5	195 ± 5
	9–74	1.05 ± 0.02	2.5 ± 0.0	4.9 ± 0.1	5.9 ± 0.1	23.5 ± 0.1	221 ± 3	9.8 ± 0.1	3.2 ± 0.1	14.3 ± 0.6	231 ± 3
	12–74	1.39 ± 0.10	2.9 ± 0.1	3.3 ± 0.1	3.2 ± 0.1	9.8 ± 0.7	213 ± 14	8.0 ± 0.2	3.2 ± 0.1	18.2 ± 0.7	205 ± 9
13 San Remo	6–73	0.49 ± 0.01	1.9 ± 0.0	2.4 ± 0.0	2.3 ± 0.3	8.1 ± 0.4	–	26.4 ± 0.7	2.6 ± 0.3	15.1 ± 0.5	131 ± 1
	3–74	1.47 ± 0.10	1.5 ± 0.1	6.6 ± 0.2	18.6 ± 0.4	9.4 ± 0.7	558 ± 23	20.8 ± 0.6	7.4 ± 0.2	8.8 ± 0.5	159 ± 5
	6–74	0.62 ± 0.04	0.4 ± 0.0	3.5 ± 0.5	9.1 ± 0.4	21.0 ± 0.3	238 ± 11	7.4 ± 0.3	3.3 ± 0.1	20.3 ± 1.6	250 ± 5
	9–74	1.07 ± 0.02	1.8 ± 0.0	1.4 ± 0.1	8.4 ± 0.1	20.4 ± 0.2	296 ± 7	14.9 ± 0.5	3.5 ± 0.2	13.2 ± 0.8	248 ± 10
	12–74	0.35 ± 0.02	1.5 ± 0.2	3.2 ± 0.1	4.4 ± 0.4	14.1 ± 0.2	315 ± 9	13.9 ± 0.3	3.2 ± 0.1	22.2 ± 0.6	249 ± 4
14 Savona	6–73	0.41 ± 0.02	3.4 ± 0.2	3.2 ± 0.4	5.4 ± 0.3	8.2 ± 0.2	–	39.5 ± 0.5	4.3 ± 0.1	29.6 ± 1.6	184 ± 3
	3–74	1.61 ± 0.08	2.0 ± 0.1	7.0 ± 0.2	21.1 ± 1.1	12.0 ± 0.3	2220 ± 41	47.8 ± 1.5	10.3 ± 0.4	17.5 ± 0.7	286 ± 6
	6–74	0.84 ± 0.04	0.4 ± 0.0	4.4 ± 0.2	8.0 ± 0.5	6.9 ± 0.2	738 ± 16	22.5 ± 0.8	3.3 ± 0.2	9.5 ± 0.6	151 ± 3
	9–74	1.44 ± 0.06	2.6 ± 0.1	4.0 ± 0.1	8.8 ± 0.1	10.6 ± 0.2	755 ± 10	54.5 ± 0.7	4.3 ± 0.1	15.0 ± 0.7	214 ± 6
	12–74	0.76 ± 0.02	1.9 ± 0.0	5.1 ± 0.1	10.0 ± 0.2	9.5 ± 0.2	801 ± 20	32.7 ± 1.3	6.4 ± 0.2	16.8 ± 0.6	224 ± 6
15 Genoa	6–73	0.40 ± 0.01	2.8 ± 0.2	2.1 ± 0.3	5.0 ± 0.3	11.0 ± 0.3	–	35.4 ± 2.6	8.5 ± 0.6	16.7 ± 0.2	197 ± 4
	3–74	1.41 ± 0.09	1.5 ± 0.2	7.3 ± 0.2	27.4 ± 0.8	12.9 ± 0.1	1210 ± 24	69.8 ± 3.4	13.2 ± 0.4	13.3 ± 0.5	260 ± 6
	6–74	0.46 ± 0.06	0.4 ± 0.0	2.2 ± 0.2	9.1 ± 0.2	7.7 ± 0.4	373 ± 6	30.2 ± 0.8	4.3 ± 0.3	7.4 ± 0.3	127 ± 4
	9–74	0.67 ± 0.04	1.8 ± 0.0	2.8 ± 0.1	12.3 ± 0.2	11.5 ± 0.2	650 ± 4	45.1 ± 0.9	5.3 ± 0.2	5.7 ± 0.3	214 ± 8
	12–74	0.75 ± 0.03	1.8 ± 0.0	4.7 ± 0.2	18.6 ± 1.6	13.2 ± 0.3	777 ± 16	52.9 ± 1.2	14.1 ± 0.5	15.7 ± 0.4	252 ± 3

REF. NO.: 76 - F - 2 SUBSTANCES: Se

Reference: Fowler, S. W. & G. Benayoun. 1976. Accumulation and distribution of selenium in mussel and shrimp tissues. Bull. Envir. Contam. Toxicol. 16:339-346.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1976?

Location: Monaco

Analytical Technique: Neutron activation analysis

Analytical Data:

TABLE 1

Tissue distribution of selenium in mussels and shrimp in terms of element concentration and percentage of total tissue content

Tissue	µg Se/g dry	µg Se/g wet	% total tissue wet weight†	% total Se in tissue
Lysmata seticaudata (whole)	*2.69	*0.65		
Viscera	7.06	2.26	8.2	31.6
Muscle	1.98	0.40	62.8	42.8
Eyes	4.86	1.22	1.8	3.8
Exoskeleton	1.51	0.47	27.2	21.8
(Molts)	0.32	0.07	19.0	2.1
Mytilus galloprovincialis				
Shell	< 0.05	< 0.05	65.2	< 10.4
Mantle	5.26	0.95	13.8	41.8
Gills	7.08	0.78	9.1	22.7
Viscera	3.22	0.77	8.7	21.4
Muscle	1.91	0.36	3.2	3.7
(whole soft parts)	*6.10	*0.89	34.8	> 89.6

* measured value, not reconstructed
† based on total weight of dissected tissues

REF. NO.: 31 - F - 1

SUBSTANCES: Mn, Co, Ni

Reference: Fox, H. M. & H. Ramage. 1931. A spectrographic analysis of animal tissues. Proc. Roy. Soc. Lond. B 108:157-173.

Organisms:
Pecten maximus
Pinna pectinata
Ostrea edulis
Anodonta cygnea

Date of Sample Collection: 1931?

Location: England

Analytical Technique: Emission spectography

Analytical Data: (dry wt, dried at 100°C)

Table III.—Distribution of Manganese in Lamellibranchs.

The numbers have the same significance as in Table II. In addition, "8" denotes an unusually high concentration of Mn.

	Foot.	Mantle.	Gills.	Ant. adductor.	Post. adductor.	Liver.	Kidney.	Testis.	Ovary.	Gonad.	Shell.
Anodonta—											
Liverpool	3, 2	7, 6	8	—	—	5	7	—	7, 7	—	2
Nowdigate	3, 4	7, 7	8	—	—	8	8	—	7	7	6
Sheffield	7, 7	7, 7	8, 8	—	—	8, 8	8	—	8	8	5
Pecten—											
Eddystone	—	0	0	0	0	2	7	5	2	—	—
Mowstone....	—	0	0	1	0	2, 2	7	3	1	—	—
Millport	—	0, 0	1, 1	2	0	2, 2	7	3	2	—	—
Ostrea	—	4	4	0, 0	0, 0	1	—	—	—	1, 2	—
Pinna	0	0	0	—	—	1	3	—	2	—	—

REF. NO.: 75 - F - 2

SUBSTANCES: Mn, Fe, Zn, Cu, Cd

Reference: Frazier, J. M. 1975. The dynamics of metals in the American oyster, Crassostrea virginica. I. Seasonal effects. Chesapeake Sci. 16:162-171.

Organisms: Crassostrea virginica

Date of Sample Collection: 1971-73

Location: Rhode River (tributary to Chesapeake Bay)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, freeze-dried)

TABLE 1. The metal composition of oyster shells collected 3/28/72 and 6/7/72 (Mean ± one standard deviation; n = 5).

	Concentration (μg/gm dry weight)				
Date	Mn	Fe	Zn	Cu	Cd
3/28/72	520 ±40	20 ±13	2.1 ±0.4	0.13 ±0.05	<0.1
6/7/73	490 ±80	18 ±8	3.0 ±1.6	0.19 ±0.09	<0.1
Average	505	19	2.5	0.16	<0.1

TABLE 3. Correlation coefficients between oyster soft tissue metal concentrations.

	Fe	Zn	Cu	Cd
Mn	0.66*	0.29	0.01	0.18
Fe	—	0.63*	0.35	0.61*
Zn	—	—	0.87*	0.88*
Cu	—	—	—	0.71*

† * Statistically significant at the 0.05 level.

TABLE 4. Range of body burdens, amount of metal deposited in shell during the 1972 shell growing season and the decrease in body burden for Cu, Zn and Cd during the 1972 shell growing season.

Metal	Range of Body Burden (μg)	Metal Deposited in Shell (μg)	Decrease in Body Burden (μg)
Mn	2-13	3,020	—
Fe	50-180	112	—
Zn	600-1800	15	500[1]
Cu	30-80	1	55[1]
Cd	0.5-7.0	<0.6	5.0[2]

[1] During August-September.
[2] During July-October.

Frazier, J. M. 1975.

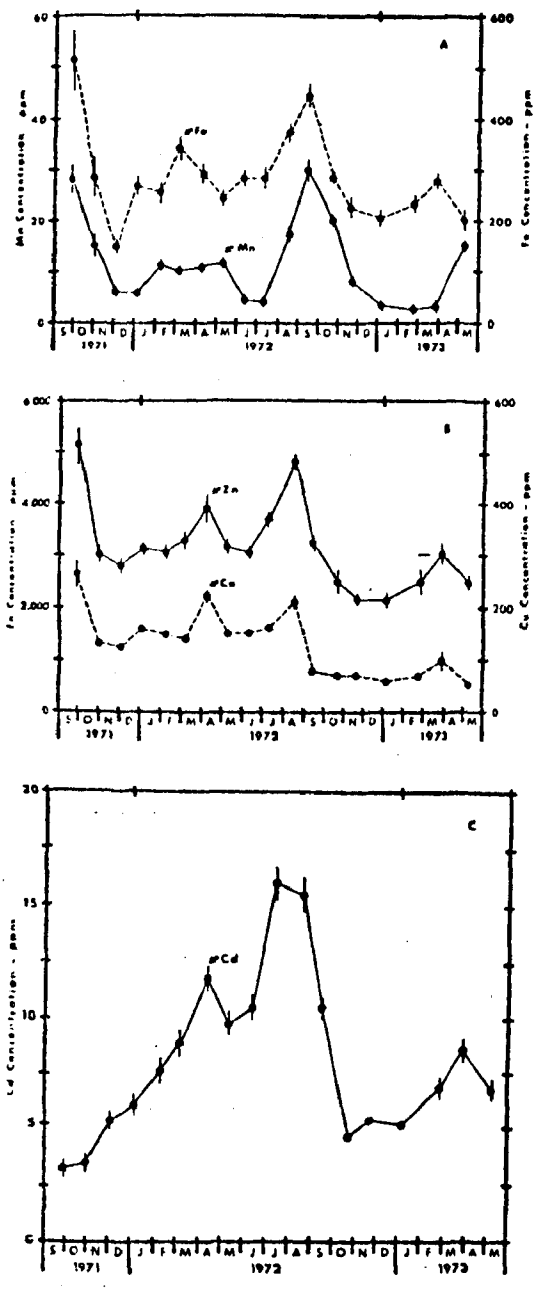


FIG. 3. (A: upper) Mn and Fe concentration, (B, middle) Zn and Cu concentration, and (C, lower) Cd concentration in whole soft tissues of genetically similar oysters: mean ± standard error of the mean for each sample of 10 oysters. No error bars indicate that SEM was less than size of symbols used.

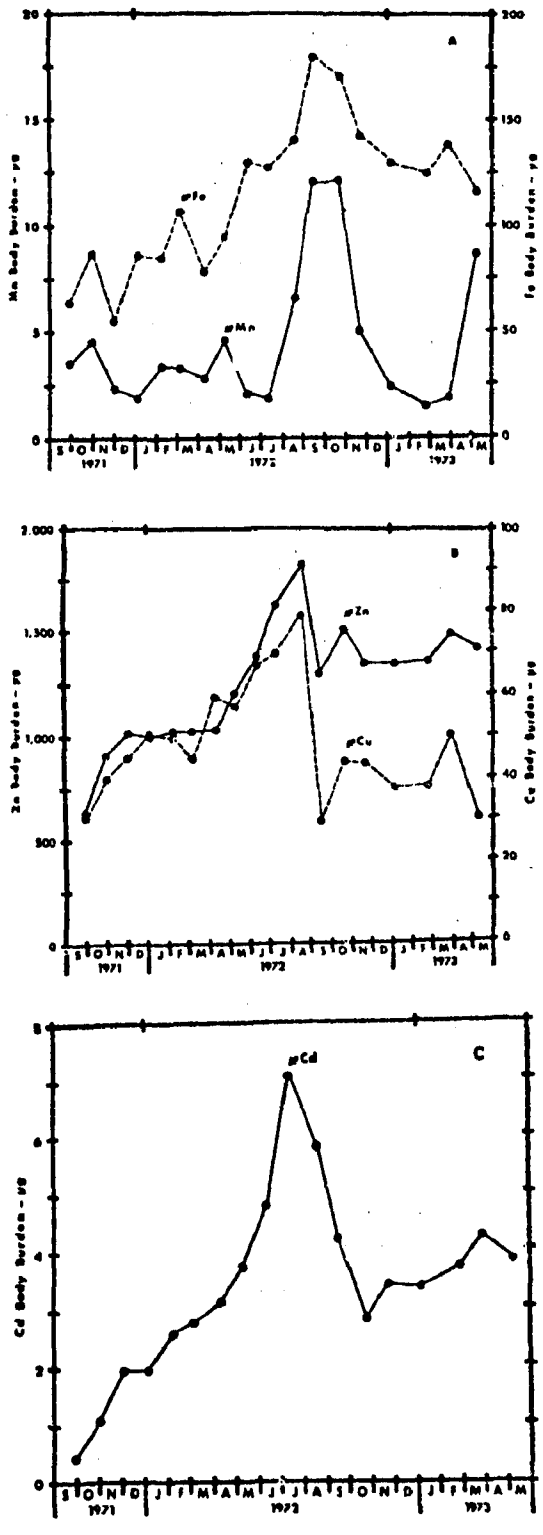


FIG. 4. (A, upper) Mn and Fe body burden, (B, middle) Zn and Cu body burden, and (C, lower) Cd body burden in whole soft tissues of genetically similar oysters.

REF. NO.: 76 - F - 3

SUBSTANCES: Mn, Fe, Zn, Cu, Cd

Reference: Frazier, J. M. 1976. The dynamics of metals in the American oyster, Crassostrea virginica. II. Environmental effects. Chesapeake Sci. 17:188-197.

Organisms: Crassostrea virginica

Date of Sample Collection: 1972-73

Location: Rhode River (tributary to Chesapeake Bay), Maryland (two locations, polluted and relatively unpolluted, compared)

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, freeze-dried)

TABLE 3: Concentration of metals in oyster shell.

Experiment	Station	Date	n	Concentration (μg/gm dry shell)				
				Mn	Fe	Zn	Cu	Cd
Oyster I*	CBCES Pier	3/28/73	5	520 ± 40	20 ± 13	2.1 ± 0.4	0.13 ± 0.05	<0.1
		6/7/73	5	490 ± 80	18 ± 8	3.0 ± 1.6	0.19 ± 0.09	<0.1
Oyster II*	CBCES Pier	2/1/73	4	440 ± 40	7 ± 6	2.0 ± 0.2	0.65 ± 0.32	<0.1
		6/7/73	4	380 ± 60	4 ± 3	1.8 ± 0.2	0.59 ± 0.24	<0.1
Oyster II*	Cadle Creek	2/1/73	4	360 ± 30	15 ± 11	5.3 ± 0.7	1.15 ± 0.22	<0.1
		6/7/73	4	330 ± 70	12 ± 6	4.4 ± 1.1	0.92 ± 0.25	<0.1

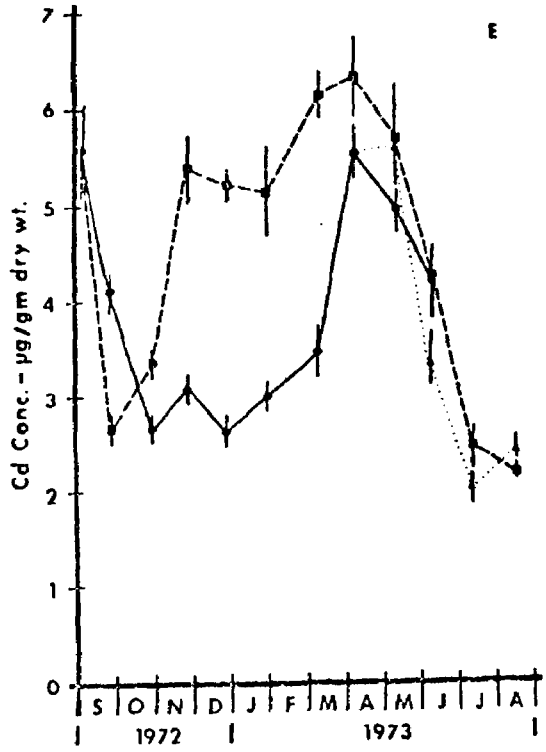
* Oyster I refers to the experiment reported in Frazier, 1975. Oyster II refers to this experiment.

TABLE 4: Ratio of metal concentrations at Cadle Creek to CBCES Pier for sediments, soft tissues, and shell.

	Mn	Fe	Zn	Cu	Cd
Sediments	1.8	1.4	4.8*	22*	2.2*
Soft tissues	0.6	0.9	2.5*	7.8*	1.9*
Shell	0.8*	2.5*	2.6*	1.7*	—

* Ratio significantly different from 1.

Frazier, J. M. 1976.



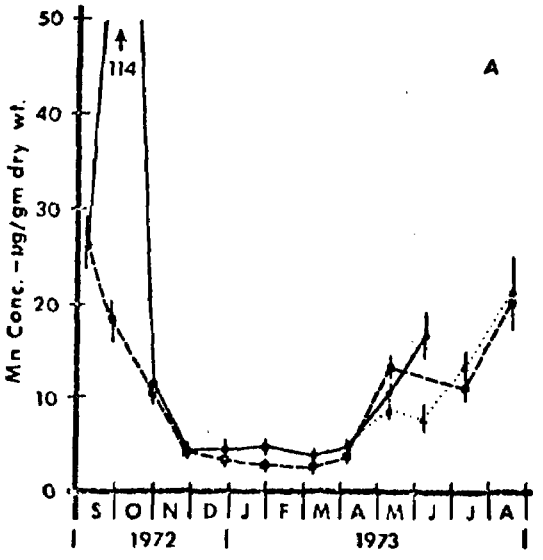
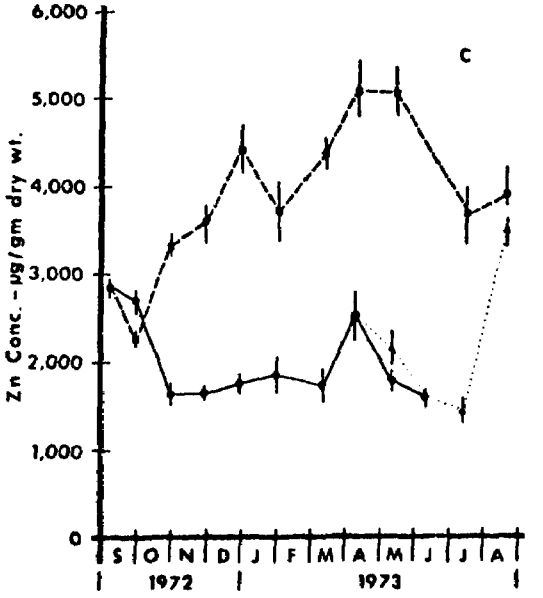
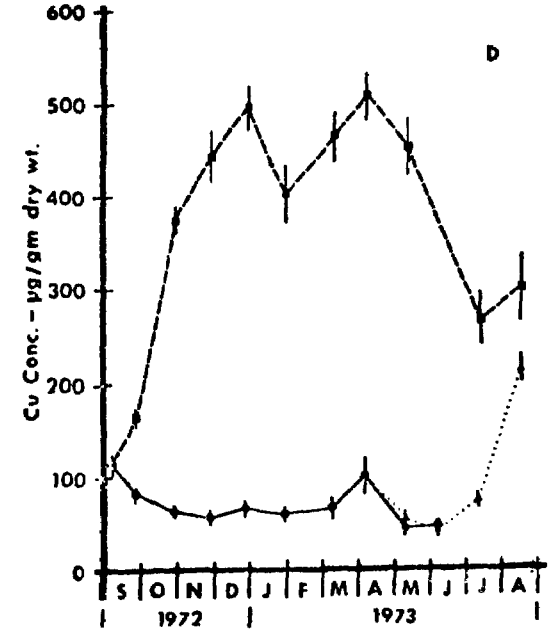
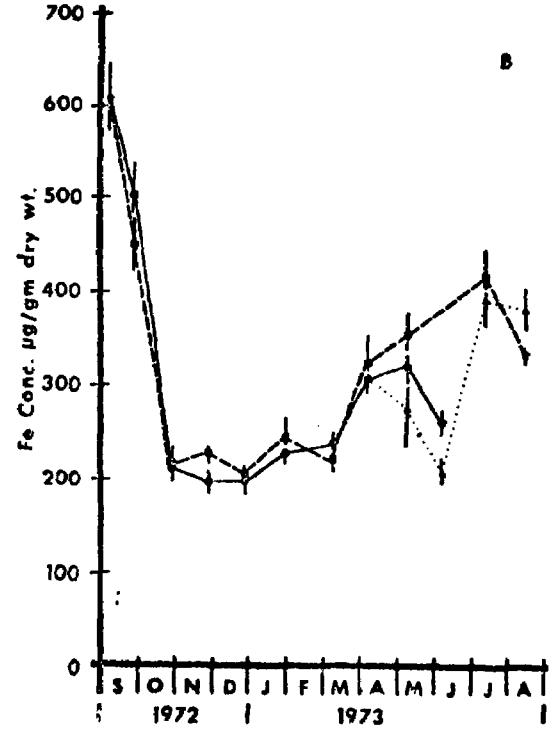


Fig. 4. Concentration of Mn (A), Fe (B), Zn (C), Cu (D), and Cd (E) in soft tissues of control (CBCES pier) and exposed (Cadle-1 and -2) oysters. Mean ± 1 standard error of the mean (n = 10). Key: ● CBCES pier, ■ Cadle-1, ▲ Cadle-2.







Frazier, J. M. 1976.

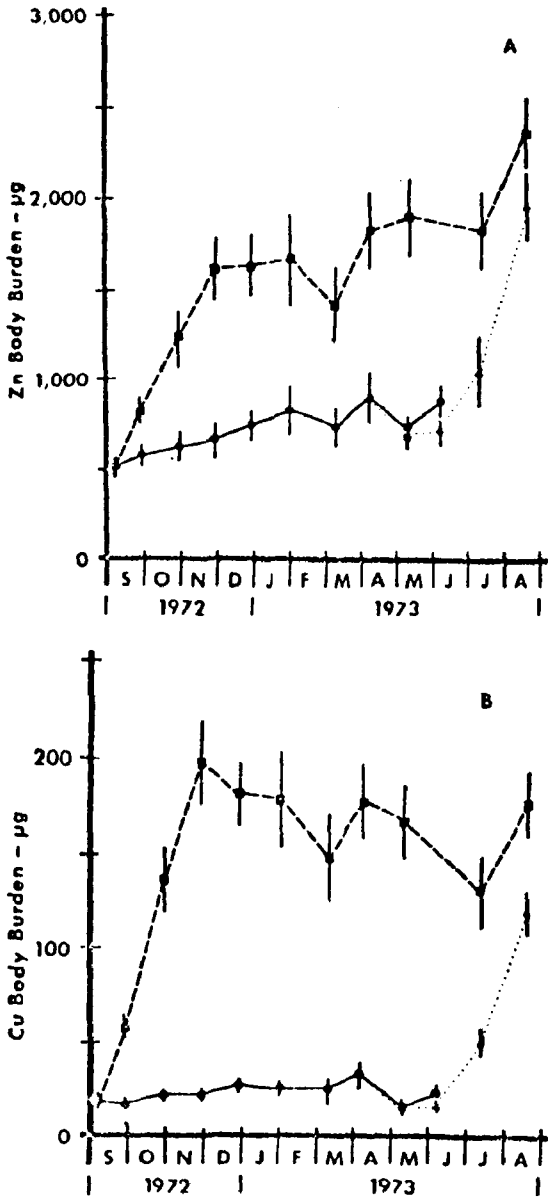


Fig. 5. Body burden of Zn (A) and Cu (B) in control (CBCES pier) and exposed (Cadle-1 and -2) oysters. Mean ± 1 standard error of the mean (n = 10). Key: ● CBCES pier, ■ Cadle-1, ▲ Cadle-2.

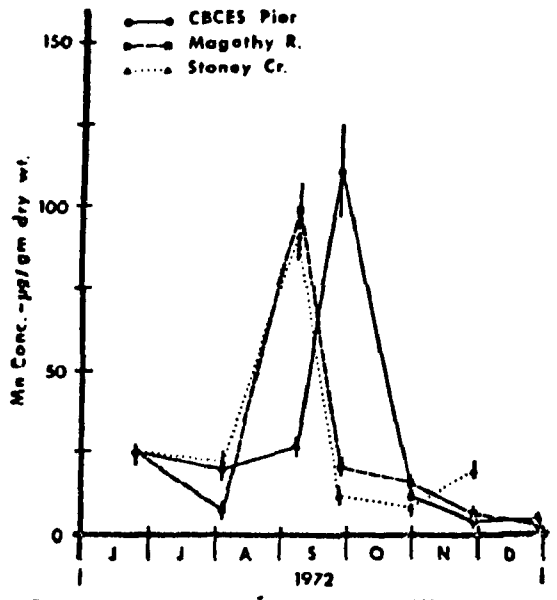


Fig. 6. Concentration of Mn in three different stocks of oysters in the Chesapeake Bay. Mean ± 1 standard error of the mean (n = 10). Key: ● CBCES pier, ■ Magothy River, ▲ Stoney Creek.

REF. NO.: 74 - F - 3

SUBSTANCES: Hg

Reference: Freeman, H. C., D. A. Horne, B. McTague & M. McMenemy. 1974. Mercury in some Canadian Atlantic coast fish and shellfish. J. Fish. Res. Bd. Can. 31:369-372.

Organisms: Volsella modiolus, Venus mercenaria, Mya arenaria, Crassostrea virginica, Placopecten magellanicus

Date of Sample Collection: 1972

Location: Malpeque Bay, near Ellerslie, P.E.I., Canada

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1. Mercury in Atlantic fish and shellfish.

Family	Species	Sex	No. of fish	Avg wt (g)	Tissue	ppm Hg range	Mean ± SD[a]
Mytilidae mussel	(*Volsella modiolus*)	–	9	41.7	total muscle	0.02–0.05	0.04±0.01
Veneridae quahog	(*Venus mercenaria*)	–	10	60.2	" "	<0.005–0.04	<0.02
Myacidae clam	(*Mya arenaria*)	–	10	61.4	" "	0.03–0.13	0.05±0.03
Ostreidae oyster	(*Crassostrea virginica*)	–	10	24.9	" "	0.06–0.13	0.10±0.02
Pectinidae scallop	(*Placopecten magellanicus*)	–	10	–	" "	0.07–0.10	0.09±0.01

REF. NO.: 65 - F - 2 **SUBSTANCES:** Cr, Fe

Reference: Fukai, R. & D. Broquet. 1965. Distribution of chromium in marine organisms. Bull. Inst. Océanogr., Monaco, 65(1336):19p.

Organisms: Mytilus edulis
Tapes decussatus
Venus verrucosa
Gryphaea angulata
Pecten jacobaeus

Date of Sample Collection: 1962-64

Location: Mediterranean (Monaco, Séte); Atlantic (Arcachon, Normandy)

Analytical Technique: isotope dilution

Analytical Data: (dry wt, dried at 100-110°C)

TABLE 3
Chromium and Iron Content of Molluscs

Organisms	Place and Date of Collection*	Cr-content µg/g-dry	Fe-content mg/g-dry	Fe/Cr by weight
MOLLUSCA				
Lamellibranchia				
Mytilus edulis (mussel) soft parts	Monaco (M) Jun. 62	1.0	0.13	0.1×10^3
Tapes decussatus (clam) soft parts	Sète (M) Jan. 64.	1.6	0.17	0.1
Venus verrucosa (venus shell) soft parts	Sète (M) Jan. 64	0.5	0.15	0.3
Gryphaea angulata (oyster) soft parts	Arcachon (A) Jan. 64	0.5	0.31	0.6
Pecten jacobaeus (scallop) soft parts	Normandy (A) Jan. 64	1.1	0.73	0.7
Gastropoda				
Patella intermedia (limpet) shell	Cap Martin (M) Jun. 62	0.07	0.13	2.0
soft parts		0.8	1.54	1.9
Murex trunculus (gastropod) soft parts	Cap Martin (M) Aug. 63	0.9	0.20	0.2
Cephalopoda				
Eledone moschata (octopus) whole animal	Monaco (M) Sep. 64	0.12	0.09	0.8
Loligo vulgaris (squid) soft parts	Bay of Biscary (A) Sep. 64	0.07	0.05	0.7

* In this column, the " M " and " A " in parentheses indicate the Mediterranean and the Atlantic, respectively.

REF. NO.: 65 - F - 3 SUBSTANCES: Cr

Reference: Fukai, R. 1965. Analysis of trace amounts of chromium in marine organisms by the isotope dilution of Cr^{51}. In Radiochemical Methods of Analysis, v. 2, p. 335-351. IAEA, Vienna.

Organisms: Mytilus edulis

Date of Sample Collection: 1962

Location: Mediterranean coast

Analytical Technique: Spectrophotometry

Analytical Data:

TABLE VII

CHROMIUM CONTENT OF VARIOUS MARINE ORGANISMS

Organism	Location and date of collection	Part of organism analysed	Cr-content (µg/g-dry matter)
MOLLUSCA			
Mytilus edulis (mussel)	Mediterranean Coast June 1962	soft parts	0.97

REF. NO.: 75 - G - 4

SUBSTANCES: Cu, Mn, Zn, Fe, Co, Pb Hg

Reference: Geldiay, R. & H. Uysal. 1975. Comparative behaviour of toxic metals in a marine ecosystem. In Origin and fate of chemical residues in food, agriculture and fish, IAEA Panel Proceedings Series STI/PUB/399, p. 69-76. IAEA, Vienna.

Organisms: Tapes decussatus

Date of Sample Collection: 1975?

Location: Izmir Bay, Turkey

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt., dried at 105°C)

TABLE I. THE MEAN CONCENTRATIONS OF TRACE METALS (EXCEPT MERCURY) IN THE WHOLE BODY, THE TISSUES, THE ORGANS AND SHELL OF Tapes decussatus
(Measured in terms of μg/g on a dry-weight basis. Concentrations of mercury are given on a wet-weight basis (samples consisting of one whole animal, the tissues and the organs, pooled from ten animals, were collected at different times of the year))

Locality	Metal	No. of whole animals analysed	Whole body (soft part)	Shell	Body fluids	Food and dig. system	Gills and palps	Mantle and siphon	Muscles	Digestive glands
Deniz Bostanlı	Cu	10	6.2	2.7	[illegible]	5.0	7.9	2.5	2.1	30.8
	Mn	10	10.1	5.4	[illegible]	3.6	10.1	4.4	5.7	6.3
	Zn	10	111.4	5.5	207.0	69.8	124.5	63.9	50.1	143.0
	Fe	10	338.1	107.7	45.5	315.5	720.5	246.7	113.9	832.1
	Pb	10	20.6	15.0	18.6	6.4	10.0	5.4	13.6	9.1
	Co	10	7.6	22.8	11.9	3.8	3.0	2.2	4.2	3.0
	Cr	10	-	-	-	-	-	-	-	-
	Hg (wet wt.)	3	3.7	2.0	[illegible]	1.3	3.0	2.0	3.4	4.4
Dry weight (%)		-	11.7	-	[illegible]	23.6	19.6	21.6	24.5	23.6
Çakalburnu fishery	Cu	10	7.2	3.4	[illegible]	4.1	11.5	6.6	1.9	16.3
	Mn	10	7.3	7.5	[illegible]	3.1	8.8	8.8	6.0	4.7
	Zn	10	106.0	16.7	137.3	57.3	108.9	59.3	48.0	143.3
	Fe	10	267.2	27.0	41.8	209.2	607.2	178.8	78.5	592.3
	Pb	10	7.8	30.7	11.1	4.0	13.4	5.3	5.5	13.0
	Co	10	7.3	7.3	31.1	3.6	4.0	1.0	3.6	3.2
	Cr	10	-	-		-	-	-	-	-
	Hg (wet wt.)	3	3.0							
Dry weight (%)		-	11.7	-	[illegible]	21.8	18.1	20.0	23.0	22.3
Tuzla	Cu	10	6.3	2.5	[illegible]	4.4	7.3	5.6	2.4	34.3
	Mn	10	12.2	10.6	[illegible]	6.4	12.0	9.0	8.5	11.3
	Zn	10	211.4	5.3	386.0	85.8	133.6	90.9	76.1	150.5
	Fe	10	363.9	165.3	165.1	364.3	679.8	316.1	146.4	536.2
	Pb	10	30.7	29.0	[illegible]	8.7	10.2	7.8	9.0	10.2
	Co	10	10.2	12.8	7.8	2.6	4.1	2.0	4.1	6.0
	Cr	10	-	-		-	-	-	-	-
	Hg (wet wt.)	3	29.1							
Dry weight (%)		-	10.0	-	[illegible]	21.0	19.7	20.6	22.0	23.3

TABLE II. MEAN CONCENTRATIONS OF METALS IN THE WHOLE BODY OF *Tapes decussatus*, COLLECTED AT DIFFERENT TIMES OF YEAR FROM DIFFERENT LOCALITIES
(μg/g dry-weight basis; only mercury according to wet-weight basis).

Metal	No. of whole animals analysed	Deniz Bostanlı	Çakalburnu fishery	Tuzla
Cu	3	6.18	7.16	6.25
Mn	3	13.06	7.32	12.24
Zn	3	111.44	106.04	211.40
Fe	3	338.08	267.16	353.94
Pb	3	20.61	7.75	20.65
Co	3	7.53	7.33	10.17
Cr	3		-	-
Hg (wet wt.)	3	3.74	3.04	20.07

TABLE III. MEAN CONCENTRATIONS OF TRACE METALS IN WHOLE-BODY SAMPLES OF DIFFERENT SIZE OF *Tapes decussatus*
(μg/g dry-weight basis: Animals were collected at different times of year).

Locality	Size of animals (mm)	Dry wt. (%)	Cu	Mn	Zn	Fe	Pb	Co
Tuzla	42	9.8	7.3	9.9	131.4	492.8	[illegible]	[illegible]
	32	11.4	5.7	12.3	260.2	[illegible]	[illegible]	[illegible]
	25	10.6	5.7	14.6	242.7	334.7	29.9	8.1
Deniz Bostanlı	43	10.9	7.5	4.3	100.3	323.6	10.4	4.7
	30	12.8	9.6	14.5	107.1	209.7	21.4	6.7
	20	11.4	1.5	20.4	126.9	421.0	30.0	18.7
Çakalburnu fishery	53	11.2	8.2	3.4	81.7	209.5	6.6	5.4
	38	12.3	7.4	10.4	111.5	225.7	9.4	3.4
	24	10.7	7.6	11.2	94.6	235.7	6.2	19.8

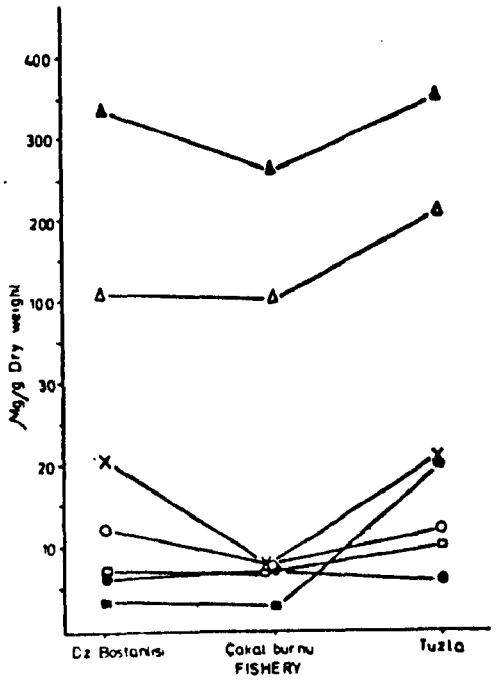


FIG.2. Izmir Bay: Concentration of trace metals such as Cu(●), Mn(○), Zn(△), Fe(▲), Pb(X), Co(□), Hg(■) (μg/g dry weight basis, except for mercury).

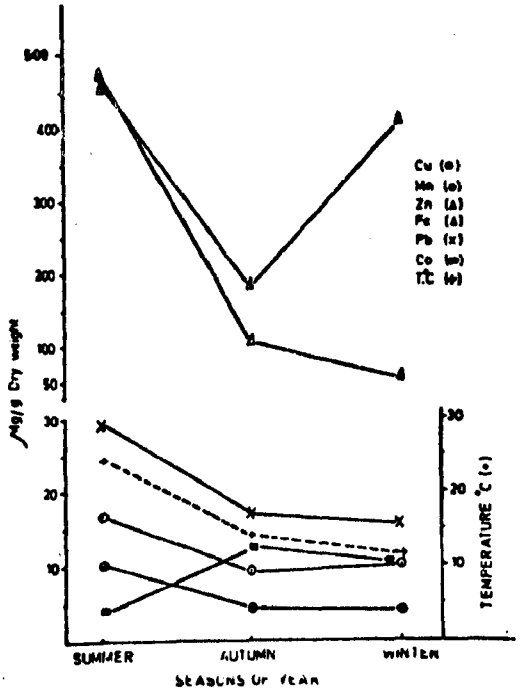


FIG.3. Izmir Bay: Seasonal differences in mean concentrations of some trace metals in Tuzla (μg/g dry weight basis).

REF. NO.: 75 - G - 3 SUBSTANCES: Zn, Cu, Fe, Mn

Reference: George, S. G. & T. L. Coombs. 1975. A comparison of trace-metal and metalloenzyme profiles in different molluscs and during development of the oyster. Proc. 9th Europ. Mar. Biol. Symp., H. Barnes, ed., p. 433-449.

Organisms: Cardium edule
Mytilus edulis
Ostrea edulis

Date of Sample Collection: 1975?

Location: Scotland, North Wales, and Channel Islands

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE I

Trace-metal content (μg/g wet wt) of the whole soft tissues of molluscs: 4 animals of each species were homogenized and combined for analysis.

Metal	Species			
	Cardium	*Haliotis*	*Mytilus*	*Ostrea*
Zinc	19	35	30	315
Copper	5	8	5	6
Manganese	1	8	1	3
Iron	83	222	47	53

REF. NO.: 63 - G - 1

SUBSTANCES: Au, Sc, Th, Co, Hg, Ag, Cr, Mn, Sr, Fe, Zn, Cd

Reference: Girardi, F. & M. Merlini. 1963. Studies on the distribution of trace elements in a mollusk from a freshwater environment by activation analysis. European Atomic Energy Community, Joint Nuclear Research Center, Ispra, Italy, EUR-474-E, 26p.

Organisms: Unio mancus elongatus

Date of Sample Collection: 1963

Location: Lake Maggiore, Italy

Analytical Technique: Neutron activation analysis

Analytical Data: data to follow - on microcards - ordered xerox

REF. NO.: 71 - G - 1

SUBSTANCES: Ag, Cd, Cr, Cu, Mn, Pb, Zn

Reference: Graham, D. L. 1971. Trace metal levels in intertidal mollusks of California. Veliger 14:365-372.

Organisms:
Mytilus californianus
Mytilus edulis
Protothaca staminea
Tapes semidecussata

Date of Sample Collection: 1971?

Location: California coast, San Francisco to Los Angeles

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 110°C)

Table 1

Concentrations of trace elements in shells of California Mollusks (ppm dry weight). N = number of individuals in pooled sample. Values given for each sample are means and standard deviations for analyses of 3 separate aliquots. Letters indicate collecting sites shown in Figure 1. Results for *Mytilus edulis* from (D) were omitted because of procedural errors.

Species	Station	N	Ag	Cd	Cr	Cu	Mn	Pb	Zn
Acmaea digitalis	B	50	11.1±1.3	6.2±0.1	<5.7	7.5±1.5	30.7±4.4	108.0±10.0	29.9±0.9
	K	50	6.3±0.2	<2.5	<5.7	<5.8	19.3±1.8	<9.0	8.4±3.0
Mytilus californianus	C	3	5.5±0.3	<2.5	<5.7	8.1±0.4	11.3±0.6	19.4± 2.7	8.6±1.5
	I	3	7.9±0.0	9.2±0.0	14.2±2.0	18.6±5.0	8.4±0.7	<9.0	17.7±3.0
	K	6	5.0±0.1	<2.5	<5.7	12.9±0.3	14.2±1.1	<9.0	26.5±2.0
Mytilus edulis	A	6	4.4±0.2	5.8±0.6	<5.7	<5.8	45.8±2.3	<9.0	14.2±1.8
	E	5	4.7±0.1	5.5±0.5	<5.7	8.6±0.1	36.2±3.6	<9.0	6.9±1.3
	K	8	6.3±0.2	<2.5	<5.7	<5.8	9.3±0.6	21.2± 0.3	9.4±2.7
Protothaca staminea	D	5	5.8±0.0	2.9±0.1	<5.7	11.5±1.0	16.8±1.0	<9.0	9.2±1.4
Tapes semidecussata	A	5	7.3±0.7	9.6±1.4	10.3±0.7	19.2±7.0	24.7±0.5	<9.0	11.2±2.0
Thais emarginata	F	10	6.4±1.4	3.3±1.0	<5.7	5.9±0.6	5.3±0.6	<9.0	1.4±0.4
	G	6	11.1±0.8	<2.5	10.5±2.6	8.2±0.3	6.0±0.8	<9.0	23.5±1.2
Tegula funebralis	F	15	7.3±0.3	9.7±0.3	15.8±0.2	21.4±0.3	8.1±1.0	9.8± 4.0	10.1±1.5
	G	6	13.5±1.6	4.6±0.7	14.4±0.1	10.6±2.3	6.9±0.9	<9.0	12.2±2.0
	H	6	9.6±0.1	<2.5	14.2±0.4	6.8±0.3	5.3±0.1	<9.0	23.8±1.5
	I	6	7.6±0.3	8.0±0.0	10.4±1.3	19.9±3.0	7.7±0.3	<9.0	18.0±1.8
	J	10	6.8±0.1	2.5±0.4	<5.7	9.2±0.6	7.0±0.5	<9.0	6.9±1.2
	K	15	7.3±0.3	<2.5	<5.7	8.6±0.3	8.9±0.3	<9.0	4.8±0.5

Table 2

Concentrations of trace elements in bodies of California mollusks (ppm dry weight). N = number of individuals in pooled sample. Values given for each sample are means and standard deviations for analyses of 3 separate aliquots. Letters indicate collecting sites shown in Figure 1. Results for *Thais emarginata* and *Tegula funebralis* from (G) were omitted because of procedural errors.

Species	Station	N	Ag	Cd	Cr	Cu	Mn	Pb	Zn
Acmaea digitalis	B	50	2.4±0.2	6.7±0.3	24.2±4.0	12.9±0.8	24.5±3.4	931.0±26.0	429.0±17.0
	K	50	2.6±0.1	12.1±0.2	7.1±0.2	11.2±0.5	25.1±1.8	7.5± 0.5	763.0±22.0
Mytilus californianus	C	3	<1.0	4.9±0.6	<1.5	9.0±1.1	7.8±1.3	23.4± 3.0	164.0± 5.0
	I	3	5.5±0.0	2.0±0.0	6.1±0.0	30.3±0.0	5.9±0.3	<2.2	310.0±10.0
	K	6	<1.0	2.2±0.0	7.8±0.8	10.7±0.2	7.6±0.1	7.8± 1.3	195.0±4.0
Mytilus edulis	A	6	1.3±0.0	6.8±0.2	5.8±2.2	11.2±1.5	28.4±1.0	<2.2	293.0±18.0
	D	5	<1.0	6.5±0.1	<1.5	5.3±0.3	20.9±0.2	<2.2	298.0±31.0
	E	5	<1.0	3.3±0.3	<1.5	8.1±0.1	8.6±0.2	7.6±0.1	204.0±36.0
	K	8	<1.0	3.1±0.2	7.6±0.1	5.0±0.7	6.1±0.2	7.9±0.3	341.0±20.0
Protothaca staminea	D	5	<1.0	5.7±0.2	<1.5	7.5±0.6	11.5±0.2	5.2±0.1	67.7± 1.5
Tapes semidecussata	A	5	7.3±0.7	9.6±1.4	10.3±0.7	19.2±7.0	24.7±0.5	<2.2	11.2± 2.0
Thais emarginata	F	10	2.1±0.0	13.5±0.1	<1.5	571.0±5.0	8.8±0.2	<2.2	1701.0±45.0
Tegula funebralis	F	15	1.0±0.1	2.2±0.0	12.2±1.7	175.0±9.0	9.4±0.5	9.8±4.0	198.0± 7.0
	H	6	3.5±0.2	2.6±0.3	<1.5	88.0±10.0	5.0±0.3	<2.2	26.8± 4.0
	I	6	2.4±0.1	3.0±0.1	3.5±0.1	14.0±0.0	5.1±0.4	<2.2	25.4± 0.4
	J	10	5.1±0.1	4.8±0.1	2.7±0.3	33.0±0.3	9.6±0.9	<2.2	99.7± 7.0
	K	15	4.7±0.5	<1.0	6.3±0.5	128.0±5.0	10.1±0.1	<2.2	261.0± 1.0

Table 3

Trace metals (ppm dry weight) in soft portions of whole bodies of *Mytilus edulis*. Values show approximate means followed by ranges in parentheses. A. Levels found in present study. B. Levels found by Brooks & Rumsby (1965) in New Zealand.

	N	Ag	Cu	Cr	Mn	Pb	Cd	Zn
California	24	1(<1-1.3)	7(5-11)	4(<2-8)	16(6-28)	5(2- 8)	5(3-7)	284(204-341)
New Zealand	6	1(0.1-1.3)	9(8-11)	16(9-24)	27(12-38)	12(3-25)	10 (10)	91(50-180)

REF. NO.: 75 - G - 2

SUBSTANCES: Ag, Cr

Reference: Greig, R. A. 1975. Comparison of atomic absorption and neutron activation analyses for the determination of silver, chromium, and zinc in various marine organisms. Anal. Chem. 47:1682-1684.

Organisms: *Spisula solidissima*

Date of Sample Collection: 1975?

Location: Middle Eastern U.S.A. coast

Analytical Technique: Atomic absorption spectrophotometry; neutron activation analysis

Analytical Data:

Greig, R. A. 1975.

Table I. Silver and Chromium Concentrations in Marine Organisms as Determined by Atomic Absorption and Neutron Activation Analyses

Species[a]	Tissue or organ	Silver concentrations[b] AAS[c]	Silver concentrations[b] NAA[d]
Surf clam	muscle	1.0	1.0
Surf clam	muscle	1.0	1.3
Surf clam	muscle	0.39	0.40
Rock crab	muscle	0.21	0.21
Rock crab	muscle	0.34	0.78
Rock crab	dig. div.		
		1.2	2.4
Rock crab	dig. div.	1.9	2.8
Rock crab	dig. div.	2.3	2.7
Rock crab	dig. div.	2.7	3.0
Rock crab	dig. div.	1.4	1.5
Rock crab	dig. div.	2.4	3.3
Rock crab	dig. div.	5.4	6.3
Rock crab	dig. div.	1.1	1.2
Rock crab	dig. div.	1.3	1.8
Rock crab	dig. div.	1.8	2.8
Chan. whelk	soft parts	8.2	7.9
Chan. whelk	dig. div.		
		30.	32.
Chan. whelk	dig. div.	23.	24.
Chan. whelk	kidney	1.5	1.3
Chan. whelk	kidney	1.3	2.5
Chan. whelk	gills	0.53	0.48
Lobster	muscle	0.37	0.54
White hake	liver	0.32	0.18
Plankton	...	1.9	1.4
Zooplankton	...	2.2	1.8
Zooplankton	...	2.3	2.0
Zooplankton	...	2.2	2.1
Zooplankton	...	2.7	3.1
Zooplankton	...	1.9	1.1

Species[a]	Tissue or organ	Chromium concentrations[b] AAS[c]	Chromium concentrations[b] NAA[d]
Fluke	muscle	0.22	0.68
Rock crab	gills	3.8	4.2
Rock crab	dig.div.[e]	0.50	0.54
Rock crab	dig. div.[e]	0.34	0.42
Rock crab	dig. div.[e]	0.52	0.24
Chan. whelk	kidney	1.3	0.56
Chan. whelk	kidney	0.73	0.48
Chan. whelk	gills	3.5	2.3
Surf clam	muscle	1.8	2.7
Surf clam	muscle	0.80	0.74
Surf clam	muscle	0.56	1.1
Surf clam	whole, edible portion	1.1	1.5
Plankton	...	4.5	5.2
Plankton	...	49.	53.
Plankton	...	13.	31.
Plankton	...	1.3	1.2
Zooplankton	...	2.8	5.8
Zooplankton	...	0.48	0.50
White hake	liver	0.20	0.59

[a] Scientific names of species are: Surf clam, *Spisula solidissima;* Rock crab, *Cancer irroratus;* Channeled whelk, *Busycon canaliculatum;* Lobster, *Homarus americanus;* White hake, *Urophycis tenuis;* and Fluke, *Paralichthys dentatus.* [b] Concentrations are ppm, wet weight basis for fish and shellfish and ppm, dry weight basis, for plankton and zooplankton. The values are means of 2–3 determinations. [c] AAS = Atomic Absorption Spectrophotometry. [d] NAA = Neutron Activation Analysis. [e] dig. div. = digestive diverticulum.

REF. NO.: 75 - G - 1

SUBSTANCES: Ag, Cd, Pb, Cu, Zn

Reference: Greig, R. A., B. A. Nelson & D. A. Nelson. 1975. Trace metal content in the American oyster. Mar. Pollut. Bull. 6:72-73.

Organisms: Crassostrea virginica

Date of Sample Collection: 1975?

Location: Housatonic River and Branford, Connecticut

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 105-115°C)

TABLE 1

Trace metal concentrations in eggs and adults of the American oyster *Crassostrea virginica*.

Metal	N*	Metal concentrations (ppm, dry wt) Avg.	S.D.	N*	Avg.	S.D.
		Housatonic River, Connecticut				
	12	Adult oysters		4	Oyster eggs	
Ag		12.1	4.45		<1.6	-
Cd		28.1	7.49		<1.6	-
Cu		2208.	793.		28.9	3.96
Pb		<4.2			<10.0	-
Zn		10460.	2483.		82.4	8.05
		Branford, Connecticut				
	13	Adult oysters		4	Oyster eggs	
Ag		16.4	6.02		<1.2	-
Cd		15.6	3.46		<1.2	-
Cu		1260.	415.		27.8	7.80
Pb		7.1	2.45		<9.9	-
Zn		8300.	1800.		65.9	19.6

*Number of individual oysters examined for adults and number of pools of eggs from two oysters for the eggs.

REF. NO.: 76 - G - 2

SUBSTANCES: Co, Cr, Se, Ag, Rb, Zn

Reference:

Greig, R. A. & J. Jones. 1976. Nondestructive neutron activation analysis of marine organisms collected from ocean dump sites of the middle eastern United States. Arch. Environ. Contam. Toxicol. 4:420-434.

Organisms: Spisula solidissima

Date of Sample Collection: 1976?

Location:

Middle Atlantic Bight and Long Island Sound, New York

Analytical Technique:

Neutron activation analysis

Analytical Data:

Table IX. *Metal concentrations in shellfish collected from various inshore marine areas of the Middle Atlantic Bight and Long Island Sound, U.S.A.*

Species	Tissue	Station	Catch date	N[a]	Metal concentrations, ppm, wet wt.					
					Cobalt	Chromium	Selenium	Silver	Rubidium	Zinc
Surf clam	Muscle	Chinc.	Spr. '71	1	0.20	*	0.7	*	*	22.5
Surf clam	Digestive gland	Chinc.	Apr. '71	1	0.40	*	1.1	3.7	*	17.0
Surf clam	Muscle	69D5	Apr. '71	1	0.30	1.3	0.7	0.7	1.5	15.2
Surf clam	Muscle	1-47	June '71	1	0.16	0.7	0.8	1.3	1.2	15.6
Surf clam	Muscle	1-106	June '71	1	0.35	2.7	0.8	1.0	2.3	—
Lobster	Muscle	1-70	June '71	1	*	*	2.0	0.5	1.0	30.2
Lobster	Digestive gland	1-70	June '71	1	0.11	*	2.9	*	*	39.0
Channeled whelk	Muscle	Lg.Is.Sd. Area 1	Sept.-Dec. '71	5	*-* *	*-0.7 <0.3	*-0.4 <0.2	*-0.3 <0.2	*-1.7 <1.3	23.5-35 27.4
Channeled whelk	Muscle	Lg.Is.Sd. Area 2	Sept.-Dec. '71	2	*-* *	*-0.4 <0.4	*-0.4 <0.4	* *	*-1.1 <1.1	22.8-25 23.9
Channeled whelk	Soft parts[b]									

*Not detected—see discussion for detection limits.

[a]N = Number of composites of 6 to 10 fish tissues analyzed.

[b]The metal concentrations of the soft parts of channeled whelk varied too greatly amongst replicate determinations to average the results. See discussion for results.

REF. NO.: 72 - G - 1

SUBSTANCES: Hg

Reference: Günther, F., I. Oostinga & O. Burckhart. 1972. Über Quecksilbergehalte in See- und Süßwasserfischen sowie in Krusten-, Muschel- und Säugetieren der ostfriesischen Küsten- und Binnengewässer. Med. u. Ernähr. 13:263-267.

Organisms: Mytilus edulis

Date of Sample Collection: 1972

Location: Ostfr. Kuste, Norddeich

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Tabelle 2: Quecksilbergehalte von Seewasserfischen, Krusten- und Muscheltieren der ostfriesischen Küstengewässer und für den Fang spezifische Daten

Nr. Art:	Alter	Geschlecht	Größe cm	Gewicht g	Fanggebiet u. Zeit	Wassergehalt %	Quecksilbergehalt in mg/kg (ppm)
30. Miesmuschel (Mytilus edulis)					Ostfr. Küste, Norddeich April 72		0,01 im Muschelfleisch

REF. NO.: 73 - H - 5

SUBSTANCES: Cd, Co, Cu, Ca, Mn, Ni, Pb, Zn

Reference: Halcrow, W., D. W. Mackay & I. Thornton. 1973. The distribution of trace metals and fauna in the Firth of Clyde in relation to the disposal of sewage sludge. J. mar. biol. Ass. U.K. 53:721-739.

Organisms: Chlamys septemradiata

Date of Sample Collection: 1971-72

Location: Firth of Clyde, Scotland

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 8. TRACE-ELEMENT CONCENTRATION IN MEMBERS OF THE BENTHIC EPIFAUNA

(μg/g dry weight; mean value for 5 trawls, based on the total sample per trawl.)

Species	Area	Cd (μg/g)	Co (μg/g)	Cu (μg/g)	Ca (%)	Mn (μg/g)	Ni (μg/g)	Pb (μg/g)	Zn (μg/g)
Chlamys septemradiata	1	9·5	5·4	33	0·84	117	13	23	792
	3	17·8	4·5	28	1·06	798	12	15	781

REF. NO.: 74 - H - 2 **SUBSTANCES:** Hg

Reference: Hall, E. T. 1974. Mercury in commercial canned sea food. J. Ass. Off. Anal. Chem. 57:1068-1073.

Organisms: oyster, clam (unspecified, canned)

Date of Sample Collection: 1974?

Location: local markets, Maryland?

Analytical Technique: Atomic absorption spectrophotometry; gas-liquid chromatography

Analytical Data:

Table 1. Mercury residues (ppm) in canned sea food

Sample	Product	GLC, methyl Hg	AAS, total Hg	Methyl Hg, %
1	shrimp	0.007	0.009	78
2	oysters	0.020	0.037	54
3	oysters	0.027	0.033	82
4	minced clams	0.029	0.046	63
5	minced clams	0.088	0.047	187
6	clam sauce	0.012	0.033	36
7[a]	cat food	0.019	0.035	54
8[a]	cat food	0.015	0.039	38
9	sardines	0.021	0.038	55
10	anchovies	0.090	0.21	43
11	kippered herring	0.081	0.13	62
12	pink salmon	0.009	0.016	56
13	pink salmon	0.023	0.064	36
14	pink salmon	0.015	0.020	75
15	red sockeye salmon	0.045	0.047	96
16	cohoe red salmon	0.025	0.018	139
17[b]	white tuna	0.31	0.38	82
18	white tuna	0.20	0.24	83
19	white tuna	0.25	0.39	64
20	white tuna	0.32	0.38	84
21	white tuna	0.22	0.20	110
22	white tuna	0.34	0.43	79
23[c]	tuna	0.28	0.36	78
24[c]	tuna	0.35	0.39	90
25	light tuna	0.68	0.73	93
26	light tuna	0.50	0.57	88
27	light tuna	0.31	0.45	69
28	light tuna	0.25	0.21	119
29	light tuna	0.53	0.60	88
30	light tuna	0.33	0.43	77
31	light tuna	0.23	0.24	96
32	light tuna	0.40	0.55	73
33	light tuna	0.15	0.13	115
34	light tuna	0.29	0.26	112
35	light tuna	0.18	0.20	90
36	light tuna	0.29	0.33	88

[a] Samples 7 and 8 had the same lot number.
[b] Average % methyl Hg in tuna Samples 17-36 = 89%.
[c] Samples 23 and 24 had the same lot number. Both cans were unlabeled.

REF. NO.: 74 - H - 4

SUBSTANCES: Hg

Reference: Häsänen, E. 1974. Mercury pollution of the aquatic environment in Finland. In Comparative Studies of Food and Environmental Contamination, Proc. Symp. Otaniemi, August 1973, p. 149-157. IAEA, Vienna.

Organisms: mussels (unspecified)

Date of Sample Collection: data from Holden, 1969[73-H-1], compared with data for other organisms from same area in other literature

Location:

Analytical Technique:

Analytical Data:

TABLE III. RESULTS OF MERCURY ANALYSES OF AQUATIC ENVIRONMENT IN FINLAND

Sample	Mean mercury content or range (ppm Hg)	Ref.
Bottom sediment, unpolluted area	0.05	[7]
polluted area	1-600	[7,8]
Mussel, unpolluted area	0.04	[9]
Baltic herring, unpolluted area	0.05	[3]
Pike, unpolluted area	0.25	[10,11]
polluted area	1-6	[10,11]
Pike-perch, unpolluted area	0.20	[10,11]
polluted area	1-2	[10,11]
Perch, unpolluted area	0.25	[10,11]
polluted area	1-4	[10,11]
Burbot, unpolluted area	0.20	[10,11]
polluted area	1-3.5	[10,11]
Bream, unpolluted area	0.20	[10,11]
polluted area	0.5-1	[10,11]
White fish, unpolluted area	0.15	[10,11]
polluted area	0.6	[10,11]
Fourhorn sculpin, unpolluted area	0.2	[12]
polluted area	0.4-1.9	[12]
Seal (fresh water)		
Juvenile muscle	1.0	[13]
liver	6.8	[13]
kidney	3.5	[13]
Adult muscle	62	[13]
liver	138	[13]
kidney	46	[13]
Seal (sea)		
Adult muscle	0.9	[13]
liver	11.8	[13]
kidney	3.2	[13]
Adult muscle	0.9	[14]
liver	62	[14]
kidney	3.2	[14]
Merganser, muscle	2.0	[15]
White-tailed eagle, muscle	4	[16]
liver	18	[16]
kidney	194	[16]

REF. NO.: 19 - H - 1

SUBSTANCES: Zn, As, Cu

Reference:

Hiltner, R. S. & H. J. Wichmann. 1919. Zinc in oysters. J. Biol. Chem. 38:205-221.

Organisms: oysters (unspecified)

Date of Sample Collection: 1919?

Location: Atlantic coast U.S.

Analytical Technique:

Analytical Data:

TABLE I.

*Determination of Zinc in Shucked Oysters.**

Sample No.	Source.	Zinc in drained oyster flesh.
		mg. per kg.
	Shell stock from oyster house, said to be from	
8,905-H	Patuxent River, Md.	111
8,906-H	Holland Point, Md.	161
8,907-H	" " "	320
8,908-H	Rappahannock River, Va.	102
8,909-H	" " "	82
8,910-H	Fishing Bay, Md.	108
	Chester River:	
18,981-H	Bed 14, Queen Annes Co., Md.	504
18,982-H	" 39, Kent Co., Del.	247
18,984-H	" 43, " " "	394
18,985-H	" 46, " " "	459
18,989-H	" 4, Queen Annes Co., Md.	274
18,991-H	" 64, Kent Co., Del.	118
	Chesapeake Bay, lower end:	
20,520-H	Bed 15, Anne Arundel Co., Md.	46
20,521-H	" 16, " " " "	38
20,522-H	" 14, " " " "	319
	Severn River:	
20,506-H	Bed 43, Anne Arundel Co., Md.	58
20,507-H	" 23, " " " "	124
20,509-H	" 27, " " " "	620
20,515-H	" 23, " " " "	217
20,517-H	" 45, " " " "	143
20,519-H	" 45, " " " "	26
18,945-H	Rhode River, Bed 72: Anne Arundel Co., Md.	74
	West River:	
18,944-H	Bed 70, Anne Arundel Co., Md.	186
18,947-H	" 81, " " " "	281
	Patuxent River:	
18,908-H	Bed 3, St. Marys Co., Md.	70
18,913-H	" 22, Calvert Co., "	186
18,994-H	" 22, St. Marys Co., "	171
18,995-H	" 22, Calvert Co., "	169
18,997-H	" 14, St. Marys Co., "	150
19,000-H	" 31, Calvert Co., "	61
—	Pink oysters (decomposed) shipped from South Norwalk, Conn.	394
	Maximum	620
	Minimum	26

* Analyses made by J. W. Sale in the Water Laboratory, Bureau of Chemistry, 1914

Hiltner, R. S. & H. J. Wichmann. 1919.

TABLE II.

*Determination of Arsenic, Copper, and Zinc in Oysters.**

Sample No.	Source.	Arsenic.	Copper.	Zinc.
		mg. per kg.	*mg. per kg.*	*mg. per kg.*
17,051-K	New York, N. Y.	0.95	86.4	556.0
17,055-K	Crisfield, Md.	None.	17.0	172.0
17,057-K	" "	0.77	17.8	133.7
17,058-K	" "	0.77	33.7	252.3
17,063-K	St. Michaels, Md.	0.84	36.4	316.5
17,064-K	New Haven, Conn.	1.24	72.9	1,115.0
17,065-K	New York, N. Y.	1.16	75.1	511.0
17,066-K	Chincoteague, Va.	1.47	11.9	171.0
17,069-K	New York, N. Y.	0.98	98.5	692.3
17,069-K	(Drained meats)	0.98	136.5	953.3
17,069-K	(Liquor)	0.77	23.9	185.8
17,070-K	New York, N. Y.	1.12	90.8	724.1
17,071-K	South Norwalk, Conn.	1.12	158.8	1,168.5
17,072-K	" " "	1.33	152.2	1,039.0
18,745-K	Boston, Mass.	Not determined.	101.2	1,000.0
20,764-L	New York, N. Y.	1.30	175.3	1,302.5

* Analyses made by H. J. Wichmann, in the Denver laboratory, January, 1915.

TABLE III.

*Determination of Amounts of Copper and Zinc in Shucked Oysters.**

Sample No.	Source.	Copper.		Zinc.	
		Drained oysters.	Liquor.	Drained oysters.	Liquor.
		mg. per kg.	*mg. per kg.*	*mg. per kg.*	*mg. per kg.*
B-812	Jamaica Bay, N. Y.	48.8	12.8	876	60.0
B-814	" " "	92.8	11.2	540	52.0
B-816	" " "	57.6	8.0	848	16.0
B-818	" " "	80.0	11.2	616	8.0
B-820	" " "	83.2	14.4	280	Trace.
B-822	" " "	64.0	11.2	648	76.0
Maximum		92.8		876	
Minimum		48.8		280	
B-840	Great South Bay, off West Sayville, N. Y.	67.0	3.0	616	Trace.
B-842	" " " " " "	51.0	1.0	598	4.0
B-844	" " " " " "	101.0	4.0	1,102	11.0
B-846	" " " " " "	87.0	5.0	742	Trace.
B-848	" " " " " "	41.0	Lost.	534	Lost.
B-849	" " " " " "	94.0	5.0	701	10.0
B-850	" " " " " "	20.0	4.0	429	5.0
Maximum		101.0		1,102	
Minimum		20.0		429	

* Analyses made by Louis D. Elliott, in the New York laboratory, 1915.

B-851	Raritan Bay.	154.0	9.0	912	85.0
B-853	" "	128.0	4.0	768	71.0
B-852	Sandy Hook	167.0	7.0	1,082	57.0
B-854	" "	141.0	5.0	912	69.0
A	Bridgeport, Conn., Bed 804	444.2	21.8	1,068	70.4
B	" " " 831	283.5	16.6	828	67.2
C	" " " 718	285.2	11.5	280	33.6
D	" " " 710	370.1	16.6	880	64.0
E	" " " 749	255.2	17.9	960	99.2
A	Milford, " " 674	283.5	19.2	920	81.6
B	" " " 657	261.5	11.5	1,184	67.2
C	" " " 607	371.5	15.4	1,176	81.6
Maximum		444.2		1,184	
Minimum		255.2		280	
A	New Haven, Conn.	539.0	25.0	1,363	56.0
B	" " "	257.0	8.0	1,760	37.0
C	" " "	244.0	13.0	1,357	60.0
D	" " "	270.0	16.0	1,475	81.0
E	" " "	308.0	19.0	1,411	83.0
F	" " "	180.0	13.0	870	94.0
Maximum		539.0		1,760	
Minimum		180.0		870	

TABLE III—*Continued.*

Sample No.	Source.	Copper.		Zinc.	
		Drained oysters.	Liquor.	Drained oysters.	Liquor.
		mg. per kg.	*mg. per kg.*	*mg. per kg.*	*mg. per kg.*
A	Vicinity Stony Creek, Conn., Flying Point	124.0	6.0	870	30.0
B	" " " " Grass Rock	131.0	4.0	714	24.0
C	" " " " near Cut-in-Two Island	120.0	5.0	749	52.0
D	" " " " between Waylands and Davis Island	124.0	6.0	932	79.0
E	" " " " between Pot and Money Islands	146.0	7.0	1,014	89.0
F	" " " " between High and Crib Islands	101.0	6.0	755	40.0
G	" " " " northeast of Governor's Island	80.0	6.0	717	74.0
H	" " " " northeast of Roger's Island	94.0	5.0	595	67.0
Maximum		146.0		1,014	
Minimum		86.0		595	
A	South Norwalk, Conn.	172.0	20.0	1,915	108.0
B	" " " Town Bed	262.0	10.0	920	94.0
C	" " " Bed 1,078	290.0	10.0	1,792	80.0
D	" " " " 1,025	371.0	18.0	2,298	60.0
E	" " " " 1,118	318.0	13.0	1,780	102.0
F	" " " " 1,152	224.0	10.0	1,388	38.0
G	" " " Town Bed	170.0	12.0	1,798	107.0
I	" " " " " 42	61.0	3.0	778	62.0
J	" " " Bed 1,048	293.0	24.0	1,891	83.0
K	" " " Tallmadges Bed	173.0	5.0	1,667	82.0
L	" " " mouth of Saugatuck River	132.0	6.0	1,351	32.0
Maximum		371.0		2,298	
Minimum		61.0		778	

3,032-K	Chesapeake Bay, Governor's Run	30.0	Not determined.	714	Not determined.
3,033-K	" " Lumps	181.0	" "	1,162	" "
3,034-K	" " Bodkin Point, Md.	214.0	" "	1,309	" "
3,035-K	" " Swan Point, Md.	179.0	" "	1,197	" "
3,036-K	" " Crab Alley Creek	59.0	" "	461	" "
3,037-K	" " Hoy Bay	101.0	" "	512	" "
3,038-K	" " Holland Point, Md.	76.0	" "	755	" "
3,039-K	" " Chester River, Md.	111.0	" "	829	" "
3,040-K	" " West River, Swan Point, Md.	111.0	" "	778	" "
3,041-K	" " Port Tobacco, Md.	101.0	" "	621	" "
3,042-K	" " Fishing Bay, Md.	28.0	" "	170	" "
3,043-K	" " Herring Bay, Md.	68.0	" "	810	47.0
3,044-K	" " mouth of Patuxent, Md.	38.0	" "	381	Not determined.
3,045-K	" " Chester River, The Cliffs	88.0	" "	522	" "
Maximum		214.0		1,309	
Minimum		28.0		170	
346-K	Potomac River, near Coles Point, Va.	38.0	Not determined.	355	Not determined.
347-K	Pocomoke Sound	52.0	" "	256	" "
348-K	Potomac River, off Point Lookout, Md.	48.0	Trace.	182	" "
349-K	" " near Blackistone Island, Md.	54.0	"	237	40.0
351-K	Blackistone Island, Md.	72.0	2.5	250	11.0
352-K	Jackson's Creek, Westmoreland Co., Va.	46.0	Not determined.	307	Not determined.
3,121-K	Chesapeake Bay	20.0	" "	189	" "
3,122-K	South of Blackistone Island, Md.	52.0	1.6	186	11.0
Maximum		72.0		355	
Minimum		20.0		182	

TABLE III—*Concluded.*

Sample No.	Source.	Copper.		Zinc.	
		Drained oysters.	Liquor.	Drained oysters.	Liquor.
		mg. per kg.	*mg. per kg.*	*mg. per kg.*	*mg. per kg.*
1,899-K	Near Charleston, S. C., Bulls Bay beds	35.0	Not determined.	189	Not determined.
1,900-K	" " " Edith Island beds	23.0	" "	493	" "
B-000	Perth Amboy, N. J.†	1,487.0	15.2	2,003	36.4
3,307-K	Sapelo beds, Atlantic Ocean, 80 miles south of Savannah, Ga.	48.0	Not determined.	410	Not determined.
3,308-K	Near Savannah, Ga., Herb River beds	24.0	2.2	182	10.0
3,309-K	East side, Savannah, Ga., Tybee Island beds	52.0	Not determined.	317	Not determined.
3,310-K	West " " " " " "	40.0	" "	189	" "
3,311-K	Near Savannah, Ga., Thunderbolt River beds	44.0	" "	346	" "
3,312-K	" " " Daufuskie Island beds	24.0	" "	502	" "
Maximum		52.0		502	
Minimum		24.0		182	
3,781-K	Crittenden, Va., mouth of James River	80.0	Not determined.	643	Not determined.
3,785-K	Lynnhaven Bay, Va.	26.0	1.0	253	12.0

† A sample of blue oysters. The bluest in the sample were selected for analysis. The oyster beds at Perth Amboy are off-shore from large copper refineries and other metallurgical works.

Hiltner, R. S. & H. J. Wichmann. 1919.

TABLE IV.

*Determination of Copper and Zinc in Shucked Oysters.**

Sample No.	Source.	Copper in drained meats.	Zinc in drained meats.
		mg. per kg.	*mg. per kg.*
498-K	Bivalve, N. J.	30.9	779
499-K	Maurice River, N. J.	17.0	472
500-K	Parker's Bay, Stockton, Md.	8.8	146
2,802-K	Johnson's Bay, Md.	7.6	175
2,803-K	Franklin City, Va.	8.8	153
2,804-K	West Sayville, L. I., N. Y.	30.2	507
2,805-K	Maurice River, N. J.	15.1	650
2,806-K	Baldwin, L. I., N. Y.	6.3	502
2,807-K	Chincoteague, Va.	18.8	201
2,808-K	Girdle Tree, Md.	19.1	168
Maximum		30.9	779
Minimum		6.3	146

* Analyses made by Clarence L. Black, in the Philadelphia laboratory, March, 1915.

TABLE V.

*Determination of Copper and Zinc in Shucked Oysters.**

Sample No.	Source.	Copper in drained meats.†	Zinc in drained meats.‡
		mg. per kg.	*mg. per kg.*
2,741-K	Opposite Sayville, L. I., N. Y.	105	939
2,742-K	Bridgeport Gut, Conn.	362	1,070
2,745-K	Seaconet, Mass.	82	1,200
2,746-K	Wickford, R. I.	68	701
2,747-K	Waquoit, Mass.	34	872
2,748-K	Wellfleet, "	82	1,220
2,749-K	Cotuit, "	28	702
2,750-K	Bluepoint, L. I., N. Y.	26	658
2,756-K	Eastham Beds, Wellfleet, Mass.	16	961
2,757-K	India Neck, Mass.	18	984
2,761-K	Warwick Bed, Narragansett Bay, R. I.	62	400
2,762-K	Hyde Hole, " " "	94	392
2,763-K	Rumstick Bed, " " "	54	608
Maximum		362	1,220
Minimum		16	308

* Analyses made by C. W. Harrison, in the Boston laboratory, 1915.
† Copper determined electrolytically.
‡ Zinc weighed as oxide.

TABLE VI.

*Determination of Amounts of Copper and Zinc in Shucked Oysters and Marine Debris.**

Sample No.	Source.	Oysters, Meats and liquor combined.		Vegetation and debris accompanying the oysters in the dredge.†	
		Copper.	Zinc.	Copper.	Zinc.
		mg. per kg.	*mg. per kg.*	*mg. per kg.*	*mg. per kg.*
781	Wellfleet, Mass.	14	705	Slight trace.	89
782	" "	10	772	" "	84
783	" "	16	224	No sample.	No sample.
784	" "	131	1,026	" "	" "
785	" "	26	916	Slight trace.	50
786	Cotuit, Mass.	31	877	" "	108
787	" "	8	477	None.	47
788	" "	Not analyzed.		Slight trace.	54
789	Osterville, Mass.	18	529	Trace.	56
790	" "	24	614	"	106
Maximum		131	1,026		108
Minimum		8	224		47

REF. NO.: 67 - H - 2

SUBSTANCES: Fe

Reference:

Hobden, D. J. 1967. Iron metabolism in *Mytilus edulis*. I. Variation in total content and distribution. J. Mar. Biol. Ass. U.K. 47:597-606.

Organisms: *Mytilus edulis*
?*Mytilus galloprovincialis*

Date of Sample Collection: 1967?

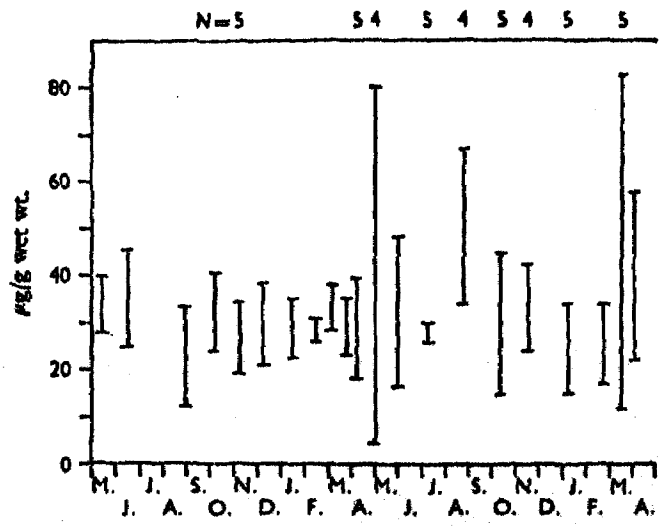
Location: Southampton

Analytical Technique:

Analytical Data:

TABLE 1. IRON CONTENT OF MYTILUS FROM DIFFERENT LOCALITIES

Locality	Sample size	Mean value (μg/g wet wt)	95 % confidence limits for mean
Hythe (Kent)	6	31·0	24·8–37·2
Hill Head (Hampshire)	6	18·9	9·9–28·0
Swanage (Dorset)	4	18·9	14·5–23·2
Plymouth (Devon)	6	22·0	17·6–26·3
Padstow (Cornwall)	3	17·0	Extend below zero



Text-fig. 1. Seasonal variation in iron content of soft tissues of *Mytilus* from Southampton, plotted as the 95 % confidence intervals for the means. The sample size (*N*) was 6 except where shown otherwise.

REF. NO.: 73 - H - 1

SUBSTANCES: Hg

Reference: Holden, A. V. 1973. Mercury in fish and shellfish. A review. J. Food Technol. 8:1-25.

Organisms: oysters, mussels, clams (unspecified)

Date of Sample Collection: (data from other sources -- review and data comparisons)

Location:

Analytical Technique:

Analytical Data: (wet wt)

Oyster	Canada (Atlantic)	0·02 -0·14	Bligh & Armstrong (1971)
	United Kingdom (Thames)	0·03 -0·20	Ministry of Agriculture, Fisheries and Food (1971)
Mussels	United Kingdom (Thames)	0·02 -0·65	Ministry of Agriculture, Fisheries and Food (1971)
Clams	Canada (Atlantic)	0·02 -0·11	Bligh & Armstrong (1971)

REF. NO.: 73 - H - 3 **SUBSTANCES:** Cd, Cu, Zn

Reference: Huggett, R. J., M. E. Bender & H. D. Slone. 1973. Utilizing metal concentration relationships in the Eastern oyster (Crassostrea virginica) to detect heavy metal pollution. Water Res. 7:451-460.

Organisms: Crassostrea virginica

Date of Sample Collection: 1971

Location: Chesapeake Bay

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (wet wt)

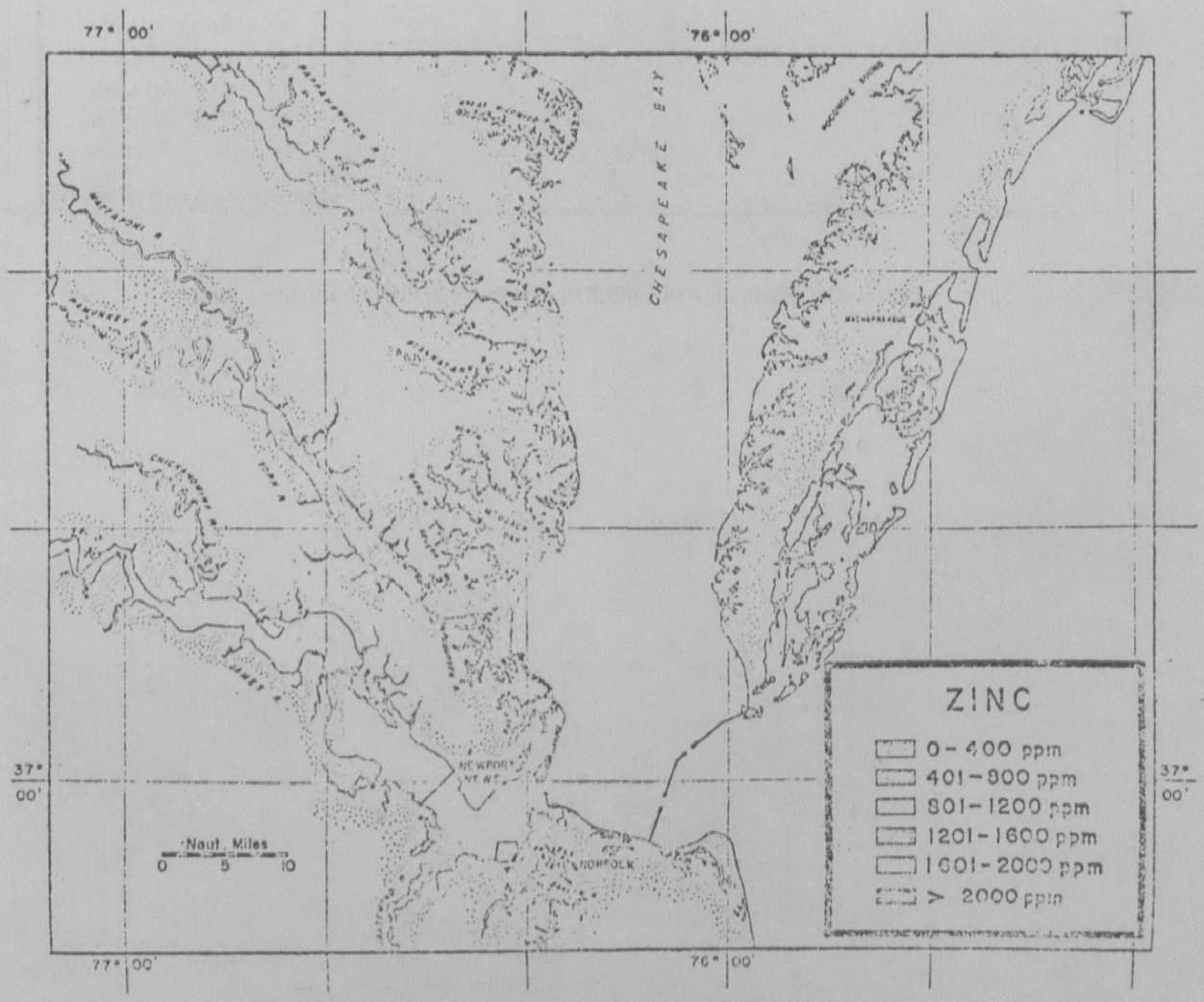


FIG. 3. The distribution of zinc in oysters from Virginia's major rivers.

Huggett, R. J. et al. 1973.

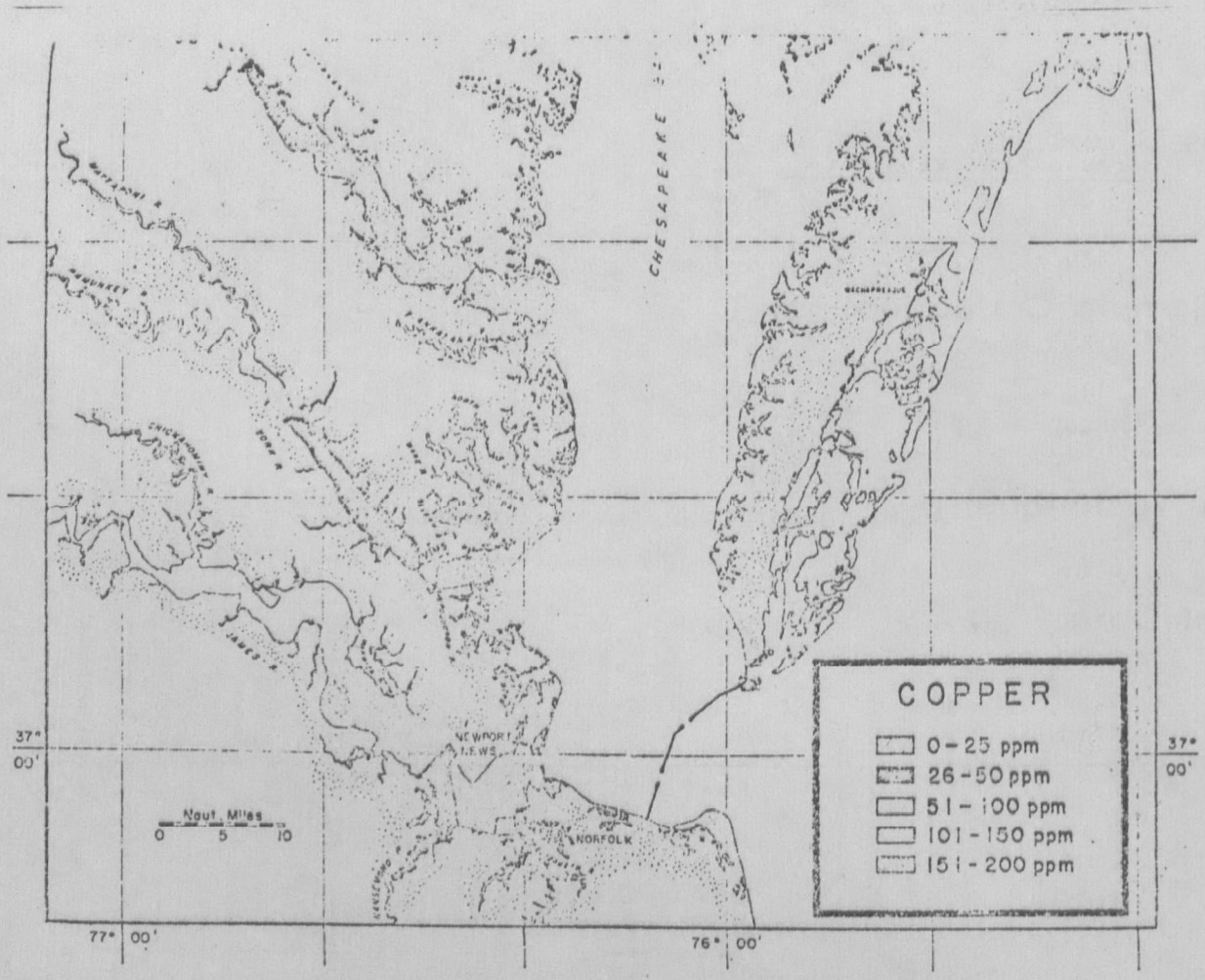


FIG. 4. The distribution of copper in oysters from Virginia's major rivers.

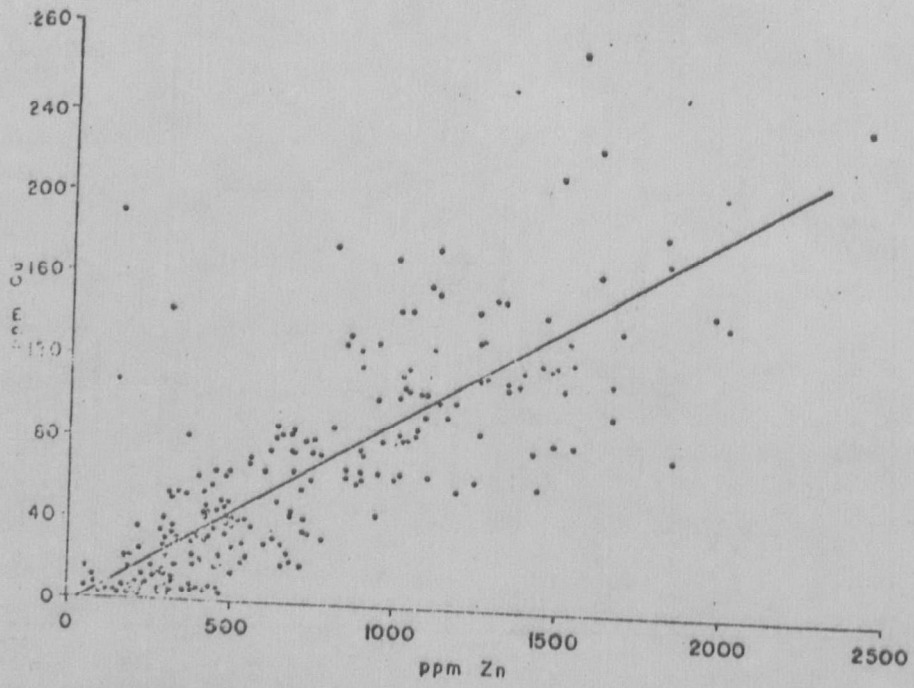


FIG. 6. Relationship between zinc and copper in oysters from Virginia's major rivers.

Huggett, R. J. et al. 1973.

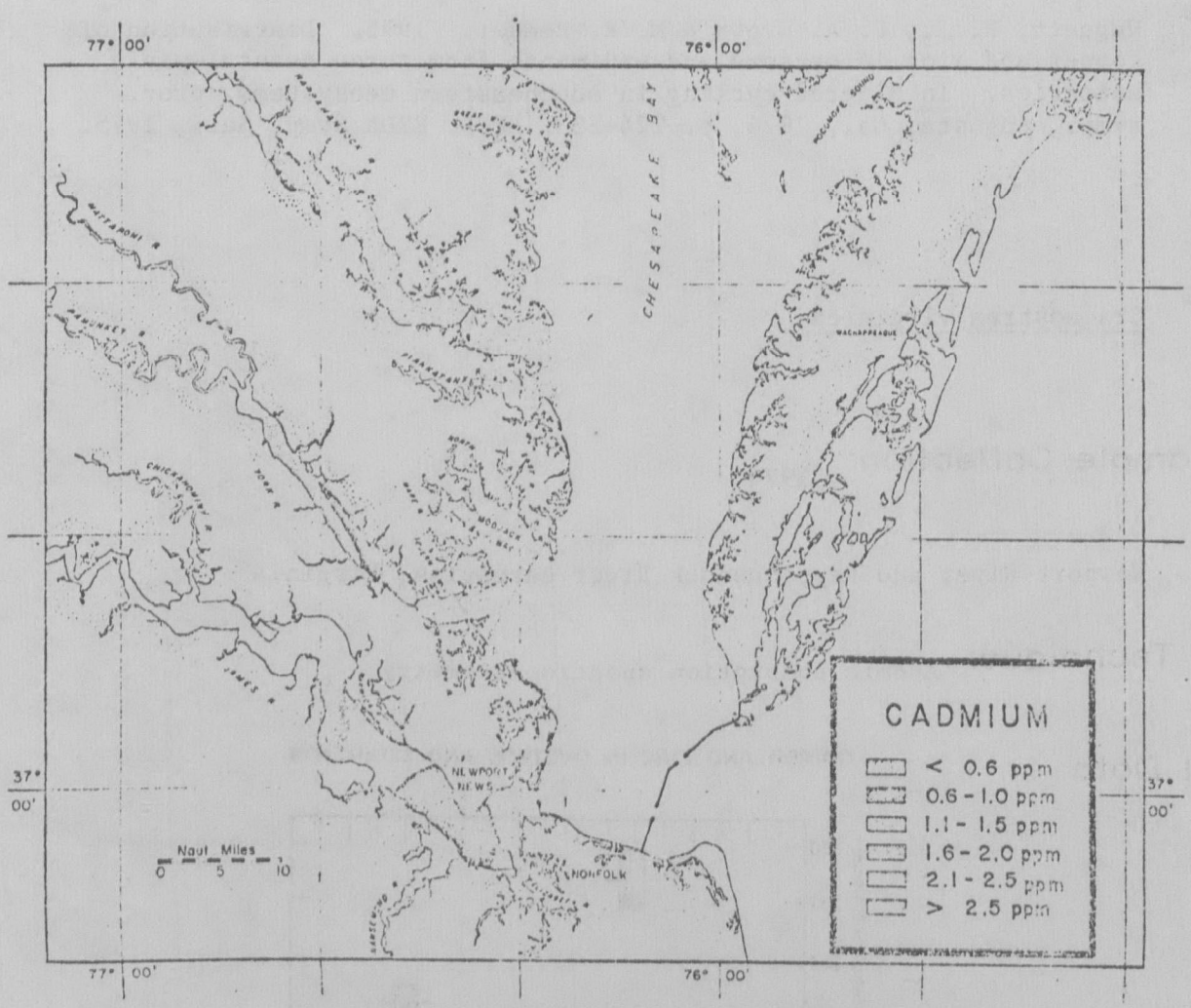


FIG. 5. The distribution of cadmium in oysters from Virginia's major rivers.

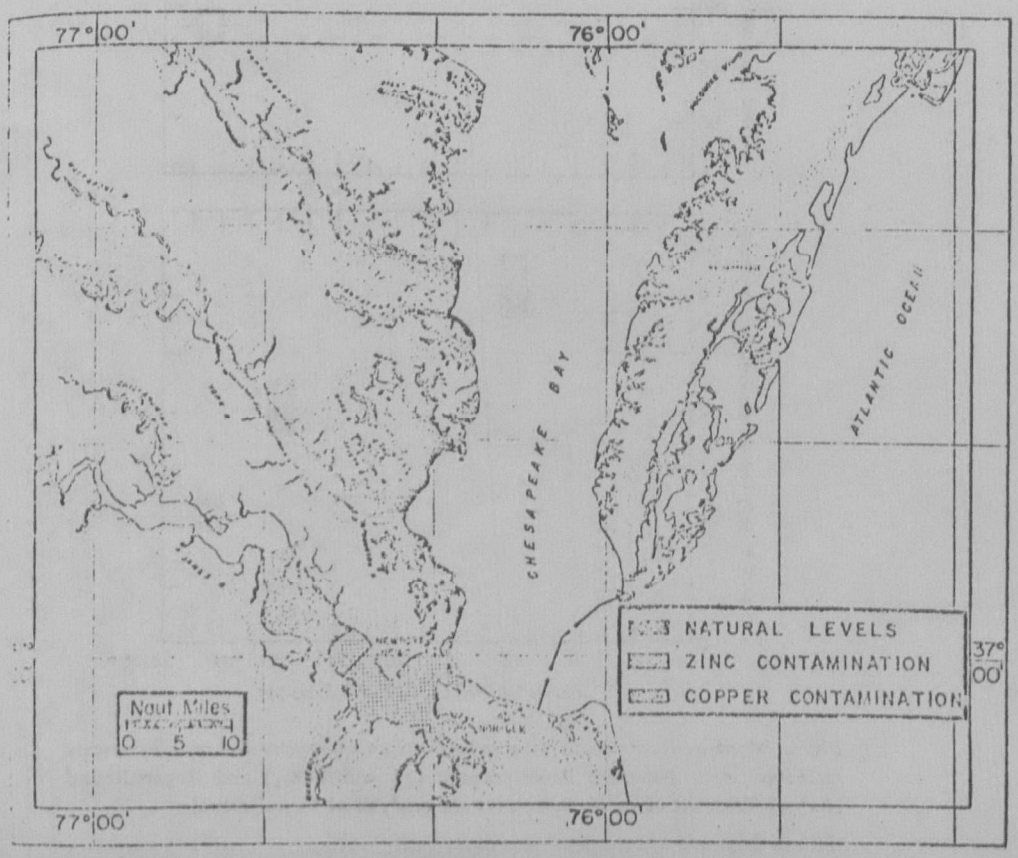


FIG. 8. The distribution of unnatural zinc and copper levels in oysters from Virginia.

REF. NO.: 75 - H - 4

SUBSTANCES: Cu, Zn

Reference: Huggett, R. J., F. A. Cross & M. E. Bender. 1975. Distribution of copper and zinc in oysters and sediments from three coastal-plain estuaries. In Mineral cycling in southeastern ecosystems, proc. symp., Augusta, Ga., 1974, p. 224-238. U.S. ERDA Symp. Ser., 1975.

Organisms: Crassostrea virginica

Date of Sample Collection: 1974

Location: Newport River and Rappahannock River estuaries, Virginia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

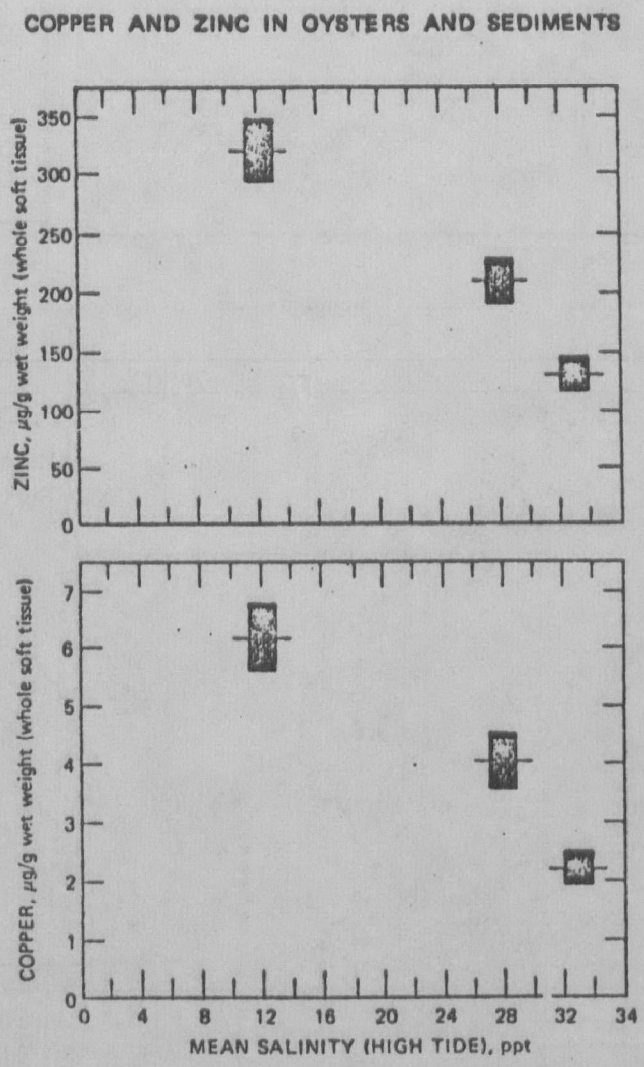


Fig. 2 Mean concentrations ∓2 standard errors of copper and zinc in oysters collected from Newport River estuary (12 and 28‰) and Bogue Sound (33‰). Each set of values represents the analysis of 50 individuals.

Huggett, R. J. et al. 1975.

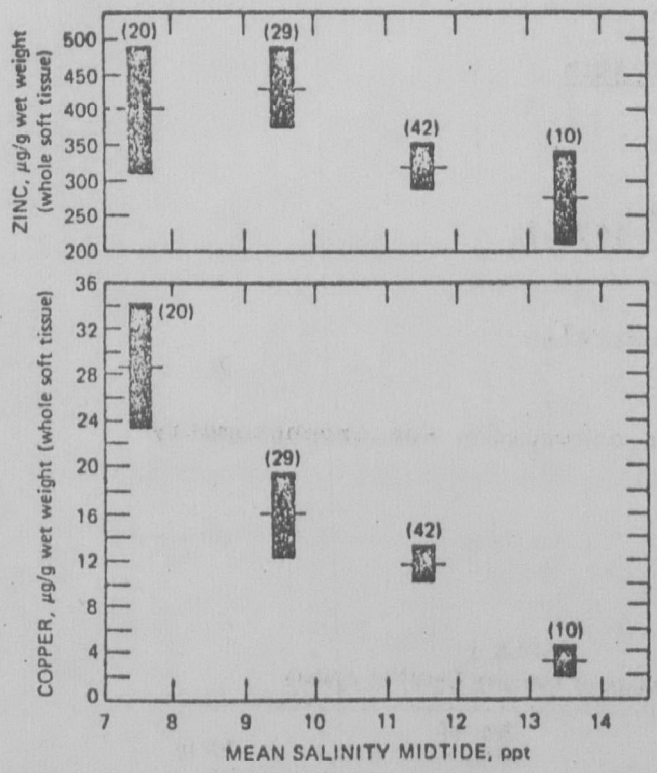


Fig. 1 Mean concentrations ∓2 standard errors of copper and zinc in oysters collected from the Rappahannock River estuary. The numbers in parentheses represent the individuals analyzed at each station.

REF. NO.: 73 - H - 2

SUBSTANCES: Hg

Reference: Hussain, M. & E. L. Bleiler. 1973. Mercury in Australian oysters. Mar. Pollut. Bull. 4:44.

Organisms: Crassostrea commercialis

Date of Sample Collection: 1971-72

Location: New South Wales, Australia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1
Concentration of mercury (ppm) in oysters

Source	No. of Samples	Range	Mean
Georges River (Site 1)	30	0.008—0.049	0.016
Georges River (Site 2)	30	0.002—0.013	0.006
Woolaware Bay (Botany Bay)	15	0.006—0.022	0.013
Port Stephens	30	0.001—0.016	0.004
Manning River	29	0.003—0.050	0.017
Hawkesbury River	30	0.002—0.010	0.003
Wallis Lake	30	0.005—0.100	0.015

REF. NO.: 74 - I - 1 SUBSTANCES: Co, Cs, Zn

Reference: Ichikawa, R. & S. Ohno. 1974. Levels of cobalt, cesium and zinc in some marine organisms in Japan. Bull. Jap. Soc. Sci. Fish. 40:501-508.

Organisms: Tapes philippinarum

Date of Sample Collection: 1969

Location: Chiba, Japan

Analytical Technique: Neutron activation analysis

Analytical Data:

Table 1. (continue)

Sample name	Sampling place & date	Tissues	Co μg/kg fresh weight	Cs μg/kg fresh weight	Zn μg/g fresh weight
short-necked clam *Tapes philippinarum*	Chiba Apr. 1969	soft part	220	49	24
		soft part	140	42	15
		soft part	110	86	17
		soft part	120	63	18
		foot, mantle	110	83	21
		gill, viscera	180	113	19
		foot, mantle	540	84	20
		gill, viscera	96	104	—

Table 2. Average values of Co, Cs and Zn in marine organisms and concentration factors of these elements

Marine Organisms	Tissues	Co			Cs			Zn		
		μg/kg wet w.	(no. sample)	C.F.	μg/kg wet w.	(no. sample)	C.F.	μg/g wet w.	(no. sample)	C.F.
Fishes	skin	31	(31)	3×10^{6}	13	(32)	3×10	49	(30)	5×10^{6}
	muscle	5	(32)	5×10	12	(31)	2×10	3.9	(30)	4×10^{6}
	viscera	48	(30)	5×10^{6}	13	(28)	3×10	28	(29)	3×10^{6}
	bone	15	(31)	2×10^{6}	14	(29)	3×10	18	(25)	2×10^{6}
Clam	soft part	190	(8)	2×10^{6}	78	(8)	2×10^{6}	19	(7)	2×10^{6}
Shrimp	soft part	17	(2)	2×10^{6}	5	(2)	10	13	(2)	10^{6}
	carapace	33	(2)	3×10^{6}	4.7	(2)	10	28	(2)	3×10^{6}
Sea urchin	ovary	76	(5)	8×10^{6}	5.5	(5)	10	41	(5)	4×10^{6}
Sea cucumber	whole body	14	(2)	10^{6}	4.3	(2)	10	17	(2)	2×10^{6}

REF. NO.: 67 - I - 1 **SUBSTANCES:** Cu

Reference: Ikuta, K. 1967. Studies on accumulation of heavy metals in aquatic organisms - I. On the copper contents in oysters. Bull. Jap. Soc. Sci. Fish. 33:405-409.

Organisms: Ostrea gigas
Ostrea spinosa
Ostrea circumpicta

Date of Sample Collection: 1965

Location: Nobeoka Bay, Miyazaki Prefecture, Japan

Analytical Technique:

Analytical Data:

Table 1. Copper-contents in oysters.

S-group (Southern coast of Nobeoka Bay)		N-group (Adjacent waters to north Nobeoka Bay)	
Location and sampling date	Copper-contents in oysters	Location and sampling date	Copper-contents in oysters
Myoken Feb. 20.	273.5* 390.8* 259.8* 420.6* 274.5* 301.8*	Urashiro Jan. 30.	37.0* 138.1* 35.9* 53.9* 39.9* 60.5*
	m. v. 320.2		m. v. 60.9
Totoro Feb. 20.	505.1* 472.2* 401.4* 489.3* 352.4* 387.4*	Tenjin Feb. 21.	35.3** 25.0** 165.0** 71.5** 125.7** 98.6**
	m. v. 434.6		m. v. 86.9
Takachibe March 18.	664.5*** 559.7*** 722.2*** 603.7*** 616.7*** 510.8***	Shimanoura Feb. 21.	100.0** 122.6** 78.1** 84.0** 103.7** 108.1**
	m. v. 612.9		m. v. 99.4
Akamizu Jan. 29.	442.3*** 517.6*** 188.8*** 444.9*** 251.9*** 293.7***	Furue Feb. 21.	163.1*** 44.1*** 107.1*** 88.5*** 63.5*** 92.5***
	m. v. 356.5		m. v. 93.0
Kojima March 18.	571.9*** 724.9*** 450.8*** 931.9*** 778.9*** [illegible]	Miyanoura Feb. 21.	44.7** 41.1** 36.3** 47.6** 44.7** 26.1**
	m. v. [illegible]		m. v. 40.0

Note: The unit is milligram per kilogram fresh body. The mean value of S-group is 432.2±174.5, and that of N-group is 76.1±39.6. The reference mark indicates oyster species, an asterisk (*) is Ostrea gigas, two (**) is O. spinosa, three (***) is O. circumpicta.

REF. NO.: 68 - I - 1

SUBSTANCES: Cu, Zn

Reference: Ikuta, K. 1968. Studies on accumulation of heavy metals in aquatic organisms - II. On accumulation of copper and zinc in oysters. Bull. Jap. Soc. Sci. Fish. 34:112-116.

Organisms: Ostrea gigas

Date of Sample Collection: 1965

Location: Urashiro Bay and Akamizu Inlet, Japan

Analytical Technique:

Analytical Data:

Table 2. The data of accumulated quantity of copper and zinc in oysters (*Ostrea gigas*) at Urashiro Bay, control field and Akamizu Inlet, test field:

Sampling date	URASHIRO		AKAMIZU	
	Cu mg/kg	Zn mg/kg	Cu mg/kg	Zn mg/kg
'65- 7- 2	34.6	—		
	19.8	—		
	65.1	201.9		
	14.9	196.7		
	18.2	217.5		
average	30.5	205.4		
'65- 7-31	7.5	90.8	29.1	290.7
	14.5	192.0	51.5	63.6
	15.7	136.1	64.2	264.4
	11.8	110.2	41.5	176.1
	10.9	101.1	—	—
average	12.1	126.0	46.6	198.7
'65- 9- 1	11.6	192.8	70.7	284.5
	10.5	63.9	103.6	444.4
	10.1	284.5	108.3	404.2
	9.6	178.6	44.7	204.3
	8.7	147.5	51.8	280.2
average	10.1	173.5	75.8	323.5
'65-10- 4	11.5	217.5	231.5	634.4
	14.1	249.9	53.5	306.6
	16.1	284.9	110.8	620.9
	10.1	242.2	144.1	470.2
	—	—	—	—
average	13.0	248.6	135.0	508.0
'65-11- 3	39.8	154.1	—	—
	39.1	237.8	242.0	713.3
	15.9	190.9	—	—
	21.2	290.7	176.1	512.2
	10.8	130.8	154.2	498.3
average	25.4	200.9	190.8	574.6

The unit used in this table is milligram copper or zinc per kilogram fresh body weight.

REF. NO.: 68 - I - 2

SUBSTANCES: Cu, Zn

Reference: Ikuta, K. 1968. Studies on accumulation of heavy metals in aquatic organisms - IV. On disappearance of abnormally accumulated copper and zinc in oysters. Bull. Jap. Soc. Sci. Fish. 34:482-487.

Organisms: Ostrea gigas

Date of Sample Collection: 1966

Location: Urashiro Bay, Japan

Analytical Technique:

Analytical Data:

Table 2. Copper- and zinc-contents in oysters.

Unit	Copper and Zinc (mg/kg fresh body)						
Sampling date / Part	Copper or Zinc	Mantles	Gills	Labial palps	Adductor muscle	The rest organs	Whole body
Aug. 8, '66	Copper	286.0	430.1	264.2	58.1	214.1	232.2
	Zinc	1072.4	1270.4	2178.9	221.5	1013.9	953.2
Aug. 26, '66	Copper	315.7	518.2	297.6	82.8	204.1	268.2
	Zinc	678.3	1226.5	890.5	261.2	581.0	678.6
Sep. 27, '66	Copper	175.4	264.5	211.1	46.5	128.3	149.0
	Zinc	621.3	917.0	820.9	202.2	460.6	533.4
Oct. 27, '66	Copper	94.3	142.3	86.4	26.7	54.0	69.6
	Zinc	403.4	529.1	347.4	143.6	217.9	283.3
Dec. 2, '66	Copper	14.3	15.3	18.0	4.8	13.4	12.6
	Zinc	95.5	171.9	112.4	37.3	122.8	108.5

REF. NO.: 73 - I - 1

SUBSTANCES: Zn

Reference: Ireland, M. P. 1973. Result of fluvial zinc pollution on the zinc content of littoral and sub-littoral organisms in Cardigan Bay, Wales. Environ. Pollut. 4:27-35.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1973?

Location: Cardigan Bay, Wales

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 105°C)

TABLE 2

ZINC CONCENTRATIONS (MG/G DRY WEIGHT) IN LITTORAL SPECIES TAKEN AT VARYING DISTANCES FROM THE SOURCE OF POLLUTION (FIG. 1)

Locality	*Species*				
	Mytilus edulis	*Thais lapillus*	*Littorina littorea*	*Balanus balanoides*	*Actinia equina*
Constitution Hill	0·359 ± 0·034	0·916 ± 0·54	0·168 ± 0·003	4·5 ± 0·09	0·454 ± 0·03
Castle Point	0·779 ± 0·045	0·947 ± 0·14	0·227 ± 0·011	8·3 ± 0·30	0·415 ± 0·04
Harbour Point	0·754 ± 0·072	1·690 ± 0·40	0·242 ± 0·005	17·3 ± 1·3	0·167 ± 0·01
Alltwen	0·327 ± 0·019	1·740 ± 0·23	0·245 ± 0·019	23·1 ± 1·1	0·603 ± 0·03
Morfa Bychan	0·253 ± 0·027	1·980 ± 0·10	0·274 ± 0·031	17·8 ± 0·9	0·176 ± 0·02
Monk's Cave		1·300 ± 0·23	0·028 ± 0·004	8·6 ± 0·5	0·190 ± 0·014
Rheidol	0·412 ± 0·053				

Means ± SEM, $n = 6$.

REF. NO.: 73 - J - 1

SUBSTANCES: Cd, Cu, Hg, Ni, Pb, Zn

Reference: Jeng, S.-S. & Y.-W. Huang. 1973. Heavy metal contents in Taiwan's cultured fish. Bull. Inst. Zool., Acad. Sinica 12:79-85.

Organisms: Crassostrea gigas

Date of Sample Collection: 1973

Location: Taiwan

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 2

Heavy metal contents of Taiwan's cultured oyster, *Crassostrea gigas* (Thunberg).

Sampling station	Date of catch	No. of oyster	Mean wt. (g)	μg/g wet tissue					
				Cd	Cu	Hg	Ni	Pb	Zn
(1)	May 17, 1973	4	1.80	0.15	27.5		0.3	0.3	78
	Jul. 17, 1973	15	0.97	0.19	26.1	0.04	0.1	0.2	95
	Aug. 17, 1973	9	1.78	0.11	6.6	0.04	0.3	0.8	
	Sep. 14, 1973	60	1.62	0.21				0.8	33
(2)	May 17, 1973	2	3.05	0.27	28.1		0.3	0.4	68
	Jul. 17, 1973	13	1.14	0.14	27.0	0.04	0.4	0.3	61
	Aug. 17, 1973	8	1.76	0.09	23.8	<0.01	0.2	0.5	
	Sep. 14, 1973	30	0.93	0.25				0.7	65
(3)	May 17, 1973	2	3.50	0.19	33.4		0.1	0.6	23
	Jul. 17, 1973	6	2.44	0.13	18.7	0.04	0.3	0.1	34
	Aug. 17, 1973	9	1.44	0.10	11.4	0.03	0.3	0.1	
	Sep. 14, 1973	30	1.76	0.22				0.6	37
(4)	May 1, 1973	15	2.27	0.14	37.9	<0.01	0.6	0.2	77
	Aug. 17, 1973	7	2.16	0.13	12.9	0.01	0.2	0.1	
	Sep. 14, 1973	30	1.55	0.21				0.5	33

REF. NO.: 73 - J - 3

SUBSTANCES: As, Cd, Cu, Hg, Ni, Pb, Zn

Reference: Jeng, S. S., Y.-W. Huang, Y. S. Lee, G.-S. Wang & S.-J. Jeng. 1973. Heavy metal contents of fishes caught in Keelung Harbor. J. Fish. Soc. Taiwan 2:78-81.

Organisms: Crassostrea gigas

Date of Sample Collection: 1973

Location: Keelung Harbor, Taiwan

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 2. The heavy metal contents of fishes caught in Keelung harbor.

Sample		(μg/g wet weight)						
		As	Cd	Cu	Hg	Ni	Pb	Zn
1. Doctor fish	Muscle	<0.04	<0.01	<0.1	—	0.10	<0.05	13.2
	Viscera	<0.09	0.13	0.72	—	0.48	0.96	37.6
2. Russell's Snapper	Muscle	0.02	<0.08	<0.2	0.29	0.07	<0.02	8.3
	Viscera	<0.02	0.81	<0.85	—	0.21	0.71	31.8
3. Cavalla	Muscle	<0.02	<0.02	0.41	0.62	0.07	0.12	9.1
	Viscera	<0.02	<0.03	<0.65	—	0.11	0.22	35.6
4. Theraponid	Muscle	<0.02	<0.004	0.98	0.34	<0.04	0.03	14.9
	Viscera	0.12	0.01	1.97	—	<0.13	0.2	31.5
5. Pompanos	Muscle	<0.02	<0.004	<0.13	0.21	<0.04	<0.02	8.0
	Viscera	1.38	0.23	<1.5	—	<0.5	0.37	52.6
6. Crab	Edible portion	0.10	0.02	0.1	—	0.16	0.04	38.5
7. Crab	Edible portion	<0.10	0.03	0.69	—	0.37	0.04	39.2
8. Crab	Edible portion	<0.52	0.01	<0.7	—	0.24	0.19	46.5
9. Shrimp	Edible portion	22.21	<0.02		0.11	0.4	<0.1	27.5
10. Oyster	Edible portion	<0.11	0.22	426	0.10	0.85	0.07	1452

REF. NO.: 74 - J - 1

SUBSTANCES: Cd, Cu, Hg, Ni, Pb, Zn

Reference: Jeng, S., G. Wang, Y. Huang & J. Lain. 1974. Heavy metal contents of fishes caught in Kaohsiung Harbor. J. Fish. Soc. Taiwan 3:29-32.

Organisms: clam (unspecified)

Date of Sample Collection: 1974

Location: Kaohsiung harbor, Taiwan

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 2. Heavy metal contents of edible portions of shellfishes caught in Kaohsiung harbor.

Sample		Mean body weight (g)	Station[a]	(μg/g wet tissue) Cd	Cu	Hg	Ni	Pb	Zn
14. Clam 蛤	(27)	16.7	D	<0.01	2.5		1.6	1.0	88.0

REF. NO.: 71- J - 1

SUBSTANCES: Hg

Reference: Jensen, A. C. & J. Foehrenbach. 1971. Testing for mercury in New York's marine fish and shellfish. Conservationist (N. Y.) 26(2):31-33.

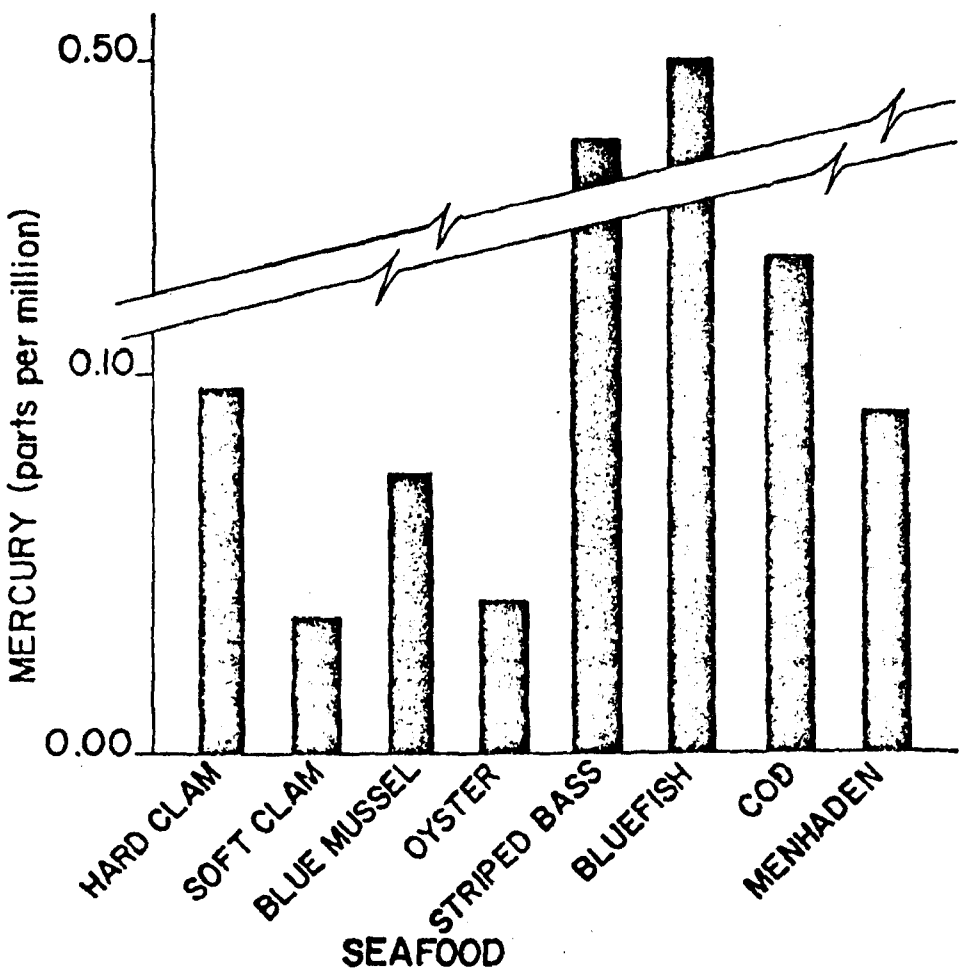
Organisms: clams, mussels, oysters (unspecified)

Date of Sample Collection: 1971?

Location: New York coast

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:



REF. NO.: 73 - J - 2

SUBSTANCES: Cu

Reference: Jones, G. B. & H. S. Matharu. 1973. Heavy metals in organisms and sediments from the east coast of Lundy. Rep. Lundy Field Soc. 23: 36-39.

Organisms: Pecten maximus

Date of Sample Collection: 1973?

Location: East coast Lundy, Great Britain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt., freeze-dried)

Table 1. The Concentrations of Copper in Organisms Collected from Lundy

Species	*Area Collected*	*Dry Weight (%)*	*Copper concentration (ppm dry weight)*
MOLLUSCA			
Pecten maximus	Knoll Pins		
Adductor muscle		24·6	1·6
Gills		11·9	8·5
Velum		20·4	2·8
Ovary		32·3	11·4

REF. NO.: 74 - J - 3

SUBSTANCES: Hg, As, Cd

Reference: Jones, G. B. The occurrence of some trace metals in organisms collected from Lundy. Lundy Fld. Soc. 25:49-52.

Organisms: Pecten maximus

Date of Sample Collection: 1974?

Location: Lundy, England

Analytical Technique: Neutron activation analysis

Analytical Data:

Table I. The Concentration of Mercury, Arsenic and Cadmium in Selected Organisms Collected from Lundy.

Species	Area collected	Dry wt. (%)	Concentration Hg (ppm dry weight)	As	Cd
MOLLUSCA					
Pecten maximus:	Knoll Pins				
Adductor muscle		24·6	0·17	14	0·47
:Gills		11·9	0·75	35	—
:Vellum		20·4	0·12	18	0·54
:Ovary		32·3	0·30	37	1·57

REF. NO.: 75 - J - 1

SUBSTANCES: Pb, Zn, Cu, Cd, Fe

Reference: Jones, L. H. 1975. The distribution of heavy metals in the Humber Estuary and its organisms. In Proc. jt. symp. Humber Estuary, 1973, no. 15, 19p. Hull, England, Univ. Dept. of Zoology, 1975.

Organisms: *Mytilus edulis*
Cerastoderma edule
Macoma balthica

Date of Sample Collection: 1973

Location: Humber Estuary, England

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 1. Metal levels in some species in the Humber Estuary in March/April 1973.

SPECIES		Metal content as µg/g dry weight				
		Pb	Zn	Cu	Cd	Fe
Cerastoderma edule	Max	37.75	73.46	4.96	2.20	538
	Av.	26.50	71.98	4.48	2.15	456
	Min.	15.50	70.80	4.05	2.10	401
Mytilus edulis	Max	21.75	104.50	6.06	3.86	525
	Av.	15.00	93.30	5.00	3.50	350
	Min.	11.06	72.00	4.78	3.00	307
Macoma balthica	Max	12.00	124.60	22.00	3.80	950
	Av.	8.67	111.50	14.60	2.14	896
	Min.	5.00	90.40	7.00	0.46	796

REF. NO.: 68 - K - 1 **SUBSTANCES:** Hg

Reference: Kitamura, S. 1968. Determination on mercury content in bodies of inhabitants, cats, fishes and shells in Minamata District and in the mud of Minamata Bay. Kumamoto University, Japan, Study Group of Minamata Disease. Minamata Disease, 1968, p. 257-266.

Organisms:
Paphia philippinarum
Meretrix meretrix
Anadara inflata
Hormomya mutabilis

Date of Sample Collection: 1966?

Location: Minamata Bay, Japan

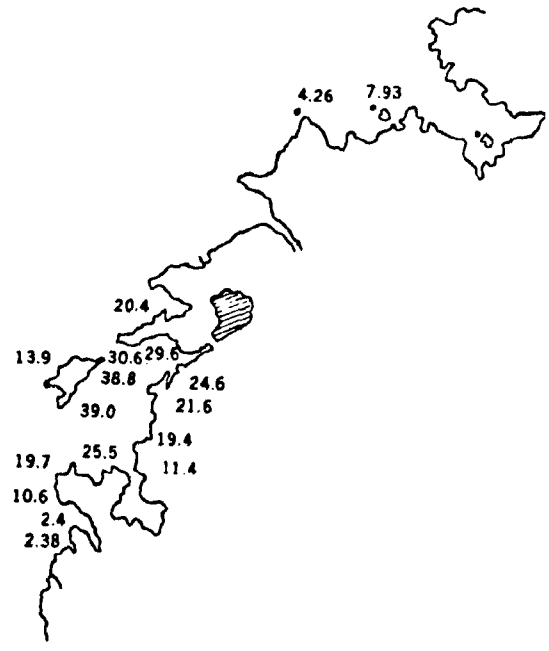
Analytical Technique:

Analytical Data:

TABLE III Mercury contents of fishery products in and near Minamata district (ppm wet weight)

Minamata district		Control district	
oyster	5.61	*Anadara inflata*+	(1.76)
Paphia philippinarum+	20.0	*Paphia philippinarum*+	0.1
		Meretrix meretrix+	0.08

Fig. 2. Mercury content in *Hormomya mutabilis* of Minamata district (ppm wet weight)



REF. NO.: 70 - K - 1

SUBSTANCES: Hg

Reference: Klein, D. H. & E. D. Goldberg. 1970. Mercury in the marine environment. Envir. Sci. Tech. 4:765-768.

Organisms: Hinnites multirugosus

Date of Sample Collection: 1970?

Location: Southern California

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table I. Mercury Concentrations in Bottom Sediments and Organisms, Collected Off La Jolla and Palos Verdes (PV)*

Sample	Station					
	La Jolla	PV(I)	PV(II)	PV(III)	PV(IV)	PV(V)
Sediment	0.02	0.3	0.2	1.0	0.3	0.2
Crab, *Cancer anthonyi*	0.8	1.0	1.2	0.5	2.3	
		1.1			0.9	
Whelk, *Kelletia kelletia*	1.5	0.9	1.8	2.3	1.6	3.2
	0.9			1.6	2.5	
	2.1					
Rock scallop, *Hinnites multirugosus*	0.7	1.0	0.4			0.5
	1.6	0.6				

* p.p.m., dry wt. basis.

REF. NO.: 76 - K - 1

SUBSTANCES: Hg

Reference: Klemmer, H. W., C. S. Unninayer & W. I. Okubo. 1976. Mercury content of biota in coastal waters in Hawaii. Bull. Environ. Contam. Toxicol. 15:454-457.

Organisms: Tapes japonica

Date of Sample Collection: 1971-74

Location: Hawaii

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE I

MERCURY CONCENTRATION (ppm) IN BIOTA COLLECTED FROM COASTAL WATERS OF HAWAII

FAMILY	SPECIES	COMMON NAME	NO. OF SAMPLES	MEAN	S.D.
Herbivore:					
Acanthuridae	*Ctenochaetus strigosus*	Surgeonfish	3	0.03	0.03
"	*Acanthurus sandvicensis*	"	17	0.04	0.04
"	" *nigroris*	"	6	0.05	0.05
"	" *leucopareius*	"	1	0.00	0.00
"	" *mata*	"	3	0.03	0.06
Mugilidae	*Neomyxus chapteli*	Diamond Scale Mullet	2	0.03	0.04
"	*Mugil cephalus*	Sea Mullet	9	0.03	0.03
"	*Mugil engeli*	Silver Mullet	3	0.01	0.02
Chanidae	*Chanos chanos*	Milkfish	2	0.03	0.01
Scaridae	*Calotomus sandvicensis*	Parrotfish	4	0.05	0.04
Blennidae	*Cirripectus linecpunctatus*	Blenny	1	0.00	0.00
Echinidae	*Tripneustes gratilla*	Sea urchin	6	0.03	0.06
Echinometridae	*Echinometra mathei*	"	3	0.00	0.00
"	*Colobocentrotus mamillatus*	Flat sea urchin	2	0.08	0.11
Patellidae	*Cellana exarata*	Limpet	9	0.02	0.03
Neritidae	*Nerita picea*	Pitchy seasnail	4	0.03	0.01
Veneridae	*Tapes japonica*	Clam	4	0.02	0.01
Plakobranchidae	*Plakobranchus ocellata*	Sea slug	1	0.00	0.00
Holothuridae	*Holothuria atra*	Sea cucumber	9	0.04	0.05
Ophiothricidae	*Ophiothrix*	Brittle star	1	0.00	0.00
			90	0.03	0.04

REF. NO.: 74 - K - 1 **SUBSTANCES:** Hg

Reference: Kondo, M. 1974. Mercury content of animal and vegetable foods. J. Hyg. Chem. 20(2):47-66.

Organisms: Clam, oyster (unspecified)
Anadara sp.

Date of Sample Collection: 1969-71

Location: Japan

Analytical Technique: ?

Analytical Data:

In Shell-Fishes

Sample	Origin		Length cm	Weight g	Total-Hg ppm	Methyl-Hg ppm	Water %	Remarks
Shrimp	Iran,	1970	5	3	0.02	ND	78	(20)[a]
	Osaka,	1970	5	2.5	0.22	ND	50	(75)
Squilla	Osaka,	1970	12	1.5	0.25	ND	74	(15)
	Osaka,	1970	13	3	0.17	0.005	73	(10)
Crab	Okayama,	1971	5	34	0.04	—	82	
	Okayama,	1971	5	22	0.03	—	86	
	Okayama,	1971	5	42	0.14	—	77	
	Okayama,	1971	7	55	0.04	—	78	
Arkshell	Osaka,	1970	—	120	0.03	ND	85	(2)
	Osaka,	1970	—	78	0.04	ND	86	(3)
Shortneck clam	Mie,	1970	—	10	0.04	0.012	79	(10)
	Ehime,	1969	—	8	0.04	0.011	78	(20)
Shortneck clam	Ehime,	1970	—	8	0.06	ND	75	Niihama (33)
	Hiroshima,	1971	—	8	0.34	ND	82	(7)
	Hiroshima,	1971	—	8	0.37	ND	80	(21)
Oyster	Ehime,	1969	—	—	ND	ND	81	(7)
	Hiroshima,	1971	—	—	0.08	ND	77	(10)
	Hiroshima,	1971	—	—	0.27	ND	74	(10)
Corb shell	Shimane,	1970	—	9	0.04	0.012	78	(38)
Clam	Nagasaki,	1970	—	19	0.03	0.011	80	(20)
Hen clam	Ehime,	1969	—	18	ND	ND	79	(10)
Anadara	Osaka,	1970	—	13	0.10	ND	82	(25)

a) Number of samples mixed before determination. Length and weight are average values of these samples.
ND : <0.01ppm (総水銀) ND <0.001ppm (メチル水銀)
M. Kondo, OECD Report (1972)

REF. NO.: 69 - K - 1

SUBSTANCES: Cu, Zn, Cr, Cd, Pb

Reference: Kopfler, F. C. & J. Mayer. 1969. Studies on trace metals in shellfish. Proc. Gulf and South Atlantic States Shellfish Sanitation Research Conference, Mobile, Ala., March 21-22, 1967, R. J. Hammerstrom & W. F. Hill, eds, p. 67-80. U.S. HEW, Cincinnati, Ohio, 1969.

Organisms: oysters (unspecified)

Date of Sample Collection: 1964-65

Location: Mobile Bay, Alabama

Analytical Technique: polarography

Analytical Data:

Table 2. Average copper and zinc content of oysters from selected areas of the South Atlantic and Gulf of Mexico

Location	Number of samples	Average[a] copper content	Average[a] zinc content
Albergotti Creek, South Carolina	6	6	750
Skull Creek, South Carolina	12	9	170
Broad & Jarvis Creeks, S. C.	4	16	280
Georgia (all locations)	12	11	327
Apalachicola Bay, Florida	28	15	71
Louisiana (all locations)	60	28	263
Galveston Bay, Texas	14	20	200
Overall	136	19	230

[a]mg/kg fresh tissue

Kopfler, F. C. & J. Mayer. 1969.

Table 3. Copper and zinc content in oysters from Mobile Bay[a]

Station	October		November		December		January	
	Copper	Zinc	Copper	Zinc	Copper	Zinc	Copper	Zinc
89	62.2	862	40.0	718	25.8	540	27.8	495
118	53.1	705	28.0	427	24.5	890	35.0	570
119	48.9	825	29.0	628	26.3	900	22.0	361

[a]mg/kg wet tissue

Table 4. Trace metal profile of station 89

January 1967

Type sample	Trace metal concentrations ppm[a]				
	Zinc	Copper	Cadmium	Chromium	Lead
Oysters	495	27.8	1.12	Trace	ND[b]
Sediment	61	2.1	0.31	2.8	3.7
Water	0.012	0.007	0.01	0.004	0.008

[a]Oyster mg/kg wet tissue
Sediment mg/kg dry sediment
Water mg/liter water

[b]Not detected

REF. NO.: 73 - K - 2

SUBSTANCES: Cd, Cr, Cu, Pb, Zn

Reference: Kopfler, F. C. & J. Mayer. 1973. Concentrations of five trace metals in the waters and oysters (Crassostrea virginica) of Mobile Bay, Alabama. Proc. Nat. Shellfish. Ass. 63:27-34.

Organisms: Crassostrea virginica

Date of Sample Collection: 1968-69

Location: Mobile Bay, Alabama

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1. *Summary of cadmium concentrations in oyster and water samples from Mobile Bay.*

Sampling Location	Cadmium concentrations Range	Median	Mean ± S.E.	Total Samples	Number Quantifiable
	Oyster samples (mg/kg wet weight)				
50	0.07-1.61	1.00	1.04±0.07	14	14
89	0.05-1.16	0.65	0.60±0.08	13	13
118	0.03-1.16	0.68	0.70±0.07	13	13
119	<0.05-1.20	0.50	0.65±0.10	12	11
83	0.20-1.30	0.47	0.53±0.08	13	13
92	0.10-0.80	0.51	0.52±0.08	15	15
104	<0.05-0.60	0.45	0.49±0.04	15	14
112	0.05-0.75	0.49	0.46±0.04	15	15
	Water samples (μg/l)				
50	<0.1-1.4	0.6	--	13	8
89	<0.1-1.5	0.4	--	12	8
118	<0.1-1.1	0.3	--	12	8
119	<0.1-9.1	0.6	--	11	8
83	<0.1-1.8	0.5	--	12	8
92	<0.1-1.3	0.5	--	11	8
104	<0.1-1.2	0.6	--	12	8
112	<0.1-1.4	0.5	--	12	9

REF. NO.: 77 - L - 1

SUBSTANCES: Cr, Fe, Ni, Cu, Zn, Ag, Cd, Hg

Reference: Lande, E. 1977. Heavy metal pollution in Trondheimsfjorden, Norway, and the recorded effects on the fauna and flora. Environ. Pollut. 12:187-198.

Organisms: Mytilus edulis

Date of Sample Collection: 1972-73

Location: Trondheimsfjorden, Norway

Analytical Technique: Atomic absorption spectroscopy

Analytical Data:

TABLE 1

RESULTS OF THE HEAVY METAL ANALYSES OF TISSUE SAMPLES FROM THE FAUNA AND FLORA OF THE INVESTIGATED AREA. THE RESULTS ARE PRESENTED AS mg/kg (ppm) DRY WEIGHT, EXCEPT FOR MERCURY, FOR WHICH THE RESULTS ARE EXPRESSED AS mg/kg (ppm) WET WEIGHT

Species, number of individuals, length, locality and sampling time	*Cr*	*Fe*	*Ni*	*Cu*	*Zn*	*Ag*	*Cd*	*Hg*
1972								
Common mussel (*Mytilus edulis*)								
(a) The soft parts of about 15 individuals from 40 to 50 mm in length								
Geitastrand (September)	49	1088	12	18	178	3	1	
Orkdalsfjorden (September)	18	899	43	88	359	6	<1	
Börsa (September)	10	729	6	38	255		3	
Flakk (September)	31	1623	14	13	136	2	5	
Storvika (September)	15	1036	15	12	99	1	4	
Langstein (September)	24	1431	14	7	119	1	2	
Verdalsöra (September)	8	789	9	5	85	1	1	
Vanvikan (September)	4	112	8	13	122	3	3	
(b) The shell of the same individuals								
Geitastrand (September)	2	52	6	4	7	4	<1	
Börsa (September)	2	17	7	8	6	4	2	
Flakk (September)	1	44	6	4	4	2	3	
Storvika (September)	2	55	8	5	6		2	
Vanvikan (September)	2	55	6	6	12	4	2	
1973								
Common mussel (*Mytilus edulis*)								
The soft parts of about 15 individuals from 40 to 50 mm in length								
Korsvika (February)	2	307	9	7	22	7		0·1

REF. NO.: 73 - L - 1

SUBSTANCES: Zn

Reference: Larsen, I. L., W. C. Renfro & N. H. Cutshall. 1973. Zinc-65 specific activity in Mytilus californianus tissues. In Radionuclides in Ecosystems, Proc. 3rd Nat. Symp. Radioecology, 1971, vol. 2, p. 747-751. U.S. Atomic Energy Commission, 1973.

Organisms: Mytilus californianus

Date of Sample Collection: 1967

Location: Oregon coast

Analytical Technique: Neutron activation analysis

Analytical Data:

Table 1. Concentrations of ^{65}Zn and stable Zn in mussels collected from the Oregon Coast

Collection area			Muscle	Foot	Mantle	Gills	Reproductive organs	Viscera
Tillamook	Sp. act.	nCi ^{65}Zn/g Zn	785 ± 11.6	835 ± 10.2	759 ± 14.9	798 ± 8.45	909 ± 6.22	766 ± 10.4
Head	^{65}Zn	pCi ^{65}Zn/g ash	413 ± 8.84	465 ± 6.35	123 ± 12.9	443 ± 3.91	571 ± 1.91	441 ± 6.12
(TH)	Stable Zn	μg Zn/g ash	526 ± 7.46	557 ± 7.94	162 ± 7.34	555 ± 7.49	628 ± 5.92	576 ± 8.38
Yaquina	Sp. act.	nCi ^{65}Zn/g Zn	140 ± 22.8	176 ± 36.4	163 ± 32.1	186 ± 15.5	231 ± 13.0	206 ± 16.3
Head	^{65}Zn	pCi ^{65}Zn/g ash	72.8 ± 21.8	42.0 ± 35.9	20.4 ± 30.0	37.1 ± 13.4	78.1 ± 9.17	84.8 ± 13.8
(YH)	Stable Zn	μg Zn/g ash	520 ± 6.65	239 ± 5.83	125 ± 11.3	200 ± 7.90	338 ± 9.20	411 ± 8.66
Cape Arago	Sp. act.	nCi ^{65}Zn/g Zn	50.1 ± 88.6	75.0 ± 110	77.0 ± 63.8	50.6 ± 76.9	116 ± 18.5	72.3 ± 21.9
(CA)	^{65}Zn	pCi ^{65}Zn/g ash	27.3 ± 88.4	18.9 ± 110	12.7 ± 63.5	7.64 ± 76.4	30.6 ± 17.4	69.4 ± 20.4
	Stable Zn	μg Zn/g ash	545 ± 5.64	252 ± 8.95	165 ± 6.38	151 ± 9.02	263 ± 6.32	961 ± 8.10

Note: ± indicates the estimated percent uncertainty in the measurements at the 95% confidence level.

Table 2. Zinc-65 specific activities in total soft tissues of *Mytilus californianus*.

Location	Approximate distance south from Columbia River		Sampling date	^{65}Zn specific activity (nCi ^{65}Zn/g Zn)	Reference
	km	mi			
Mouth, Columbia River	0	0	August 1964	706	Alexander and Rowland 1966
Tillamook Head, Oregon	31	19	March 1964	506*	Oregon State University (unpublished)
			August 1964	278	Alexander and Rowland 1966
Cannon Beach, Oregon	40	25	July 1969	308	Toombs 1969 (personal communication)
Nehalem River Jetty, Oregon	64	40	July 1969	466	Toombs 1969 (personal communication)
Agate Beach, Oregon	172	107	August 1969	147	Toombs 1969 (personal communication)
Yaquina Head, Oregon	174	108	March 1964	135*	Oregon State University (unpublished)
Cape Arago, Oregon	335	208	March 1964	67*	Oregon State University (unpublished)
La Jolla, California	1770	1100	1964–1965	0.39	Alexander and Rowland 1966

*Muscle tissue.

REF. NO.: 74 - L - 1

SUBSTANCES: As, Cd, Sb, Hg

Reference: Leatherland, T. M. & J. D. Burton. 1974. The occurrence of some trace metlas in coastal organisms with particular reference to the Solent region. J. mar. biol. Ass. U.K. 54:457-468.

Organisms:

Mytilus edulis
Cardium edule
Mercenaria mercenaria
Ostrea edulis
Crassostrea angulata
Anodonta cygnea

Date of Sample Collection: 1970-71

Location: England

Analytical Technique:

Analytical Data:

TABLE 2. TRACE METALS IN ORGANISMS FROM SOUTHAMPTON WATER AND THE SOLENT

Organism and location		Dry weight (%)	Ppm dry weight Zn	As	Cd	Sb	Hg
LAMELLIBRANCHIA							
Mytilus edulis	Town Quay	11·3	269	15	2·5	0·042	0·63
	Hamble	17·4	—	9·5	—	0·042	1·9
	Lee	15·6	—	15	—	0·047	0·42
Cardium edule	Hamble	14·6	—	6·3	—	0·043	0·80

TABLE 4. TRACE METALS IN ORGANISMS FROM REGIONS OTHER THAN THE SOLENT

Organism	Location	Dry weight (%)	Ppm dry weight Zn	As	Cd	Sb	Hg
LAMELLIBRANCHIA							
Ostrea edulis	Helford Estuary, Cornwall	16·8	—	8·2	—	0·010	0·76
	Blackwater Estuary, Essex	12·9	—	6·9	—	0·015	0·36
	Poole, Dorset	16·6	—	2·6	—	0·010	1·2
Crassostrea angulata	Blackwater Estuary, Essex	12·7	—	10	—	—	0·56
Cardium edule: whole soft tissues	Solway Firth	12·0	81	6·3	0·81	0·063	0·06
mantle cavity fluids	Solway Firth	5·5	95	8·4	2·1	c·18	0·07
whole soft tissues	Poole, Dorset	18·7	52	5·1	0·92	0·034	0·86
Anodonta cygnea	River Test (near Southampton)	14·8	141	4·3	0·49	0·029	c·07
	River Thames (Chertsey)	10·0	650	4·3	9·2	0·054	0·76

Leatherland, T. M. & J. D. Burton. 1974.

TABLE 3. TRACE METALS IN *MERCENARIA MERCENARIA* FROM SOUTHAMPTON WATER AND THE SOLENT

Location	Dry matter (%)	Ppm dry weight			
		As	Cd	Sb	Hg
Town Quay					
Whole soft tissue	22·2	5·9	—	—	0·57
Visceral mass	24·3	6·5	—	—	0·40
Mantle	17·6	7·8	—	—	0·48
Foot	28·0	4·3	—	—	0·83
Adductors	25·6	1·8	—	—	0·64
Gills	14·5	12·2	—	—	1·46
Town Quay	15·1	6·1	—	0·015	0·54
Marchwood	14·5	4·1	—	0·009	0·50
Marchwood*	13·2	7·1	—	0·013	0·77
Hythe	14·7	6·9	—	0·014	0·28
Netley					
3 year-olds	13·1	3·8	0·59	0·014	0·16
4 year-olds	15·4	4·7	0·60	0·011	0·20
10 year-olds	14·0	9·3	0·48	0·008	0·22
15 year-olds	17·0	8·4	0·30	0·006	0·22
Hamble	18·3	3·2	—	0·007	0·18
Lee	17·3	4·5	—	0·013	0·17

* This specimen was transferred to the Blackwater Estuary, Essex, one year before collection.

REF. NO.: 73 - L - 2

SUBSTANCES: As

Reference: LeBlanc, P. J. & A. L. Jackson. 1973. Arsenic in marine fish and invertebrates. Mar. Pollut. Bull. 4:88-90.

Organisms: Macoma sp.
Clinocardium sp.

Date of Sample Collection: 1973?

Location: Canada, Pacific coast

Analytical Technique: Colorimetry

Analytical Data:

TABLE 1
Concentrations of arsenic in marine fish and invertebrates from location 1, western coast of Canada.

	No. of samples analysed	Minimum µg/g (wet weight)	Median µg/g (wet weight)	Maximum µg/g (wet weight)
Marine invertebrates				
Crab (*Cancer magister*)	18	2.2	8.6	27.0
Clam (*Macoma* sp; *Clinocardium* sp.)	6	<0.8	0.9	3.0
Marine fish				
Shark (*Hexanchus griseus*)	6	1.9	4.5	5.9
Dogfish (*Squalus acanthias*)	10	1.7	3.0	5.6
Skate (*Raja* sp.)	1	–	–	16.2
Ratfish (*Hydrolagus colliei*)	3	0.4	10.2	10.3
Salmon (*Oncorhyncus* sp.)	5	–	–	<0.4
Steelhead (*Salmo gairdneri*)	1	–	–	<0.4
Cod (*Olphiodon elongatus*)	1	–	–	0.3
Rockfish (*Sebastes* sp.)	27	<0.3	0.3	2.6
Greenling (*Hexagrammos* sp.)	2	–	–	<0.4
Sole (*Psettichthys melanostictus* and *Parophrys vetulus*)	3	0.6	1.1	11.5

TABLE 3
Concentrations of arsenic in marine fish and invertebrates from location 3, western coast of Canada.

	No. of samples analysed	Minimum µg/g (wet weight)	Median µg/g (wet weight)	Maximum µg/g (wet weight)
Marine invertebrates				
Crab (*Cancer magister*)	18	2.4	6.3	17.4
Clam (*Macoma* sp.; *Clinocardium* sp.)	10	<0.5	1.1	15.6
Marine fish				
Shark (*Hexanchus griseus*)	5	<0.4	3.2	5.6
Dogfish (*Squalus acanthias*)	7	1.5	2.8	5.6
Rockfish (*Sebastes* sp.)	7	<0.3	<0.6	2.1
Greenling (*Hexagrammos* sp.)	2	<0.4	–	0.8

TABLE 4
Concentrations of arsenic in marine fish and invertebrates from location 4, western coast of Canada.

	No. of samples analysed	Minimum µg/g (wet weight)	Median µg/g (wet weight)	Maximum µg/g (wet weight)
Marine invertebrates				
Crab (*Cancer magister*)	9	2.4	6.6	14.0
Clam (*Macoma* sp.; *Clinocardium* sp.)	4	<1.0	<1.0	2.8
Marine fish				
Rockfish (*Sebastes* sp.)	3	<0.4	<0.4	1.7
Greenling (*Hexagrammos* sp.)	1	–	–	<0.4

REF. NO.: 74 - L - 2

SUBSTANCES: Rb, Cs, Co, Zn, Hg, Fe, La, Ce, Eu, Sb, Se, Th

Reference: Lulic, S. & P. Strohal. 1974. The application of neutron activation analysis in studying the marine pollution processes. Rev. Intern. Oceanogr. Med. 33:119-123.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1974?

Location: Northern Adriatic

Analytical Technique: Neutron activation analysis

Analytical Data:

REF. NO.: 70 - L - 1

SUBSTANCES: As

Reference: Lunde, G. 1970. Analysis of arsenic and selenium in marine raw materials. J. Sci. Fd Agric. 21:242-247.

Organisms: Mytilus edulis
Pecten maximus
Ostrea edulis

Date of Sample Collection: 1970?

Location: Norway (commercial samples)

Analytical Technique: Neutron activation analysis

Analytical Data:

TABLE I
Arsenic and selenium content in dehydrated raw material and N liquor, ppm

Sample	Name	Raw material		N liquor	
		Arsenic	Selenium	Arsenic	Selenium
Mussel	*Mytilus edulis*	8·0	3·9	9·7	1·1
Clam	*Pecten maximus*	11·6	2·6	18	1·0
Oyster	*Ostrea edulis*	7·6	n.d.	9·8	0·9

TABLE II
Arsenic content in samples fractionated by molecular gel filtration

Sample	N liquor			Enzyme-hydrolysed presscake		
	Wt. of sample to be fractionated, g	Wt. of fraction, g	As μg	Wt. of sample to be fractionated, g	Wt. of fraction, g	As μg
Clam	0·9	0·057 0·22	2·7 2·2	0·6	0·17	0·90

TABLE III
Selenium content in the protein fraction from molecular gel filtration

Sample	N liquor		Enzyme-hydrolysed presscake	
	Wt. of fraction, g	Se, μg	Wt. of fraction, g	Se, μg
Clam	0·15	1·6	0·022	0·04
Oyster	0·13	0·47	0·037	0·09

REF. NO.: 73 - L - 3

SUBSTANCES: As

Reference: Lunde, G. 1973. Separation and analysis of organic-bound and inorganic arsenic in marine organisms. J. Sci. Fd Agric. 24:1021-27.

Organisms: Mytilus edulis

Date of Sample Collection: 1973?

Location: Western Norway

Analytical Technique: Neutron activation and X-ray fluorescence

Analytical Data:

TABLE 1. Organic bound and inorganic[a] arsenic in marine samples

Sample	Locality	Arsenic (parts/million dry weight) Neutron activation Inorganic	Organic	Total	X-ray fluorescence
Shrimp *Pandalus borealis*	Skagerak	2.5	29.5	30	37
Shrimp *Pandalus borealis*	Oslofiord	1.8	36.5	42	39
Mussel *Mytilus edulis*	Western Norway	1.5	12.4	14	12

REF. NO.: 75 - M - 2 **SUBSTANCES:** Cu, Zn, Cd, Pb, As

Reference:

Mackay, N. J., R. J. Williams, J. L. Kacprzac, M. N. Kazacos, A. J. Collins & E. H. Auty. 1975. Heavy metals in cultivated oysters (Crassostrea commercialis = Saccostrea cucullata) from the estuaries of New South Wales. Aust. J. mar. Freshwat. Res. 26:31-46.

Organisms: Crassostrea commercialis

Date of Sample Collection: 1973

Location: New South Wales

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Mackay, N. J. et al. 1975.

Table 1. Sample locations and metal concentrations (ppm wet weight)

Site location	Site no.	Approx. distance from estuary mouth (km)	Cu	Zn	Cd	Pb	As	% dry wt.
Tweed River	1	3·5	3	80	0·1	0·3	1·4	18·6
	2	4·5	11	370	0·1	0·8	1·5	10·0
	3	8	9	190	0·2	0·9	1·6	18·1
Richmond River	1	2	16	340	0·2	1·1	1·1	13·6
	2	6	24	250	0·2	1·0	0·9	11·8
Clarence River	1	2	28	610	0·1	0·7	0·3	12·6
Wooli Wooli Creek	1	3·5	19	270	0·2	1·0	0·9	10·5
Macleay River	1	3	15	240	0·1	0·4	0·7	10·1
Hastings River	1	5	10	175	0·2	0·9	1·3	10·3
Camden Haven In.	1	7	20	320	0·3	0·7	1·2	10·2
Manning River	1	2·5	9	150	0·3	0·8	0·9	12·5
	2	5	27	280	0·1	0·7	0·7	13·3
	3	4	27	275	0·2	0·9	0·8	12·4
Wallis Lake	1	3·5	15	265	0·2	0·7	1·8	18·7
	2	8	10	110	0·2	0·8	1·3	15·9
	3	9·5	28	205	0·3	0·8	1·6	15·4
	4	11	37	245	0·2	1·1	—	—
	5	14·5	25	180	0·2	1·0	0·9	14·2
Port Stephens	1	7	8	280	0·1	0·6	1·3	17·7
	2	34·5	27	225	0·1	1·0	1·2	10·5
Hawkesbury River	1	14	48	430	0·2	1·3	0·8	22·9
	2	14	33	285	0·1	0·6	0·8	13·4
	3	16	34	270	0·1	0·7	0·9	15·5
	4	23	29	425	0·1	0·6	0·8	14·3
	5	23	35	435	0·3	0·5	0·9	17·0
	6	24	26	295	0·2	0·5	0·5	14·7
	7	26	29	500	0·2	0·6	1·0	16·6
	8	31	38	430	0·4	0·5	0·4	18·2
Georges River	1	8	20	305	0·4	0·8	1·0	13·3
	2	10	31	385	0·6	1·1	0·8	18·8
	3	15	44	470	0·4	1·3	0·8	18·8
	4	18	45	640	1·0	1·0	0·3	15·5
	5	22	46	665	1·0	1·0	0·8	14·1
Crookhaven River	1	1	9	175	0·1	1·0	1·2	12·2
	2	2·5	15	510	0·1	0·9	1·2	12·5
	3	4	18	160	0·2	0·8	0·9	10·1
Clyde River	1	5·5	15	195	0·1	0·9	1·3	13·1
	2	7·5	10	195	0·2	1·0	1·1	17·8
	3	14·5	14	135	0·2	1·0	0·8	10·2
Tuross Lake	1	5	19	100	0·2	1·1	1·2	11·0
Wagonga River	1	2	10	170	0·3	1·1	3·4	18·8
	2	6	21	305	0·1	0·9	3·1	14·9
Wapengo Lake	1	1	11	130	0·2	0·8	1·8	15·9
	2	3	4	100	0·1	0·6	0·9	—
Merimbula Lake	1	0·5	3	130	0·2	0·6	1·8	15·2
	2	3	6	170	0·2	0·8	1·9	17·0

REF. NO.: 38 - M - 1

SUBSTANCES: Cu

Reference: Marks, G. W. 1938. The copper content and copper tolerance of some species of mollusks of the Southern California coast. Biol. Bull. 75:224-237.

Organisms:

Chione undatella
Donax gouldii
Mytilus edulis
Paphia staminea laciniata
Pecten circularis aequisulcatus
Tivela crassatelloides
Mytilus californianus

Date of Sample Collection: 1938?

Location: Southern California

Analytical Technique: Colorimetry

Analytical Data:

TABLE III

The copper content of groups of organs of the sea mussel, *Mytilus californianus* *

Length of mussels	No. of mussels used	Hepatopancreas, intestines and heart	Mantle and gonads	Muscles and foot	Gills and palps
cm.					
Range: 6.3–7.5	30	(*a*) 0.0038	0.0032	0.0022	0.0047
Mean: 6.9		(*b*) 27.4	23.0	15.8	33.8
		(*c*) 1.34	0.20	0.36	0.65
		(*d*) 9.35	2.52	2.26	7.70
Range: 6.6–7.7	30	(*a*) 0.0049	0.0034	0.0025	0.0052
Mean: 7.1		(*b*) 30.6	21.2	15.6	32.6
		(*c*) 1.66	0.20	0.36	0.55
		(*d*) 13.6	2.79	2.44	7.07
Range: 11.9–13.0	5	(*a*) 0.0159	0.0216	0.0042	0.0148
Mean: 12.5		(*b*) 28.2	38.2	7.4	26.2
		(*c*) 0.86	0.21	0.14	0.39
		(*d*) 8.70	3.26	1.00	5.44
Range: 11.8–12.4	4	(*a*) 0.0172	0.0234	0.0039	0.0102
Mean: 12.1		(*b*) 31.5	42.8	7.1	18.6
		(*c*) 0.85	0.23	0.12	0.27
		(*d*) 8.21	1.65	0.57	3.66

* The data for each group of organs of each series is placed in the following order:
(*a*) mg. of copper per group of organs per mussel (mean values),
(*b*) per cent of total copper present per mussel,
(*c*) mg. of copper per 100 grams of moist tissue,
(*d*) mg. of copper per 100 grams of dry tissue. @ 105°-120°C

Marks, G. W. 1938.

TABLE II

The copper content of mollusks

Species	Length or weight of animals	Mg. of Cu per 100 grams of moist tissue	Mg. of Cu per 100 grams of dry tissue
Archidoris montereyensis	30.5 grams (one animal)[a]	0.13	0.59
Astraea undosa (wavy top)		0.80	2.83
		1.26	4.34
Chione undatella (cockle)	2.7–3.9 cm., mean 3.6 cm. (7 animals)[b]	0.12	0.94
		0.20	1.24
Donax gouldii (bean clam)		0.06	0.41
		0.07	0.44
Helix aspersa (common terrestrial snail)	0.1–1.5 grams	1.63	10.7
	4.7–7.6 grams	10.8	56.1
Ischnochiton conspicuus (conspicuous chiton)	22–32.5 grams	0.37	1.03
		0.25	0.97
		0.28	1.08
Navanax inermis (striped mollusk)	51 grams (one animal)[c]	0.44	4.98
Mytilus edulis (bay mussel)		0.23	1.17
		0.37	2.38
Paphia staminea var. *laciniata* (rock cockle)		0.24	1.31
		0.18	1.48
	4.0 ± 0.2 cm.	0.21	1.68
	5.2 ± 0.1 cm. (three animals)[d]	0.18	1.44
Pecten circularis aequisulcatus (speckled scallop)	5.5–6.5 cm.[e]	0.31	2.40
Tegula gallina (speckled turban)		0.61	2.03
		0.61	2.30
Tegula viridula var. *ligulata* (banded turban)		0.81	3.25
		0.92	5.93
Tivela crassatelloides (clam)		0.21	1.19
		0.23	1.39

[a] Amount of copper per animal: [a] 0.039 mg.; [b] 0.006 mg.; [c] 0.213 mg.; [d] 0.009 mg.; [e] 0.043 mg.; [f] 0.013 mg.

REF. NO.: 71 - M - 1

SUBSTANCES: Hg

Reference: Massachusetts Department of Public Health. 1971. Mercury levels in marine life and sediment. New England J. Med. 285:1031-1032.

Organisms: shellfish (unspecified)

Date of Sample Collection: 1970

Location: Massachusetts

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

55 areas sampled

Quisset Harbor, Falmouth and Sippican Harbor, Marion >0.5ppm
All other areas <0.5ppm

REF. NO.: 61 - M - 1 **SUBSTANCES:** Zn, Cu

Reference: McFarren, E. F., J. E. Campbell & J. B. Engle. 1961. The occurrence of copper and zinc in shellfish. Proc. Shellfish Sanitation Workshop Appendix R, Washington D.C., 1961, p. 229-234.

Organisms: oysters, clams, mussels (unspecified)

Date of Sample Collection: 1960-61

Location: East coast U. S., Atlantic

Analytical Technique: ?

Analytical Data:

Table 1

Zinc and Copper Content of East Coast Shellfish

Sample No.	Kind of Shellfish	Date Collected	Location	Content, mg/kg Copper	Zinc
A	Oysters	8/24/60	Old Orchard, Tangier Sound, Md.	28.00	960.0
B-1	Oysters	8/25/60	Tollys Point, Chesapeake Bay, Md.	130.00	3200.0
B-2	Oysters	9/28/60	Tollys Point, Chesapeake Bay, Md.	230.00	3900.0
C	Clams	8/30/60	Kent Shore, Upper Chesapeake Bay	7.10	76.0
D	Mussels	9/2/60	Swan Point, Upper Chesapeake Bay	0.72	44.0
E	Oysters	3/2/60	Swan Point, Upper Chesapeake Bay	200.00	4000.0
VFL-1	Oysters	8/31/60	York River, Clay Bank, Va.	36.00	920.0
VFL-2	Oysters	8/31/60	Mouth Cherrystone Creek, Va.	8.80	330.0
F	Oysters	9/7/60	Shoal Sands, Delaware Bay	36.00	1900.0
G	Oysters	8/16/60	New Hampshire	12.00	650.0
H	Clams	8/16/60	New Hampshire	1.90	20.0
I	Oysters	9/20/60	Chincoteague, Va. Eastern Shore	16.00	310.0
J	Oysters	10/31/60	Black Rock Bar, Upper Chesapeake Bay	420.00	3300.0
K-1	Oysters	10/7/60	West Neck, Long Island	160.00	1200.0
K-2	Oysters	10/7/60	West Neck, Long Island	520.00	2000.0
L	Oysters	11/11/60	Turnagain Bay, North Carolina	30.00	390.0
M-1	Oysters	3/10/60	York River, Virginia	170.00	1000.0
M-2	Oysters	3/2/60	Egg Island, Horn Harbor	66.00	560.0

McFarren, E. F. & J. E. Campbell. 1961.

Table V

Seasonal Variations in Zinc Content of Oysters From One Area of Chesapeake Bay

Sample Date	Zn, mg/kg Swan Point	Zn, mg/kg Hackett Bar
1/17/61	2485	2032
2/17/61	3064	1853
3/17/61	2274	2178
4/19/61	2723	2402
5/17/61	2345	3686
6/19/61	2632	3492
7/18/61	2764	3728
8/23/61	2764	3728
8/23/61	3613	4013
9/25/61	2900	3759

Table II

Copper and Zinc in Oyster Meat and Liquor

Portion	Cu, mg/kg	Zn, mg/kg
Meat plus Liquor	41.0	1323
Drained Meat	56.0	1657
Liquor	6.9	145

Table III

Copper and Zinc in Processed Oysters

Sample Date	Control Cu, mg/kg	Control Zn, mg/kg	Processed Cu, mg/kg	Processed Zn, mg/kg
1/17/61	64	2032	63	1851
2/17/61	64	1853	69	1830
3/17/61	82	2178	60	1557

Table IV

Copper and Zinc in Oyster Parts

Parts	Percent of Total Weight	Percent of Total Cu	Percent of Total Zn
Mantle	23.1	26.0	26.9
Gills	25.7	28.6	22.8
Liver and Stomach	21.0	21.5	21.5
Palps	5.6	3.6	5.6
Abductor Muscle	8.9	3.8	4.9
Remainder	15.5	16.3	18.6

REF. NO.: 24 - M - 1

SUBSTANCES: Fe, Cu, Mn, Zn

Reference: McHargue, J. S. 1924. The significance of the occurrence of copper, manganese and zinc in shell-fish. Science 60:530.

Organisms: mussels, clams, oyster (unspecified)

Date of Sample Collection: 1924?

Location: ?

Analytical Technique: ?

Analytical Data:

The Significance of the Occurrence of Copper, Manganese and Zinc in Shell-Fish: J. S. McHargue. Small amounts of the elements copper, manganese and zinc are widely distributed in nature. The author found, in parts per million of the moisture-free matter, copper, iron, manganese and zinc in the following species of shellfish: Crayfish, 75 cu; 896 Fe; 250 Mn; 320 Zn. Mussel, 12 cu; 1,325 Fe; 5,424 Mn; 750 Zn. Clam, 16 cu; 711 Fe; 43 Mn; 1,359 Zn. Oyster, 231 cu; 208 Fe; 49 Mn; 4,284 Zn. Lobster (edible meat) 85 cu; 54 Fe; 12 Mn; 160 Zn. Crabs (entire bodies), 68 cu; 134 Fe; 16 Mn; 1,216 Zn. The author assumes that copper, manganese and zinc are vitally concerned in the metabolism of shell-fish and are probably vital factors in the metabolism of higher animals as well.

REF. NO.: 65 - M - 1

SUBSTANCES: Mn

Reference: Merlini, M., F. Girardi, R. Pietra & A. Brazzelli. 1965. The stable manganese content of molluscs from Lake Maggiore determined by activation analysis. Limnol. Oceanogr. 10:371-378.

Organisms: Unio mancus elongatulus
Anodonta cygnea

Date of Sample Collection: 1965?

Location: Lake Maggiore, Northern Italy

Analytical Technique: Activation analysis

Analytical Data:

TABLE 3. *The manganese content of shells of* Unio *collected from two different areas of Lake Maggiore, Angera and Lisanza. Calculations are based on dry weight (100C). Average values are for different size classes*

Angera		Lisanza	
Shell length (cm)	Mn, ppm	Shell length (cm)	Mn, ppm
4.30	216	4.60	181
5.15	222	4.80	208
5.45	336	5.00	252
5.95	293	5.00	335
Average:	267	5.25	356
6.00	413	5.50	276
6.00	371	5.65	204
6.00	252	5.70	261
6.00	319	5.70	345
6.05	593	5.75	440
6.10	388	5.90	524
6.15	354	Average:	307
6.20	318	6.00	517
6.35	268	6.00	353
6.40	479	6.00	264
6.60	184	6.05	568
Average:	337	6.05	374
7.35	632	6.10	299
7.40	575	6.10	267
7.50	838	6.10	350
7.90	766	Average:	374
Average:	689	7.00	429
		7.00	577
		7.15	650
		7.20	745
		7.25	603
		Average:	600

TABLE 4. *The amount of Mn in the soft tissues of* Unio *of different size classes*

Size classes, cm	Mn, ppm			
	Gills	Mantle	Visceral sac	Muscle
4.5–5.95	8,874	3,106	774	752
6.0–6.6	10,782	5,465	975	971
7.35–7.90	21,666	18,427	3,207	3,554

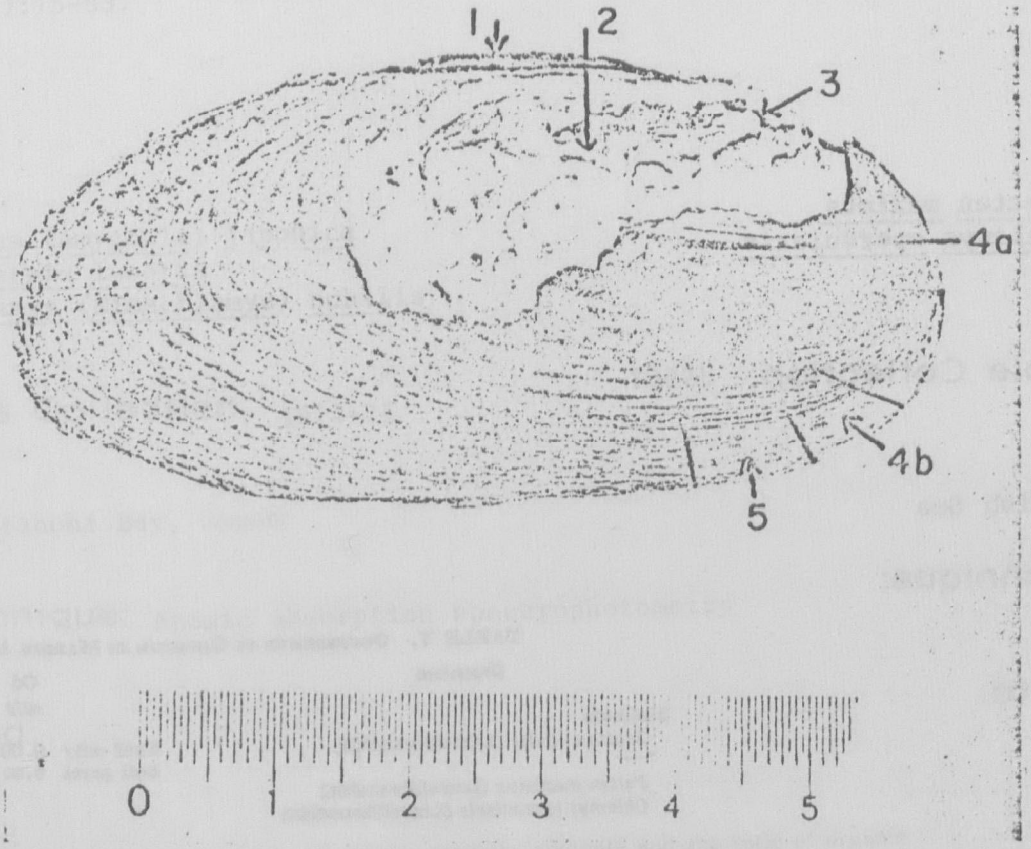


FIG. 2. A typically eroded shell of *Unio mancus elongatulus* (Pfeiffer) (7.15 cm in length) of Lake Maggiore. The different areas of the shell are numbered and the concentration of Mn is given for each area as ppm, dry weight.

Shell area	Mn, ppm	Shell area	Mn, ppm
1. Hinge:			
Nacre (mother-of-pearl)	279	3. Umbo of heavy nacre	924
Ligament of conchiolin	299	4a. Shell edge, all layers	452
Ligament of conchiolin plus nacre	108	4b. Same	595
2. Thin layer of nacre near umbo	705	5. Shell edge, all layers minus conchiolin	627

TABLE 5. *Manganese level in soft tissues of* Unio *collected from two different areas of Lake Maggiore*

	Average length (cm)	Mn, ppm			
		Gills	Mantle	Visceral sac	Muscle
Angera	6.20	12,974 ± 1,245	7,032 ± 737	888 ± 92	1,009 ± 220
Lisanza	6.05	15,382 ± 598	11,842 ± 1,702	3,599 ± 649	1,697 ± 204

In *Unio*, instead, it has been possible to correlate the preferential sites of ^{54}Mn accumulation with that of stable Mn. The distribution of ^{54}Mn among the different parts of *Unio* (Gaglione and Ravera 1964) and that of the stable element, determined by us, expressed as per cent of content in the whole animal, is as follows:

	Per cent stable Mn	Per cent ^{54}Mn
Shell	34.4	35.0
Soft tissues	65.6	65.0
Gills	23.6	18.0
Mantle	25.4	38.0
Visceral sac	16.6	8.7

TABLE 6. *The quantity of manganese in the shell and soft parts of* Anodonta cygnea *collected from the area of Lisanza in Lake Maggiore. Data are given as ppm of dry matter (100C)*

Shell length (cm)	Mn, ppm				
	Shell	Gills	Mantle	Visceral sac	Muscle
4.95	317	13,326	2,818	418	70
5.25	425	16,310	2,821	1,318	57
5.85	295	17,782	6,216	717	249
6.05	442	17,796	3,412	1,094	154
6.25	338	29,306	4,576	1,521	151
6.35	408	16,636	5,877	989	622
7.15	592	18,824	7,191	1,599	304
7.25	449	19,259	5,675	1,744	77
8.15	428	19,056	7,243	1,076	229
Average:	410	18,699	5,092	1,164	212

REF. NO.: 56 - M - 1 **SUBSTANCES:** Cd

Reference:

Mullin, J. B. & J. P. Riley. 1956. The occurrence of cadmium in seawater and in marine organisms and sediments. J. Mar. Res. 15:103-122.

Organisms: Pecten maximus
Chlamys opercularis

Date of Sample Collection: 1956?

Location:

Irish Sea

Analytical Technique:

Analytical Data:

TABLE V. OCCURRENCE OF CADMIUM IN MARINE ANIMALS

Organism		Cd µg/g	Concentration factor × 10^{-3}
Mollusca			
Mytilus edulis (Lamellibranchia)	Shell only	0.003	0.03
	Soft parts	3.21	28.4
Pecten maximus (Lamellibranchia)			See Table IX
Chlamys opercularis (Lamellibranchia)			See Table VII

TABLE VI. CADMIUM IN *Chlamys opercularis*

	Shell	Gills	Mantle + Viscera	Muscle	Gonad
Sulphated ash, %	—	19.0	21.6	6.5	10.4
Cd, µg/g	0.008	1.24	9.71, 9.53*	0.87	2.21
Concⁿ. factor × 10^{-3}	0.007	11	85	8	20
Cd in ash, µg/g	0.008	6.5	44.5	13.4	21.2

* Duplicate determinations on different samples.

TABLE IX. CADMIUM IN *Pecten maximus*

Unpurged

	Shell	Gills	Full gonad	Spent gonad	Striped muscle	Unstriped muscle	Foot
Sulphated ash, %	—	25.1	10.7	3.2	6.0	4.7	51.9
Cd, µg/g	0.001	8.5	0.79	9.3	1.95	1.86	6.3
Concⁿ. factor × 10^{-3}	0.01	75	7	82	17	16	56
Cd in ash, µg/g	0.001	34	7.3	291	33	40	12

	Mantle + Gut + Digestive gland	Mantle	Gut	Digestive gland	Renal organ
Sulphated ash, %	13.9	13.3	12.6	7.2	27.2
Cd, µg/g	39.5	5.8	6.2	532	152
Concⁿ. factor × 10^{-3}	350	49	55	4707	1348
Cd in ash, µg/g	284	44	49	7400	559

Purged

	Gills	Male gonad	Female gonad	Striped muscle	Foot	Gut + Gonad + Digestive gland	Mantle	Renal organ
Sulphated ash, %	25.0	3.0	10.2	12.7	9.3	10.9	9.4	36.7
Cd, µg/g	12.5	0.55	0.11	1.58	16.5	111	4.1	127
Concⁿ. factor × 10^{-3}	111	45	1	14	146	983	36	1124
Cd in ash, µg/g	50	18	11	12	177	1018	44	346

REF. NO.: 75 - N - 4 SUBSTANCES: Hg

Reference: Nakano, A., I. Wakisaka & Y. Shinkawa. 1975. Mercury concentration in marine fish and shellfish from Shiranuhi Bay. Acta Medica Univ. Kagoshima 17(2):75-83.

Organisms: Tapes (Amygdala) japonica
Meretrix lusoria
Chlamys (Mimachlamys) nobilis

Date of Sample Collection: 1974-75

Location: Shiranuhi Bay, Japan

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 2. Total, inorganic and organic mercury contents and the ratio of organic mercury to total mercury in fishes and shellfishes.

Species	No. of samples	Inorganic mercury (ppm)	Organic mercury (ppm)	Total mercury (ppm)	Ratio of organic mercury to total mercury (%)
Total species	70	0.0163 ± 0.0277 (sd)	0.0839 ± 0.0959 (sd)	0.1002 ± 0.1094 (sd)	80.21 ± 17.72 (sd)
Fishes	49	0.0108 ± 0.0216 (sd)	0.0867 ± 0.0998 (sd)	0.0975 ± 0.1159 (sd)	85.32 ± 12.10 (sd)
Species other than Fishes	21	0.0293 ± 0.0358 (sd)	0.0744 ± 0.0858 (sd)	0.1034 ± 0.0916 (sd)	68.27 ± 30.84 (sd)
Crustacea	6	0.0147	0.1434	0.1580	89.07
Flat fish	2	0.0103	0.2691	0.2794	96.10
Sea eel	1	0.1479	0.4263	0.5742	74.20
Gray mullet	2	0.0095	0.0175	0.0270	62.60
Bivalve (shells)	2	0.0390	0.0134	0.0523	24.45
Spiral shell	3	0.0117	0.0675	0.0791	86.10
Liver of spiral shell	3	0.1010	0.0621	0.1631	38.43
Spawn of sea chestnut	1	0.0466	0	0.0466	0
Octopus	2	0.0052	0.0368	0.0421	85.45
Cuttle fish	2	0.0031	0.0920	0.0936	96.60

REF. NO.: 72 - N - 1

SUBSTANCES: Cd, Pb, Zn

Reference: Nickless, G., R. Stenner & N. Terrill. 1972. Distribution of cadmium, lead and zinc in the Bristol Channel. Mar. Poll. Bull. 3:188-190.

Organisms: Mytilus edulis

Date of Sample Collection: 1971

Location: Bristol Channel

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1
Concentration of zinc (in ppm) in Bristol Channel samples

Collecting point	*Fucus*	*Littorina*	*Patella*	*Nucella*	*Mytilus*
Steepholm		147	375	–	–
Flatholm	355	140	280	4200	–
Sully Island	320	180	220	3050	–
Fontygary Bay	560	140	290	–	250
Sker Head	130	140	170	1800	130
Aberavon	370	210	–		250
Oystermouth	180	130	200	–	200
Mumbles	130	110	250	1200	–
Bracelet Bay	110	97	260	1300	240
Rhossili	–	–	130	330	–
Laugharne	41	–	–	–	–
Pendine	42	100	120	280	62
Amroth	–	83	150	175	82
Saundersfoot	41	80	200	220	90
Tenby	80	75	210	850	70
Lydstep Haven	34	100	120	480	140
Freshwater West	–	60	65	340	150
Dale Roads	32	85	125	660	97
Westdale Bay	42	–	110	530	–

TABLE 2
Concentration of cadmium (in ppm) in Bristol Channel samples

Collecting point	*Fucus*	*Littorina*	*Patella*	*Nucella*	*Mytilus*
Steepholm	–	29	260	–	–
Flatholm	30	58	265	725	–
Sully Island	31	75	500	630	–
Fontygary Bay	40	38	490	–	60
Sker Head	7	24	150	110	15
Aberavon	10	40	–	–	20
Oystermouth	6	24	57	–	20
Mumbles	7	13	100	160	–
Bracelet Bay	10	15	57	130	15
Rhossili	–	–	68	60	–
Laugharne	10	–	–	–	–
Pendine	8	24	26	31	8
Amroth		25	33	32	14
Saundersfoot	10	21	40	40	14
Tenby	14	17	33	155	10
Lydstep Haven	75	15	28	100	20
Freshwater West	–	8	12	50	15
Dale Roads	2	9	9	70	4
Westdale Bay	10	–	34	55	–

TABLE 3
Concentration of lead (in ppm) in Bristol Channel samples

Collecting point	*Fucus*	*Littorina*	*Patella*	*Nucella*	*Mytilus*
Steepholm	–	19	27	–	–
Flatholm	19	17	27	38	–
Sully Island	10	4	14	10	–
Fontygary Bay	10	6	4	–	ND
Sker Head	ND	3	7	13	ND
Aberavon	6	11	–	–	30
Oystermouth	ND	7	3	–	18
Mumbles	7	6	13	5	–
Bracelet Bay	3	2	9	1	3
Rhossili	–	–	15	10	–
Laugharne	12	–	–	–	–
Pendine	ND	14	2	ND	ND
Amroth	–	ND	ND	4	ND
Saundersfoot	ND	ND	ND	ND	ND
Tenby	ND	3	3	7	9
Lydstep Haven	ND	ND	6	ND	ND
Freshwater West	–	–	2	2	3
Dale Roads	5	1	3	ND	1
Westdale Bay	ND	–	4	2	–

ND = Not detectable

REF. NO.: 74 - N - 1

SUBSTANCES: Cd, Pb, Fe, Zn

Reference: Nielsen, S. A. 1974. Vertical concentration gradients of heavy metals in cultured mussels. N.Z. J. Mar. Fresh. Res. 8:631-636.

Organisms: Perna canaliculus

Date of Sample Collection: 1972

Location: Kenepuru Sound and Waiheke Island, New Zealand

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 100°C)

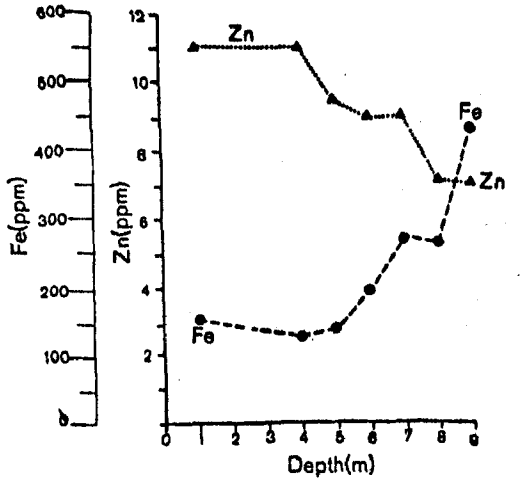


FIG. 1—Zinc and iron concentrations in green-lipped mussels, *Perna canaliculus*, from Kenepuru Sound, September 1972.

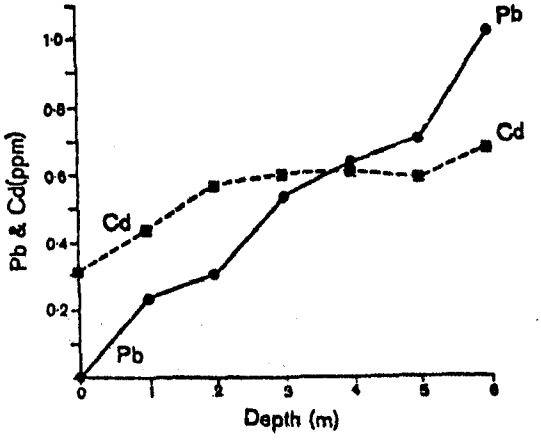


FIG. 2—Lead and cadmium concentrations in green-lipped mussels, *Perna canaliculus*, from Kenepuru Sound, September 1972.

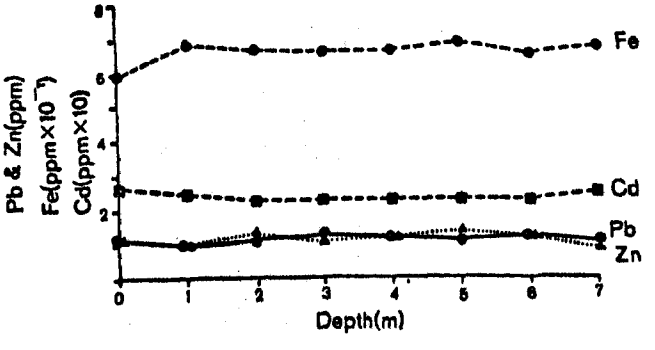


FIG. 3—Iron, cadmium, lead, and zinc concentrations in green-lipped mussels, *Perna canaliculus*, from Waiheke Island, September 1972.

REF. NO.: 75 - N - 2

SUBSTANCES: Cu, Pb, Zn, Cd, Fe, Hg

Reference: Nielsen, S. A. & A. Nathan. 1975. Heavy metal levels in New Zealand molluscs. N. Z. J. Mar. Freshwat. Res. 9:467-481.

Organisms:

Crassostrea glomerata	Pecten novaezelandiae	Paphies subtriangulata
Ostrea lutaria	Paphies ventricosa	Anomia walteri
Perna canaliculus	Aulacomya maoriana	Chione stutchburyi
Mytilus edulis	Paphies australis	Modiolus neozelanicus

Date of Sample Collection: 1972-73

Location: New Zealand

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

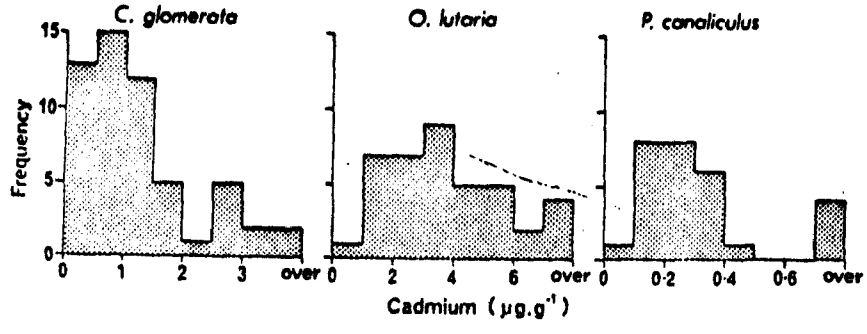


FIG. 4—Cadmium concentrations ($\mu g.g^{-1}$, wet weight) against frequency of occurrence in all samples of rock oysters *Crassostrea glomerata*, dredge oysters *Ostrea lutaria*, and green-lipped mussels *Perna canaliculus*.

CADMIUM

The average for each species examined was:

SPECIES	Av. Cd, $\mu g.g^{-1}$	RANGE
Crassostrea glomerata	1.3	0.12–5.0
Ostrea lutaria	3.9	0.12–7.9
Perna canaliculus	0.30	0.10–1.0
Mytilus edulis	0.63	0.26–1.6
Pecten novaezelandiae	0.18	0.14–0.28
Stomach	137	15–329
Gonad	1.5	0.59–2.4
Adductor muscle	0.51	0.20–0.82
Haliotis iris	0.17	0.09–0.24
Paphies ventricosa	0.11	0.07–0.17
Paphies australis	0.13	0.12–0.14
Paphies subtriangulata	0.29	0.29–0.34
Aulacomya maoriana	0.94	0.16–2.40
Anomia walteri	2.00	–
Chione stutchburyi	0.19	–
Modiolus neozelanicus	0.04	–

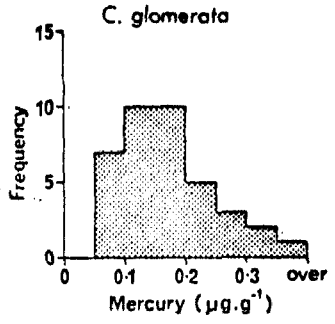


FIG. 6—Mercury concentrations ($\mu g.g^{-1}$, wet weight) against frequency of occurrence in all samples of rock oysters *Crassostrea glomerata*.

MERCURY

Average mercury levels were generally quite low (much less than 0.50 $\mu g.g^{-1}$) in all six species examined. At 0.23 $\mu g.g^{-1}$, *Mytilus edulis* had the highest average level. The averages for *Crassostrea glomerata* and *Ostrea lutaria* were 0.18 $\mu g.g^{-1}$ and 0.19 $\mu g.g^{-1}$. In *Haliotis iris*, *Perna canaliculus*, and *Pecten novaezelandiae* the averages were 0.10, 0.09, and 0.05 $\mu g.g^{-1}$ respectively.

Figure 6, the histogram for mercury in *C. glomerata*, shows the distribution of mercury to be quite regular, with the greatest frequency between 0.1 and 0.2 $\mu g.g^{-1}$.

ZINC

The average for each species was:

SPECIES	Av. Zn, $\mu g.g^{-1}$	RANGE
Crassostrea glomerata	337	97–900
Ostrea lutaria	66	19–246
Perna canaliculus	21	0.5–28.0
Mytilus edulis	14	3.8–26.0
Pecten novaezelandiae	20.8	18–31
Stomach	24	0.8–35.0
Gonad	27	–
Adductor muscle	16	–
Haliotis iris	13.5	12.9–15.3
Paphies ventricosa	9.8	6.9–15.0
Paphies australis	13	–
Paphies subtriangulata	7.0	–
Aulacomya maoriana	8.1	3.2–11.0
Anomia walteri	19	–
Chione stutchburyi	10	–

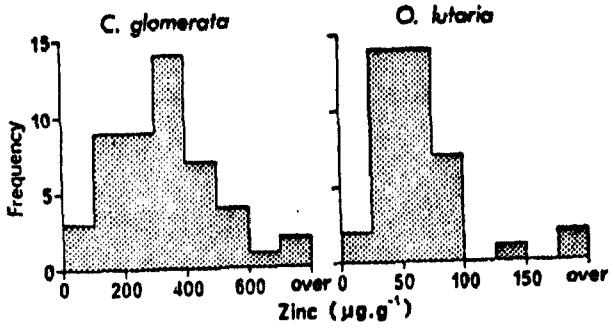


FIG. 7—Zinc concentrations ($\mu g.g^{-1}$, wet weight) against frequency of occurrence in all samples of rock oysters, *Crassostrea glomerata* and dredge oysters *Ostrea lutaria*.

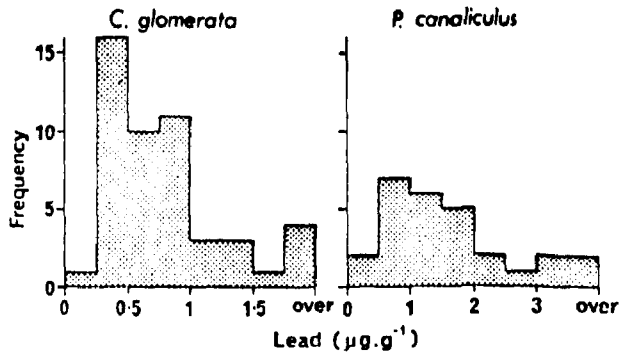


FIG. 5—Lead concentrations ($\mu g.g^{-1}$, wet weight) against frequency of occurrence in all samples of rock oysters *Crassostrea glomerata* and green-lipped mussels *Perna canaliculus*.

LEAD

The average lead levels for all species examined were:

SPECIES	Av. Pb, $\mu g.g^{-1}$	RANGE
Crassostrea glomerata	0.90	0.2–21.0
Ostrea lutaria	0.69	0.1–2.2
Perna canaliculus	1.8	0.1–7.8
Mytilus edulis	0.67	0.1–2.0
Pecten novaezelandiae	1.14	0.4–3.5
Stomach	1.2	0.4–4.0
Gonad	0.25	0.1–0.4
Adductor muscle	0.45	0.2–0.7
Haliotis iris	0.50	0.40–0.65
Paphies ventricosa	0.76	0.5–1.0
Paphies australis	0.4	–
Paphies subtriangulata	0.65	0.4–0.9
Aulacomya maoriana	0.52	0.2–0.8
Anomia walteri	0.4	–
Chione stutchburyi	1.8	–

COPPER

With the exception of *Crassostrea glomerata*, copper levels were relatively low in the species examined. The averages are:

SPECIES	Av. Cu, $\mu g.g^{-1}$	RANGE
Crassostrea glomerata	40.0	4.4–380.0
Ostrea lutaria	11.0	1.0–41.0
Perna canaliculus	1.8	0.2–28.0
Mytilus edulis	8.3	1.7–18.0
Pecten novaezelandiae	1.46	0.9–2.5
Stomach	10.0	2.5–40.0
Gonad	2.1	–
Adductor muscle	6.6	6.5–6.7
Paphies ventricosa	1.7	1.1–2.9
Paphies australis	1.0	0.7–1.3
Paphies subtriangulata	5.1	1.4–8.7
Aulacomya maoriana	9.0	3.3–19.0
Anomia walteri	14.0	–

Nielsen, S. A. & A. Nathan. 1975.

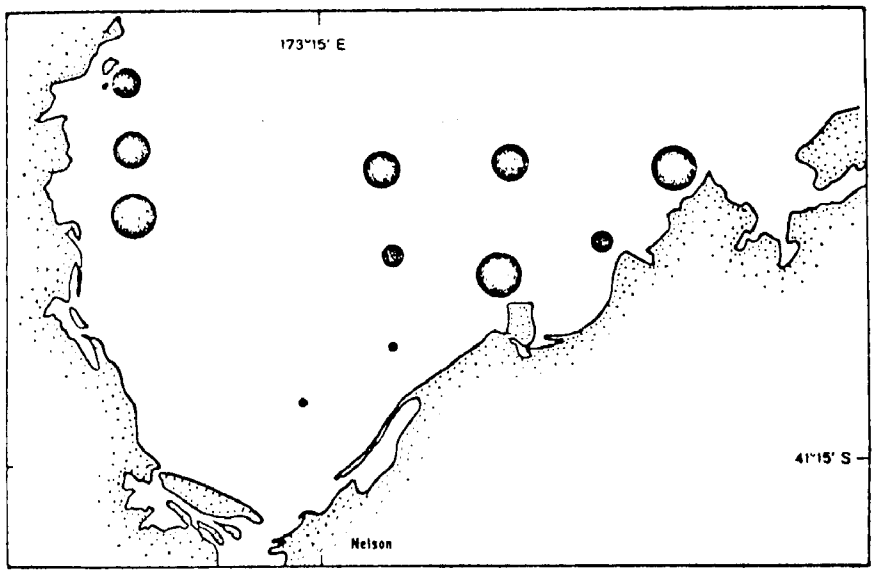


FIG. 3—Cadmium concentrations in the stomachs of scallops *Pecten novaezelandiae* from Tasman Bay, July 1973. The diameters of the circles are proportional to the concentration of cadmium; the largest circles represent 329 $\mu g.g^{-1}$, wet weight. Populated areas shaded.

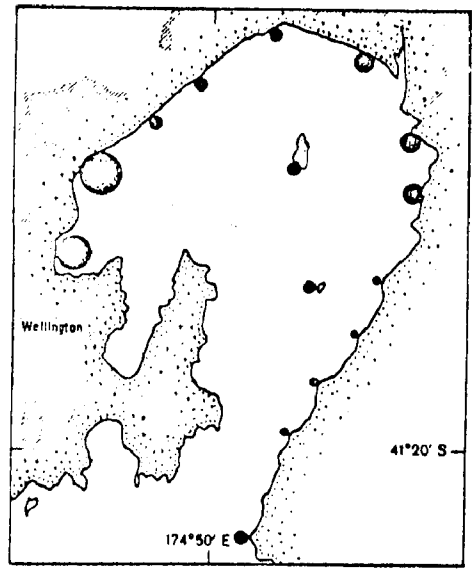


FIG. 2—Lead concentrations in green-lipped mussels *Perna canaliculus* from Wellington, January 1972. The diameters of the circles are proportional to the concentration of lead; the largest circle represents 7.8 $\mu g.g^{-1}$, wet weight. Populated areas shaded.

Nielsen, S. A. & A. Nathan. 1975.

APPENDIX—Sampling localities and concentrations of heavy metals ($\mu g.g^{-1}$, wet weight) in 13 species of New Zealand molluscs; in each sample, 14 or more average-sized specimens were analysed whole unless otherwise stated (– = not analysed; * = gonad only, Sample 150, † = stomach only, Samples 151, 153, 159–177; ‡ = adductor muscle only, Sample 152; § = foot only, Sample 192).

Sample No.	Location	Sampling Site	Cd	Pb	Hg	Zn	Cu	Fe
Rock oyster *Crassostrea glomerata*								
1	Whangaroa	Whangaroa wharf	5.3	3.5	0.12	350	34	33
2		Whangaroa Heads	0.90	0.8	0.18	458	33	50
3		Cable Bay river mouth	3.0	0.9	0.08	255	20	90
4		West Cavalli Islands	5.0	0.9	0.08	150	6.3	35
5	Bay of Islands	Kawakawa River mouth	0.68	0.7	—	450	16	—
6		Russell wharf	1.5	0.5	0.25	345	62	25
7		Waitangi	2.0	1.2	0.28	63	—	25
8		Waitanai River mouth	1.4	0.2	—	200	34	16
9		Wairoa Bay, 0 m culture	0.55	0.7	—	500	13	45
10		Wairoa Bay, 0.3 m culture	—	—	0.29	—	—	—
11		Wairoa Bay, 0.6 m culture	0.75	1.5	—	77	—	24
12		Wairoa Bay reef, central	—	—	0.23	—	—	—
13		Wairoa Bay reef, eastern	0.91	1.2	0.22	47	—	16
14		Wairoa Bay reef, western	1.2	0.3	0.36	200	4.8	25
15		Brampton Shoals	1.0	1.3	0.11	550	11	50
16		Opito Bay	—	—	0.27	—	—	—
17	Whangarei	Whangarei Heads	0.56	—	—	—	30	24
18		Whangarei Harbour	0.38	—	0.16	—	9.5	14
19	Kaipara	Kellys Bay	0.46	—	—	—	22	35
20		Tinopai	0.50	—	0.14	—	74	18
21		Ruawai	0.21	—	0.16	—	12	29
22	Great Barrier	Shoal Bay	1.5	0.6	0.14	350	40	63
23		Whangaparapara whale sta	0.71	0.6	—	313	20	17
24		Tryphena town	1.9	0.5	—	275	9.2	71
25		Tryphena wharf	2.2	1.0	—	312	24	17
26		Arid Island	3.0	0.5	—	350	22	18
27		Blind Cove stream	1.8	0.3	—	238	21	27
28		Needle Cove	3.0	0.6	0.13	213	25	27
29		Port Fitzroy	2.7	0.5	0.23	450	33	46
30		Whangaparapara wood mill	1.4	0.4	—	350	29	63
31		Harataonga Bay	3.8	3.1	—	289	32	36
32		Blind Cove, central	2.7	1.6	—	200	11	18
33		Miners Head	*3.4	1.4	—	—	—	33
34	Mahurangi	Jacksons Bay oyster farm	0.42	—	0.16	—	22	40
35		Jacksons Bay	0.91	1.0	—	175	28	65
36		Goatspit	0.44	—	—	—	18	34
37		Martin Bay	0.42	—	0.46	—	10	20
38	Kawau Island	Copper Mine	1.1	0.7	—	130	390	25
39		20 m E of copper mine	1.7	0.8	0.12	180	385	29
40		40 m E of copper mine	1.5	0.5	0.14	232	165	35
41	Auckland	Browns Island	0.60	0.4	0.11	550	45	11
42		Hauraki Channel [illegible]	0.45	0.5	—	425	[illegible]	18
43		Naval pier, Devonport	0.68	0.7	0.15	[illegible]	52	29
44		Devonport ferry wharf	0.42	0.9	0.11	550	40	17
45		Hobson Wharf	0.72	0.8	0.38	900	100	36
46		Motuihe Island pier	0.89	0.7	—	475	58	35

APPENDIX—*continued*

Sample No.	Location	Sampling Site	Cd	Pb	Hg	Zn	Cu	Fe
Rock oyster *Crassostrea glomerata* (continued)								
47	Waiheke Island	Rocky Bay	0.77	0.4	—	315	21	8.9
48		Awaawaroa Point	1.1	0.4	—	525	23	20
49		Putiki Point	0.98	0.5	—	275	28	27
50		Matiatia Bay	1.2	0.7	—	650	28	16
51	Ponui Island	North Bay	1.3	0.4	—	350	25	24
52		Kauri Point	1.0	0.7	—	275	15	14
53		Scullys Reef	1.6	0.5	—	475	20	20
54		Second Bay	1.1	0.4	—	350	4.4	18
55	Coromandel	Coromandel oyster farm	0.44	1.2	0.09	320	30	43
56		Tapu	0.12	0.8	—	145	10	5.0
57		Te Kouma	1.2	0.7	—	210	28	33
58	Bay of Plenty	Ohiwa oyster farm	0.90	0.9	0.10	530	21	58
59		Ohiwa Harbour pier	0.44	4.7	0.06	193	21	70
60		Omokoroa Heads	0.50	0.8	—	500	14	68
61		Omokoroa sewer outfall	0.48	21	0.09	425	24	58
62	Raglan	Raglan Harbour	—	—	0.26	—	—	—
Dredge oyster *Ostrea lutaria*								
63	Wellington	Evans Bay	0.12	1.4	—	—	41	45
64	Marlborough Sounds	Ships Cove pier	—	—	0.66	—	—	—
65		Kenepuru Sound	1.3	2.2	—	210	—	122
66	Golden Bay	No details	1.4	0.4	—	99	10	36
67	Tasman Bay	41° 11.3'S, 173° 13.7'E	2.9	1.0	—	19	4.8	29
68		41° 2.4'S, 173° 5.2'E	3.3	1.2	—	40	4.7	104
69		41° 9.0'S, 173° 10.7'E	2.1	0.8	—	35	3.6	77
70		41° 2.4'S, 173° 8.1'E	1.9	1.1	—	39	4.3	72
71		40° 45.0'S, 172° 58.1'E	3.5	0.5	—	51	4.3	49
72		40° 48.2'S, 173° 3.0'E	5.4	1.3	—	48	2.9	89
73		41° 6.2'S, 173° 18.0'E	3.8	0.9	—	44	3.9	66
74		41° 5.6'S, 173° 16.6'E	2.8	1.0	—	47	3.1	56
75		40° 53.3'S, 173° 6.0'E	3.6	0.5	—	55	3.2	73
76		40° 45.0'S, 172° 56.3'E	4.0	1.1	—	57	3.9	55
77		41° 4.0'S, 173° 24.5'E	5.9	0.9	0.06	55	2.7	73
78		40° 59.8'S, 173° 4.1'E	3.0	1.1	—	34	2.6	106
79		41° 2.5'S, 173° 34.0'E	4.4	0.4	—	37	3.5	62
80		41° 7.0'S, 173° 23.7'E	4.7	1.2	—	39	2.0	104
81	Foveaux Strait	46° 34.5'S, 168° 5.6'E	6.8	0.2	—	75	11	25
82		46° 47.0'S, 169° 4.8'E	4.3	0.3	—	37	13	35
83		46° 41.8'S, 169° 25.4'E	3.7	0.4	—	5[illegible]	1.0	16
84		46° 48.0'S, 168° 11.7'E	5.2	0.3	—	40	17	18
85		46° 34.5'S, 167° 54.6'E	7.5	0.2	0.08	65	22	25
86		46° 38.7'S, 168° 16.6'E	3.0	0.1	—	54	7.3	18
87		46° 41.9'S, 168° 31.3'E	4.4	0.2	0.07	58	9.4	25
88		46° 44.4'S, 168° 23.9'E	4.0	—	—	41	11	25
89		46° 44.0'S, 166° 12.4'E	3.4	0.4	0.10	24	17	4.2
90		46° 42.3'S, 167° 59.4'E	4.5	0.7	—	36	29	15
91		46° 31.4'S, 167° 55.2'E	6.4	0.4	—	63	24	39
92		46° 38.5'S, 167° 54.0'E	7.9	0.9	—	61	12	73
93		46° 42.3'S, 168° 26.2'E	5.9	0.9	—	10[illegible]	[illegible]	70

APPENDIX—*continued*

Sample No.	Location	Sample Site	Cd	Pb	Hg	Zn	Cu	Fe
Dredge oyster *Ostrea lutaria* (continued)								
94	Foveaux Strait	46° 48.5'S, 168° 18.7'E	5.8	0.8	—	57	4.5	99
95		46° 45.7'S, 169° 15.2'E	7.3	1.0	—	22	10	143
96	Stewart Island	Port Adventure, Oyster Cove	1.8	0.1	—	76	2.0	17
97		Port Adventure North Arm	1.4	1.0	—	68	4.8	150
98		Shipbuilders Cove	3.7	0.3	—	90	9.4	25
99		Port Pegasus, North Arm	1.7	0.2	—	77	17	45
100		Port Pegasus, Islet Cove	2.2	0.6	—	69	13	26
101		Paterson Inlet	1.7	0.6	—	246	30	44
102		Lords River	2.2	0.6	—	127	13	36
103		Black Rock Point	7.1	1.1	—	89	22	36
104		Bravo Island Bay	5.2	0.1	—	54	13	27
Green-lipped mussel *Perna canaliculus*								
105	Bay of Islands	Kawakawa River mouth	0.22	0.1	—	—	28	—
106		Russell	0.31	1.3	—	20	1.9	36
107	Kaipara	Ruawai	0.20	0.6	—	6.0	5.0	26
108	Auckland	Mariwai Beach	—	—	—	7.0	—	280
109	Waiheke Island	Matiatia Bay	0.20	0.7	—	33	1.8	57
110		Cultured mussels	0.27	1.2	—	1.2	1.6	60
111	Coromandel	Cultured mussels	0.22	0.9	0.10	15	1.9	208
112	East Cape	Tolaga Bay	0.10	0.9	—	11	2.0	55
113	Wellington Harbour	Somes Island, north	0.14	2.0	—	21	—	65
114		Somes Island, south	0.15	1.6	—	16	—	65
115		Ward Island, north	0.15	1.9	—	17	—	54
116		Ward Island, south	0.16	1.7	—	8.8	—	49
117		Duncarrow Head	0.15	2.4	—	—	0.8	—
118		Winds Point	1.0	1.5	0.12	72	1.7	—
119		Point Arthur	0.24	1.6	—	26	1.0	—
120		Mahina Bay	0.24	3.1	—	46	1.2	—
121		Point Howard	0.26	5.0	0.09	36	0.9	—
122		Potoma Beach	0.16	3.1	—	34	1.7	—
123		Ngauranga Stream mouth	0.24	2.1	0.14	40	1.7	—
124		Kaiwharawhara Stream mouth	0.86	7.8	—	76	0.5	—
125		Inter Island Ferry Wharf	0.16	6.4	—	39	1.0	—
126	Marlborough Sounds	Cultured mussels	—	—	0.09	12	—	122
127		Pirl Rock	—	—	0.04	—	—	—
128		Nikau Bay wharf	—	—	0.19	—	—	—
129	Golden Bay	No details	0.74	0.7	—	9.3	7.0	89
130	Tasman Bay	41° 6.7'S, 173° 18.0'E	0.30	0.7	—	7.6	0.4	6[illegible]
131		41° 2.4'S, 173° 5.2'E	0.40	0.7	—	7.8	1.2	9[illegible]
132		41° 11.9'S, 173° 13.7'E	0.22	0.7	—	5.0	1.2	4[illegible]
133		41° 9.0'S, 173° 10.7'E	0.36	0.2	—	4.6	0.4	4[illegible]
134		41° 7.0'S, 173° 25.7'E	0.31	1.3	—	—	0.2	9[illegible]
135		41° 2.4'S, 173° 5.2'E	0.31	1.3	—	[illegible]	0.3	1[illegible]
136		41° 11.3'S, 173° 13.7'E	0.35	0.5	—	[illegible]	1.4	[illegible]
137		41° 9.7'S, 173° 18.3'E	0.29	0.7	—	7.9	0.4	6[illegible]
138		41° 4.0'S, 173° 24.5'E	0.42	1.3	0.06	1[illegible]	0.4	51
Blue mussel *Mytilus edulis*								
139	Bay of Islands	Waitangi River mouth	0.41	0.4	—	19	18	4[illegible]

APPENDIX—*continued*

Sample No.	Location	Sampling Site	Cd	Pb	Hg	Zn	Cu	Fe
Blue mussel *Mytilus edulis* (continued)								
140	Wellington Harbour	Somes Island	0.26	2.0	—	26	—	33
141	Marlborough Sounds	Bird Rocks	—	—	0.02	—	—	—
142		Maude Island pier	—	—	0.25	—	—	—
143		Ships Cove	—	—	0.45	—	—	—
144		Scenic Reserve pier	—	—	0.05	—	—	—
145	Stewart Island	Shipbuilders Cove	0.99	0.1	—	8.7	17	18
146		Paterson Inlet	0.60	1.2	—	22	8.7	27
147		Bravo Island Bay	1.6	0.4	—	11	2.0	16
148	*Fiordland*	Preservation Inlet	0.36	0.2	—	6.5	2.5	8.3
149		Chalky Inlet	0.30	0.4	0.35	3.8	1.7	11
Scallop *Pecten novaezelandiae*								
150*	Golden Bay	No details	0.59	0.1	—	32	—	—
151†		"	21	0.7	—	35	9.1	117
152†		"	0.20	0.2	—	18	6.7	9.1
153†		40° 39.9'S, 172° 46.7'E	15	1.2	—	25	4.9	229
154	Tasman Bay	No details	0.19	0.4	0.03	18	1.2	15
155		"	0.14	0.6	0.06	18	1.1	12
156		"	0.28	3.5	0.06	31	2.5	19
157		"	0.05	0.6	0.06	18	0.9	11
158		"	0.14	0.6	0.06	19	1.6	14.7
159†		40° 45.0'S, 172° 56.3'E	126	1.5	—	18	6.2	235
160†		41° 6.7'S, 173° 18.0'E	99	1.0	—	28	7.7	255
161†		41° 3.6'S, 173° 16.6'E	200	1.2	—	25	5.9	26
162†		41° 9.7'S, 173° 18.5'E	25	1.3	—	19	2.5	698
163†		41° 4.0'S, 173° 24.5'E	224	1.0	—	33	8.4	259
164†		41° 6.5'S, 173° 8.6'E	329	1.2	0.03	31	8.5	428
165†		40° 59.8'S, 173° 4.1'E	156	1.1	—	20	6.1	260
166†		41° 2.5'S, 173° 34.0'E	260	1.3	—	30	8.3	291
167†		41° 7.0'S, 173° 23.7'E	257	1.2	—	30	8.7	289
168†		41° 9.7'S, 173° 30.0'E	122	0.9	—	20	7.6	222
169†		40° 48.2'S, 173° 3.0'E	244	1.2	0.06	30	7.5	295
170†		41° 2.4'S, 173° 5.2'E	217	1.0	—	29	5.0	211
171†	Admiralty Bay	No details	165	1.1	—	25	6.7	209
172†	Stewart Island	Shipbuilders Cove	111	0.5	—	6.7	17	107
173†		Bravo Island Bay	80	0.5	—	8.6	17	149
174†		Paterson Inlet	45	4.0	—	24	40	164
175†	Fiordland	Preservation Inlet	79	0.4	—	23	9.8	81
176†		Chalky Inlet	63	1.3	—	0.8	18	151
177†		Isthmus Sound (Pres. Inlet)	70	0.4	—	50	8.4	60
Toheroa *Paphies ventricosa*								
178	Orati Beach	New River mouth	0.14	0.8	—	15	2.9	80
179		3 km W of New River	0.08	0.8	—	8.0	2.4	72
180		6 km W of New River	0.13	1.0	—	12	2.1	87
181		9 km W of New River	0.12	0.8	—	8.9	1.2	64
182		12 km W of New River	0.09	0.8	—	9.1	1.1	70
183	Te Wae Wae Bay	Waiau River mouth	0.07	0.5	—	6.9	1.5	116
184		2 km E of Waiau River	0.17	0.6	—	9.8	1.4	81
185		1 km E of Waiau River	0.12	0.8	—	8.9	1.2	64

APPENDIX—*continued*

Sample No.	Location	Sampling Site	Cd	Pb	Hg	Zn	Cu	Fe
Ridged mussel *Aulacomya maoriana*								
186	Stewart Island	Paterson Inlet	0.90	0.8	—	11	5.0	25
187		Lords River	0.84	0.5	—	10	3.3	34
188		Bravo Island Bay	2.4	0.3	—	10	19	33
189	Fiordland	Chalky Inlet	0.44	0.2	—	6.3	8.7	18
190		Preservation Inlet	0.16	0.8	—	3.2	—	16
Paua or abalone *Haliotis iris*								
191	Marlborough Sounds	Bird Rocks	—	—	0.07	—	—	—
192§		Bird Rocks	—	—	0.13	—	—	—
193	Wellington	Oteranga Bay	0.24	0.5	—	15.3	8.1	46
194		Oteranga Bay	0.09	0.4	—	12.9	2.5	32
195		Oteranga Bay	0.14	0.4	—	13.6	4.2	35
196		Oteranga Bay	0.19	0.6	—	13.2	6.2	36
Pipi *Paphies australis*								
197	Kaipara	Kellys Bay	0.14	—	—	—	1.3	24
198	Tauranga	Papamoa Beach	0.12	0.4	—	13	0.7	21
Tuatua *Paphies subtriangulata*								
199	Tauranga	Papamoa Beach	0.34	0.9	—	7.2	1.4	43
200	Stewart Island	Port Pegasus	0.24	0.4	—	6.7	8.7	18
Saddle oyster *Anomia walteri*								
201	Fiordland	Preservation Inlet	2.0	0.4	—	19	14	41
Cockle *Chione stutchburyi*								
202	Bay of Islands	Waiross Bay	0.19	1.8	—	10	—	31
Black mussel *Modiolus neozelanicus*								
203	Kaipara	Ruawai	0.04	—	—	—	2.6	144

REF. NO.: 75 - N - 3 SUBSTANCES: Cd

Reference: Nielsen, S. A. 1975. Cadmium in New Zealand dredge oysters: geographic distribution. Intern. J. Environ. Anal. Chem. 4:1-7.

Organisms:
Ostrea lutaria
Crassostrea glomerata
Ostrea edulis
Crassostrea virginica

Date of Sample Collection: 1975?

Location: Foveaux Strait, New Zealand plus composite of data from other locales, other sources, including unpublished data by author

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE I
Cd content of various oyster species

Country and species		Locality[a]	ppm Cd wet weight[b]
New Zealand			
	Ostrea lutaria	Wellington (2)	0.12 (8)
		Marlborough Sounds (2)	1.3 (12)
		Golden Bay (2)	1.42 (12)
		Tasman Bay (1)	approx. 6 (6)
		Foveaux Strait (this study)	5.75 (360)
	Crassostrea glomerata	Bay of Islands (2)	0.65 (40)
		Auckland (2)	0.75 (118)
		Bay of Plenty (2)	0.55 (60)
United Kingdom			
	Ostrea edulis	England and Wales (3)	1.2 (49)
United States			
	Crassostrea virginica	East coast (4)	2.40 (30)
		Florida (5)	0.2 (3)

[a] Literature reference indicated in parentheses.
[b] Number of samples indicated in parentheses.

Nielsen, S. A. 1975.

TABLE II

Cadmium in *Ostrea lutaria* from Foveaux Strait and Stewart Island

Station	Location	ppm Cd wet weight	ppm Cd dry weight (105°C)
1	46° 31.4′ S, 167° 55.2′ E	6.43	35.7
2	46° 34.0′ S, 167° 54.0′ E	7.54	49.6
3	46° 37.4′ S, 167° 49.4′ E	7.10	44.0
4	46° 38.5′ S, 167° 54.0′ E	7.90	48.2
5	46° 34.5′ S, 168° 05.6′ E	6.82	39.0
6	46° 38.0′ S, 168° 03.2′ E	7.15	34.0
7	46° 42.0′ S, 167° 59.4′ E	4.30	27.4
8	46° 47.0′ S, 168° 04.8′ E	4.33	25.2
9	46° 40.0′ S, 168° 09.3′ E	4.49	29.2
10	46° 44.1′ S, 168° 12.1′ E	3.42	22.4
11	46° 48.0′ S, 168° 11.7′ E	5.24	32.4
12	46° 38.7′ S, 168° 16.6′ E	2.99	17.4
13	46° 41.8′ S, 168° 25.4′ E	3.65	19.4
14	46° 44.4′ S, 168° 23.8′ E	4.04	21.1
15	46° 41.9′ S, 168° 31.3′ E	4.40	27.6
16	Kaipipi Bay, Paterson Inlet	1.72	9.2
17	South West Bay, Paterson Inlet	5.15	31.4
18	White Beach, Port Adventure	2.79	14.9
19	Oyster Cove, Port Adventure	1.76	8.7
20	North Arm, Port Adventure	1.40	14.0
21	Lord's River	2.20	12.8
22	Shipbuilder's Cove, Port Pegasus	3.68	22.8
23	North Arm, Port Pegasus	1.68	10.7
24	Islet Cove, Port Pegasus	2.17	12.2

REF. NO.: 74 - P - 2 **SUBSTANCES:** Cu, Fe, Mn, Zn

Reference: Pascual, E. & R. Establier. 1974. Variaciones del contenido en cobre, hierro, manganeso y cinc en relación con la maduración sexual del ostión, Crassostrea angulata de las costas de Cádiz. Inv. Pesq. 38:387-395.

Organisms: Crassostrea angulata

Date of Sample Collection: 1974?

Location: Cádiz, Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLA I

Contenido en cobre, hierro, manganeso y cinc en ostiones, por sexos separados y en varios estadios de madurez sexual. Las concentraciones de los cuatro cationes están expresadas en mg/100 grs. de peso de la carne

	Estadio 1		*Estadio 3*		*Estadio 4*	
	M.	*H.*	*M.*	*H.*	*M.*	*H.*
COBRE						
P. fresco	13,89	15,21	22,08	19,72	16,84	20,04
P. seco	101,61	107,03	103,26	96,14	103,89	128,38
HIERRO						
P. fresco	5,52	5,90	5,46	5,17	7,86	7,61
P. seco	40,38	41,52	25,52	26,61	48,49	48,75
MANGANESO						
P. fresco	0,97	0,79	0,60	1,24	0,61	1,01
P. seco	7,10	5,56	2,80	6,10	3,76	6,47
CINC						
P. fresco	65,23	69,10	89,42	90,47	72,05	82,77
P. seco	477,18	486,28	420,17	442,47	444,47	430,23

TABLA II

Contenido en cobre, hierro, manganeso y cinc en ovarios y testículos de ostiones. Cantidades expresadas en mg/100 grs. de peso

		Cu	*Fe*	*Mn*	*Zn*
Ovarios					
	P. fresco	3,81	3,85	3,18	21,22
	P. seco	14,59	14,75	12,17	81,27
Ovarios					
	P fresco	1,84	3,02	2,55	9,32
	P. seco	6,34	15,87	8,77	32,10
Testículos					
	P. fresco	1,93	3,51	0,15	11,70
	P. seco	7,94	14,44	0,47	48,15

TABLA III

Resultado de los análisis de manganeso en el cuerpo total de ostiones según sexo y estadio de maduración sexual

MACHOS			*HEMBRAS*		
Humedad %	*Manganeso mg/100 g.*		*Humedad %*	*Manganeso mg/100 g.*	
	P. húmedo	*P. seco*		*P. húmedo*	*P. seco*
		ESTADIO 1			
86,33	0,97	7,10	85,79	0,79	5,56
85,27	0,92	6,25	87,60	0,45	3,62
85,84	0,74	5,23	86,60	0,78	5,82
			87,44	0,38	3,03
		ESTADIO 2			
83,50	0,38	2,30	82,63	0,71	4,08
80,20	0,65	3,28	81,04	0,83	4,38
81,57	0,71	3,85	82,89	0,69	4,03
			81,72	0,70	3,82
		ESTADIO 3			
79,83	0,54	2,68	79,28	1,22	5,89
77,36	0,66	2,92	74,83	1,51	6,00
83,58	0,58	3,53	83,70	1,00	6,13
81,47	0,40	2,16	81,24	1,11	5,92
76,51	0,43	1,83	79,52	1,16	5,66
79,35	0,40	1,94	73,07	1,40	5,20
			84,25	0,80	5,08
		ESTADIO 4			
83,79	0,61	3,76	84,39	1,01	6,47
86,28	0,49	3,57	87,14	0,90	7,00
81,16	0,65	3,45	86,42	0,68	5,00
85,81	0,49	3,45	84,31	0,88	5,62
			84,56	0,71	4,59
			82,33	0,61	3,45

REF. NO.: 69 - P - 1 SUBSTANCES: Zn

Reference: Pequegnat, J. E., S. W. Fowler & L. F. Small. 1969. Estimates of the zinc requirements of marine organisms. J. Fish. Res. Bd. Can. 26:145-150.

Organisms: Crassostrea virginica
Mytilus edulis

Date of Sample Collection:

Location: Data from various locales, other literature

Analytical Technique: Emission spectroscopy, polarography, wet chemistry

Analytical Data:

TABLE 1. Measured concentrations of zinc in marine plants and animals.

Organism	ppm Zn (*wet wt*)	Method[a]	Reference
Mollusca			
Bathydoris sp.	158	AAS	"
Crassostrea virginica	2040[d]	ES	Alexander and Rowland (1966)
Crassostrea virginica	1330[b]	WC	Chipman et al. (1958)
Mytilus edulis	81[e]	P	Macchi (1965)

[a]WC, wet chemistry; NA, neutron activation analysis; AAS, atomic absorption spectrometry; ES, emission spectroscopy; P, polarography.
[b]Average of several determinations.
[c]Unpublished data.
[d]Assuming a dry-to-live-weight ratio of 0.2.
[e]Assuming an ash-to-live-weight ratio of 0.03.

REF. NO.: 74 - P - 3

SUBSTANCES: Zn, Cu, Mn, Fe, Pb, Cd, Cr, Ni, Co

Reference: Perkins, E. J. 1974. The biology of estuaries and coastal waters. Academic Press, London & New York.

Organisms:
Crassostrea virginica
Mya arenaria
Mercenaria mercenaria
Crassostrea gigas

Date of Sample Collection: ? (data from other literature)

Location: East and west coast U. S.

Analytical Technique: ?

Analytical Data:

Table 16.10. The concentrations of trace metals in shellfish in parts per million of wet weight (after Pringle *et al.*[840])

		East Coast, U.S.					
	West Coast, U.S.	*Crassostrea virginica*		*Mya arenaria*		*Mercenaria mercenaria*	
Element	*Crassostrea gigas*	Range	Mean	Range	Mean	Range	Mean
Zinc	86–344	180–4120	1428	9·0–28	17	11·50–40·20	20·6
Copper	7·80–37·50	7·0–517	91·50	1·20–90	5·80	1·0–16·50	2·6
Manganese	0·90–16	0·14–15·0	4·30	0·10–29·90	6·70	0·7–29·70	5·8
Iron	15·30–91·40	31–238	67·00	49·70–1710	405	9·0–83·0	30
Lead	0·10–4·50	0·10–2·30	0·47	0·10–10·20	0·70	0·10–7·50	0·52
Chromium	0·10–0·30	0·04–3·40	0·10	0·10–5·0	0·10	0·19–5·80	0·20
Nickel	0·10–0·20	0·08–1·80	0·19	0·10–2·30	0·27	0·10–2·40	0·24
Cobalt	0·10–0·20	0·06–0·20	0·40	0·10–0·20	0·52	0·10–0·20	0·31
Cadmium	0·20–2·10	0·10–7·80	3·10	0·10–0·90	0·27	0·10–0·73	0·19

REF. NO.: 75 - P - 2 SUBSTANCES: As

Reference: Penrose, W. R., R. Black & M. J. Hayward. Limited arsenic dispersion in sea water, sediments, and biota near a continuous source. J. Fish. Res. Bd. Can. 32:1275-1281.

Organisms: Mytilus edulis

Date of Sample Collection: 1975?

Location: Moreton's Harbour, Newfoundland

Analytical Technique:

Analytical Data:

TABLE 6. Arsenic concentrations in organisms found in Moreton's Harbour.

Organism and location	As concn (*ppm* ± SD)	*t*-test
Mytilus edulis (except shell)		
Station 1	5.3 ± 5.4 (n = 8)	
Station 10	1.6 ± 0.9 (n = 13)	$t = 1.89$, n.s.[a]
Control sites[b]	1.6 ± 0.5 (n = 4)	

[a]n.s. = not significant; n.a. = *t*-test not applicable.
[b]Control sites are either Whale's Gulch (5 km distant) or Middle Cove (300 km distant).

REF. NO.: 71 - P - 1

SUBSTANCES: Cu, Mn, Fe, Al, Zn, Ag, V, Ti, Ba, Sr, Cr, Li, Cd, Zr

Reference: Petkevich, T. A. & I. A. Stepanyuk. 1971. The seasonal variability of the chemical composition of Black Sea mussels. Biologiia Morya, Kiev, 22:77-85.

Organisms: mussels (unspecified)

Date of Sample Collection: 1971?

Location: ? (article in Russian)

Analytical Technique: ?

Analytical Data:

Petkevich, T. A. & I. A. Stepanyuk. 1971.

Содержание микроэлементов у черноморских мидий (в % на воду)

Элемент	1963 г.						
	I.VII	I4.VII	23.VII	3I.VII	22.VIII	23.VIII	I2.IX
Cu	0,0048	0,0080	0,0200	0,0080	0,0060	0,0047	0,0095
Mn	0,0063	0,0700	0,0390	0,0370	0,0040	0,0034	0,0209
Fe	3,50	5,00	4,57	5,00	I,50	I,55	6,45
Al	0,50	I,I5	0,20	0,04	0,007I	0,I3	0,40
Zn	0,03	0,03	0,02	0,02	0,0I	0,02	0,02
Ag	-	-	-	-	-	-	-
Ni	0,0050	0,0048	0,0046	0,0046	0,0072	0,0I07	0,I000
V	0,00I4	0,00I4	0,00I3	0,00I3	<0,00I0	0,00I3	0,00I4
Ti	0,0050	0,0I70	0,0040	0,0024	0,00I4	0,0020	0,0020
Ba	0,0400	0,0067	0,0065	0,0I00	0,0I35	0,0I80	-
Sr	0,I7	0,20	0,09	<0,I0	0,I26	0,I5	0,20
Cr	0,0035	0,0040	0,00I8	0,002I	0,0020	0,00I9	0,00I8
Li	-	-	-	0,0I74	0,0I00	0,0I85	0,0400
Cd	<0,03	<0,03	<0,03	-	-	-	<0,03
Zr	0,005	0,004	0,003	-	-	0,004	0,003

	1964 г.								
	3I.I	I8.III	25.III	I4.V	I8.VIII	I8.IX	27.X	I8.XI	22.XII
Cu	0,0I50	0,0300	0,033I	0,0I26	0,0090	0,0280	0,0200	0,0052	0,0065
Mn	0,0I70	0,0600	0,0078	0,0090	0,0II0	0,0I00	0,0020	0,0080	0,0070
Fe	7,00	7,00	I,26	2,34	2,50	I,50	I,45	4,25	I,70
Al	0,20	2,00	0,02	0,30	0,I8	0,50	0,07	0,60	0,39
Zn	0,03	0,I0	0,06	0,03	0,02	0,06	0,06	0,03	0,02
Ag	-	0,00I3	-	-	-	0,0009	-	-	0,0009
Ni	0,0200	0,0044	0,0033	0,0038	0,0035	0,0030	-	0,003I	0,0030
V	<0,00I0	0,00I6	-	0,00I4	0,00I3	0,00I4	0,00I3	<0,00I0	0,00I3
Ti	0,0026	0,0I00	0,00I5	0,0040	0,002I	0,0030	0,0025	0,0090	0,0050
Ba	-	-	-	0,0080	-	0,0057	-	-	-
Sr	<0,03	0,07	0,003	0,I0	0,0I8	0,I0	0,09	0,06	0,03
Cr	0,0070	0,0080	0,0059	0,0044	0,0022	0,0020	0,00I6	0,00I8	0,0017
Li	0,0200	0,0200	-	-	0,0I00	-	-	-	-
Cd	-	0,02	-	<0,03	-	<0,03	<0,03	<0,03	<0,03
Zr	-	0,004	-	0,004	-	-	0,005	0,004	-

REF. NO.: 66 - P - 1

SUBSTANCES: Fe, Zn, Sc, Sm

Reference: Phelps, D. K. 1966. Partitioning of the stable elements Fe, Zn, Sc and Sm within a benthic community, Añasco Bay, Puerto Rico. In Radioecological Concentration Processes, proc. symp. Stockholm, April, 1966, B. Aberg & F. P. Hungate, eds., p. 721-734. Pergamon Press.

Organisms: Tellina sp.
Codakia sp.
Pitar sp.

Date of Sample Collection: 1966?

Location: Añasco Bay, Puerto Rico

Analytical Technique: Neutron activation analysis

Analytical Data:

Table III. Stable element content of dominant Pelecypoda, Crustacea and Echinodermata collected at one location in Añasco Bay, Puerto Rico (Station 6)

	Iron (mg/g dry wt.)	Zinc (μg/g dry wt.)	Scandium (μg/g dry wt.)	Samarium (μg/g dry wt.)
PELECYPODA				
Tellina sp.	0·3	—	0·1	0·1
Codakia sp.	0·1	—	trace	—
	0·6	—	—	—
		—	0·2	—
Pitar sp.	0·1	—	0·8	—
Pelecypoda 4	0·02	—	—	—
	0·06	—	—	—
		—	0·2	—

REF. NO.: 73 - P - 2

SUBSTANCES: Cr

Reference: Phelps, D. K., G. Telek & R. L. Lapan Jr. 1973. Assessment of heavy metal distribution within the food web. In Marine Pollution and Marine Waste Disposal, proc. 2nd internat. congr., San Remo, 17-21 Dec., 1973, p. 341-348. Pergamon Press.

Organisms: Mercenaria mercenaria

Date of Sample Collection: 1968-73

Location: Narragansett Bay and Rhode Island Sound

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

(dry wt, dried at 95°C)

TABLE 4

Cr levels found in replicates from two individual Mercenaria mercenaria *from each location at each point in time.*

	Station 1	Station 5		Station 1	Station 5
4/70	27.3	5.4	8/70	8.4	3.4
	23.9	5.0		11.5	4.5
	24.4	4.5		12.1	3.6
	22.9	4.8		10.2	5.5
	25.2	5.8		10.8	2.9
				9.8	3.5
Mean	24.7	6.5	Mean	10.5	3.9
5/70	19.7	8.0	10/70		1.7
	23.4	7.9		14.2	1.8
	27.1	8.0		11.4	2.0
	30.9	5.9		10.5	3.2
	26.2	6.0		9.5	2.1
	22.9	5.8		11.0	2.6
Mean	25.0	6.9	Mean	11.3	2.2
6/70	23.8	3.0	12/70	6.7	5.6
	16.8	3.3		7.9	5.1
	17.2	3.3		7.2	5.9
	15.0	10.0		18.2	4.6
	15.4	10.2		18.2	4.6
	17.2	9.9		17.6	14.
Mean	17.6	5.0	Mean	12.7	4.1
7/70	20.0	3.6			
	20.9	3.3			
	22.3	3.1			
	17.0	3.3			
	19.6	2.7			
	15.1	4.1			
Mean	19.1	3.3			

REF. NO.: 76 - P - 1

SUBSTANCES: Zn, Cd, Pb, Cu

Reference: Phillips, D. J. H. 1976. The common mussel *Mytilus edulis* as an indicator of pollution by zinc, cadmium, lead and copper. II. Relationship of metals in the mussel to those discharged by industry. Mar. Biol. 38:71-80.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1974

Location: Port Phillip Bay and Western Port Bay, Australia

Analytical Technique:

Analytical Data:

Phillips, D. J. H. 1976.

Table 1. *Mytilus edulis*. Mean concentrations ± standard deviations (µg/g wet weight) of zinc, cadmium, lead and copper in whole soft parts of mussels from 23 locations in Port Phillip Bay and 9 locations in Western Port Bay, Victoria, Australia. Data for wet weights and shell lengths of each sample are also included

Location[a]	Zinc	Cadmium	Lead	Copper	Wet weight (g)	Shell length (mm)
1 Portsea	ND[b]	0.81±0.17	4.42±2.74	0.87±0.29	1.38±0.43	41.6±4.25
(weight-normalized)			2.40±0.42	0.66±0.12		
2 Rye	28.2± 9.0	0.76±0.20	2.89±0.81	0.84±0.13	1.79±0.20	43.8±2.04
3 Rosebud	29.5± 7.6	0.80±0.18	2.74±1.40	0.97±0.15	1.54±0.19	42.4±1.58
(weight-normalized)		0.66±0.09				
4 Mornington	34.3± 6.3	0.67±0.13	1.57±0.22	0.62±0.12	2.02±0.28	45.1±1.91
5 Frankston	35.7±15.0	0.51±0.09	0.78±0.13	0.47±0.13	2.28±0.33	45.9±2.42
6 Mordialloc	52.3±22.1	2.52±1.17	2.82±1.61	1.45±0.53	1.83±0.33	44.0±2.62
7 Black Rock	41.2±17.7	0.73±0.22	1.23±0.48	0.56±0.27	1.43±0.29	41.4±2.88
8 Sandringham	68.2±15.1	0.97±0.42	10.02±5.45	0.80±0.38	1.56±0.25	40.2±2.39
9 Brighton	53.2±15.3	0.76±0.15	2.83±1.17	0.86±0.21	1.51±0.13	39.5±1.18
10 St. Kilda	82.3±39.4	0.67±0.19	3.69±0.49	0.47±0.28	1.70±0.32	41.7±2.16
11 Generator Beacon	97.1±67.0	1.81±0.52	2.37±1.11	0.78±0.15	1.67±0.34	45.7±1.63
12 Parsons Marina	76.6±28.9	1.73±0.59	3.04±2.27	0.84±0.14	1.70±0.35	40.3±3.16
13 Breakwater Pier	71.9±53.6	0.97±0.33	1.51±0.49	0.70±0.12	2.34±0.42	47.3±1.83
14 Gellibrand Light	33.6±13.7	1.26±0.33	2.10±0.45	0.98±0.18	1.11±0.14	45.9±1.90
15 Altona	33.4±12.7	1.14±0.18	0.71±0.20	0.94±0.30	1.27±0.24	40.6±1.58
16 Point Wilson	16.4± 3.3	1.32±0.32	0.86±0.14	0.51±0.16	1.54±0.26	40.5±2.22
17 Refinery Pier	39.9± 9.7	5.93±0.72	0.96±0.18	0.57±0.12	1.66±0.23	39.7±1.57
18 Corio Quay	69.8±29.8	8.01±1.61	1.99±0.67	0.85±0.18	2.18±0.44	43.6±2.79
19 Rippleside Pier	39.2± 8.9	18.16±10.66	1.33±0.18	0.62±0.15	1.74±0.15	39.5±1.58
20 Yarra Pier	47.7±11.8	12.87±2.47	ND	0.50±0.17	1.88±0.27	43.4±1.65
21 Point Henry	25.9± 6.3	2.72±0.59	ND	0.40±0.19	1.88±0.27	44.2±1.32
22 Portarlington	36.0±13.6	1.25±0.26	ND	0.47±0.18	1.94±0.22	43.5±2.22
23 Pope's Eye	35.9±18.8	0.49±0.10	0.91±0.46	0.79±0.25	1.74±0.23	47.0±1.41
24 San Remo	22.2± 5.3	0.35±0.10	BDL[c]	BDL	1.74±0.45	43.0±1.41
(weight-normalized)		0.35±0.03				
25 Corinella	29.5± 9.7	0.39±0.12	BDL	BDL	1.73±0.39	42.3±2.04
(weight-normalized)		0.40±0.05				
26 Cowes	30.4± 7.1	0.42±0.10	BDL	BDL	1.71±0.30	43.5±1.46
(weight-normalized)		0.43±0.07				
27 Tankerton	29.3±11.5	1.52±0.27	BDL	BDL	1.75±0.22	44.0±1.65
28 Stony Point	28.9±10.1	0.24±0.08	BDL	BDL	1.76±0.38	43.9±1.93
(weight-normalized)		0.25±0.05				
29 Crib Point	31.1± 7.2	0.29±0.03	BDL	BDL	1.49±0.21	43.7±1.86
30 Hastings	29.6±10.1	1.60±0.75	BDL	BDL	2.16±0.92	46.0±4.15
(weight-normalized)		1.80±0.37				
31 Tyabb	33.6±12.8	0.20±0.05	BDL	BDL	1.66±0.20	43.5±1.80
32 Lysaght	41.3± 9.9	3.31±0.86	BDL	BDL	1.40±0.26	43.8±1.98
(weight-normalized)		2.40±0.27				

[a]Numbers refer to locations shown in Fig. 1.

[b]ND: no data.

[c]BDL: below detection limits for these samples.

REF NO.: 76 - P - 2

SUBSTANCES: Zn, Cd, Pb, Cu

Reference: Phillips, D. J. H. 1976. The common mussel Mytilus edulis as an indicator of pollution by zinc, cadmium, lead and copper. I. Effects of environmental variables on uptake of metals. Mar. Biol. 38:59-69.

Organisms: Mytilus edulis

Date of Sample Collection: 1974-75

Location: Port Phillip Bay, Victoria, Australia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 1. *Mytilus edulis*. Mean concentrations and standard deviations (µg/g wet weight) of zinc, cadmium and copper in whole soft parts of mussels from 3 locations in Port Phillip Bay, Victoria, Australia. Data for mean wet weights and shell lengths of each sample are also included

Location	Date	Zinc	Cadmium	Cadmium (Norm)[a]	Copper	Wet weight (g)	Shell length (mm)
Gellibrand Lighthouse	24 June 1974	17.6± 5.0	0.29±0.08	NSR	0.61±0.28	2.44±0.64	46.4±3.1
	7 Sept. 1974	33.6±13.7	1.26±0.33	NSR	0.98±0.18	1.11±0.14	45.9±1.9
	25 March 1975	24.8±10.5	0.33±0.15	0.45±0.08	No data	2.98±0.59	47.9±1.6
Station Pier	24 June 1974	39.1± 7.9	0.47±0.13	NSR	No data	1.76±0.33	45.3±2.5
	25 March 1975	21.7± 5.0	0.25±0.09	0.69±0.12	No data	3.23±0.46	46.9±1.8
Generator Beacon	24 June 1974	60.1±24.7	0.61±0.17	NSR	No data	2.13±0.48	45.5±2.3
	25 March 1975	19.3± 7.6	0.20±0.07	0.53±0.17	No data	3.73±0.57	46.6±2.0

[a]Normalized data. NSR: No significant regression (no normalization possible).

Table 2. *Mytilus edulis*. Mean concentrations and standard deviations (μg/g wet weight) of zinc, cadmium, lead and copper in whole soft parts of mussels from different depths at Generator Beacon in winter. Sampled on 6 October, 1974. Data for wet weights and shell lengths of each sample are also included

Depth (m)[a]	Zinc	Cadmium	Lead	Copper	Wet weight (g)	Shell length (mm)
0.5	97.1±67.0	1.81±0.52	2.37±1.11	0.78±0.15	1.67±0.34	45.7±1.6
1.5	44.2±12.5	1.31±0.28	2.29±0.64	BDL[b]	1.28±0.35	41.7±3.9
3.5	29.9± 6.4	1.06±0.18	1.35±0.44	BDL[b]	1.85±0.40	41.5±2.7
6.5	31.7± 9.6	1.14±0.24	1.22±0.15	BDL[b]	1.96±0.40	42.1±2.6
9.5	20.6± 4.1	0.85±0.20	1.15±0.21	BDL[b]	1.91±0.29	42.3±3.4

[a]All depths refer to metres below spring high-water mark.

[b]BDL: below detection limits for these samples.

Table 3. *Mytilus edulis*. Mean concentrations and standard deviations (μg/g wet weight) of zinc and cadmium in whole soft parts of mussels from different depths at Generator Beacon in summer. Sampled on 13 March, 1975. Data for wet weights and shell lengths of each sample are also included

Depth (m)[a]	Zinc	Cadmium	Cadmium (normalized)[b]	Wet weight (g)	Shell length (mm)
0.5	19.3±6.5	0.35±0.10	0.56±0.12	3.33±0.69	46.5±2.4
1.5	19.9±8.1	0.31±0.06	0.41±0.07	2.34±0.64	42.0±2.6
3.5	18.0±5.7	0.36±0.07	0.44±0.05	2.04±0.60	40.3±3.3
6.5	17.8±7.2	0.51±0.12	0.50±0.07	1.35±0.13	37.2±0.6
9.5	15.5±6.1	0.41±0.18	0.55±0.12	2.58±1.02	48.8±6.1

[a]All depths refer to metres below spring high-water mark.

[b]Normalized data, calculated by method of Johnels *et al.* (1967).

REF. NO.: 77 - P - 2

SUBSTANCES: Pb, Fe, Mn

Reference: Phillips, D. J. H. 1977(?). The common mussel *Mytilus edulis* as an indicator of trace metals in Scandinavian waters. II. Lead, iron and manganese. Marine Biology, in press [received in pers. comm. July 1977].

Organisms: *Mytilus edulis*

Date of Sample Collection: 1976

Location: Norway, Finland, Sweden, Denmark

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Phillips, D. J. H. 1977?

Table 1. *Mytilus edulis*. Concentrations (means±standard deviations, µg/g dry weight) of lead, iron and manganese in whole soft parts of mussels from 54 locations in Scandinavian waters.

Location	Number[a]	Lead	Iron	Manganese
Helsinki, offshore	1	20±4.6	183±66	35.8±13.4
Kopparnäs	2	30±12.7	217±54	34.5±11.1
Saggö, Åland	3	69±14.6	164±29	9.8±1.4
Finbö, Åland	4	95±40.3	145±26	10.5±2.6
Öregrund	5	187±64.9	200±26	8.2±1.1
Edöfjorden	6	128±29.3	169±32	8.7±1.2
Grissleholmen	7	99±28.7	300±105	37.8±14.4
Korsholmen	8	146±55.0	392±92	71.3±19.1
Rånö	9	210±31.0	510±159	56.6±21.9
Landsort	10	113±33.7	241±34	22.3±4.0
Sävösund	11	86±34.0	577±163	47.5±15.2
Risö	12	92±28.8	557±76	91.7±15.4
Utterholmen	13	98±43.5	336±95	79.9±32.8
Oxelösund ironworks	14	264±59.7	1367±385	64.4±27.5
Navekvarn	15	56±15.6	242±61	52.8±24.6
Isö	16	54±15.5	390±67	39.7±13.5
Simpevarp intake	17	97±52.9	140±25	32.3±8.8
Simpevarp, Lillegrund	18	42±15.3	160±29	14.6±4.7
Southern Öland	19	80±23.9	217±70	28.1±3.8
Torhamn	20	51±28.6	145±42	12.6±3.1
Barsebäck	21	99±41.2	184±40	40.9±10.0
Kullen	22	46±23.1	97±13	35.5±7.7
Steninge	23	14±2.7	56±17	30.4±8.7
Ringhals, Viskan	24	17±5.0	76±10	10.7±3.3
Ringhals, reference	25	12±3.6	56±13	7.7±1.3
Onsala	26	14±4.2	59±17	6.9±1.2
Långholmen	27	30±11.2	112±52	11.5±3.3
Rivö	28	24±8.7	59±25	10.0±2.7
Göteborg	29	58±14.7	128±55	12.0±4.3
Stenungsön	30	13±3.7	31±9	6.2±1.1
Stenungsund	31	14±4.2	47±27	7.1±2.0
St. Askerön	32	16±2.6	31±8	7.9±2.1
Flatholmen	33	4±1.3	52±11	14.7±2.5
Brofjorden	34	3±0.7	61±12	9.7±1.1
Fakse Ladeplads	35	66±35.4	60±13	16.1±6.2
Mosede	36	75±32.6	89±28	8.7±0.6
Köbenhavn	37	18±3.6	25±8	8.9±1.4
Taarbäk	38	14±4.2	35±16	9.9±1.3
Niverod	39	9±2.4	111±43	15.8±3.0
Helsingör	40	5±0.8	18±4	9.1±2.5
Risö	41	5±1.1	31±7	31.5±10.0
Nyrup	42	3±0.7	16±4	6.6±2.6
Svallerup	43	10±6.0	26±5	7.6±1.1
Korsör	44	9±3.5	15±3	14.2±4.0
Svinö	45	51±17.5	39±7	10.8±2.8
Nyborg	46	5±0.9	14±4	7.4±1.5
Bogense	47	29±11.3	27±9	9.0±2.0
Gylling Näss	48	54±15.3	50±13	13.9±2.8
Århus	49	32±8.5	27±4	10.1±1.3
Ebeltoft	50	23±7.6	24±7	6.9±1.7
Steilene	51	34±14.9	21±3	6.8±1.2
Östöya	52	32±5.6	32±9	5.1±0.9
Malmöykalven	53	34±9.1	21±2	8.1±2.0
Hovedöya	54	28±5.1	26±4	4.9±1.0

[a]Numbers refer to those in the text and in Fig. 1.

Table 2. *Mytilus edulis*. Concentrations (means or ranges, µg/g dry weight) of lead, iron and manganese in whole soft parts of mussels from various waters throughout the world. A dry weight:wet weight ratio of 13% was used where authors quoted results by wet weight and gave no conversion ratio.

Reference	Sampling location	Lead	Iron	Manganese
Brooks and Rumsby, 1965	Tasman Bay, New Zealand	12	1960	27
Segar *et al.*, 1971	Lee-on-Solent, U.K.	9	1700	3.5
Bellamy *et al.*, 1972	East coast of U.K.	118-343	100-3400	–
Nickless *et al.*, 1972	Bristol Channel, U.K.	1-30	–	–
Winter, 1972	Weser estuary, Germany	–	80-230	–
Schulz-Baldes, 1973	Weser estuary and German Bight	1.3-9.7	–	–
Stenner and Nickless, 1974	Hardangerfjord, Norway	15-3100	–	–
	Skjerstadfjord, Norway	2-6	–	–
Boyden, 1975	Poole Harbour, U.K.	7-19	87-154	3-5
Nielsen and Nathan, 1975	Coasts of New Zealand	1-15	64-377	–
Stenner and Nickless, 1975	Atlantic coasts of Spain and Portugal	2-15	–	–
George *et al.*, 1976	River Ythan estuary, U.K.	–	510	–
Phillips, 1976b	Port Phillip Bay, Australia	5.5-77	–	–
Lande, 1977	Trondheimsfjord, Norway	–	122-1623	–
Wharfe and Van den Broek, 1977	Lower Medway estuary, U.K.	6-17	–	–
This study	Scandinavia, low salinity[b]	20-264	60-1366	8.2-92
	The Sound and Great Belt	4.5-99	14-184	7.4-41
	Kattegat and Skagerrak	3.0-58	16-128	6.2-35

Phillips, D. J. H. 1977?

[a]Species quoted as *Mytilus edulis aoteanus*.

[b]Gulf of Finland, southern Bothnian Sea, Baltic proper.

REF. NO.: 77 - P - 1

SUBSTANCES: Zn, Cd

Reference: Phillips, D. J. H. 1977(?). The common mussel *Mytilus edulis* as an indicator of trace metals in Scandinavian waters. 1. Zinc and cadmium. Marine Biology, in press [received in pers. comm. July 1977].

Organisms: *Mytilus edulis*

Date of Sample Collection: 1976

Location: Norway, Finland, Sweden, Denmark

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Phillips, D. J. H. 1977?

Table 1. *Mytilus edulis*. Concentrations (means±standard deviations, μg/g dry weight) of zinc and cadmium in whole soft parts of mussels from 54 locations in Scandinavia.

Location	Number[a]	Zinc	Cadmium	Location	Number[a]	Zinc	Cadmium
Helsinki, offshore	1	147±38	5.3±0.82	Rivö	28	41±17	0.9±0.22
Koppar[illegible]	2	105±21	4.2±1.26	Göteborg	29	125±42	[illegible].5±0.30
Saggö, Åland	3	140±30	6.0±1.05	Stenungsön	30	25±10	[illegible].7±0.12
Finnö, Åland	4	211±83	9.3±3.76	Stenungsund	31	29±13	0.8±0.24
Öregrund	5	115±20	4.0±0.83	St. Askerön	32	23±4	0.7±0.09
Eckö[illegible]jorden	6	110±35	2.8±0.80	Flatholmen	33	15±9	0.5±0.13
Grisslehamn	7	124±22	3.6±0.91	[illegible]	34	14±3	0.4±0.05
Korsholmen	8	21[illegible]±52	9.5±2.58	Fakse Ladeplads	35	90±19	[illegible].4±0.12
Rånö	9	210±61	11.7±4.59	Mosede	36	125±31	2.5±0.20
Landsort	10	180±27	5.3±0.90	København	37	60±22	0.8±0.15
Ölvösund	11	150±57	5.6±2.13	Taarbæk	38	115±57	1.5±0.52
Risö	12	147±42	4.2±0.97	Niverød	39	155±51	1.9±0.32
Utterholmen	13	144±63	1.7±0.42	Helsingør	40	60±15	0.7±0.10
Oxelösund Ironworks	14	4[illegible]0±171	4.8±1.60	Risø	41	97±31	1.0±0.16
Navelvarn	15	149±43	1.8±0.49	Nyrup	42	37±13	0.5±0.09
[illegible]	16	111±29	1.3±0.43	Svellerup	43	26±5	0.8±0.17
Simpevarp Intake	17	177±76	5.8±1.34	Korsör	44	65±28	1.1±0.28
Simpevarp, Illegrund	18	205±96	12.9±4.33	Svinö	45	53±18	1.2±0.28
Southern Öland	19	212±60	4.7±1.64	Nyborg	46	30±11	0.6±0.19
Torhamn	20	128±32	2.6±0.52	Bogense	47	43±19	0.7±0.20
Barcebäck	21	177±51	4.2±0.96	Gylling Mies	48	86±23	1.2±0.31
Hullen	22	117±16	1.9±0.44	Århus	49	42±15	0.8±0.11
Steningo	23	33±7	0.8±0.14	Ebeltoft	50	21±5	0.5±0.05
Ringhals, Vicken	24	61±31	0.7±0.23	Steilene	51	48±11	0.9±0.14
Ringhals, reference	25	29±14	0.6±0.18	Ostöya	52	26±11	0.8±0.12
Onsala	26	41±10	0.6±0.10	Malmöykalven	53	50±27	0.9±0.15
Lingholmen	27	50±21	1.0±0.31	Hovedöya	54	66±30	1.2±0.27

[a]Numbers refer to those in the text and in Fig. 1.

REF. NO.: 72 - P - 1

SUBSTANCES: Cu, Zn, Cd, Pb

Reference: Portmann, J. E. & J. D. Yardley. 1972. The distribution of some metals in shellfish taken from the coasts of England and Wales. ICES C.M. Papers & Reports, C.M. 1972/K:12, 10p.

Organisms: *Mytilus edulis*
Cardium edule
Ostrea edulis

Date of Sample Collection: 1972?

Location: England and Wales

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 2 Concentrations (ng/kg wet weight) of copper, zinc, cadmium and lead in mussels

Area of collection	Number of samples	Copper		Zinc		Cadmium		Lead	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Berwick	1		< 0.5		60		NA		< 0.5
Budle	1		2.5		14		NA		< 0.5
Wash	3	3.7-15	7.5	17-21	18	<0.05-0.75	0.50	< 0.5	< 0.5
Wells	1		< 0.5		20		0.75		< 0.5
Brancaster	1		2.5		5.3		< 0.05		< 0.5
Poole	15	0.5-6.0	3.3	13-28	16	0.2-5.9	2.6	< 0.5-5.5	2.2
Portland Bill-Teignmouth-St Austell Bay	3	3.0-3.5	3.2	11-13	12	0.13-0.45	0.25	< 0.5-3.0	1.3
South Wales coast-Burry Inlet	3	2.5	2.5	13	13	0.75-1.7	1.2	0.5-2.0	1.2
Anglesey-Solway-Conway	10	2.5-6.0	3.9	9-50	21	<0.05-0.90	0.47	0.5-2.5	1.0
Northern Ireland	6	2.0-10	5.4	6.0-25	11	0.15-1.2	0.68	< 0.5-2.5	1.0

NA = not analysed.

Table 3 Concentrations (mg/kg wet weight) of copper, zinc, cadmium and lead in cockles

Area of collection		Number of samples	Copper		Zinc		Cadmium		Lead	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean
Whitby to Mablethorpe	Humber	1	5.7	5.7	20.5	20.5	< 0.05	< 0.05	< 0.5	< 0.5
Mablethorpe to Hunstanton	Wash	5	< 0.5-5.0	1.7	6.0-29	11.7	0.05-0.25	0.08	< 0.5	< 0.5
Hunstanton to Harwich	N. Norfolk	1	1.5	1.5	8.4	8.4	0.2	0.2	< 0.5	< 0.5
Harwich to Margate	Thames Estuary	12	< 0.5-3.3	1.6	9.3-14	11.3	< 0.05-1.3	0.5	< 0.5	< 0.5
Beachy Head to Portland Bill	Poole	2	2.5	2.5	3.5-16	9.8	< 0.05-0.25	0.12	< 0.5	< 0.5
Hartland Point to St David's Head	Burry Inlet	2	12	12	12.6	12.6	0.40-0.45	0.43	1.0-2.0	1.5

Table 4 Concentrations (mg/kg wet weight) of copper, zinc, cadmium and lead in oysters

Area of collection		Number of samples	Copper		Zinc		Cadmium		Lead	
			Range	Mean	Range	Mean	Range	Mean	Range	Mean
Harwich to Margate	Crouch	5	99-113	104	100-580	390	1.5-1.8	1.7	0.5-1.0	0.8
	Roach	3	56-80	65	520-650	565	1.4-1.9	1.6	0.5-1.0	0.8
	Blackwater	13	48-75	60	60-600	280	0.36-1.8	0.88	< 0.5-2.5	1.1
Beachy Head to Portland Bill	Poole	2	33	33	110-340	225	1.3-2.6	1.9	< 0.5-1.0	0.5
Portland Bill to St Austell Bay	R. Dart	1	153	153	100	100	0.50	0.50	< 0.5	< 0.5
St Austell Bay to Hartland Point	R. Fal and Helford	25	20-121	80	100-1030	565	< 0.05-1.2	0.48	< 0.5-3.5	0.9

REF. NO.: 68 - P - 2

SUBSTANCES: Zn, Cu, Mn, Fe, Pb, Cr, Ni, Co, Cd

Reference: Pringle, B. H., D. E. Hissong, E. L. Katz & S. T. Mulawka. 1968. Trace metal accumulation by estuarine mollusks. J. Sanit. Eng. Div., Proc. Amer. Soc. Civil Engineers 94:455-475.

Organisms:
Crassostrea virginica
Mya arenaria
Mercenaria mercenaria
Crassostrea gigas

Date of Sample Collection: 1965-67

Location: Atlantic coast U.S., Maine through N. Carolina; Pacific coast, Washington

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 2.—AVERAGE TRACE METAL LEVELS IN SHELLFISH TAKEN FROM ATLANTIC COAST WATERS, IN PARTS PER MILLION OF WET WEIGHT

Element	Crassostrea virginica Eastern Oyster	Mya arenaria Soft Shell Clam	Mercenaria mercenaria Northern Quahaug
Zinc	1428	17	20.6
Copper	91.50	5.80	2.6
Manganese	4.30	6.70	5.8
Iron	67.00	405	30
Lead	0.47	0.70	0.52
Cobalt	0.10	0.10	0.20
Nickel	0.19	0.27	0.24
Chromium	0.40	0.52	0.31
Cadmium	3.10	0.27	0.19

TABLE 3.—RANGE OF TRACE METAL VALUES IN SHELLFISH HARVESTED FROM ATLANTIC AND PACIFIC WATERS, IN PARTS PER MILLION OF WET WEIGHT

Element	C. virginica Oysters		Mya arenaria Soft Shell Clam	Mercenaria mercenaria Northern Quahaug
	East Coast, U.S.	West Coast, U.S. (C. gigas)		
Zinc	180 - 4120	86 - 344	9.0 - 28	11.50 - 40.20
Copper	7.0 - 517	7.80 - 37.50	1.20 - 90	1.0 - 16.50
Manganese	0.14 - 15.0	0.90 - 16	0.10 - 29.90	0.7 - 29.70
Iron	31 - 238	15.30 - 91.40	49.70 - 1710	9.0 - 83.0
Lead	0.10 - 2.30	0.10 - 4.50	0.10 - 10.20	0.10 - 7.50
Chromium	0.04 - 3.40	0.10 - 0.30	0.10 - 5.0	0.19 - 5.80
Nickel	0.08 - 1.80	0.10 - 0.20	0.10 - 2.30	0.10 - 2.40
Cobalt	0.06 - 0.20	0.10 - 0.20	0.10 - 0.20	0.10 - 0.20
Cadmium	0.10 - 7.80	0.20 - 2.10	0.10 - 0.90	0.10 - 0.73

Pringle, B. H. et al. 1968.

TABLE 4.—SEASONAL VARIATIONS OF TRACE METAL LEVELS IN THE PACIFIC OYSTER (CRASSOSTREA GIGAS) ALONG THE WASHINGTON COAST

Element	Average Values for the Periods Indicated, in parts per million, Wet Weight											
	Phase I March–June, 1965		Phase II July–December, 1965		Phase III December–June, 1966		Phase IV July–October, 1966		Phase V October, 1966–March, 1967		Phase VI May–July, 1967	
	Manchester	Purdy	Manchester	Purdy	Manchester	Purdy	Manchester	Purdy	Manchester	Purdy	Manchester	Purdy
Zinc	211	210	243	275	221	199	262	225	224	199	250	206
Copper	24.0	20.20	22.40	20.30	20.60	14.20	25.80	19.20	17.40	12.50	18.30	14.30
Manganese	4.50	3.70	11.60	8.60	4.70	3.10	6.90	8.30	4.30	4.40	3.41	2.24
Iron	42.00	41.80	40.30	28.50	29.00	20.20	35.10	24.90	38.40	30.30	67.10	48.50
Lead	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Chromium	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Nickel	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cobalt	<0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium	—	—	—	—	—	—	1.30	1.40	1.12	1.30	0.90	0.80

TABLE 6.—THE ANATOMICAL DISTRIBUTION OF LEAD IN THE EASTERN OYSTER (CRASSOSTREA VIRGINICA) FROM A CONTROLLED ACCUMULATION SYSTEM

Environmental Level in parts per million (1)	Anatomical Area (2)	Accumulation Values, in milligrams per kilogram		Accumulation Rate, in milligrams per kilogram per day (5)	Time, in days (6)
		Initial (3)	Final (4)		
0.025	muscle	0	9	0.20	49
0.05	muscle	0	23	0.50	49
0.1	muscle	0	50	1.13	49
0.2	muscle	0	115	2.30	49
0.025	mantle edge	0	15	0.30	49
0.05	mantle edge	0	32	0.70	49
0.1	mantle edge	0	73	1.50	49
0.2	mantle edge	0	192	3.90	49
0.025	mantle	0	14	0.30	49
0.05	mantle	0	37	0.78	49
0.1	mantle	0	75	1.60	49
0.2	mantle	0	212	4.30	49
0.025	remainder	0	18	0.36	49
0.05	remainder	0	34	0.71	49
0.1	remainder	0	75	1.60	49
0.2	remainder	0	237	4.8	49
0.025	gill	0	23	0.49	49
0.05	gill	0	65	1.35	49
0.1	gill	0	160	3.10	49
0.2	gill	0	274	5.60	49
0.025	gonad	0	28	0.56	49
0.05	gonad	0	55	1.20	49
0.1	gonad	0	163	3.28	49
0.2	gonad	0	325	6.60	49
0.025	liver	0	28	0.59	49
0.05	liver	0	66	1.40	49
0.1	liver	0	145	2.95	49
0.2	liver	0	368	7.40	49

REF. NO.: 75 - R - 3 SUBSTANCES: Hg

Reference: Rasmussen, L. F. & D. C. Williams. 1975. The occurrence and distribution of mercury in marine organisms in Bellingham Bay. Northwest Sci. 49:87-94.

Organisms:

Mya arenaria	Clinocardium nuttallii
Saxidomus giganteus	Macoma nasuta
Mytilus edulis	Crassostrea gigas
Prototheaca staminea	Schizothaerus nuttallii

Date of Sample Collection: 1973

Location: Bellingham Bay, Washington

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1. A survey of mercury content in intertidal species from Bellingham Bay and vicinity. Number of organisms analyzed indicated in parentheses. Values are means ± standard error where indicated.

Collection* site (Station #)	Organism	Tissue sample	Total Hg mg/kg wet weight
	MOLLUSCS		
1	Soft shell clam, *Mya arenaria* (6)	siphon	0.16 ± .006
		viscera	0.10 ± .009
1	Butter clam, *Saxidomus giganteus* (2)	siphon	0.02 ± .001
		viscera	0.06 ± .013
1	Edible mussel, *Mytilus edulis* (10)	whole animal (w.a.)	0.12 ± .020
2	Steamer clam, *Prototheaca staminea* (13)	siphon	0.17 ± .008
		viscera	0.13 ± .008
2	Butter clam, *Saxidomus giganteus* (4)	siphon	0.05 ± .001
		viscera & foot	0.27 ± .089
2	Cockle, *Clinocardium nuttallii* (5)	viscera	0.08 ± .010
2	Bent nose clam, *Macoma nasuta* (2)	siphon	0.11 ± .001
		viscera	0.09 ± .0004
2	Edible mussel, *Mytilus edulis* (17)	w.a.	0.12 ± .003
2	Pacific oyster, *Crassostrea gigas* (2)	w.a.	0.10 ± .02
4	Edible mussel, *Mytilus edulis* (15)	w.a.	0.05 ± .001
5	Edible mussel, *Mytilus edulis* (14)	w.a.	0.05 ± .002
6	Edible mussel, *Mytilus edulis* (5)	w.a.	0.01 ± .0006
6	Butter clam, *Saxidomus giganteus* (8)	siphon	0.01 ± .001
		viscera	0.02 ± .0008
6	Steamer clam, *Prototheaca staminea* (3)	siphon	0.01 ± .001
		viscera	0.02 ± .0008
6	Horse clam, *Schizothaerus nuttallii* (10)	siphon	0.01 ± .001
		viscera & foot	0.01 ± .002
6	Bent nose clam, *Macoma nasuta* (3)	w.a.	0.02 ± .001

REF. NO.: 74 - R - 3

SUBSTANCES: Zn, Cd, Cu

Reference: Ratkowsky, D. A., S. J. Thrower, I. J. Eustace & J. Olley. 1974. A numerical study of the concentration of some heavy metals in Tasmanian oysters. J. Fish. Res. Bd Can. 31:1165-1171.

Organisms: *Crassostrea gigas*
Ostrea angasi
Crassostrea commercialis

Date of Sample Collection: 1974?

Location: Tasmania

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Ratkowsky, D. A. et al. 1974.

TABLE 1. Weight, age, and mean concentrations of selected heavy metals in Tasmanian oyster populations sampled in 1972. Sample sizes are all 10, except PITT N which is 5, and TAMAR4 which is 8. Oyster species are all *Crassostrea gigas*, except for MONTAG, ANSONS, ST. HEL (in part), TRIA N, PITT N, PCNATV, and RBNATV, which are *Ostrea angasi*; and SYDROC, which is *C. commercialis*.

Location (*see Fig. 1*)	Code name	Age (*m.*)	Zn	Cd	Cu	Wet wt (*g*)	Dry wt (*g*)
			(*μg/g, wet wt basis*)				
1	MONTAG	u[a]	1043	2.31	9.0	4.70	0.86
2	ULV 1	u	415	3.61	15.4	5.80	0.85
2	ULV 2	u	443	3.03	19.9	5.80	0.81
3	DEVONP	u	572	3.19	29.3	8.60	1.10
4	PT.SOR	u	333	2.76	29.0	6.85	0.81
5	ANSONS	u	550	0.24	4.0	6.83	1.41
6	ST.HEL	u	371	0.51	9.7	10.66	2.80
7	TRIA P	u	376	0.69	61.3	22.00	4.46
7	TRIA N	u	783	0.41	80.5	7.06	1.52
8	SANDSP	20	359	0.00	17.3	9.03	1.81
9	BLAKMN	20	480	0.86	9.4	7.65	1.54
10	DUNALY	20	653	3.54	12.5	8.45	1.84
11	PITT P	u	1038	2.02	68.8	23.13	5.07
11	PITT N	u	1067	2.54	68.9	11.70	2.93
12	PIPCL1	29	3449	3.73	84.4	12.19	2.41
12	PIPCL2	20	2966	5.69	60.7	6.99	1.65
12	PIPCL3	17	1817	2.86	47.6	6.68	1.31
12	PIPCL4	17	2009	2.72	44.1	9.36	1.98
12	PCNATV	u	2576	1.18	44.0	8.12	1.70
12	PCSPAT	6	689	3.21	44.8	0.75	0.10
12	PCXRB1	19	6111	15.03	91.8	9.25	2.23
12	PCXRB2	17	6239	12.35	103.0	7.22	1.36
12	PCXRB3	17	5787	10.33	95.0	7.21	1.59
12	PCXRB4	17	7420	15.31	121.5	4.82	0.85
12	PCXRB5	20	4796	9.76	85.0	13.01	3.32
12	PCXRB6	13	2254	3.20	43.7	3.78	0.74
13	SMNBAY	20	1136	2.18	19.6	6.47	1.23
14	CYGNET	20	338	0.61	13.2	8.50	2.07
15	LNGBAY	20	620	3.66	25.6	5.95	1.01
16	RB2481	31	6838	19.08	110.1	8.33	1.94
16	RB1881	31	6558	11.58	81.2	10.20	1.75
16	RB2951	28	10019	16.02	122.0	6.90	1.20
16	RB2952	28	9251	17.87	129.6	8.87	1.43
16	RB2953	28	7356	16.48	105.7	15.06	2.82
16	RB2954	28	9863	17.24	147.7	8.70	1.39
16	RB2955	16	7087	34.53	115.1	4.55	0.77
16	RB2956	16	7300	29.88	110.5	8.11	1.52
16	RB2957	16	7523	30.69	112.8	6.55	1.16
16	RB1361	17	6244	10.09	72.9	5.68	1.24
16	RB1882	19	6301	17.46	74.7	9.45	2.11
16	RB7972	19	6564	17.30	93.0	6.50	1.61
16	RBNATV	u	8865	18.65	55.7	6.30	1.37
17	TAMAR6	17	526	2.83	104.3	9.63	2.49
17	TAMAR5	20	451	2.29	87.4	11.27	2.96
17	TAMAR4	u	1160	4.18	192.2	15.08	3.37
17	TAMAR3	29	797	4.95	110.6	16.84	4.22
18	TAMAR2	29	1354	7.17	124.2	4.30	0.68
19	TAMAR1	29	1602	14.59	98.9	6.44	1.14
S[b]	SYDROC	u	318	0.00	18.7	6.49	1.49

[a]u: age unknown.
[b]Location S: Georges River, Sydney, N.S.W.

REF. NO.: 75 - R - 3

SUBSTANCES: Hg

Reference: Reimer, A. A. & R. D. Reimer. 1975. Total mercury in some fish and shellfish along the Mexican coast. Bull. Environ. Contam. Toxicol. 14:105-111.

Organisms: Crassostrea virginica
Anadara tuberculosa
Codakia orbicularis

Date of Sample Collection: 1975?

Location: Gulf and Pacific coasts of Mexico

Analytical Technique:

Analytical Data:

TABLE 4

Mercury present in some edible mollusks

Locality, source, kind of mollusk	No. of samples	Mercury content µg/g mean±S.D.	range
TAMPICO, Laguna Tamihaua Crassostrea virginica	15	0.02±0.01	0.01-0.06
CIUDAD DEL CARMEN Boca de Atasta Crassostrea virginica	14	0.03±0.02	0.01-0.06
VERACRUZ, fish market Codakia orbicularis	14	0.09±0.06	0.03-0.22
MAZATLAN, fish market Anadara tuberculosa	14	0.05±0.02	0.02-0.10

REF. NO.: 76 - R - 3

SUBSTANCES: Hg

Reference: Renzoni, A. & E. Bacci. 1976. Bodily distribution, accumulation and excretion of mercury in a fresh-water mussel. Bull. Environ. Contam. Toxicol. 15:366-373.

Organisms: *Unio* cfr. *elongatulus*

Date of Sample Collection: 1976?

Location: Paglia River, Italy

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Renzoni, A. & E. Bacci. 1976.

TABLE 1

Mercury distribution in organs and tissues of Unio e. after their collection (0) and after various periods (15,30 and 60 days) in clean water in laboratory.

ORGANS or TISSUES	TIME	$\bar{X}$	S.E.	95% C.L.
Digestive gland	0	1.403	0.107	1.156 - 1.650
	15	1.070	0.107	0.826 - 1.314
	30	0.955	0.069	0.799 - 1.111
	60	0.705	0.065	0.558 - 0.854
Gill	0	1.259	0.139	0.938 - 1.580
	15	0.732	0.058	0.531 - 0.933
	30	0.692	0.057	0.561 - 0.823
	60	0.598	0.058	0.467 - 0.729
Gonad	0	1.232	0.210	0.748 - 1.716
	15	0.621	0.093	0.410 - 0.832
	30	0.563	0.038	0.477 - 0.649
	60	0.390	0.054	0.266 - 0.514
Mantle	0	0.866	0.106	0.621 - 1.111
	15	0.495	0.103	0.260 - 0.730
	30	0.493	0.035	0.414 - 0.572
	60	0.344	0.040	0.252 - 0.436
Foot	0	0.855	0.060	0.716 - 0.994
	15	0.654	0.126	0.368 - 0.940
	30	0.622	0.054	0.499 - 0.745
	60	0.431	0.043	0.334 - 0.530
Adductor muscle	0	0.818	0.051	0.699 - 0.927
	15	0.586	0.065	0.438 - 0.734
	30	0.544	0.041	0.450 - 0.638
	60	0.421	0.113	0.129 - 0.715

REF. NO.: 74 - R - 4

SUBSTANCES: V, Cr, Cd, Al, Mn, Pb, Zn, Ni, Cu, Co, Fe, Ag

Reference:

Reynolds, B. & G. Pesch. 1974. Metals residues in tissues of mahogany clams, Arctica islandica, and other mollusc and echinoderm tissues. In Environmental survey of two interim dumpsites Middle Atlantic Bight, supplemental report, Operation "Fetch" cruise report 5-10 Nov. 1973, D. W. Lear ed., p. 13-46+app. U.S. EPA, Annapolis Field Office, Annapolis, Md., October 1974.

Organisms:

Arctica islandica
Pecten sp.
Spisula sp.

Date of Sample Collection: 1973

Location: Middle Atlantic Bight, off Delaware Bay

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

APPENDIX 1

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica — µgm/gm Wet Weight

*		14	9	17	1	2	5	8	11
Fe	Mean	20.31	33.47	44.67	59.00	29.31	24.73	43.73	32.95
	Range	10.01-	20.15-	14.81-	10.69-	14.18-	17.36-	17.09-	22.38-
		28.17	49.20	95.15	310.92	62.45	29.76	108.05	64.30
	# Samples	3	10	8	12	4	3	5	6
Cu	Mean	0.65	0.75	0.10	1.09	0.85	0.73	.073	0.54
	Range	0.44-	0.36-	0.48-	0.42-	0.39-	0.57-	0.37-	0.38-
		0.94	1.12	0.95	3.37	1.38	0.90	0.86	0.72
	# Samples	3	10	8	12	4	3	5	6
Zn	Mean	11.56	8.04	9.13	11.03	11.20	8.56	11.51	8.55
	Range	6.80-	5.54-	6.29-	5.62-	7.82-	5.71-	5.96-	3.76-
		17.56	10.93	11.68	34.39	16.34	11.13	16.80	12.63
	# Samples	3	10	8	12	4	3	5	6
Cd	Mean	0.413	0.263	0.443	0.316	0.303	0.398	0.254	0.268
	Range	0.224-	0.174-	0.220-	0.141-	0.229	0.212-	0.134-	0.166-
		0.616	0.402	0.731	0.726	0.441	0.526	0.329	0.414
	# Samples	3	9	8	11	4	3	5	6
Ag	Mean	0.24	0.24	32.23	0.24	0.24	0.16	0.23	0.16
	Range	0.12-	0.10-	0.17-	0.11-	0.14-	0.10-	0.09-	0.09-
		0.42	0.39	256.0	0.79	0.39	0.23	0.65	0.26
	# Samples	3	10	8	12	4	3	5	6
Mn	Mean	0.25	1.03	1.18	6.89	0.75	0.82	0.78	0.74
	Range	0.03-	0.54-	0.91-	0.34-	0.31-	0.58-	0.56-	0.16-
		0.39	1.74	1.90	72.83	1.54	1.28	1.21	1.71
	# Samples	3	10	8	12	4	3	5	6
Pb	Mean	0.54	1.11	0.76	1.18	0.56	0.88	0.51	0.62
	Range	0.34-	0.36-	0.67-	0.51-	0.37-	0.59-	0.03-	0.40-
		0.65	5.17	0.91	9.00	0.74	1.18	0.87	0.85
	# Samples	3	10	8	12	4	3	5	6
Co	Mean	0.16	0.14	0.10	0.17	0.11	1.2	0.13	0.12
	Range	0.09-	0.09-	0.08-	0.06-	0.09-	0.08-	0.06-	0.08-
		0.23	0.18	0.13	0.43	0.18	0.15	0.22	0.20
	# Samples	3	10	8	12	4	3	5	6
Ni	Mean	2.00	1.07	1.14	1.40	1.04	1.42	1.50	1.43
	Range	1.17-	0.599-	0.68-	0.08-	0.63-	0.584-	0.674-	0.89[illegible]-
		2.79	1.85	2.07	1.77	1.51	1.99	2.725	2.23
	# Samples	3	10	8	12	4	3	5	6
Cr	Mean	3.01	0.533	0.448	0.347	0.286	0.392	0.304	0.325
	Range	0.196-	0.376-	0.277-	0.173-	0.234-	0.30	0.16	0.20
		0.428	0.839	0.595	0.585	0.346	0.474	0.414	0.43
	# Samples	3	10	8	12	4	3	5	6
Al	Mean	1.13	4.46	3.26	3.13	2.20	3.61	4.18	1.92
	Range	0.262-	1.79-	2.06-	1.75-	1.71-	2.35-	1.33-	1.25-
		1.58	10.83	6.86	5.76	2.56	5.27	9.99	2.45
	# Samples	3	10	7	11	3	3	5	6
V	Mean	0.217	0.487	0.442	0.339	0.329	0.274	0.247	0.247
	Range	0.167-	0.379-	0.255-	0.266-	0.257-	0.148-	0.176-	0.213-
		0.261	0.728	0.585	0.655	0.433	0.377	0.409	0.303
	# Samples	3	10	8	12	4	3	5	6

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica — µgm/gm Wet Weight

*		E	C	D	G	B	A	H
Fe	Mean	39.60	153.15	25.54	113.55		148.37	30.69
	Range	12.19-	--	5.11-	21.23-		--	--
		73.72	--	45.18	389.74		--	--
	# Samples	10	1	6	8		1	1
Cu	Mean	0.67	1.01	0.72	0.90		1.01	0.77[illegible]
	Range	0.45		0.52	0.58		--	--
		1.02		1.14	1.24		--	--
	# Samples	10	1	6	8		1	1
Zn	Mean	8.14	9.571	9.44	9.10		9.719	14.76[illegible]
	Range	4.29		7.15	4.72		--	--
		12.22	--	12.99	13.21		--	--
	# Samples	10	1	6	8		1	1
Cd	Mean	0.2789	0.404	0.250	0.340		0.307	0.407
	Range	0.170-	--	0.151-	0.141-		--	--
		0.428	--	0.305	0.591		--	--
	# Samples	10	1	6	8		1	1
Ag	Mean	0.20	0.181	0.21	0.24		0.213	0.3[illegible]
	Range	0.08-	--	0.11-	0.07-		--	--
		0.41	--	0.56	0.59		--	--
	# Samples	10	1	6	8		1	1
Mn	Mean	1.03	5.505	0.80	3.23		6.665	0.79[illegible]
	Range	0.22-	--	0.40-	0.50-		--	--
		1.22	--	1.20	9.78		--	--
	# Samples	10	1	6	8		1	1
Pb	Mean	0.88	1.077	0.60	1.12		0.900	0.87[illegible]
	Range	0.50-	--	0.46-	0.51		--	--
		1.63	--	0.82	2.52		--	--
	# Samples	10	1	6	8		1	1
Co	Mean	0.21	0.686	0.09	0.47		0.120	0.217
	Range	0.07-	--	0.06-	0.08-		--	--
		0.77	--	0.12	2.80		--	--
	# Samples	10	1	6	8		1	1
Ni	Mean	1.27	--	2.02	2.23		--	5.44
	Range	0.81-	--	0.528-	0.77-		--	--
		1.847	--	4.711	5.10		--	--
	# Samples	10	0	6	6		0	1
Cr	Mean	0.410	0.852	0.293	0.711		0.553	0.68[illegible]
	Range	0.25-	--	0.239-	0.34-		--	--
		0.661	--	0.354	1.43		--	--
	# Samples	10	1	6	8		1	1
Al	Mean	3.03	--	2.42	12.60		--	4.23
	Range	1.629-	--	1.71-	1.98-		--	--
		6.211	--	3.85	25.85		--	--
	# Samples	10	0	6	7		0	1
V	Mean	0.266	0.722	0.281	0.684		1.110	0.3[illegible]
	Range	0.200-	--	0.158-	0.309-		--	--
		0.373	--	0.360	0.741		--	--
	# Samples	10	1	6	8		1	1

* Numeral and letter headings refer to sample stations

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean	192.74	275.05	339.9	523.21	205.90	213.07	397.50	346.54
	Range	111.50-245.94	182.36-422.02	108.08-616.61	87.98-3349.20	73.05-372.60	147.16-250.85	142.23-1059.80	233.72-737.75
	# Samples	3	10	8	12	4	3	5	6
Cu	Mean	6.29	6.11	5.28	9.74	7.23	6.29	6.87	5.51
	Range	4.96-8.25	3.41-8.13	3.96-6.52	4.11-36.30	4.28-12.78	4.81-8.01	3.21-9.97	4.36-7.02
	# Samples	3	10	8	12	4	3	5	6
Zn	Mean	111.44	65.84	70.496	104.48	100.865	73.19	100.69	87.982
	Range	66.05-153.27	50.34-84.51	49.21-84.78	21.92-370.45	61.75-150.32	51.00-94.33	52.55-164.80	43.180-143.23
	# Samples	3	10	8	12	4	3	5	6
Cd	Mean	3.94	2.134	3.378	2.45	2.588	3.461	2.19	2.77
	Range	3.167-5.337	1.424-2.862	1.604-5.00	1.29-3.22	2.624-2.822	1.80-4.700	1.17-2.74	1.627-4.079
	# Samples	3	9	8	11	4	3	5	6
Ag	Mean	2.273	2.026	2.087	2.30	2.220	1.366	1.97	1.785
	Range	1.35-3.68	0.759-3.220	1.070-2.720	0.41-8.50	0.85-3.86	0.82-2.05	0.86-5.71	1.250-2.580
	# Samples	3	10	8	12	4	3	5	6
Mn	Mean	3.277	8.532	9.059	6.78	6.055	7.040	6.70	8.353
	Range	3.14-3.43	4.86-14.24	6.100-12.30	2.89-13.93	2.81-9.18	5.160-10.79	4.89-10.05	4.37-19.65
	# Samples	3	10	8	11	4	3	5	6
Pb	Mean	5.163	5.373	5.98	5.68	4.883	7.577	6.24	6.425
	Range	3.78-6.30	3.22-7.52	4.33-7.50	3.54-7.82	4.120-6.410	4.99-9.90	4.15-9.12	4.50-9.70
	# Samples	3	10	8	11	4	3	5	6
Co	Mean	1.50	1.126	0.764	1.48	1.068	1.073	1.12	1.230
	Range	0.89-2.03	0.720-1.520	0.540-1.040	0.45-4.52	0.54-1.94	0.69-1.28	0.81-1.95	0.87-1.94
	# Samples	3	10	8	11	4	3	5	6
Ni	Mean	19.50	8.80	8.80	10.82	9.73	12.10	12.60	14.47
	Range	11.42-24.38	4.89--15.84	5.29-15.06	2.51-16.29	5.00-16.69	5.20-16.85	5.95-23.77	10.26-21.99
	# Samples	3	10	8	9	4	3	4	6
Cr	Mean	2.88	4.33	3.40	3.17	2.51	3.38	2.62	3.38
	Range	2.18-3.73	3.54-6.08	2.03-4.07	1.87-3.99	2.07-2.80	2.59-4.24	1.39-3.34	2.03-4.89
	# Samples	3	10	8	12	4	3	5	6
Al	Mean	11.63	36.79	26.51	30.18	22.05	31.32	34.89	19.91
	Range	2.28-17.23	16.57-92.89	15.03-63.20	16.86-60.34	17.03-25.55	19.92-47.01	11.13-75.50	12.27-24.38
	# Samples	3	10	7	11	3	3	5	6
V	Mean	2.12	4.02	3.37	2.90	2.86	2.36	2.13	2.56
	Range	1.86-2.53	2.59-5.77	2.30-4.01	2.55-3.60	2.58-3.34	1.26-3.17	1.49-3.61	1.90-3.25
	# Samples	3	10	8	12	4	3	5	6

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean	377.80	624.00	226.90	504.40		630.95	292.8
	Range	122.73-894.30	-- --	46.42-395.60	181.57-1149.11		-- --	-- --
	# Samples	10	1	6	8		1	1
Cu	Mean	6.11	4.2	6.40	5.07		4.334	7.350
	Range	3.91-8.14	--	4.57-11.12	3.18-6.54		-- --	-- --
	# Samples	10	1	6	8		1	1
Zn	Mean	74.98	39.0	83.76	52.28		41.334	140.99
	Range	53.26-112.16	--	61.93-126.41	24.54-70.98		--	--
	# Samples	10	1	6	8		1	1
Cd	Mean	2.59	1.6	2.19	1.88		1.308	3.891
	Range	1.71-3.89	-- 11	1.47-2.65	1.107-2.890		-- --	-- --
	# Samples	10	1	6	8		1	1
Ag	Mean	1.86	0.7	1.89	1.406		0.909	0.378
	Range	0.78-4.11	-- --	0.98-4.95	0.360-5.080		-- --	-- --
	# Samples	10	1	6	8		1	1
Mn	Mean	9.12	22.4	7.01	14.566		28.346	7.568
	Range	5.43-23.39	-- --	3.53-9.74	4.30-28.80		-- --	-- --
	# Samples	10	1	6	8		1	1
Pb	Mean	7.84	4.4	5.31	5.673		3.830	8.378
	Range	5.73-11.45	-- --	4.16-7.13	2.42-8.39		-- --	-- --
	# Samples	10	1	6	8		1	1
Co	Mean	2.25	2.8	0.751	2.584		0.512	2.074
	Range	0.61-9.59	-- --	0.536-1.087	0.480-8.230		-- --	-- --
	# Samples	10	1	6	8		1	1
Ni	Mean	11.47	--	17.62	24.27		--	51.9
	Range	6.74-15.76	-- --	4.57-38.28	6.97-46.64		-- --	-- --
	# Samples	8	1	6	6		1	1
Cr	Mean	3.79	3.47	2.59	3.73		2.35	6.27
	Range	2.156-5.15	-- --	2.07-3.13	2.98-5.46		-- --	-- --
	# Samples	10	1	6	8		1	1
Al	Mean	28.96	--	21.51	62.00		--	40.36
	Range	18.16-53.47	-- --	15.37-33.33	17.01-123.44		-- --	-- --
	# Samples	10	1	6	7		1	1
V	Mean	2.47	2.94	2.49	3.69		4.74	3.24
	Range	2.00-2.99	-- --	1.28-3.18	2.34-4.59		-- --	-- --
	# Samples	10	1	6	8		1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

ugm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean	627.60	972.8	1324.15	727.18	861.5	679.5	1247.2	976.2
	Range	296.8-	615.7-	416.3-	330.4-	368.9-	520.0-	498.8	635.2-
		896.8	1373.0	2798.0	1131.0	1931.0	816.7	3299.0	1856.0
	# Samples	3	10	8	11	4	3	5	6
Cu	Mean	20.23	22.11	20.72	27.93	24.05	20.02	19.92	15.97
	Range	13.19-	9.99-	12.72-	11.33-	10.44-	17.00-	10.12-	10.96-
		30.08	35.86	29.62	61.80	36.14	23.37	26.08	21.36
	# Samples	3	10	8	11	4	3	5	6
Zn	Mean	256.0	236.0	270.0	250.0	312.0	241.0	319.0	255.0
	Range	205.21-	147.1-	166.7-	125.1-	227.3-	148.1-	168.5-	108.6-
		306.1	332.7	355.4	457.9	425.0	333.3	513.0	359.6
	# Samples	2	10	8	11	4	3	5	6
Cd	Mean	12.76	7.698	13.128	9.891	8.68	10.90	6.984	8.015
	Range	8.43-	4.60-	6.18-	4.16-	6.15-	6.37-	3.69-	5.26-
		19.61	12.23	22.71	27.91	13.65	13.65	9.62	13.14
	# Samples	3	10	8	11	4	3	5	6
Ag	Mean	4.59	6.88	5.18	5.26	6.68	4.28	6.27	4.60
	Range	3.59-	3.35-	3.28-	2.87-	4.38-	2.89-	2.69-	2.88-
		5.59	8.80	17.13	10.48	11.29	5.96	18.30	7.85
	# Samples	2	10	8	11	4	3	5	6
Mn	Mean	10.30	29.60	41.20	48.40	22.10	22.80	21.50	23.50
	Range	8.36-	16.41-	21.36-	10.75-	7.95-	15.00-	15.40-	11.50-
		12.50	51.20	60.33	264.94	47.57	35.19	35.26	49.44
	# Samples	3	10	8	11	4	3	5	6
Pb	Mean	16.50	19.20	22.90	19.80	22.90	24.20	19.80	18.40
	Range	10.04-	10.79-	17.44-	13.46-	10.03-	17.63-	13.06-	11.34-
		19.72	28.96	56.76	25.48	22.75	32.30	29.24	24.40
	# Samples	3	10	8	11	4	3	5	6
Co	Mean	4.80	4.03	4.20	4.34	3.17	3.53	3.52	3.65
	Range	2.77-	2.59-	2.06-	0.96-	2.49-	1.99-	1.81-	2.18-
		7.42	5.56	6.53	11.95	4.74	4.52	6.13	6.25
	# Samples	3	10	8	11	4	3	5	6
Ni	Mean	61.66	31.06	33.53	37.10	28.96	40.35	39.93	42.90
	Range	35.65-	17.576-	24.00-	18.42-	15.377-	15.128-	19.09-	25.518-
		88.92	46.705	58.04	54.94	40.66	59.556	74.78	70.83
	# Samples	3	10	8	9	4	3	4	6
Cr	Mean	9.31	15.75	13.38	10.86	8.12	10.769	8.20	9.64
	Range	5.82-	10.58-	7.35-	8.00-	6.293-	9.185-	4.895-	6.175-
		13.62	26.82	18.55	22.48	10.706	12.308	10.73	12.29
	# Samples	3	10	8	11	4	3	5	6
Al	Mean	34.07	127.36	96.21	76.37	59.59	98.352	106.85	56.80
	Range	8.33-	48.42-	57.92-	20.38-	49.85-	70.37-	39.04-	37.32-
		48.02	256.88	198.35	156.11	66.67	136.53	219.07	74.97
	# Samples	3	10	7	11	3	3	5	6
	Mean	6.66	14.16	13.15	9.54	9.41	7.501	6.74	7.33
	Range	4.95-	7.594-	6.747-	1.21-	6.916-	4.444-	5.245-	6.239-
		7.909	22.18	18.195	25.19	13.382	10.37	11.594	9.615
	# Samples	3	10	8	12	4	3	5	6

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

µmg/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean	1138.18	6092.0	791.53	3383.5		8156.00	915.0
	Range	329.50-	--	496.2-	616.1-		--	--
		2114.00	--	1280.0	8987.0-		--	--
	# Samples	10	1	6	8		1	1
Cu	Mean	19.11	40.52	20.09	28.83		56.62	22.97
	Range	13.39-	--	14.35-	17.49-		--	--
		32.33	--	31.92	47.94		--	--
	# Samples	10	1	6	8		1	1
Zn	Mean	233.00	381.00	266.00	303.00		534.00	441.00
	Range	114.40-	--	199.6-	174.4-		--	--
		278.80	--	362.7	464.4			
	# Samples	10	1	6	8		1	1
Cd	Mean	8.048	16.09	7.10	11.29		16.91	12.16
	Range	4.59-	--	4.23-	4.47-		--	--
		13.03	--	8.93	20.92		--	--
	# Samples	10	1	6	8		1	1
Ag	Mean	5.64	7.19	6.04	7.15		11.76	1.18
	Range	2.15-	--	3.05-	1.18-		--	--
		10.63	--	15.58	17.25		--	--
	# Samples	10	1	6	8		1	1
Mn	Mean	29.20	219.00	22.7	99.7		366.00	23.6
	Range	14.63-	--	11.13-	14.59-		--	--
		78.76	--	33.83	225.49		--	--
	# Samples	10	1	6	8		1	1
Pb	Mean	22.00	42.80	17.10	29.00		49.50	26.20
	Range	15.39-	--	12.82-	15.53-		--	--
		51.70	--	24.05	58.17		--	--
	# Samples	10	1	6	8		1	1
Co	Mean	5.94	27.30	2.43	15.5		6.62	6.48
	Range	2.18-	--	1.54-	2.43-		--	--
		20.54	--	3.39	64.46		--	--
	# Samples	10	1	6	8		1	1
Ni	Mean	35.20	--	56.95	71.19		25.25	62.16
	Range	23.26-	--	15.428-	29.77-		--	--
		43.19	--	133.037	161.56		--	--
	# Samples	7	1	6	6		1	1
Cr	Mean	11.89	33.91	8.30	21.93		30.392	79.59
	Range	7.01-	--	6.701-	10.12-		--	--
		20.99	--	10.32	33.17		--	--
	# Samples	10	1	6	8		1	1
Al	Mean	88.51	--	68.80	484.04		--	126.13
	Range	44.03-	--	50.04-	57.72-		--	--
		162.73	--	112.49	1140.00		--	--
	# Samples	10	1	6	7		1	1
	Mean	7.62	28.74	7.96	21.20		61.27	10.14
	Range	5.68-	--	4.45-	9.32-		--	--
		10.80	--	10.32	35.95		--	--
	# Samples	10	1	6	8		1	1

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - viscera & foot

*		14	9 (wet wt.)	H (wet wt.)	9 (dry wt.)	H (dry wt.)	9 (ash wt.)	H (ash wt.)
Fe	Mean		130.44	189.01	586.77	720.97	46.91	7747.0
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Cu	Mean		1.343	0.653	6.042	2.491	48.30	26.77
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Zn	Mean		12.605	12.855	56.701	49.04	4533.0	526.9
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Cd	Mean		0.075	0.132	0.337	0.505	2.70	5.43
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Ag	Mean		0.484	0.704	2.176	2.667	17.40	28.87
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Mn	Mean		5.590	10.507	25.14	40.073	201.01	430.65
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Pb	Mean		0.474	0.673	2.130	2.567	17.03	27.58
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Co	Mean		0.414	0.464	1.861	1.771	14.88	19.03
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Ni	Mean		0.529	0.483	2.383	1.841	19.048	19.785
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Cr	Mean		0.484	0.881	2.176	3.362	17.399	36.129
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Al	Mean		48.89	144.02	219.93	549.38	1758.2	5903.2
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
V	Mean		0.688	1.259	3.093	4.803	24.725	51.613
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only

*		14	9 (wet wt.)	H (wet wt.)	9 (dry wt.)	H (dry wt.)	9 (ash wt.)	H (ash wt.)
Fe	Mean		27.56	39.77	105.56	156.12	1604.0	2621.0
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Cu	Mean		0.331	0.264	1.268	1.038	19.26	17.42
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Zn	Mean		10.565	9.964	40.455	39.11	614.7	656.6
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Cd	Mean		0.018	0.023	0.071	0.090	1.08	1.52
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Ag	Mean		0.033	0.069	0.128	0.271	1.95	4.55
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Mn	Mean		0.267	0.920	1.022	3.610	15.53	60.61
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Pb	Mean		0.380	0.249	1.453	0.977	22.08	16.41
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Co	Mean		0.059	0.061	0.227	0.240	3.46	4.04
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Ni	Mean		2.102	0.257	8.048	1.008	122.29	16.919
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Cr	Mean		0.067	0.115	0.256	0.451	3.89	7.576
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
Al	Mean		2.567	10.27	9.829	40.31	149.35	676.77
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1
V	Mean		0.037	0.115	0.142	0.451	2.164	7.576
	Range		--	--	--	--	--	--
			--	--	--	--	--	--
	# Samples		1	1	1	1	1	1

* Numeral and letter headings refer to sample stations

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - total		wet wt.		dry wt.		ash wt	
	14	9	17	9	17	9	17
Fe Mean		104.21	49.50	448.776	209.39	4152.0	1664.0
Range		--	36.09-	--	93.34-	--	1076.0-
		--	62.23	--	259.86	--	2754.0
# Samples		1	4	1	4	1	4
Cu Mean		1.084	1.20	4.673	4.75	26.50	38.81
Range		--	0.87-	--	0.68-	--	26.09-
		--	1.57	--	7.33	--	50.00
# Samples		1	4	1	4	1	4
Zn Mean		12.084	14.30	430.11	68.05	469.50	479.3
Range		--	12.38-	--	64.57-	--	369.1-
		--	17.42	--	71.24	--	770.8
# Samples		1	4	1	4	1	4
Cd Mean		0.06	0.13	0.260	0.575	2.537	4.79
Range		--	0.05-	--	0.24-	--	1.36-
		--	0.28	--	1.14	--	12.50
# Samples		1	4	1	4	1	4
Ag Mean		0.368	0.20	1.588	0.933	15.849	6.78
Range		--	0.15-	--	0.79-	--	4.35-
		--	0.28	--	1.14	--	12.50
# Samples		1	4	1	4	1	4
Mn Mean		4.232	2.13	18.223	9.82	182.39	133.32
Range		--	1.53-	--	8.05-	--	45.52-
		--	3.67	--	14.17	--	277.17
# Samples		1	4	1	4	1	4
Pb Mean		0.450	0.85	1.935	3.91	17.537	29.90
Range		--	0.58-	--	3.03-	--	13.68-
		--	1.60	--	6.44	--	70.83
# Samples		1	4	1	4	1	4
Co Mean		0.458	0.16	1.392	0.728	13.734	6.43
Range		--	0.06-	--	0.31-	--	1.74-
		--	0.38	--	1.52	--	16.67
# Samples		1	4	1	4	1	4
Ni Mean		0.93	1.44	4.01	7.33	29.41	41.59
Range		--	1.373-	--	6.512-	--	37.82-
		--	1.549	--	8.135	--	46.19
# Samples		1	3	1	3	1	3
Cr Mean		0.38	0.28	1.63	1.41	16.04	8.02
Range		--	0.248-	--	1.324-	--	7.42-
		--	0.301	--	1.583	--	8.96
# Samples		1	3	1	3	1	3
Al Mean		37.08	19.06	159.29	95.59	1596.76	544.55
Range		--	12.73-	--	68.197-	--	379.53-
		--	25.094	--	116.998	--	679.49
# Samples		1	3	1	3	1	3
V Mean		0.52	0.55	2.21	2.80	22.46	15.89
Range		--	0.334-	--	1.790-	--	9.964-
		--	0.838	--	4.397	--	24.876
# Samples		1	3	1	3	1	3

		wet wt		dry wt.		ash wt.	
		G	H	G	H	G	H
Fe	Mean	102.43	150.95	434.24	579.58	4489.0	6847.2
	Range	--	--	--	--	--	--
		--	----	--	--	--	--
	# Samples	1	1	1	1	1	1
Cu	Mean	0.656	0.553	2.781	541.27	28.75	25.13
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Zn	Mean	12.388	12.117	52.52	46.561	542.9	535.77
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Cd	Mean	0.052	0.097	0.222	0.401	2.29	5.16
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Ag	Mean	0.250	0.542	1.058	2.033	10.94	27.207
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Mn	Mean	3.981	8.062	16.878	30.975	174.48	405.351
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Pb	Mean	0.473	0.564	2.005	1.572	20.73	21.816
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Co	Mean	0.171	0.361	0.726	1.358	7.50	18.005
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Ni	Mean	0.361	0.31	1.532	1.22	15.833	17.11
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Cr	Mean	0.271	0.31	1.149	29.11	11.875	9.52
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
Al	Mean	38.577	44.38	163.54	167.38	1690.63	1034.10
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1
V	Mean	0.333	11.21	1.411	1.54	14.583	10.59
	Range	--	--	--	--	--	--
		--	--	--	--	--	--
	# Samples	1	1	1	1	1	1

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Wet Weight

		14	9	17	C	5	8	11
Fe	Mean	17.41		11.74	32.39		5.05	31.66
	Range	9.83-		--	--		--	14.18-
		25.20		--	--		--	65.72
	# Samples	5		1	1		1	3
Cu	Mean	0.034		0.272	0.555		0.290	0.24
	Range	0.29-		--	--		--	0.23-
		0.43		--	--		--	0.26
	# Samples	5		1	1		1	3
Zn	Mean	16.11		13.620	14.390		12.861	17.78
	Range	14.28-		--	--		--	13.72-
		19.01		--	--		--	24.10
	# Samples	5		1	1		1	3
Cd	Mean	1.09		0.302	0.317		0.155	0.68
	Range	0.68-		--	--		--	0.47-
		1.43		--	--		--	0.85
	# Samples	5		1	1		1	3
Ag	Mean	0.06		0.052	0.051		0.062	0.05
	Range	0.05-		--	--		--	0.03-
		0.07		--	--		--	0.06
	# Samples	5		1	1		1	3
Mn	Mean	1.83		0.479	0.816		0.923	3.02
	Range	0.80-		--	--		--	1.09-
		4.80		--	--		--	6.03
	# Samples	5		1	1		1	3
Pb	Mean	0.44		0.332	0.334		0.373	0.48
	Range	0.37-		--	--		--	0.44
		0.48		--	--		--	0.51
	# Samples	5		1	1		1	3
Co	Mean	0.04		8.708	0.215		0.073	0.04
	Range	0.02-		--	--		--	0.02-
		0.07		--	--		--	0.05
	# Samples	4		1	1		1	3
Ni	Mean	3.470		0.086	--		0.156	1.128
	Range	0.593-		--	--		--	0.153-
		6.589		--	--		--	2.638
	# Samples	4		1	1		1	3
Cr	Mean	0.6014		0.112	0.136		0.104	0.437
	Range	0.116-		--	--		--	0.12-
		1.162		--	--		--	1.001
	# Samples	4		1	1		1	3
Al	Mean	6.310		5.094	4.192		4.356	13.758
	Range	2.857-		--	--		--	5.519-
		1.074		--	--		--	25.599
	# Samples	5		1	1		1	3
V	Mean	0.182		0.129	0.113		0.207	0.228
	Range	0.099-		--	--		--	0.055-
		0.313		--	--		--	0.329
	# Samples	4		1	1		1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Dry Weight

		14	9	17	1	C	5	8	11
Fe	Mean	96.99		50.42		140.381		10.005	161.46
	Range	58.87-		--		--		--	71.52-
		127.65		--		--		--	328.45
	# Samples	5		1		1		1	3
Cu	Mean	1.94		1.168		2.406		0.575	1.25
	Range	1.69-		--		--		--	1.16-
		2.46		--		--		--	1.31
	# Samples	5		1		1		1	3
Zn	Mean	90.873		58.49		62.349		25.45	93.92
	Range	81.091-		--		--		--	68.56-
		113.807		--		--		--	134.86
	# Samples	5		1		1		1	3
Cd	Mean	6.10		1.298		1.375		0.308	3.48
	Range	3.791-		--		--		--	2.63-
		8.40		--		--		--	4.29
	# Samples	5		1		1		.	3
Ag	Mean	0.332		0.223		0.221		0.123	0.234
	Range	0.281-		--		--		--	0.18-
		0.411		--		--		--	0.30
	# Samples	5		1		1		1	3
Mn	Mean	10.609		2.058		3.535		1.826	16.30
	Range	4.53-		--		--		--	5.49-
		28.70		--		--		--	33.73
	# Samples	5		1		1		1	3
Pb	Mean	2.498		1.427		1.448		0.739	2.50
	Range	2.125-		--		--		--	2.23-
		2.894		--		--		--	2.75
	# Samples	5		1		1		1	3
Co	Mean	0.206		0.037		0.933		0.144	0.19
	Range	0.116-		--		--		--	0.124-
		0.392		--		--		--	0.275
	# Samples	4		1		1		1	3
Ni	Mean	19.236		0.371		--		0.308	5.715
	Range	3.549-		--		--		--	0.856-
		37.416		--		--		--	13.307
	# Samples	4		1		1		1	3
Cr	Mean	3.386		0.482		0.589		0.205	2.224
	Range	0.634-		--		--		--	0.673-
		6.599		--		--		--	5.057
	# Samples	4		1		1		1	3
Al	Mean	34.919		21.876		18.164		8.621	70.013
	Range	16.219-		--		--		--	30.887-
		56.083		--		--		--	127.92
	# Samples	5		1		1		1	3
V	Mean	0.647		0.556		0.491		15.519	1.153
	Range	0.559-		--		--		--	0.306-
		1.584		--		--		--	1.663
	# Samples	4		1		1		1	3

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Ash Weight

		14	9	17	C	5	8	11
Fe	Mean	813.98		552.8	1869.0		270.0	1478.0
	Range	545.4- 1385.0		-- --	-- --		-- --	676.1- 3061.0
	# Samples	5		1	1		1	3
Cu	Mean	15.65		12.81	32.03		15.56	11.32
	Range	12.71- 22.28		-- --	-- --		-- --	10.86- 12.04
	# Samples	5		1	1		1	3
Zn	Mean	742.0		641.3	830.1		688.9	831.0
	Range	539.9- 1056.8		--	-- --		-- --	638.9- 1113.6
	# Samples	5			1		1	3
Cd	Mean	51.0		14.23	18.30		8.33	31.7
	Range	28.65- 86.74		-- --	-- --		-- --	21.72- 40.57
	# Samples	5		1	1		1	3
Ag	Mean	2.65		2.44	2.94		3.33	2.15
	Range	2.27- 3.41		-- --	-- --		-- --	1.52- 2.85
	# Samples	5		1	1		1	3
Mn	Mean	80.97		22.56	47.06		49.44	140.2
	Range	32.93- 210.17		-- --	-- --		-- --	51.89- 278.54
	# Samples	5		1	1		1	3
Pb	Mean	20.19		15.65	19.28		20.00	22.5
	Range	15.45- 27.27		-- --	-- --		-- --	21.07- 23.61
	# Samples	5		1	1		1	3
Co	Mean	1.35		0.41	12.42		3.89	1.77
	Range	0.00- 2.85		-- --	-- --		-- --	1.16- 2.27
	# Samples	5		1	1		1	3
Ni	Mean	161.606		4.065	--		8.333	53.54
	Range	25.989- 271.951		-- --	-- --		-- --	7.071- 128.79
	# Samples	5		1	1		1	3
Cr	Mean	26.52		5.285	7.843		5.555	20.716
	Range	5.085- 47.967		-- --	-- --		-- --	5.555- 47.799
	# Samples	5		1	1		1	3
Al	Mean	301.14		239.84	241.83		233.33	643.81
	Range	117.886- 670.455		-- --	-- --		-- --	255.05- 1192.13
	# Samples	5		1	1		1	3
Y	Mean	8.899		6.098	6.535		11.111	10.712
	Range	4.065- 18.939		-- --	-- --		-- --	2.525- 15.723
	# Samples	4		1	1		1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot — µgm/gm Wet Weight

		14	9	17	C	5	8	11
Fe	Mean	111.66		1.23	151.09		171.68	233.41
	Range	57.55- 164.54		-- --	-- --		-- --	205.47- 274.15
	# Samples	5		1	1		1	3
Cu	Mean	1.01		2.52	1.484		0.996	1.27
	Range	0.87- 1.19		-- --	-- --		-- --	0.85- 1.58
	# Samples	5		1	1		1	3
Zn	Mean	10.37		16.119	12.394		15.809	9.72
	Range	7.80- 14.96		-- --	-- --		-- --	9.25- 10.14
	# Samples	5		1	1		1	3
Cd	Mean	10.69		8.993	7.424		3.977	16.01
	Range	8.28- 14.95		-- --	-- --		-- --	11.23- 19.23
	# Samples	5		1	1		1	3
Ag	Mean	0.15		0.097	0.087		0.136	0.12
	Range	0.11- 0.20		-- --	-- --		-- --	0.08- 0.16
	# Samples	5		1	1		1	3
Mn	Mean	3.90		2.549	4.571		6.292	7.87
	Range	2.94- 5.36		-- --	-- --		-- --	6.07- 10.07
	# Samples	5		1	1		1	3
Pb	Mean	0.40		0.534	0.624		0.743	0.54
	Range	0.33- 0.50		-- --	-- --		-- --	0.50- 0.57
	# Samples	5		1	1		1	3
Co	Mean	0.17		0.136	0.166		0.063	0.17
	Range	0.07- 0.43		-- --	-- --		-- --	0.14- 0.19
	# Samples	5		1	1		1	3
Ni	Mean	0.499		0.484	0.345		2.940	0.508
	Range	0.346- 0.749		-- --	-- --		-- --	0.488- 0.542
	# Samples	4		1	1		1	3
Cr	Mean	0.4103		0.738	0.807		0.471	0.782
	Range	0.372- 0.447		-- --	-- --		-- --	0.705- 0.913
	# Samples	5		1	1		1	3
Al	Mean	37.56		50.522	68.713		62.83	91.686
	Range	7.216- 58.534		-- --	-- --		-- --	15.54- 135.69
	# Samples	5		1	1		1	3
Y	Mean	1.828		4.454	3.660		2.039	2.683
	Range	1.555- 2.011		-- --	-- --		-- --	2.268- 2.982
	# Samples	5		1	1		1	3

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot

µgm/gm Dry Weight

		14	9	17	C	5	8	11
Fe	Mean	849.56		5.416	872.38		906.22	1207.8
	Range	575.13-		--	--		--	1022.8-
		1093.89		--	--		--	1321.9
	# Samples	5		1	1		1	3
Cu	Mean	8.09		11.041	8.574		5.260	6.77
	Range	6.67-		--	--		--	4.11-
		9.84		--	--		--	9.85
	# Samples	5		1	1		1	3
Zn	Mean	86.526		70.602	71.563		83.44	51.01
	Range	53.937-		--	--		--	42.87-
		149.49		--	--		--	63.09
	# Samples	5		1	1		1	3
Cd	Mean	87.865		39.390	42.87		20.996	84.23
	Range	55.05-		--	--		--	54.17-
		137.48		--	--		--	109.39
	# Samples	5		1	1		1	3
Ag	Mean	1.211		0.427	0.504		0.718	0.65
	Range	0.836		--	--		--	0.358-
		1.69		--	--		--	0.968
	# Samples	5		1	1		1	3
Mn	Mean	31.521		11.166	26.39		43.758	40.32
	Range	21.20-		--	--		--	34.67-
		49.32		--	--		--	48.54
	# Samples	5		1	1		1	3
Pb	Mean	3.306		2.340	3.602		3.921	2.80
	Range	2.190-		--	--		--	2.386-
		4.94		--	--		--	3.36
	# Samples	5		1	1		1	3
Co	Mean	1.471		0.594	0.961		0.334	0.882
	Range	0.547-		--	--		--	0.68-
		4.306		--	--		--	1.10
	# Samples	5		1	1		1	3
Ni	Mean	3.272		2.118	1.993		15.519	2.671
	Range	2.324-		--	--		--	2.288-
		6.884		--	--		--	3.372
	# Samples	4		1	1		1	3
Cr	Mean	3.304		3.233	4.659		2.487	4.131
	Range	2.607-		--	--		--	3.771-
		4.110		--	--		--	4.389
	# Samples	5		1	1		1	3
Al	Mean	300.17		221.29	396.73		331.66	497.55
	Range	47.976-		--	--		--	72.063-
		467.46		--	--		--	751.86
	# Samples	5		1	1		1	3
V	Mean	14.633		19.509	21.133		10.760	14.156
	Range	12.341-		--	--		--	10.938-
		18.496		--	--		--	18.554
	# Samples	5		1	1		1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot

µgm/gm Ash Weight

		14	9	17	C	5	8	11
Fe	Mean	3119.0		3932.0	5766.0		5013.0	8798.0
	Range	1385.0-		--	--		--	6443.0-
		4764.0		--	--		--	10292.0
	# Samples	5		1	1		1	3
Cu	Mean	27.77		81.18	56.67		29.10	47.94
	Range	22.28-		--	--		--	30.06-
		33.17		--	--		--	64.09
	# Samples	5		1	1		1	3
Zn	Mean	279.6		519.1	473.0		461.6	364.4
	Range	227.9-		--	--		--	317.9-
		360.0		--	--		--	431.4
	# Samples	5		1	1		1	3
Cd	Mean	291.8		289.6	283.33		116.14	614.6
	Range	239.73-		--	--		--	395.74-
		405.45		--	--		--	896.91
	# Samples	5		1	1		1	3
Ag	Mean	4.10		3.14	3.33		3.97	4.35
	Range	3.06-		--	--		--	3.61-
		5.48		--	--		--	4.88
	# Samples	5		1	1		1	3
Mn	Mean	107.6		82.10	174.44		242.06	297.9
	Range	70.75		--	--		--	190.24
		145.45		--	--		--	354.64
	# Samples	5		1	1		1	3
Pb	Mean	10.96		17.21	23.81		21.69	20.4
	Range	9.54-		--	--		--	16.91-
		12.00		--	--		--	26.80
	# Samples	5		1	1		1	3
Co	Mean	4.39		4.37	6.35		1.85	6.41
	Range	2.00-		--	--		--	4.95-
		10.37		--	--		--	8.76
	# Samples	5		1	1		1	3
Ni	Mean	14.006		15.574	13.175		85.85	19.071
	Range	9.903-		--	--		--	16.990-
		20.303		--	--		--	23.024
	# Samples	4		1	1		1	3
Cr	Mean	11.282		23.77	30.794		13.766	30.76
	Range	8.957-		--	--		--	22.114-
		12.121		--	--		--	42.612
	# Samples	5		1	1		1	3
Al	Mean	1037.65		1627.05	2622.22		1834.66	3133.18
	Range	208.937-		--	--		--	725.00-
		1710.03		--	--		--	4885.85
	# Samples	5		1	1		1	3
V	Mean	50.294		143.443	139.68		59.524	101.33
	Range	37.415-		--	--		--	79.91-
		54.75		--	--		--	130.58
	# Samples	5		1	1		1	3

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total µgm/gm Wet Weight

		14	9	17	1	2	5	8	11	C	D	G
Fe	Mean	84.75	36.13	6.439	79.07	40.11	123.69	121.029	167.23	100.84		89.71
	Range	44.05-	--	--	75.44-	--	17.12-	--	143.36-	--		--
		119.91	--	--	82.69	--	230.25	--	200.75	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Cu	Mean	0.82	0.972	1.405	0.90	0.721	1.32	0.782	0.92	1.09		0.738
	Range	0.74-	--	--	0.80-	--	0.94-	--	0.68-	--		--
		0.93	--	--	1.00	--	1.70	--	1.13	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Zn	Mean	11.97	--	14.88	14.85	18.04	27.87	14.913	12.27	13.24		14.96
	Range	9.28-	--	--	12.84-	--	20.99	--	11.37-	--		--
		15.05	--	--	16.86	--	34.76	--	12.83	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Cd	Mean	8.86	3.497	4.685	2.88	2.578	2.93	2.816	10.77	4.415		2.95
	Range	7.41-	--	--	2.76-	--	2.77-	--	8.18-	--		--
		11.46	--	--	3.00	--	3.08	--	12.35	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Ag	Mean	0.12	--	0.074	0.20	0.154	0.16	0.1134	0.10	0.071		0.179
	Range	0.09-	--	--	0.17-	--	0.14-	--	0.07-	--		--
		0.15	--	--	9.22	--	0.19	--	0.12	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Mn	Mean	3.35	--	1.523	5.19	2.653	13.30	6.050	6.22	2.946		4.423
	Range	2.36-	--	--	4.62-	--	2.90-	--	4.65-	--		--
		5.22	--	--	5.75	--	23.68	--	8.92	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Pb	Mean	0.41	--	0.433	0.79	0.567	0.97	0.618	0.51	0.501		0.596
	Range	0.34-	--	--	0.62-	--	0.62-	--	0.49-	--		--
		0.48	--	--	0.96	--	1.32	--	0.53	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Co	Mean	0.14	--	--	0.07	0.052	0.10	0.0661	0.12	0.186		0.092
	Range	0.07-	--	--	0.06-	--	0.08-	--	0.11-	--		--
		0.31	--	--	0.08	--	0.17	--	0.13	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1
Ni	Mean	1.22	2.441	0.29	0.430	0.423	1.861	2.094	0.75	8.41		0.321
	Range	0.71-	--	--	0.365-	--	0.289-	--	0.39-	--		--
		1.77	--	--	0.494	--	3.430	--	1.30	--		--
	# Samples	3	1	1	2	1	2	1	3	1		1
Cr	Mean	1.04	0.302	0.43	0.325	0.248	0.473	0.3593	0.69	0.52		0.964
	Range	0.31-	--	--	0.271-	--	0.289-	--	0.53-	--		--
		2.91	--	--	0.378	--	0.657	--	0.95	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1
Al	Mean	86.16	19.38	28.00	39.16	17.43	36.805	45.053	121.09	41.40		39.69
	Range	4.99-	--	--	30.369-	--	7.821-	--	88.19-	--		--
		306.91	--	--	47.951	--	65.789	--	174.13	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
V	Mean	1.42	1.59	2.35	2.030	1.341	1.795	1.482	1.86	2.16		1.24
	Range	1.34-	--	--	1.879-	--	1.709-	--	1.64-	--		--
		1.53	--	--	2.180	--	1.880	--	2.06	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total

µgm/gm Dry Weight

		14	9	17	1	2	5	8	11	C	D	G
Fe	Mean	588.60	203.43	27.94	480.3	264.8	537.8	423.96	870.71	510.38		548.56
	Range	367.44-	--	--	476.62-	--	95.63-	--	700.17	--		--
		765.91	--	--	483.81	--	979.96	--	1007.51	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Cu	Mean	5.86	5.477	6.098	5.46	4.762	6.25	2.739	4.83	5.523		4.517
	Range	5.13-	--	--	5.15-	--	5.24-	--	3.40	--		--
		7.03	--	--	5.77	--	7.26	--	6.48	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Zn	Mean	86.91	89.24	64.54	89.74	119.04	141.75	52.239	54.84	67.01		91.47
	Range	64.49-	--	--	82.321-	--	89.34-	--	29.89	--		--
		122.11	--	--	97.157	--	194.15	--	69.39	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Cd	Mean	58.34	19.69	20.32	17.56	17.006	14.51	9.863	56.38	22.35		18.04
	Range	38.10-	--	--	15.913-	--	11.80-	--	41.07	--		--
		92.62	--	--	19.210	--	17.22	--	67.70	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Ag	Mean	0.84	2.879	0.329	1.21	1.02	0.79	0.398	0.51	0.363		1.095
	Range	0.69-	--	--	1.005-	--	0.77-	--	0.34	--		--
		1.09	--	--	1.406	--	0.80	--	0.67	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Mn	Mean	24.39	19.40	6.606	31.41	17.498	58.55	21.194	32.08	15.09		27.04
	Range	15.07-	--	--	29.653-	--	16.30-	--	24.77	--		--
		42.63	--	--	33.166	--	100.80	--	44.78	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Pb	Mean	2.43	4.58	1.882	4.74	3.742	4.54	2.209	2.68	2.536		3.647
	Range	1.05-	--	--	3.949-	--	3.48-	--	2.48	--		--
		3.57	--	--	5.528	--	5.60	00	3.03	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Co	Mean	1.05	0.377	0.315	0.43	0.34	0.46	0.232	0.64	0.947		0.561
	Range	0.50-	--	--	0.334-	--	0.18-	--	0.58	--		--
		2.54	--	--	0.535	--	0.73	--	0.71	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1
Ni	Mean	11.91	13.74	1.24	2.60	2.79	8.108	7.334	4.90	42.58		1.964
	Range	7.07-	--	--	2.343-	--	1.615-	--	3.22	--		--
		15.73	--	--	2.848	--	14.60	--	6.03	--		--
	# Samples	3	1	1	2	1	2	1	3	1		1
Cr	Mean	3.88	1.699	1.86	1.96	1.63	2.207	1.259	3.51	2.65		5.89
	Range	1.87-	--	--	1.740-	--	1.615-	--	2.98	--		--
		4.88	--	--	2.178	--	2.80	--	4.51	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1
Al	Mean	207.62	109.07	121.47	235.58	114.97	161.84	157.831	359.28	209.52		242.70
	Range	46.90-	--	--	194.78-	--	43.686-	--	65.00	--		--
		334.64	--	--	276.38	--	280.00	--	506.68	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
V	Mean	12.30	8.971	10.02	12.31	8.843	8.773	5.191	9.71	10.93		7.576
	Range	10.01-	--	--	12.048-	--	8.00-	--	8.16	--		--
		13.86	--	--	12.563	--	9.545	--	11.83	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1

Reynolds, B. & G. Pesch. 1974.

Metals Concentrations in Echinoderm and Mollusc Tissues

	Pecten - total											µgm/gm Ash Weight
		14	9	17	1	2	5	8	11	C	D	G
Fe	Mean	2942.79	1670.0	2604.0	2883.0	1323.0	4062.2	4690.41	8151.45	4492.0		2785.0
	Range	1266.85-	--	--	2802.0-	--	700.3-	--	5888.21-	--		--
		4286.68	--	--	2964.0	--	7424.0	--	9437.25	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Cu	Mean	26.47	44.96	53.70	32.89	23.81	46.75	28.179	43.91	48.61		22.93
	Range	21.06-	--	--	29.84-	--	38.44-	--	28.87-	--		--
		32.10	--	--	35.94	--	55.05	--	59.37	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Zn	Mean	326.99	732.6	546.32	540.45	595.2	1049.30	477.060	406.29	526.23		464.4
	Range	256.57-	--	--	476.7-	--	676.8-	--	370.56-	--		--
		406.52	--	--	604.2	--	1421.7	--	458.88	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Cd	Mean	265.95	161.63	228.27	105.10	85.03	107.74	108.807	553.55	243.83		91.60
	Range	214.72-	--	--	98.96-	--	89.39-	--	373.66-	--		--
		367.91	--	--	111.24	--	126.08	--	820.79	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Ag	Mean	3.94	23.64	3.838	7.195	5.10	5.86	3.926	4.12	3.271		5.56
	Range	3.010-	--	--	6.25-	--	5.65-	--	3.54-	--		--
		5.30	--	--	8.14	--	6.06	--	4.42	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Mn	Mean	107.06	159.30	88.56	188.98	87.41	441.50	222.96	277.31	155.45		137.32
	Range	66.98-	--	--	171.71-	--	119.35-	--	159.37-	--		--
		152.51	--	--	206.25	--	763.64	--	350.15	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Pb	Mean	11.93	37.60	21.693	28.625	18.71	33.98	21.575	20.68	23.134		18.52
	Range	10.21-	--	--	22.87-	--	25.54-	--	17.74-	--		--
		13.32	--	--	34.38	--	42.42	--	26.29	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Co	Mean	4.00	3.10	3.487	2.59	1.70	3 45	1.989	5.92	7.254		2.85
	Range	2.07-	--	--	2.08-	--	1.34-	--	4.81-	--		--
		9.12	--	--	3.10	--	5.56	--	8.15	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
Ni	Mean	59.69	112.78	13.01	15.637	13.95	61.217	80.575	22.51	178.04		9.972
	Range	20.92-	--	--	13.566-	--	11.828-	--	16.60-	--		--
		133.54	--	--	17.708	--	110.606	--	32.16	--		--
	# Samples	3	1	1	2	1	2	1	3	1		1
Cr	Mean	18.08	13.953	19.65	11.81	8.163	16.520	13.199	31.13	27.37		29.915
	Range	10.80-	--	--	10.078-	--	11.827-	--	19.93-	--		--
		32.87	--	--	13.542	--	21.212	--	43.07	--		--
	# Samples	4	1	1	2	1	2	1	3	1		1
Al	Mean	1016.84	895.35	1318.09	1423.33	574.83	1220.55	1725.74	1554.01	2267.42		1232.2
	Range	454.81-	--	--	1127.91-	--	319.89-	--	595.66-	--		--
		1583.77	--	--	1718.75	--	2121.21	--	3362.68	--		--
	# Samples	5	1	1	2	1	2	1	3	1		1
V	Mean	49.53	73.64	112.85	73.946	44.22	65.249	56.231	92.05	119.84		38.462
	Range	47.29-	--	--	69.767-	--	60.606-	--	75.34-	--		--
		51.65	--	--	78.125	--	69.892	--	120.37	--		--
	# Samples	4	1	1	2	1	2.	1	3	1		1

REF. NO.: 68 - R - 1

SUBSTANCES: As

Reference: Riego, A. F. del. 1968. Determinacion del arsenico en los organismos marinos. Bol. Inst. Espanol Oceanogr. 134:

Organisms: Mytilus edulis
Cardium edule
Tapes pullastra
Pecten maximus
Ostrea edulis

Date of Sample Collection: 1968?

Location: Spain

Analytical Technique:

Analytical Data:

CUADRO I

CONTENIDO DE ARSENICO EN MILIGRAMOS POR KILOGRAMO DE CARNE SECA A 105° C.

Especie	Parte analizada	Localidad de la toma de muestra	Fecha de la toma de muestra	Arsénico p. p. m.
Mytilus edulis	»	Domayo (ría de Vigo).	14- 8-67	11,1
»	»	Camposancos (La Guardia).	8-12-67	16,8
Cardium edule . . .	»	Cesantes (ría de Vigo).	20- 6-67	7,3
Tapes pullastra . . .	»	»	»	25,6
Pecten maximus . .	»	Bueu (ría de (Pontevedra).	17-10-67	4,5
»	»	»	17-11-67	10,5
Ostrea edulis	»	Rande (Vigo).	8-2-68	26,3
»	»	»	»	9,4

REF. NO.: 74 - R - 2

SUBSTANCES: Zn, Cu, Fe

Reference: Romeril, M. G. 1974. Trace metals in sediments and bivalve mollusca in Southampton water and the Solent. Rev. Intern. Oceanogr. Med. 33: 31-47.

Organisms: Mercenaria mercenaria
Cerastoderma edule

Date of Sample Collection: 1970-71

Location: Southampton and the Solent, Great Britain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE II
Trace metal levels in the hard shell clam, Mercenaria mercenaria

	Location				
	American coast #		Southampton water *		
	Average	Range	Average	Range A	Range B
Zinc	20.6	11.5 - 40.2	18.4	12.4 - 27.6	18.8
Copper	2.6	1.0 - 16.5	5.9	3.6 - 9.2	5.0
Iron	30.0	9 - 83	36.1	18 - 81	23.8

All values expressed as µg/g wet weight of tissue
* Converted from dry weight using a factor of 5
# Pringle, Hissong, Katz and Mulawka, 1968
A. Present study-average of all observations for one year
B. Segar, Collins and Riley, 1971.

TABLE III
Trace metal levels in the common cockle, Cerastoderma edule

Site	Iron	Zinc
Royal Pier*	735	88
Marchwood *	923	83
Cracknore	1327	140
Solent Breezes*	485	63
Calshot*	456	64
Lee-on-Solent	590	130
Beaulieu River	390	69
River Medway (Kent)	1060	-
Shoeburyness (Essex) #	514	208
The Wash #	885	108
Menai (Wales) #	498	175

All values expressed as µg/g dry weight tissue
* Mean of all survey observations
Cracknore : winter samples only
Lee-on-Solent : from Segar, Collins and Riley, 1971
Beaulieu River : July, 1972, samples only.
River Medway : Nov., 1972 samples only.
Winter values provided by Dr C. Boyden, Imperial College, London.

REF. NO.: 20 - R - 1

SUBSTANCES: Cu

Reference: Rose, W. C. & M. Bodansky. 1920. Biochemical studies on marine organisms. I. The occurrence of copper. J. Biol. Chem. 44:99-112.

Organisms: oysters, clams (unspecified)

Date of Sample Collection: 1920?

Location: Gulf of Mexico?

Analytical Technique: Colorimetry

Analytical Data:

TABLE IV.

Distribution of Copper in Oysters.

Tissue.	Amount taken for analysis.	Cu found.	Cu per kilo.
	gm.	*mg.*	*mg.*
Mantles	84.0	3.00	35.7
Digestive glands	56.7	1.95	34.4
Adductor muscles	38.5	0.70	18.2
Residue	102.0	4.10	40.2
Total	281.2*	9.75	34.7

* 300 gm. of fresh oysters were used for this experiment, but small fragments of tissue were unavoidably lost during the dissections, and considerable evaporation of water occurred. These factors account for the decrease of 18.8 gm. in weight.

TABLE III.

Quantity of Copper in Marine Animals.

Analysis No.	Animal.	Amount taken for analysis.	Cu found.	Cu per kilo.	Remarks.
		gm.	*mg.*	*mg.*	
	Cœlenterata.				
9	Jellyfish	200	0.30	1.5	Entire animal ground.
42	Portuguese man-of-war	272	0.60	2.2	One entire animal.
44	Portuguese man-of-war	81	0.30	3.7	Two small individuals.
	Pelecypoda.				
2	Oysters	100	4.52	45.2	Shucked.
4	"	100	6.00	60.0	Shucked.
31	"	100	4.30	43.0	Shucked.
32	"	100	2.40	24.0	Shucked.
37	"	100	4.70	47.0	Shucked.
39	Clams	77	0.0	0.0	Shucked.

REF. NO.: 61 - R - 1

SUBSTANCES: Mg, Sr, Mn, Na

Reference: Rucker, J. B. & J. W. Valentine. 1961. Salinity response of trace element concentration in Crassostrea virginica. Nature 190:1099-1100.

Organisms: Crassostrea virginica

Date of Sample Collection: 1961?

Location: U. S., Atlantic and Gulf of Mexico

Analytical Technique:

Analytical Data:

Table 1. Mean Concentrations ($\bar{X}$) and Standard Errors among Individuals (*S.E.*) of Selected Trace Elements in Shells of *Crassostrea virginica*, together with Mean Annual Temperatures and Salinities of Waters in which the Oysters grew

Locality	No. of shells	Mean annual temp. °C.	Mean annual Salinity ‰	Magnesium		Strontium		Manganese		Sodium	
				$\bar{X}$ p.p.m.	*S.E.*	$\bar{X}$ p.p.m.	*S.E.*	$\bar{X}$ p.p.m.	*S.E.*	$\bar{X}$ p.p.m.	*S.E.*
1	10	12·1	29·4	2062	386	1412	222	36·0	7·7	3225	10[illegible]
2	5	14·1	13·2	2186	365	1048	225	115·0	21·4	2064	243
3	16	16·1	19·2	2133	446	1472	140	61·3	10·7	2816	549
4	5	19·3	30·4	2070	340	1262	518	26·9	4·1	3170	553
5	5	20·1	?	2714	372	1142	158	75·9	44·5	2600	317
6	5	25·0	25·0	1972	429	1486	215	21·8	5·1	2570	639
7	5	21·0	30·0	1964	494	1572	23	44·6	23·3	3264	1614
8	5	21·5	13·7	2288	402	1184	57	54·2	12·3	2060	186
9	5	22·5	17·4	1964	431	1554	299	227·6	34·6	2150	317
10	5	21·9	13·3	2218	583	1425	36	67·7	54·4	2840	600
11	5	22·5	18·2	2158	459	1040	223	38·8	9·7	3150	529

Localities are: 1, West Chatham, Mass.; 2, Solomons, Md.; 3, Gloucester Point, Va.; 4, Beaufort, N.C.; 5, Sapelo Is., Ga.; 6, St. Petersburg, Fla.; 7, Alligator Harbor, Fla.; 8, St. George Is., Fla.; 9, Ocean Springs, Miss.; 10, Barataria Bay, La.; 11, Port Aransas, Tex.

REF. NO.: 75 - R - 2 **SUBSTANCES:** Zn, Cu

Reference: Ruddell, C. L. & D. W. Rains. 1975. The relationship between zinc, copper and the basophils of two Crassostreid oysters, C. gigas and C. virginica. Comp. Biochem. Physiol. 51A:585-591.

Organisms: Crassostrea gigas
Crassostrea virginica

Date of Sample Collection: 1975?

Location: San Francisco, California

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 2. The numbers of basophils per unit area in oyster mantles compared with zinc and copper levels in Pacific and American oysters

Reference designation and species*	Basophils per unit area per oyster (±S.E.)	Sample size	Part of oyster analyzed†	No. of determinations	ppm Zn dry wt.	ppm Cu dry wt.
1P	44·5 (±4) (1·6–105·7)§	27	WO	3 (3)‡	336 (70–588)§	149 (52–231)§
			M	3 (2)	328 (268–445)	129 (81–194)
			D	2 (2)	214 (141–287)	61 (36–87)
2P	85·4 (±7·8) (5·4–195·2)	40	WO	13 (1, 5)	422 (233–594)	19 (10–46)
			M	3 (2)	1039 (715–1666)	47 (25–80)
			D	2 (2)	400 (252–549)	18 (13–22)
3P	189·2 (±19·7) (83·6–287)	10	WO	1 (4)	429	482
			M	2 (2)	1508 (1215–1800)	900 (575–1225)
4P	346·4 (±51·4) (266·5–507·7)	5	WO	2 (5)	1656 (1644–1668)	319 (296–342)
5A	213·7 (±38·9) (115·3–332·5)	5	WO	2 (3)	1335 (1262–1408)	290 (244–335)
6A	743 (±105·4) (469·4–1577)	10	WO	6 (3)	4598 (1463–6883)	913 (600–2100)
			M	2 (2)	5285 (2140–8430)	968 (930–1005)

* See Table 1.
† WO, Whole oyster; M, mantle; D, digestive diverticula.
‡ Number in brackets indicates the number of oysters per determination.
§ Range.

Table 4. A comparison between the numbers of basophils per unit area and zinc and copper levels in digestive diverticula (D) and mantle in Pacific oysters from Drake's Estero

	D	N	Mantle	N
Basophils (±S.E.)	17·4 (±3·0)	11	95·63 (±18·5)	11
(range)	(1·1–34·1)	2 (2)*	(12·3–157·1)	
Zn (ppm)	400	2 (2)*	1039	3 (2)*
(range)	(252–549)		(715–1666)	
Cu (ppm)	18	2 (2)	47	3 (2)
(range)	(13–22)		(25–80)	

* Number in brackets indicates the number of oysters per determination or sample.

REF. NO.: 76 - S - 2

SUBSTANCES: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo

Reference: Saenko, G. N., N. N. Belcheva, T. A. Biryukova & N. A. Sinkov. 1976. Metal accumulation in viscera of starfish and molluscs. Zh. Obsh. Biol. 37:286-291.

Organisms:
Mactra sulcataria
Grenomytilus grayanus
Mercenaria stimpsoni
Mizhupecten yessoensis

Date of Sample Collection: 1972?

Location: ? (USSR)

Analytical Technique: Atomic absorption spectrophotometry ?

Analytical Data: (dry wt., dried at 103°C)

Таблица 1

Концентрация микроэлементов в отдельных органах моллюсков
(в % на сухой вес)

Орган	Вид	Концентрация металлов, $n \cdot 10^{-n}$%									
		Tl	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Mo
Мускул muscle	M. sulcataria	—	0,8	—	0,7	5,4	—	0,3	0,5	—	0,1
	G. grayanus	—	0,1	—	0,4	0,2	—	—	1,0	—	0,1
	M. stimpsoni	—	0,8	—	0,4	4,3	—	След	0,3	—	След
	M. yessoensis	—	0,8	—	0,6	2,1	—	—	0,2	—	—
Мантия mantle	M. sulcataria	—	0,6	—	3,9	5,1	—	0,3	1,3	0,6	0,7
	G. grayanus	—	1,2	—	0,3	9,2	—	0,2	1,4	След	0,6
	M. stimpsoni	—	0,4	—	0,3	3,6	—	0,4	1,2	0,8	0,5
	M. yessoensis	—	След	—	0,3	1,2	—	0,4	0,6	7,8	0,5
Жабры liver	M. sulcataria	0,7	След	0,7	0,4	3,4	0,4	0,4	9,3	4,0	5,4
	G. grayanus	1,0	—	0,8	1,3	6,4	0,7	0,6	17,3	5,8	1,3
	M. stimpsoni	0,1	—	0,8	0,6	4,5	2,4	0,3	9,8	7,1	0,9
	M. yessoensis	0,6	—	0,7	4,4	2,4	0,3	1,6	5,5	39,0	0,7
Печень gills	M. sulcataria	21,1	4,3	След	2,9	6,1	0,4	1,5	5,0	3,3	1,5
	G. grayanus	3,1	21,0	0,1	2,3	9,6	1,2	1,1	5,6	45,0	1,8
	M. stimpsoni	2,7	16,2	След	2,1	6,5	0,5	1,2	3,7	5,2	1,1
	M. yessoensis	0,5	6,4	—	0,3	5,7	След	0,5	6,4	20,2	0,6
Гонады gonads	G. grayanus	—	—	—	0,5	5,0	—	—	8,4	—	—
	M. stimpsoni	—	—	—	1,2	7,0	0,1	0,5	2,3	—	—
	M. yessoensis	—	—	—	0,4	6,0	—	0,7	20,2	—	1,1
Кеберов орган Keber's organ	G. grayanus	8,8	—	10^{-1}	0,1	2,3	12,8	21,0	32,0	8,0	7,8
Морская вода		$1,0 \cdot 10^{-7}$*	$4,4 \cdot 10^{-7}$	$2,0 \cdot 10^{-9}$*	$6,4 \cdot 10^{-7}$	$37,5 \cdot 10^{-6}$	$5 \cdot 10^{-7}$	$4,2 \cdot 10^{-7}$	$2,5 \cdot 10^{-7}$	$66,6 \cdot 10^{-7}$	$11 \cdot 10^{-7}$

* По А. П. Виноградову (1967).

Saenko, G. N. et al. 1976.

REF. NO.: 63 - S - 1

SUBSTANCES: Ti

Reference: Schroeder, H. A., J. J. Balassa & I. H. Tipton. 1963. Abnormal trace metals in man: titanium. J. chron. Dis. 16:55-69.

Organisms: oysters, clams, scallops (unspecified)

Date of Sample Collection: 1963?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 4. TITANIUM IN FOOD

Sample	Conc. (μg/g wet wt)	*μg/100 calories
Oysters, fresh	0.14	28
Clams, fresh, soft	0.04	8
Clams, fresh, hard	0.18	36
Scallops, fresh	0.75	75

REF. NO.: 63 - S - 2

SUBSTANCES: V

Reference: Schroeder, H. A., J. J. Balassa & I. H. Tipton. 1963. Abnormal trace metals in man--vanadium. J. chron. Dis. 16:1047-1071.

Organisms: scallops, oysters (unspecified)

Date of Sample Collection: 1963?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 4. VANADIUM IN FOODS

Item	(μg/g wet wt)	(μg/100 calories)
FISH AND MEAT		
Scallops	2.1	200
Oysters	0.11	22

REF. NO.: 65 - S - 1

SUBSTANCES: Nb

Reference: Schroeder, H. A. & J. J. Balassa. 1965. Abnormal trace metals in man: niobium. J. chron. Dis. 18:229-241.

Organisms: oysters, scallops (unspecified)

Date of Sample Collection: 1965?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 1. NIOBIUM IN FOODS
(wet weight)

Food	μg/g	μg/100 calories
Fish and sea food—*contd.*		
Oysters, fresh frozen	1.29	258
Scallops, fresh	0.55	53

REF. NO.: 66 - S - 1

SUBSTANCES: As

Reference: Schroeder, H. A. & J. J. Balassa. 1966. Abnormal trace metals in man: arsenic. J. chron. Dis. 19:85-106.

Organisms: oysters, scallops (unspecified)

Date of Sample Collection: 1966?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 1. ARSENIC IN FOODS (wet weight)

Food	μg/g	μg/100 calories
Fish and sea food		
Oysters, fresh	2.9	580
Oysters, frozen	2.7	540
Scallops, fresh	1.67	160
Shrimp, fresh frozen	1.50	132
Shrimp shells	15.3	—
Clams, fresh frozen	2.52	525

REF. NO.: 66 - S - 2

SUBSTANCES: Zr

Reference: Schroeder, H. A. & J. J. Balassa. 1966. Abnormal trace metals in man: zirconium. J. chron. Dis. 19:573-586.

Organisms: clams, scallops (unspecified)

Date of Sample Collection: 1966?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 3. ZIRCONIUM IN COMMON FOODS (wet weight)

Item	µg/g	µg/100 calories
Sea food		
Shrimp, fresh frozen	0.56	49
Clams, fresh frozen	1.26	262
Scallops, fresh	0.23	22

REF. NO.: 67 - S - 1

SUBSTANCES: Ge

Reference: Schroeder, H. A. & J. J. Balassa. 1967. Abnormal trace metals in man: germanium. J. chron. Dis. 20:211-224.

Organisms: oysters, clams, scallops (unspecified)

Date of Sample Collection: 1967?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 1. GERMANIUM IN FOODS, WET WT

	μg/g	μg/100 cal.
Seafood		
Oysters	0.12	24
Clams, raw	2.03	401
Clams, raw	0.32	64
Clams, raw	1.92	380
Clams, fresh frozen	0.23	46
Shrimp, fresh frozen	0.32	28
Scallops	0.08	8

REF. NO.: 70 - S - 1 SUBSTANCES: Se

Reference: Schroeder, H. A., D. V. Frost & J. J. Balassa. 1970. Essential trace metals in man: selenium. J. chron. Dis. 23:227-243.

Organisms: oysters, scallops, clams (unspecified)

Date of Sample Collection: 1970?

Location: probably East coast U.S.

Analytical Technique:

Analytical Data:

TABLE 1. SELENIUM IN FOODS, WET WEIGHT

	µg/g
Seafood	
Oysters, McCready	0.49
Scallops	0.77
Clams, raw	0.55*

REF. NO.: 73 - S - 3

SUBSTANCES: Pb

Reference: Schulz-Baldes, M. 1973. Die miesmuschel Mytilus edulis als indikator für die bleikonzentration im Weserästuar und in der Deutschen Bucht. Mar. Biol. 21:98-102.

Organisms: Mytilus edulis

Date of Sample Collection: 1972-73

Location: Weser Estuary and German Bight

Analytical Technique:

Analytical Data: (dry wt, dried at 105°C)

Tabelle 1. *Mytilus edulis. Literaturwerte der Bleikonzentration. TG: Trockengewicht*

Autor	Jahr	Ort	µg Pb/g TG
Chapman und Linden	1927	England	10—20
Cheftel *et al.*	1949	Iles Glénan (Frankreich)	5—6
Costa und Molins	1959	Vigo (Spanien)	0,15—0,36
Brooks und Rumsby	1965	Neuseeland	12
Segar *et al.*	1971	Lee-on-Solent (England)	9,1
Graham	1972	San Francisco (USA)	2,2—7,9
Nickless *et al*	1972	Bristol Channel (England)	1—30

Tabelle 2. *Mytilus edulis. Bleikonzentration (µg Pb/g Trockengewicht) in verschiedenen Größenklassen bei Tonne 12*

	Gruppe 1	Gruppe 2	Gruppe 3
Schalenlänge (mm)	15	22	35
Mittleres Trockengewicht (mg)	12	37	139
Bleikonzentration (µg/g)	5,7	3,8	4,2
	6,1	4,3	4,4
	6,1	4,7	4,5
	6,2	4,8	4,5
	6,2	4,9	4,6
	6,2	5,3	4,7
	6,3	5,5	4,7
	6,3	5,6	4,8
	7,0	5,9	5,0
	7,1	6,1	5,0
	7,1	6,2	5,0
	7,5	6,8	5,5
	7,7	7,0	5,6
	8,1	7,0	5,8
	8,6	7,3	6,0
Mittelwert	6,81	5,68	4,95
Standardabweichung	0,85	1,06	0,54

Student's *t*-Test:

$t_{1-2} = 3{,}22$ Irrtumswahrscheinlichkeit P = 1 %

$t_{1-3} = 7{,}12$ P = 0,1 %

$t_{2-3} = 2{,}36$ P = 5 %

Schulz-Baldes, M. 1973.

Tabelle 3. *Mytilus edulis. Bleikonzentration (µg Pb/g Trockengewicht) im Weichkörper von Tieren aus dem Weserästuar und der Deutschen Bucht*

Strom-Kilometer	Station	Datum	Anzahl der Tiere	Mittlere Bleikonzentration (µg/g)	Minimum – Maximum (µg/g)	Standard-abweichung (µg/g)	Variations-koeffizient (%)
80	Tonne W	2. I. 1973	9	6,4	4,3 – 9,7	1,65	25,8
85	Tonne F3	8. II. 1973	6	5,2	3,8 – 5,8	0,78	15,0
87	Tonne F/C	8. II. 1973	6	5,9	4,3 – 7,0	1,06	18,0
89	Tonne F1	8. II. 1973	6	5,7	4,1 – 7,6	1,34	23,5
97	Tonne 12	20. III. 1973	45	5,8	3,8 – 8,6	1,13	19,4
98	Tegeler Plate	27. II. 1973	9	4,9	3,7 – 5,8	0,75	15,3
108	Tonne 7	4. X. 1972	9	4,3	3,0 – 5,7	0,91	21,2
124	Tonne A/B	8. I. 1973	8	3,5	2,7 – 3,9	0,40	11,4
130	Tonne Nordergründe	4. X. 1972	4	2,7	2,3 – 3,1	0,35	13,0
150	Helgoland Südhafen	15. II. 1973	6	2,6	1,7 – 3,6	0,73	28,1
150	Helgoland Südmole	15. II. 1973	6	2,2	1,3 – 2,8	0,47	21,4
150	Helgoland Nordmole	15. II. 1973	6	2,2	1,6 – 2,8	0,44	20,0
150	Helgoland Düne	15. II. 1973	6	1,9	1,5 – 2,4	0,38	20,0

Tabelle 4. *Mytilus edulis. Bleikonzentration (µg Pb/g Trockengewicht) in einzelnen Organen von Tieren verschiedener Standorte*

	A: Tonne 12				B: Helgoland Nordmole				ø A : ø B
	Tier 1	Tier 2	Tier 3	ø	Tier 1	Tier 2	Tier 3	ø	
Schalenlänge (mm)	51	51	49		47	53	52		
Trockengewicht (mg)	521	473	429		433	618	590		
Bleikonzentration (µg/g)									
Fuß	1,5	1,5	1,7	1,6	1,5	1,3	1,1	1,3	1,2 : 1
Kiemen, Mundlappen	2,3	4,1	3,4	3,3	2,1	1,7	3,5	2,4	1,4 : 1
Mantel mit Gonaden	2,9	4,7	4,5	4,0	1,1	2,0	2,3	1,8	2,2 : 1
Schließmuskel	4,9	6,3	4,7	5,3	1,5	1,8	2,3	1,9	2,8 : 1
Darm, Mitteldarmdrüse (mit Inhalt)	6,0	6,6	8,0	6,9	2,5	2,0	2,5	2,3	3,0 : 1
Niere	18,9	24,0	15,6	20,4	7,4	7,3	9,1	7,9	2,6 : 1
Mittlere Bleikonzentration des Weichkörpers (µg/g) (aus Tabelle 3)				5,8				2,2	2,6 : 1

REF. NO.: 71 - S - 2

SUBSTANCES: Fe, Mg, Co, Ni, Cd, Cu, Pb, Zn, Ag, Cr, Mn, Al, Na, K, Ca, Sr, P

Reference: Segar, D. A., J. D. Collins & J. P. Riley. The distribution of the major and some minor elements in marine animals. Part II. Molluscs. J. mar. biol. Ass. U.K. 51:131-136.

Organisms:

Pecten maximus
Chlamys opercularis
Glycymeris glycymeris
Modiolus modiolus
Mytilus edulis
Cardium edule
Mercenaria mercenaria
Anodonta sp.

Date of Sample Collection: 1971?

Location: Irish Sea

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1. ELEMENTAL COMPOSITION OF THE SHELLS OF SOME MOLLUSCS

Nd = not determined. All concentrations as p.p.m. in the specimen dried at 60 °C

Class ...	LAMELLIBRANCHIA										
Genus ...	*Pecten maximus*			*Chlamys opercularis*		*Glycymeris*	*Modiolus*	*Mytilus*	*Cardium*	*Mercenaria*	*Anodonta*
Species ...	Mixed	Upper valve	Lower valve			*glycymeris*	*modiolus*	*edulis*	*edule*	*mercenaria*	sp.
Iron	30	37	49	120	64	47	15	290	1,600	1,600	2,600
Manganese	16	12	4·9	18	17	1·5	20	3·6	2·0	1·5	560
Cobalt	0·31	0·20	0·20	0·27	0·22	0·20	0·30	0·15	0·16	1·2	0·22
Nickel	0·21	1·2	2·4	0·18	0·69	0·16	0·20	2·1	0·11	2·4	1·2
Cadmium	0·04	0·04	0·04	0·13	0·04	0·03	0·03	0·95	0·34	0·80	0·43
Copper	1·1	0·09	0·09	0·70	0·38	0·09	1·9	2·0	3·0	1·7	7·6
Lead	2·0	0·62	0·60	1·7	0·64	0·60	1·9	0·40	0·44	0·43	0·60
Zinc	6·6	4·1	6·1	11	7·3	160	6·2	0·04	6·8	3·4	6·4
Silver	Nd	Nd	Nd	Nd	Nd	Nd	Nd	0·10	0·11	0·21	0·15
Chromium	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	0·37	0·45
Aluminium	190	230	230	430	300	420	150	76	84	71	173
Sodium	3,300	2,800	2,500	3,700	2,900	4,400	4,700	4,200	5,600	5,700	1,920
Potassium	18	19	18	120	19	43	88	18	160	230	61
Calcium	280,000	320,000	330,000	320,000	330,000	320,000	280,000	390,000	360,000	330,000	350,000
Magnesium	910	770	590	1,300	790	210	440	690	460	48	76
Strontium	660	270	270	410	270	700	73	14	1,300	170	150
Phosphorus	Nd	410	430	Nd	630	36	Nd	66	10	28	39

Segar, D. A. et al. 1971.

TABLE 2. ELEMENTAL COMPOSITION OF THE ENTIRE SOFT PARTS OF SOME MOLLUSCS

Nd = not determined. All concentrations as p.p.m. in the specimen dried at 60 °C

Class ...	LAMELLIBRANCHIA							
Genus ...	*Modiolus*	*Modiolus*	*Glycymeris*	*Pecten*	*Mytilus*	*Mercenaria*	*Anodonta*	*Cardium*
Species ...	*modiolus*	*modiolus*	*glycymeris*	*maximus*	*edulis*	*mercenaria*	sp.	*edule*
Dry wt (%)	25	20·8	Nd	28·3	11·1	20·0	11·9	13·0
Iron	350	300	68	170	1,700	5,400	5,500	590
Manganese	47	150	34	140	3·5	18	2,100	6·3
Cobalt	5·5	0·49	0·92	8·5	1·6	4·3	0·42	7·1
Nickel	133	9·4	1·4	49	3·7	11	0·35	7·9
Cadmium	7·1	4·5	3·3	13	5·1	2·1	1·2	1·5
Copper	10	44	5·7	3·3	9·6	25	3·0	11
Lead	42	23	3·5	8·3	9·1	18	1·2	0·76
Zinc	530	320	120	230	91	94	120	130
Silver	Nd	0·26	Nd	Nd	0·03	1·3	0·28	0·04
Chromium	Nd	0·14	Nd	Nd	1·5	0·79	0·84	Nd
Aluminium	260	210	110	610	1,230	615	107	2,700
Sodium	38,000	48,000	48,000	11,000	58,000	17,000	1,400	40,000
Potassium	12,000	11,000	12,000	14,000	12,000	11,000	1,400	15,000
Calcium	4,700	3,400	4,000	2,600	9,300	3,200	70,000	3,300
Magnesium	4,800	6,100	6,000	2,200	6,000	2,700	860	5,300
Strontium	47	30	29	12	24	13	19	17
Phosphorus	9,800	5,000	4,900	11,000	3,600	4,200	9,300	3,400

TABLE 3. ELEMENTAL COMPOSITION OF *PECTEN MAXIMUS*

Nd = not determined. All concentrations as p.p.m. in specimen dried at 60 °C

Sample	Entire soft parts	Muscle	Gut and digestive gland	Mantle and gills unwashed	Mantle and gills washed	Gonad unwashed	Gonad washed	Mixed shell	Upper valve shell	Lower valve shell
Dry wt (%)	28·3	Nd	24·3	Nd	7·7	Nd	21·1	—	—	—
Iron	170	30	2,900	240	570	160	100	30	37	49
Manganese	140	22	410	200	4·0	31	8·6	16	12	4·9
Cobalt	8·5	0·34	0·68	0·45	0·58	2·7	0·18	0·31	0·20	0·20
Nickel	49	1·7	0·96	0·30	0·82	0·44	1·5	0·21	1·2	2·4
Cadmium	13	1·9	96	17	3·1	2·5	2·5	0·04	0·04	0·04
Copper	3·3	1·2	25	4·4	2·8	13	14	1·1	0·09	0·09
Lead	8·3	17	1·7	2·8	1·5	31	0·40	2·0	0·62	0·60
Zinc	230	70	1,100	160	420	360	180	6·6	4·1	6·1
Silver	Nd	Nd	8·9	Nd	0·36	Nd	0·059	Nd	Nd	Nd
Chromium	Nd	Nd	1·8	Nd	0·76	Nd	0·45	Nd	Nd	Nd
Aluminium	610	53	310	200	95	130	100	190	230	230
Sodium	11,000	6,100	39,000	48,000	24,000	24,000	21,000	3,300	2,800	2,500
Potassium	14,000	16,000	3,700	16,000	8,800	17,000	10,000	18	19	18
Calcium	2,600	5,500	1,900	4,100	2,500	2,400	2,400	280,000	320,000	330,000
Magnesium	2,200	2,000	2,000	8,000	4,000	4,200	3,000	910	770	590
Strontium	12	9·9	13	16	11	23	12	660	270	270
Phosphorus	11,000	Nd	3,300	Nd	3,000	Nd	8,300	Nd	410	430

Segar, D. A. et al. 1971.

TABLE 4. ELEMENTAL COMPOSITION OF *MODIOLUS MODIOLUS*

Nd = not determined. All concentrations as p.p.m. in specimen dried at 60 °C

Sample	Shell	Entire soft parts	Entire soft parts	Mantle and gills	Muscle	Gonad	Gut and digestive gland
Dry wt (%)	—	25·0	20·8	9·1	16·7	15·4	11·1
Iron	15	350	300	220	51	130	1,100
Manganese	20	47	150	160	71	49	140
Cobalt	0·30	5·5	0·49	2·9	0·30	0·72	1·1
Nickel	0·20	133	9·4	3·2	2·0	1·2	0·59
Cadmium	0·03	7·1	4·5	7·0	2·8	4·6	4·2
Copper	1·9	10	44	42	14	19	45
Lead	1·9	42	23	18	7·5	25	22
Zinc	6·2	530	320	180	68	140	190
Silver	Nd	Nd	0·26	0·24	0·03	0·07	0·81
Chromium	Nd	Nd	0·14	0·15	0·20	0·20	0·19
Aluminium	150	260	210	210	95	230	860
Sodium	4,700	38,000	48,000	25,000	28,000	31,000	26,000
Potassium	88	12,000	11,000	3,900	6,400	5,900	4,400
Calcium	280,000	4,700	3,400	4,700	2,200	2,400	4,100
Magnesium	440	4,800	6,100	5,700	4,000	5,900	5,300
Strontium	73	47	30	41	23	33	41
Phosphorus	Nd	9,800	5,000	4,200	2,300	8,600	4,600

REF. NO.: 74 - S - 4

SUBSTANCES: Pb, Zn, Cu, Ni, Mn

Reference: Sheppard, C. R. C. & D. J. Bellamy. 1974. Pollution of the Mediterranean around Naples. Mar. Pollut. Bull. 5:42-44.

Organisms: Mytilus sp.

Date of Sample Collection: 1973

Location: Naples and Bristol Channel

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 2

	Pb	Zn	Cu	Ni	Mn
Mytilus, Naples	56·7 ± 8·1	227 ± 21·0	8·0 ± 1·7	6·6 ± 1·6	43·4 ± 6·7
Mytilus, Bristol Channel	2·0–9·5				
Shellfish, G.B.	·37–2·3				

REF. NO.: 75 - S - 2

SUBSTANCES: Cu

Reference: Shigematsu, T., M. Matsui, O. Fujino, S. Mitsuno & T. Nagahiro. 1975. Determination of copper in sea water and shellfishes by atomic absorption spectrometry with a carbon tube atomizer. Nippon Kagaku Kaishi 8:1328-1331.

Organisms: clam (unspecified)

Date of Sample Collection: 1975?

Location: Fukuura Seaside, Ako, Hyogo, Japan

Analytical Technique: Atomic absorption spectrometry

Analytical Data: (dry wt, dried at 105°C)

Table 4 Determination of copper in shellfish and soft tissue by the standard addition and calibration curve methods

Sample (g)		Cu added (10^{-8} g)	Cu found (10^{-8} g)	Cu in shellfish and soft tissue (ppm)
Shellfish	1.045	0	12.1	0.115
〃		5	16.1	0.106
〃		10	21.7	0.112
〃		20	32.0	0.115
〃		40	52.5	0.120
			Average	0.114±0.004
Soft tissue (dry)	0.0266	0	18.9	7.11
〃	0.0532	0	35.6	6.69
〃	0.1064	0	74.5	7.02
			Average	6.94±0.15

Table 5 Concentration of copper in shell of clam (Fukuura Seaside, Ako, Hyogo)

Sample No.	Length from umbo (mm)	Left valve		Right valve	
		Weight (g)	Concn. of Cu (ppm)	Weight (g)	Concn. of Cu (ppm)
1	0~26	2.499	0.26	2.393	0.19
2	26~35	1.711	0.15	1.785	0.15
3	35~43	1.846	0.15	1.798	0.18
4	43~51	2.172	0.18	2.606	0.17
5	51~57	2.264	0.16	1.900	0.19
6	57~64	2.823	0.22	3.226	0.18
7	64~71	3.269	0.26	3.185	0.27
8	71~75	1.441	0.42	1.638	0.33
Average shell			0.22		0.22

Table 6 Determination of copper in individual organs of clam (Fukuura Seaside, Ako, Hyogo)

Organ	Wet (ppm)	Dry (ppm)
Mantle	1.7	9.4
Gills	1.4	7.9
Siphon	0.82	4.2
Foot	0.84	3.2
Foot muscle	0.49	1.8
Liver	8.3	32
Kidney	3.3	14
Organ of Keber	2.2	8.8
Labial palps	3.3	15
Adductor muscles	0.43	1.7
Average soft tissue	1.7	

REF. NO.: 68 - S - 1

SUBSTANCES: Zn, Cu, Fe, Mn, Cd, Cr, Pb, Ni, Co

Reference: Shuster, C. N. Jr. & B. H. Pringle. 1968. Effects of trace metals on estuarine mollusks. Proc. 1st Mid-Atlantic Industrial Waste Conference, University of Delaware, 1968, CE-5, p. 285-304.

Organisms: Crassostrea virginica
Mercenaria mercenaria
Mya arenaria

Date of Sample Collection: 1968?

Location: East coast U. S., Maine through North Carolina

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 3. TRACE METAL LEVELS IN SHELLFISH FROM ATLANTIC COAST WATERS (Maine through North Carolina)

	Eastern Oyster		Northern Quahaug		Softshell Clam	
Element	Range	Average	Range	Average	Range	Average
Zinc	180 -4120	1428	11.50-40.20	20.6	9.0 - 28	17
*	310.0 -4000.0	1641				
**	710 -2760	1468				
***	740 -1332	1018				
Copper	7.0 - 517	91.50	1.0 -16.50	2.6	1.20- 90	5.80
*	8.80- 520.00	137.5				
**	84 - 600	230				
****	34.4 - 137.2	78.5				
Iron	31 - 238	67	9.0 -83.0	30	49.70-1710	405
**	23 - 183	57				
****	24.9 - 47.1	34.8				
Manganese	0.14- 15.0	4.30	0.7 -29.70	5.8	0.10- 29.90	6.70
**	1.5 - 10.2	3.7				
****	1.05- 3.00	2.3				
Cadmium	0.10- 7.80	3.10	0.10- 0.73	0.19	0.10- 0.90	0.27
Lead	0.10- 2.30	0.47	0.10- 7.50	0.52	0.10- 10.20	0.70
Chromium	0.04- 3.40	0.40	0.19- 5.80	0.31	0.10- 5.0	0.52
Nickel	0.08- 1.80	0.19	0.10- 2.40	0.24	0.10- 2.30	0.27
Cobalt	0.06- 0.20	0.10	0.10- 0.20	0.20	0.10- 0.20	0.10

Note: trace metal values are given in ppm of shellfish wet tissue weights; studies denoted by asterisks were determined by methods other than via atomic absorption.

* From McFarren et al (1962): New Hampshire through North Carolina (1960 data).

** From dry weight data (divided by 5) of Galtsoff (1964): Long Island Sound (1933-1935).

*** From dry weight data (divided by 5) of Chipman et al (1958): oysters--Connecticut through Georgia.

**** From Coulsen et al (1932): Rhode Island through New Jersey (1931 data).

REF. NO.: 74 - S - 1

SUBSTANCES: Hg

Reference: Simpson, R. E., W. Horwitz & C. A. Roy. 1974. Surveys of mercury levels in fish and other foods. Pest. Monit. J. 7:127-138.

Organisms: mussels, clams, oysters, scallops (unspecified)

Date of Sample Collection: 1970-72

Location: U. S.

Analytical Technique: Atomic absorption spectrophotometry; neutron activation analysis

Analytical Data:

TABLE 2.—*Mercury in freshwater fish*[1]—Continued

State	Areas	Findings
Massachusetts	Launton River area	Fish, 0.17-1.21 ppm; shellfish, mussels, clam, 0.3-4 ppm
Texas	Houston Ship Channel Lavaca Bay	Waters, 19 ppm (?) oysters >5 ppm

TABLE 8.—*Mercury in wholesale fish*

Fish Type	Mean Mercury Level, ppm	Total Sub-samples	No. of Lots	Std. Dev. Within Lots	Std. Dev. Between Lots (Component of Variance)	Upper 99% Confidence Limit on Mean	Upper 95% Tolerance Limit on 99% of Lots	Upper 99% Tolerance Limit on 99% of Lots
Clams	0.03	158	81	0.03	0.03	0.04	0.13	0.13
Oysters	0.03	203	86	0.02	0.04	0.04	0.15	0.18
Scallops	0.02	171	76	0.01	0.02	0.03	0.07	0.08

REF. NO.: 74 - S - 3

SUBSTANCES: Cd, Cu, Pb, Zn, Hg

Reference:

Stenner, R. D. & G. Nickless. 1974. Distribution of some heavy metals in organisms in Hardangerfjord and Skjerstadfjord, Norway. Wat. Air Soil Poll. 3:279-291.

Organisms:

Cardium edule
Mytilus edulis

Date of Sample Collection: 1972

Location: Norway

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

(dry wt)

	Cd		Cu		Pb		Zn	
Site	*Mytilus edulis*	*Card. edule*	*Mytilus edulis*	*Card. edule*	*Mytilus edulis*	*Card. edule*	*Mytilus edulis*	*Card. edule*
Hardangerfjord								
1 Skanevik	7.8	7.5	18	15	16	32	300	210
2 Gjermundshamn								
3 Mundheim	6.1		3		18		270	
4 Strandebarm	14.0		10		92		720	
5 Tørvikbygd	16		14		102		770	
6 Cystese	23	19.3	22	27	80	110	670	1160
7 Utne	25.5		14		201		710	
8 Nå	29		13		600		1480	
9 Æme	140		21		3100		2370	
10 Eitrheim								
11 Eitrheimness								
12 Eidfjord								
13 Vikedal	4.8		14		15		195	
14 Etne	6.8		14		15		170	
15 Markhus	7.5		20		34		320	
Skjerstadfjord								
1 Bodøsjoen		4.5		18		12		165
2 Saltstraumen								
3 Fauske	4.7		130		6		280	
4 Leivsetodden	1.9		15		2		145	
5 Setsaa	3.2		15		3		105	

TABLE V

Hg, ppm in dry specimen

Species	Site	Hg
Mytilus edulis	Mundheim	0.2
	Utne	0.2
	Æme	0.65
	Fauske	0.2

REF. NO.: 75 - S - 1

SUBSTANCES: Cd, Cu, Pb, Zn

Reference:

Stenner, R. D. & G. Nickless. 1975. Heavy metals in organisms of the Atlantic coast of S.W. Spain and Portugal. Mar. Pollut. Bull. 6:89-92.

Organisms:

Mytilus edulis	Spisula subtruncata	Venus striatula
Cardium edule	Spisula solida	Donax vittatus
Venerupis decussata	Thracia distorta	Ensis arcuatus
Venerupis rhomboides	Crassostrea angulata	Solen marginatus

Date of Sample Collection: 1972

Location:

S.W. Spain and Portugal

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1
Metals (ppm in dry specimens) from Portugal and Spain.

Site	*Fucus* species	*Enteromorpha* species	*Mytilus edulis*	*Cardium edule*	*Patella* species	*Nucella lapillus*
Cadmium						
1. Sines		7.4	2.9		5.0	16
2. Sagres			2.6		7.1	
3. Quarteira		1.2	1.7	0.3		
5. Ayamonte (Rio)	3.2		2.5			
6. Ayamonte (Playa)		0.8	ND	0.4		
10. Cadiz Bay	1.7			0.6	1.1	
11. Playa de Cortadura			3.6		3.6	
Copper						
1. Sines		6	6.5		9.0	25
2. Sagres			14		10	
3. Quarteira		18	8	6		
5. Ayamonte (Rio)	31		14			
6. Ayamonte (Playa)		22	11	26		
10. Cadiz Bay	9			6	5	
11. Playa de Cortadura			12		7	
Lead						
1. Sines		ND	2		2	9
2. Sagres			5		11	
3. Quarteira		4	5	2		
5. Ayamonte (Rio)	5		ND			
6. Ayamonte (Playa)		22	ND	0.7		
10. Cadiz Bay	13			2	16	
11. Playa de Cortadura			15		12	
Zinc						
1. Sines		110	280		110	320
2. Sagres			230		90	
3. Quarteira		75	260	200		
5. Ayamonte (Rio)	345		370			
6. Ayamonte (Playa)		130	260	160		
10. Cadiz Bay	110			100	105	
11. Playa de Cortadura			190		120	

ND = Not detected, less than twice level of blank.

TABLE 6
Metals (ppm in dry specimens) found at certain sites, Portugal and Spain.

Species		Site	Shore zone	Cd	Cu	Pb	Zn	No. of specimens
Gibbula umbilicalis	1.	Sines	L	7.8	30	14	60	7
	10.	Cadiz Bay	L	3.6	48	20	70	10
Gibbula lineata	2.	Sagres	U	6.2	22	8	66	10
Gibbula cineraria	11.	Playa de Cortadura	L	5.0	23	25	50	4
Calliostoma zizyphinum	1.	Sines	L	9	50	27	60	1
Venerupis decussata	4.	Faro	L	1.6	12	5	137	5
Venerupis rhomboides	10.	Cadiz Bay	L	3.7	ND	ND	90	1
	11.	Playa de Cortadura	L	2.8	14	30	230	1
Spisula subtruncata	9.	Mazagón	L	9.4	505	20	190	12
	7.	Isla Cristina	L	2.9	76	6	140	5
Spisula solida	7.	Isla Cristina	L	0.7	66	2	118	8
Thracia distorta	10.	Cadiz Bay	L	ND	5	ND	100	1
Acanthocardia aculeata	7.	Isla Cristina	L	ND	65	14	240	1
Crassostrea angulata	4.	Faro	L	3.5	180	4	310	1
	10.	Cadiz Bay	L	3.2	120	10	440	3
	11.	Playa de Cortadura	L	2.9	435	11	920	4
Eupagurus bernhardus	2.	Sagres	L	7.9	168		260	4
	7.	Isla Cristina	L	2.9	290		330	2
	11.	Playa de Cortadura	L	7.4	110		180	2
Venus striatula	9.	Mazagón	L/M	7.7	170	17	135	20
	7.	Isla Cristina	L/M	2.7	60	3	120	15
	6.	Ayamonte (Playa)	L/M	1.2	30	ND	95	12
Donax vittatus	7.	Isla Cristina	L	1.3	100	2	180	15
	6.	Ayamonte (Playa)	L	ND	85	ND	165	1
Ensis arcuatus	7.	Isla Cristina	L	0.3	35	2		1
Solen marginatus	6.	Ayamonte (Playa)	L	0.9	34	40	95	4
Asterias rubens	1.	Sines	L	12	8	14	90	1
	2.	Sagres	L	0.6	6	22	70	1

ND = Not detected.

REF. NO.: 71 - S - 1

SUBSTANCES: Hg

Reference: Strohal, P. & M. Dzajo. 1971. Concentration of mercury in the North Adriatic biota. Thalassia Jugoslavica 7:591-596.

Organisms: Ostrea edulis
Mytilus galloprovincialis

Date of Sample Collection: 1971?

Location: Northern Adriatic

Analytical Technique: Neutron activation analysis

Analytical Data: (dry wt, dried at 110°C)

TABLE II

Concentration of mercury in crustaceans and molluscs

Sample	Grams Hg/gram of biota	
	Wet weight	Dry weight
Ostrea edulis L.	5.51×10^{-8}	2.59×10^{-7}
Mytilus galloprovincialis Lam.	6.65×10^{-8}	4.08×10^{-7}

TABLE VI

Concentration of mercury in organs and tissues of Mytilus galloprovincialis *Lam.*

Sample	Grams Hg/gram of sample		Distribution factor*
	Wet weight	Dry weight	
Whole animal	6.6×10^{-8}	4.1×10^{-7}	1
Gills	4.5×10^{-7}	4.3×10^{-8}	0.79
Muscle tissues	5.7×10^{-7}	3.2×10^{-8}	3.57
Foot	3.0×10^{-7}	1.8×10^{-8}	4.49
Mantle	3.6×10^{-7}	4.1×10^{-8}	5.35
Shell	$< 10^{-8}$	$< 10^{-8}$	—
Residual edible part	8.1×10^{-7}	5.7×10^{-8}	12.16

* grams of Hg per gram of organ/grams of Hg per gram of whole animal

REF. NO.: 71 - S - 3

SUBSTANCES: Sr, Mg, Zn, Cu

Reference: Sturesson, U. & R. A. Reyment. 1971. Some minor chemical constituents of the shell of Macoma balthica. Oikos 22:414-416.

Organisms: Macoma balthica

Date of Sample Collection: 1971?

Location: West and Baltic coasts of Sweden

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Tab. 1. Amounts of elements (ppm) in shells of *Macoma balthica*.

	Bälinge archipelago			Gullmaren		
	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N
strontium	2150	72	30	1660	60	10
magnesium	310	23	30	760	22	10
zinc	53	18	12	37	17	6
copper	41	18	20	117	32	10

REF. NO.: 76 - T - 3

SUBSTANCES: Cd

Reference: Talbot, V. W., R. J. Magee & M. Hussain. 1976. Cadmium in Port Phillip Bay mussels. Mar. Pollut. Bull. 7:84-86.

Organisms: *Ostrea angasi*
Mytilus edulis

Date of Sample Collection: 1975

Location: Port Phillip Bay, Victoria, Australia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt)

TABLE 1
Analytical results for mussels from Port Phillip and Corio Bays.

Location	Cd (ppm)	Location	Cd (ppm)	Location	Cd (ppm)
1	63	8	12.3	15	10.5
2	48.4	9	8.3	16	14.8
3	83	10	17	17	9.4
4	43	11	9	18	16.3
5	33.6	12	24.8	19	5.3
6	62.4	13	6.8	20	6.1
7	18.3	14	21	21	17
				22	7.3

TABLE 2
Oyster analysis.

Location	Cd (ppm)
2	35.5
3	174.3
6	64.9

TABLE 3
Mussel analysis from piers.

Location	Cd (ppm)
4	13.5
8	4.2
10	7.7
11	2.8

REF. NO.: 76 - T - 4

SUBSTANCES: Pb

Reference

Talbot, V., R. J. Magee & M. Hussain. 1976. Lead in Port Phillip Bay mussels. Mar. Pollut. Bull. 7:234-237.

Organisms: Mytilus edulis

Date of Sample Collection: 1975

Location:

Port Phillip Bay, Australia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1
Levels of Pb in Port Phillip and Corio Bay mussels.

Location	Metal		Foot	Gills	Stomach	Mantle	Muscle	Shell	Bulk
1	Pb	ppm	6.4	32.6	18.9	4.6	12.3	27.4	15.2*
		s.d.	1.3	13.8	9.7	3.2	3.9	3.6	4.3
2			8.3	16.3	8.9	4.6	10.1	24.3	10.7+
			2.8	4.8	4.2	3.8	3.4	4.7	2.9
3			8.2	14.6	9.6	8.2	9.8	27.3	13.3+
			3.2	4.8	3.1	2.9	2.1	4.3	3.7
4			7.3	24.6	22.9	5.3	15.3	36.3	19.8*
			2.2	10.8	8.1	2.4	4.2	5.1	3.9
5			4.3	15.9	9.3	4.1	4.2	24.8	11.1+
			2.4	4.1	4.4	2.7	3.1	15.4	4.2
6			3.7	19.4	8.9	8.6	10.1	81	18.9*
			2.8	6.4	2.3	2.4	2.9	12.6	3.8
7			4.2	18.7	9.4	6.8	6.1	35.8	17.9*
			2.8	6.8	2.1	2.4	2.3	5.8	4.1
8			8.3	15.3	12.6	9.1	10.3	18.9	11.3+
			4.6	3.8	4.1	2.8	3.4	6.9	3.7
9			5.1	12.4	11.6	8.6	8.7	37.1	10.3+
			2.1	3.6	2.9	2.7	2.9	9.6	4.2
10			8.3	11.2	9.6	4.8	5.4	16.3	9.7—
			4.9	2.1	3.2	2.9	3.3	5.3	2.8
11			7.4	23.8	14.3	7.4	12.1	8.7	16.4*
			2.1	6.7	5.9	4.3	6.4	4.1	4.7
12			3.7	18.8	16.9	7.5	8.5	33.4	15.2*
			2.1	3.6	4.7	2.7	2.9	11.8	4.9
13			4.7	18.7	13.9	6.5	10.2	36.4	16.8*
			2.3	2.6	4.8	3.1	3.8	8.6	5.1
14			5.7	26.8	29.4	14.5	17.8	17.4	22.4*
			3.2	8.4	9.2	4.9	6.7	5.4	2.8
15			7.3	12.8	13.4	6.9	7.7	36	8.6—
			4.1	5.5	5.3	2.4	3.2	7.8	3.4
16			7.8	17.8	20.6	7.8	13.5	61.7	14.1+
			3.4	4.7	4.3	3.1	4.6	18.9	4.8
17			8.3	20.6	19.3	8.7	15.1	53.4	17.9*
			4.6	4.3	3.9	2.8	4.6	16.7	5.2
18			6.4	18.7	17.3	8.9	9.4	46.0	16.8*
			3.3	4.5	6.8	4.6	4.4	13.5	6.2
19			7.3	23.8	21.8	13.7	14.6	29.4	18.9*
			2.9	7.6	5.8	4.3	4.8	9.9	5.2
20			4.9	13.5	12.6	7.2	10.4	36.1	13.6+
			2.1	5.4	4.9	3.8	5.1	12.9	4.6
21			8.4	19.1	23.6	7.3	14.8	52.0	18.9*
			3.6	6.7	5.8	2.3	3.8	17.4	7.2
22			6.2	14.3	12.6	5.4	7.2	26.1	8.3—
			2.1	4.7	3.4	2.1	3.8	9.7	2.9

* = Exceeds W.H.O Standards. + = Borderline. — = Under.

TABLE 2
Lead analysis for mussels from the inter-tide zone of piers.

Location	Metal	Foot	Gills	Stomach	Muscle	Mantle	Shell	Bulk
4	Pb	3.4	4.9	4.8	2.9	2.2	13.4	4.7
		1.1	1.4	1.7	1.3	1.2	2.8	1.4
8		3.1	4.7	5.1	3.3	2.6	12.6	4.6
		1.4	2.1	2.2	1.8	1.4	3.1	2.4
10		2.1	4.8	4.6	3.9	2.7	11.9	3.7
		1.5	2.7	2.2	2.6	1.4	2.8	1.1
11		2.4	5.1	4.8	3.8	3.1	11.4	3.4
		0.9	2.1	1.6	1.6	1.3	3.1	1.4

REF. NO.: 74 - T - 4

SUBSTANCES: Hg, As, Cd, Cu, Pb, Zn

Reference: Taylor, D. D. & T. J. Bright. 1974. Preliminary reports of heavy metals in organisms of the West Flower Garden Bank. In Biota of the West Flower Garden Bank, T. J. Bright & L. H. Pequegnat, eds., p. 58-63. Gulf Publishing Co., Book Div., Houston, Tx.

Organisms: *Spondylus americanus*

Date of Sample Collection: 1974?

Location: West Flower Garden Bank, Gulf of Mexico

Analytical Technique: Atomic absorption spectrophotometry; colorimetry

Analytical Data:

	Specimen	Hg Muscle Tissue	Hg Liver	As Muscle Tissue	Cd Muscle Tissue	Cu Muscle Tissue	Pb Muscle Tissue	Zn Muscle Tissue
INVERTEBRATES								
	Spondylus americanus (Thorny oyster)	0.025						
	Spondylus americanus (Thorny oyster)	0.01						
	Spondylus americanus (Thorny oyster)	0.03			7.04	0.59	0.98	40.27
	Spondylus americanus (Thorny oyster)				3.21			
	Spondylus americanus (Thorny oyster)				2.61			
	Scyllarides sp. (Spanish lobster)	0.07		6.99				
	Scyllarides sp. (Spanish lobster)				2.18			
	Sponge	0.07						
SEDIMENTS		< 0.03						

REF. NO.: 75 - T - 1 **SUBSTANCES:** Zn, Cd, Cu

Reference: Thornton, I., H. Watling & A. Darracott. 1975. Geochemical studies in several rivers and estuaries used for oyster rearing. Sci. Total Envir. 4:325-345.

Organisms: Crassostrea gigas

Date of Sample Collection: 1970

Location: River Helford, Poole Harbour and River Colne, Wales

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt, dried at 100°C)

TABLE 4

DRY WEIGHT AND METAL CONTENT OF THE PACIFIC OYSTER (*Crassostrea gigas*) PLACED AT COMMERCIAL OYSTER LAYS IN THE ESTUARIES OF THREE RIVERS

	Estuary		*Zinc*			
	Mean dry wt. (mg)		*Mean conc. in D.M. (ppm)*		*Mean total metal in individuals (μg)*	
	Initial	*After 8 months*	*Initial*	*After 8 months*	*Initial*	*After 8 months*
Helford	48	550	1640	2585	79	1422
Colne	310	1210	1540	1350	477	1634
Poole Harbour	94	650	1190	2670	112	1735

	Cadmium				*Copper*			
	Mean conc. in D.M. (ppm)		*Mean total metal in individuals (μg)*		*Mean conc. in D.M. (ppm)*		*Mean total metals in individuals (μg)*	
	Initial	*After 8 months*	*Initial*	*After 8 months*	*Initial*	*After 8 months*	*Initial*	*After 8 months*
Helford	6.0	2.2	0.3	1.2	273	643	13	354
Colne	4.0	4.8	1.2	5.8	110	207	34	250
Poole	4.0	26.7	0.4	17.4	155	396	15	257

REF. NO.: 73 - T - 1

SUBSTANCES: Zn, Cd, Cu

Reference:

Thrower, S. J. & I. J. Eustace. 1973. Heavy metal accumulation in oysters grown in Tasmanian waters. Food Tech. Aust. 25:546-553.

Organisms:

Crassostrea gigas
Ostrea angasi

Date of Sample Collection: 1972

Location: Tasmania

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1

Levels of zinc, cadmium and copper in oysters grown in the Derwent and Tamar Estuaries†

Location	Map Reference	Species	Age (Months)	Date of Collection	Sample Size	Dry Matter Content (%)	Metal Concentration parts per million (wet weight basis)		
							Zinc	Cadmium	Copper
							Mean ± S.D.*	Mean ± S.D.	Mean ± S.D.
DERWENT ESTUARY									
Ralphs Bay ..	16	*C. gigas*	16	29/5/72	30	18.1	7303 ± 1170	31.7 ± 8.3	112.8 ± 26.7
		C. gigas	28	29/5/72	40	16.6	9122 ± 3146	16.9 ± 4.4	126.5 ± 42.7
		C. gigas	17	13/6/72	10	21.8	6244 ± 597	10.1 ± 1.3	72.8 ± 9.8
		C. gigas	19	18/8/72	10	22.2	6301 ± 2372	17.5 ± 2.1	74.7 ± 13.4
		C. gigas	31	18/8/72	10	16.5	6558 ± 1598	11.6 ± 4.0	81.2 ± 18.4
		C. gigas	31	24/8/72	10	23.7	6838 ± 1213	19.1 ± 3.7	110.1 ± 22.1
		C. gigas	19	7/9/72	10	24.8	6564 ± 889	17.3 ± 3.6	93.0 ± 13.4
		O. angasi	Variable	7/9/72	10	22.7	8865 ± 2137	18.7 ± 4.2	55.7 ± 24.3
TAMAR ESTUARY									
Supply River ..	19	*C. gigas*	29	13/6/72	10	17.4	1602 ± 359	14.6 ± 3.7	98.9 ± 21.7
Rullins Bay ..	18	*C. gigas*	29	13/6/72	10	15.4	1354 ± 249	7.2 ± 0.7	124.2 ± 24.4
Middle Island ..	17	*C. gigas*	Variable	20/9/72	10	22.4	1146 ± 361	5.0 ± 1.3	136.0 ± 38.3
Mud flats adjacent to Middle Island	17	*C. gigas*	17	13/6/72	10	26.0	526 ± 97	2.8 ± 0.8	104.3 ± 12.5
		C. gigas	29	13/6/72	10	24.9	797 ± 103	4.95 ± 1.0	110.6 ± 12.7
		C. gigas	Variable	13/6/72	8	22.3	1160 ± 383	4.2 ± 0.9	192.0 ± 47.1
		C. gigas	20	20/9/72	10	26.6	451 ± 87	2.3 ± 0.4	87.4 ± 8.8

† Results from different areas are not strictly comparable due to different dates of collection.
* S.D. — Standard deviation.

Thrower, S. J. & I. J. Eustace. 1973.

TABLE 2

Levels of zinc, cadmium and copper in oysters grown in Tasmanian waters†

Location	Map Reference	Species	Age (Months)	Date of Collection	Sample Size	Dry Matter Content (%)	Metal Concentration parts per million (wet weight basis) Zinc (40 ppm*) Mean ± S.D.*	Cadmium (5.5 ppm*) Mean ± S.D.	Copper (30 ppm*) Mean ± S.D.
Montagu	1	*O. angasi*	Variable	29/8/72	10	18.1	1043 ± 553	2.3 ± 0.4	9.0 ± 2.5
Ulverstone ..	2	*C. gigas*	Variable	5/8/72	20	14.3	429 ± 97	3.3 ± 0.6	17.7 ± 3.9
Devonport	3	*C. gigas*	Variable	7/8/72	10	13.2	572 ± 128	3.2 ± 1.1	29.3 ± 8.0
Port Sorell ..	4	*C. gigas*	Variable	7/8/72	10	11.6	333 ± 103	2.8 ± 0.6	28.9 ± 9.8
Ansons Bay ..	5	*O. angasi*	Variable	11/10/72	10	20.8	550 ± 287	<2.0	4.0 ± 1.5
St. Helens	6	*O. angasi* & *C. gigas*	Variable	11/10/72	10	23.4	371 ± 248	<2.0	9.7 ± 2.2
Triabunna .. .	7a	*C. gigas*	Variable	13/10/72	10	20.9	376 ± 127	<2.0	61.3 ± 8.6
	b	*O. angasi*	Variable	13/10/72	10	21.4	783 ± 344	<2.0	80.5 ± 22.4
Sandspit	8	*C. gigas*	20	24/9/72	10	20.2	359 ± 63	<2.0	17.3 ± 2.2
Blackman Bay ..	9	*C. gigas*	20	5/9/72	10	20.2	480 ± 65	<2.0	9.4 ± 1.9
Dunalley	10	*C. gigas*	8	5/9/72	10	21.9	653 ± 131	3.5 ± 0.8	12.5 ± 2.8
Pittwater	11a	*C. gigas*	Variable	10/7/72	10	22.3	1038 ± 386	2.0 ± 0.4	68.8 ± 24.8
	b	*O. angasi*	Variable	10/7/72	5	25.2	1067 ± 281	2.5 ± 1.1	68.9 ± 25.0
Pipe Clay Lagoon	12a	*C. gigas*	29	7/6/72	10	19.7	3449 ± 592	3.7 ± 1.3	84.4 ± 16.4
	b	*C. gigas*	17	7/6/72	20	20.2	1913 ± 356	2.8 ± 1.0	45.9 ± 7.1
	c	*C. gigas*	20	20/9/72	10	23.6	2966 ± 969	5.7 ± 2.1	60.7 ± 17.3
	d	*O. angasi*	Variable	7/6/72	10	19.6	2576 ± 965	<2.0	44.0 ± 20.8
Simmonds Bay	13	*C. gigas*	20	17/9/72	10	19.3	1136 ± 599	2.2 ± 1.0	19.6 ± 10.5
Cygnet	14	*C. gigas*	20	28/8/72	10	23.3	338 ± 59	<2.0	13.2 ± 1.9
Long Bay	15	*C. gigas*	20	5/9/72	10	19.6	620 ± 146	3.7 ± 0.7	25.6 ± 4.7

† Results from different areas not strictly comparable due to different dates of collection.
* S.D. — Standard deviation.
* Levels permitted by present Tasmanian Public Health Regulations (1971).

Table 3

Ranges of zinc levels in oysters reported in the literature

Zinc ppm Wet weight basis	Dry weight basis	Unspecified basis	Origin	References
	48-8400		UK	Orton (1923)
20-4284			USA	Vinogradov (1953)
391-3174			USA	Chipman et al. (1958)
310-4000			USA	McFarren et al. (1962)
	2000-14,000		USA	Galtsoff (1964)
		80-1500	New Zealand	Brooks & Rumsby (1965)
		150-500	Not stated	Orten (1966)
	950-1160		FAO/WHO	Cheftel (1967)
900-1970			Canada	Mannell (1967)
1074-1487			USA	Schroeder et al. (1967)
64-713			Japan	Ikuta (1968)
180-4120			Atlantic, USA	Pringle et al. (1968)
86-344			Pacific, USA	Pringle et al. (1968)
45-190			Portugal	Establier (1969)
		330-480 Commercial	Canada	Quayle (1969)
		34,000 Polluted	Canada	Quayle (1969)
159-245			USA	Wolfe (1970)
	1430		Canada	Somers & Smith (1971)
395-1055			UK	Coombs (1972)
		1100-3000	USA	US Fd. & Drug Admin.

REF. NO.: 73 - T - 3

SUBSTANCES: Zn, Cu, Cd

Reference: Thrower, S. J. & I. J. Eustace. 1973. Heavy metals in Tasmanian oysters. Aust. Fish. 32(10):7-10.

Organisms: Crassostrea gigas
Ostrea angasi

Date of Sample Collection: 1972

Location: Tasmania

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Levels of zinc, cadmium and copper in oysters growing in Tasmanian waters

Region	Map reference	Species	Number of samples	Metal concentration, parts per million (wet weight basis) Zinc (40 ppm+) Mean ± SD*	Cadium (5.5 ppm+) Mean ± SD*	Copper (30 ppm+) Mean ± SD*
North coast	1, 2, 3, 4	*C. gigas*	50	561 ± 360	3.0 ± 0.8	21 ± 10
East coast	5, 6, 7, 8, 9	*C. gigas* & *O. angasi*	60	486 ± 257	<2.0	30 ± 31†
Frederick Henry Bay	10, 11, 12	*C. gigas* & *O. angasi*	75	2010 ± 1100	3.1 ± 1.7	53 ± 26
Huon/D'Entrecasteaux						
Huon Estuary	13, 14, 15	*C. gigas*	30	698 ± 482	2.2 ± 1.5	19 ± 8
Tamar River (> 20 miles from Launceston)	17	*C. gigas*	48	802 ± 376	3.8 ± 1.5	123 ± 44
Tamar River (Approx. 16 miles from Launceston)	18	*C. gigas*	10	1350 ± 249	7.2 ± 0.7	124 ± 24
Tamar River (Approx. 11 miles from Launceston)	19	*C. gigas*	10	1600 ± 359	14.6 ± 3.7	99 ± 22
Ralphs Bay	16	*C. gigas*	130	7670 ± 2390	19.8 ± 8.7	102 ± 37

SD* Standard deviation

+ Upper limits permitted by Tasmanian food regulations

† Large SD Due to high levels of copper in oysters of both species from Triabunna, a centre of some industries.

REF. NO.: 74 - T - 3

SUBSTANCES: Hg

Reference: Ting, R. Y., O. H. Weeler & E. Robles de Irizarry. 1974. The determination of mercury in commercially important aquatic organisms. Puerto Rico Dept. of Agriculture, NMFS, 1973. Nat. Tech. Inform. Serv., U.S. Dept. of Commerce, 36p.

Organisms: *Crassostrea rhizophorae*
Tivela mactroides

Date of Sample Collection: 1973?

Location: Puerto Rico

Analytical Technique:

Analytical Data:

Species	Location	Tissue	No. of samples	PPM Hg/wet weight Min.	Max.	Ave.
Crassostrea rhizophorae	Parguera	flesh	4	0	.01	<.01
Tivela mactroides	Mayaguez	flesh	14	.01	.18	.09

REF. NO.: 73 - T - 2 **SUBSTANCES:** Cu, Zn, Cd, Pb

Reference: Topping, G. 1973. Heavy metals in shellfish from Scottish waters. Aquaculture 1:379-384.

Organisms: *Mytilus edulis*
Pecten maximus
Chlamys sp.

Date of Sample Collection: 1973?

Location: Scotland

Analytical Technique:

Analytical Data:

TABLE 4

Distribution of trace metals in scallops

(Six scallops from Kilbrennan Sound, Firth of Clyde were opened up and separated into meat, gonads and viscera. Individual meat and gonads + total viscera were analysed for Cu, Zn, Cd and Pb. All results are given in ppm wet weight.)

		Pb	Cd	Cu	Zn
Gonads	1	0.2	0.73	2.9	51.0
	2	0.7	0.63	3.2	46.8
	3	0.3	0.88	2.6	110
	4	<0.2	0.30	3.0	51.0
	5	0.5	0.58	2.6	46.2
	6	1.7	0.75	4.7	62.5
Muscle	1	<0.2	0.88	0.4	18.0
	2	0.2	1.03	0.5	18.0
	3	<0.2	0.55	0.5	16.2
	4	<0.2	0.55	0.4	16.7
	5	0.3	0.90	0.4	14.5
	6	0.5	0.73	0.5	18.7
Mixed viscera		0.8	15.4	11.5	17.6

Topping, G. 1973.

TABLE 1

Trace metals in shellfish from Scottish waters

Sample description	Number in sample	Metals (mg/kg wet wt) Copper	Zinc	Cadmium	Lead
Mussels (homogenate)					
Wemyss Bay	10	2.00	43.1	0.58	5.5
Helensburgh Pier	10	0.95	23.1	0.13	1.0
Holy Loch	10	0.95	27.2	0.10	1.2
Ythan Estuary	10	2.00	13.1	0.20	1.4
Aberdeen	10	1.50	24.0	0.40	2.8
Anstruther	10	5.00	24.0	0.30	3.9
Dornoch Firth	100	2.0	19.1	0.13	0.4
Findhorn	100	1.2	16.4	0.08	<0.2
Findhorn Bay	100	1.5	12.9	0.18	<0.2
Musselburgh	100	2.0	28.2	0.93	2.7
Orkney	100	1.2	22.7	0.38	1.5
Longniddry	100	1.2	20.0	0.75	2.1
Shetland	100	0.5	32.5	0.18	0.4
Barra	100	2.0	82.5	2.0	1.2
Sheen Fank Ardvar } Loch	100	1.0	12.5	0.25	<0.2
Ardvar } Begg	100	1.0	14.5	0.20	<0.2
Martins Point } Sutherland	100	2.5	12.5	0.10	1.2
Scallops (homogenate)					
Orkney	10	0.4	19.1	7.1	1.0
Mallaig	20	0.9	45.5	5.1	0.4
E. Shetland	10	0.4	25.0	23.0	0.2
Ullapool	10	0.5	28.5	7.0	<0.1
Nephrops (homogenate of whole body)					
North Minch	10	4.4	10.2	<0.03	<0.2
Anstruther	4	11.3	12.2	<0.03	0.5
Lossiemouth	10	4.0	12.2	<0.03	0.5
Forth	10	4.2	11.0	0.1	0.3
Clyde	9	2.1	8.5	<0.03	<0.2
Moray Firth	10	4.2	12.2	<0.03	<0.2

*Sample wt = 0.5 g.

REF. NO.: 75 - T - 2

SUBSTANCES: Hg

Reference: Torre, J. A. & C. Masso. 1975. El contenido en mercurio de los moluscos en la Ría de Pontevedra como medida de su grado de contaminación en dicho metal. Bol. Inst. Español Oceanografia 191:10p.

Organisms: clams, mussels (unspecified)

Date of Sample Collection: 1975?

Location: Ría de Pontevedra, Spain

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Torre, J. A. & C. A. Masso. 1975.

CUADRO 2

Situación del punto de recogida	Clase de molusco	Número de ejemplares de la muestra	Talla media en cm	ppm de Hg
1	Almeja fina.	12	2,5	0,17
1	Berberecho.	12	3,0	0,24
2	Berberecho.	17	3,0	0,23
3	Almeja babosa.	12	3,5	0,27
3	Berberecho.	15	3,2	0,22
4	Almeja fina.	8	2,8	0,31
5	Mejillón.	6	7,4	0,20
6	Almeja babosa.	14	3,6	0,13
6	Berberecho.	10	2,6	0,12
7	Berberecho.	12	3,3	0,12
8	Almeja fina.	6	2,9	0,11
8	Berberecho.	12	2,8	0,08
9	Almeja fina.	12	2,9	0,10
9	Berberecho.	8	3,2	0,10
10	Berberecho.	8	3,1	0,08
10	Almeja babosa.	10	3,0	0,08
11	Mejillón.	6	8,1	0,17
12	Berberecho.	10	3,5	0,12
12	Almeja fina.	8	4,0	0,13
13	Berberecho.	6	3,5	0,09
14	Berberecho.	10	3,0	0,13
15	Berberecho.	8	3,5	0,09
16	Berberecho.	6	3,7	0,10
17	Almeja fina.	8	3,0	0,12
18	Mejillón.	6	7,8	0,08
19	Mejillón.	5	8,6	0,10
20	Mejillón.	6	8,3	0,09
21	Almeja rubia.	6	5,5	0,11
22	Almeja rubia.	6	5,2	0,09
23	Almeja rubia.	6	5,0	0,06
24	Almeja rubia.	10	4,3	0,05
25	Almeja rubia.	12	4,9	0,04
25	Mejillón.	6	8,9	0,04
26	Almeja rubia.	8	5,2	0,05
26	Mejillón.	8	6,7	0,06
27	Almeja rubia.	6	4,5	0,06
28	Almeja rubia.	6	5,1	0,06
28	Mejillón.	6	7,9	0,04
29	Almeja rubia.	10	4,4	0,09
30	Almeja fina.	5	4,4	0,04
30	Berberecho.	5	3,9	0,01
31	Berberecho.	6	3,9	0,01
31	Almeja fina.	7	4,4	0,02
32	Mejillón.	5	9,1	0,01
33	Mejillón.	5	8,8	0,01
34	Almeja fina.	5	3,5	0,03
34	Berberecho.	8	2,9	0,02
35	Almeja fina.	5	3,6	0,03
35	Berberecho.	7	3,3	0,02
36	Berberecho.	6	3,7	0,02
36	Almeja fina.	6	3,9	0,03
36	Mejillón.	5	7,8	0,01
37	Mejillón.	5	6,7	0,01
38	Mejillón.	5	7,1	0,03

[almeja = clam; berberecho = clam; mejillon = mussel]

REF. NO.: 74 - V - 1

SUBSTANCES: Pb, Cd, Zn

Reference: Valiela, I., M. D. Banus & J. M. Teal. 1974. Response of salt marsh bivalves to enrichment with metal-containing sewage sludge and retention of lead, zinc and cadmium by marsh sediments. Environ. Pollut. 7:149-157.

Organisms: Mercenaria mercenaria, Crassostrea virginica (experimental plants); Modiolus demissus (native populations)

Date of Sample Collection: 1974?

Location: Great Sippewissett Marsh, Cape Cod, Massachusetts

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 4

CONCENTRATION OF METALS IN PPM (MEAN ± STD. ERROR) IN THE THREE BIVALVE SPECIES IN THE EXPERIMENTAL PLOTS COLLECTED IN NOVEMBER 1972. VERTICAL LINES JOINING MEANS SIGNIFY NO STATISTICAL DIFFERENCES (KRAMER, 1956) AT 0·05 LEVEL

		Concentration of metal in ppm, dry weight basis		
		Pb	*Zn*	*Cd*
Clams (Mercenaria)	HF	2·7 ± 0·3	298·0 ± 20·0	2·08 ± 0·12
	LF	3·5 ± 0·1	296·8 ± 12·6	2·18 ± 0·13
	C	2·8 ± 0·6	252·0 ± 9·7	1·25 ± 0·12
Oysters (Crassostrea)	LF	<1	9650 ± 3188	9·45 ± 0·51
	HF	<1	7650 ± 1609	8·60 ± 0·49
	C	<1	12675 ± 1609	7·18 ± 0·52
Ribbed Mussels (Modiolus)	HF	2·6 ± 0·4	52·0 ± 2·0	7·13 ± 3·24
	LF	3·2 ± 0·3	52·0 ± 1·4	3·75 ± 0·13
	C	2·7 ± 0·3	49·0 ± 0·4	1·98 ± 0·09

REF. NO.: 73 - V - 2

SUBSTANCES: Cr, Fe, Zn, Co
Mn, Sb, Cs

Reference: Van As, D., H. O. Fourie & C. M. Vleggaar. 1973. Accumulation of certain trace elements in marine organisms from the sea around the Cape of Good Hope. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 1972, p. 615-624. IAEA, Vienna.

Organisms: Choromytillus meridionalis
Donax serra

Date of Sample Collection: 1973?

Location: South Africa

Analytical Technique: Atomic absorption spectrophotometry; neutron activation analysis

Analytical Data:

TABLE II. CONCENTRATIONS OF TRACE ELEMENTS IN MARINE ORGANISMS (μg/g fresh weight, i.e. ppm)

Species		Cr	Fe	Zn	Co	Mn	Sb	Cs
Mollusca	Choromytillus meridionalis	0.13 ± 0.07	18 ± 5	16 ± 2	0.037 ± 0.005	1.7 ± 0.4	0.20	0.0070 ± 0.0030
	Donax serra	0.19 ± 0.09	47 ± 19	16 ± 3	0.040 ± 0.028	0.84 ± 0.20	0.27	0.0049 ± 0.0027

REF. NO.: 75 - V - 1

SUBSTANCES: Cr, Co, Fe, Zn, Mn, Sb, Cs

Reference: Van As, D., H. O. Fourie & C. M. Vleggaar. 1975. Trace element concentrations in marine organisms from the Cape West Coast. S. Afr. J. Sci. 71:151-154.

Organisms: Choromytilus meridionalis
Donax serra

Date of Sample Collection: 1975?

Location: South Africa, west coast

Analytical Technique: Atomic absorption spectrophotometry; neutron activation analysis

Analytical Data:

Table 2 Concentration of trace elements in marine organisms (μg/g fresh weight, i.e. p.p.m.)

		Cr	Fe	Zn	Co	Mn	Sb	Cs
Molluscs	*Choromytillus meridionalis*	0.10 ± 0.06	20 ± 7	16 ± 1	0.038 ± 0.006	2.7 ± 1.1	0.20 *	0.0072 ± 0.0027
	Donax sera	0.24 ± 0.03	59 ± 27	18 ± 4	0.038 ± 0.024	1.0 ± 0.4	0.18 ± 0.08	0.0072 ± 0.0054

REF. NO.: 73 - V - 1

SUBSTANCES: Zn, Co

Reference: Van Weers, A. W. 1973. Uptake and loss of ^{65}Zn and ^{60}Co by the mussel Mytilus edulis L. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 1972, p. 385-401. IAEA, Vienna.

Organisms: Mytilus edulis

Date of Sample Collection: 1968-70

Location: North Sea, Netherlands

Analytical Technique: Atomic absorption spectrometry; neutron activation analysis

Analytical Data:

(dry wt., dried at 110°C)

TABLE I. STABLE ZINC CONCENTRATION IN THE SOFT PARTS OF Mytilus edulis L., SAMPLED AT THE NORTH SEA SHORE NEAR PETTEN, THE NETHERLANDS [a]

Sampling date	Concentration in dry material (ppm)	Concentration in fresh material (ppm)
68-1-18	220	56
68-2-14	220	59
68-3-13	170	28
68-4-10	420	112
68-6-11	360	96
68-7-9	340	98
69-12-10	180 ± 20 [b]	48 ± 5 [b]
70-1-7	130 ± 30 [b]	34 ± 7 [b]
Mean	260	66
Stand. dev.	100	32

[a] Determined by atomic absorption spectrometry in 0.1N HCl extracts of ashed material.
[b] Mean and standard deviation of 5 replicate samples

Van Weers, A. W. 1973.

TABLE II. STABLE COBALT CONCENTRATION IN THE SOFT PARTS OF *Mytilus edulis* L., SAMPLED AT THE NORTH SEA SHORE NEAR PETTEN, THE NETHERLANDS

Sampling date	Concentration in dry material (ppm)		Concentration in fresh material (ppb)
	a	b	
68-1-18	1.1	1.5	330
68-2-14	1.4	1.4	380
68-3-13	1.1	1.8	240
68-4-10	1.5	4.3	790
68-5-14	1.4	-	380
68-6-11	3.1	3.8	900
68-7-9	2.7	3.2	900
69-8-12	-	0.9	240
Mean	1.9		520
Stand. dev.	0.9		290.

[a] Irradiation 4 d at 4×10^{13} n cm^{-2} s^{-1}, cooling time one week. Ash dissolved in dilute HCl and cobalt extracted with α-nitroso-naphthiol ^{60}Co measured with NaI scintillation detector.

[b] Irradiation 4 d at 4×10^{13} n cm^{-2} s^{-1}, cooling time 4 months. ^{60}Co without chemical separation measured with NaI scintillation detector.

REF. NO.: 76 - V - 1

SUBSTANCES: Cd, Zn

Reference:

Vattuone, G. M., K. S. Griggs, D. R. McIntyre, J. L. Littlepage & F. L. Harrison. 1976. Cadmium concentrations in rock scallops in comparison with some other species. Lawrence Livermore Laboratory, University of California, Livermore, 11p. Nat. Tech. Inform. Serv.

Organisms:

Hinnites multirugosus	*Pecten maximus*
Mytilus californianus	*Crassostrea gigas*
Mytilus edulis	*Crassostrea commercialis*
Aequipecten irradians	*Crassostrea virginica*

Date of Sample Collection: 1973

Location: Anacapa Island and Santa Barbara Island, off Southern California

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table 4. Concentration factors and percentage distributions of ^{109}Cd in body parts of rock scallops and mussels.

	Rock scallop		Mussel	
	CF	%[a]	CF	%
Mantle	1,100	12.5	94	5.3
Gills and labial palps	2,000	12.2	440	21.3
Muscle	450	15.8	55	2.1
Digestive gland and stomach	6,800	18.9	2,700	23.4
Viscera	1,400	12.9	240	10.3
Kidney	11,800	12.6	4,500	12.8
Body fluid	15	0.4	4	1.6
Remainder	850	14.4	220	15.2
Byssus	—	—	2,700	8.0
Total soft tissues	3,525	100	1,580	100

[a]Percentage of ^{109}Cd in total body less shell.

Vattuone, G. M. et al. 1976.

Table 1. Cadmium concentrations (µg/g wet wt) in mussels and rock scallops collected at Santa Barbara Island.

Mussels[a]	Rock scallop[b]		
Total soft tissues	Total soft tissues	Adductor muscle	Visceral mass
1.75	3.8	0.30	5.5
2.63	32.9	0.32	48.8
2.56	46.8	0.30	69.4
1.60	42.7	0.68	63.1
1.65	1.8	0.48	2.5
1.43	30.0	0.32	44.4
1.72	39.9	0.30	59.2
2.02	33.2	0.26	49.2
1.53	29.9	0.26	44.3
	37.7	0.40	55.8
	44.9	0.28	66.6
	—	0.27	—
1.88[c]	31.2[c]	0.35[c]	46.3[c]
(0.44)	(15.2)	(0.12)	(22.6)

[a]Each value represents one animal.

[b]Each set of three values represents one animal.

[c]Mean; standard deviation in parentheses.

Table 2. Concentrations (µg/g wet wt) of Cd and Zn in selected tissues of rock scallops collected at Anacapa Island.

Size (cm)	Adductor muscles	Kidney		Digestive gland and stomach	
g	Cd	Cd	Zn	Cd	Zn
7.6	0.60	11.5	35.0	153	67.5
8.9	0.39	5.8	16.7	123	—
9.5	0.32	5.7	34.1	196	73.5
9.5	0.58	8.1	31.2	241	96.7
10.2	0.37	16.6	—	213	56.8
10.2	0.50	3.8	25.0	210	—
10.2	0.51	10.0	30.0	127	47.2
11.4	0.55	10.1	54.0	234	—
12.0	0.47	13.3	58.3	141	76.6
12.0	0.59	4.3	23.4	235	59.9
12.0	0.54	11.4	21.4	—	—
12.7	—	11.0	25.0	268	74.8
12.7	0.40	9.2	21.4	217	77.7
12.7	0.63	11.4	—	262	69.9
12.7	—	—	—	261	78.1
13.3	0.55	16.2	125	245	—
14.0	0.37	8.4	20.3	120	35.9
14.0	0.66	—	—	288	83.3
14.0	0.79	10.8	33.3	240	—
14.6	0.57	13.7	51.7	246	—
15.2	0.33	11.5	26.0	201	64.0
$\bar{X}$	0.51	10.1	37.2	211	68.8
S.D.	0.12	3.6	25.7	51.9	15.3

Vattuone, G. M. et al. 1976.

Table 5. Values from the literature for cadmium concentrations in marine organisms. The underscored ranges are from areas receiving waste effluent; the higher values are from organisms closer to the source.

Sample	Concentration (μg/g wet wt)	Ref.
Molluscs (soft parts)		
Mytilus edulis	0.8-12[a]	8
	3.21	12
Aquipecten irradians	1.15	2
Pecten maximus	2.6[a]	14
Crassostrea gigas	14-27	15
	0.8-1.0	15
C. commercialis	0.2	16
C. virginica	>2.5	17
	<0.6	17
	0.33	2
	2.4	18

[a]Dry weight was assumed to be 20 percent of wet weight.

REF. NO.: 75 - V - 2

SUBSTANCES: Zn, Cu

Reference: Vidal, C. E. S. & M. J. A. Ruiz. 1975? Distribucion de cobre y zinc en mejillon (Mytilus californianus) en la parte noroccidental de la Baja California. Unidad de Ciencias Marinas, Universidad Autonoma de Baja California. Ensenada, Mexico.

Organisms: Mytilus californianus

Date of Sample Collection: 1973

Location: Baja California, Mexico

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Vidal, C. E. S. & M. J. A. Ruiz. 1975?

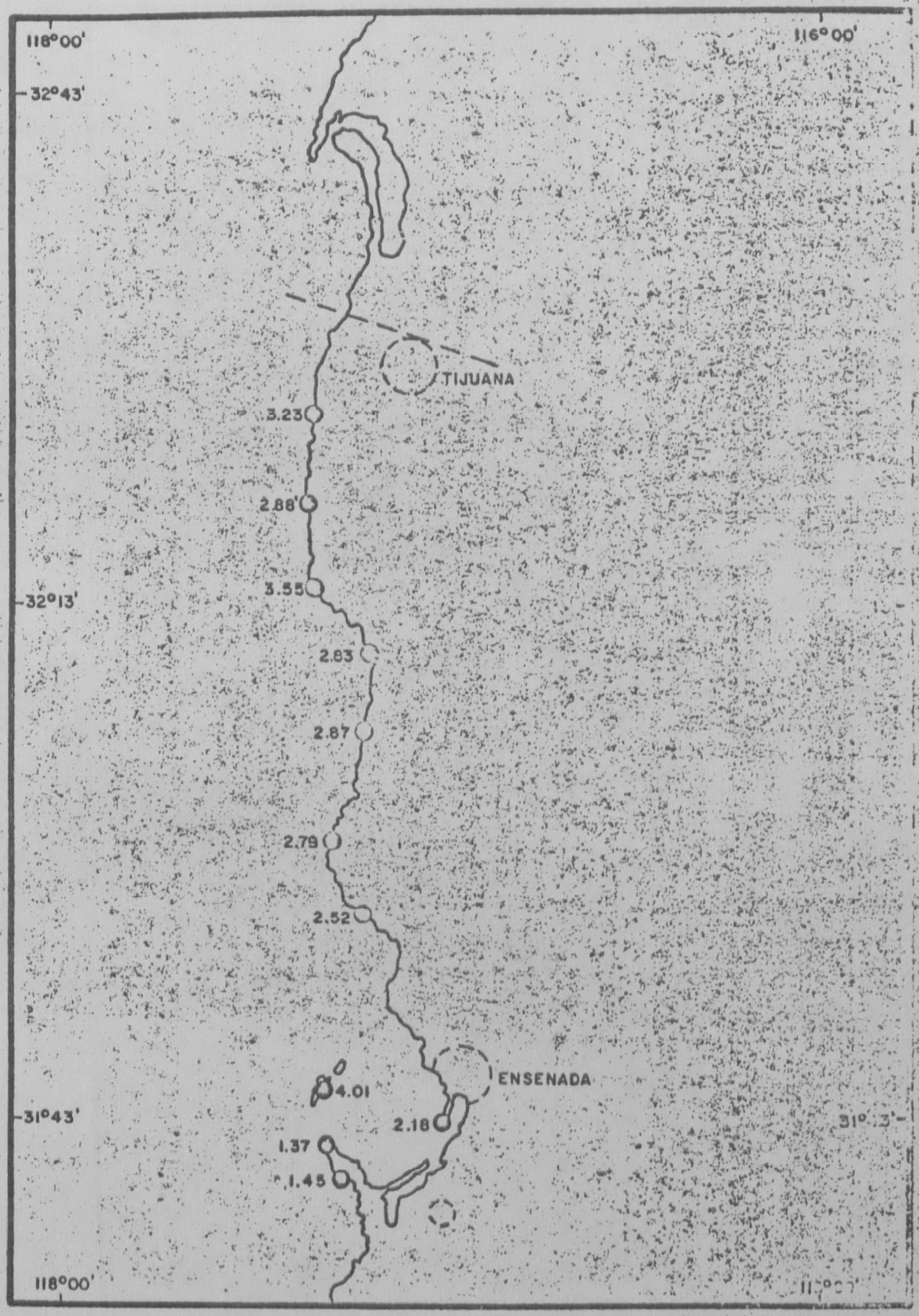


FIG. 2.- CONCENTRACIONES DE Cu (ppm DE MATERIA SECA) EN *Mitylus sp.* EN 1974

Vidal, C. E. S. & M. J. A. Ruiz. 1975?

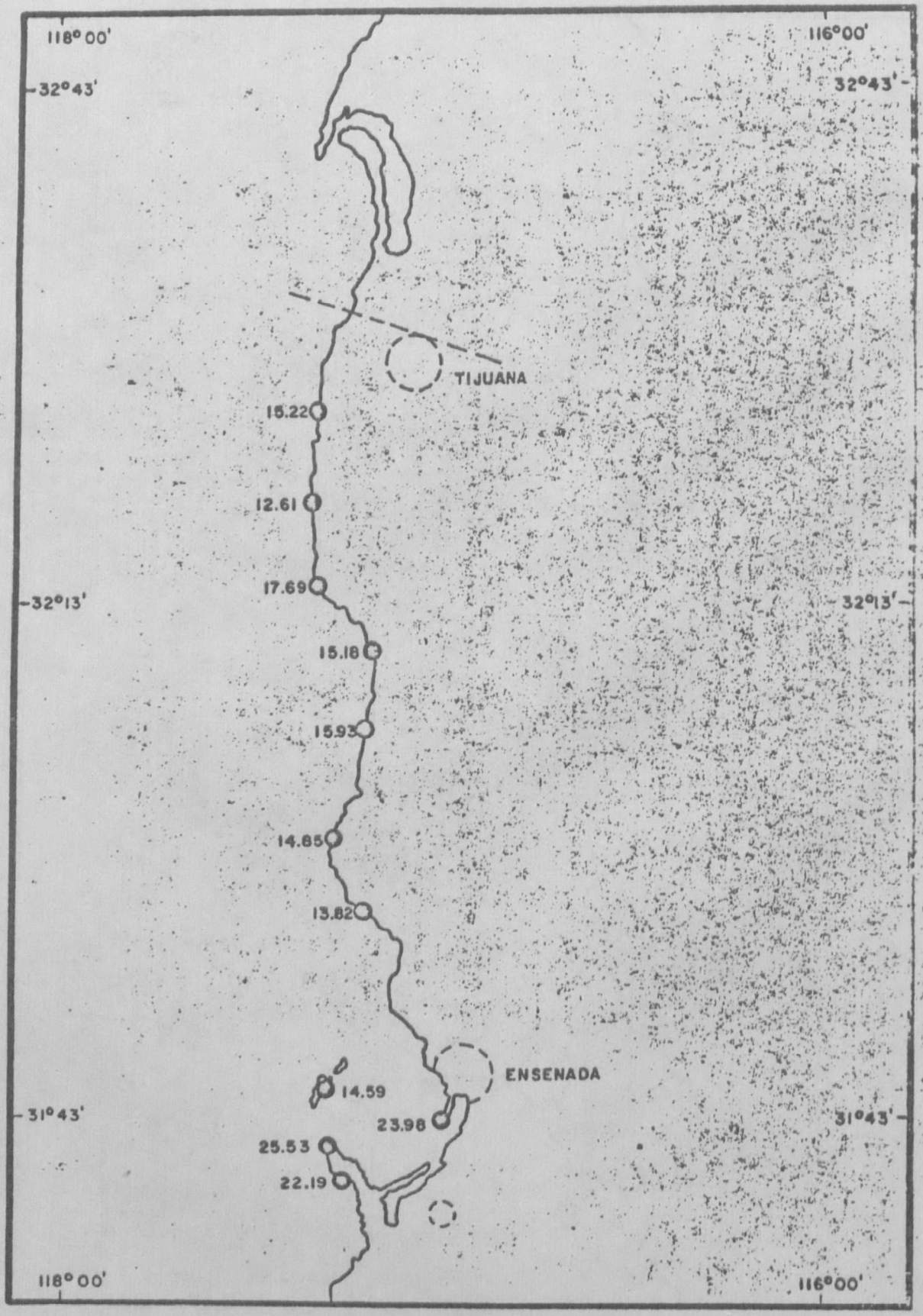


FIG. 3 -- CONCENTRACIONES DE Zn (ppm DE MATERIA SECA) EN *Mytilus sp.* EN 1974

REF. NO.: 67 - V - 1

SUBSTANCES: Cu

Reference: Vilela, H. 1967. Exploraçao e salubridade de moluscos testaceos marinhos en 1966. Boletim da Pesca 95:23-71.
[Reference and data are taken from Establier 1969 (69-E-2); paper is available at charge from Library of Congress, Photoduplication Service.]

Organisms: Crassostrea angulata

Date of Sample Collection: 1966

Location: Tajo and Sado River estuaries, Portugal

Analytical Technique:

Analytical Data:

Tajo River estuary: 5.9 - 23.5 per 100 gr wet wt.

Sado River estuary: 4.0 - 43.0 per 100 gr wet wt.

REF. NO.: 66 - V - 1

SUBSTANCES: Cu

Reference: Vilela, H. 1966. Exploraçao e salubridade de moluscos testaceos marinhos, 1965. Boletim da Pesca 90:11-42.
[Reference and data are taken from Establier 1969 (69-E-2); paper is available at charge from Library of Congress, Photoduplication Service.]

Organisms: Crassostrea angulata

Date of Sample Collection: 1965

Location: Tajo and Sado River estuaries, Portugal

Analytical Technique:

Analytical Data:

Tajo River estuary: 6.8 - 26.2 per 100 gr wet wt.

Sado River estuary: 8.2 - 24.0 per 100 gr wet wt.

REF. NO.: 65 - V - 1

SUBSTANCES: Cu

Reference: Vilela, H. 1965. Exploraçao e salubridade de moluscos testaceos marinhos, 1964. Boletim da Pesca 86:23-45.
[Reference and data are taken from Establier 1969 (69-E-2); paper is available at charge from Library of Congress, Photoduplication Service.]

Organisms: Crassostrea angulata

Date of Sample Collection: 1964

Location: Tajo and Sado River estuaries, Portugal

Analytical Technique:

Analytical Data:

Tajo River estuary: 3.9 - 9.0 per 100 gr wet wt.

Sado River estuary: 4.6 - 18.0 per 100 gr wet wt.

REF. NO.: 53 - V - 1

SUBSTANCES: trace elements

Reference: Vinogradov, A. P. 1953. The elementary chemical composition of marine organisms. Sears Foundation for Marine Research, Memoir, 647p. New Haven, Conn.

Organisms: numerous species

Date of Sample Collection:

Location:

Analytical Technique:

Analytical Data:

TABLE 173

COMPOSITION OF MOLLUSCA (% OF LIVING MATTER)

ORGANISM	Comments	K	Na	Ca	Mg	P	S	Cl	Fe	Si	Ash	Locality	Author
Lamellibranchiata													
Crassostrea commercialis	Soft	0.57	0.16	0.09	0.05	0.15	-	-	0.005	—	2.3	Australia	Clements and Hutchinson, 1939
Crassostrea gigas		—	—	0.0628	0.48	0.192	--	--	0.0075	—	—	Pacific Coast, U.S.A.	Nilson and Coulson, 1939
Crassostrea virginica		—	—	0.0579	0.032	0.1121	-	-	0.0061	—	—	East Coast, U.S.A.	" " " "
Mytilus edulis		0.38	0.08	0.03	0.02	0.17	-	-	0.001	—	1.6	Australia	Clements and Hutchinson, 1939
Ostrea lurida		—	—	0.0632	0.024	0.3154	-	-	0.0049	—	—	Pacific Coast, U.S.A.	Nilson and Coulson, 1939
Pecten fumatus		0.34	0.20	0.04	0.02	0.26	-		0.001	—	1.8	Australia	Clements and Hutchinson, 1939

Vinogradov, A. P. 1953.

TABLE 174

COMPOSITION OF VARIOUS ORGANS OF MOLLUSCA (IN %, OF LIVING MATTER)

ORGANISM	Ash	Na	K	Ca	Mg	P	S	Fe	Cl	Author
Cardium edule										
podium . .	—	0.51	0.305	0.041	0.093	—	—	0.0155	—	McCance and Shipp, 1933
mantle . .	—	0.61	0.18	0.180	0.117	—	—	0.0175	—	" "
muscle* . .	—	0.388	0.269	0.078	0.090	—	—	0.005	—	" "
intestines and liver. . .	—	0.241	0.302	0.145	0.094	—	—	0.081	—	" "
Pecten maximus	1.38	—	—	—	—	0.21	0.24	—	—	Taylor, 1925-b
podium . .	—	0.612	0.148	0.052	0.104	—	—	0.0009	—	McCance and Shipp, 1933
mantle . .	—	0.742	0.387	0.026	0.063	—	—	0.0018	—	" "
muscle . .	—	0.424	0.283	0.038	0.078	—	—	0.0058	—	" "
gonads . .	—	0.566	0.143	0.054	0.111	—	—	0.0017	—	" "
gills . . .	—	0.726	0.262	0.118	0.080	—	—	0.0112	—	" "
intestines . .	—	0.351	0.305	0.041	0.093	—	—	0.0155	—	" "
Tivela stultorum										
muscle . .	—	—	—	0.8	0.4	—	—	—	—	"
liver . . .	—	—	—	0.6	0.1	—	—	—	—	"
Mytilus edulis										
muscle . .	2.4	0.144	0.906	0.013	0.070	0.360	0.010	0.005	0.110	Griffiths, 1905
Mytilus edulis .	—	0.290	1.315	0.090	0.023	—	—	0.0058	—	McCance and Shipp, 1933
" " .	2.22	—	—	—	—	0.17	0.43	—	—	Taylor, 1925-b
Anodonta sp.										
muscle . .	1.8	0.110	0.677	0.115	0.054	0.267	0.008	0.004	0.083	Griffiths, 1905
Mya arenaria										
muscle . .	1.2	0.031	0.470	0.007	0.037	0.179	0.005	0.003	0.055	"
Venus mercenaria										
muscle . .	1.46	0.205	0.311	0.038	0.048	0.153	0.225	0.0	0.322	Correa, 1927
Ostrea edulis .	—	0.650	0.258	0.185	0.041	—	—	0.006	—	Meigs, 1915
Crassostrea virginica . .	2.76	—	—	—	—	0.13	0.33	—	—	McCance and Shipp, 1933
"	1.7	—	—	0.089	0.246	0.112	0.315	0.0012	—	Taylor, 1925-b Coulson,

TABLE 187

MANGANESE IN MOLLUSCA (IN %)

ORGANISM	Comments	Ash	Dry matter	Locality	Author
Lamellibranchiata (soft parts)					
Venus mercenaria		—	0.0043	U.S.A.	McHargue, 1927
Crassostrea virginica		—	0.0049	"	" "
Pinna japonica (*Atrina pectinata*)	3; byssus	14.1	0.18	——	Suto, 1938
" "	3; hepatopancreas	3.9	0.60	——	" "
" "	3; mantle glands	7.13	0.18	——	" "
" "	3; kidneys	3.1	0.73	——	" "
" "	3; muscles	2.93	—	——	" "
Mytilus edulis		—	6×10^{-6}*	——	Clements and Hutchinson, 1939
Pecten fumatus		—	5×10^{-6}*	——	" "
Pecten maximus		0.008	—	——	Webb, 1937†
Freshwater Unionidae	Mixed	—	0.5424	U.S.A.	McHargue, 1927
Lamellibranchiata (shell)					
Anodonta cygnea		0.078	—	Dnieper	Vinogradov, 1938-c
" "		0.078	—	Leningrad, Sablino	" "
Cardium edule		0.001	—	Barents Sea	" "
Mytilus edulis		0.002	—	——	——
Margaritana margaritifera		0.04	—	Kazanka River	Vinogradov, 1938-c
"		0.035	—	Vorgusa River	" "
Pecten islandicus		0.001	—	Barents Sea	" "
Ostrea sp.		0.01	—	Avachinsky Bay, Kamchatka	" "
Unio pictorum		0.055	—	Dnieper	" "
Unio tumidus		0.069	—	"	" "

TABLE 192

MANGANESE IN LAMELLIBRANCHIATA* (IN %)

ORGANISM	No. of analyses	Living matter	Dry matter	Ash	Locality	Author
Anomia ephippium .		0.00017	0.00088	0.00437	——	Wang-Tai-Si, 1928
Pectunculus glycemeri	4	0.00058	0.00275	0.00992	——	" " " "
Mytilus edulis . .	4	0.00023	0.01266	0.08440	——	" " " "
" " . .	4	—	0.004†	—	England	Boycott and Cameron, 1930
" " . .	4	0.000150	—	—	——	Bertrand and Medigreceanu, 1913
Mytilus galloprovincialis .		0.00025	—	—	——	Dubuisson and Heuverswyn, 1931
Pecten jacobaeus . .	2	0.00202	0.01198	0.06099	——	Wang-Tai-Si, 1928
" " . .	2	0.001917†	—	—	——	Bertrand and Medigreceanu, 1913
Pecten varius . .		0.00239†	0.01799	0.05600	——	Wang-Tai-Si, 1928
Pecten maximus . .	5	0.000466	0.00376	0.01176	——	" " " "
" " . .	5	—	0.0050	—	England	Boycott and Cameron, 1930
Pecten opercularis .		—	0.040†	—	"	" " "
" " .	4	0.000601	0.00466	0.01568	——	Wang-Tai-Si, 1928
Crassostrea virginica	4	0.0002†	—	—	——	Coulson, Remington and Levine, 1932
" "	4	0.00021	—	—	——	Peterson and Skinner, 1931
Crassostrea angulata		0.000649	—	—	——	Bertrand and Medigreceanu, 1913
Ostrea edulis . . .	4	0.000315	0.00149	0.00833	——	" " "
" " . . .	4	—	0.004	—	England	Boycott and Cameron, 1930
" " . . .	4	0.0001	—	—	"	Bertrand and Medigreceanu, 1913
Pinna pectinata . .		0.0008†	—	—	——	Dubuisson and Heuverswyn, 1931
Tellina crassa . .	3	0.00074	0.00690	0.01112	——	Wang-Tai-Si, 1928
Tellina tenuis . .	4	0.00115	0.00371	0.02323	——	" " " "
Mactra corallina . .	3	0.00013	0.00123	0.00302	——	" " " "
Scrobicularia piperata	3	0.00041	0.00301	0.00723	——	" " " "
Venus verrucosa . .	4	0.00038	0.00166	0.00917	——	" " " "
Venus mercenaria .	4	0.00026	0.00190	0.00803	——	" " " "
Tapes decussatus . .	4	0.00016	0.00091	0.00547	——	" " " "
" " . .		0.00071§	—	—	——	Dubuisson and Heuverswyn, 1931
" " . .		0.000109	—	—	——	Bertrand and Medigreceanu, 1913
Tapes aureus . . .	2	0.00048	0.00309	0.01387	——	Wang-Tai-Si, 1928
Dosinia exoleta . .		0.00693†	0.03372	0.1712	——	" " " "
Cytherea chione . .	2	0.00172	0.00794	0.0442	——	" " " "
Cardium edule . .	4	0.00035	0.00266	0.01196	——	" " " "
" " . .	4	0.000163	—	—	——	Bertrand and Medigreceanu, 1931
" " . .	4	none	—	—	England	Boycott and Cameron, 1930
Cardium norvegicum		0.00001§	0.00005	0.00062	——	Wang-Tai-Si, 1928
Mya arenaria . .	3	0.00008	0.00054	0.00212	——	" " " "
Lutraria elliptica .	2	0.00059	0.00258	0.00821	——	" " " "
Solen siliqua . . .	4	0.00005	0.00026	0.00164	——	" " " "
Avicula hirundo . .		0.0013	—	—	——	Dubuisson and Heuverswyn, 1931
Donax tronchulus . .	7	0.000287	0.00264	0.00614	——	Wang-Tai-Si, 1928
Unio sinuatus[α] . .		0.00741	—	—	——	Bertrand and Medigreceanu, 1913
Unio sp.[α]		1.06	—	5.02	Mississippi	Bradley, 1910-a
Anodonta[α] . . .		1.04	—	4.8	"	" "

* The presence of manganese was shown qualitatively in *Mytilus edulis* by Pichard (1898) and Bradley (1907-a).
† Maximum. § Without the liver, mantle and gills. α Fresh water.

TABLE

MANGANESE IN VARIOUS ORGANS OF LAMELLIBRANCHIATA (IN % OF DRY MATTER)

ORGANISM	Podium	Muscles	Gills	Sex organs: Male	Sex organs: Female	Mantle	Pericardial glands	Liver	Kidneys	Author
Mya arenaria	—	0.00011	0.00063	0.00261		0.00173	—	0.00088	0.00173	Wang-Tai-Si, 1928
Pectunculus glycemeris	—	0.00023	0.0022	0.00081		0.00177	0.0082	0.00078	—	" " " "
Cardium edule	0.00057	0.00085	0.00094	0.00103		0.00315	—	0.00426	—	" " " "
Mytilus edulis	0.00138	—	0.00490	0.00289		0.00161	0.00704	0.0021	—	" " " "
Ostrea edulis	—	—	0.00842	0.00067		0.00317	—	0.00131	—	" " " "
" "	—	—	0.002	—	—	0.002	—	trace	—	Fox and Ramage, 1931
Pinna rudis	—	0.00038	0.00140	0.00119		0.00105	—	0.00086	0.00677	Wang-Tai-Si, 1928
Pinna pectinata	—	—	0.00224*	—	—	0.00049*	—	—	—	Dubuisson and Heuverswyn, 1931
" "	none	—	none	—	<0.0008	none	—	trace	0.0008	Fox and Ramage, 1931
Pecten maximus	none	—	<0.008	0.002	<0.0008	trace	—	<0.0008	>0.0008	" " " "
" "	—	—	0.00142	—	—	0.00080	0.03125	0.00142	0.666	Wang-Tai-Si, 1928
Pecten jacobaeus	—	0.00016	0.0076	—	—	0.00382	—	0.01335	0.08739	" " " "
Crassostrea angulata	—	0.00166	0.001131	0.00714		0.00793	—	0.00473	—	" " " "
Cytherea chione	—	0.0002	0.0022	0.00180		0.02552	—	0.06709	0.12336	" " " "

* In percent of living matter.

Vinogradov, A. P. 1953.

TABLE 194

MANGANESE IN THE ORGANS OF UNIONIDAE (IN % OF DRY MATTER)

ORGANISM	Stomach	Podium (muscle)	Eggs	Mantle	Gills	Shell	Liver	Kidneys	Author
Unionidae	0.831	0.293	0.749	2.457	1.638	—	2.107	1.434	Bradley, 1910-a*
Anodonta cygnea	—	0.0010	—	—	>0.008†	0.0008	0.004	—	Fox and Ramage, 1931α
"	—	0.0013	—	—	>0.008†	0.008	—	—	" "
"	—	>0.008†	—	—	>0.008	0.004	—	—	" "
"	—	0.01143§	—	0.02201§	0.21076§	—	—	0.00726§	Heuverswyn, 1930β
"	—	0.116	—	—	0.405	—	1.098	0.1156	Waele, 1930β

* U.S.A.: Mississippi, Madison, and so forth.
† The sign > in the analyses of Fox and Ramage indicates a high manganese content.
α England: Liverpool, Sheffield, etc. § In percent of living matter. β Belgium: Flanders.

TABLE 195

IRON IN MOLLUSCA (IN %)

ORGANISM	Living matter	Dry matter	Author
Meretrix meretrix	0.00414	0.01745	Oya and Shimada, 1933
Ommatostrephes sloanipacificus	0.00428	0.01917	" " " "
Haliotis japonica	0.00265	0.0141	" " " "
Freshwater Unionidae*	—	0.1325	McHargue, 1927
Venus mercenaria	—	0.0711	" "
Crassostrea virginica	—	0.0208	" "
" "	0.0061	—	Nilson and Coulson, 1939
Crassostrea gigas	0.00751	—	Daniel, 1920
Ostrea lurida	0.00494	—	Nilson and Coulson, 1939

* Mixed.

TABLE 200

IRON IN LAMELLIBRANCHIATA (IN %)

ORGANISM	Comments	Living matter	Dry matter	Ash	Author
Ostrea edulis		—	0.0018	—	Dastré, 1898
*Ostrea edulis**	5	—	0.0365	—	Chatin and Müntz, 1894
" "	5; gills	—	0.0668	—	" " " "
" "		—	—	0.266	Griffiths, 1905
" "		0.0060	—	—	McCance and Shipp, 1933
" "	4	0.005	0.022	0.120	Wang-Tai-Si, 1928
" "	4	—	—	0.27	Albu and Neuberg, 1906
Crassostrea virginica		0.00314	—	—	Peterson and Elvehjem, 1928
" "		—	0.016	—	Skinner and Sale, 1931
" "		0.0104†	—	—	Coulson, Remington and Levine, 1932
" "		0.0057†	—	—	Galtsoff, 1934
Crassostrea angulata	4	0.002	0.016	0.057	Wang-Tai-Si, 1928
Mytilus edulis		—	0.34	2.80	Brandt and Raben, 1919–1922
" "	2	—	0.21	—	Delff, 1912
" "	Muscles	—	0.0036†	—	Henriques and Roche, 1927
" "		0.0058	—	—	McCance and Shipp, 1933
" "		0.003	0.014	0.097	Wang-Tai-Si, 1928
" "	"	—	—	0.21	Griffiths, 1905
Anomia ephippium		0.002	0.010	0.050	Wang-Tai-Si, 1928
Pectunculus glycemeris	4	0.003	0.017	0.057	" " " "
Pecten jacobaeus	2	0.006	0.038	0.197	" " " "
Pecten varius	2	0.003	0.020	0.069	" " " "
Pecten maximus	5	0.001	0.015	0.050	" " " "
Tellina tenuis	4	0.009	0.031	0.185	" " " "
Tellina crassa	3	0.004	0.036	0.061	" " " "
Mactra corallina		0.002	0.020	0.033	" " " "
Donax tronchulus	7	0.001	0.011	0.026	" " " "
Strobicularia piperata	3	0.005	0.047	0.093	" " " "
Venus verrucosa	4	0.009	0.045	0.248	" " " "
Venus mercenaria		0.001	0.006	0.028	" " " "
Venus mercenaria	Muscle	0.0	—	—	Meigs, 1915
Tapes decussatus	4	0.004	0.025	0.158	Wang-Tai-Si, 1928
Tapes aureus		0.011†	0.072	0.415	" " " "
Dosinia exoleta	4	0.018†	0.089	0.450	" " " "
Cytherea chione	2	0.002	0.009	0.058	" " " "
Cardium edule	4	0.002	0.016	0.075	" " " "
" "	Muscle	0.0039	—	—	McCance and Shipp, 1933
Mya arenaria	3	0.018†	0.113	0.417	Wang-Tai-Si, 1928
" "		—	1.225	—	Delff, 1912
" "	Muscle	—	—	0.28	Griffiths, 1905
Lutraria elliptica	2	0.007	0.044	0.120	Wang-Tai-Si, 1928
Solen siliqua	4	0.007†	0.032	0.205	" " " "
Anodonta cygnea	Fresh water	0.0357†	—	—	Bütschli, 1908
Anodonta mutabilis	"	0.07	0.518	—	Meyer, 1914

* Soft parts without gills. † Maximum.

TABLE 201

IRON IN VARIOUS ORGANS OF LAMELLIBRANCHIATA (IN % OF DRY MATTER)

ORGANISM	Muscle	Gills	Mantle	Sex organs	Kidneys	Liver	Author
Pectunculus glycemeris	0.005	0.031	0.035	0.010	—	0.031	Wang-Tai-Si, 1928
Mytilus edulis . .	0.006	—	0.033	0.010	—	0.140	" " " "
Pecten jacobaeus . .	0.002	0.087	0.022	—	0.097	0.042	" " " "
Pecten maximus . .	0.007	0.017	0.0075	0.03	—	—	McCance and Shipp, 1933
Crassostrea angulata .	0.003	0.013	0.030	0.005	—	0.015	Wang-Tai-Si, 1928
Mactra helvetica . .	0.003	0.007	0.017	0.008	0.051	0.049	" " " "
Donax tronchulus . .	0.004	0.008	0.027	—	—	0.050	" " " "
Solen siliqua . . .	—	0.017	0.041	0.040	0.138	0.066	" " " "
Mya arenaria . .	0.005	0.037	0.024	0.018	0.043	0.044	" " " "
Lutraria elliptica .	—	0.038	0.050	—	—	0.017	" " " "
Cytherea chione . .	0.003	0.030	0.023	0.018	0.044	0.032	" " " "
Cardium edule . .	0.0147	0.044	0.113	—	—	—	——
" " . .	0.008	0.009	0.015	0.020	—	0.047	Wang-Tai-Si, 1928
Cardium norvegicum .	—	0.022	0.028	—	—	0.063	" " " "

TABLE 202

IRON IN THE LIVER OF LAMELLIBRANCHIATA (IN % OF DRY MATTER)

ORGANISM	Liver	Rest of body	Author
Ostrea edulis	0.011	0.0018	Dastré, 1898
Pecten jacobaeus	0.020	0.004	" "
Mytilus edulis	0.016	—	" "
*Tivella stultorum**	(0.64)	(1.07)	Albrecht, 1920–1921, 1923-b
Lottia gigantea (?)* . . .	—	(1.13)	" " "

* Muscles.

TABLE 204

COPPER IN MOLLUSCA (IN %)

ORGANISM	Comments	Living matter	Dry matter	Ash	Locality	Author
Ostrea edulis						
maximum		0.1000	—	—	England	Orton, 1924
minimum		0.004	—	—	"	" "
green		0.330	—	—	"	" "
maximum		0.0352	—	—	"	Kohn, 1898
minimum		0.0025	—	—	"	" "
Ostrea lurida		0.001240	—	—	U.S.A. (Pacific)	Nilson and Coulson, 1939
Crassostrea virginica						
maximum		0.0158	—	—	New York, Maryland, U.S.A	Hiltner and Wichmann, 1919
minimum		0.0017	—	—		
average	16	0.0081	—	—		" "
maximum		0.1487	—	—	U.S.A.	Elliot, 1915*
minimum		0.002	—	—	"	" "
maximum		1.0161	—	—	New York, U.S.A.	" "
minimum		0.0029	—	—		" "
average	13	0.0073	—	—	"	" "
maximum		0.0539	—	—	Connecticut, U.S.A.	" "
minimum		0.0064	—	—		" "
average	37	0.0225	—	—	"	" "
maximum		0.0214	—	—	Maryland, U.S.A.	" "
minimum		0.0028	—	—		" "
average	14	0.0098	—	—	"	" "
maximum		0.0089	—	—	Georgia, New York, Virginia, U.S.A.	" "
minimum		0.0024	—	—		" "
average	20	0.0119	—	—		" "
maximum		0.003	—	—	New York, Maryland, U.S.A.	Black, 1915*
minimum		0.0006	—	—		" "
average	10	0.0016	—	—		" "
maximum		0.0362	—	—	New York, Mass., U.S.A.	Harrison, 1915*
minimum		0.0016	—	—		" "
average	13	0.0079	—	—	" "	" "
maximum		0.0131	—	—	Mass., U.S.A.	Feldstein, 1917*
minimum		0.0008	—	—	" "	" "
average	10	0.0031	—	—	" "	" "
green	3	—	—	2.72	New Jersey, U.S.A.	Nelson, 1915
Crassostrea virginica	2	—	—	0.487	——	Nelson, 1925
"		—	0.0231	—	U.S.A.	McHargue, 1924
Crassostrea virginica		0.00313	—	—	U.S.A. (Atlantic)	Nilson and Coulson, 1939
Crassostrea gigas		0.001230	—	—	Japan	" "
Pecten maximus	Mantle	—	—	0.007	England	Webb, 1937
Pecten fumatus		0.00001	—	—	Australia	Clements and Hutchinson, 1939
Pecten circularis laquisulcatus		0.00031	0.00240	—	U.S.A. (Pacific)	Marks, 1938
Modiola modiola	Gonads	—	—	0.008	England	Webb, 1937

Table 204, cont.

ORGANISM	Comments	Living matter	Dry matter	Ash	Locality	Author
Chione undatella		0.00012	0.00094	—	"	" "
" "		0.00020	0.00124	—	"	" "
Donax gouldii		0.00006	0.00041	—	"	" "
" "		0.00007	0.00044	—	"	" "
Mytilus edulis		0.00023	0.00017	—	"	" "
" "		0.00037	0.00238	—	"	" "
" "		—	0.0012	—	U.S.A.	McHargue, 1924
Mytilus obscurus		0.00002	—	—	Australia	Clements and Hutchinson, 1939
Paphia staminea var. *laciniata*		0.00021	0.00168	—	U.S.A. (Pacific)	Marks, 1938
" "		0.00018	0.00144	—	"	" "
" "		0.00018	0.000148	—	"	" "
" "		0.00024	0.00238	—	"	" "
Tivela crassatelloides		0.00021	0.00119	—	"	" "
" "		0.00023	0.00139	—	"	" "
Venus mercenaria		—	0.0016	—	U.S.A.	McHargue, 1924
Saxostrea commercialis		0.00003	—	—	Australia	Clements and Hutchinson, 1939

Vinogradov, A. P. 1953.

TABLE 212

COPPER IN OYSTERS (IN %, OF LIVING MATTER)

ORGANISM	No. of analyses	Minimum	Maximum	Average	Locality	Author
Crassostrea virginica	34	0.006	0.170†	0.05	East Coast, U.S.A.	Willard, 1908
" "	31	0.0026	0.062†	—	U.S.A.	Hiltner and Wichmann, 1919
" "		0.0024	0.0060	0.0042	——	Rose and Bodansky, 1920
" "		—	—	0.0049	——	Nelson, 1915
" "		0.0072	0.0432	—	Atlantic and Gulf coasts, U.S.A.	" "
" "		0.00025	0.0095	—	——	Coulson, Remington and Levine, 1932
" "		—	—	0.007†	——	Skinner and Sale, 1930
" "		—	—	0.0031	——	Lindow, Elvehjem and Peterson, 1929
" "		—	—	0.00027	——	" "
" "		—	0.04*	0.00(?)	——	Nelson, 1915
" "	9	0.012	0.199*	—	Long Island Sound, U.S.A.	Galtsoff and Lepkofsky, 1930
" "		0.0072	0.0432*	—	" "	Galtsoff, 1934
Ostrea edulis . .		—	—	0.216§	Falmouth, Mass., U.S.A.	Cuzent, 1863-b
" " . .		—	—	0.2*	——	Ferrand, 1863
" " . .		—	—	0.006α	Oran (?)	Balland, 1898-a
" " . .		—	—	0.062β	Algiers	Jaillard, 1881 (?)
" " . .		0.0016	0.006	—	?	Lehmann, 1895
" " . .		—	—	0.040γ	Swansea	Löwe, 1897
" " . .		0.00965	0.0138*	—	France	Dubois, 1900
" " . .		—	—	0.0043	——	White, 1921
" " . .		—	—	0.0026γ	——	Herdmann and Boyce, 1900
" " . .		0.0024	0.330*	—	Long Island Sound, U.S.A.	Orton, 1924
" " . .		0.0181	0.0303	0.024	Various places	Paul and Cownley, 1896
Ostrea lurida . .	8	—	—	0.0004	Pacific Coast	Severy, 1923

† In the dry matter.
α 2 specimens.
* Green oysters.
β 12 specimens.
§ 25 specimens.
γ 1 specimen.

TABLE 213

COPPER IN THE BODY OF LAMELLIBRANCHIATA (IN %)

ORGANISM	No. of analyses	Living matter	Dry matter	Ash	Locality	Author
Mytilus edulis		0.00324	—	—	——	Dubois, 1900
" "		0.00071	—	—	Gulf of Kola	Kubovets, 1932
" "	4	0.000945	0.00529	0.03381	France (Atlantic)	Wang-Tai-Si, 1928
" "		—	0.00024	—	——	Bertrand, 1943-c
Mytilus californica		0.00018	—	—	U.S.A. (Pacific)	Severy, 1923
Anomia ephippium		0.00113	0.00567	0.02812	France (Atlantic)	Wang-Tai-Si, 1928
Pectunculus glycemeris	4	0.000493	0.002846	0.00810	" "	" " " "
Pecten jacobaeus	2	0.00140	0.00845	0.04336	" "	" " " "
" "		0.0047	—	—	——	Dubois, 1900
" "		0.00471	—	—	——	" "
Pecten varius	2	0.00034	0.00204	0.00800	France (Atlantic)	Wang-Tai-Si, 1928
Pecten maximus	5	0.00011	0.00102	0.00310	——	" " " "
" "		0.00023	—	—	——	Lindow, Elvehjem and Peterson, 1929
Gryphea angulata	4	0.000515	0.00385	0.01438	France (Atlantic)	Wang-Tai-Si, 1928
Tellina crassa	3	0	0	0	" "	" " " "
Tellina tenuis	4	0	0	0	" "	" " " "
Mactra corallina	3	0.00018	0.00204	0.00368	" "	" " " "
Donax tronchulus	3	0.00065	0.00467	0.00961	" "	" " " "
Scrobicularia piperata	3	0.00020	0.00174	0.00773	" "	" " " "
Venus verrucosa	4	0.000875	0.00449	0.024635	" "	" " " "
Venus mercenaria	4	0.00083	0.00625	0.02841	" "	" " " "
Venus kennicotti		0.00	—	—	U.S.A. (Pacific)	Severy, 1923
Tapes decussatus	4	0.00037	0.00216	0.01324	France (Atlantic)	Wang-Tai-Si, 1928
Tapes aureus	2	0.00042	0.00213	0.00942	" "	" " " "
Dosinia exoleta	4	0.00080	0.00398	0.02033	" "	" " " "
Cytherea chione	2	0.00017	0.00083	0.00481	" "	" " " "
Cardium edule	4	0.00125	0.00887	0.03959	" "	" " " "
Mya arenaria	3	0.00010	0.00063	0.00224	" "	" " " "
" "		0	0	—	U.S.A. (Pacific)	Rose and Bodansky, 1920
Lutraria elliptica	2	0.00025	0.00142	0.00357	France (Atlantic)	Wang-Tai-Si, 1928
Solen siliqua	4	0.00014	0.00065	0.00412	" "	" " " "
Ensis americanus		0.00	—	—	——	Severy, 1923
Unio sp.*		—	0.00130	—	——	Phillips, 1922
Unio margaritifera		trace	—	—	——	Dubois, 1900
Crassostrea sp.		—	0.00020	—	——	Bertrand, 1943-c

* Fresh water.

Vinogradov, A. P. 1953.

TABLE 214

COPPER IN VARIOUS ORGANS OF LAMELLIBRANCHIATA (IN % OF LIVING MATTER)

ORGANISM	Mantle	Muscle	Gills	Intestines	Liver	Sex organs	Precordial glands
*Crassostrea virginica**	0.0036	0.00	—	0.0035	—	—	—
" "	0.00029	—	0	—	0	0	—
Crassostrea angulata	0.00036	0	0.00034	—	0.0007	0.00121	—
Mytilus edulis	0.00069	0.00053	—	—	0.00208	0.0012	—
Pecten jacobaeus	0.00036	0.00008	0.00025	—	0.00146	—	—
Pectunculus glycemeris	0.0013	0.0000	0.00057	—	0.00132	0.00125	0.00306
Mactra helvetica	0	—	0	—	0.00054	0	0
Donax tronchulus	0	0	0	—	0.00222	—	—
Venus verrucosa	0.00023	0	0	—	0.00075	0.00035	0.00463
Venus mercenaria	0.00104	—	—	—	0.00236	—	—
Tapes decussatus	0.00055	—	0.00077	—	0.00207	0.00267	—
Cytherea chione	0.00023	0	—	—	0	0	0.00119
Cardium edule	0.00052	0	0	—	0.00174	0	—
Mya arenaria	0	0	0.00001	—	0.00037	0	0
Lutraria elliptica	0	—	0	—	0	—	—
Solen siliqua	0.00025	—	0	—	—	0	—

* Analyses by Rose and Bodansky (1920); all other analyses by Wang-Tai-Si (1928).

TABLE 217

ZINC IN LAMELLIBRANCHIATA (IN %)

ORGANISM	No. of analyses	Living matter	Dry matter	Ash	Author
Mytilus edulis		0.0021	0.0113	—	Bertrand and Vladesco, 1923
" "		0.00413	0.02322	0.11487	Wang-Tai-Si, 1928
" "		—	0.0106	—	Delezenne, 1919
Mytilus californica		0.0049	—	—	Severy, 1923
Ostrea edulis	4	0.02010	0.11460	—	Bertrand and Vladesco, 1923
" "	2	0.03095	0.1458	0.7797	Wang-Tai-Si, 1928
Ostrea lurida	8	0.006497	—	—	Severy, 1923
Crassostrea virginica	5	0.02598	—	—	Bodansky, 1920
" "	153	—	0.1	—	Hiltner and Wichmann, 1919
" "		—	0.006(?)		Skinner and Sale, 1930
Crassostrea angulata	4	0.00993	0.4966	—	Bertrand and Vladesco, 1923
" "		0.05966	0.38296	1.48625	Wang-Tai-Si, 1928
Venus verrucosa		0.0033	0.0127	—	Bertrand and Vladesco, 1923
" "		0.00470	0.02447	0.13234	Wang-Tai-Si, 1928
Venus mercenaria		0.00451	0.033450	0.14870	" " " "
Venus kennicotti		0.00051	—	—	Severy, 1923
Tapes decussatus		0.0017	0.0102	—	Bertrand and Vladesco, 1923
" "		0.00435	0.02539	0.15329	Wang-Tai-Si, 1928
Tapes aureus		0.00450	0.02938	0.12802	" " " "
Cardium edule		0.0014	0.0066	—	Bertrand and Vladesco, 1923
" "		0.00455	0.03255	0.07603	Wang-Tai-Si, 1928
Cardium norvegicum		0.00383	0.0160	0.14094	" " " "
Cytherea chione		0.00490	0.01851	0.07131	" " " "
" "		0.00277	0.01660	—	Bertrand and Vladesco, 1923
Pecten jacobaeus	2	0.0086	0.435	—	" " " "
" "	2	0.00268	0.01605	0.08141	Wang-Tai-Si, 1928
*Pecten jacobaeus**		—	0.0439	—	Delezenne, 1919
Pecten maximus	2	0.00586	0.04422	0.16178	Wang-Tai-Si, 1928
Pecten varius		0.00520	0.03138	0.10987	" " " "
Mya arenaria	2	0.00391	0.02533	0.09540	" " " "
" "		0.0077	—	—	Bodansky, 1920
Pectunculus glycemeris		0.00255	0.01142	0.02589	Wang-Tai-Si, 1928
Tellina crassa		0.00799	0.06424	0.10948	" " " "
Tellina tenuis		0.0157	0.03691	0.21428	" " " "
Mactra helvecea		0.0062	0.02886	0.09669	" " " "
Mactra corallina		0.00523	0.0546	0.10744	" " " "
Donax tronchulus		0.0174	0.10058	0.2169	" " " "
Scorbicularia piperata		0.00526	0.04045	0.08172	" " " "
Dosinia exoleta		0.0074	0.02338	0.11918	" " " "
Lutraria elliptica		0.00946	0.05850	0.18194	" " " "
Ensis americanus	3	0.001163	—	—	Severy, 1923
Unio sp.†		—	0.0160	—	Phillips, 1922

* Liver. † Fresh water.

Vinogradov, A. P. 1953.

TABLE 218

ZINC IN *CRASSOSTREA VIRGINICA* AND OTHER MOLLUSCA (IN %)

ORGANISM	Fresh matter	Locality	Author
Crassostrea virginica			
maximum . . .	0.1168	New York and Maryland	Hiltner and Wichmann, 1919
minimum . . .	0.0133	" " " "	" " " "
average (16). .	0.0652	Connecticut, Massachusetts, and New Jersey	Elliot, 1915 (see Hiltner and Wichmann, 1919)
maximum . . .	0.1102	" "	" "
minimum . . .	0.0280	" "	" "
average (13). .	0.0658	Maryland	Sale, 1914 (see Hiltner and Wichmann, 1919)
maximum . . .	0.062	"	" "
minimum . . .	0.0026	"	" "
average (31). .	0.0200	Connecticut	Elliot, 1915 (see Hiltner and Wichmann, 1919)
maximum . . .	0.2298	"	" "
minimum . . .	0.028	"	" "
average (37). .	0.1153	Maryland	" "
maximum . . .	0.1309	"	" "
minimum . . .	0.017	"	" "
average (14). .	0.0730	——	" "
maximum . . .	0.0089	——	" "
minimum . . .	0.0020	——	" "
average (18). .	0.441	New Jersey, Virginia, New York and Maryland	Black, 1915 (see Hiltner and Wichmann, 1919)
maximum . . .	0.0779	" "	" "
minimum . . .	0.0146	" "	" "
average (10). .	0.0383	New York, Connecticut, Massachusetts and other states	Harrison, 1915 (see Hiltner and Wichmann, 1919)
maximum . . .	0.1220	" "	" "
minimum . . .	0.0398	" "	" "
average (13). .	0.0829	Massachusetts	Feldstein, 1917 (see Hiltner and Wichmann, 1919)
maximum . . .	0.1026	"	" "
minimum . . .	0.0224	"	" "
Crassostrea virginica	0.4284	U.S.A.	McHargue, 1924
Mytilus edulis . .	0.0750	"	" "
Venus mercenaria .	0.1359	"	" "

TABLE 219

ZINC IN VARIOUS ORGANS OF AMPHINEURA AND LAMELLIBRANCHIATA (IN % OF LIVING MATTER)

ORGANISM	Muscle	Intestinal glands	Mantle	Gills	Other organs	Author
Cryptochiton stelleri	0.00187	0.0003	0.0040	—	—	Severy, 1923
Crassostrea virginica	0.0160	0.0237	0.0267	—	0.0269	Bodansky, 1920
Crassostrea angulata	0.0312	—	0.1074	0.0652	0.3223	Bertrand and Vladesco, 1923
Pecten jacobaeus	0.005	—	0.0043	0.0086	0.0082	" " " "

TABLE 220

STRONTIUM IN THE ORGANS AND TISSUES OF MOLLUSCA (IN % OF DRY MATTER)

ORGANISM	Parts of organisms	Sr	Author
Pinna squamosa	calcite predominates	0.04	" "
Mytilus edulis	——	0.3	Vinogradov and Borovik-Romanova, 1934
Pecten islandicus	calcite	0.5	" " " " "
" "	——	0.05	Potapenko, 1925
Cardium edule	——	0.3	Vinogradov and Borovik-Romanova, 1934
Anodonta cygnea	aragonite	0.08	" " " " "
Tellina calcarea	——	0.05	" "

TABLE 221

STRONTIUM AND BARIUM IN MOLLUSCA (IN % OF ASH RESIDUE)

ORGANISM	Comments	Sr	Ba	Author
Modiola modiola	Gonads	0.03	0.003	Webb, 1937*
Pecten maximus	"	0.02	—	" "
" "	Mantle	0.03	0.05	" "
Pecten islandicus	Shell	—	0.001–0.005	Borovik-Romanova, 1939
Mytilus edulis	"	—	0.001	McCance and Masters, 1937
Astarte crenata	"	—	0.004	" " " "
Anodonta cygnea	"	—	0.03	" " " "

* Percent of total cations in the ash. Preliminary data.

Vinogradov, A. P. 1953.

TABLE 223

TITANIUM IN MOLLUSCA, WITHOUT SHELLS (IN %), FROM BERTRAND AND VORONCA-SPIRT, 1930

ORGANISM	Living matter	Dry matter
Crassostrea angulata	0.0003	0.00214
Cardium edule	0.0003	0.00205
Mytilus edulis	0.0006	0.00273
Pecten jacobaeus	0.00018	0.00083
Helix pomatia	0.00006	0.00036
Helix aspersa	0.00006	0.00046

TABLE 224

NICKEL AND COBALT IN MOLLUSCA, WITHOUT SHELLS (IN % OF DRY MATTER)

ORGANISM	Comments	Ni	Co	Author
Mytilus edulis		0.000235	—	Bertrand and Mâcheboeuf, 1925-a
Crassostrea sp.		0.000174	—	" " " "
Pinna sp.	Kidneys	0.005	0.006	" " " "
Anodonta sp.		trace	—	" " " "
Cardium edule	2	0.0022	—	Paulais, 1936

TABLE

COBALT AND NICKEL IN VARIOUS PARTS OF MOLLUSCA (IN MG PER 100 G)

ORGANISM	Co Whole		Ni Whole		Ni Siphon		Ni Gills		Ni Mantle		Ni Hepatopancreas		Ni Podium, sex organs		Ni Muscle		Author
	living matter	dry matter	living matter	dry matter	living matter	dry matter	living matter	dry matter	living matter	dry matter	living matter	dry matter	living matter	dry matter	living matter	dry matter	
Mya arenaria	—	—	—	—	0.0191	0.0[illegible]%	0.0208	0.1475	0.0164	0.0910	0.0234	0.111	0.0083	0.0445	0.0037	0.0200	Paulais, 1936
Pecten maximus	—	—	—	—	—	—	0.0148*	0.0160*	—	—	0.0258	0.1280	0.0054	0.0315	—	—	" "
Pecten islandicus	1.5×10^{-5}	6.8×10^{-5}	4.5×10^{-6}	2.1×10^{-5}	—	—	—	—	—	—	—	—	—	—	—	—	Maliuga, 1946
Crassostrea angulata	—	—	—	—	—	—	0.0213	0.1295	0.0133	0.0935	0.0170§	0.10§	—	—	—	—	Paulais, 1936
Scrobicularia piperata	—	—	—	—	0.0438†	0.240†	—	—	—	—	0.0940	0.435	0.0150	0.0725	—	—	" "
Cardium edule	—	—	—	—	—	—	0.1755*	1.495*	—	—	0.301	2.345	0.1585	0.1340	—	—	" "
" "	4.3×10^{-5}	2.1×10^{-4}	1.5×10^{-4}	7×10^{-4}	—	—	—	—	—	—	—	—	—	—	—	—	Maliuga, 1946
Mytilus edulis	3.3×10^{-5}	1.7×10^{-4}	4.8×10^{-5}	2.4×10^{-4}	—	—	—	—	—	—	—	—	—	—	—	—	" "

Vinogradov, A. P. 1953.

TABLE 226

LEAD IN MOLLUSCA (IN %), FROM CHAPMAN AND LINDEN, 1926

ORGANISM	No. of analyses	Dry matter
Mytilus edulis	2	0.0015
Cardium edule	2	0.00035
Ostrea edulis	3	0.0144 !
Crassostrea angulata	5	0.0078 !

TABLE 227

LEAD IN MOLLUSCA, FROM MORE RECENT DATA (IN %)

ORGANISM	Comments	Living matter	Ash	Author
Modiola modiola	" "	—	0.015	" "
Pecten maximus		—	0.02	" "
Ostrea edulis		2×10^{-5}	—	Monier-Williams, 1938

TABLE 228

ALUMINUM IN MOLLUSCA (IN %)

ORGANISM	Comments	Dry matter	Ash	Author
Meretrix meretrix	2	0.1069	—	Oya and Shimada, 1933

TABLE 230

ARSENIC IN MOLLUSCA, WITHOUT SHELLS (IN %)

ORGANISM	No. of analyses	Living matter	Dry matter	Author
Ostrea edulis	5	0.00041	—	Chapman, 1926
" "		0.00037	—	Cox (see Orton, et al., 1924)
" "		0.0002	—	White, 1933
Crassostrea virginica	11	0.00011	—	Hiltner and Wichmann, 1919
Crassostrea angulata	4	0.0034	—	Chapman, 1926
" "	8	0.0034	—	" "
Mytilus edulis	6	0.0068	—	" "
Cardium edule	6	0.0019	—	" "
Mya arenaria		0.0002	—	White, 1933

REF. NO.: 76 - W - 1

SUBSTANCES: Zn, Cd, Cu, Fe, Mn, Ni, Ag

Reference: Watling, H. R. & R. J. Watling. 1976. Trace metals in oysters from Knysna estuary. Mar. Pollut. Bull. 7:45-48.

Organisms:

Crassostrea gigas
Ostrea edulis
Crassostrea margaritacea

Date of Sample Collection: 1975

Location: Knysna estuary, South Africa

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data: (dry wt., dried at 105°C)

TABLE 1
Trace-metal concentrations in *Crassostrea gigas*.

Reference	Sample location	Mean dry tissue (g)*	Dry tissue (%)	Concentrations in dry tissue (µg/g) Zn	Cd	Cu	Fe	Mn	Ni	Ag
Present study	Knysna, 1975	1.56(57)	13.4	396	3.7	32	128	16	1.6	1.9
Thornton *et al.* (in press)	Colne R., UK 1971	1.79(30)		1896	4	276	493	27	<5	
	Helford R., UK 1972	1.19(20)		2154	2	434	327	29	1	
	Poole Harbour, UK 1972	0.65(30)		2672	27	395	471	31	2	
	Conway R., UK 1971	0.42(30)		2785	3	145	490	36	10	
Boyden & Romeril (1974)	Menai Straits, UK 1973	1.40(5)		2750	6	340	158	28	2	
	Hinkley Power 1972	0.30(6)		9860	40	6480	392	20	7	
	Station UK 1973	0.47(7)		35120	27	1760	422	16	4	
Watling (unpub. data)	Langebaan Lagoon 1974	1.28(50)		450	9	35	224	15	2	2
	RSA 1974	1.41(10)		347	8	22	271	13	2	2
Thrower & Eustace (1973)‡	Derwent estuary, 1972 Tasmania			min. 28642	175	334				
				max. 54952	46	762				
	Tamar estuary, 1972 Tasmania			min. 1695	9	861				
				max. 9207	84	329				
Pringle *et al.* (1968)†	Pacific coast 1966			1834	9	146	245	62	<1	
	USA 1967			1750	6	128	470	24	<1	

TABLE 2
Trace-metal concentrations in *Ostrea edulis*.

Reference	Sample location and date	Mean dry tissue (g)*	Dry tissue (%)	Concentration in dry tissue (µg/g) Zn	Cd	Cu	Fe	Mn	Ni	Ag
Present study	Knysna, 1975	0.53(56)	19.4	660	3.1	38	167	6	1.7	6.4
Watling (unpub. data)	Helford R., UK 1972	0.72(30)		6787	4	1786	429	12	3	
	Restronguet Creek, 1972	0.91(28)		3846	3	777	513	11	3	
	R. Lyner, UK 1972			5084	5	780	237	15	3	

*sample number in parentheses

Watling, H. R. & R. J. Watling. 1976.

TABLE 3
Trace-metal concentrations in *Crassostrea margaritacea*.

Reference	Sample location and date	Mean dry tissue (g)*	Dry tissue (%)	Concentration in dry tissue (μg/g)						
				Zn	Cd	Cu	Fe	Mn	Ni	Ag
Present study	Knysna, 1975	1.02(56)	17.8	886	2.5	17	57	2	1.6	2.6
Watling (unpub. data)	Langebaan Lagoon, 1974	1.54(18)		972	7	11	47	4	<1	1
	1974	1.42(10)		941	7	19	43	3	1	2

*Sample number in parentheses

TABLE 4
Logarithmic regression coefficients relating element content (μg) to dry tissue (g) for oysters grown at Knysna.

Species	Zn	Cd	Cu	Fe
Crassostrea gigas	0.589 (0.711)*	0.792 (0.932)	0.415 (0.526)	0.702 (0.890)
Crassostrea margaritacea	0.707 (0.693)	0.889 (0.735)	0.686 (0.541)	0.775 (0.766)
Ostrea edulis	0.824 (0.420)	0.645 (0.601)	1.064 (0.497)	0.627 (0.336)

*Coefficient of determination in parentheses.

REF. NO.: 76 - W - 2

SUBSTANCES: Zn, Cd, Cu, Fe, Mn, Pb, Co, Bi, Ag, Ni, Cr

Reference: Watling, H. R. & R. J. Watling. 1976. Trace metals in Choromytilus meridionalis. Mar. Pollut. Bull. 7:91-94.

Organisms: Choromytilus meridionalis
Crassostrea gigas

Date of Sample Collection: 1976?

Location: South Africa

Analytical Technique: Atomic absorption spectrometry

Analytical Data: (dry wt., dried at 105°C)

TABLE 1
Trace-metal concentrations (μg/g) in sediments and *Crassostrea gigas* dry tissue.

	Zn	Cd	Cu	Pb	Mn	Ni	Co	Bi
Sediment								
min.	3.5	0.4	1.9	9	4	4	1	—
max.	14.4	1.4	6.8	32	31	10	7	—
mean	8.7	0.7	3.3	17	12	6	3	—
C. gigas (mean dry tissue 1.37 g)	424	9	33	1	12	1	1	4

TABLE 5
Regression coefficients for the relationship between metal content (μg) and dry tissue (g) in *Choromytilus meridionalis*.

Element	Female ($n = 37$)	Male ($n = 41$)	Total sample ($n = 78$)
Zn	0.936	0.815	0.725
Cd	0.295	0.552	0.355
Cu	0.775	0.694	0.677
Fe	0.555	0.543	0.500
Mn	0.929	0.602	0.639
Pb	0.731	0.815	0.806
Co	0.689	0.942	0.764
Bi	0.546	0.729	0.648
Ag	0.540	0.636	0.582
Ni	0.511	0.393	0.497
Cr	0.422	0.260	0.385

TABLE 2
Trace-metal concentrations for *Choromytilus meridionalis* growing at three sites in Saldanha Bay.

Site	Mean dry tissue (g)	μg metal/g dry tissue							
		Zn	Cd	Cu	Pb	Mn	Ni	Co	Bi
1	2.73(24)*	73	1	8	2	9	2	2	5
2	1.84(12)	101	8	7	4	11	3	3	6
3	0.78(12)	113	2	14	5	11	2	2	6

*Sample number in parentheses.

Watling, H. R. & R. J. Watling. 1976.

TABLE 4

Mean trace-metal concentrations (μg/g) in dry tissues of *Choromytilus meridionalis*.

		Dry tissue (g)	Zn	Cd	Cu	Fe	Mn	Pb	Co	Bi	Ag	Ni	Cr
Female	mean	3.15	97	0.9	7.7	66	12	1.8	0.9	3.4	0.3	5.2	1.4
$n = 37$	range	(1.2–5.2)											
Male	mean	3.40	54	0.9	5.9	54	6	2.1	1.0	4.0	0.3	5.7	1.4
$n = 41$	range	(2.1–4.8)											

TABLE 3

Correlation coefficients for inter-element and element/dry tissue relationships for *Choromytilus meridionalis*.

	Dry tissue	Zn	Cd	Cu	Fe	Mn	Pb	Co	Bi	Ag	Ni
Female: Sample no. 37											
Zn	0.985										
Cd	0.477	0.480									
Cu	0.928	0.925	0.450								
Fe	0.733	0.724	0.543	0.743							
Mn	0.877	0.891	0.515	0.835	0.570						
Pb	0.930	0.922	0.434	0.891	0.776	0.810					
Co	0.842	0.832	0.585	0.776	0.702	0.812	0.868				
Bi	0.936	0.915	0.424	0.906	0.724	0.800	0.921	0.797			
Ag	0.865	0.869	0.587	0.880	0.749	0.773	0.858	0.796	0.859		
Ni	0.648	0.647	0.631	0.649	0.669	0.609	0.669	0.755	0.606	0.674	
Cr	0.386	0.384	0.172	0.382	0.376	0.261	0.359	0.268	0.407	0.275	0.428
Male: Sample no. 41											
Zn	0.821										
Cd	0.760	0.616									
Cu	0.814	0.722	0.522								
Fe	0.497	0.413	0.452	0.502							
Mn	0.623	0.615	0.372	0.549	0.317						
Pb	0.856	0.706	0.608	0.646	0.563	0.451					
Co	0.822	0.565	0.637	0.644	0.542	0.417	0.787				
Bi	0.891	0.654	0.674	0.651	0.390	0.503	0.827	0.786			
Ag	0.865	0.626	0.459	0.843	0.372	0.515	0.704	0.689	0.762		
Ni	0.378	0.293	0.507	0.295	0.403	0.245	0.261	0.472	0.304	0.271	
Cr	0.178	0.232	0.209	0.187	−0.003	0.101	0.148	0.191	0.208	0.212	0.348

REF. NO.: 77 - W - 1

SUBSTANCES: Hg, Zn, Cu, Pb, Cd

Reference: Wharfe, J. R. & W. L. F. Van Den Broek. 1977. Heavy metals in macro-invertebrates and fish from the Lower Medway Estuary, Kent. Mar. Pollut. Bull. 8:31-34.

Organisms: Mytilus edulis

Date of Sample Collection: 1973-76

Location: Lower Medway Estuary, Kent, England

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1

Mean concentrations and range of metals in macroinvertebrates from the lower Medway estuary. (mg/kg wet wt).

	Hg	Zn	Cu	Pb	Cd
Mytilus edulis L. (mussel)					
Bedlams Bottom	0.30 (0.19–0.46)	31.6 (25.5–4.32	1.9 (0.5–3.8)	0.75 (0.45–1.20)	0.73 (0.63–0.90)
Motney Hill	0.14 (0.05–0.21)	32.2 (28.0–35.8)	2.3 (1.5–3.0)	1.20 (0.75–1.58)	0.71 (0.55–0.88)
Gillingham	0.14 (0.10–0.16)	33.6 (22.8–48.3)	2.0 (0.5–2.5)	1.76 (1.05–2.23)	1.19 (1.01–1.40)
Lower Upnor	0.14 (0.11–0.19)	41.8 (26.0–58.8)	2.3 (1.5–3.0)	2.17 (1.50–3.00)	1.18 (1.01–1.50)
Hoo	0.14 (0.07–0.18)	29.0 (26.3–37.0)	2.2 (1.5–2.5)	1.91 (1.23–2.25)	1.01 (0.90–1.20)
Damhead Creek	0.18 (0.14–0.22)	41.6 (40.5–42.3)	2.0 (1.5–2.5)	1.42 (0.78–1.65)	1.21 (1.15–1.25)

REF. NO.: 08 -W - 1

SUBSTANCES: Cu

Reference: Willard, J. T. 1908. On the occurrence of copper in oysters. J. Amer. Chem. Soc. 30:902-904.

Organisms: oysters (unspecified)

Date of Sample Collection: 1907

Location: East coast U. S.

Analytical Technique:

Analytical Data:

TABLE SHOWING COPPER IN OYSTERS.

Serial number.	Place of purchase.	Name.	Per cent. of copper in Liquid.	Meat.	Sample.	Dry sample.
12,094	Manhattan	Bulk, "Booth's"	...	0.0072	0.0072	0.087
12,095	"	" "	0.0056	0.0083	0.0072	0.079
12,096	"	" "	0.0016	0.0084	0.0071	0.079
12,097	"	" "	.....	.....	0.0062	0.059
12,098	Washington, D.C.	Bulk, No. 1	.....	.....	0.0084	0.085
12,099	" "	Bulk, No. 2	.....	.....	0.0022	0.023
12,100	" "	Curryoman	0.0048	0.0056	0.0052	0.055
12,101	" "	Rockaway.	0.0048	0.0060	0.0055	0.043
12,102	" "	York River	0.0024	0.0056	0.0042	0.034
12,103	" "	Hampton Bars	0.0064	0.0056	0.0061	0.058
12,104	" "	Cape Cod	0.0048	0.0068	0.0058	0.040
12,105	" "	Blue Points	0.0016	0.0064	0.0041	0.029
12,106	" "	Coam River	.....	.....	0.0058	0.044
12,107	" "	Blue Points	.....	.....	0.0044	0.034
12,108	" "	Lynnhaven Bay	.....	.....	0.0104	0.064
12,109	" "	Rockaways	.....	.....	0.0080	0.060
12,110	" "	Clarke River	.....	.....	0.0008	0.006
12,111	Philadelphia	Tucker Salts, Barnegat Bay	.....	.....	0.0076	0.052
12,112	"	Rockaway, Partial Salts	.....	.....	0.0032	0.018
12,113	"	Chituque Salts, Jersey Coast	.....	.....	0.0068	0.048
12,114	"	Maurice River Cove, Baltimore Bay	.....	.....	0.0008	0.006
12,115	"	Cedar Rock Salts, Jersey Coast	.....	.....	0.0016	0.012
12,116	"	Maurice River Cove, transplanted	.....	.....	0.0048	0.032
12,117	New York	Cape Cod	.....	.....	0.0032	0.021
12,118	"	Lynnhaven, Va.	.....	.....	0.0008	0.005
12,119	"	Rockaways, Long Island	.....	.....	0.0052	0.047
12,120	"	Blue Points, Long Island	.....	.....	0.0092	0.071
12,121	"	Sea Puits	.....	.....	0.0072	0.051
12,122	Baltimore	Easton Bay, Md.	.....	.....	0.0076	0.087
12,123	"	Lynnhaven	.....	.....	0.0164	0.170
12,124	"	Chester River	.....	.....	0.0084	0.110
12,125	"	Horn Harbor	.....	.....	0.0028	0.025
12,126	"	West River, Md.	.....	.....	0.0048	0.052
12,127	"	Swamp Point	.....	.....	0.0028	0.038

REF. NO.: 72 - W - 1

SUBSTANCES: Fe, Mn, Zn, Cu, Ag

Reference:

Windom, H. L. & R. G. Smith. 1972. Distribution of iron, magnesium, copper, zinc, and silver in oysters along the Georgia coast. J. Fish. Res. Bd Can. 29:450-452.

Organisms: Crassostrea virginica

Date of Sample Collection: 1971?

Location: Georgia

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

TABLE 1. Mean concentration and standard deviation of metals in oyster samples (Concentration on dry weight basis).

		Shells				Soft tissue					
Station no.	Salinity %	No. of samples	Fe (ppm)	Mn (ppm)	Zn (ppm)	No. of samples	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (%)	Ag (ppm)
1	19–32	5	38±30	121±36	3.0±1.4	6	405±63	35±10	261±105	0.57±.22	–
2	20–31	3	31±31	52±30	2.6±0.5	3	528±139	43±4	87±18	0.16±.08	–
3	0–24	5	17±11	33±3	2.2±0.6	6	738±266	40±11	75±35	0.23±.10	–
4	11–25	5	27±16	42±11	1.9±1.2	6	555±189	51±15	62±25	0.21±.09	–
5	5–33	5	12±4	62±28	2.2±1.2	6	372±107	35±11	48±23	0.12±.05	28±16
6	3–22	5	14±8	45±9	1.5±0.9	6	275±77	24±9	112±46	0.22±.04	42±10
7	0–18	5	17±5	42±9	4.6±2.4	6	356±57	33±11	114±26	0.36±.12	82±13
8	15–30	5	15±11	45±12	2.7±1.9	5	233±40	24±6	91±19	0.35±.07	57±20
9	20–33	5	79±60	70±22	8.1±4.5	5	357±165	32±14	68±17	0.15±.02	34±10
10	15–31	5	34±14	36±10	5.9±1.7	5	399±241	30±14	55±22	0.21±.05	36±10

[a]Analysis for silver was not attempted on samples from stations 1 through 4.

REF. NO.: 73 - W - 3

SUBSTANCES: Mn, Fe, Zn

Reference:

Wolfe, D. A., F. A. Cross & C. D. Jennings. 1973. The flux of Mn, Fe and Zn in an estuarine ecosystem. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 1972, p. 159-175. IAEA, Vienna.

Organisms:

Crassostrea virginica
Tagelus plebius
clams, scallops (unspecified)

Date of Sample Collection:

Location: Newport River estuary, North Carolina

Analytical Technique: (Data from other literature)

Analytical Data:

TABLE III. COMMERCIAL YIELD, STANDING CROP AND TRACE ELEMENTAL CONTENTS OF REPRESENTATIVE MACROBENTHOS AND PLANKTON

Species	Estimated standing crop[a]	Annual commercial yield[b]	Feeding type[c]	Mn	Fe	Zn	Reference or source
	- - - Thousands of Kilograms - - -			- - - - ppm wet wt[d] - - - -			
Hard clams	17	1.36	F	1.6	28	8.2	[9]
American oyster	220	17.7	F	3.1	59	170	[9]
Bay scallop	5.3	0.891	F	72	84	30	[9]
Tagelus plebeius	--	--	F	3.3	160	13	[10]

[a] For first three species, estimated from commercial yields as follows: mean life of 2.5 years assumed for clams and oysters, 2.0 for scallops; non-commercial area = 5X commercial area for clams and oysters, 3X for scallops; Standing crop = annual commercial yield X life span X area ratio.
[b] From National Marine Fisheries Service Statistics Office, Beaufort, N.C. 28516; 5-year mean (1967-1971).
[c] F = filter-feeder; D = deposit-feeder; C = Carnivore.

REF. NO.: 73 - W - 5

SUBSTANCES: Hg, Cd, Pb, Cu

Reference: Won, J. H. 1973. The concentration of mercury, cadmium, lead and copper in fish and shellfish of Korea. Bull. Korean Fish. Soc. 6 (1&2):1-19.

Organisms:

Patinopecten yessoensis
Crassostrea gigas
Anadara granosa bisenensis
Mytilus edulis
Meretrix lusoria
Tapes japonica
Mya arenaria oonogai
Corbicula elatior
Cyclina sinensis
Anadara broughtoni
Saxidomus purpuratus
Mactra chinensis
Solen gouldi
Atrina pectinate
Dosinia japonica
Tresus keenae
Coelomactra antiquata

Date of Sample Collection: 1971-72

Location: Korea

Analytical Technique:

Analytical Data:

Table 1. The concentrations of mercury, cadmium, lead and copper in fish and shellfish of Korea

Sample	Catch location	Catch date	Tissue	H_2O(%) of sample	Concentration (ppm, Wet base) Hg	Cd	Pb	Cu
Patinopecten yessoensis (큰가리비)	Yeongil Bay	Jan. 6 1972	Soft tissue	79.51	0.09	0.55	1.09	24.86
Crassostrea gigas (참굴)	Yongyudo, Incheon	Feb. 26 1972	Soft tissue	89.09	0.13	0.20	1.08	28.50
	Estuary of Geum River	Mar. 1 1972	Soft tissue	93.35	0.16	0.17	0.38	28.69
	Chungmu	Mar. 16 1972	Soft tissue	80.36	0.12	0.25	1.73	5.35
	Off Sogcho	Jan. 13 1972	Soft tissue	79.86	0.08	0.26	0.84	7.09
Anadara granosa bisenensis (꼬막)	Gwangyang Bay	Mar. 16 1972	Soft tissue	82.91	0.02	0.41	1.18	0.75
Mytilus edulis (진주담치)	Goseong, Gyeongnam	Mar. 16 1972	Soft tissue	80.57	0.08	0.17	1.25	1.14
	Off Sogcho	Jan. 13 1972	Soft tissue	79.82	0.17	0.02	1.21	0.80
	Gyeonghwadong, Jinhae	Jan. 18 1972	Soft tissue	79.73	0.37	0.12	1.81	1.13
Meretrix lusoria (백합)	Gunsan	Mar. 1 1972	Soft tissue Soft tissue	75.01	0.19	0.26 0.13	0.46 0.64	1.07 large 1.20 small
	Estuary of Nagdong River	Mar. 15 1972	Soft tissue			0.12	0.79	1.93
Cyclina sinensis (동죽)	Off Sogcho	Jan. 13 1972	Soft tissue	82.07	0.22	0.05	0.44	1.64
Tapes japonica (바지락)	Off Sogcho	Jan. 13 1972	Soft tissue	83.02	0.14	0.13	0.72	1.74
	Ungcheon, Gyeongnam	Jan. 18 1972	Soft tissue	84.83	0.03	0.10	0.63	1.22
	Beach, Hahangri, Janghang	Mar. 1 1972	Soft tissue	89.68	0.28	0.07	0.66	1.61
	Noryang, Namhae	Mar. 16 1972	Soft tissue	82.73	0.25	0.11	0.54	1.51

Won, J. H. 1973.

Sample	Catch location	Catch date	Tissue	H_2O(%) of sample	Concentration (ppm, Wet base) Hg	Cd	Pb	Cu
Tresus keenae (왕우럭)	Samcheonpo	Mar. 18 1972	Soft tissue	85.85	0.10	0.31	0.61	1.61
	Beach, Gunsan Airport	Mar. 2 1972	Soft tissue	87.67		0.11	0.96	1.88
	Hadong	Mar. 17 1972	Soft tissue	86.20	0.30	0.06	2.24	1.51
Mya arenaria oonogai (우럭)	Off Sogcho	Jan. 2 1972	Soft tissue	75.23	0.23	0.06	0.36	3.18
Neverita didyma (한구슬우럭)	Yubudo beach, estuary of Geum River	Mar. 2 1972	Soft tissue	79.75	0.29	0.20	0.69	16.98
Haliotis discus hannai (전복)	Geojedo	Mar. 17 1972	Soft tissue	77.09		0.10	0.33	3.40
			Soft tissue +Viscera		0.16			
			Viscera			1.30	0.57	17.2
	Guryongpo	Jan. 6 1972	Soft tissue		0.12	<0.02	0.39	1.83
			Viscera		0.13	2.03	2.53	4.18
Corbicula elatior (재첩)	Eomgung, Busan	Mar. 16 1972	Soft tissue	78.53	0.03	0.35	1.21	4.23
	Hadong	Mar. 17 1972	Soft tissue	86.30	0.26	0.33	1.44	2.20
	Gupo, Busan	Mar. 18 1972	Soft tissue	83.01	0.17	0.17	0.74	4.28
Saxidomus purpuratus (개조개)	Jinhae Bay	Mar. 16 1972	Soft tissue	78.28.	0.02	0.07	2.90	1.21
	Goseong, Gyeongnam	Mar. 16 1972	Soft tissue	81.64		<0.02	2.37	2.17
Mactra chinensis (개량조개)	Pohang	Jan. 6 1972	Soft tissue	81.63	0.09	0.11	0.25	0.97
	Off Sogcho	Jan. 13 1972	Soft tissue	83.82	0.22	0.06	0.27	1.57
Dosinia japonica (피조개)	Estuary of Nagdong River	Mar. 15 1972	Soft tissue	76.93	0.41	0.03	0.74	1.58
	Yubudo, estuary of Geum River	Mar. 2 1972	Soft tissue		0.23	0.22	3.80	6.33
Solen gouldi (맛조개)	Beach, Gunsan Airport	Mar. 3 1972	Soft tissue	83.01		0.03	0.11	1.08
*Coelomactra antiquata*명 (명주개량조개)	Yubudo, estuary of Geum River	Mar. 2 1972	Soft tissue	83.98	0.06	0.25	0.75	
	Gaeyado, Oggugun	Feb. 25 1972	Soft tissue	83.84		0.10	2.15	1.23
Atrina pectinate (키조개)	Yeosu	Mar. 16 1972	Soft tissue	85.81	0.07	0.35	0.60	0.64
Anedara broughtoni (피조개)	Goseong, Gyeongnam	Mar. 16 1972	Soft tissue	74.65	0.03	0.78	1.53	0.68
	Yubudo, estuary of Geum River	Mar. 2 1972	Soft tissue	78.01	0.36	0.42	0.37	1.16
	Hongdo	Apr. 2 1972	Soft tissue	86.74		0.24	1.02	1.54

REF. NO.: 67 - Y - 1

SUBSTANCES: Hg

Reference: Yoshida, T., T. Kawabata & Y. Matsue. 1967. Transference mechanism of mercury in marine environment. J. Tokyo Univ. Fish. 53:73-84.

Organisms: Oysters (unspecified)

Date of Sample Collection: 1960

Location: Japan

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

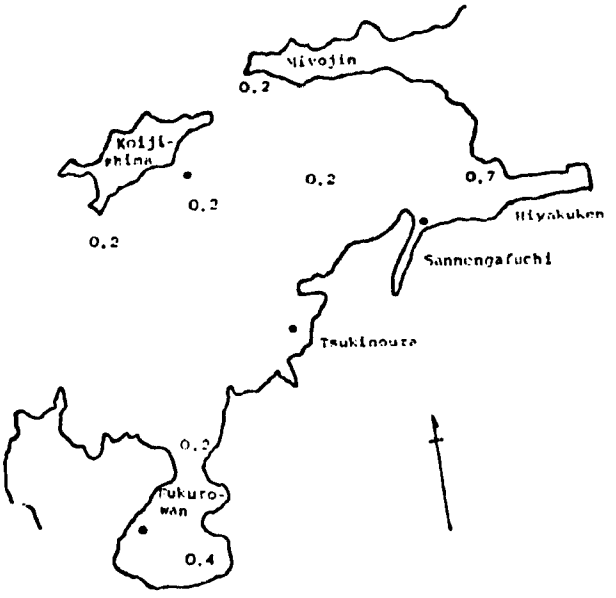


Fig. 1. Minamata Bay showing shellfish sampling location and Hg contents in ppm in its waters.

Table 1. Determination of mercury in the shellfish collected from Minamata Bay

Samples	Locality	Hg content ppm
" Kurogai "	Tsukinoura	63
Oyster	Aannengafuchi	15
Pearl oyster	Koiji-shima	
mid-gut gland		39
other parts		17
Pearl oyster	Fukuro-wan	
mid-gut gland		52
other parts		9

Samples were collected in May 25, 1960

Determination was carried out by dithizone method with Beckman DU type spectrophotometer

REF. NO.: 71 - Y - 1

SUBSTANCES: Hg

Reference: Young, D. R. 1971. Mercury in the environment: a summary of information pertinent to the distribution of mercury in the Southern California Bight. Southern California Coastal Water Research Project, Los Angeles, Ca., 24p.

Organisms: Hinnites multirugosus

Date of Sample Collection:

Location: Southern California

Analytical Technique: (Data from other literature)

Analytical Data:

Table 1. Mercury concentrations (mg/kg dry weight) in bottom sediments and organisms collected off La Jolla and Palos Verdes (PV). From Klein and Goldberg, 1970, tab. 1, p. 767.

	Hg (ppm)*					
Sample	La Jolla	PV (I)	PV (II)	PV (III)	PV (IV)	PV (V)
Sediment	0.02	0.3	0.2	1.0	0.3	0.2
Crab (*Cancer anthonyi*)	0.8	1.0 1.1	1.2	0.5	2.3 0.9	
Whelk (*Kelletia kelleti*)	1.5 0.9 2.1	0.9	1.8	2.3 1.6	1.6 2.5	3.2
Rock scallop (*Hinnites multirugosus*)	0.7 1.6	1.0 0.6	0.4			0.5

*Values listed are for dry weight concentrations.

REF. NO.: 76 - Y - 1

SUBSTANCES: Ag, Cd, Cr, Cu, Pb, Ni, Zn

Reference: Young, D. R. & T. K. Jan. 1976. Metals in scallops. Southern California Coastal Water Research Project Ann. Rep. 1976, p. 117-121. El Segundo, Ca.

Organisms: *Hinnites multirugosus*

Date of Sample Collection: 1974

Location: Southern California

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

	Digestive Gland		Gonad		Adductor Muscle	
	Outfall	Control	Outfall	Control	Outfall	Control
Silver						
Median	2.3	0.26	0.075	0.015	0.022	0.006
Mean	2.3	0.31	0.080	0.018	0.026	0.008
±95% CL**	1.2	0.17	0.031	0.017	0.018	0.008
Cadmium						
Median	490	600	2.4	4.1	0.92	0.33
Mean	520	540	2.6	5.4	0.95	0.34
±95% CL	210	150	1.0	5.9	0.26	0.07
Chromium						
Median	48	2.2	2.2	0.38	0.31	≤0.03
Mean	41	2.2	2.6	0.39	0.35	0.05
±95% CL	19	1.2	0.73	0.13	0.12	0.06
Copper						
Median	170	48	3.3	1.9	0.29	0.11
Mean	190	64	3.2	2.2	0.41	0.16
±95% CL	95	42	0.53	1.3	0.25	0.11
Nickel						
Median	1.3	1.4	0.30	0.15	0.22	0.10
Mean	1.3	1.5	0.72	0.26	0.22	0.12
±95% CL	0.55	0.28	0.73	0.27	0.10	0.13
Lead						
Median	14	5.1	<0.02	<0.02	<0.01	<0.01
Mean	13	4.4	<0.02	<0.02	<0.01	<0.01
±95% CL	7.3	3.7	–	–	–	–
Zinc						
Median	120	90	48	10	24	22
Mean	130	100	46	20	25	22
±95% CL	35	46	15	18	3.8	1.8

*Values based on analyses of 8 scallops from the outfall area and 6 from the island stations.

**Confidence limit.

Table 1. Trace metal concentrations (mg/wet kg) in tissues of the scallop *Hinites multirugosus* collected during 1974 from the Palos Verdes outfall zone and from island control stations.*

Metal	Digestive Gland	Gonad	Adductor Muscle
Silver	7.4	4.4	3.2
Cadmium	0.95	0.48	2.8
Chromium	19	6.7	7.0
Copper	3.0	1.4	2.6
Nickel	0.87	2.8	1.8
Lead	3.0	–	–
Zinc	1.3	2.3	1.1

Table 2. "Contamination ratios" (outfall-to-control region ratios of mean metal concentrations) for seven metals in three scallop tissues.

REF. NO.: 75 - Y - 1

SUBSTANCES: Cu, Cr, Ni, Zn

Reference: Young, D. R. & D. J. McDermott. 1975. Trace metals in harbor mussels. Southern California Coastal Water Research Project Ann. Rep. 1975, p. 139-142. El Segundo, Ca.

Organisms: Mytilus edulis

Date of Sample Collection: 1974

Location: Southern California

Analytical Technique: Optical emission spectroscopy

Analytical Data:

Table 1. Concentrations of copper, chromium, nickel, and zinc (ppm, dry weight) and 1254 PCB (ppb, wet weight) in tissues of intertidal mussels (Mytilus edulis) from San Diego Harbor and adjacent coastline

	Station					
Constituent	A	B	C	D	E	F
1254 PCB	710	860	700	280	44	47
Copper						
Digestive gland	52	77	34	36	19	24
Gonads	15	23	11	12	13	9.6
Muscle	7.0	34	7.2	12	7.7	53
Remainder	17	34	15	11	12	15
Chromium						
Digestive gland	7.4	5.4	3.8	7.3	4.0	7.0
Gonads	3.0	<2.0	1.0	1.9	0.7	0.8
Muscle	1.0	1.6	0.7	2.5	1.0	11
Remainder	1.8	0.8	1.8	3.4	1.2	1.6
Nickel						
Digestive gland	6.0	4.6	2.3	3.0	3.9	5.2
Gonads	<2.6	<1.0	<1.1	<1.0	–	–
Muscle	2.8	2.4	<1.0	2.0	–	14
Remainder	2.9	<2.0	<1.9	<1.9	<1.0	<2.6
Zinc						
Digestive gland	152	124	125	185	116	119
Gonads	180	93	114	122	121	112
Muscle	156	138	103	156	172	162
Remainder	244	166	169	153	192	175

REF. NO.: 76 - Z - 1

SUBSTANCES: Hg, Pb, Cd, Cr, As

Reference: Zook, E. G., J. J. Powell, B. M. Hackley, J. A. Emerson, J. R. Brooker & G. M. Knobl Jr. 1976. National Marine Fisheries Service preliminary survey of selected seafoods for mercury, lead, cadmium, chromium, and arsenic content. J. Agric. Food Chem. 24:47-53.

Organisms:

Mercenaria mercenaria
Mya arenaria
Spisula solidissima
Crassostrea virginica
Aequipecten irradians
Aequipecten gibbus
Placopecten magellanicus

Date of Sample Collection: 1970-71

Location: East coast U.S.

Analytical Technique: Atomic absorption spectrophotometry

Analytical Data:

Table II. Microconstituent Content of Edible Portion of Selected Seafoods

Seafood, common name, scientific name, area and site[a] of catch	No. of samples and information on samples	Microconstituent, ppm				
		Hg	Pb	Cd	Cr	As
Clams, hard (Quahog) (*Mercenaria mercenaria*), Atlantic: Upper Chincoteague Bay, 10	10 11/22-12/20/71[e] Little necks (sm.), 3[l] Cherrystones (med.), 2 Chowder (lg.), 5	0.05 ± 0.02 0.02-0.07	0.28 ± 0.18 0.00-0.63	0.122 ± 0.020 0.098-0.159	0.17 ± 0.17 0.06-0.64	1.8 ± 0.6 1.0-2.5
Clams, soft (*Mya arenaria*), Atlantic: Kent Island Area, Chesapeake Bay, Md., 10	10 7/1-12/2/71[e]	0.03 ± 0.02 0.01-0.05	0.40 ± 0.29 0.00-0.87	0.184 ± 0.082 0.059-0.293	0.23 ± 0.12 0.00-0.43	1.2 ± 0.5 0.6-2.1
Clams, surf (*Spisula solidissima*), Atlantic: Ocean City, Md., 9; Chincoteague, Va., 1	10 11/16-12/6/71[e] Hearts & tongues, 9[m] Hearts only, 1	0.05 ± 0.02 0.01-0.07	0.52 ± 0.25 0.16-0.80	0.061 ± 0.030 0.000-0.098	0.39 ± 0.15 0.20-0.69	1.6 ± 0.3 1.2-2.2

Table III. Literature Values[a] for Seafoods from Fish Families Surveyed in This Study

Seafood	Microconstituent, ppm				
	Hg	Pb	Cd	Cr	As
Clams, all species	22 0.08 ± 0.05 0.01-0.26	9 1.60 ± 2.28 0.15-7.37	12 0.22 ± 0.17 0.03-0.58	6 0.33 ± 0.12 0.17-0.44	11 3.13 ± 3.85 0.90-12.72
Oysters (*Virginica*)	9 0.10 ± 0.06 0.03-0.23	12 24.92 ± 38.97 0.20-100.00	11 1.88 ± 1.29 0.11-3.60	2 0.12 ± 0.04 0.09-0.14	10 9.12 ± 15.59 0.45-42.74
Scallops, sea	5 0.04 ± 0.008 0.03-0.05	6 0.32 ± 0.12 0.15-0.47	5 2.77 ± 4.45 0.03-10.55	5 0.09 ± 0.02 0.05-0.11	7 8.76 ± 12.80 0.39-33.56

PESTICIDES &

HALOGENATED HYDROCARBONS

REF. NO.: 75 - A - 1

SUBSTANCES: PCBs, DDE, heptachlor epoxide

Reference: Albright, L. J., T. G. Northcote, P. C. Olaffs & S. Y. Szeto. 1975. Chlorinated hydrocarbon residues in fish, crabs, and shellfish of the Lower Fraser River, its estuary, and selected locations in Georgia Strait, British Columbia - 1972-73. Pest. Monit. J. 9:134-140.

Organisms: *Crassostrea gigas*
Mytilus edulis
Cardium corbis

Date of Sample Collection: 1972-73

Location: British Columbia

Analytical Technique: Gas-liquid chromatography; mass spectrometry

Analytical Data:

TABLE 2. *Chlorinated hydrocarbon concentrations in various faunal species, Fraser River estuary, British Columbia—1972-73*

Station No.	Species [1]	Shell size, mm: Mean	Shell size, mm: Range	Heptachlor Epoxide: Mean, ppb	Heptachlor Epoxide: Range, ppb	Heptachlor Epoxide: N [2]	Heptachlor Epoxide: N [3]	Heptachlor Epoxide: N [4]	p,p'-DDE: Mean, ppb	p,p'-DDE: Range, ppb	p,p'-DDE: N [2]	p,p'-DDE: N [3]	p,p'-DDE: N [4]	PCB's [5]: Mean, ppb	PCB's [5]: Range, ppb	PCB's [5]: N [2]	PCB's [5]: N [3]	PCB's [5]: N [4]	PCB's [6]: Mean, ppb	PCB's [6]: N [2]	PCB's [6]: N [3]	PCB's [6]: N [4]	No. Samples
M	CC	8 [7]		ND		0	0	1	ND		0	0	1	ND		0	0	1	11.9	1	0	0	1
M	CG	11 [7]		ND		0	0	1	T		0	1	0	2724.1		1	0	0	ND	0	0	1	1
R	CM	10.8 [8]		ND		0	0	1	82.0		1	0	0	105.3		1	0	0	ND	0	0	1	1
Q	CM	13.1 [8,9]	9.5-16.1	7.7	ND-22.0	2	0	3	95.6	23.0-295.8	5	0	0	781.8	234.2-2100.3	5	0	0	ND	0	0	5	5
L	CC	all [7,10] sizes		23.0		1	0	0	32.0		1	0	0	295.0		1	0	0	ND	0	0	1	1
L	ME	4 [10,11]		ND		0	0	1	ND		0	0	1	T		0	1	0	ND	0	0	1	1
L	CS	3 [7,10,12]		ND		0	0	1	T		0	1	0	214.0		1	0	0	ND	0	0	1	1
O	CCO	9.5 [11,12]		ND		0	0	1	ND		0	0	1	193.0		1	0	0	ND	0	0	1	1
O	CM	13.5 [8]	11.9-15.5	3.3	ND-18.9	2	0	5	36.8	ND-141.1	5	1	1	559.3	170.1-1375.4	7	0	0	ND	0	0	7	7
S	CM	15.4 [8,9]	14.8-16.1	3.7	ND-11.4	2	0	3	101.4	23.1-176.9	5	0	0	839.7	154.3-1607.1	5	0	0	ND	0	0	5	5
S	CG	13 [7,14]		ND		0	0	1	T		0	1	0	322.3		1	0	0	ND	0	0	1	1

NOTE: ND = not detectable; T = trace.

[1] CC = *Callianassa californiensis*; CG = *Crassostrea gigas*; CM = *Cancer magister*; ME = *Mytilus edulis*; CS = *Citharichthyes stigmaeus*; and CCO = *Cardium corbis*.
[2] No. samples with concentrations > 4 ppb.
[3] No. samples with trace of residue.
[4] No. samples with no detectable residue.
[5] Similar to Aroclor 1254.
[6] Similar to Aroclor 1242.
[7] Entire animal assayed.
[8] Hepatopancreas assayed.
[9] One sample had a trace of dieldrin.
[10] More than one individual in this sample.
[11] Soft tissue assayed.
[12] Body length.
[13] Two samples had traces of *p,p'*-DDD.
[14] One sample had a trace of *p,p'*-DDT.

REF. NO.: 73 - B - 6

SUBSTANCES: HCH, dieldrin, aldrin, DDE, TDE, DDT, PCB, heptachlor

Reference:

Baluja, G., J. M. Franco & M. A. Murado. 1973. Contaminación del medio por plaguicidas organoclorados. VI. Residuos de insecticidas y PCB en especies marinas, significado ecológico y su relación con la contaminación litoral nacional. Inv. Pesq. 37:593-620.

Organisms: Mytilus edulis

Date of Sample Collection: 1968-70

Location:

Analytical Technique: Gas-liquid chromatography

Analytical Data:

TABLA 1

Niveles de contaminación en ppm en mejillones del puerto de Blanes (muestreo 20-1-70)

Muestras [a]			*α-HCH*	*γ-HCH*	*Heptacloro*	*Dieldrin*	*pp'-DDE*	*pp'-TDE*	*pp'-DDT*	*PCB*
Grupos	*Long. cm*	*Peso g*								
1	4,94	49,7	0,001	0,007	0,016	0,002	0,054	0,003	0,020	0,78
2	4,19	20,2	0,003	0,009	0,016	0,002	0,022	0,018	0,008	0,40
3	4,08	22,6	0,004	0,014	0,030	0,002	0,030	0,012	0,008	0,57

(a) La muestra está representada por grupos de 10 ejemplares de los que se anota la longitud media del eje mayor de la concha y el peso total del tejido blando analizado de cada grupo.

El aldrin se ha detectado a niveles no superiores a 0,001 ppm y el heptacloro-epóxido y op-DDT en cantidades menores de 0,001 ppm o no detectados. El endrin no se detecta.

TABLA 2

Niveles de contaminantes en ppm en mejillones del puerto de Barcelona

Muestras [a]				*α-HCH*	*γ-HCH*	*Aldrin*	*pp'-DDE*	*pp'-TDE*	*pp'-DDT*	*PCB*
Grupos	*Muestreos*	*Long. cm*	*Peso g*							
1	4-3-68	4,16	29,3	0,023	0,015	0,005	0,045	0,46	0,20	nc [b]
2	"	5,30	51,1	0,020	0,110		0,030	0,20	0,20	nc
3	"	4,49	27,4	0,030	0,020		0,040	0,46	0,10	nc
4	"	4,88	31,5	0,015	0,020	0,010	0,030	0,20	0,10	nc
5	"	4,76	41,8	0,025	0,010	0,002	0,020	0,20	0,10	nc
1	11-2-70	3,80	17,6	0,015	0,026	0,006	0,075	0,075	0,022	1,50
2	"	4,98	49,6	0,004	0,008	0,002	0,058	0,014	0,005	1,00
3	"	6,20	95,4	0,003	0,007	0,001	0,030	0,014	0,007	0,66

(a) La misma leyenda que en la tabla 1.

(b) Presente pero no calculado

El heptacloro, heptacloro-epóxido, dieldrin y op-DDT, en cantidades menores de 0,001 ppm o no se detectan. El endrin no se detecta.

Baluja, G. et al. 1973.

TABLA 3

Niveles de contaminantes en ppm en mejillones del puerto de Ampolla (delta del Ebro) (muestreo 12-2-70)

Muestras [a]			α-HCH	γ-HCH	Heptacloro	pp'-DDE	pp'-TDE	pp'-DDT	PCB
Grupos	Long. cm	Peso g							
1	3,04	14,0	0,019	0,013	0,001	0,200		<0,005	1,80
2	4,03	29,6	0,009	0,015	0,001	0,070	0,062	<0,005	0,90
3	4,03	24,0	0,006	0,017	0,001	0,140	0,060	<0,005	1,40

(a) La misma leyenda que en la tabla 1.
El aldrin, dieldrin, heptacloro-epóxido y op-DDT en cantidades menores de 0,001 ppm o no se detectan. El endrin no se detecta.

TABLA 4

Niveles de contaminantes en ppm en mejillones del puerto de Castellón (muestreo 15-2-70)

Muestras [a]			α-HCH	γ-HCH	Dieldrin	pp'-DDE	pp'-TDE	pp'-DDT	PCB
Grupos	Long. cm	Peso g							
1	6,6	96,3	<0,001	0,010	0,030	0,002	0,010	0,009	0,62
2	6,6		<0,001	0,040	0,020	0,001	0,009	0,015	0,60
3	6,5	79,6	<0,001	0,004	0,025	0,001	0,015	0,005	0,62

(a) La misma leyenda que en la tabla 1.
El heptacloro, heptacloro-epóxido, aldrin y op-DDT en cantidades no superiores a 0,001 ppm o no se detectan. El endrin no se detecta.

TABLA 5

Niveles de contaminantes en ppm en mejillones de la ría de Vigo

Muestras [a]				α-HCH	γ-HCH	Dieldrin	pp'-DDE	pp'-TDE	pp'-DDT	PCB
Unidad	Muestreos	Long. cm	Peso g							
1	10-1-68	8,3	18,8	0,010	0,001	<0,001	0,020	0,040	<0,005	nc [b]
2	»	9,0	23,3	0,012	0,008	<0,001	0,020	0,040	0,005	nc
3	»	9,2	40,8	0,010	0,010	<0,001	0,020	0,050	0,100	nc
4	»	8,1	19,2	0,020	0,010	0,003	0,010	0,050	0,100	nc
5	»	8,2	26,1	0,015	0,010	<0,001	0,010	0,050	0,100	nc
6	»	8,0	18,3	0,020	0,015	<0,001	0,020	0,050	0,050	nc
7	»	8,3	23,9	0,010	0,005	(?)0,010	0,020	0,070	0,100	nc
8	»	8,1	26,3	0,010	0,008	<0,001	0,020	0,030	0,040	nc
9	»	9,0	35,7	0,010	0,010	<0,001	0,010	0,020	<0,005	nc
Grupos										
1	10-1-68	7,6	160,2	0,010	0,006	<0,001	0,010	0,030	0,020	nc
2	»	7,5	120,8	0,007	0,010	<0,001	0,010	0,035	0,050	nc
3	»	8,8	161,0	0,005	0,004	<0,001	0,010	0,060	0,030	nc
4	24-1-70	8,9	154,7	<0,001	0,003	<0,001	0,004	0,009	0,005	0,14
5	»	8,3	142,5	<0,001	0,004	nd [c]	0,005	0,002	0,007	0,09
6	»	8,0	120,0	0,001	0,002	nd	0,005	0,008	0,005	0,09

(a) Mejillones cultivados. Se analizan individuos y grupos, los dos primeros de 5 individuos y los 4 últimos de 10 individuos. De los pesos totales de grupos se toman partes alícuotas para el análisis.
(b) Presente pero no calculado.
(c) No detectado.
El heptacloro, heptacloro-epóxido y op-DDT no fueron detectados o en cantidades inferiores a 0,001 ppm. El aldrin fue detectado en cantidades muy poco significativas en sólo 4 muestras. El endrin no fue detectado.

Baluja, G. et al. 1973.

TABLA 6

Niveles de contaminantes en ppm en mejillones de la costa de Santander (cabo Menor) (Muestreo 17-5-70)

Muestras[a]										
Grupos	*Long. cm*	*Peso g*	*α-HCH*	*γ-HCH*	*Aldrin*	*Dieldrin*	*pp'-DDE*	*pp'-TDE*	*pp'-DDT*	*PCB*
1	3,72	12,9	0,003	0,030	0,001	0,001	0,002	0,002	0,007	0,71
2	3,83	15,8	0,017	0,040	0,001	0,001	0,001	0,009	0,005	0,71
3	3,81	13,5	0,004	0,016	0,001	0,001	0,002	0,003	0,005	0,56

(a) La muestra está representada por grupos de 10 ejemplares de los que se anota la longitud media del eje mayor de la concha y el peso total del tejido blando analizado de cada grupo.

El heptacloro, heptacloro-epóxido y op-DDT no se detectan o en cantidades inferiores a 0,001 ppm. El endrin no se detecta.

TABLA 14. — Niveles medios e intervalos de contaminación más significativa que se obtienen de los valores más representativos de las tablas 1 a 13, expresados en ppm sobre el peso de tejido fresco (muestreos 1970)

Zona litor.	*M*[a]	*HCH (α+γ)*[b]	*Aldrin*	*Dieldrin*	*DDT*$_T$[c]	*PCB*
Blanes mej.		0,012 (0,008-0,018)	<0,001 (nd-<0,001)	0,002 (0,002-0,002)	0,055 (0,040-0,077)	0,58 (0,40-0,78)
Barcelona mej		0,020 (0,010-0,041)	0,003 (0,001-0,006)	<0,001 (nd-<0,001)	0,100 (0,046-0,172)	1,05 (0,66-1,50)
Ampolla mej.		0,036 (0,023-0,062)	<0,001 (nd-<0,001)	<0,001 (nd-<0,001)	0,180 (0,137-0,205)	1,36 (0,90-1,80)
Castellón mej.		0,020 (0,004-0,041)		0,025 (0,020-0,030)	0,025 (0,021-0,030)	0,61 (0,60-0,62)
Vigo mej.		0,003 (0,003-0,004)	<0,001 (nd-<0,001)	<0,001 (nd-<0,001)	0,017 (0,014-0,020)	0,10 (0,08-0,14)
Santander mej.		0,036 (0,020-0,057)	0,001 (0,001-0,001)	0,001 (0,001-0,001)	0,012 (0,010-0,015)	0,67 (0,56-0,74)

(a) M = muestras; mej. = tejido blando de mejillón; sar. = sardina total (cabeza y cuerpo); mie. M = tejido muscular de mielga, mie. H = hígado de mielga.

(b) Suma de los isómeros α y γ.

(c) DDT$_T$ = total de p,p'-TDE + pp'DDE + pp' + pp'DDT.

(d) Muestreo realizado en 1968.

(e) Existe en cantidades significativas pero no pudo calcularse.

REF. NO.: 68 - B - 1

SUBSTANCES: DDT, TDE, DDE, methoxychlor

Reference: Bedford, J. W., E. W. Roelofs & M. J. Zabik. 1968. The freshwater mussel as a biological monitor of pesticide concentrations in a lotic environment. Limnol. Oceanogr. 13:118-126.

Organisms:
Lampsilis siliquoidea
Lampsilis ventricosa
Anodonta grandis

Date of Sample Collection: 1966

Location: Red Cedar River, Michigan

Analytical Technique: Electron-capture gas chromatography

Analytical Data: (wet wt)

TABLE 1. *Mean concentrations of DDT and its metabolites (in ppm) in* L. siliquoidea *removed from the Red Cedar River (mussels placed in the river on 16 June 1966)*

Sta.	Date removed (1966)	DDT	TDE	DDE	Total
I	30 Jun	0.0136	0.0073	0.0041	0.0250
	28 Jul	0.1465	0.0351	0.0108	0.1926
	25 Aug*	0.0109	0.0058	0.0047	0.0214
II	30 Jun	0.0390	0.0331	0.0077	0.0798
	28 Jul	0.1400	0.0793	0.0201	0.2394
	25 Aug	0.1448	0.0939	0.0261	0.2646
III	30 Jun	0.0931	0.2019	0.0247	0.3197
	28 Jul	0.1858	0.3775	0.0666	0.6299
	25 Aug	0.2488	0.3528	0.0834	0.6850
IV	30 Jun	0.0731	0.2343	0.0242	0.3316
	28 Jul	0.2369	0.5218	0.0930	0.8517
	25 Aug	0.1994	0.3639	0.0735	0.6318

* *L. ventricosa.*

TABLE 3. *Mean concentrations of methoxychlor in* L. siliquoidea *removed from the Red Cedar River at three different times (mussels placed in the river on 16 June 1966)*

Sta.	Methoxychlor (ppm) 30 Jun	28 Jul	25 Aug
III	0.1190	0.1310	0.1028
IV	0.0702	0.2221	0.0816

TABLE 5. *Mean concentrations of DDT and its metabolites (in ppm) in* A. grandis *removed from the Red Cedar River (mussels placed in the river on 25 July 1966)*

Sta.	Date removed (1966)	DDT	TDE	DDE	Total
II	8 Aug	0.1006	0.0496	0.0106	0.1609
	5 Sep	0.3448	0.0763	0.0238	0.4449
	3 Oct	0.1055	0.0473	0.0133	0.1661
III	8 Aug	0.1401	0.2695	0.0491	0.4585
	5 Sep	0.1185	0.1910	0.0372	0.3467
	3 Oct	0.0799	0.2385	0.0417	0.3591
VI	8 Aug	0.0496	0.0452	0.0179	0.1127
	5 Sep	—	—	—	—
	3 Oct	—	—	—	—

TABLE 7. *Mean concentrations of aldrin (ppm) in* L. siliquoidea *removed on 28 July 1966 (placed in river on 16 June 1966) and* A. grandis *removed on 8 August (placed in river on 25 July 1966)*

Sta.	*L. siliquoidea*	*A. grandis*
I	1.7920	
II	0.7140	1.0355
III	0.4079	1.9718
IV	0.1723	
VI		3.6932

REF. NO.: 73 - B - 4 **SUBSTANCES:** detergent residues

Reference: Bellassai, S. & S. Sciacca. 1973. Aspetti biologici dell'inquinamento da detergenti ricerca di composti del tipo anionico in esemplari di pesci marini. Ig. Mod. 66:347-360.

Organisms: Donax trunculus
Mytilus edulis

Date of Sample Collection:

Location:

Analytical Technique:

Analytical Data:

MOLLUSCHI

Specie	Pesci			
	Determinazione N.	N. dei pesci esaminati (in singolo gruppo)	Detergenti anionici	
			Esito della ricerca	Concentrazione mg/Kg di materiale
Donax trunculus	1	30	—	0
	2	30	—	0
	3	30	—	0
Mytilus edulis (provenienti dal mercato)	1	30	+—	0,75
	2	20	+—	0,50
	3	40	+—	1,20
Mytilus edulis (stabulazione in mare inquinato)	1	30	++	1,4
	2	40	++	1,6
	3	40	++	1,8
Mytilus edulis (stabulazione in mare puro)	1	40	—	0
	2	30	—	0
	3	40	—	0

(*) +, ++, +++, concentrazione progressivamente più elevata di composti estraibili con il blu di metilene (detergenti anionici).

(**) La concentrazione di detergente in mg riferita a Kg di materiale esaminato (polpa di pesce o visceri) nella colonna 4 ha un significato approssimativo, date le molteplici possibilità di errata stima in rapporto alle manipolazioni cui il materiale è stato sottoposto.

REF. NO.: 74 - B - 3 **SUBSTANCES:** DDT, PCBs

Reference: Berkhiser, E. 1974. Decrease of DDT in mussels. S. Calif. Coastal Wat. Res. Proj., Ann. Rep. 1974: 101-103.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1971-73

Location: Southern California

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

Berkhiser, E. 1974

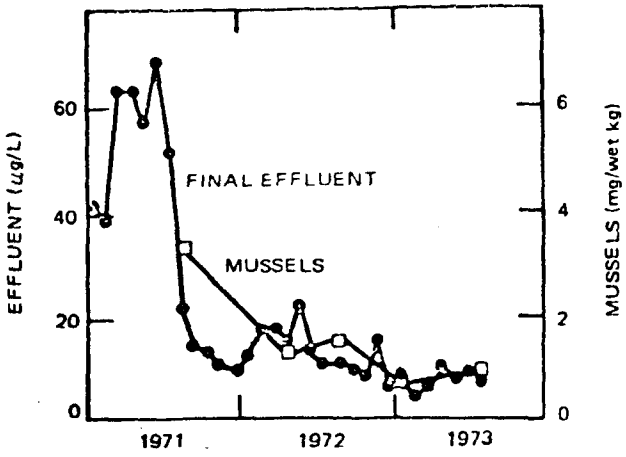


Figure 1. DDT concentrations in the final effluent from the Joint Water Pollution Control Plant, Los Angeles County Sanitation Districts, and in mussels from Royal Palms State Beach

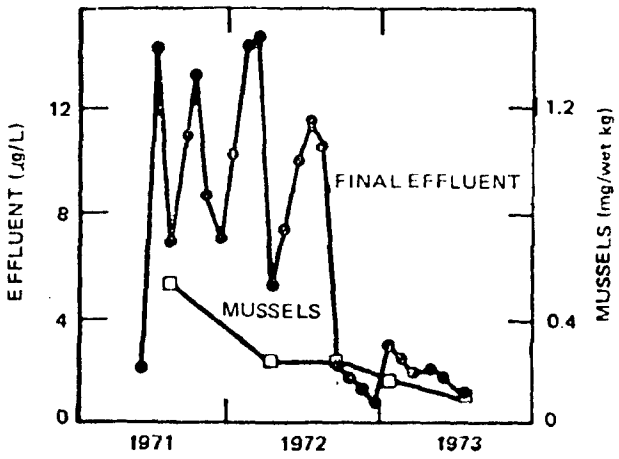


Figure 2. PCB concentrations in the final effluent from the Joint Water Pollution Control Plant, Los Angeles County Sanitation Districts, and in mussels from Royal Palms State Beach

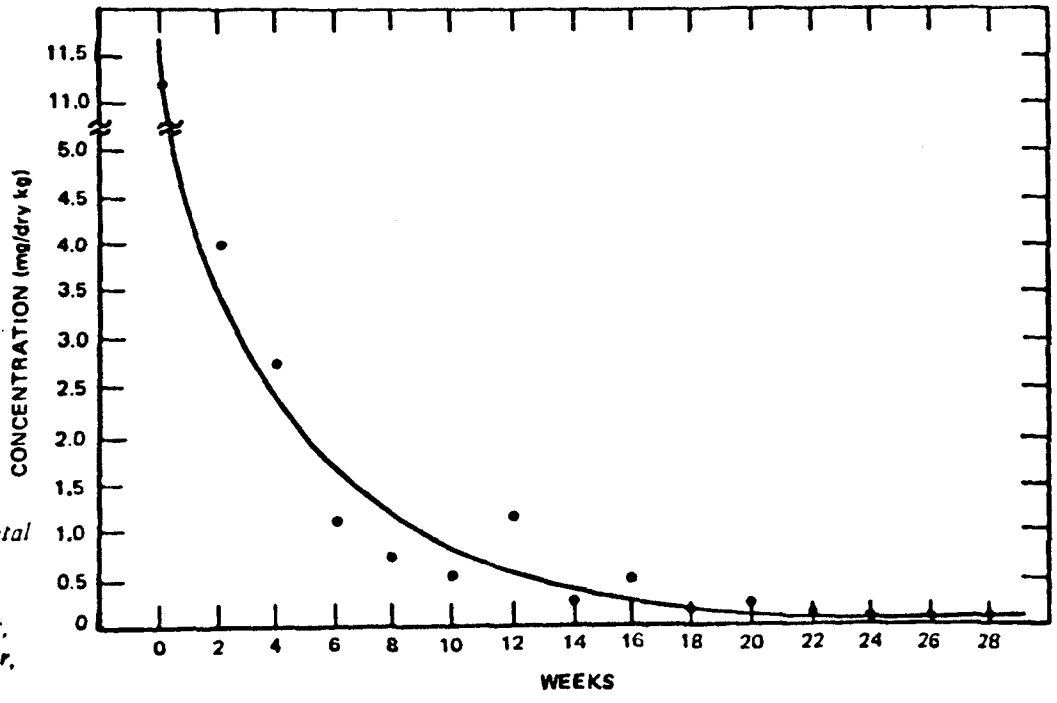


Figure 3. Decreases in total DDT concentrations in Palos Verdes mussels suspended from Scripps Pier, La Jolla, April to October, 1973.

REF. NO.: 73 - B - 5 **SUBSTANCES:** mirex

Reference: Borthwick, P. W., T. W. Duke, A. J. Wilson Jr., J. I. Lowe, J. M. Patrick Jr. & J. C. Oberheu. 1973. Accumulation and movement of mirex in selected estuaries of South Carolina, 1969-71. Pest. Monit. J. 7:6-26.

Organisms: *Crassostrea virginica*

Date of Sample Collection: 1969-70

Location: Toogoodoo Creek, South Carolina

Analytical Technique: Electron-capture gas chromatography

Analytical Data: Not detected (samples taken from 12 to 16 weeks after application of mirex to coastal areas)

REF. NO.: 74 - B - 4 **SUBSTANCES:** mirex

Reference: Borthwick, P. W., G. H. Cook & J. M. Patrick Jr. 1974. Mirex residues in selected estuaries of South Carolina - June 1972. Pest. Monit. J. 7:144-145.

Organisms: *Crassostrea virginica*
Mercenaria mercenaria

Date of Sample Collection: 1972

Location: Toogoodoo Creek and Cooper River, South Carolina

Analytical Technique: Electron-capture gas chromatography

Analytical Data: $<$.01 ppm ww (samples taken 2 yrs after application of mirex to coastal areas)

REF. NO.: 67 - B - 1

SUBSTANCES: aldrin, BHC-lindane, chlordane, DDT, DDE, DDD, dieldrin, endrin, heptachlor, heptachlor epoxide, methoxychlor, toxaphene, trithion

Reference:

Bugg, J. C. Jr., J. E. Higgins & E. A. Robertson Jr. 1967. Chlorinated pesticide levels in the Eastern oyster (Crassostrea virginica) from selected areas of the south Atlantic and Gulf of Mexico. Pest. Monit. J. 1(3):9-12.

Organisms: oysters (unspecified)

Date of Sample Collection: 1964-1966

Location: Atlantic and Gulf of Mexico, U.S. (South Carolina to Texas)

Analytical Technique: Electron-capture gas chromatography, thin-layer chromatography, dual-column electron capture gas chromatography

Analytical Data:

TABLE 2.—*Distribution of chlorinated pesticides at different residue levels—all oyster samples*

[Period of sampling—Feb. 1, 1964 through Aug. 24, 1966]

Pesticide	No. Samples Examined	Residue Levels in ppm Drained Weight			
		Not Detected	<0.01	0.01-0.05	>0.05
Aldrin	133	116	16	1	0
BHC-Lindane	133	78	27	27	1
Chlordane	132	112	19	1	0
DDD	81	0	2	72	7
DDE	131	8	24	83	16
p,p'-DDT	131	14	17	90	10
Dieldrin	115	61	16	38	0
Endrin	115	88	19	7	1
Heptachlor	133	121	12	0	0
Heptachlor epoxide	133	113	20	0	0
Methoxychlor	133	127	6	0	0
Toxaphene	133	127	2	1	3
Trithion [3]	55	55	0	0	0

Bugg, J. C. et al. 1967.

TABLE 1.—*Frequency of chlorinated pesticide residues in oyster samples*

[Period of sampling—Feb. 1, 1964 through Aug. 24, 1966]

Pesticide	No. Samples Examined	No. Samples Positive for Pesticide Shown	Residue (ppm drained weight)		
			Median	Low	High
Aldrin	133	17	<0.01	<0.01	0.03
BHC-Lindane	133	55	0.01	<0.01	0.50
Chlordane	132	20	<0.01	<0.01	0.01
DDD	81	81	0.02	<0.01	0.37
DDE	131	123	0.02	<0.01	0.12
p,p'-DDT	131	117	0.02	<0.01	0.22
Dieldrin	115	54	0.01	<0.01	0.03
Endrin	115	27	<0.01	<0.01	0.07
Heptachlor	133	12	<0.01	<0.01	<0.01
Heptachlor epoxide	133	20	<0.01	<0.01	<0.01
Methoxychlor	133	6	<0.01	<0.01	<0.01
Toxaphene	133	6	0.08	<0.01	1.00
Trithion *	55	0	—	—	—

Aldrin	not less than 95% of 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4-*endo-exo*-5,8-dimethano-naphthalene
BHC-Lindane	1,2,3,4,5,6-hexachlorocyclohexane, mixed isomers
Chlordane	1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindane
DDD	1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethane
DDE	1,1-dichloro-2,2-bis(*p*-chlorophenyl)ethylene
p,p'-DDT	1,1,1-trichloro-2,2-bis(*p*-chlorophenyl)ethane
Dieldrin	not less than 85% of 1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-*endo-exo*-5,8-dimethanonaphthalene
Endrin	1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-*endo-endo*-5,8-dimethanonaphthalene
Heptachlor	1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene
Heptachlor epoxide	1,4,5,6,7,8,8-heptachloro-2,3-epoxy-3a,4,7,7a-tetrahydro-4,7-methanoindan
Methoxychlor	1,1,1-trichloro-2,2-bis(*p*-methoxyphenyl)ethane
Toxaphene	chlorinated camphene containing 67% to 69% chlorine
Trithion *	*S*-[(*p*-chlorophenylthio)methyl] *O,O*-diethyl phosphorodithioate

APPENDIX I.—*Distribution of residues of specific chlorinated pesticides, by region*

[Period of sampling—Feb. 1, 1964 through Aug. 24, 1966]

	South Carolina	Georgia	Florida	Mississippi	Louisiana	Texas	Total
No. Samples examined	32	22	44	1	20	14	133
No. Samples in which one or more pesticides detected	29	21	44	1	19	12	126
CHLORINATED PESTICIDES (ppm drained weight)							
ALDRIN							
No. positive	(1)	(1)	(8)	(0)	(4)	(3)	(17)
Median	—	—	<0.01	—	<0.01	<0.01	<0.01
Low	—	—	<0.01	—	<0.01	<0.01	<0.01
High	<0.01	<0.01	<0.01	—	<0.01	0.03	0.03
BHC-LINDANE							
No. positive	(14)	(5)	(19)	(0)	(9)	(8)	(55)
Median	0.01	<0.01	<0.01	—	<0.01	0.01	0.01
Low	<0.01	<0.01	<0.01	—	<0.01	<0.01	<0.01
High	0.50	0.01	0.01	—	0.02	0.02	0.50
CHLORDANE							
No. positive	(6)	(4)	(8)	(1)	(1)	(0)	(20)
Median	<0.01	<0.01	<0.01	—	—	—	<0.01
Low	<0.01	<0.01	<0.01	—	—	—	<0.01
High	<0.01	<0.01	<0.01	<0.01	0.01	—	0.01

REF. NO.: 69 - B - 1

SUBSTANCES: DDT, dieldrin, endrin

Reference: Butler, P. A. 1969. The significance of DDT residues in estuarine fauna. In Chemical, M. W. Miller & G. G. Berg, p. 205-220. Charles C. Thomas, Publisher, Springfield, Ill.

Organisms:
Mya sp.
Crassostrea sp.
?*Ostrea* sp.

Date of Sample Collection: 1967

Location: Washington, Maine, Virginia, Texas, California

Analytical Technique: Electron-capture gas chromatography; thin-layer gas chromatography

Analytical Data:

TABLE 9-I
PESTICIDE RESIDUES IN ESTUARINE MOLLUSKS COLLECTED AT MONITORING STATIONS IN FIVE STATES IN 1967

State	*Number of Stations*	*Number of Samples**	*Percentage of Positive Samples*	*Maximum Level Detected (μg/kg)*		
				DDT†	*Dieldrin*	*Endrin*
Washington	18	211	12	98	0	0
Maine	7	78	13	31	0	0
Virginia	10	123	86	256	40	0
Texas	12	129	90	335	85	19
California	12	140	91	1600	39	19

*Collected at 30-day intervals.
†DDT includes the metabolites DDE and DDD.

REF. NO.: 73 - B - 2

SUBSTANCES: DDT, PCBs, dieldrin, endrin, mirex, toxaphene

Reference: Butler, P. A. 1973. Organochlorine residues in estuarine mollusks, 1965-72 -- National Pesticide Monitoring Program. Pest. Monit. J. 6: 238-246.

Organisms:

Crassostrea gigas	Modiolus modiolus	Mya arenaria
Crassostrea virginica	Mytilus californianus	Corbicula fluminea
Ostrea lurida	Mytilus edulis	
Modiolus demissus	Mercenaria mercenaria	

Date of Sample Collection: 1965-72

Location: U.S. -- Atlantic, Pacific and Gulf of Mexico coasts

Analytical Technique: Electron-capture gas chromatography; thin-layer chromatography

Analytical Data: (wet wt)

TABLE 3.—*Summary of organochlorine residues detected in estuarine mollusks by State—1965-72*

State	Total Number of Samples	Number of Samples with Residues >5 PPB (µg/kg) and Maximum Residue ( ) Detected in PPB (µg/kg)					
		DDT	Dieldrin	Endrin	Mirex	Toxaphene	PCB's
Alabama	33	33 (616)	6 (21)				
California	772	712 (3,970)	194 (57)	14 (19)		4 (11,000)	[1] 21
Delaware	287	216 (205)	37 (25)				
Florida	374	230 (5,390)	27 (28)				25 (390)
Georgia	664	96 (96)	141 (230)			128 (54,000)	[1] 16
Maine	396	72 (359)	14 (38)				
Maryland	88	71 (70)	11 (22)				
Mississippi	470	285 (135)	19 (20)				
New Jersey	219	219 (278)	52 (26)				[1] 6
New York	1,059	858 (596)	456 (132)				
North Carolina	1,031	768 (566)	12 (19)				
South Carolina	610	332 (154)	24 (154)		12 (540)		
Texas	728	530 (1,249)	134 (87)	22 (32)		[1] 1	[1] 5
Virginia	669	585 (678)	112 (40)				19 (2,[illegible])
Washington	695	78 (176)	1 (120)				

[1] Present but not quantified.

Butler, P. A. 1973.

TABLE 4.—*Listing of States in order of frequency and maximum value of DDT residues in mollusks*

State	Frequency of Residues (%)	State	Maximum Value in PPB
Alabama	100	Florida	5,390
New Jersey	100	California	3,970
California	92	Texas	1,249
Virginia	87	Virginia	678
New York	81	Alabama	616
Maryland	81	New York	596
Delaware	75	North Carolina	566
North Carolina	75	Maine	359
Texas	73	New Jersey	278
Florida	62	Delaware	205
Mississippi	61	Washington	176
South Carolina	54	South Carolina	154
Maine	18	Mississippi	135
Georgia	15	Georgia	96
Washington	11	Maryland	70

NOTE: These comparisons are limited in that the number of samples, number of sampling stations, periods (years) of sampling, and species of mollusks differ for each State.

TABLE 5.—*Listing of States in order of frequency and maximum value of dieldrin residues in mollusks*

State	Frequency of Residues (%)	State	Maximum Value in PPB
New York	43	Georgia	230
California	25	South Carolina	154
New Jersey	24	New York	132
Georgia	21	Washington	120
Alabama	18	Texas	87
Texas	18	California	57
Virginia	17	Virginia	40
Delaware	13	Maine	38
Maryland	13	Florida	28
Florida	7	New Jersey	26
Mississippi	4	Delaware	25
South Carolina	4	Maryland	22
Maine	4	Alabama	21
North Carolina	1	Mississippi	20
Washington	<1	North Carolina	19

NOTE: These comparisons are limited in that the number of samples, number of sampling stations, periods (years) of sampling, and species of mollusks differ for each State.

TABLE 6.—*Percent distribution of DDT residues of different magnitude in estuarine mollusks by State—1965-71 (7,000 samples)*

State	Percent Distribution of Samples							
	<11 PPB		11-100 PPB		101-1,000 PPB		>1,000 PPB	
	First 2 to 5 Years	1971	First 2 to 5 Years	1971	First 2 to 5 Years	1971	First 2 to 5 Years	1971
Alabama			69		31			
California	14	7	30	64	51	28	5	1
Delaware	23	30	62	67	15	3		
Florida (1 station)	43	100	57					
Georgia	85	96	15	4				
Maine	82	98	17	2	1			
Maryland	19	50	81	50				
Mississippi	42	72	56	27	2	1		
New Jersey		7	69	74	31	19		
New York	26	22	60	74	14	4		
North Carolina	22	76	68	24	10			
South Carolina	52	82	47	18	1			
Texas	34	52	53	45	13	3	<1	
Virginia	18		67	95	15	5		
Washington (1 station)	92	94	8	6				
Mean	39	56	49	39	11	5	<0.5	

Butler, P. A. 1973.

TABLE 7.—*Trends in magnitude of DDT residues in oysters, 10 stations, North Carolina*

Year	Total Number of Samples	<11 PPB		11-100 PPB		101-1,000 PPB	
		Number of Samples	Percent Distribution	Number of Samples	Percent Distribution	Number of Samples	Percent Distribution
1966	60	5	8	45	75	10	17
1967	119	9	8	90	76	20	16
1968	120	26	22	70	58	24	20
1969	120	29	24	77	64	14	12
1970	109	61	56	46	42	2	2
Subtotal	528	130	25	328	62	70	13
1971	115	87	76	26	22	2	2
Percent change in 1971 from average for 1966-70		+204%		−65%		−85%	

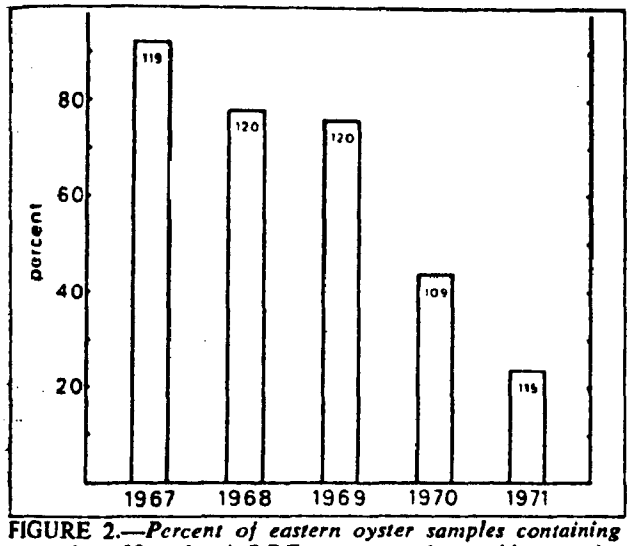


FIGURE 2.—*Percent of eastern oyster samples containing more than 10 ppb of DDT, average of monthly samples collected at 10 stations in North Carolina (Numbers in bars indicate total number of samples)*

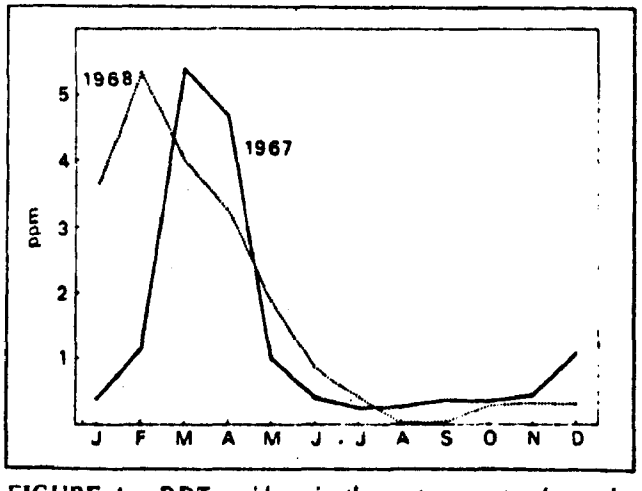


FIGURE 1.—*DDT residues in the eastern oyster from the Caloosahatchee River Basin, Lee County, Fla., by month of collection—1967 and 1968*

REF. NO.: 67 - C - 1

SUBSTANCES: BHC-lindane, DDE, DDT, dieldrin, endrin, heptachlor, aldrin, chlordane, heptachlor epoxide, methoxychlor, toxaphene, trithion

Reference:

Casper, V. L. 1967. Galveston Bay pesticide study - water and oyster samples analyzed for pesticide residues following mosquito control program. Pest. Monit. J. 1(3):13-15.

Organisms: oysters (unspecified)

Date of Sample Collection: 1964

Location: Galveston Bay

Analytical Technique: Electron-capture gas chromatography; thin-layer chromatography

Analytical Data:

TABLE 1.—*Summary of oyster analyses*

[ND = Not detected]

Sampling point	Date of sampling	Pesticides in ppm wet drained weight[1]							
		BHC-Lindane	DDE	DDT	Dieldrin	Endrin	Heptachlor	Aldrin	Others[2]
EAST GALVESTON BAY (Lease 357-A)	4/23/64	ND	ND	ND	ND	ND	ND	ND	ND
EAST GALVESTON BAY (Miller's Reef)	5/11/64	ND	ND	ND	ND	ND	ND	ND	ND
EAST GALVESTON BAY	6/04/64	0.01	0.02	0.01	ND	ND	ND	ND	ND
EAST GALVESTON BAY	6/24/64	0.01	0.01	0.01	ND	ND	ND	ND	ND
EAST GALVESTON BAY (Blume's Reef)	7/07/64	ND	0.05	0.07[3]	0.01	0.02	ND	0.03	ND
EAST GALVESTON BAY (Blume's Reef)	7/18/64	ND	0.05	0.1[3]	0.01	0.01	ND	ND	ND
GALVESTON BAY (Todd's Dump)	9/03/64	<0.01	0.01	0.01	<0.01	<0.01	ND	ND	ND
GALVESTON BAY (Hanna's Reef)	9/09/64	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	ND	ND
GALVESTON BAY (Scott's Reef)	9/14/64	<0.01	<0.01	0.01	<0.01	<0.01	ND	ND	ND
GALVESTON BAY (Redfish Bar)	9/14/64	<0.01	0.02	0.02	<0.01	<0.01	<0.01	ND	ND

1 Analysis by gas chromatography with electron capture.
2 Includes chlordane, heptachlor epoxide, methoxychlor, toxaphene, and Trithion®.
3 *p,p'*-DDT.

REF. NO.: 69 - C - 1

SUBSTANCES: chlorinated pesticides

Reference: Casper, V. L., R. J. Hammerstrom, E. A. Robertson Jr., J. C. Bugg Jr. & J. L. Gaines. 1969. Study of chlorinated pesticides in oysters and estuarine environment of the Mobile Bay area. U.S. Dept. HEW, Consumer Protection and Environmental Health Service, 47p.

Organisms: oysters (unspecified)

Date of Sample Collection: 1965-66

Location: Mobile Bay, Alabama

Analytical Technique:

Analytical Data:

Table 1. CHLORINATED PESTICIDE RESIDUES IN POSITIVE OYSTER SAMPLES

Pesticide	Number of samples		Residue (ppm drained weight)		
	Examined	Positive	Median	Low	High
Aldrin	82	4	<0.01	<0.01	<0.01
BHC-lindane	82	11	<0.01	<0.01	0.08
Chlordane	78	25	<0.01	<0.01	<0.01
DDD	82	82	0.11	0.01	1.72
DDE	82	82	0.23	0.01	2.31
DDT (pp')	82	81	0.03	<0.01	0.58
Total DDT[a]	82	82	0.33	0.03	4.61
Dieldrin	52	47	<0.01	<0.01	0.08
Endrin	52	36	<0.01	<0.01	0.03
Heptachlor	78	0	-	-	-
Heptachlor-epoxide	78	11	<0.01	<0.01	<0.01
Methoxychlor	78	0	-	-	-
Toxaphene	78	0	-	-	-

[a] Total DDT comprised of DDT (pp'), DDD, and DDE.

Table 2. DISTRIBUTION OF ALL OYSTER SAMPLES ACCORDING TO PESTICIDE RESIDUE LEVELS

Pesticide	Residue levels (ppm drained weight)			
	Not detected	<0.01	0.01-0.049	≥0.05
Aldrin	78	4	0	0
BHC-lindane	71	6	4	1
Chlordane	53	25	0	0
DDD	0	0	20	62
DDE	0	0	14	68
DDT (pp')	1	4	58	19
Total DDT[a]	0	0	1	81
Dieldrin	5	37	9	1
Endrin	16	33	3	0
Heptachlor	78	0	0	0
Heptachlor-epoxide	67	11	0	0
Methoxychlor	78	0	0	0
Toxaphene	78	0	0	0

[a] Total DDT comprised of DDT (pp'), DDD, and DDE.

Casper, V. L. et al. 1969.

Table 3. TOTAL DDT[a] IN POSITIVE OYSTER SAMPLES ACCORDING TO SAMPLING STATION

Sampling station	Number of samples		Residue (ppm drained weight)	
	Examined	Positive	Median	Range
Cedar Point Reef	21	21	0.68	0.08-4.61
Dauphin Island Bay	20	20	0.29	0.06-2.17
Shell Bank Reef	21	21	0.51	0.08-2.21
Bon Secour Reef	20	20	0.32	0.06-1.45

[a] Total DDT comprised of DDT (pp'), DDD, and DDE.

Table 10. SUMMARY OF ANALYSES OF CHLORINATED PESTICIDE RESIDUES[a] IN OYSTERS

Pesticide	Mobile Bay area				South Atlantic and Gulf Coast areas				Louisiana coastal area			
	No. samples examined	Percent positive	Median	Range[b]	No. samples examined	Percent positive	Median	Range	No. samples examined	Percent positive	Median	Range
Aldrin	82	4.9	<0.01	<0.01	133	7.4	<0.01	<0.01-0.03	145	7.6	<0.01	<0.01
BHC-lindane	82	13	<0.01	<0.01-0.06	133	26	0.01	<0.01-0.03	145	27	<0.01	<0.01-0.02
Chlordane	78	39	<0.01	<0.01	132	6.6	<0.01	<0.01-0.01	145	17	<0.01	<0.01-0.03
DDD	82	100	0.11	0.01-1.72	81	76	0.02	<0.01-0.37	145	95	0.01	<0.01-0.07
DDE	83	100	0.25	0.01-2.31	131	92	0.02	<0.01-0.12	145	99	<0.01	<0.01-0.06
DDT	82	99	0.03	<0.01-7.58	131	89	0.02	<0.01-0.22	145	95	<0.01	<0.01-0.40
Dieldrin	32	37	0.01	<0.01-0.08	115	46	0.01	<0.01-0.03	145	86	<0.01	<0.01-0.09
Endrin	52	44	<0.01	<0.01-0.03	115	23	<0.01	<0.01-0.07	145	36	<0.01	<0.01-0.07
Heptachlor	78	8	-	-	133	9.0	<0.01	<0.01	145	5.5	<0.01	<0.01
Heptachlor-epoxide	78	12	<0.01	<0.01	131	15	<0.01	<0.01	145	13	<0.01	<0.01-0.01
Methoxychlor	78	0	-	-	133	2	<0.01	<0.01	145	6.2	<0.01	<0.01-0.02
Toxaphene	78	0	-	-	133	3	0.06	<0.01-1.00	145	0	-	-

[a] Residues in parts per million drained weight.

[b] Single value indicates all positive samples were <0.01 ppm.

Casper, V. L. et al. 1969.

APPENDIX A. SUMMARY OF OYSTER ANALYSES (Continued):

PESTICIDE RESIDUES IN POSITIVE OYSTER SAMPLES

Pesticide	Shell Bank Reef				Bon Secour Reef			
	Number of samples		Pesticide residue (ppm drained weight)		Number of samples		Pesticide residue (ppm drained weight)	
	Exam.	Pos.	Median	Range	Exam.	Pos.	Median	Range
Aldrin	21	2	<0.01	<0.01	20	1	<0.01	<0.01
BHC-lindane	21	3	<0.01	<0.01-0.08	20	5	<0.01	<0.01-0.03
Chlordane	20	6	<0.01	<0.01	19	7	<0.01	<0.01
DDD	21	21	0.16	0.04-0.82	20	20	0.14	0.02-0.50
DDE	21	21	0.31	0.03-1.23	20	20	0.20	0.01-0.83
DDT	21	21	0.04	<0.01-0.16	20	20	0.03	0.01-0.12
Dieldrin	13	11	<0.01	<0.01-0.02	13	12	<0.01	<0.01-0.02
Endrin	13	8	<0.01	<0.01-0.01	13	8	<0.01	<0.01
Heptachlor	20	0	-	-	19	0	-	-
Heptachlor-epoxide	20	5	<0.01	<0.01	19	2	<0.01	<0.01
Methoxychlor	20	0	-	-	19	0	-	-
Toxaphene	20	0	-	-	19	0	-	-

[a] Number of samples examined for pesticide shown.
[b] Number of samples positive for pesticide shown.
[c] Single value indicates all positive samples were <0.01 ppm.

APPENDIX A. SUMMARY OF OYSTER ANALYSES:

PESTICIDE RESIDUES IN POSITIVE OYSTER SAMPLES

Pesticide	Cedar Point Reef				Dauphin Island Bay			
	Number of samples		Pesticide residue (ppm drained weight)		Number of samples		Pesticide residue (ppm drained weight)	
	Exam.[a]	Pos.[b]	Median	Range[c]	Exam.	Pos.	Median	Range
Aldrin	21	0	-	-	20	1	<0.01	<0.01
BHC-lindane	21	2	0.03	0.01-0.04	20	1	0.03	0.03
Chlordane	20	6	<0.01	<0.01	19	6	<0.01	<0.01
DDD	21	21	0.16	0.02-1.72	20	20	0.05	0.01-0.95
DDE	21	21	0.19	0.01-2.31	20	20	0.19	0.04-0.88
DDT	21	20	0.03	0.01-0.58	20	20	0.02	0.01-0.34
Dieldrin	13	12	<0.01	<0.01-0.08	13	12	<0.01	<0.01
Endrin	13	12	<0.01	<0.01-0.03	13	8	<0.01	<0.01
Heptachlor	20	0	-	-	19	0	-	-
Heptachlor-epoxide	20	2	<0.01	<0.01	19	1	<0.01	<0.01
Methoxychlor	20	0	-	-	19	0	-	-
Toxaphene	20	0	-	-	19	0	-	-

REF. NO.: 72 - C - 1

SUBSTANCES: DDE, TDE, DDT, PCBs

Reference: Claeys, R. R., R. S. Caldwell, N. H. Cutshall & R. Holton. 1972. Chlorinated pesticides and polychlorinated biphenyls in marine species, Oregon/Washington coast, 1972.

Organisms: *Clinocardium nuttallii*
Mya arenaria
Mytilus edulis
Corbicula fluminea
Anodonta sp.

Date of Sample Collection: 1971-72

Location: Oregon, Washington

Analytical Technique: gas-liquid chromatography

Analytical Data:

Claeys, R. R. et al. 1972.

TABLE 4. *Chlorinated hydrocarbons in Oregon estuarine mollusks, 1972*

Species	Date	Concentration, μg/kg wet weight			
		p,p'-DDE	*p,p'*-TDE	*p,p'*-DDT	PCB[1]
		Columbia River			
Corbicula fluminea	2/24	21	20	12	570
	4/14	ND	ND	ND	1170
	7/28	35	28	15	390
	10/5	30	17	10	420
Anodonta	4/14	7	4	3	160
	7/28	7	2	1	35
	10/4	2	NS	NS	NS
Mytilus edulis	2/24	NS	NS	NS	44
		Coos Bay			
Mya arenaria	1/25	0.6	0.8	2	NS
	4/17	0.7	NS	1.6[1]	NS
	7/12	0.7	0.7	3	NS
	9/30	ND	NS	NS	26
Clinocardium nuttallii	1/25	NS	NS	NS	NS
	4/17	NS	NS	NS	NS
	7/12	0.3	NS	0.4	NS
	9/30	ND	NS	NS	NS
		Tillamook			
Mya arenaria	1/14	NS	NS	NS	NS
	4/13	NS	NS	NS	NS
	7/9	0.2	NS	0.3	NS
	10/5	0.6	NS	NS	NS
Clinocardium nuttallii	1/14	NS	NS	NS	NS
	4/13	0.5	NS	0.4	NS
	7/9	0.1	NS	NS	NS
	10/5	0.6	NS	NS	NS
		Umpqua			
Mya arenaria	1/13	0.6	<0.7	<0.5	NS
	1/13	0.6	NS	NS	NS
	4/17	1.0	0.5[1]	0.4[1]	NS
	7/11	0.2	0.3	NS	NS
	10/2	1.2	NS	NS	NS
Mytilus edulis	1/26	0.7	NS	NS	NS
	5/19	1.0	NS	NS	NS
	7/12	0.8	0.3	NS	NS
	10/2	1.8	NS	NS	NS
		Yaquina			
Mya arenaria	1/24	0.2	NS	NS	NS
	4/15	0.5	NS	NS	NS
	7/8	0.2	NS	NS	NS
	9/25	0.6	NS	NS	5
Clinocardium nuttallii	1/1	NS	NS	NS	NS
	4/15	0.2	0.5	NS	NS
	7/8	0.2	NS	NS	NS
	9/25	0.3	NS	NS	7
Blanks[2,3]	Winter	0.2	0.3	0.5	19
	Spring	0.2	0.2	0.4	9
	Summer	0.1	0.2	0.4	5
	Fall	0.2	0.2	0.4	1

NOTE: Values have been corrected for sea water blanks.
ND = no data because of interference with analytical process.
NS = residues not significant (less than twice the blank values).

[1] Confirmed by base hydrolysis.
[2] Values assume 30-g sample weight.
[3] Average of two blanks.

REF. NO.: 74 - C - 1

SUBSTANCES: DDT, DDD, DDE, dieldrin

Reference: Clegg, D. E. 1974. Chlorinated hydrocarbon pesticide residues in oysters (*Crassostrea commercialis*) in Moreton Bay, Queensland, Australia, 1970-72. Pest. Monit. J. 8:162-166.

Organisms: *Crassostrea commercialis*

Date of Sample Collection: 1970-72

Location: Moreton Bay, Queensland, Australia

Analytical Technique: gas chromatography

Analytical Data:

Clegg, D. E. 1974.

TABLE 2. *Chlorinated hydrocarbon levels in oysters* (Crassostrea commercialis), *Moreton Bay, Queensland, Australia*

Sampling Station	Sampling Date	Residues, ppm			
		DDE	DDD	DDT	Dieldrin
1	4-2-70	0.007	0.006	0.006	0.007
	7-2-70	—	—	—	—
	10-8-70	0.039	0.023	0.046	—
Coomera River	1-14-71	0.008	0.007	—	0.022
	4-22-71	0.014	0.007	0.038	0.047
	8-3-71	0.023	—	0.161	—
	11-29-71	0.011	0.007	0.068	0.005
	3-9-72	0.007	0.008	0.036	0.013
2	4-2-70	0.007	—	—	—
	7-2-70	0.055	—	—	—
	10-8-70	0.020	—	0.055	—
Logan River	1-14-71	0.006	0.007	—	0.027
	4-22-71	0.009	0.007	—	0.012
	8-3-71	0.014	—	0.022	—
	11-29-71	0.007	0.007	0.005	—
	3-9-72	—	—	—	0.010
3	4-2-70	0.022	0.020	0.029	0.009
	7-2-70	0.035	—	0.011	—
	10-8-70	0.035	0.010	0.26	—
Redland Bay	1-14-71	0.010	0.010	0.017	0.025
	4-22-71	0.016	0.014	0.034	0.032
	8-3-71	0.028	0.009	0.071	—
	11-29-71	0.046	0.025	0.318	0.006
	3-9-72	0.018	0.012	0.049	0.015
4	4-2-70	0.007	—	0.016	—
	7-2-70	—	—	—	—
	10-8-70	0.017	—	0.073	—
Tingalpa Creek	1-14-71	—	—	—	—
	4-22-71	0.010	0.007	0.019	0.022
	8-3-71	0.014	—	—	—
	11-29-71	0.018	0.013	0.061	—
	3-9-72	0.008	0.005	0.014	0.016
5	4-2-70	0.037	0.116	0.203	0.094
	7-2-70	0.20	0.51	0.94	0.34
	10-8-70	0.033	0.107	0.094	0.083
Brisbane River	1-14-71	0.072	0.057	0.150	0.069
	4-22-71	0.026	0.034	0.097	0.071
	8-3-71	0.045	0.085	0.168	0.116
	11-29-71	0.146	0.119	0.427	0.150
	3-9-72	0.026	0.019	0.054	0.111
6	4-2-70	0.009	—	0.013	0.020
	7-2-70	—	—	—	0.058
	10-8-70	0.020	0.014	—	0.057
Cabbage Tree Creek	1-14-71 [1]				
	4-22-71	0.039	0.022	0.022	0.058
	8-3-71	0.023	0.011	0.051	0.033
	11-29-71	0.028	—	0.046	0.027
	3-9-72	—	—	0.006	0.023
7	4-2-70	0.009	0.023	0.012	0.023
	7-2-70	0.016	—	—	—
	10-8-70	0.021	0.017	0.040	0.051
Pine Rivers	1-14-71	0.035	0.027	0.035	0.010
	4-22-71	0.021	0.009	0.014	0.032
	8-3-71	0.023	0.007	0.095	0.020
	11-29-71	0.005	—	0.030	0.014
	3-9-72	—	—	0.012	0.044
8	4-2-70	0.009	—	0.007	0.018
	7-2-70	0.059	—	—	—
	10-8-70 [1]				
Caboolture River	1-14-71	0.008	—	—	—
	4-22-71	0.009	—	—	0.013
	8-3-71	0.009	—	—	0.016
	11-29-71	0.006	—	0.006	0.012
	3-9-72	—	0.006	0.010	0.035

NOTE: — = < 0.005 ppm

[1] Large interfering peaks prevented analysis.

REF. NO.: 68 - C - 1

SUBSTANCES: dieldrin, DDT, DDE, TDE, BHC

Reference: Connor, P. M. & J. E. Portmann. 1968. The toxicity of pesticides to marine animals, and further data on the occurrence of pesticides in oysters. I.C.E.S. C. M. Papers and Reports, C. M. 1968/K:13, 8p.

Organisms: *Ostrea edulis*

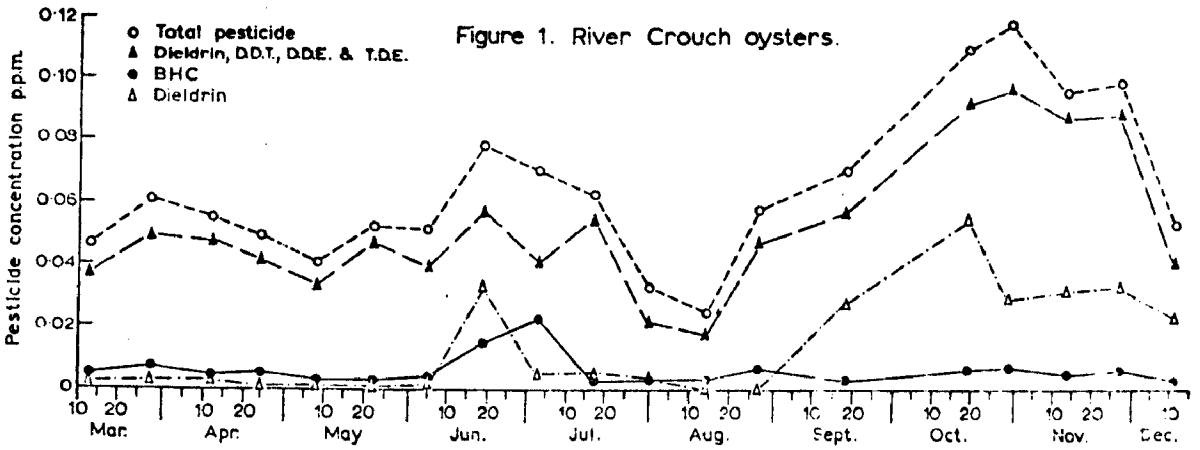
Date of Sample Collection: 1967

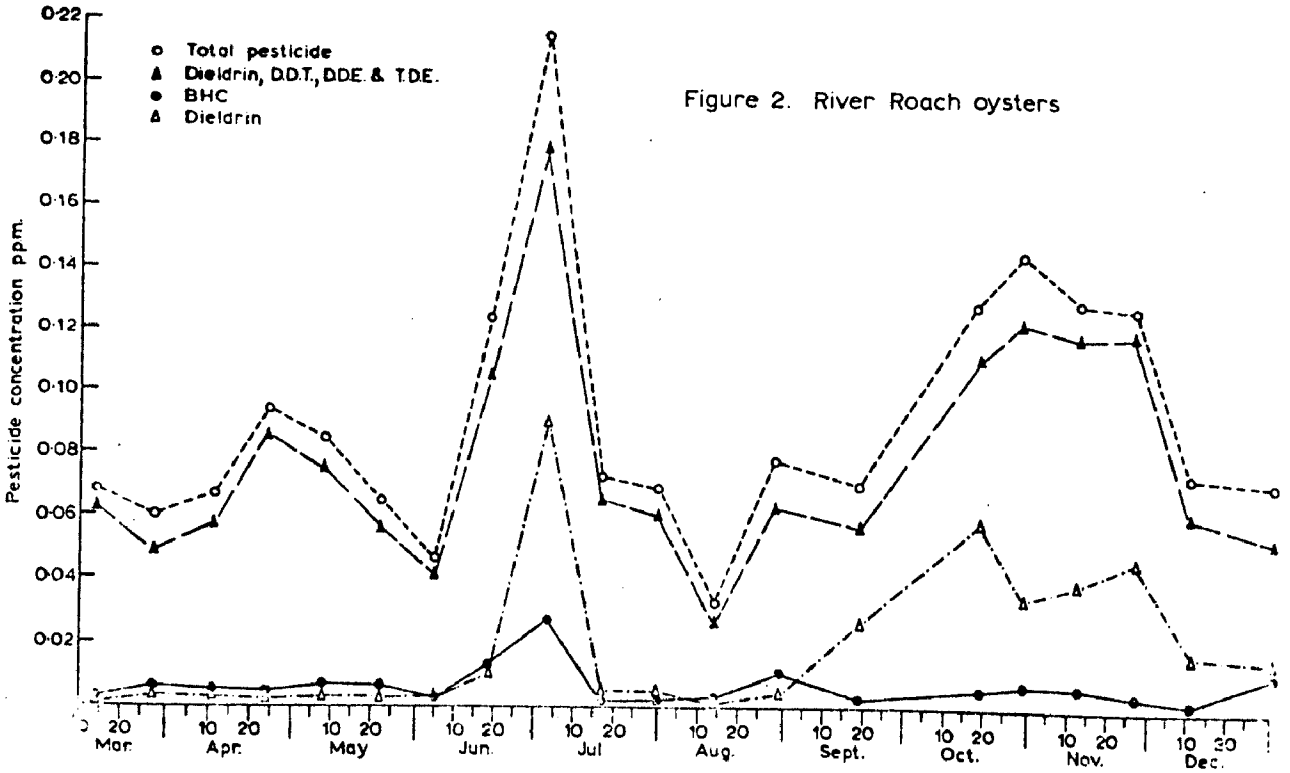
Location: Roach and Crouch Rivers estuaries, England

Analytical Technique: Electron capture gas chromatography

Analytical Data:

Connor, P. M. & J. E. Portmann. 1968.





REF. NO.: 76 - C - 1 **SUBSTANCES:** PCBs

Reference: Courtney, W. A. M. & G. R. W. Denton. 1976. Persistence of polychlorinated biphenyls in the hard clam (Mercenaria mercenaria) and the effect upon the distribution of these pollutants in the estuarine environment. Environ. Pollut. 10:55-64.

Organisms: Mercenaria mercenaria

Date of Sample Collection: 1976?

Location: Southampton, U.K.

Analytical Technique: gas-liquid chromatography; thin-layer chromatography

Analytical Data: $0.11 \pm .04$ parts/10^6 ww

REF. NO.: 76 - D - 1

SUBSTANCES: halogenated hydrocarbons

Reference: Dickson, A. G. & J. P Riley. 1976. The distribution of short-chain halogenated aliphatic hydrocarbons in some marine organisms. Mar. Pollut. Bull. 7:167-169.

Organisms: Modiolus modiolus
Pecten maximus

Date of Sample Collection: 1976?

Location: near Port Erin, Isle of Man, in the Irish Sea

Analytical Technique: gas chromatography

Analytical Data:

TABLE 1
Halogenated hydrocarbons in molluscs (ng g^{-1} on a dry (150°C) weight basis).

Species and organ	$CFCl_3$	CH_3I	$CHCl_3$	CCl_4	CCl_2:CHCl	CCl_2:CCl_2	CH_3CCl_3
Buccinum undatum							
Digestive gland	0.3	14	117	8	2	33	—
Muscle	—	—	129	5	—	39	—
Modiolus modiolus							
Digestive tissue	0.2	10	56	20	56	—	4
Mantle	4.4	188	438	114	250	63	—
Muscle	—	15	200	28	33	16	—
Pecten maximus							
Gill	0.5	24	1040	14		88	—
Mantle	1.4	3	224	2	—	40	—
Muscle	0.4	9	440	6	—	24	—
Ovary	1.2	3	720	16	—	—	—
Testis	0.4	4	448	3	—	176	—

* Detected but not measured.

REF. NO.: 72 - D - 1

SUBSTANCES: DDT, DDE, DDD

Reference: Dow, R. L. 1972. Pesticides in fish and shellfish. Maine Sea & Shore Fisheries, Res. Bull. 32:5p.

Organisms:

Mya arenaria
Mercenaria mercenaria
Mytilus edulis
Modiolus modiolus
Modiolus demissus plicatus
Crassostrea virginica
Placopecten magellanicus

Date of Sample Collection: 1965-69

Location: Maine

Analytical Technique: ?

Analytical Data:

Table 3

PESTICIDE ANALYSIS SUPPORT
BUREAU OF COMMERCIAL FISHERIES
PESTICIDE MONITORING PROGRAM

Chemical Analyses Supervised
By: Alfred J. Wilson, Jr.
BCF Biological Field Station
Gulf Breeze, Florida 32561

LABORATORY:
Fisheries Research Station
Department of Sea and Shore Fisheries
West Boothbay Harbor, Maine 04575

Verified by: [illegible]
Date: 6 August 19[illegible]

DATE d-m-y	DESCRIPTION	STATION LOCATION	PARTS PER MILLION DDM	DDD	DDT	TOTAL	OTHER
8-2-67	Lobster	Small Point	.029	--	tr	.029	--
21-6-68	Scallop	Small Point	.032	.012	--	.044	--
21-6-68	Starfish	Small Point	.028	.030	.050	.108	--
21-6-68	Lobster	Small Point	.25	.023	.041	.314	Dieldrin .011
21-6-68	Lobster	Small Point	.41	.065	.16	.635	Dieldrin .013
21-6-68	Green Crab	Small Point	.086	.020	.015	.121	--
21-6-68	Cancer Crab	Small Point	.099	.015	tr	.114	--
21-6-68	Horse Mussel	Small Point	.013	.013	.021	.045	--
21-6-68	Blue Mussel	Small Point	.013	.018	.020	.051	--
21-6-68	Polinices	Small Point	.044	.054	.068	.166	--
29-7-68	Mussel	Small Point	.035	.044	.28	.359	--
30-8-68	Mussel	Small Point	.021	.025	.077	.123	--
5-9-68	Starfish	Small Point	.019	.013	.038	.070	--
5-9-68	Lobster	Small Point	.50	.014	.032	.546	--
5-9-68	Scallop	Small Point	.017	--	--	.017	--
5-9-68	Cancer Crab	Small Point	.14	.026	.013	.179	--
5-9-68	Horse Mussel	Small Point	.011	.014	.022	.047	--
5-9-68	Green Crab	Small Point	.076	.011	.011	.098	--
5-9-68	Blue Mussel	Small Point	.017	.020	.068	.105	--
5-9-68	Lobster	Small Point	.41	.017	.071	.518	--

REF. NO.: 70 - D - 1

SUBSTANCES: PCBs (Aroclor 1254)

Reference: Duke, T. W., J. I. Lowe & A. J. Wilson Jr. 1970. A polychlorinated biphenyl (Aroclor 1254) in the water, sediment, and biota of Escambia Bay, Florida. Bull. Environ. Contam. Toxicol. 5:171-180.

Organisms: oysters (unspecified)

Date of Sample Collection: April - October 1969

Location: Escambia Bay, Florida

Analytical Technique: electron-capture gas chromatography

Analytical Data:

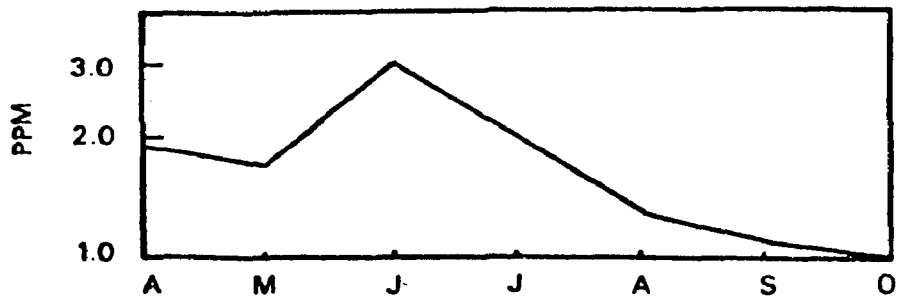


Figure 2B. Aroclor 1254 in live oysters from Escambia Bay (Station 5).

REF. NO.: 74 - D - 1

SUBSTANCES: BHC, HCH, DDT, DDE, DDD, PCBs

Reference: Duursma, E. K., M. Marchand & D. Vas. 1974. Chlorinated hydrocarbon residues in biota, sediments and water collected from the Ligurian Sea. In Activities of the International Laboratory of Marine Radioactivity, 1974 Report. IAEA, Vienna. pp. 138-156.

Organisms: *Mytilus galloprovincialis*

Date of Sample Collection: 1974?

Location: Ligurian Sea

Analytical Technique: gas chromatography

Analytical Data:

Table 47. Chlorinated hydrocarbons in mussels (*Mytilus galloprovincialis*) collected from the Ligurian Sea

St. No.	Location	Dry Tissue (ppb) α BHC	γ BHC (Lindane)	HCH	pp'DDT	pp'DDD	pp'DDE	Σ DDT	PCB	Σ DDT / PCB	Wet tissue (ppb) Σ DDT	Wet tissue (ppb) PCB
1	Sète(étang)	11	191	82	125	587	272	984	1753	0.56	285	508
2	Grau du Roi	11 (9-13)	14 (14-13)	10 (10-10)	140 (126-154)	101 (82-120)	14 (10-17)	255	2080 (2105-2055)	0.12	74	610
3	Port St.Louis	30 (28-31)	58 (52-63)	18 (18-18)	140 (188-91)	146 (148-145)	34 (32-36)	320	2111 (2039-2183)	0.16	84	557
4	Marseille	6	5	4	278	103	21	402	4580	0.09	93	1062
5	Cap de l'Aigle	4	15	T	274	9	13	296	1866	0.16	69	434
6	Cap Sicie	5 (3-6)	12 (9-14)	5	96 (109-82)	22 (30-13)	5	123	1313 (1329-1298)	0.09	28	296
7	Toulon	7 (9-4)	14 (12-15)	3 (6-T)	114	19	ND	133	2461 (2490-2432)	0.05	29	541
8	Cap Camarat	11 (8-13)	11 (8-14)	4 (3-5)	78 (41-116)	26 (10-42)	45 (21-68)	147	396 (372-415)	0.37	34	93
9	St. Tropez	8 (10-5)	13 (20-6)	2 (T-3)	136	56 (97-15)	29 (35-23)	221	746 (828-665)	0.30	49	164
10	St. Raphaël	11 (9-12)	4 (4-4)	32 (29-34)	177 (188-168)	172 (170-175)	21 (10-32)	370	2660 (2879-2320)	0.14	90	631
	Cannes	4	4	2	394	65	ND	459	1916	0.24	132	550
	Antibes	3	15	T	200	52	12	264	1179	0.22	61	273
	Golf Juan	12	6	5	246	179	31	456	1830	0.25	105	424
14	Genoa	8	10	5	618	87	73	778	445	1.76	223	127

Numbers in parenthesis represent analysis of two samples collected from same location. The reported value is the average of these two measurements rounded to the nearest whole number.

T = Trace
ND = Not detectable

Duursma, E. K. et al. 1974.

REF. NO.: 74 - E - 4 **SUBSTANCES:** DDT, DDD, DDE

Reference: Ernst, W., R. G. Schaefer, H. Goerke & G. Eder. 1974. Aufarbeitung von Meerestieren für die Bestimmung von PCB, DDT, DDD, γ-HCH und HCB. Z. Anal. Chem. 272:358-363.

Organisms: Chlamys opercularis

Date of Sample Collection: 1974?

Location: North Sea ?

Analytical Technique: Gas chromatography- mass spectrometry

Analytical Data:

Tabelle 1. Extraktionsausbeuten für DDT, Σ DDT und PCB bei verschiedenen Tierarten und Organen

Substanz	Tierart	Organ	Einwaage (g)	Substanzgehalt (ppm)	Extraktionsausbeute (%)
DDT-^{14}C (oral appliziert)	Scholle, *Pleuronectes platessa* (Pisces)	Leber	0,6	0,26	100
	Scholle, *Pleuronectes platessa* (Pisces)	Skelettmuskulatur	2	0,065	97
	Scholle, *Pleuronectes platessa* (Pisces)	Skelettmuskulatur	6	0,013	98
DDT-^{14}C (zugesetzt)	Kabeljau, *Gadus morhua* (Pisces)	Leber	2	0,31	99
	Hering, *Clupea harengus* (Pisces)	Skelettmuskulatur	4	0,22	96
	Blauleng, *Molva dipterygia dipterygia* (Pisces)	Skelettmuskulatur	2	0,12	99
Σ DDT-^{14}C (24% DDT-^{14}C, 18% DDD-^{14}C, 58% DDE-^{14}C) (zugesetzt)	Pilgermuschel, *Chlamys opercularis* (Bivalvia)	Weichkörper	4	0,28	98
	Seemaus, *Aphrodite aculeata* (Polychaeta)	mittlerer Körperabschnitt	4	0,28	100
	Tiefseegarnele, *Pandulus borealis* (Crustacea)	Abdominalmuskulatur	4	0,28	99
	Andromedastern, *Psilaster andromeda* (Asteroidea)	Arm + Mundscheibensektor	4	0,28	100
	Bastardmakrele, *Trachurus trachurus* (Pisces)	Leber	4	0,28	99
	Bastardmakrele, *Trachurus trachurus* (Pisces)	Skelettmuskulatur	4	0,28	99
PCB[a] (oral appliziert)	Seezunge, *Solea solea* (Pisces)	Skelettmuskulatur	2	1,4	98
PCB[a] („natürlich" enthalten)	Kabeljau, *Gadus morhua* (Pisces)	Leber	2,3	3,0	98
	Kabeljau, *Gadus morhua* (Pisces)	Leber	2	3,7	97

[a] als Clophen A 60 berechnet.

Ernst, W. et al. 1974.

Tabelle 3. Wiederfindung von zugesetztem Chlorkohlenwasserstoff bei verschiedenen Tierarten und Organen nach dem gesamten Aufarbeitungsgang

Substanz	Tierart	Organ	Einwaage (g)	Substanzgehalt (ppm)	Wiederfindung (%)			
					HCB	γ-HCH	DDE	DDT + DDD
Σ DDT-^{14}C (24% DDT-^{14}C, 18% DDD-^{14}C, 58% DDE-^{14}C)	Pilgermuschel, *Chlamys opercularis* (Bivalvia)	Weichkörper	4	0,28			100	95
	Seemaus, *Aphrodite aculeata* (Polychaeta)	Vorderhälfte	4	0,28			99	100
	Tiefseegarnele, *Pandalus borealis* (Crustacea)	Abdominalmuskulatur	4	0,28			100	97
	Andromedastern, *Psilaster andromeda* (Asteroidea)	Arm + Mundscheibensektor	4	0,28			100	98
	Bastardmakrele, *Trachurus trachurus* (Pisces)	Leber	4	0,28			100	98
	Bastardmakrele, *Trachurus trachurus* (Pisces)	Skelettmuskulatur	4	0,28			99	100
DDE-^{14}C	Glattbutt, *Scophthalmus rhombus* (Pisces)	Leber	2	0,1			97	
	Scholle, *Pleuronectes platessa* (Pisces)	Leber	2	0,1			98	
HCB	Kabeljau, *Gadus morhua* (Pisces)	Leber	2	0,4	87			
	Kabeljau, *Gadus morhua* (Pisces)	Skelettmuskulatur	4	0,2	79			
γ-HCH	Kabeljau, *Gadus morhua* (Pisces)	Leber	2	0,4		102		
	Kabeljau, *Gadus morhua* (Pisces)	Skelettmuskulatur	4	0,2		92		

REF. NO.: 76 - E - 2

SUBSTANCES: PCB, DDT, DDD, DDE

Reference: Ernst, W., H. Goerke, G. Eder & R. G. Schaefer. 1976. Residues of chlorinated hydrocarbons in marine organisms in relation to size and ecological parameters. I. PCB, DDT, DDE, and DDD in fishes and molluscs from the English Channel. Bull. Envir. Contam. Toxicol. 15:55-65.

Organisms: Chlamys opercularis

Date of Sample Collection: 1971

Location: English Channel

Analytical Technique: Gas chromatography - mass spectrometry

Analytical Data:

TABLE 4

Residue concentrations in digestive gland (DG), adductor muscle (AM) and mantle musculature (MM) of pooled molluscs. Values are averaged from two analyses except when indicated by [a]. w: ppm - wet weight; l: ppm - lipid weight; nd: not detected, detection limit 0.0005 ppm

Species	Average wet weight[b] (g)	Tissue and no. of animals		Lipid (%)	Residue concentration (µg/g)										PCB[c]/ΣDDT
					PCB		DDE		DDD		DDT		ΣDDT[c]		
					w	l	w	l	w	l	w	l	w	l	
Chlamys opercularis[a]	1.9	DG	13	3.6	0.069	1.9	0.009	0.25	0.010	0.28	0.025	0.70	0.044	1.2	1.6
	4.5	DG	16	8.9	0.24	2.7	0.043	0.48	0.006	0.070	0.023	0.25	0.071	0.81	3.4
	7.5	DG	11	9.6	0.11	1.2	0.017	0.18	0.033	0.34	0.035	0.37	0.086	0.89	1.3
	10.4	DG	6	9.1	0.20	2.2	0.042	0.46	0.009	0.97	0.026	0.29	0.077	0.85	2.7
Chlamys opercularis	1.9	AM	13	0.13	0.022	17	0.001	0.53	nd	nd	0.006	4.3	0.007	5.0	3.4
	4.5	AM	16	0.34	0.030	9.0	0.001	0.42	nd	nd	0.001	0.30	0.003	0.84	11
	7.5	AM	11	0.17	0.048	29	0.002	1.4	0.001	0.78	0.003	1.7	0.007	3.9	7.4
	10.4	AM	6	0.16	0.035	22	0.002	1.1	nd	nd	0.001	0.81	0.003	2.1	11
Loligo forbesi	260	MM	4	1.2	0.18	15	0.012	0.99	0.012	1.0	0.035	2.9	0.059	4.9	3.1
	365	MM	4	1.0	0.17	17	0.012	1.1	0.002	0.23	0.014	1.4	0.029	2.7	6.0
	533	MM	4	1.1	0.10	9.1	0.005	0.47	0.001	0.13	0.007	0.66	0.014	1.3	7.3
	1030	MM	2	1.2	0.11	8.9	0.006	0.49	0.003	0.25	0.013	1.1	0.021	1.8	4.9
	1420	MM	1	0.91	0.083	9.0	0.004	0.47	0.001	0.09	0.007	0.76	0.012	1.3	6.8

[a] Single analysis.
[b] Soft parts in the case of *Chlamys opercularis*.
[c] Calculated before rounding of figures.

REF. NO.: 72 - F - 1 **SUBSTANCES:** DDD, DDE

Reference: Fay, R. R. & L. W. Newland. 1972. Organochlorine insecticide residues in water, sediment, and organisms, Aransas Bay, Texas - September 1969-June 1970. Pest. Monit. J. 6:97-102.

Organisms: Crassostrea virginica

Date of Sample Collection: 1970

Location: Aransas Bay, Texas

Analytical Technique: Gas-liquid chromatography

Analytical Data:

TABLE 4.—*Organochlorine residues in organisms, Aransas Bay, Texas—1969-70*
[T = Trace = <0.1 ppb; — = not detected]

Collection Date	Type of Sample	Sampling Location	Residues Detected in ppb (ng/g)
1969 July	2nd year, sea trout (muscle)	St. Chas. Bay	dieldrin (3.4) *p,p'*-DDE (25.5) *p,p'*-DDD (2.1) *p,p'*-DDT (5.5)
	2nd year, drum (whole)	St. Chas. Bay	dieldrin (9.7) *p,p'*-DDE (3.6) *p,p'*-DDT (2.1)
1970 Jan.	oysters	A-1	*p,p'*-DDE (5.9) *p,p'*-DDD (T)
Mar.	blue crab (muscle)	Aransas Bay	*p,p'*-DDE (7.8) *p,p'*-DDD (T)
	blue crab (viscera)	Aransas Bay	—
	blue crab (eggs)	Aransas Bay	—
	silverside minnows	Aransas Bay	*p,p'*-DDE (33.3) *p,p'*-DDD (30.0) dieldrin (13.3)
	yellowtail croaker	Aransas Bay	*p,p'*-DDE (66.5) *p,p'*-DDD (60.0) *p,p'*-DDT (T)
	ribbon fish	Aransas Bay	*p,p'*-DDE (33.6) *p,p'*-DDD (41.0)
	brown shrimp	Aransas Bay	—
	yellowtail croaker	Aransas Bay	*p,p'*-DDE (25.0) *p,p'*-DDD (T)

REF. NO.: 71 - F - 1

SUBSTANCES: DDT, DDE, DDD
dieldrin

Reference: Foehrenbach, J.,G. Mahmood & D. Sullivan. 1971. Chlorinated hydrocarbon residues in shellfish (Pelecypoda) from estuaries of Long Island, New York. Pest. Monit. J. 5:242-247.

Organisms: *Mercenaria mercenaria*
Mytilus edulis
Crassostrea virginica
Mya arenaria
Brachidontes demissus plicatulus
Aequipecten irradians

Date of Sample Collection: 1968-70

Location: Long Island, New York

Analytical Technique: Electron-capture gas chromatography; thin-layer gas chromatography

Analytical Data: (wet wt)

Foehrenbach, J. et al. 1971.

TABLE 1.—*DDT concentrations in shellfish, October 1968-July 1970*

[— = <0.007 mg/kg; T = trace = >0.007 mg/kg but <0.010 mg/kg]

Date	Residues in mg/kg (wet weight)									
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10
Oct. 1968	0.012	—	—	—	— (Oys.)	—	—	—	—	—
Nov. 1968	—	—	—	—	— (Oys.)	—	—	—	—	—
Dec. 1968	—	—	—	—	— (Oys.)	—	—	T	—	—
Jan. 1969	T	—	—	—	T (Oys.)	—	—	—	—	—
Feb. 1969	0.012	—	—	—	T (Oys.)	—	—	T	—	0.014
Mar. 1969	T	—	—	—	— (Oys.)	—	0.019	0.010	—	0.043 (B. mus.)
Apr. 1969	0.038	—	—	—	T (Oys.)	0.045 (R. mus.)	0.060 (B. mus.)	0.034 (B. mus.)	0.026 (B. mus.)	0.043 (B. mus.)
May 1969	0.033	—	—	0.021 (B. mus.)	0.024 (S. clam)	—	0.032 (B. mus.)	0.021	0.032 (B. mus.)	0.012
June 1969	T	—	—	—	0.010 (S. clam)	—	0.048 (R. mus.)	0.046 (R. mus.)	—	T
July 1969	—	—	—	—	— (S. clam)	—	0.020 (S. clam)	0.050 (B. mus.)	T	T
Aug. 1969	—	—	—	0.12 (B. mus.)	— (S. clam)	—	— (S. clam)	—	—	—
Sept. 1969	—	—	—	T (B. mus.)	— (S. clam)	0.075 (R. mus.)	T– (S. clam)	0.047 (B. mus.)	—	0.074 (B. mus.)
Oct. 1969	0.012	—	0.024	T (B. mus.)	— (S. clam)	—	0.015 (B. mus.)	0.028 (B. mus.)	0.017 (Oys.)	0.049 (S. clam)
Nov. 1969		— (Oys.)	— (B. sc.)	— (S. clam)	— (S. clam)	— (B. sc.)	0.026 (B. mus.)	0.055 (B. mus.)	—	0.047 (S. clam)
Dec. 1969	0.043	—	—	0.022 (B. mus.)		—	0.017 (B. mus.)	0.050 (B. mus.)	—	0.046 (S. clam)
Jan. 1970	—	—		— (B. mus.)				0.061 (B. mus.)		0.076 (S. clam)
Feb. 1970		—	—	— (S. clam)	0.052 (S. clam)		0.025 (B. mus.)	0.040 (B. mus.)	0.020 (Oys.)	0.015
Mar. 1970	0.011	—	T	— (S. clam)	0.049 (S. clam)	—	0.036 (B. mus.)	0.049 (B. mus.)	0.011 (S. clam)	0.062 (S. clam)
Apr. 1970	0.040	—	—	— (S. clam)	0.010 (Oys.)	0.012 (R. mus.)	— (B. mus.)	0.012 (B. mus.)	—	0.029 (S. clam)
May 1970		—	—	T (S. clam)	— (Oys.)	—	0.036 (B. mus.)	0.040 (B. mus.)	0.034 (B. mus.)	0.054 (S. clam)
June 1970		T	—	0.021 (B. mus.)	0.032 (B. mus.)	— (S. clam)	0.029 (B. mus.)	0.040 (B. mus.)	T	0.070 (B. mus.)
July 1970		0.01	0.011 (S. clam)	0.024 (B. mus.)	T (Oys.)	T (S. clam)	0.028 (B. mus.)	0.055 (B. mus.)	0.024 (B. mus.)	0.017

NOTE: All species are the hard clam except those indicated in parentheses as follows:

B. mus. = Blue mussel – Mytilus edulis
Oys. = Oyster – Crassostrea virginica
S. clam = Soft clam – Mya arenaria
R. mus. = Ribbed mussel – Brachidontes demissus plicatulus
B. sc. = Bay scallop – Aequipecten irradians

Foehrenbach, J. et al. 1971.

TABLE 2.—*DDD concentrations in shellfish, October 1968-July 1970*

[— = <0.007 mg/kg; T = trace = >0.007 mg/kg but <0.010 mg/kg]

Date	Residues in mg/kg (wet weight)									
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10
Oct. 1968	0.018	—	—	T	0.031 (Oys.)	0.033	—	0.036	0.011	0.029
Nov. 1968	0.016	0.017	—	—	0.026 (Oys.)	0.039	—	0.022	—	—
Dec. 1968	0.014	0.012	0.011	T	0.023 (Oys.)	0.033	T	0.044	—	0.024
Jan. 1969	0.021	T	0.010	T	0.031 (Oys.)	0.027	T	—	—	0.018
Feb. 1969	0.030	0.013	0.024	0.017	0.047 (Oys.)	0.044	0.012	0.037	0.016	0.036 (B. mus.)
Mar. 1969	0.018	—	0.013	—	0.021 (Oys.)	0.040	—	0.038	0.012	0.035
Apr. 1969	0.015	T	0.013	0.016	0.043 (Oys.)	0.067 (R.mus.)	0.025 (B.mus.)	0.039 (B.mus.)	0.027 (B.mus.)	0.033 (B.mus.)
May 1969	0.028	—	0.013	0.038 (B.mus.)	0.031 (S. clam)	0.033	0.024 (B.mus)	0.024	0.028 (B.mus.)	0.018
June 1969	0.013	—	—	T	0.029 (S. clam)	0.028	0.036 (R.mus.)	0.104	0.011 (R.mus.)	0.019
July 1969	0.018	—	T	T	0.021 (S. clam)	0.019	0.022 (S. clam)	0.100 (B.mus.)	0.015	0.022
Aug. 1969	0.019	—	T	0.021 (B.mus.)	0.010 (S. clam)	0.023	0.020 (S. clam)	0.023	—	0.010
Sept. 1969	0.014	T	—	0.020 (B.mus.)	0.010 (S. clam)	0.049 (R.mus.)	0.014 (S. clam)	0.127 (B.mus.)	—	0.093 (B.mus.)
Oct. 1969	0.021	T	—	0.016 (B.mus.)	— (S. clam)	T	0.029 (B.mus.)	0.073 (B.mus.)	0.055 (Oys.)	0.062 (S. clam)
Nov. 1969	—	0.024 (Oys.)	0.012 (B. sc.)	— (S. clam)	0.023 (S. clam)	0.020 (B. sc.)	0.039 (B.mus.)	0.084	0.013	0.057 (S. clam)
Dec. 1969	0.021	0.013	T	0.024 (B.mus.)		0.028	0.036 (B.mus.)	0.080 (B.mus.)	T	0.057 (S. clam)
Jan. 1970	0.013	T		0.018 (B.mus.)				0.090		0.071 (S. clam)
Feb. 1970		0.013	T	0.013 (S. clam)	0.027 (S. clam)		0.037 (B.mus.)	0.058 (B.mus.)	0.052 (Oys.)	0.033
Mar. 1970	0.020	0.011	0.013	T (S. clam)	0.027 (S. clam)	0.026	0.037 (B.mus.)	0.060 (B.mus.)	0.019 (S. clam)	0.051 (S. clam)
Apr. 1970	0.019	—	—	— (S. clam)	0.014 (Oys.)	0.022 (R.mus.)	0.011 (B.mus.)	0.022 (B.mus.)	—	0.028 (S. clam)
May 1970		T	0.014	0.019 (S. clam)	0.045 (Oys.)	0.030	0.049 (B.mus.)	0.050 (B.mus.)	0.044 (B.mus.)	0.033 (S. clam)
June 1970		0.016	0.020	0.034 (B.mus.)	0.036 (B.mus.)	0.029 (S. clam)	0.045 (B.mus.)	0.059 (B.mus.)	0.016	0.048 (B. mus.)
July 1970		T	0.021 (S. clam)	0.018 (B.mus.)	0.025 (Oys.)	0.029 (S. clam)	0.059 (B.mus.)	0.146 (B.mus.)	0.037 (B.mus.)	0.022

NOTE: All species are the hard clam except those indicated in parentheses as follows:

B. mus. = Blue mussel
Oys. = Oyster
S. clam = Soft clam
R. mus. = Ribbed mussel
B. sc. = Bay scallop

Foehrenbach, J. et al. 1971.

TABLE 3.—*DDE concentrations in shellfish, October 1968-July 1970*

[— = <0.007 mg/kg; T = trace = >0.007 mg/kg but <0.010 mg/kg]

Date	Residues in mg/kg (wet weight)									
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10
Oct. 1968	0.102	—	—	—	0.036 (Oys.)	0.015	0.015	0.013	—	—
Nov. 1968	—	T	—	—	0.033 (Oys.)	0.015	—	T	—	—
Dec. 1968	T	—	T	—	0.033 (Oys.)	0.014	—	0.015	—	—
Jan. 1969	T	—	—	—	0.032 (Oys.)	0.012	—	—	—	—
Feb. 1969	0.010	—	0.010	T	0.027 (Oys.)	0.018	—	0.013	T	0.010 (S. clam)
Mar. 1969	—	—	—	—	0.019 (Oys.)	0.016	—	0.014	T	0.014
Apr. 1969	—	—	T	0.011	0.037 (Oys.)	0.029 (R. mus.)	0.012	0.018 (B. mus.)	0.013 (B. mus.)	0.013 (B. mus.)
May 1969	0.011	—	—	0.020 (B. mus.)	0.020 (S. clam)	0.015	0.015 (B. mus)	T	0.024 (B. mus.)	0.018
June 1969	—	—	—	—	0.021 (S. clam)	0.014	0.016 (R. mus.)	0.030	— (R. mus.)	0.015
July 1969	—	—	—	—	0.019 (S. clam)	0.010	0.018 (S. clam)	0.029 (B. mus.)	—	T
Aug. 1969	—	—	—	0.012 (B. mus.)	T (S. clam)	0.021	0.014 (S. clam)	0.015	—	—
Sept. 1969	—	—	—	0.014 (B. mus.)	0.010 (S. clam)	0.020 (R. mus.)	0.013 (S. clam)	0.034 (B. mus.)	—	0.034 (B. mus.)
Oct. 1969	—	—	—	0.010 (B. mus.)	— (S. clam)	—	0.017 (B. mus.)	0.024 (B. mus.)	0.027 (Oys.)	0.030 (S. clam)
Nov. 1969		0.011 (Oys.)	T (B. sc.)	— (S. clam)	0.012 (S. clam)	0.013 (B. sc.)	0.023 (B. mus.)	0.028 (B. mus.)	T	0.023 (S. clam)
Dec. 1969	0.010	T	—	0.013 (B. mus.)		0.013	0.021 (B. mus.)	0.030 (B. mus.)	—	0.026 (S. clam)
Jan. 1970	—	—		0.011 (B. mus.)				0.038 (B. mus.)		0.041 (S. clam)
Feb. 1970		—	—	— (S. clam)	0.019 (S. clam)		0.017 (B. mus.)	0.015 (B. mus.)	0.027 (Oys.)	0.011
Mar. 1970	T	—	T	— (S. clam)	0.021 (S. clam)	0.014	0.022 (B. mus.)	0.023 (B. mus.)	0.010 (S. clam)	0.024 (S. clam)
Apr. 1970	—	—	—	— (S. clam)	0.016 (Oys.)	T (R. mus)	— (B. mus.)	— (B. mus.)	— (B. mus.)	0.013 (S. clam)
May 1970		—	T	0.010 (S. clam)	0.032 (Oys.)	0.013	0.025 (B. mus.)	0.020 (B. mus.)	0.024 (B. mus.)	0.012 (S. clam)
June 1970		T	T	0.018 (B. mus.)	0.016 (B. mus.)	0.014 (S. clam)	0.021 (B. mus.)	0.013 (B. mus.)	T	0.018 (B. mus.)
July 1970		—	T (S. clam)	0.010 (B. mus.)	0.021 (Oys.)	0.014 (S. clam)	0.024 (B. mus.)	0.021 (B. mus.)	0.016 (B. mus.)	0.010

NOTE: All species are the hard clam except those indicated in parentheses as follows:

B. mus. = Blue mussel
Oys. = Oyster
S. clam = Soft clam
R. mus. = Ribbed mussel
B. sc. = Bay scallop

Foehrenbach, J. et al. 1971.

TABLE 4.—*Dieldrin concentrations in shellfish, October 1968-July 1970*

[— = <0.007 mg/kg; T = trace = >0.007 mg/kg but <0.010 mg/kg]

Date	Residues in mg/kg (wet weight)									
	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8	Station 9	Station 10
Oct. 1968	—	—	—	—	0.053	—	—	—	—	0.020 (B. sc.)
Nov. 1968										
Dec. 1968	—	—	—	—	— (Oys.)	—	—	T	—	0.048
Jan. 1969	—	—	—	—	— (Oys.)	—	—	—	—	0.037
Feb. 1969	—	—	—	—	— (Oys.)	—	T	—	T	0.028
Mar. 1969	—	0.012	T	0.010	— (Oys.)	—	0.019	0.033	0.015	0.022 (B. mus.)
Apr. 1969	0.014	—	0.020	T	T (Oys.)	0.032 (R. mus.)	0.024 (B. mus.)	0.024 (B. mus.)	0.030 (B. mus.)	0.054 (B. mus.)
May 1969	T	—	—	0.014 (B. mus.)	0.012 (S. clam)	0.017	0.015 (B. mus.)	0.014	0.024 (B. mus.)	0.085
June 1969	T	—	—	T	— (S. clam)	0.107	— (R. mus.)	0.104 (R. mus.)	0.086	0.013
July 1969	0.018	—	—	—	— (S. clam)	0.011	T (S. clam)	0.026 (B. mus.)	0.016	0.033
Aug. 1969	0.017	—	—	— (B. mus.)	0.022 (S. clam)	—	— (S. clam)	T	—	0.038
Sept. 1969	0.020	0.059	—	T (B. mus.)	— (S. clam)	0.014 (R. mus.)	0.015 (S. clam)	0.018 (B. mus.)	0.017	0.132 (B. mus.)
Oct. 1969	0.012	—	—	0.046 (B. mus.)	— (S. clam)	0.093	0.026 (B. mus.)	— (B. mus.)	— (B. mus.)	0.028 (S. clam)
Nov. 1969	—	0.019 (Oys.)	0.026 (B. sc.)	— (S. clam)	— (S. clam)	— (S. clam)	0.018 (B. mus.)	0.023 (B. mus.)	0.015	0.040 (S. clam)
Dec. 1969	0.017	0.012	—	— (B. mus.)		—	0.013 (B. mus.)	0.031 (B. mus.)	0.018	0.031 (S. clam)
Jan. 1970	—	—		0.014 (B. mus.)				0.018 (B. mus.)		0.029 (S. clam)
Feb. 1970		T	—	— (S. clam)	— (S. clam)		0.016 (B. mus.)	0.016 (B. mus.)	0.031 (Oys.)	0.030
Mar. 1970	0.014	—	—	0.012 (S. clam)	— (S. clam)	0.011	0.019 (B. mus.)	0.017 (B. mus.)	0.012 (S. clam)	0.030 (S. clam)
Apr. 1970	T	—	—	— (S. clam)	— (Oys.)	— (R. mus.)	0.020 (B. mus.)	0.038 (B. mus.)	0.037	0.025 (S. clam)
May 1970		—	—	— (S. clam)	T (Oys.)	—	0.026 (B. mus.)	0.022 (B. mus.)	0.023 (B. mus.)	0.030 (S. clam)
June 1970		T	T	0.012 (B. mus.)	0.010 (B. mus.)	— (S. clam)	0.020 (B. mus.)	0.021 (B. mus.)	0.011	0.033 (B. mus.)
July 1970		—	— (S. clam)	T (B. mus.)	— (Oys.)	T (S. clam)	0.023 (B. mus.)	0.026 (B. mus.)	0.019 (B. mus.)	0.020

NOTE: All species are the hard clam except those indicated in parentheses as follows:

B. mus. = Blue mussel
Oys. = Oyster
S.clam = Soft clam
R. mus. = Ribbed mussel
B. sc. = Bay scallop

REF. NO.: 72 - F - 2

SUBSTANCES: DDT, DDE, DDD
dieldrin

Reference: Foehrenbach, J. 1972. Chlorinated pesticides in estuarine organisms. J. Wat. Poll. Cont. Fed. 44:619-624.

Organisms: *Mercenaria mercenaria*, *Crassostrea virginica*, *Mytilus edulis*, *Mya arenaria*, *Brachidontes demissus plicatulus*, *Aequipecten irradians*, *Ensis directus*

Date of Sample Collection: 1968-70

Location: Long Island, New York

Analytical Technique: Electron-capture gas chromatography; thin-layer gas chromatography

Analytical Data:

TABLE I.—DDT + DDD + DDE Residues in Shellfish

Date	Residue in Shellfish at Given Sampling Station (mg/kg wet weight organic tissue)									
	1	2	3	4	5	6	7	8	9	10
October 1968	0.047	0.005	0.000	0.013	0.066*	0.048	0.020	0.019	0.016	0.032
November 1968	0.022	0.031	0.000	0.000	0.059*	0.054	0.000	0.030	0.000	0.008
December 1968	0.022	0.017	0.019	0.013	0.053*	0.017	0.013	0.068	0.009	0.034
January 1969	0.115	0.014	0.015	0.012	0.072*	0.037	0.011	0.005	0.000	0.030
February 1969	0.052	0.019	0.036	0.026	0.083*	0.064	0.024	0.058	0.023	0.060
March 1969	0.032	0.008	0.019	0.012	0.040*	0.060	0.019	0.062	0.019	0.092†
April 1969	0.059	0.014	0.022	0.027	0.088*	0.142‡	0.097†	0.091†	0.066†	0.039†
May 1969	0.072	0.000	0.019	0.079†	0.075§	0.048	0.071†	0.054	0.084†	0.048
June 1969	0.020	0.007	0.010	0.010	0.060§	0.042	0.100‡	0.180‡	0.011	0.043
July 1969	0.022	0.008	0.011	0.013	0.040§	0.029	0.060§	0.179†	0.028	0.037
August 1969	0.024	0.009	0.011	0.045†	0.017§	0.035	0.034§	0.038	0.000	0.015
September 1969	0.019	0.012	0.003	0.043†	0.020§	0.144‡	0.035§	0.208†	0.000	0.201†
October 1969	0.039	0.010	0.031	0.036†	0.010§	0.013	0.061†	0.125†	0.099*	0.141§
November 1969	—	0.035†	0.020#	0.010§	0.035§	0.033#	0.088†	0.167†	0.020	0.127§
December 1969	0.073	0.021	0.014	0.059†	—	0.041	0.074†	0.160†	0.013	0.129§
January 1970	0.019	0.015	—	0.029†	—	—	—	0.182†	—	0.188§
February 1970	—	0.019	0.011	0.019§	0.098§	—	0.079†	0.113†	0.099*	0.059
March 1970	0.040	0.017	0.027	0.015§	0.097§	0.040	0.095†	0.132†	0.040§	0.137§
April 1970	0.064	0.000	0.000	0.000§	0.040*	0.051‡	0.016†	0.040†	0.000	0.070§
May 1970	—	0.012	0.022	0.036§	0.083*	0.043	0.110†	0.110†	0.099†	0.099§
June 1970	—	0.032	0.034	0.073†	0.084†	0.043§	0.095†	0.112†	0.033	0.136†
July 1970	—	0.023	0.041§	0.052†	0.053*	0.050§	0.111†	0.222†	0.077†	0.085

All samples were hard clam except those designated by footnote as follows:
* Oyster.
† Blue mussel.
‡ Ribbed mussel.
§ Soft clam.
# Bay scallop.

Foehrenbach, J. 1972.

TABLE II.—Dieldrin Residues in Shellfish

Date	Residue in Shellfish at Given Station (mg/kg wet weight organic tissue)									
	1	2	3	4	5	6	7	8	9	10
December 1968	0.006	0.000	0.000	0.000	0.000*	0.000	0.004	0.007	0.006	0.048
January 1969	0.011	0.004	0.000	0.002	0.000*	0.000	0.004	0.008	0.004	0.037
February 1969	0.004	0.000	0.000	0.000	0.000*	0.000	0.008	0.006	0.008	0.028
March 1969	0.004	0.012	0.007	0.010	0.000*	0.006	0.019	0.032	0.015	0.022†
April 1969	0.014	0.016	0.024	0.008	0.009*	0.032‡	0.024†	0.024†	0.030	0.051†
May 1969	0.007	0.000	0.000	0.014†	0.012§	0.017	0.015†	0.014	0.024†	0.085
June 1969	0.007	0.000	0.004	0.007	0.005§	0.107	0.000‡	0.104‡	0.086	0.013
July 1969	0.018	0.005	0.006	0.005	0.000§	0.011	0.009§	0.026†	0.016	0.033
August 1969	0.017	0.005	0.005	0.006†	0.022§	0.003	0.005§	0.008	0.005	0.038
September 1969	0.020	0.059	0.003	0.007†	0.005§	0.014‡	0.015§	0.018†	0.017	0.132†
October 1969	0.012	0.004	0.005	0.046†	0.000§	0.093	0.026†	0.000†	0.004*	0.028§
November 1969	—	0.019*	0.026#	0.003§	0.004§	0.006#	0.018†	0.023†	0.015	0.040§
December 1969	0.017	0.016	0.005	0.006†	—	0.006	0.013†	0.034†	0.018	0.031§
January 1970	0.004	0.000	—	0.014†	—	—	—	0.018†	—	0.029§
February 1970	—	0.007	0.004	0.004§	0.006§	—	0.016†	0.016†	0.031*	0.030
March 1970	0.014	0.006	0.005	0.012§	0.005§	0.011	0.019†	0.017†	0.012§	0.030§
April 1970	0.009	0.004	0.005	0.004§	0.005*	0.004‡	0.020†	0.038†	0.037	0.025§
May 1970	—	0.004	0.006	0.005§	0.007*	0.006	0.026†	0.022†	0.023†	0.030§
June 1970	—	0.007	0.007	0.012†	0.010†	0.006§	0.020†	0.021†	0.011	0.033†
July 1970	—	0.004	0.004§	0.007†	0.005*	0.007§	0.023†	0.026†	0.019†	0.019

All samples were hard clam except those designated by footnote as follows:
* Oyster.
† Blue mussel.
‡ Ribbed mussel.
§ Soft clam.
# Bay scallop.

TABLE III.—Residues in Fish and Other Marine Organisms

Date	Sample*	Station	Concentration of DDT, DDD, and DDE (mg/kg)	Concentration of Dieldrin (mg/kg)
7-9-69	Atlantic mackerel	7	0.177	0.050
8-4-69	Menhaden	6	0.343	0.019
10-1-69	Northern lobster	7	0.216	0.012
4-7-70	Razor clam	4	0.029	0.004
5-29-70	Mud snail	1	0.076	0.011
6-30-70	Oyster toadfish	1	0.123	0.012
7-27-70	Grass shrimp	1	0.061	0.236
7-27-70	Winter flounder	1	0.059	0.043
8-12-70	Blue claw crab	6	0.083	0.008
8-12-70	Blue claw crab	5	0.136	0.013
9-12-70	Bluefish	6	0.199	0.012
9-24-70	Blue claw crab	1	0.088	0.028
9-15-70	Fiddler crab	4	0.083	0.015
9-24-70	Blue claw crab	3	0.010	0.004
9-25-70	Fiddler crab	9	0.081	0.015
9-14-70	White perch	5	1.990	0.025
9-10-70	Menhaden (head and body cavity contents)	10	2.330	0.130
9-10-70	Menhaden (body)	10	1.530	0.450

* Mackerel —*Scomber scombrus*
Menhaden —*Brevoortia tyrannus*
Lobster —*Homarus americanus*
Razor clam —*Ensis directus*
Snail —*Nassarius obsoletus*
Fiddler crab —*Uca* sps.
Oyster toadfish—*Opsanus tau*
Shrimp —*Palaemonetes vulgaris*
Flounder —*Pseudopleuronectes americanus*
Blue claw crab —*Callinectes sapidus*
Bluefish —*Pomatomus saltatrix*
White perch —*Roccus americanus*

REF. NO.: 68 - G - 1

SUBSTANCES: DDE, DDD, DDT, chlordane, endrin

Reference: Godsil, P. J. & W. C. Johnson. 1968. Pesticide monitoring of the aquatic biota at the Tule Lake National Wildlife Refuge. Pest. Monit. J. 1:21-26.

Organisms: Gonidea sp.

Date of Sample Collection: 1965-67

Location: Tule Lake National Wildlife Refuge, Oregon

Analytical Technique: Gas chromatography

Analytical Data:

TABLE 5.—*Chlorinated hydrocarbon pesticides in largemouth bass and clams held in cages at Pump B*

[— = Results below analytical sensitivity]

	Clams					
GROUP I						
12/14/65	0	5	2.5	4	25	—
12/28/65	14	4	2	2	8	1.7
1/28/66	45	3	2.5	5	5	3.5
3/04/66	80	3	2.25	2	6	—
3/30/66	106	2	1	1	—	2.5
GROUP II						
3/30/66	0	5	1	—	—	—
5/02/66	33	5	1.5	3	4	—
6/22/66	84	5	2	2	4	2
7/14/66	106	5	2	4	3	—
8/16/66	139	4	—	—	2	2.5
8/30/66	153	5	0.75	—	—	90
9/16/66	170	5	—	—	3	18
9/30/66	184	5	—	—	6	14
10/13/66	197	5	3	2	—	12.6
11/16/66	231	5	6.3	2.0/3.0	3	7
1/10/67	255	5	2.4	2.3	5.1	5.9

[1] Single values represent a total response, i.e., where DDD and DDT could not be separated.

TABLE 4.—*Chlorinated hydrocarbon pesticides contained in the biota at Pump B*

[— = Results below analytical sensitivity]

	Clams			
8/10/65	4.0	4.0	3.0	34.0
12/28/65	4.0	3.0	4.5	4.0
7/22/66	4.8	4.8	12.0	2.0

[1] Single values represent a total response, i.e., where DDD and DDT could not be separated.

REF. NO.: 74 - H - 1

SUBSTANCES: PCBs

Reference: Halcrow, W., O. W. Mackay & J. Bogan. 1974. PCB levels in Clyde marine sediments and fauna. Mar. Pollut. Bull. 5:134-136.

Organisms: Nucula sulcata
Chlamys septemradiata

Date of Sample Collection: 1974?

Location: Firth of Clyde, Scotland

Analytical Technique: Gas chromatography

Analytical Data:

TABLE 2

PCB levels (ng/g wet wt.) in the tissues of three species of mollusc from the Garroch Head area.

Trawl	Species *Buccinum undatum*	*Nucula sulcata*	*Chlamys septemradiata*
1	–	39	173
2	61	98	225
3	73	217	332
4	376	–	471
5 and 6	38	121	55

REF. NO.: 67 - H - 1

SUBSTANCES: aldrin, lindane, chlordane, DDD, DDE, DDT, dieldrin, endrin, heptachlor, methoxychlor, toxaphene

Reference:

Hammerstrom, R. J., R. T. Russell, R. M. Tyo, E. A. Robertson Jr., J. L. Gaines & J. C. Bugg Jr. 1967. Study of pesticides in shellfish and estuarine areas of Louisiana. U.S. Dept. HEW, Water Supply and Sea Resources Program, Cincinnati, Ohio, 1967. 26p.

Organisms: oysters (unspecified)

Date of Sample Collection: 1964-1966

Location: Louisiana

Analytical Technique: Electron-capture gas chromatography; thin-layer gas chromatography

Analytical Data:

Table 3--Chlorinated Pesticides in Samples Collected During Sampling Period A

Sample Type	Number of samples								
	Examined[1]	Positive for One or More Pesticides	Positive[2] for						
			Aldrin	BHC-lindane	DDE	DDT (pp')	Dieldrin	Endrin	Heptachlor
Oyster	43	18	1	0	18	13	5	4	0
Water	25	3	0	1	0	2	0	0	0
Bottom Sediment	21	6	0	0	5	6	0	0	0
Fish & Shrimp	6	4	0	0	3	1	0	0	1

[1] All samples examined for aldrin, BHC-lindane, chlordane, DDD, DDE, DDT (pp'), dieldrin, endrin, heptachlor, heptachlor-epoxide, methoxychlor, and toxaphene.

[2] At levels of 0.01 ppm or greater for oyster, bottom sediment, and fish and shrimp samples and at levels of 0.001 ppm or greater for water samples.

Hammerstrom, R. J. et al. 1967.

Table 4 — Chlorinated Pesticide Residues in All 145 Positive Oyster Samples Collected During Sampling Periods B and C[1]

Pesticide	No. Samples Positive for Pesticide Shown	Residue (ppm drained weight)		
		Median	Low	High
Aldrin	11	<0.01	<0.01	<0.01
BHC-lindane	39	<0.01	<0.01	0.02
Chlordane	78	<0.01	<0.01	0.03
DDD	143	0.01	<0.01	0.07
DDE	144	<0.01	<0.01	0.06
DDT (pp')	137	0.01	<0.01	0.40
Total DDT*	144	0.01	<0.01	0.46
Dieldrin	128	<0.01	<0.01	0.09
Endrin	110	<0.01	<0.01	0.07
Heptachlor	8	<0.01	<0.01	<0.01
Heptachlor-Epoxide	19	<0.01	<0.01	0.01
Methoxychlor	9	<0.01	<0.01	0.02
Toxaphene	0	-------	-------	-------

[1] Periods of sampling—November 10, 1964, through June 23, 1965, and October 13, 1965, through June 15, 1966.

*Total DDT comprised of DDT (pp'), DDD, and DDE.

Table 7 — Distribution of All Oyster, Water, and Bottom Sediment Samples According to Pesticide Residue Levels — Sampling Periods B and C[1]

Pesticide	Oyster				Water				Bottom Sediment			
	*	(x) <0.01	(x) 0.01–0.049	(x) ≥0.05	*	(y) <0.001	(y) 0.001–0.0049	(y) ≥0.005	*	(z) <0.01	(z) 0.01–0.049	(z) ≥0.05
Aldrin	134	11	0	0	180	4	0	0	158	23	3	0
BHC-Lindane	106	31	8	0	148	34	2	0	168	15	1	0
Chlordane	67	77	1	0	109	75	0	0	98	86	0	0
DDD	2	47	91	5	63	121	0	0	33	145	5	1
DDE	1	78	65	1	41	143	0	0	20	160	3	1
DDT	8	69	57	11	61	123	0	0	28	129	26	1
Dieldrin	17	87	38	3	118	66	0	0	73	108	3	0
Endrin	35	85	24	1	107	77	0	0	84	96	3	1
Heptachlor	137	8	0	0	177	7	0	0	165	19	0	0
Heptachlor-Epoxide	126	18	1	0	179	5	0	0	179	5	0	0
Methoxychlor	136	8	1	0	177	7	0	0	182	2	0	0
Toxaphene	145	0	0	0	184	0	0	0	184	0	0	0

[1] Periods of sampling—November 10, 1964, through June 23, 1965, and October 13, 1965, through June 15, 1966.

*Not detected.

(x) Pesticide residue levels in ppm drained weight.

(y) Pesticide residue levels in ppm.

(z) Pesticide residue levels in ppm settleable solids weight.

Appendix A — Summary of Oyster Analyses — Sampling Period A[1]

Sampling Area	No. Samples Examined*	No. Samples in which One or More Pesticides Found[2]	Chlorinated Pesticides (ppm drained weight)				
			Aldrin	DDE	DDT (pp')	Dieldrin	Endrin
I	4	1		(1)[3] 0.01	(1) 0.01	(1) 0.01	(1) 0.01
II	13	4	(1) 0.01	(4) 0.01–0.02	(4) 0.01	(3) 0.01	(3) 0.01
Miss. River Delta	3	2		(2) 0.01–0.02	(1) 0.01		
III-A	14	5		(5) 0.01–0.03	(5) 0.01–0.04		
III-B	4	2		(2) 0.01–0.02	(1) 0.01		
VII	5	4		(4) 0.01–0.02	(1) 0.01	(1) 0.01	
TOTAL	43	18	(1) 0.01	(18) 0.01–0.03	(13) 0.01–0.04	(5) 0.01	(4) 0.01

[1] Period of sampling—January 7, through September 29, 1964.

[2] Only findings of pesticides in samples at levels of 0.01 ppm or greater reported in this table.

[3] Figures in parentheses indicate number of samples in which pesticide shown was found.

*All samples examined for aldrin, BHC-lindane, chlordane, DDD, DDE, DDT (pp'), dieldrin, endrin, heptachlor, heptachlor-epoxide, methoxychlor, and toxaphene.

Hammerstrom, R. J. et al 1967.

Appendix E — Summary of Oyster Analyses — Sampling Periods B and C[1]
Pesticide Residues in Positive Oyster Samples

Station	No. Samples Examined	No. Samples in which One or More Pesticides Detected	Chlorinated Pesticides (ppm drained weight)											
			Aldrin				BHC-Lindane				Chlordane			
			No. Pos.	Positive Samples			No. Pos.	Positive Samples			No. Pos.	Positive Samples		
				Median	Low	High		Median	Low	High		Median	Low	High
Station B, Long Bay	16	16	0	.....	.....	.....	6	<0.01	<0.01	<0.01	7	<0.01	<0.01	<0.01
Station Z, Ostrica Canal at Quarantine Bay	20	20	2	<0.01	<0.01	<0.01	3	<0.01	<0.01	<0.01	8	<0.01	<0.01	<0.01
Station M-1, Adams Bay	23	23	0	.....	.....	.....	7	<0.01	<0.01	<0.01	14	<0.01	<0.01	<0.01
Station Q, Bastian Bay	18	18	2	<0.01	<0.01	<0.01	4	<0.01	<0.01	0.02	11	<0.01	<0.01	<0.01
Four Bayou	10	10	2	<0.01	<0.01	<0.01	4	<0.01	<0.01	0.02	3	<0.01	<0.01	<0.01
Middle Bank Light	10	10	3	<0.01	<0.01	<0.01	4	<0.01	<0.01	<0.01	1	.....	.....	<0.01
Cat Bay Light	10	10	0	.....	.....	.....	1	.....	.....	<0.01	10	<0.01	<0.01	<0.01
Sugar Bend Reef	17	17	0	.....	.....	.....	4	<0.01	<0.01	0.01	9	<0.01	<0.01	0.03
Bird Island Reef	9	9	0	.....	.....	.....	3	<0.01	<0.01	0.02	3	<0.01	<0.01	<0.01
Bay des Ilettes	12	12	2	<0.01	<0.01	<0.01	3	<0.01	<0.01	<0.01	12	<0.01	<0.01	<0.01
TOTAL	145	145	11	<0.01	<0.01	<0.01	39	<0.01	<0.01	0.02	78	<0.01	<0.01	0.03

[1] Periods of sampling—November 10, 1964, through June 23, 1965, and October 13, 1965, through June 15, 1966.

Appendix E — Summary of Oyster Analyses — Sampling Periods B and C (Continued)
Pesticide Residues in Positive Oyster Samples

Station	Chlorinated Pesticides (ppm drained weight)											
	DDD				DDE				DDT (pp')			
	No. Pos.	Positive Samples			No. Pos.	Positive Samples			No. Pos.	Positive Samples		
		Median	Low	High		Median	Low	High		Median	Low	High
Station B, Long Bay	16	<0.01	<0.01	0.04	16	<0.01	<0.01	0.01	15	<0.01	<0.01	0.04
Station Z, Ostrica Canal at Quarantine Bay	18	<0.01	<0.01	0.04	19	<0.01	<0.01	0.01	17	<0.01	<0.01	0.04
Station M-1, Adams Bay	23	0.02	<0.01	0.07	23	0.01	<0.01	0.03	22	<0.01	<0.01	0.04
Station Q, Bastian Bay	18	0.02	<0.01	0.05	18	0.01	<0.01	0.03	17	0.01	<0.01	0.01
Four Bayou	10	0.03	<0.01	0.05	10	0.01	<0.01	0.01	10	0.04	<0.01	0.17
Middle Bank Light	10	0.02	<0.01	0.05	10	<0.01	<0.01	0.01	9	0.03	<0.01	0.06
Cat Bay Light	10	<0.01	<0.01	0.02	10	0.01	<0.01	0.02	10	<0.01	<0.01	0.01
Sugar Bend Reef	17	0.01	<0.01	0.04	17	0.01	<0.01	0.01	17	0.01	<0.01	0.07
Bird Island Reef	9	0.02	<0.01	0.03	9	<0.01	<0.01	0.02	8	0.03	<0.01	0.40
Bay des Ilettes	12	0.01	<0.01	0.03	12	0.01	<0.01	0.06	12	<0.01	<0.01	0.02
TOTAL	143	0.01	<0.01	0.07	144	<0.01	<0.01	0.06	137	0.01	<0.01	0.10

Appendix E — Summary of Oyster Analyses — Sampling Periods B and C (Continued)
Pesticide Residues in Positive Oyster Samples

Station	Chlorinated Pesticides (ppm drained weight)											
	Dieldrin				Endrin				Heptachlor			
	No. Pos.	Positive Samples			No. Pos.	Positive Samples			No. Pos.	Positive Samples		
		Median	Low	High		Median	Low	High		Median	Low	High
Station B, Long Bay	11	<0.01	<0.01	0.03	9	<0.01	<0.01	0.03	1	--------	--------	<0.01
Station Z, Ostrica Canal at Quarantine Bay	17	<0.01	<0.01	0.05	12	<0.01	<0.01	0.01	2	<0.01	<0.01	0.01
Station M-1, Adams Bay	19	<0.01	<0.01	0.04	17	<0.01	<0.01	0.01	1	--------	--------	0.01
Station Q, Bastian Bay	17	<0.01	<0.01	0.06	15	0.01	<0.01	0.01	1	--------	--------	0.01
Four Bayou	9	0.02	<0.01	0.09	9	0.02	<0.01	0.07	3	<0.01	<0.01	<0.01
Middle Bank Light	8	0.01	<0.01	0.02	7	<0.01	<0.01	0.02	0	--------	--------	--------
Cat Bay Light	10	<0.01	<0.01	<0.01	9	<0.01	<0.01	<0.01	0	--------	--------	--------
Sugar Bend Reef	15	<0.01	<0.01	0.02	15	<0.01	<0.01	0.02	0	--------	--------	--------
Bird Island Reef	7	<0.01	<0.01	0.05	5	<0.01	<0.01	0.02	0	--------	--------	--------
Bay des Ilettes	12	<0.01	<0.01	<0.01	12	<0.01	<0.01	0.01	0	--------	--------	--------
TOTAL	128	<0.01	<0.01	0.09	110	<0.01	<0.01	0.07	8	<0.01	<0.01	0.01

Appendix E — Summary of Oyster Analyses — Sampling Periods B and C (Continued)
Pesticide Residues in Positive Oyster Samples

Station	Chlorinated Pesticides (ppm drained weight)											
	Heptachlor-Epoxide				Methoxychlor				Toxaphene			
	No. Pos.	Positive Samples			No. Pos.	Positive Samples			No. Pos.	Positive Samples		
		Median	Low	High		Median	Low	High		Median	Low	High
Station B, Long Bay	2	<0.01	<0.01	0.01	1	--------	--------	<0.01	0	--------	--------	--------
Station Z, Ostrica Canal at Quarantine Bay	2	<0.01	<0.01	<0.01	2	0.01	<0.01	0.02	0	--------	--------	--------
Station M-1, Adams Bay	1	--------	--------	<0.01	1	--------	--------	<0.01	0	--------	--------	--------
Station Q, Bastian Bay	3	<0.01	<0.01	0.01	2	<0.01	<0.01	<0.01	0	--------	--------	--------
Four Bayou	2	<0.01	<0.01	0.01	1	--------	--------	<0.01	0	--------	--------	--------
Middle Bank Light	4	<0.01	<0.01	<0.01	1	--------	--------	<0.01	0	--------	--------	--------
Cat Bay Light	0	--------	--------	--------	0	--------	--------	--------	0	--------	--------	--------
Sugar Bend Reef	2	<0.01	<0.01	<0.01	0	--------	--------	--------	0	--------	--------	--------
Bird Island Reef	3	<0.01	<0.01	<0.01	1	--------	--------	<0.01	0	--------	--------	--------
Bay des Ilettes	0	--------	--------	--------	0	--------	--------	--------	0	--------	--------	--------
TOTAL	19	<0.01	<0.01	0.01	9	<0.01	<0.01	0.02	0	--------	--------	--------

Appendix H — Summary of Oyster, Water, and Bottom Sediment Analyses — Sampling Periods B and C[1]
Total DDT* in Positive Oyster, Water, and Bottom Sediment Samples

Station	Oyster					Water					Bottom Sediment				
	No. Samples Examined	No. Samples Positive	ppm drained weight			No. Samples Examined	No. Samples Positive	ppm			No. Samples Examined	No. Samples Positive	ppm settleable solids weight		
			Median	Low	High			Median	Low	High			Median	Low	High
Station B, Long Bay	16	16	0.02	<0.01	0.13	17	13	<0.001	<0.001	<0.001	17	16	<0.01	<0.01	0.02
Station Z, Ostrica Canal at Quarantine Bay	20	19	0.02	<0.01	0.07	20	16	<0.001	<0.001	0.002	19	19	0.01	<0.01	0.02
Mississippi River, Empire Water Station	--------	--------	--------	--------	--------	24	21	<0.001	<0.001	<0.001	23	22	0.02	<0.01	0.50
Station M-1, Adams Bay	23	23	0.05	<0.01	0.10	22	17	<0.001	<0.001	<0.001	23	22	0.01	<0.01	0.02
Station Q, Bastian Bay	18	18	0.05	<0.01	0.09	23	17	<0.001	<0.001	<0.001	23	22	0.01	<0.01	0.02
Four Bayou	10	10	0.09	<0.01	0.23	13	10	<0.001	<0.001	0.002	13	11	0.01	<0.01	0.02
Middle Bank Light	10	10	0.06	<0.01	0.09	11	9	<0.001	<0.001	<0.001	11	8	<0.01	<0.01	0.01
Cat Bay Light	10	10	0.03	0.01	0.03	11	11	<0.001	<0.001	0.001	11	11	0.01	<0.01	0.01
Sugar Bend Reef	17	17	0.04	<0.01	0.11	22	18	<0.001	<0.001	<0.001	22	22	0.01	<0.01	0.02
Bird Island Reef	9	9	0.08	<0.01	0.46	10	8	<0.001	<0.001	<0.001	10	9	<0.01	<0.01	0.01
Bay des Ilettes	12	12	0.01	0.01	0.09	11	11	<0.001	<0.001	0.001	12	12	0.01	<0.01	0.01
TOTAL	145	144	0.04	<0.01	0.46	184	151	<0.001	<0.001	0.002	181	174	0.01	<0.01	0.30

[1] Period of sampling—November 10, 1964, through June 23, 1965, and October 13, 1965, through June 15, 1966.
*Total DDT [illegible] of DDT [illegible], DDD and DDE.

Hammerstrom, R. J. et al. 1967.

Appendix I — Distribution of All Oyster Samples According to Pesticide Residue Levels — Sampling Periods B and C[1]

Station	Aldrin				BHC-Lindane				Chlordane				DDD			
	*	(z) <0.01	(z) 0.01-0.049	(z) ≥0.05	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05
Station B, Long Bay	16	0	0	0	10	6	0	0	9	7	0	0	0	13	3	0
Station Z, Ostrica Canal at Quarantine Bay	18	2	0	0	17	3	0	0	12	8	0	0	2	10	8	0
Station M-1, Adams Bay	23	0	0	0	16	5	2	0	9	14	0	0	0	2	19	2
Station Q, Bastian Bay	16	2	0	0	0	17	1	0	7	11	0	0	0	1	16	1
Four Bayou	8	2	0	0	6	2	2	0	7	3	0	0	0	1	8	1
Middle Bank Light	7	3	0	0	6	3	1	0	9	1	0	0	0	3	6	1
Cat Bay Light	10	0	0	0	9	1	0	0	0	10	0	0	0	6	4	0
Sugar Bend Reef	17	0	0	0	13	3	1	0	8	8	1	0	0	8	9	0
Bird Island Reef	9	0	0	0	6	2	1	0	6	3	0	0	0	2	7	0
Bay des Ilettes	10	2	0	0	9	3	0	0	0	12	0	0	0	1	11	0
TOTAL	134	11	0	0	106	31	8	0	67	77	1	0	2	47	91	5

[1] Periods of sampling—November 10, 1964, through June 23, 1965, and October 13, 1965, through June 15, 1966.
*Not detected.
(z) Pesticide residue levels in ppm.

Appendix I — Distribution of All Oyster Samples According to Pesticide Residue Levels — Sampling Periods B and C (Continued)

Station	DDE				DDT (pp')				Dieldrin				Endrin			
	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05
Station B, Long Bay	0	12	4	0	1	10	4	1	2	9	5	0	7	7	2	0
Station Z, Ostrica Canal at Quarantine Bay	1	15	4	0	3	10	7	0	3	13	3	1	8	11	1	0
Station M-1, Adams Bay	0	10	13	0	1	13	9	0	4	15	4	0	6	16	1	0
Station Q, Bastian Bay	0	9	9	0	1	7	10	0	1	8	8	1	3	7	8	0
Four Bayou	0	4	6	0	0	1	4	5	1	1	7	1	1	3	5	1
Middle Bank Light	0	7	3	0	1	3	5	1	2	3	5	0	3	5	2	0
Cat Bay Light	0	5	5	0	0	8	2	0	0	10	0	0	1	9	0	0
Sugar Bend Reef	0	8	9	0	0	8	8	1	2	11	4	0	2	13	2	0
Bird Island Reef	0	6	3	0	1	2	2	3	2	5	2	0	4	3	2	0
Bay des Ilettes	0	2	9	1	0	7	5	0	0	12	0	0	0	11	1	0
TOTAL	1	78	65	1	8	69	57	11	17	87	38	3	35	85	24	1

Appendix I — Distribution of All Oyster Samples According to Pesticide Residue Levels — Sampling Periods B and C (Continued)

Station	Heptachlor				Heptachlor-Epoxide				Methoxychlor				Toxaphene			
	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05	*	<0.01	0.01-0.049	≥0.05
Station B, Long Bay	15	1	0	0	14	1	1	0	15	1	0	0	16	0	0	0
Station Z, Ostrica Canal at Quarantine Bay	18	2	0	0	18	2	0	0	18	1	1	0	20	0	0	0
Station M-1, Adams Bay	22	1	0	0	22	1	0	0	22	1	0	0	23	0	0	0
Station Q, Bastian Bay	17	1	0	0	15	3	0	0	16	2	0	0	18	0	0	0
Four Bayou	7	3	0	0	8	2	0	0	9	1	0	0	10	0	0	0
Middle Bank Light	10	0	0	0	6	4	0	0	9	1	0	0	10	0	0	0
Cat Bay Light	10	0	0	0	10	0	0	0	10	0	0	0	10	0	0	0
Sugar Bend Reef	17	0	0	0	15	2	0	0	17	0	0	0	17	0	0	0
Bird Island Reef	9	0	0	0	6	3	0	0	8	1	0	0	9	0	0	0
Bay des Ilettes	12	0	0	0	12	0	0	0	12	0	0	0	12	0	0	0
TOTAL	137	8	0	0	126	18	1	0	136	8	1	0	115	0	0	0

REF. NO.: 69 - H - 3

SUBSTANCES: aldrin, BHC-lindane, chlordane, DDD, DDE, DDT, dieldrin, endrin, heptachlor, heptachlor-epoxide, methoxychlor, toxaphene

Reference:

Hammerstrom, R. J., V. L. Casper, E. A. Robertson Jr., J. C. Bugg Jr. & J. L. Gaines. 1969. Studies of pesticides in shellfish and estuarine areas of Louisiana and Alabama. Proc. Gulf and South Atlantic States Shellfish Sanitation Research Conference, Mobile, Ala., March 21-22, 1967, R. J. Hammerstrom & W. F. Hill, eds, p. 85-112. U. S. HEW, Cincinnati, Ohio.

Organisms:

oysters (unspecified)

Date of Sample Collection: 1964-66

Location:

Louisiana and Alabama

Analytical Technique: Electron capture gas chromatography

Analytical Data:

LOUISIANA STUDY

TABLE 1 - CHLORINATED PESTICIDES IN SAMPLES COLLECTED DURING SAMPLING PERIOD A

Sample type	Number of samples								
	Examined*	Positive for one or more pesticides	Positive+ for						
			Aldrin	BHC-lindane	DDE	DDT (pp')	Dieldrin	Endrin	Heptachlor
Oyster	43	18	1	0	18	13	3	4	0
Water	25	3	0	1	0	2	0	0	0
Bottom sediment	21	6	0	0	5	6	0	0	0
Fish & Shrimp	6	4	0	0	3	1	0	0	1

* All samples examined for aldrin, BHC-lindane, chlordane, DDD, DDE, DDT (pp'), dieldrin, endrin, heptachlor, heptachlor-epoxide, methoxychlor, and toxaphene.

\+ At levels of 0.01 ppm or greater for oyster, bottom sediment, and fish and shrimp and at levels of 0.001 ppm or greater for water.

Hammerstrom, R. J. et al. 1969.

LOUISIANA STUDY

TABLE 2 - CHLORINATED PESTICIDE RESIDUES IN ALL 145 POSITIVE OYSTER SAMPLES COLLECTED DURING SAMPLING PERIODS B AND C[ϕ]

Pesticide	No. samples positive for pesticide shown	Residue (ppm drained weight)		
		Median	Low	High
Aldrin	11	<0.01	<0.01	<0.01
BHC-lindane	39	<0.01	<0.01	0.02
Chlordane	78	<0.01	<0.01	0.03
DDD	143	0.01	<0.01	0.07
DDE	144	<0.01	<0.01	0.06
DDT (pp')	137	0.01	<0.01	0.40
Total DDT*	144	0.04	<0.01	0.46
Dieldrin	128	<0.01	<0.01	0.09
Endrin	110	<0.01	<0.01	0.07
Heptachlor	8	<0.01	<0.01	<0.01
Heptachlor-epoxide	19	<0.01	<0.01	0.01
Methoxychlor	9	<0.01	<0.01	0.02
Toxaphene	0	-	-	-

ϕ Periods of sampling - November 10, 1964 through June 23, 1965 and October 13, 1965 through June 15, 1966.

* Total DDT comprised of DDT (pp'), DDD, and DDE.

LOUISIANA STUDY

TABLE 3 - DISTRIBUTION OF ALL OYSTER, WATER, AND BOTTOM SEDIMENT SAMPLES ACCORDING TO PESTICIDE RESIDUE LEVELS - SAMPLING PERIODS B AND C[ϕ]

Pesticide	Oyster				Water				Bottom sediment			
	*	(x) <0.01	(x) 0.01-0.049	(x) ≥0.05	*	(y) <0.001	(y) 0.001-0.0049	(y) ≥0.005	*	(z) <0.01	(z) 0.01-0.049	(z) ≥0.05
Aldrin	134	11	0	0	180	4	0	0	158	23	3	0
BHC-lindane	106	31	8	0	148	34	2	0	168	15	1	0
Chlordane	67	77	1	0	109	75	0	0	98	86	0	0
DDD	2	47	91	5	63	121	0	0	33	143	5	1
DDE	1	78	65	1	41	143	0	0	20	160	3	1
DDT	8	69	57	11	61	123	0	0	28	129	26	1
Dieldrin	17	87	38	3	118	66	0	0	73	108	3	0
Endrin	35	85	24	1	107	77	0	0	84	96	3	1
Heptachlor	137	8	0	0	177	7	0	0	163	19	0	0
Heptachlor-epoxide	126	18	1	0	179	5	0	0	179	5	0	0
Methoxychlor	136	8	1	0	177	7	0	0	182	2	0	0
Toxaphene	145	0	0	0	184	0	0	0	184	0	0	0

ϕ Periods of sampling - November 10, 1964 through June 23, 1965 and October 13, 1965 through June 15, 1966.
* Not detected.
(x) Pesticide residue levels in ppm drained weight.
(y) Pesticide residue levels in ppm.
(z) Pesticide residue levels in ppm settleable solids weight.

Hammerstrom, R. J. et al. 1969.

ALABAMA STUDY

TABLE 6 - CHLORINATED PESTICIDE RESIDUES IN 82 OYSTER SAMPLES COLLECTED DURING SAMPLING PERIODS A AND B[#]

Pesticide	No. samples positive for pesticide shown	Residue (ppm drained weight)		
		Median	Low	High
Aldrin	4	<0.01	<0.01	<0.01
BHC-lindane	11	<0.01	<0.01	0.08
Chlordane	25	<0.01	<0.01	<0.01
DDD	82	0.11	0.01	1.72
DDE	82	0.23	0.01	2.31
DDT (pp')	81	0.03	<0.01	0.58
Total DDT*	82	0.33	0.03	4.61
Dieldrin	47	<0.01	<0.01	0.08
Endrin	36	<0.01	<0.01	0.03
Heptachlor	0	-	-	-
Heptachlor-epoxide	11	<0.01	<0.01	<0.01
Methoxychlor	0	-	-	-
Toxaphene	0	-	-	-

[#] Periods of sampling - March 29 through July 23, 1965 and October 12, 1965 through July 19, 1966.

* Total DDT comprised of DDT (pp'), DDD, and DDE.

ALABAMA STUDY

TABLE 9 - DISTRIBUTION OF ALL OYSTER, WATER, AND BOTTOM SEDIMENT SAMPLES ACCORDING TO PESTICIDE RESIDUE LEVELS

Pesticide	Oyster				Water				Bottom Sediment			
	*	(x) <0.01	(x) 0.01-0.049	(x) >0.05	*	(y) <0.001	(y) 0.001-0.0049	(y) >0.005	*	(z) <0.001	(z) 0.001-0.0049	(z) >0.005
Aldrin	78	4	0	0	130	1	0	0	64	1	0	0
BHC-lindane	71	6	4	1	111	20	0	0	64	1	0	0
Chlordane	53	25	0	0	99	32	0	0	30	35	0	0
DDD	0	0	20	62	26	104	1	0	0	2	32	31
DDE	0	0	14	68	21	108	2	0	1	2	24	38
DDT (pp')	1	4	58	19	28	101	1	1	1	2	43	19
Dieldrin	5	37	9	1	47	29	0	0	38	20	7	0
Endrin	16	33	3	0	39	37	0	0	39	17	8	1
Heptachlor	78	0	0	0	130	1	0	0	64	1	0	0
Heptachlor-epoxide	67	11	0	0	130	1	0	0	64	1	0	0
Methoxychlor	78	0	0	0	128	3	0	0	63	0	0	0
Toxaphene	78	0	0	0	131	0	0	0	63	0	0	0

* Not detected.
(x) Pesticide residue levels in ppm drained weight.
(y) Pesticide residue levels in ppm.
(z) Pesticide residue levels in ppm settleable solids weight.

Hammerstrom, R. J. et al. 1969.

ALABAMA STUDY

TABLE 10 - TOTAL DDT* IN OYSTER, WATER, AND BOTTOM SEDIMENT SAMPLES

Station	Oyster					Water					Bottom sediment				
	No. of samples	No. pos.	ppm drained weight			No. of samples	No. pos.	ppm			No. of samples	No. pos.	ppm settleable solids weight		
			Median	Low	High			Median	Low	High			Median	Low	High
Mobile River	-	-	-	-	-	20	18	<0.001	<0.001	0.009	13	13	0.366	0.027	2.302
Tensaw River	-	-	-	-	-	21	18	<0.001	<0.001	0.001	-	-	-	-	-
White House Reef	-	-	-	-	-	8	6	<0.001	<0.001	0.001	-	-	-	-	-
Cedar Point Reef	21	21	0.68	0.08	4.61	21	18	<0.001	<0.001	<0.001	13	13	0.012	<0.001	0.017
Dauphin Island Bay	20	20	0.29	0.06	2.17	21	17	<0.001	<0.001	0.003	13	13	0.013	<0.001	0.024
Shell Bank Reef	21	21	0.51	0.08	2.21	21	18	<0.001	<0.001	<0.001	13	13	0.010	<0.001	0.017
Bon Secour Reef	20	20	0.32	0.06	1.45	19	17	<0.001	<0.001	<0.001	13	13	0.007	0.003	0.023

* Total DDT comprised of DDT (pp'), DDD, and DDE.

REF. NO.: 72 - H - 2

SUBSTANCES: PCB

Reference: Helminen, M., E. Karppanen & K. Henriksson. 1972. PCB in the Finnish Environment. PCB Conference II, Stockholm, Stockholm, December 14, 1972, p. 19-22. National Swedish Environment Protection Board.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1972?

Location: Gulf of Finland

Analytical Technique: Electron-capture gas chromatography

Analytical Data: 0.003-0.042 mg/kg fresh tissue

REF. NO.: 72 - H - 1

SUBSTANCES: PCB, BHC, DDT, DDD, DDE, dieldrin

Reference: Hidaka, K., T. Ohe & K. Fujiwara. 1972. Studies on polychlorinated biphenyls and organochlorine pesticide residues in Corbiculae. J. Food Hygienic Soc. Japan 13:523-530.

Organisms: Corbicula sandai

Date of Sample Collection: 1963, 1971

Location: Lake Biwa, Japan

Analytical Technique: Gas chromatography

Analytical Data:

Table 1. Concentration of Chlorinated Hydrocarbons in Corbiculae in 1963. (ppm on fat basis and fresh tissue basis) Parentheses show ppm on fresh tissue basis

Sampling point	PCB	α-BHC	β-BHC	γ-BHC	Total BHC	pp'-DDT	pp'-DDE	pp'-DDD	op'-DDD	** Total DDT	Dieldrin	Fat %
1	370 (2.4)	0.69	2.0	0.77	3.5 (0.022)	0.63	0.70	3.5	0.96	5.8 (0.038)	0.19 (0.001)	0.65
2	254 (1.4)	0.99	3.2	1.5	5.7 (0.032)	1.2	3.1	2.2	0.45	7.0 (0.039)	0.35 (0.002)	0.56
3	47 (0.30)	0.58	1.8	0.58	3.0 (0.020)	0.55	1.7	2.2	0.75	5.2 (0.031)	0.20 (0.001)	0.67
4	—	2.4	3.3	1.5	7.2 (0.067)	0.60	3.5	3.3	1.1	8.5 (0.078)	0.36 (0.003)	0.92
5	*16 (0.24)	1.9	2.8	1.1	5.8 (0.075)	2.5	3.1	2.6	0.75	9.0 (0.13)	0.26 (0.001)	1.44
6	14 (0.15)	1.5	2.5	1.0	5.0 (0.037)	2.5	2.4	4.2	1.3	10.4 (0.080)	0.47 (0.004)	0.77
7	7.3 (0.01)	1.3	2.4	0.88	4.6 (0.025)	1.9	4.2	2.1	0.51	8.7 (0.048)	0.15 (0.001)	0.55
8	45 (0.07)	1.3	2.8	0.96	5.1 (0.022)	3.1	2.8	5.2	0.97	12.1 (0.051)	0.22 (0.001)	0.43
9	*18 (0.10)	1.2	2.6	1.1	4.9 (0.028)	3.0	4.0	5.1	1.6	13.7 (0.079)	0.19 (0.001)	0.53
10	15 (0.14)	1.6	3.1	1.4	6.1 (0.057)	2.9	3.3	3.2	1.0	10.4 (0.097)	0.34 (0.003)	0.94
11	29 (0.21)	1.2	2.5	1.1	4.8 (0.032)	1.1	3.8	3.8	1.1	9.8 (0.068)	0.19 (0.001)	0.70
12	*13 (0.16)	1.1	2.5	0.94	4.5 (0.060)	0.09	3.5	6.0	1.7	11.3 (0.14)	0.18 (0.002)	1.30
13	—	1.4	2.7	0.96	5.1 (0.040)	0.91	2.0	3.3	0.84	7.1 (0.056)	0.14 (0.001)	0.79
14	23 (0.10)	0.62	1.6	0.66	2.9 (0.013)	1.1	2.7	3.8	1.3	8.9 (0.039)	0.13 (0.001)	0.44
15	42 (0.22)	1.3	2.8	1.1	5.2 (0.029)	1.7	2.7	2.3	1.1	7.8 (0.038)	0.31 (0.002)	0.50
Mean	68.7 (0.42)	1.27	2.54	1.04	4.8 (0.037)	1.59	2.9	3.5	1.03	9.0 (0.067)	0.25 (0.002)	0.75

* : Saponified with alkali

** : Total DDT stands for the sum of DDT, DDE and DDD

Hidaka, K. et al. 1972.

Table 2. Concentration of Chlorinated Hydrocarbons in Corbiculae in 1971. (ppm on fat basis and fresh tissue basis) Parentheses show ppm on fresh tissue basis

Sampling point	PCB	α-BHC	β-BHC	γ-BHC	Total BHC	pp'-DDT	pp'-DDE	pp'-DDD	op'-DDD	Total DDT**	Dieldrin	Fat %
A	62 (0.95)	0.99	4.0	0.72	5.7 (0.087)	0.68	0.85	1.4	nd	2.9 (0.044)	0.16 (0.003)	1.5
B	42 (1.1)	1.8	7.1	1.1	10.0 (0.25)	0.58	1.5	1.7	nd	3.8 (0.093)	0.11 (0.003)	2.5
C	13 (0.32)	2.8	6.6	1.2	10.6 (0.25)	0.63	0.85	1.1	nd	2.6 (0.061)	0.16 (0.004)	2.3
D	20 (0.46)	2.4	6.3	1.1	9.8 (0.22)	0.75	1.2	0.79	nd	2.7 (0.062)	0.09 (0.002)	2.3
E	5.4 (0.11)	2.5	5.4	0.95	8.9 (0.18)	0.61	0.86	0.57	nd	2.0 (0.042)	0.14 (0.003)	2.1
F	2.9 (0.05)	1.8	4.3	0.91	7.1 (0.13)	0.77	0.71	0.46	nd	1.9 (0.038)	0.16 (0.003)	1.9
G	4.4 (0.12)	1.7	6.3	0.72	8.7 (0.25)	1.1	1.0	0.66	nd	2.8 (0.075)	0.12 (0.003)	2.8
H	14 (0.33)	1.2	4.9	0.46	6.6 (0.13)	1.2	1.1	1.4	0.41	4.1 (0.074)	0.20 (0.004)	2.0
I	5.2 (0.15)	2.2	5.4	0.94	8.5 (0.17)	1.4	1.1	0.65	nd	3.2 (0.057)	0.11 (0.002)	2.0
Mean	18.3 (0.40)	1.9	5.6	0.90	8.4 (0.19)	0.87	1.01	0.97	–	2.9 (0.051)	0.141 (0.003)	2.1

** : Total DDT stands for the sum of DDT, DDE and DDD

Table 3. Comparison of Chlorinated Hydrocarbon Residues in 1963 with Those in 1971 (ppm on fresh tissue basis and fat basis)

Sampling point		PCB		Total BHC		Total DDT		Dieldrin	
'63	'71	'63	'71	'63	'71	'63	'71	'63	'71
1	A	2.4 (370)	0.95 (62)	0.022 (3.5)	0.087 (5.7)	0.023 (5.8)	0.044 (2.9)	0.001 (0.19)	0.003 (0.19)
2	B	1.4 (251)	1.1 (42)	0.032 (5.7)	0.25 (10.0)	0.038 (7.0)	0.093 (3.8)	0.002 (0.35)	0.003 (0.11)
3	C	0.30 (47)	0.32 (13)	0.020 (3.0)	0.25 (10.6)	0.031 (5.2)	0.061 (2.6)	0.001 (0.20)	0.004 (0.16)
6	F	0.15 (14)	0.06 (2.9)	0.037 (5.0)	0.13 (7.1)	0.030 (10.4)	0.038 (1.9)	0.004 (0.47)	0.003 (0.16)
7	G	0.04 (7.3)	0.12 (4.4)	0.025 (4.6)	0.25 (8.7)	0.048 (8.7)	0.075 (2.8)	0.001 (0.15)	0.003 (0.12)
8	H	0.07 (45)	0.33 (14)	0.022 (5.1)	0.13 (6.6)	0.051 (12.1)	0.074 (4.1)	0.001 (0.22)	0.004 (0.20)
9	I	0.10 (18)	0.15 (5.2)	0.028 (1.9)	0.17 (8.5)	0.079 (13.7)	0.057 (3.2)	0.001 (0.19)	0.002 (0.11)

Total DDT stands for the sum of DDT, DDE and DDD. Ppm on fat basis is parenthesized.

REF. NO.: 70 - H - 1

SUBSTANCES: DDE, DDT, TDE, PCB, dieldrin

Reference: Holden, A. V. 1970. International cooperative study of organochlorine pesticide residues in terrestrial and aquatic wildlife, 1967/1968. Pest. Monit. J. 4:117-135.

Organisms: Mytilus edulis
Modiolus demissus

Date of Sample Collection: 1967-68

Location: Atlantic and Pacific, Canada, U. S. and European countries

Analytical Technique: Gas liquid chromatography; thin-layer chromatography

Analytical Data:

TABLE 9.—*Analyses of mussels*

Location	Weight (grams)	Length of Shell (centimeters)	Mean Values and Ranges in PPM				
			Dieldrin	DDE	TDE	*p,p'*-DDT	PCB
Canada							
Portage Island (10)		6.3-6.8	0.001 (<0.0001-0.001)	0.016 (0.006-0.041)	0.012 (0.004-0.016)	0.010 (0.002-0.053)	
St. John (10 groups of 5)		2.6-3.2	0.001 (<0.0001-0.002)	0.027 (0.009-0.091)	0.016 (0.008-0.030)	0.057 (0.020-0.104)	
British Columbia (10)	Fat 0.5%	4.0-5.0	0.002 (<0.0001-0.006)	0.021 (0.007-0.106)	0.010 (0.002-0.062)	0.038 (0.015-0.126)	
Euratom							
Magra-Tillaro, 7 groups of 5	6.5-16.5	4.2-6.5	T ≤0.005	0.015 (0.012-0.021)	0.026 (0.020-0.030)	0.078 (0.046-0.099)	Absent
Ireland							
Clonakilty (10) singly		6.0-8.0	0.03 (0.01-0.05)	0.02 (<0.01-0.07)	<0.01	<0.01	
(10) group		6.2-7.3	0.03	0.02			
Kinsale (10) singly		6.9-8.3	0.016 (<0.01-0.03)	0.01 (<0.01-0.02)	<0.01	<0.01	
(10) group			0.01	0.02			
East Ferry: (10) singly		7.1-7.5	0.04 (0.02-0.06)	0.02 (0.01-0.07)	<0.01	<0.01	
(10) group			0.04	0.05			
Finland							
6 groups of 10	5.02-6.71	2.8-3.1	<0.001	<0.01 (<0.01-0.01)	<0.01 (<0.01-0.01)	0.017 incl. *o,p'*-DDT (<0.01-0.03)	0.06
Netherlands							
1967 IJmuiden	5.5-14.5		0.016 (0.010-0.020)	0.020 (0.013-0.025)	NC	NC	0.44
Scheveningen	12.7-15.1		0.042 (0.031-0.057)	0.032 (0.022-0.041)	NC	NC	0.47
Grevelingendam W	10.0-24.3		0.009 (0.006-0.011)	≤0.009	NC	NC	0.26
Grevelingendam E	13.5-18.8		0.006 (0.004-0.007)	0.022 (0.018-0.031)	NC	NC	0.46

Holden, A. V. 1970.

TABLE 9.—*Analyses of mussels*—Continued

Location	Weight (grams)	Length of Shell (centimeters)	Mean Values and Ranges in PPM				
			Dieldrin	DDE	TDE	*p,p'*-DDT	PCB
Netherlands—Continued							
1968 Wadden Sea	24.6		<0.007	NC	NC	NC	
Schiermonnikoog	18.1		0.013	NC	NC	NC	
Den Helder	26.5		0.018	NC	NC	NC	
IJmuiden	25.2		0.018	NC	NC	NC	
Scheveningen	17.9-18.4		0.046 (0.039-0.053)	NC	NC	NC	Mean 0.46
Hoek van Holland	21.7		0.034	NC	NC	NC	
Grevelingendam N	29.4		0.015	NC	NC	NC	
Grevelingendam E	34.2		0.010	NC	NC	NC	
Westkapelle	29.4		0.012	NC	NC	NC	
Norway							
singly	52-113	7.3-8.9	0.0021 (0.001-0.003)	0.0015 (0.001-0.002)	0.0033 (0.002-0.006)	0.0036 (<0.001-0.020)	
3 groups of 3, 5, 6		2.2-3.2	T	0.005 (0.004-0.006)	<0.001	0.009 (<0.001-0.027)	0.004
Portugal							
Aveiro		5.8-8.3	0.004 (0.001-0.005)	0.009 (0.004-0.013)	0.004 (0.002-0.006)	0.012 (0.005-0.017)	
Setubal		6.6-9.2	0.006 (0.003-0.010)	0.024 (0.020-0.034)	0.020 (0.009-0.035)	0.059 (0.037-0.084)	
Cascais		3.0-6.1	0.034 (0.022-0.047)	0.036 (0.020-0.062)	0.059 (0.039-0.083)	0.184 (0.128-0.278)	
Spain							
Vigo	12.03-40.30	7.52-9.20	0.001	0.014	0.046	0.053	
Barcelona	2.74-5.11	4.16-5.30	<0.001	0.033	0.304	0.140	T
Sweden							
Fiskebäckskil	10.51-20.87	6.5-7.9	<0.001	0.004 (0.001-0.013)	<0.01	0.010 (0.004-0.026)	0.048
Graddö			<0.001	0.003	<0.01	0.010	0.032
Askö	4.5-6.6	3.14-3.36	<0.001	0.008 (0.002-0.017)	<0.01	0.015 (0.006-0.023)	0.036
Lundakrabukten	4.53-6.19	3.63-3.76	<0.001	0.007 (0.005-0.009)	<0.01	0.007 (0.003-0.011)	0.029
United Kingdom							
R. Roach			0.0230 (0.012-0.047)	0.0254 (0.018-0.033	0.0304 (0.019-0.055)	0.011 (0.008-0.018)	
R. Crouch			0.0204 (0.012-0.036)	0.0230 (0.005-0.072)	0.0328 (0.010-0.073	0.005 (0.002-0.012)	
Loch Linnhe		5.0-6.0	0.00335 (0.002-0.006)	0.0214 (0.013-0.037)	0.0157 (0.009-0.032)	<0.016 (<0.01-<0.02)	
Lochgoilhead		5.8-7.3	0.0168 (0.006-0.035)	0.0250 (0.007-0.087)	0.0279 (0.007-0.042)	<0.015 (<0.01-0.3)	T
United States							
Modiolus demissus, groups	8.20-14.20	4.1-4.9	0.02 (<0.02-0.04)	0.13 (0.08-0.18)	0.10 (0.07-0.13)	0.08 (0.05-0.12)	T

NOTE: T = Trace; NC = Present, but not calculated (due to PCB interference).

REF. NO.: 72 - H - 3 **SUBSTANCES:** PCB

Reference: Holden, A. V. 1972. Monitoring PCB in water and wildlife. PCB Conference II, Stockholm, December 14, 1972, p. 23-33. National Swedish Environment Protection Board.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1969-71

Location: 10 countries

Analytical Technique: Gas liquid chromatography

Analytical Data:

Table 2. Ranges of PCB in wildlife

Sample	Tissue	Range of Concentrations
Marine plankton	Total	<0.01 – 10 ppm
Marine molluscs	Soft tissue	<0.01 – 2 ppm
Marine fish	Muscle	<0.01 – 20 ppm
Freshwater fish	Muscle	<0.01 – 100 ppm
Birds	Muscle	<0.01 – 10,000 ppm
	Eggs	<0.1 – >100 ppm
Seals	Lipid	<1 – 3,000 ppm

Table 3. Ranges of PCB in wildlife
OECD study 1969–71

Species	No. of countries	PCB range (ppm)
Mussels	10	0.02–1.7
Herring	8	0.10–3.2
Pike	6	<0.01–0.95
Terns	3	2.4 –149

REF. NO.: 72 - H - 4

SUBSTANCES: organochlorines

Reference: Holden, A. V. & G. Topping. 1972. Occurrence of specific pollutants in fish in the Forth and Tay estuaries. Proc. Roy. Soc. Edinburgh B 71 [1971/72]:189-194.

Organisms: Mytilus edulis

Date of Sample Collection: 1971-72

Location: Coast of Scotland

Analytical Technique: ?

Analytical Data:

TABLE 3

Organochlorine residues in Scottish mussels
(mg/kg wet weight soft tissue)
1970

Location	D	DDE	TDE	DDT	Total DDT	PCB
Helensburgh, Clyde	0·06	0·04	0·03	0·05	0·12	0·6
Kilcreggan, Clyde	0·07	0·03	0·03	0·03	0·09	0·5
Wemyss Bay, Clyde	0·04	0·01	0·01	0·02	0·04	0·2
Anstruther, Forth	<0·01	0·02	<0·01	0·01	0·03	<0·1
Montrose, South Esk	0·01	<0·01	0·02	0·02	0·04	<0·1
Ythan Estuary	<0·01	0·01	<0·01	<0·01	0·02	<0·1
Aberdeen	<0·01	0·02	0·03	0·03	0·08	0·2

REF. NO.: 73 - H - 4

SUBSTANCES: DDE, DDT, TDE, PCBs, Hg, dieldrin

Reference: Holden, A. V. 1973. International cooperative study of organochlorine and mercury residues in wildlife, 1969-71. Pest. Monit. J. 7:37-52.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1969-71

Location: Canada, Denmark, Finland, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom, United States

Analytical Technique: Gas chromatography

Analytical Data:

Holden, A. V. 1973.

TABLE 9.—*Analyses of wildlife samples—mussels*

Location	Number of Mussels in Sample	Mean Values in mg/kg						Pollution Category
		Dieldrin	DDE	TDE	*p,p'*-DDT	PCB's	Hg	
Canada								
Miramichi Bay	30	0.02	0.02	0.01	0.01	0.14	0.02	Polluted
Denmark								
Vejle	2	0.005	0.005	0.004	0.002	0.06		Slightly polluted
Esbjerg	3	0.011	0.016	0.004	0.004	0.28		Slightly polluted
Finland								
Tvärminne	60	<0.005	<0.005	<0.005	0.008	0.033	0.04	Unpolluted
Södarskär	20	<0.005	<0.005	<0.005	0.020	0.027	0.03	Unpolluted
Netherlands								
1969 Vlieland	5	0.016	0.016			1.7	0.14	Slightly polluted
Noordpolderzijl	5	0.007	0.006			0.87	0.13	Slightly polluted
1970 Noordpolderzijl	10	0.010	0.013			0.28	0.08	Slightly polluted
Ijmuiden	35	0.016	0.020			0.45	0.21	Slightly polluted
Scheveningen	27	0.015	0.018			0.38	0.31	Slightly polluted
Hoek van Holland	31	0.017	0.027			0.21	0.22	Slightly polluted
Grevelingen W	23	0.010	0.016			0.47	0.11	Slightly polluted
Grevelingen 0	10	0.007	0.023			0.52	0.14	Slightly polluted
Vlissinger	25	0.023	0.022			0.48	0.14	Slightly polluted
Cadzand	28	0.008	0.015			0.33	0.21	Slightly polluted
Norway								
Hurumlandet	15	<0.005	<0.005	<0.005	<0.005	<0.005		Unpolluted
Portugal								
Aveiro	60	<0.001	0.002	0.001	0.004	0.03		Unpolluted
Cascais	36	0.005	0.007	0.012	0.029	0.17		Polluted
Spain								
Blances	30	0.002	0.035	0.011	0.012	0.58		Polluted
Barcelona	30	<0.001	0.054	0.034	0.010	1.05		Polluted
Ampolla	30	<0.001	0.137	0.061	0.005	0.77		Polluted
Castellon	30	0.025	0.001	0.014	0.010	0.61		Polluted
Vigo	30	<0.001	0.005	0.006	0.006	0.10		Unpolluted
Santander	30	0.001	0.002	0.025	0.006	0.67		Unpolluted
Sweden								
Fiskebäckskil	90		0.003	0.002	0.004	0.041	0.15	Unpolluted
Askö	90		0.008	0.003	0.005	0.017	0.03	Polluted
Gräddö	90		0.008	0.002	0.005	0.017	0.08	Polluted
United Kingdom								
Montrose	30	0.010	0.006	0.023	0.019	<0.1		Unpolluted
Lochgoilhead	30	0.013	0.014	0.009	0.013	<0.1		Unpolluted
Ythan Estuary	30	0.003	0.011	0.006	0.006	0.1	0.23	Unpolluted
Helensburgh (Clyde)	30	0.059	0.035	0.037	0.046	0.62	0.07	Polluted
Kilcreggan (Clyde)	30	0.074	0.034	0.031	0.032	0.48	0.04	Polluted
Holy Loch (Clyde)	30	0.026	0.016	0.012	0.017	0.44	0.46	Polluted
United States								
New York	30	0.032	0.025	[1] 0.069	[1] 0.073	Present		Polluted
Cape Split	30	<0.010	<0.010	<0.010	<0.010	Present		Unpolluted

NOTE: Where residues were not detected, the limit of detection was stated.
[1] PCB's not separated.

REF. NO.: 75 - H - 1

SUBSTANCES: DDT, TDE, DDE, lindane, dieldrin, PCBs

Reference: Huschenbeth, E. & U. Harms. 1975. On the accumulation of organochlorine pesticides, PCB and certain heavy metals in fish and shellfish from Thai coastal and inland waters. Arch. FischWiss. 26:109-122.

Organisms: Mytilus viridis
Anadara granosa

Date of Sample Collection: 1972

Location: Thailand coastal area

Analytical Technique: Cold vapour atomic absorption photometry

Analytical Data:

Table 1: Accumulation of chlorinated hydrocarbons in fish and shellfish from the Inner Gulf

Number	Scientific name	Common name	Length cm ⌀	Weight g ⌀	Fat %	PCB µg/g ppm	DDT µg/g ppm	TDE µg/g ppm	DDE µg/g ppm	Lindane µg/g ppm	Dieldrin µg/g ppm	Σ DDT µg/g ppm
100	Mytilus viridis		6	12	1.40	0.103	0.085	0.071	0.250	0.013	0.020	0.407

Table 2: Accumulation of chlorinated hydrocarbons in fish and shellfish from the Rayong area

Number	Scientific name	Common name	Length cm ⌀	Weight g ⌀	Fat %	PCB µg/g ppm	DDT µg/g ppm	TDE µg/g ppm	DDE µg/g ppm	Lindane µg/g ppm	Dieldrin µg/g ppm	Σ DDT µg/g ppm
40	Mytilus viridis		8	—	1.55	0.010	0.004	0.007	0.013	0.001	0.010	0.024

Table 4: Accumulation of chlorinated hydrocarbons in fish and shellfish from the Phuket area

Number	Scientific name	Common name	Length cm ⌀	Weight g ⌀	Fat %	PCB µg/g ppm	DDT µg/g ppm	TDE µg/g ppm	DDE µg/g ppm	Lindane µg/g ppm	Dieldrin µg/g ppm	Σ DDT µg/g ppm
85	Anadara granosa	Arch-shell	2	—	1.54	0.031	0.010	0.011	0.014	0.004	0.009	0.035

Table 7: Accumulation of heavy metals in fish and shellfish from the Rayong area

Number	Scientific name	Common name	Hg	Cd	Pb	Cu	Zn
40	Mytilus viridis		0.02	0.38	0.110	7.3	14.2

Table 9: Accumulation of heavy metals in fish and shellfish from the Phuket area

Number	Scientific name	Common name	Hg	Cd	Pb	Cu	Zn
85	Anadara granosa	Arch-shell	<0.01	0.28	0.18	5.6	16.[illegible]

REF. NO.: 69 - J - 1

SUBSTANCES: DDT, PCB

Reference: Jensen, S., A. G. Johnels, M. Olsson & G. Otterlind. 1969. DDT and PCB in marine animals from Swedish waters. Nature 224:247-250.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1965-68

Location: Sweden, west coast, Baltic Sea and Archipelago of Stockholm

Analytical Technique: Gas chromatography and electron capture

Analytical Data:

Table 1. CONCENTRATION OF ORGANOCHLORINE COMPOUNDS IN SWEDISH MARINE ORGANISMS 1965–68

	No. in sample	P.p.m. in fat			P.p.m. in fresh tissue			Per cent fat
		sDDT	DDT	PCB	sDDT	DDT	PCB	
Swedish West Coast								
Mussel	17	1	0·6	2	0·02	0·007	0·084	1·3
Oct. 1966		(0·4–5)	(0·3–1·3)	(0·5–7·0)	(0·005–0·04)	(0·002–0·03)	(0·011–0·33)	(0·66–2·6)
Dec. 1967								
Plaice	3	1		5	0·006	0·004	0·021	0·5
Sept. 1966		(0·9–2)	n.a.	(0·4–14)	(0·003–0·009)	(trace—0·006)	(0·002–0·056)	(0·4–0·5)
Cod	4	1		7·3	0·005	0·003	0·019	0·30
Sept. 1967		(0·6–2)	n.a.	(1·8–16)	(0·001–0·006)	(n.d.—0·006)	(0·006–0·030)	(0·19–0·34)
Picked dogfish	7	1·5	0·91	1·5	0·15	0·091	0·15	9·6
Aug. 1968		(0·29–3·9)	(0·15–2·3)	(0·81–2·4)	(0·028–0·33)	(0·015–0·21)	(0·054–0·30)	(6·7–14)
Fish oil	3	2·1	1·2	0·74				100
Oct. 1968		(1·5–2·6)	(0·83–1·4)	(0·54–1·0)				
Baltic Sea proper incl. the Sound								
Mussel	40	6	1·8	4·3	0·03	0·02	0·03	0·92
Oct. 1966, Dec. 1966		(0·9–10)	(0·5–2·9)	(1·9–8·6)	(0·009–0·07)	(0·003–0·023)	(0·008–0·057)	(0·46–1·6)
Dec. 1967, Jan. 1968								
Herring	18	17	9·7	6·8	0·68	0·40	0·27	4·4
April, Sept. 1966–68		(4·1–37)	(1·5–21)	(0·5–23)	(0·093–2·3)	(0·012–1·3)	(0·009–1·0)	(0·7–12)
Plaice	6	2·7	2·1	2·7	0·018	0·013	0·017	0·65
Sept. 1967		(1·4–7·6)	(0·6–7·2)	(1·7–4·8)	(0·006–0·036)	(0·003–0·029)	(0·010–0·032)	(0·55–0·71)
Cod	5	19	9·8	11	0·063	0·032	0·033	0·32
Sept. 1967		(12–31)	(3·5–19)	(3·2–20)	(0·027–0·11)	(0·008–0·068)	(0·012–0·057)	(0·23–0·44)
Salmon*	11	31	14	2·9	3·4	1·5	0·30	11·0
Autumn 1968		(20–53)	(7·7–20)	(1·1–8·2)	(0·26–7·1)	(0·095–3·1)	(0·014–0·54)	(1·2–20)
Fish oil	1	16	7·3	3·5				100
Oct. 1968								
Seal (grey) liver	1	96	41	44	3·9	1·7	1·8	4·1
Seal (common and grey)	2	130	62	30	66	32	15	52
Sept., Nov. 1968		(110–150)	(57–66)	(16–43)	(58–74)	(31–32)	(8·5–21)	(45–55)
Eggs from guillemot	9	570	20	250	40	1·2	16	7·0
May 1968		(300–790)	(7·5–38)	(140–360)	(20–51)	(0·7–2·3)	(7·9–21)	(3·6–11)
The Archipelago of Stockholm								
Mussel	15	3	1	5·2	0·04	0·02	0·037	1·1
Oct. 1966, Dec. 1967		(1–4·7)	(1–1·8)	(3·4–7·0)	(0·01–0·061)	(0·01–0·024)	(0·032–0·044)	(0·94–1·3)
Herring	4	7·7	3·9	5·1	0·23	0·11	0·17	2·6
May 1965		(4·3–11)	(2·0–5·3)	(3·3–8·5)	(0·094–0·30)	(0·044–0·15)	(0·073–0·23)	(2·2–2·8)

REF. NO.: 73 - K - 1

SUBSTANCES: DDE, DDD, DDT, toxaphene

Reference: Keiser, R. K. Jr., J. A. Amado A. & R. Murillo S. 1973. Pesticide levels in estuarine and marine fish and invertebrates from the Guatemalan Pacific coast. Bull. Mar. Sci. 23:905-924.

Organisms: Mytella strigata

Date of Sample Collection: 1970

Location: Pacific coast Guatemala

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 5

PESTICIDE LEVELS IN FISH AND INVERTEBRATES FROM AREA II
(All levels are reported on a wet-weight basis [with exception of salt-dried shrimp] in parts per million [ppm])

	p,p'-DDE	*o,p'*-DDD	*p,p'*-DDD	*p,p'*-DDT	Total DDT	Toxaphene*
Laguneta Rama Blanca, July 23, 1970						
Dormitator latifrons	3.39	n.d.	0.76	2.23	6.38	+
Lile stolifera	11.08	n.d.	2.77	3.93	17.78	+
Cardisoma sp.	1.98	n.d.	n.d.	1.58	3.56	–
Mytella strigata	6.48	n.d.	3.71	5.65	15.84	–
Strombus galeatus	1.89	n.d.	0.69	0.44	3.02	–
Laguneta Rama Blanca, Sept. 1, 1970						
Dormitator latifrons	1.79	n.d.	1.98	5.31	9.08	+
Mugil sp.	4.89	n.d.	n.d.	3.63	8.52	+
Poecilia sphenops	8.65	n.d.	4.84	7.65	21.14	+
Mytella strigata	3.31	0.68	2.06	0.34	6.39	+

REF. NO.: 66 - K - 1 **SUBSTANCES:** DDT

Reference: Keith, J. O. & E. G. Hunt. 1966. Levels of insecticide residues in fish and wildlife in California. Trans. 31st North American Wildlife Conference, Mar. 1966, Pitsburgh, Pa., p. 150-177. Wildlife Management Inst., Washington, D.C.

Organisms: Saxidomus nuttali, Schizothaerus nuttali, Protothaca staminea, Crassostrea gigas, Tapes semidecussata, Hinnites multirugosus, Macoma nasuta

Date of Sample Collection: 1963-65

Location: California

Analytical Technique: Gas chromatography

Analytical Data: (wet wt)

Table 14. Summary of DDT residues found in flesh of shellfish

Species	No. of Samples Analyzed a/	Average DDT Residues in parts per million (ranges in parentheses)
Common Washington clam Saxidomus nuttali	4	0.05 (0.00-0.20)
Common littleneck clam Protothaca staminea	6	0.23 (0.00-1.39)
Japanese littleneck clam Tapes semidecussata	1	0.00
Bent-nose clam Macoma nasuta	1	0.00
Gaper clam Schizothaerus nuttali	4	0.00
Giant Pacific oyster Crassostrea gigas	10	0.17 (0.00-0.68)
Rock scallop Hinnites multirugosus	1	0.16

a/ All samples contained several to numerous individual animals.

REF. NO.: 77 - K - 1

SUBSTANCES: DDT, DDE, TDE, PCB

Reference: Klaas, E. E. & A. A. Belisle. 1977. Organochlorine pesticide and polychlorinated biphenyl residues in selected fauna from a New Jersey salt marsh--1967 vs. 1973. Pest. Monit. J. 10:149-158.

Organisms: Geukensia demissa

Date of Sample Collection: 1967 and 1973

Location: Cape May, New Jersey

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 7. *Comparison of ΣDDT residues in selected biota from salt marshes, Cape May County, New Jersey—1967 vs. 1973*

	Residues, ppm wet weight						
	1967			1973			
Species	n[1]	Geometric mean	Range	n[1]	Geometric mean	Range	Percent change[2]
Clapper Rail	43	3.36	0.55-18.70	27	0.54	0.18-3.4	-84
Sheepshead Minnow	5	8.59	3.20-21.00	5	0.31	0.12-0.91	-96
Mummichog	6	9.05	0.84-34.00	6	0.20	0.11-0.43	-98
Striped Killifish	3	3.97	1.03-21.00	6	0.19	0.09-0.66	-95
Fiddler Crab	5	1.33	0.41-4.19	6	0.13	0.03-0.76	-90
Ribbed Mussel	5	1.61	0.02-12.87	6	0.03	0.02-0.11	-98
Periwinkle	1	0.63	—	6	0.03	0.00-0.04	-95
Mud Snail	3	0.87	0.05-7.59	6	0.06	0.03-0.21	-93
Salt Marsh Snail	6	2.60	0.24-13.86	6	0.03	0.00-0.10	-99

[1] For clapper rail, n = number of individuals; for all others, n = number of pooled samples.
[2] Changes are all significant at probability levels of 0.05 or less (two-tailed, Wilcoxen two-sample test).

TABLE 6. *Chlorinated hydrocarbon residues in pooled samples of invertebrates from Cape May County, New Jersey —1967 and 1973*

				Residues, ppm wet weight					
Locality	Year	Sample weight, g	Percent lipid	p,p'-DDE	p,p'-TDE	o,p'-TDE	p,p'-DDT	o,p'-DDT	PCB's
Ribbed Mussel (*Geukensia demissa*)									
Ocean City	1967	55.75	0.8	0.27	0.36	0.07	2.3	0.47	0.17
	1973	91.36	0.4	0.02	0.01	ND	ND	ND	ND
Sea Isle City	1967	62.64	0.3	0.37	0.51	0.09	3.6	0.73	0.05
	1973	107.97	0.2	0.01	0.01	ND	ND	ND	ND
Avalon	1973	101.59	0.2	0.02	ND	ND	ND	ND	0.10
Palermo	1967	25.19	0.7	0.94	1.5	0.23	9.0	1.2	0.36
	1973	83.98	0.2	0.06	0.03	ND	0.02	ND	0.22
Ocean View	1967	54.95	0.6	0.20	0.24	0.05	1.6	0.20	0.27
	1973	56.05	0.5	0.02	ND	ND	ND	ND	0.02
Swainton	1967	66.92	0.2	0.02	ND	ND	ND	ND	0.10
	1973	37.03	0.3	0.03	ND	ND	ND	ND	0.24

REF. NO.: 69 - K - 1

SUBSTANCES: PCBs

Reference: Koeman, J. H., M. C. Ten Noever De Brauw & R. H. De Vos. 1969. Chlorinated biphenyls in fish, mussels and birds from the River Rhine and the Netherlands coastal area. Nature 221:1126-1128.

Organisms: Mytilus edulis

Date of Sample Collection: 1968

Location: Netherlands coast

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

Table 1. MASS NUMBERS AND NUMBERS OF CHLORINE ATOMS/MOLECULE (IN PARENTHESES) OF PEAKS WITH RELATIVE RETENTION TIMES (RELATIVE DIELDRIN = 1) LONGER THAN 0·20 AND SHORTER THAN 1·00

Sampling area	Type of sample	0·25	0·32	0·33	0·34	0·40	r_r 0·48	0·57	0·61	0·65	0·71	0·72	0·83	(
1	Roach (*Leuciscus rutilus*) total body extracts 1967, 1968	HCB 282 (6)	256 (3)	256 (3)		256 (3) + 290 (4)	290 (4)	290 (4)	290 (4)		290 (4)		324 (5)	324
1	Groundling (*Gobio gobio*) total body extracts 1968	+	+	+		+	+		+		+		+	
2	Mussel (*Mytilus edulis*) 1968	+			+	+				+			+	
3	Sand eel (*Ammodytes lanceolatus*) total body extracts 1966	+		+		+	+	+	+		+			
3	Sandwich tern (*Sterna sandricensis*) tissue and egg extracts 1965, 1966	HCB 282 (6)				256 (3)	290 (4)	290 (4)	Telodrin 406 (8)		290 (4) + 376 (8)		324 (5)	
3	Elder (*Somateria mollissima*) tissue and egg extracts 1966, 1967	HCB 282 (6)				256 (3)			Telodrin 406 (8)		290 (4) + 376 (8)		324 (5)	
	Phenochlor DP 6											324 (5)	324 (5)	
	Arochlor 1260											324 (5)	324 (5)	
	Clophen A 60											324 (5)	324 (5)	

With the exception of HCB, telodrin and compound 370 (8) all compounds identified are conformable to PCBs. +, At the given retention time a p is present in the chromatogram. A 10 per cent *DC* 200 on Gaschrom *Q* (80-100 mesh) column was used. $t = 200°$ C. Carrier Gas N, ($\pm$ 50 ml./min). N number calculations are based on Cl = 35. The sampling places are indicated in Fig. 2. HCB = Hexachlorobenzene; telodrin = 1,3,4,5,6,7,8,8-octach 1,3,3a,4,7,7a hexahydro-4,7-methano-isobenzofuran.

Table 2. MASS NUMBERS AND NUMBERS OF CHLORINE ATOMS/MOLECULE (IN PARENTHESES) OF PEAKS WITH RELATIVE RETENTION TIMES (RELATIVE TO DIELDRIN = 1) OF PEAKS LONGER THAN 1·00

Sampling area	Type of sample	1·01	1·17	1·23	1·45	1·57	r_r 1·69	1·96	2·27	2·67	3·20	3·58
1	Roach (*Leuciscus rutilus*) total body extracts 1967, 1968	DDE 316 (4) + 324 (5)	358 (6)	358 (6)	358 (6)	392 (7)	358 (6) 392 (7)	392 (7)	392 (7)	392 (7)	392 (7)	426 (8)
1	Groundling (*Gobio gobio*) total body extracts 1968	+	+	+	+	+	+	+	+	+	+	+
2	Mussel (*Mytilus edulis*) 1968	+	+	+	+	+	+	+	+	+	+	+
3	Sand eel (*Ammodytes lanceolatus*) 1966	+	+	+	+	+	+	+	+	+	+	+
3	Sandwich tern (*Sterna sandricensis*) tissue and egg extracts 1965, 1966	DDE 316 (4) + 324 (5)		358 (6) + 324 (5)	358 (6)		358 (6)	392 (7)	392 (7)	392 (7)	392 (7)	426 (8)
3	Elder (*Somateria mollissima*) tissues and egg extracts 1966, 1967	DDE 316 (4) + 324 (5)		358 (6) + 324 (5)	358 (6)		358 (6)	392 (7)	392 (7)	392 (7)	392 (7)	426 (8)
	Phenochlor DP 6	358 (6)	358 (6)	358 (6)	358 (6)	392 (7)	358 (6)	392 (7)	392 (7)	392 (7)	392 (7)	426 (8)
	Arochlor 1260	358 (6)	358 (6)	358 (6)	358 (6)	392 (7)	358 (6)	392 (7)	392 (7)	392 (7)	392 (7)	426 (8)
	Clophen A 60	358 (6)	358 (6)	358 (6)	358 (6)	392 (7)	358 (6)	392 (7)	392 (7)	392 (7)	392 (7)	426 (8)

With the exception of DDE all compounds identified are conformable to PCBs. +, At the given retention time a peak is present in the chromatogram. See notes under Table 1.

REF. NO.: 74 - M - 3

SUBSTANCES: PCB, DDT

Reference: Marchand, M.,D. Vas & E. Duursma. 1974. Résidus de DDT et de polychlorobiphényles (PCB) dans les moules, le sédiment et le plancton de la côte nord-ouest méditerranéenne. Iles Journées Étud. Pollutions, p. 171-174. Monaco, C.I.E.S.M.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1974?

Location: Northwest Mediterranean coast, between Sete and Genoa

Analytical Technique: Electron capture gas chromatography

Analytical Data:

Marchand, M. et al. 1974.

Tableau I

Concentrations de ΣDDT et de PCB dans les moules *(Mytilus galloprovincialis)* et le sédiment de la côte nord-ouest Méditerranéenne

Stations	Date	Moules ppb/poids sec ΣDDT	Moules ppb/poids sec PCB	Moules ppb/poids sec ΣDDT/PCB	Sédiment ppb/poids sec ΣDDT	Sédiment ppb/poids sec PCB	Sédiment ppb/poids sec ΣDDT/PCB
Saint-Pierre-sur-Mer	III-74	453	1092	0,41			
Sète	VI-73	984	1753	0,56	19	29	0,66
	III-74	1960	4088	0,48			
	VI-74	805	3423	0,23			
Grau du Roi	VI-73	255	2080	0,12	0,98	4	0,26
	III-74	361	2733	0,13			
	VI-74	443	3425	0,13			
Port Saint-Louis	VI-73	320	2111	0,16	2,33	26	0,09
	III-74	120	754	0,16			
	VI-74	160	1330	0,12			
Marseille	VI-73	402	4580	0,09			
	III-74	1329	4315	0,31			
	VI-74	10608	9880	1,07			
Bec de l'Aigle	VI-73	296	1866	0,16			
	III-74	127	754	0,17			
	VI-74	120	632	0,19			
Cap Sicié	VI-73	123	1313	0,09	0,04	0,83	0,05
	VI-74	244	708	0,34			
Saint-Mandrier	III-74	473	3570	0,13			
	VI-74	535	3899	0,14			
Toulon	VI-73	113	2461	0,05	0,66	3,40	0,19
	III-74	2640	6084	0,43			
	VI-74	3802	11500	0,33			
Cap Camarat	VI-73	147	396	0,37	0,60	1,60	0,40
Saint-Tropez	VI-73	221	746	0,30	2,10	10,3	0,20
	III-74	204	768	0,26			
	VI-74	91	693	0,13			
Saint-Raphaël	VI-73	370	2660	0,14	1,50	8,50	0,17
	VI-74	205	663	0,31			
Cannes	VI-73	459	1916	0,24			
	VI-74	171	3942	0,04			
Antibes	VI-73	264	1179	0,22			
	III-74	193	1003	0,19			
	VI-74	298	1248	0,24			
Nice Airport*	II-73				0,39	29	0,01
Nice Casino*	II-73				31,3	1165	0,03
Villefranche*	II-73				8,6	86	0,10
Monaco	III-73				2,9	5,5	0,53
	III-74	273	2016	0,13			
	VI-74	203	1580	0,13			
San Remo	VI-73				17	4,8	3,5
	III-74	478	197	2,43			
	VI-74	4018	940	4,27			
Savona	VI-73				0,05	1,8	0,03
	III-74	502	264	1,90			
	VI-74	198	457	0,43			
Gênes	VI-73	778	445	1,29	1,30	4,0	0,30
	VI-74	496	4800	0,10			

* profondeur — 100 mètres.

REF. NO.: 75 - M - 3

SUBSTANCES: DDT, PCBs

Reference: Marchand, M. & E. Duursma. 1975. Residus de DDT et de polychlorobiphenyles (PCB). Identification et dosage dans les moules et le plancton de la cote nord-ouest Mediterranenne. Bull. Un. Oceanogr. Fr. 7(1-2):21-24.

Organisms: *Mytilus galloprovincialis*

Date of Sample Collection: 1973-74

Location: Northwest Mediterranean

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

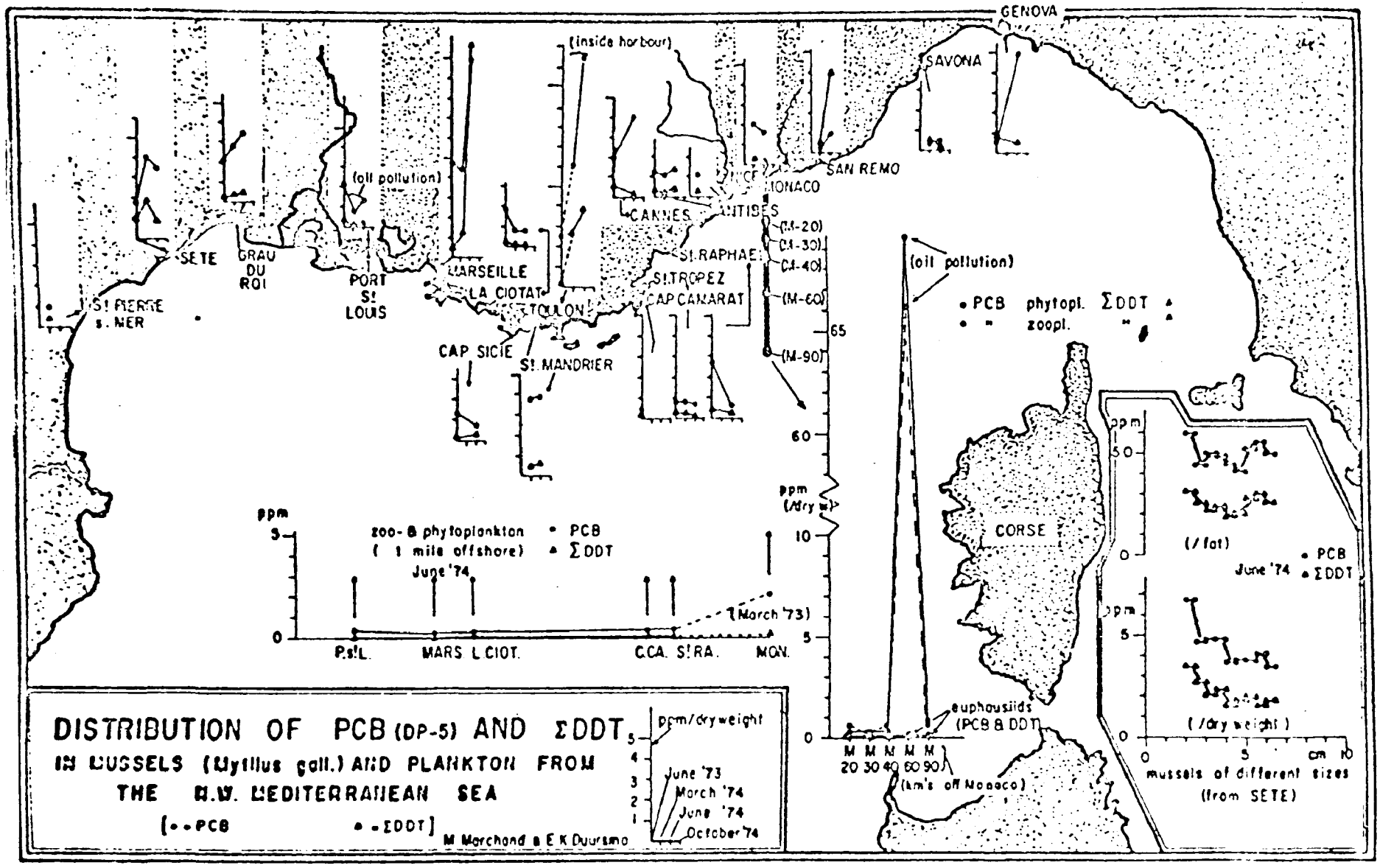


Figure 5. Distribution des PCB (DP-5) et du DDT dans les moules (Mytilus galloprovincialis) et le plancton de la côte Nord-Ouest méditerranéenne.

REF. NO.: 76 - M - 1

SUBSTANCES: DDT, PCB

Reference: Marchand, M., D. Vas & E. K. Duursma. 1976. Levels of PCBs and DDTs in mussels from the N.W. Mediterranean. Mar. Pollut. Bull. 7:65-68.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1973-74

Location: Mediterranean, France and Italy

Analytical Technique: Electron capture gas chromatography

Analytical Data: (dry wt, freeze-dried)

TABLE 2
Comparison of PCB and DDT concentrations in mussels at various locations throughout the world.

Date	Location	[PCB] ng/g	Σ DDT ng/g
1973–1974	Northwestern Mediterranean	268	88 present study
1966–1968	Baltic Sea	30	30 Jensen *et al.* (1969)
1966–1967	Archipelago of Stockholm	37	40 Jensen *et al.* (1969)
1965–1968	Holland coast, mouth of river Rhine	600–1100	100–250 Koeman & Van Genderen (1972)
1972	Sweden	95	13 ICES (1974)
	Norway	30	25 ICES (1974)
	Germany	90	25 ICES (1974)
1972	Holland	237	9 Ten Berge & Hillbrand (1974)
1970	Canadian Atlantic coast	140	20 Zitko (1971)
1965–1966	California coast		19–34 Risebrough *et al.*, (1967)

TABLE 3
Temporal comparisons of PCB concentrations (ng/g) in mussels from four northwestern Mediterranean stations.

	Our values July 1973 – Dec. 1974				De Lappe *et al.*, (1972)
Stations	Dry weight	Wet weight (calculated)	+ 1 σ	Range	Wet weight
Grau du Roi	2492	299	+ 91	(208 – 390)	520
Marseille	7686	922	+ 432	(490–1354)	1920
St. Tropez	801	96	+ 32	(64 – 128)	120
Cannes	1978	237	+ 59	(178 – 296)	450

Marchand, M. et al. 1976.

TABLE 1

DDT and metabolites and polychlorinated biphenyls (PCB) in mussels from the northwestern Mediterranean coast. (ppb (ng/g) expressed in dry weight).

Stations	Date	pp'DDT	op'DDT	pp'DDD	pp'DDE	ΣDDT	PCB	ΣDDT/PCB	% extractable material to dry weight
St. Pierre s/Mer	3/74	176	34	78	165	453	920	0.49	6.01
Sète	6/73	125	–	587	272	984	1810	0.54	5.33
	3/74	890	220	660	190	1960	3650	0.54	7.33
	6/74	447	126	126	106	805	2960	0.27	–
	9/74	85	8	173	89	355	1020	0.35	3.91
	12/74	245	145	294	199	833	3140	0.28	6.73
Grau du Roi	6/73	140	–	101	14	255	2380	0.11	5.82
	3/74	173	41	57	90	361	3260	0.11	6.36
	6/74	197	60	71	115	443	3450	0.13	5.56
	9/74	65	–	65	78	208	1570	0.13	4.45
	12/74	19	–	–	30	49	1800	0.03	3.47
Port St. Louis	6/73	140	–	146	34	320	2180	0.15	7.13
	3/74	83	–	17	20	120	685	0.18	5.57
	6/74	101	27	16	16	160	1330	0.12	7.05
	9/74	31	–	41	20	92	370	0.25	5.03
	12/74	21	–	99	8	128	680	0.19	5.55
Marseille	6/73	278	–	103	21	402	3580	0.11	6.41
	3/74	893	204	144	88	1329	4450	0.30	5.95
	6/74	6612	1504	1474	1018	10608	10900	0.97	7.32
	9/74	759	–	2070	607	3436	11400	0.30	6.03
	12/74	266	–	460	200	926	8100	0.11	7.59
Bec de l'Aigle	6/73	274	–	9	13	296	1695	0.17	6.37
	3/74	90	7	3	27	127	807	0.16	6.49
	6/74	95	–	6	19	120	632	0.19	4.87
Cap Sicié	6/73	96	–	22	5	123	1240	0.10	5.42
	6/74	71	–	168	5	244	770	0.32	4.95
St. Mandrier	3/74	321	88	36	28	473	3680	0.13	5.43
	6/74	380	101	25	29	535	4080	0.13	6.45
	9/74	79	–	15	28	122	1475	0.08	3.32
Toulon	6/73	114	–	19	ND	113	2920	0.04	6.36
	3/74	1740	426	296	178	2640	6400	0.41	7.30
	6/74	2216	477	762	347	3802	13500	0.28	12.45
	9/74	1167	339	580	873	2959	6020	0.49	7.60
	12/74	164	–	178	151	493	4050	0.12	3.84
Cap Camarat	6/73	78	–	26	45	147	312	0.47	4.18
	9/74	32	–	17	27	76	182	0.42	3.11
	12/74	15	–	23	10	48	320	0.15	5.70
St. Tropez	6/73	136	–	56	29	221	625	0.35	5.19
	3/74	105	31	23	45	204	748	0.27	4.86
	6/74	74	–	2	15	91	728	0,12	6.10
	9/74	53	–	8	33	94	585	0.16	5.19
	12/74	17	–	12	8	37	1320	0.03	6.58
St. Raphael	6/73	177	–	172	21	370	2660	0.14	9.71
	6/74	102	41	26	36	205	765	0.27	4.74
	9/74	94	–	75	58	227	990	0.23	5.37
	12/74	63	–	207	26	296	915	0.32	5.31
Cannes	6/73	394	–	65	ND	459	1825	0.25	6.78
	6/74	161	–	ND	10	171	2530	0.07	5.67
	9/74	67	–	45	18	130	1250	0.10	1.92
	12/74	80	–	162	–	242	2310	0.10	4.19
Antibes	6/73	200	–	52	12	264	1050	0.25	7.15
	3/74	144	–	11	38	193	780	0.25	7.66
	6/74	177	63	4	54	298	1310	0.23	7.98
	9/74	52	17	34	43	146	715	0.20	4.70
	12/74	27	–	216	9	252	605	0.42	4.08
Monaco	3/74	203	–	46	23	273	2310	0.12	6.70
	6/74	145	–	34	24	203	1670	0.12	6.70
	9/74	55	–	40	36	131	540	0.24	5.55
	12/74	103	–	51	18	172	2580	0.07	5.75
San Remo	3/74	191	65	122	100	478	197	2.42	2.72
	6/74	2680	730	268	340	4018	990	4.06	4.88
	9/74	2075	478	1019	434	4006	2450	1.63	7.72
	12/74	493	234	136	156	1019	1080	1.00	5.84
Savona	3/74	63	–	439	Tr	502	264	1.90	2.95
	6/74	91	–	102	5	198	360	0.55	6.47
	9/74	53	–	34	30	117	800	0.15	4.28
	12/74	31	–	35	6	72	645	0.11	2.35
Genoa	6/73	618	–	87	73	778	480	1.62	4.12
	6/74	382	100	ND	14	496	5050	0.10	10.57
	9/74	39	–	101	10	150	585	0.26	2.74
	12/74	140	–	21	44	205	2600	0.08	7.48

REF. NO.: 75 - M - 4

SUBSTANCES: PCB, DDT, TDE, DDE, HCH, aldrin, dieldrin

Reference: Marcos, G. B. 1975. Residuos de insecticidas cloridas y PCB en algunas especies marinas del entorno europeo y su incidencia en la alimentación. Invest. Pesq. 39(1):219-224.

Organisms: Mytilus edulis

Date of Sample Collection: 1968-70

Location: Mediterranean and Atlantic -- Italy, Portugal, England, Holland, Norway, Sweden, Finland

Analytical Technique:

Analytical Data:

TABLA 1

Niveles medios de residuos órgano-clorados en especies marinas capturadas en las cercanías costeras de los países europeos que se citan

Residuos	*España*		*Italia*	*Portugal*	*Inglaterra*	*Holanda*	*Noruega*	*Suecia*	*Finlandia*
	Mediterráneo (1)	*Atlántico*							
Especies muestreadas en 1968									
MEJILLÓN *(Mytilus edulis)* (ppm sobre peso tejido blando fresco)									
Dieldrín	0,001	0,001	< 0,005	0,008	0,015	0,018	0,002	< 0,001	< 0,001
pp'-DDE	0,033	0,014	0,015	0,023	0,023	0,021	0,003	0,005	< 0,010
pp'-TDE	0,030		0,026	0,028	0,026	nc (2)	0,002	< 0,010	< 0,010
pp'DDT	0,140	0,050	0,078	0,080	0,012	nc	0,006	0,010	0,017
PCB	nc	nc			T (3)	0,420	0,004	0,030	0,060
Especies muestreadas en 1970									
MEJILLÓN (ppm sobre peso tejido blando)									
Dieldrín	0,007	< 0,001		0,002	0,030	0,013	< 0,005		< 0,005
pp'-DDE	0,055	0,003		0,009	0,020	0,017	< 0,005		< 0,005
pp'-TDE	0,024	0,006		0,005	0,020		< 0,005		< 0,005
pp'-DDT	0,010	0,005		0,012	0,022		< 0,005	0,013 (4)	0,011
PCB	0,880	0,150		0,080	0,300	0,600	< 0,005	0,020	0,030

(1) Mejillón no destinado a consumo humano. (2) No calculado. (3) Trazas. (4) DDT total. (5) No detectado. Estos niveles sólo reflejan la media de varias zonas costeras entre las que existen algunas apenas polucionadas con trazas.

TABLA II

Niveles medios de residuos órgano-clorados en mejillón y sardina muestreados en 1970 en las proximidades costeras de zonas mediterráneas y atlánticas españolas que se citan

Procedencia	*HCH* ($\alpha+\gamma$)	*Aldrin*	*Dieldrin*	*pp'-DDE*	*pp'-TDE*	*pp'-DDT*	*PCB*
MEJILLÓN *(Mytilus edulis)*, ppm por peso de tejido blando fresco							
Blanes	0,012	< 0,001	0,002	0,035	0,011	0,012	0,58
Barcelona	0,020	0,003	< 0,001	0,054	0,034	0,011	1,05
Ampolla	0,036	< 0,001	< 0,001	0,143	0,061	0,005	1,36
Castellón	0,020		0,025	0,001	0,014	0,009	0,61
Vigo	0,003	< 0,001	< 0,001	0,004	0,006	0,006	0,10
Santander	0,036	0,001	0,001	0,002	0,004	0,005	0,67

REF. NO.: 72 - M - 1

SUBSTANCES: organophosphorous pesticides

Reference:

Marganian, V. M. & W. J. Wall Jr. Dursban® and diazinon residues in biota following treatment of intertidal plots on Cape Cod—1967-69. Pest. Monit. J. 6:160-165.

Organisms: Modiolus demissus
Crassostrea virginica
Mercenaria mercenaria

Date of Sample Collection: 1967-69

Location:

Cape Cod, Massachusetts

Analytical Technique:

Analytical Data:

TABLE 2.—*Dursban® residues in marine organisms at various intervals after treatment at a concentration of 0.05 lb/acre*

Organism	Substrate	Dursban® Residues in PPM (fresh-weight basis)[1]								
		Days								
		1	2	3	4	7	9	10	12	22
Mya arenaria (clam)	Intertidal sand		T	—	—	0.01				
Mollusca										
Modiolus demissus (ribbed mussel)	Salt marsh mud	—	2.58	0.12			—			

NOTE: Dursban® applied as 1% technical grade Dursban® in granular form; blank = no sample taken; — = no residue detected; T = trace = <0.01 ppm.

[1] Represents one analysis per sample.

TABLE 3.—*Diazinon residues in marine organisms at various intervals following treatment*

Organism	Substrate	Application Rate lb/acre	Diazinon Residues in PPM (fresh-weight basis)[1]															
			Days															
			1	2	3	4	5	6	7	8	9	11	14	15	22	29	36	38	45
Mollusca																			
Mercenaria mercenaria (quahog)	Salt marsh	0.25	4.36	T		0.07	1.80												
Crassostrea virginica (oyster)	Salt marsh	0.25				0.56				1.69	0.81		—	0.11	0.03	3.16		—	—
Modiolus demissus (ribbed mussel)	Salt marsh	0.25	50.00	2.06		2.93	3.93		0.99			0.09	0.23			T	0.03		

NOTE: Diazinon applied as 2% technical grade in granular form; blank = no sample taken;

[1] Represents one analysis per sample.

— = no residue detected; T = trace = <0.01 ppm.

REF. NO.: 74 - M - 1

SUBSTANCES: DDE, TDE, DDT, aroclor

Reference: Markin, G. P., J. C. Hawthorne, H. L. Collins & J. H. Ford. 1974. Levels of mirex and some other organochlorine residues in seafood from Atlantic and Gulf coastal states. Pest. Monit. J. 7:139-143.

Organisms: oysters, clams (unspecified)

Date of Sample Collection: 1971

Location: Atlantic and Gulf coast, U.S.

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 1.—*Summary of seafood samples from Atlantic and Gulf Coastal sites*

Location	Type of Seafood [1]							
	Crabs	Shrimps	Oysters & Shellfish	Squids	Predators/ Game Fish	Bottom Fish	Herring	Fish Products
1. Mississippi Sound	+	+	–	+	+	–	–	+
2. Mobile Bay	+	+	+	+	+	+	+	–
3. Tampa Bay	+	–	–	–	+	+	–	–
4. Jacksonville, Fla.	+	+	–	–	+	+	–	–
5. Savannah, Ga.	+	+	+	+	+	+	+	–
6. Charleston, S. C.	+	+	+	+	+	+	–	–
7. Morehead City, N. C.	+	+	+	–	+	+	–	+
8. Chesapeake Bay	+	–	–	–	+	–	+	–
9. Delaware Bay	+	–	–	–	+	+	–	–

[1] Plus sign (+) denotes sample collected minus sign (–) denotes no sample collected.

TABLE 2.—*Mirex, DDT and metabolites, and PCB residues in seafood*

Species	Sample quantity	Residues in ppm					
		DDE	TDE	DDT	Total DDT & Metabolites	Aroclor 1260	Mirex
Sampling Area 1—Mississippi Sound							
Crabs	15	0.102	0.024	0.020	0.146	0.07	–
Shrimp	1 kg	0.004	–	0.003	0.007	–	–
Squid	1 kg	0.001	0.009	0.007	0.017	0.03	–
Flounder	3	0.031	0.007	0.009	0.047	0.03	–
Speckled sea trout	3	0.100	0.040	0.060	0.200	0.20	–
Spanish mackerel	3	0.095	0.026	0.040	0.161	0.06	–
Weak fish	5	0.049	0.010	0.050	0.109	0.12	–
Atlantic whiting	5	0.070	–	0.020	0.090	0.10	–
Fish oil	1 liter	0.070	0.030	0.020	0.120	0.02	–
Fish meal	1 kg	0.030	0.016	0.011	0.057	0.02	–
Ground fish (unprocessed)	1 kg	0.120	0.030	0.027	0.177	0.04	–
Sampling Area 2—Mobile Bay, Ala.							
Blue crabs	15	0.157	0.040	0.037	0.234	0.12	–
Shrimp	1.3 kg	0.006	0.002	0.003	0.011	0.01	–
Oysters	20+	0.042	0.004	0.003	0.049	0.03	–
Squid	10	–	–	–	–	0.04	–
Flounder	3	0.085	0.017	0.036	0.138	0.11	–
Speckled sea trout	1	0.710	0.170	0.280	1.160	0.40	–
Spanish mackerel	2	0.020	0.008	0.014	0.042	0.18	–

REF. NO.: 75 - M - 1 SUBSTANCES: PCB

Reference: McDermott, D. J., D. R. Young & T. C. Heesen. 1975. Polychlorinated biphenyls in marine organisms off Southern California. Southern California Coastal Water Research Project, TM 223:45p.

Organisms: *Mytilus californianus*
Mytilus edulis

Date of Sample Collection: 1971-75

Location: Southern California

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

Table 12. Decrease of 1254 PCB in whole soft tissues of *Mytilus californianus* between 1971 and 1974.*

Station	Decrease Between 1971 and 1974 (%)
Coastal	
Gaviota	79
Santa Barbara	25
Point Hueneme	208**
Palos Verdes Peninsula	
Point Vicente	73
Royal Palm	73
San Clemente	58
Point Loma	54
Island	
Anacapa	29
Santa Barbara	65
Santa Catalina	30
San Nicolas	72
San Clemente	6**
Median Decrease	54

*1254 PCB was the PCB identified that most closely resembled Aroclor 1954.
**Percent increase between 1971 and 1974.

(.014 - .520 mg/wet kg)

McDermott, D. J. et al. 1975.

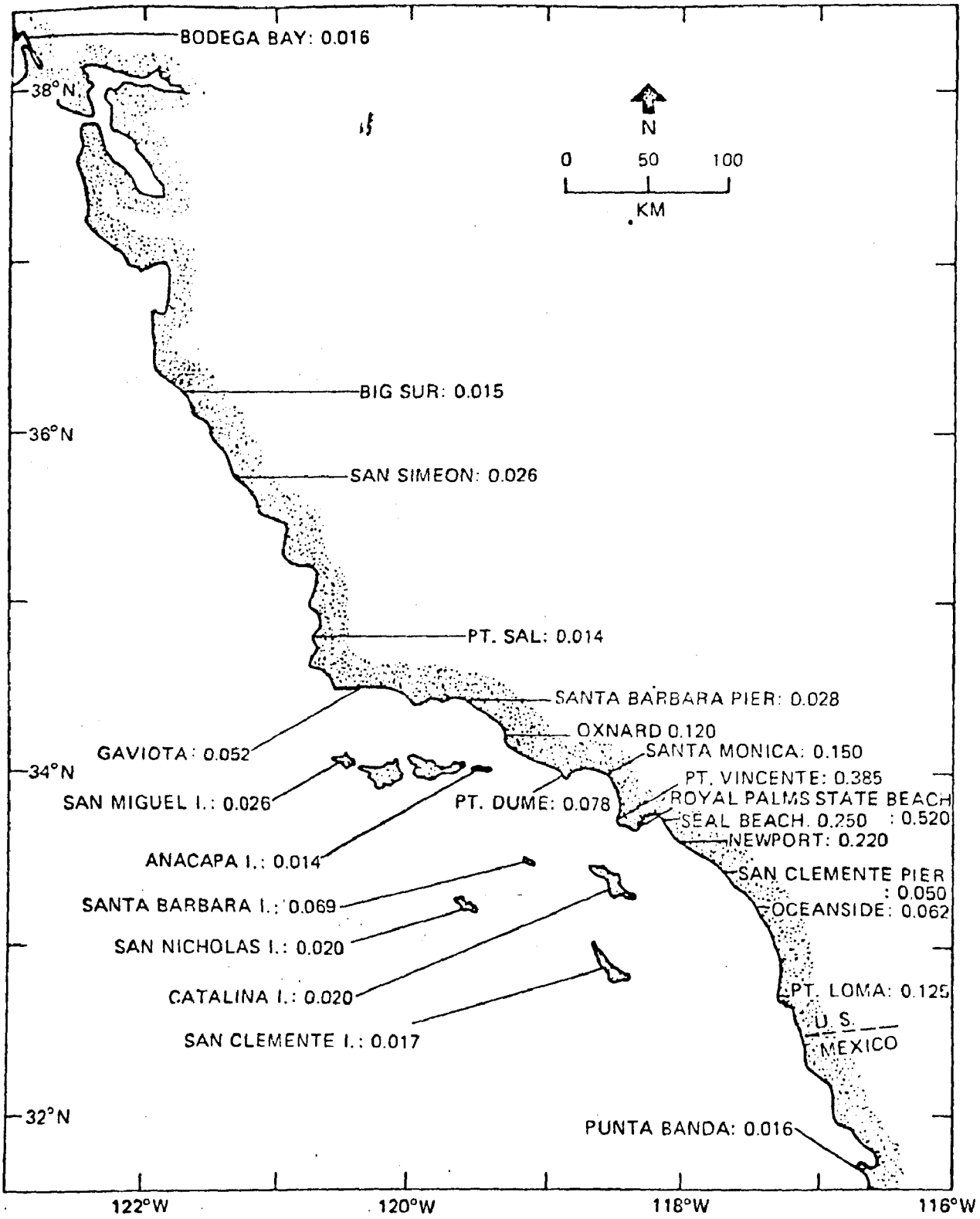


Figure 5. Concentrations (mg/wet kg) of the PCB most closely resembling Aroclor 1254 in whole soft tissue of *Mytilus californianus*, 1971. From Southern California Coastal Water Research Project 1973, fig. 8-17.

McDermott, D. J. et al. 1975.

(.006 - . 370 mg/wet kg)

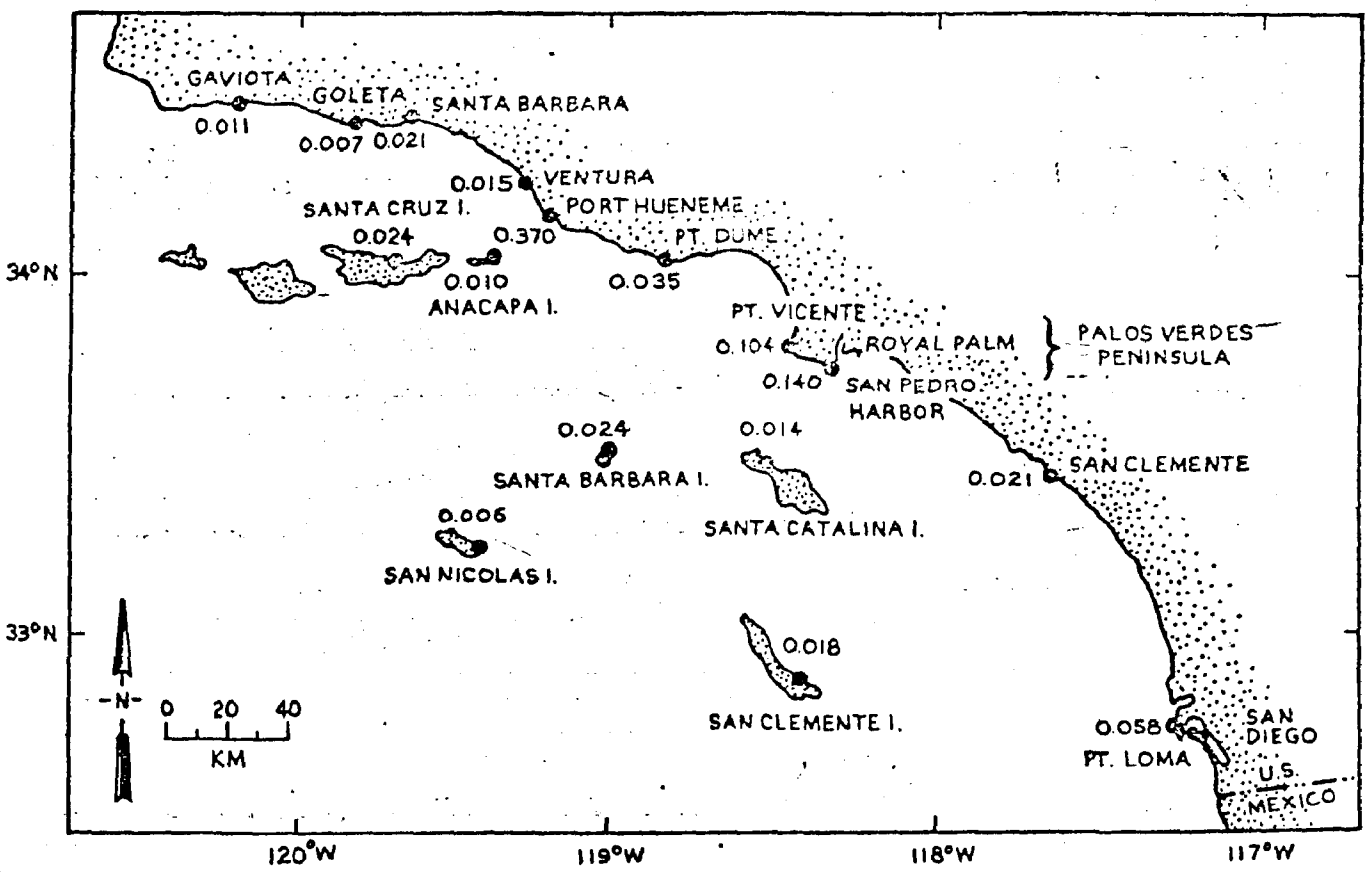


Figure 6. Concentrations (mg/wet kg) of the PCB most closely resembling Aroclor 1254 in the whole soft tissue of Mytilus californianus, 1974. After de Lappe et al. 1975.

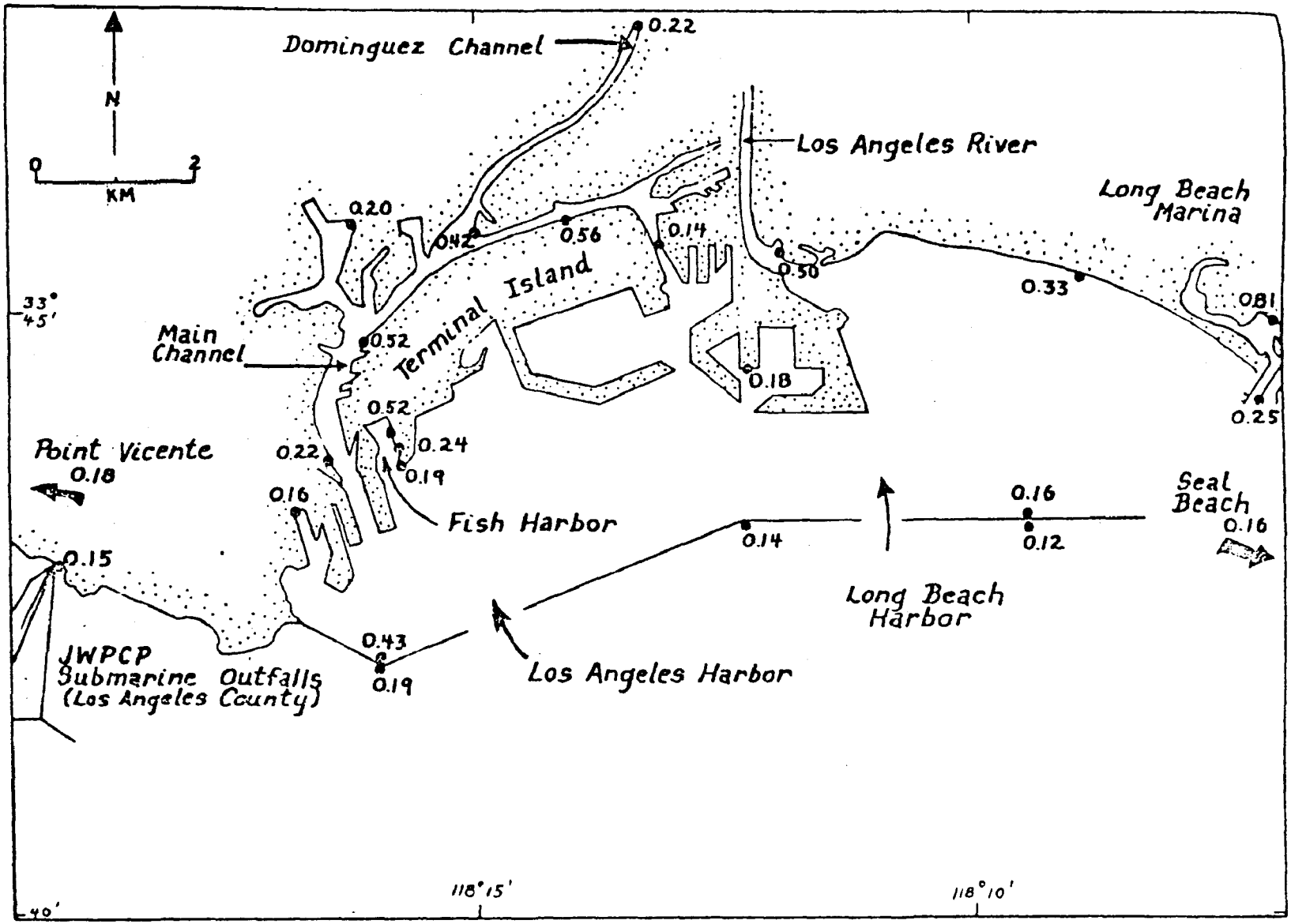


Figure 7. Total PCB concentrations (mg/wet kg) in whole soft tissues of *Mytilus edulis* in San Pedro Harbor, January 1974. After Young et al. 1975b.

McDermott, D. J. et al. 1975.

(.12 - .81 mg/wet kg)

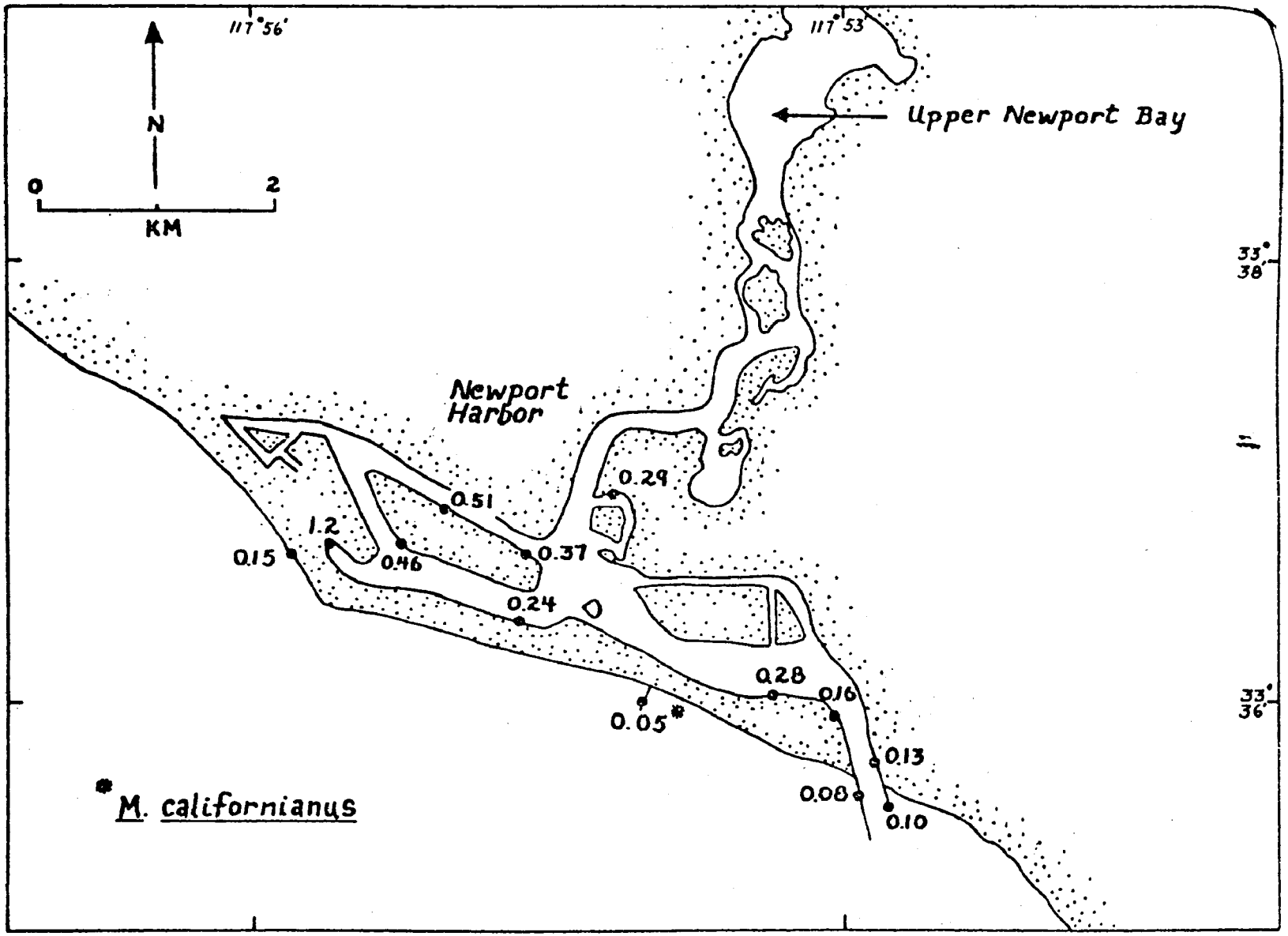


Figure 8. Total PCB concentrations (mg/wet kg) in whole soft tissues of Mytilus edulis from Newport Bay, January 1974. After Young et al. 1975b.

McDermott, D. J. et al. 1975.

(.05 - 1.2 mg/ wet kg)

(.04 - 1.3 mg/wet kg)

McDermott, D. J. et al. 1975.

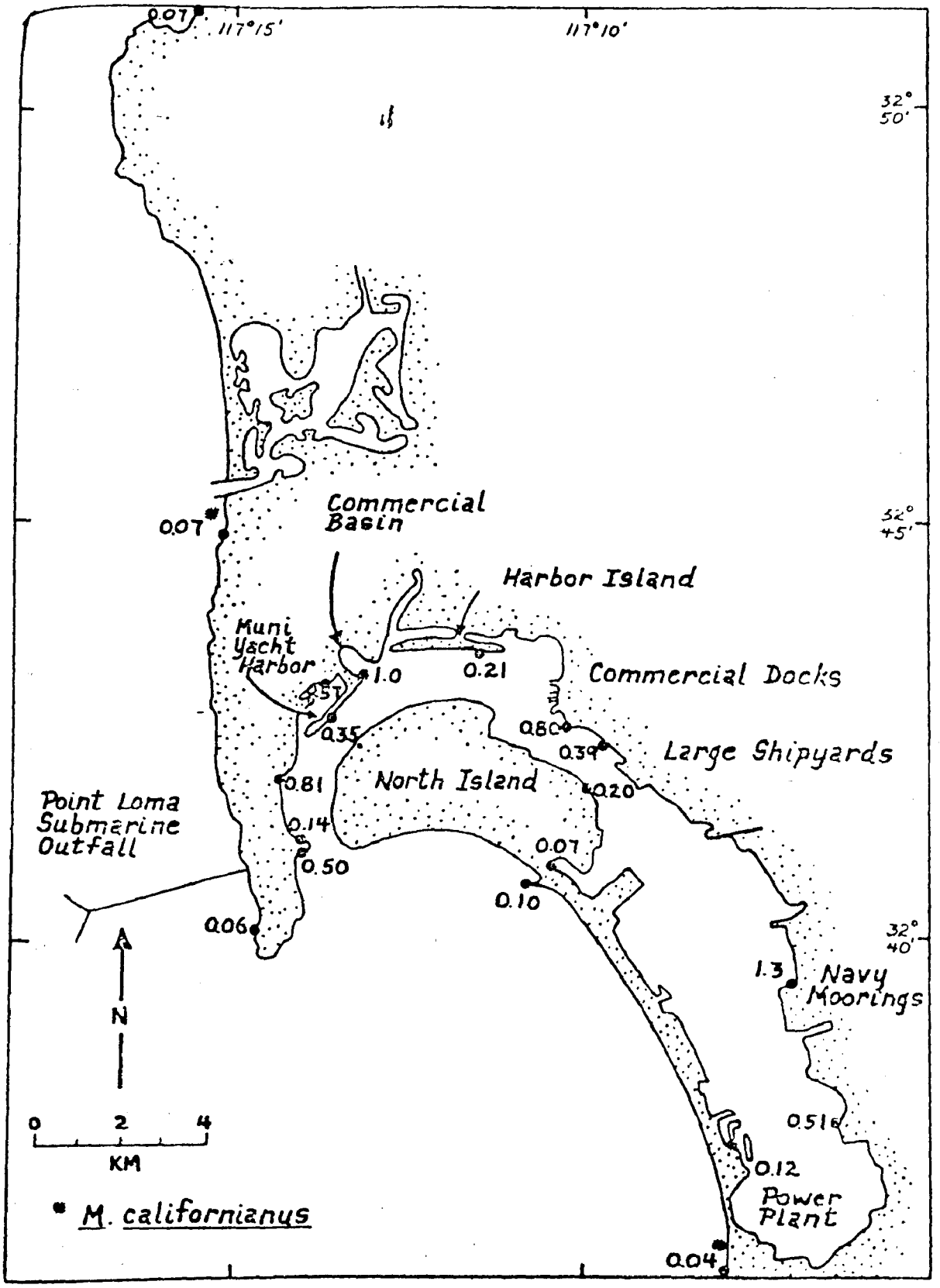


Figure 9. Total PCB concentrations (mg/wet kg) in whole soft tissues of Mytilus edulis in San Diego Bay, January 1974. After Young et al. 1975b.

McDermott, D. J. et al. 1975.

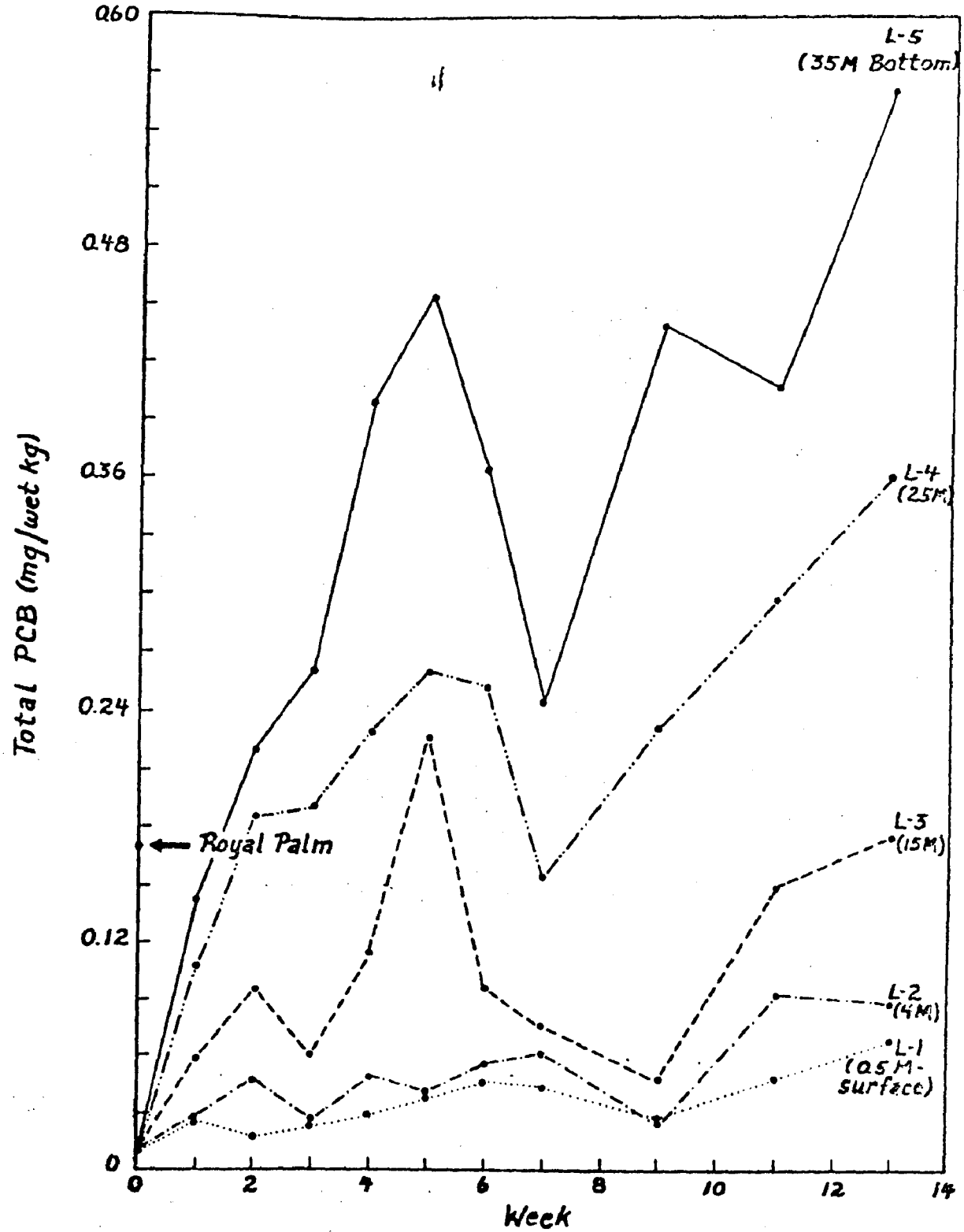


Figure 10. Total PCB concentrations in whole soft tissue composites of Mytilus californianus suspended from a buoy off Palos Verdes, June through September 1974. After Young et al. 1975c.

REF. NO.: 68 - M - 1

SUBSTANCES: DDE, DDD, DDT, dieldrin

Reference: Modin, J. C. 1968. Pesticide concentrations in California bays and estuaries. Proc. Symposium on Mollusca, Cochin, Jan. 12-16, 1968, Pt. II, p. 519-530. Mar. Biol. Ass. India.

Organisms: Ostrea lurida
Crassostrea gigas
Corbicula fluminea

Date of Sample Collection: 1966-67

Location: California

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE I

Concentrations of pesticides in parts per billion in oysters sampled from California bays, January-April 1966

	January				February				March				April			
	DDE	DDD	DDT	Di*	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di
Humboldt Bay																
Bird Island																
Gunther Island			Tr				10								47	
Tomales Bay																
Nicks Cove					12	Tr	Tr		11							
Tomales Bay Oyster Co.	Tr				Tr	Tr										
Drakes Estero																
Schooner Bay					Tr				Tr	Tr						
Berries Bar					13	15	Tr		Tr	Tr			10	17		
San Francisco Bay																
Marin Pier	13	19	13		30	36	13		47	60	19		52	83	23	14
Coyote Point	48	66	54		77	100	84	27	42	54	43	20	72	88	70	29
Elkhorn Slough																
Round Island	155	155	230		210	215	285	20	96	120	110	11	96	110	96	20
Morro Bay																
Baywood	73	32	22		73	31	24		82	35	26		75	25	20	24
Los Osos Creek	51	24	22		49	22	17		43	17	14		88	39	30	27

* Dieldrin. Tr. Trace only.

Modin, J. C. 1968.

TABLE II

Concentrations of pesticides in parts per billion in shellfish sampled from California bays, May-August 1966

	May				June				July				August			
	DDE	DDD	DDT	Di*	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di
Humboldt bay																
Bird Island																
Gunther Island			11		Tr	Tr	14		11	17			Tr		11	
Tomales Bay																
Nicks Cove	Tr				Tr				11				11	Tr		
Tomales Bay Oyster Co.	Tr	11	Tr						14	Tr			11	Tr		
Drakes Estero																
Schooner Bay	Tr	Tr			Tr				Tr				Tr			
Berries Bar	13	16	Tr		10	10			17	13			11	11		
San Francisco Bay																
Marin Pier	69	120	45	20	59	92	38		37	47	24		52	82	43	
Coyote Point																
Native Oyster	71	91	74	23	47	66	46		30	38	39		35	46	42	
Bay Mussel													29	51	49	
Elkhorn Slough																
Round Island																
Pacific Oyster	89	95	85	18	88	82	65		86	79	64		72	77	55	
Bay Mussel													60	46	30	
Morro Bay																
Baywood	76	32	24	16	52	19	14		55	20			62	25	18	
Los Osos Creek	65	25	20	10	40	16			43	16			53	22	14	

* Dieldrin. Tr. Trace only.

TABLE III

Concentrations of pesticides in parts per billion in shellfish sampled from California bays, September–December 1966

	September				October				November				December			
	DDE	DDD	DDT	Di*	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di
Humboldt Bay																
Bird Island																
Gunther Island	Tr	21			Tr	Tr	18		Tr	Tr	14		Tr	Tr	20	
Tomales Bay																
Nicks Cove	Tr				Tr				Tr	Tr			Tr			
Tomales Bay Oyster Co.	14	11			14	12			Tr				Tr			
Drakes Estero																
Schooner Bay					Tr	Tr			Tr	Tr						
Berries Bar	12	Tr			Tr	Tr			Tr	Tr			11	10		
San Francisco Bay																
Marin Pier	57	90	49		51	88	33	11	55	84	40	15	55	110	98	20
Coyote Point	50	65	55		42	71	62	21	33	51	40	15	63	79	75	21
Elkhorn Slough																
Round Island	79	66	41		84	65	56	10	130	77	76		190	160	210	30
Morro Bay																
Baywood	59	35	26		69	34	24		69	33	25		100	37	46	
Los Osos Creek	73	34	23		10	27	23		71	33	25		72	31	37	
Bolinas Lagoon	10				Tr	Tr			Tr	10						

* Dieldrin. Tr. Trace only.

Modin, J. C. 1968.

TABLE IV

Concentrations of pesticides in parts per billion in oysters sampled from California bays and rivers, January-April 1967

	January				February				March				April			
	DDE	DDD	DDT	Di*	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di
Humboldt Bay																
Bird Island																
Gunther Island	10	Tr	30		Tr		28		Tr		12		Tr	Tr	19	
Tomales Bay																
Nicks Cove	12	Tr	Tr		13	10	11		13	12	Tr		14	12	11	
Tomales Bay Oyster Co.	Tr		Tr		12	Tr	10		11	Tr	Tr		11	12	11	
Drakes Estero																
Schooner Bay	Tr				Tr				10	Tr			11	13	10	
Berries Bar	Tr	Tr			11	14			17	20	Tr		14	18	10	
Bolinas Lagoon		11				13			10	16			10	17	11	
San Francisco Bay																
Marin Pier	52	130	88	23	34	65	49	11	30	59	49	15	42	75	70	19
Coyote Point	41	60	58	26	49	68	72	26	51	74	79	28	61	82	89	23
Elkhorn Slough																
Round Island	200	160	260		220	230	440	25	200	200	390	29	230	260	690	30
Morro Bay																
Baywood	110	29	58		110	42	73		62	50	96		130	47	130	
Los Osos Creek	62	29	41		120	47	96		63	43	130		110	42	120	
San Joaquin River																
West Island	280	230	200		330	370	300	20	320	350	320	22	270	250	250	17
False River													470	410	970	24

* Dieldrin. Tr. Trace only.

TABLE V

Concentrations of pesticides in parts per billion in oysters sampled from California bays and rivers, May–August 1967

	May				June				July				August			
	DDE	DDD	DDT	Di*	DDE	DDD	DDT	Di	DDE	DDD	DT	Di	DDE	DDD	DDT	Di
Humboldt Bay																
Bird Island											24					
Gunther Island	Tr		19		Tr	Tr	19		Tr	Tr	24		Tr		12	
Tomales Bay																
Nicks Cove	10	Tr	Tr		Tr	Tr	Tr		11	Tr	Tr		Tr			
Tomales Bay Oyster Co.	Tr	Tr	Tr		11	14	13		Tr	Tr	Tr		Tr			
Drakes Estero																
Schooner Bay	Tr	13			11	13	Tr		Tr	Tr			15	18	10	
Berries Bar	16	17	11		12	14	10		13	15	Tr		Tr	18	10	
Bolinas Lagoon	11	16	14			14	12		11	21	13		13	20	11	
San Francisco Bay																
Marin Pier	23	55	34	13	39	85	64	21	45	120	89	19	53	130	63	17
Coyote Point	65	76	69	21	52	78	70	25	51	84	80	17	47	58	50	43
Elkhorn Slough																
Round Island	210	340	860	39	300	390	920	33	160	200	390	10	200	260	500	10
Morro Bay																
Baywood	80	34	67		120	49	70		51	29	37		82	40	49	
Los Osos Creek	93	57	92		130	56	80		64	46	52		81	44	49	
San Joaquin River																
West Island	320	250	260	12	230	210	270	18	170	130	150	Tr	140	93	130	15
False River	460	320	910	19	320	200	640	20	420	260	780	16	270	180	500	16

* Dieldrin. Tr. Trace only.

Modin, J. C. 1968.

TABLE VI

Concentrations of pesticides in parts per billion in oysters sampled from California bays and rivers, September–December 1967

	September				October				November				December			
	DDE	DDD	DDT	Di*	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di	DDE	DDD	DDT	Di
Humboldt Bay																
Bird Island							Tr								Tr	
Gunther Island		Tr	16		Tr	Tr	15		Tr	Tr	21		Tr	Tr	22	
Tomales Bay																
Nicks Cove	Tr	Tr							14							
Tomales Bay Oyster Co.	Tr								11	Tr	Tr					
Drakes Estero																
Schooner Bay									Tr							
Berries Bar	13	16	10		15	18	Tr		14	17	Tr		Tr	Tr		
Bolinas Lagoon									Tr	11			Tr	Tr		
San Francisco Bay																
Marin Pier	30	74	38	11	31	68	36									
Coyote Point	39	58	50	13	33	37	43		46	86	11	16	46	84	51	16
Elkhorn Slough																
Round Island	190	210	390	15	62	55	110		19	15	34	14	25	23	37	17
Moro Bay																
Baywood	55	23	46		48	21	26		35	10	15		46	13	16	
Los Osos Creek					43	20	25		37	14	20		29	10	12	
San Joaquin River																
West Island	170	150	230	20	180	150	270	10	69	49	1·1	20	39	31	77	18
False River													40	35	21	17

* Dieldrin. Tr. Trace only.

REF. NO.: 73 - N - 2

SUBSTANCES: mirex

Reference: Naqvi, S. M. & A. A. de la Cruz. 1973. Mirex incorporation in the environment: residues in nontarget organisms--1972. Pest. Monit. J. 7:104-111.

Organisms: Eupera singleyi
Crassostrea virginica
Polymesoda caroliniana

Date of Sample Collection: 1972

Location: Mississippi

Analytical Technique: Gas-liquid chromatography

Analytical Data:

TABLE 1.—*Mirex residues in nontarget organisms collected at five sites in Mississippi, 1972*—Continued

Species Collected and Habitat		Basic Food Habit	Mirex Residues in ppm[1], Wet-Weight Basis
Scientific Name	Common Name		
LOUISVILLE AND NOXAPATER AREAS (Winston Co., Miss.)[4]—Continued			
Eupera singleyi (Pelecypoda: Mollusca)	Clam	Omnivore	0.15
ST. LOUIS BAY ESTUARY (Hancock Co., Miss.)[4]			
Estuary:			
Crassostrea virginica (Pelecypoda: Mollusca)	Oyster	Omnivore	0.07
Crassostrea virginica (Pelecypoda: Mollusca)	Oyster	Omnivore	0.11
Marginella apicina (Gastropoda: Mollusca)	Snail	Omnivore	0.19
Polymesoda caroliniana (Pelecypoda: Mollusca)	Clam	Omnivore	0.19
Uca sp. (Decapoda: Crustacea)	Crab	Omnivore	0.21
Crassostrea virginica (Pelecypoda: Mollusca)	Oyster	Omnivore	0.24
Littorina angulifera (Gastropoda: Mollusca)	Snail	Omnivore	0.41

Total number of samples: 7
Average residue level: 0.20 ppm

REF. NO.: 75 - P - 4

SUBSTANCES: chlorinated hydrocarbons

Reference: Pearson, C. R. & G. McConnell. 1975. Chlorinated C_1 and C_2 hydrocarbons in the marine environment. Proc. R. Soc. Lond. B 189:305-332.

Organisms: Mytilus edulis
Cerastoderma edule
Ostrea edulis

Date of Sample Collection: 1971-75

Location: Liverpool Bay, Firth of Forth, Thames Estuary

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

TABLE 6. CHLORINATED HYDROCARBONS IN MARINE ORGANISMS

(Concentrations expressed as parts per 10^9 by mass on wet tissue.)

species	source	CCl_2CHCl	CCl_2CCl_2	$CH_3CCl_3 + CCl_4$		$CHCl_3$	HCBD
Mytilus edulis (mussel)	Liverpool Bay	4–11.9	1.3–6.4	2.4–5.4		9–10	3.2–3.8
	Firth of Forth	9	9	10	2	8	7
	Thames Estuary	8	1	5	0.7	3	ND
Cerastoderma edule (cockle)	Liverpool Bay	6–11	2–3	0–2	0.4–1	4–150	ND
Ostrea edulis (oyster)	Thames Estuary	2	0.5	0.9	0.1	3	ND

REF. NO.: 74 - P - 1

SUBSTANCES: DDT, dieldrin

Reference: Petrocelli, S. R., J. W. Anderson & A. R. Hanks. 1974. DDT and dieldrin residues in selected biota from San Antonio Bay, Texas--1972. Pest. Monit. J. 8:167-172.

Organisms:
Rangia cuneata
Crassostrea virginica
Mercenaria campechiensis
Tagelus plebeius
Macoma constricta

Date of Sample Collection: 1972

Location: San Antonio Bay, Texas

Analytical Technique: Gas-liquid chromatography

Analytical Data:

TABLE 1. *Baseline residues (μg/kg) of DDT and dieldrin in blue crabs, oysters, clams, and brown shrimp, San Antonio Bay System, Tex.—1972*

Sample No.[1]	Wet Weight, g	p,p'-DDE	Dieldrin	Month of Collection
Oysters				
213	10.85	29.85	9.28	April
214	5.17	46.59	19.62	April
215	4.16	28.18	22.91	April
216	9.31	27.11	13.38	April
234	7.70	51.87	27.11	April
235	14.10	29.76	13.14	April
236	2.90	72.25	31.90	April
237	2.12	70.17	36.08	April
294[2]	28.81	ND	ND	June
295[3]	131.73	3.74	ND	June
405	3.48	28.50	ND	June
406	2.73	28.90	ND	June
407	7.14	28.80	ND	June
408	9.15	28.40	ND	June
409	3.96	37.30	ND	June
551	8.39	27.00	ND	July
Oysters, cont'd				
552	7.01	ND	22.20	July
553	7.38	106.00	20.60	July
554	8.57	24.40	24.20	July
555	7.73	ND	ND	July
556	5.56	ND	ND	July
557	7.08	ND	ND	July
558	2.55	ND	ND	July
559	3.26	ND	ND	July
560	4.14	ND	ND	July
592	2.42	ND	26.00	October
593	3.21	23.00	ND	October
594	5.51	25.00	ND	October
595	5.60	48.00	ND	October
596	7.53	ND	ND	October
Clams				
221	10.89	18.42	13.73	April
222	13.64	22.86	ND	April
296[10]	33.81	21.90	ND	June
297[11]	56.27	18.40	ND	June
339	21.51	25.40	ND	June
340	23.18	37.00	6.65	June
341	16.42	36.70	ND	June
342	18.68	32.90	3.73	June
343	18.25	42.40	3.75	June
344	20.62	38.70	3.16	June
346	11.75	42.80	9.34	June
347	9.06	59.90	1.07	June
348	10.69	50.20	12.40	June
349	6.28	ND	13.90	June
356	10.85	34.70	3.53	June
357	5.36	ND	ND	June
358	11.63	54.80	2.50	June
359	10.96	35.80	ND	June
360	10.18	ND	ND	June
541[12]	3.20	ND	ND	September
542	3.91	ND	ND	September
543	4.63	ND	ND	September
544	7.80	ND	ND	September
561	6.50	36.00	14.00	April
562	7.55	30.00	12.00	April
563	6.36	ND	ND	April
564	6.22	43.00	ND	April
565[14]	7.83	15.00	ND	April
566	7.52	ND	ND	April
567	6.99	10.00	ND	April
568	9.20	ND	ND	April
569	7.83	ND	ND	April
570	7.02	ND	5.10	April
571[16]	18.67	ND	2.00	April
598	6.30	ND	ND	October
599	4.71	18.00	ND	October
600	4.58	ND	18.00	October
601	3.65	ND	ND	October
602	2.82	79.00	ND	October
603	9.74	20.00	ND	October
605	8.12	ND	ND	October
606[15]	5.92	16.00	ND	October
607	12.33	16.00	ND	October

NOTE: Residue totals and averages listed in Table 3.
ND = not detected.
TR = trace (< 1.0 μg/kg).

[1] Samples represent individual specimens unless indicated otherwise.
[2] Sample taken from Bludworth Island.
[3] Sample contained 18.60 μg/kg p,p'-DDE.
[4] Composite of two crabs.
[5] Composite of six crabs.
[6] Composite of four crabs.
[7] Composite of three crabs.
[8] Composite of ten small oysters.
[9] Composite of ten large oysters.
[10] Composite of ten small clams.
[11] Composite of ten large clams.
[12] Sample taken from Sundown Bay.
[13] Sample contained 33.00 μg/kg p,p'-DDE.
[14] Composite of five clams.
[15] Sample contained 47.00 μg/kg p,p'-DDE.

Petrocelli, S. R. et al. 1974.

TABLE 2. *Baseline residues (μg/kg) of DDT and dieldrin in miscellaneous species, San Antonio Bay System, Tex.—1972*

Sample No.	Organism[1]	Location[2]	Wet Weight, g	p,p'-DDE	Dieldrin	Month of Collection
223	*Anchoa mitchilli*	Bludworth Island	32.80	52.61	5.38	April
224	*Tagelus plebeius*	Bludworth Island	29.84	5.67	2.68	April
238	*Paralichthys lethostigma*	Refuge	14.72	13.32	ND	April
239	*Paralichthys lethostigma*	Refuge	14.78	14.21	ND	April
435	*Mercenaria campechiensis*	Hynes Bay	75.95	ND	ND	July
436	*Mercenaria campechiensis*	Hynes Bay	34.28	ND	ND	July
437	*Mercenaria campechiensis*	Hynes Bay	55.66	ND	ND	July
438	*Mercenaria campechiensis*	Hynes Bay	25.41	ND	ND	July
439	*Mercenaria campechiensis*	Hynes Bay	42.58	ND	ND	July
450	*Tagelus plebeius*	Refuge	4.75	ND	ND	July
451	*Tagelus plebeius*	Refuge	8.07	ND	ND	July
452	*Macoma constricta*	Refuge	2.83	ND	ND	July
526	*Spartina spartinae*	Dunham Bay	57.43	2.20	ND	August
527	*Spartina spartinae*	Mustang Lake	57.25	ND	ND	August
528	*Spartina spartinae*	Dunham Bay	49.11	ND	ND	August
533	*Mercenaria campechiensis*	Hynes Bay	95.26	ND	1.30	October
534	*Mercenaria campechiensis*	Hynes Bay	135.69	ND	1.20	October
535	*Mercenaria campechiensis*	Hynes Bay	109.45	ND	1.40	October
536	*Mercenaria campechiensis*	Hynes Bay	155.47	ND	1.00	October
537	*Mercenaria campechiensis*	Hynes Bay	20.43	ND	ND	October
538	*Mercenaria campechiensis*	Hynes Bay	11.52	ND	ND	October
539	*Mercenaria campechiensis*	Hynes Bay	17.95	ND	ND	October
540	*Tagelus plebeius*	Sundown Bay	4.24	ND	ND	September

[1] See text for common names.
[2] Compare map, Fig. 2.

TABLE 3. *Summary of insecticide residues detected in biological samples, San Antonio Bay System, Tex.—1972*

Species	No. Organisms Analyzed	No. Organisms Containing Insecticide Residues and Percent Total Analyzed		
		p,p'-DDE	Dieldrin	Both
Blue crabs	81	76 (94%)	26 (32%)	23 (28%)
Oysters	48	29 (60%)	12 (25%)	10 (21%)
Clams	65	44 (68%)	20 (31%)	12 (18%)
Shrimp	23	3 (13%)	6 (26%)	0 (0%)
Miscellaneous	23	7 (30%)	6 (26%)	2 (9%)
Total	240	159 (66%)	70 (29%)	47 (20%)

REF. NO.: 75 - P - 5

SUBSTANCES: dieldrin

Reference: Petrocelli, S. R., J. W. Anderson & A. R. Hanks. 1975. Seasonal fluctuations of dieldrin residues in the tissues of the marsh clam, Rangia cuneata, from a Texas estuary. Texas J. Sci. 26:443-448.

Organisms: Rangia cuneata

Date of Sample Collection: 1970-71

Location: Trinity Bay, Texas

Analytical Technique: Gas-liquid chromatography

Analytical Data:

Rangia collected from Trinity Bay in October and December of 1970 had lower residues of dieldrin than those collected in February, April, and July 1971 (Figure 1). The means and standard deviations for October and December were 7.9 ± 1.5 ppb and 6.8 ± 1.1 ppb, respectively, while those for February, April, and July were 16.4 ± 2.8 ppb, 16.6 ± 1.4 ppb, and 14.8 ± 1.8 ppb, or at least twice the October/ December levels.

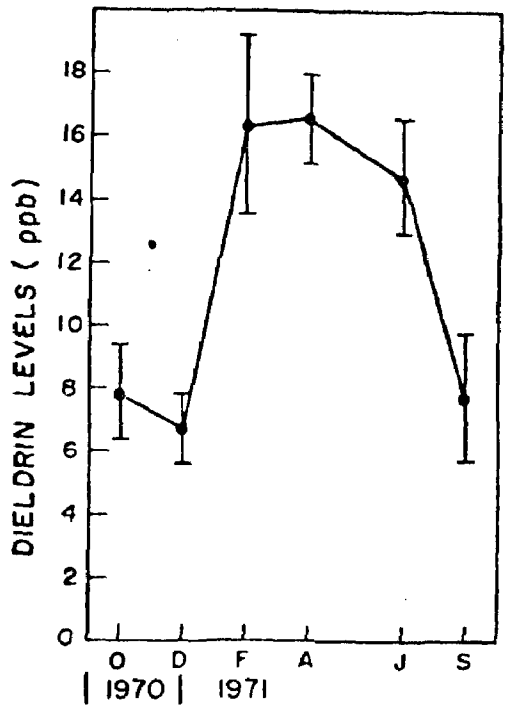


Figure 1. Seasonal levels of dieldrin (ppb) in *Rangia* tissue. Means connected by curve and standard deviations (n=10) represented by vertical bars.

REF. NO.: 75 - P - 1

SUBSTANCES: DDT, dieldrin

Reference: Portmann, J. E. 1975. The bioaccumulation and effects of organochlorine pesticides in marine animals. Proc. R. Soc. Lond. B 189:291-304.

Organisms: molluscs (unspecified)

Date of Sample Collection: (Data from various other literature)

Location:

Analytical Technique:

Analytical Data:

TABLE 3. LEVELS OF DDT AND DIELDRIN IN SEVERAL MARINE ORGANISMS (mg/kg, WET MASS BASIS)

organism	DDT	dieldrin
molluscs (Holden & Topping 1971/72)	0.008–0.10	0.001–0.02
herring (I.C.E.S. 1974)	0.03–0.33	0.002–0.05
cod (I.C.E.S. 1974)	0.003–0.05	0.001–0.02
seals (Holden 1972)	0.01–20	0.06–2.8
birds (Holdgate 1971)	0.6–3.1	—

TABLE 4. LEVELS OF DDT IN MARINE ORGANISMS ON FRESH MASS AND LIPID MASS BASIS (μg/kg)

organism	fresh	lipid
phytoplankton (Harvey *et al.* 1973)	0.2–0.5	40–100
zooplankton (Harvey *et al.* 1973)	0.01–9.5	up to 154
fish (flying fish) (Harvey *et al.* 1973)	0.6–4	180–1480
mollusc (I.C.E.S. 1974)	8–100	800–10000
cod (I.C.E.S. 1974)	3–50	1500–2500
seal (Holden 1972)	10–20000	20–40000

REF. NO.: 74 - R - 1 **SUBSTANCES:** toxaphene

Reference: Reimold, R. J. & C. J. Durant. 1974. Toxaphene content of estuarine fauna and flora before, during, and after dredging toxaphene-contaminated sediments. Pest. Monit. J. 8:44-49.

Organisms: Crassostrea virginica

Date of Sample Collection: 1972

Location: Terry Creek, Brunswick, Georgia

Analytical Technique:

Analytical Data:

TABLE 2.—*Toxaphene concentrations, ppm, found during fall 1972 monitoring of Terry Creek dredging operations*

	Replicate No.	Cruise No. 1 (Sept. 2)		Cruise No. 2 (Sept. 14)	Cruise No. 3 (Sept. 21)	Cruise No. 4 (Sept. 28)	Cruise No. 5 (Oct. 5)	Cruise No. 6 (Oct. 12)	Cruise No. 7 (Oct. 19)		Cruise No. 8 (Oct. 26)
Eastern oyster (*Crassostrea virginica*)	1	1.20	1972	1.42	1.55	1.21	1.26	1.19	1.70	1972	0.94
	2	1.37		1.33	1.71	1.15	1.23	1.24	1.79		0.95

Reimold, R. J. & C. J. Durant. 1974.

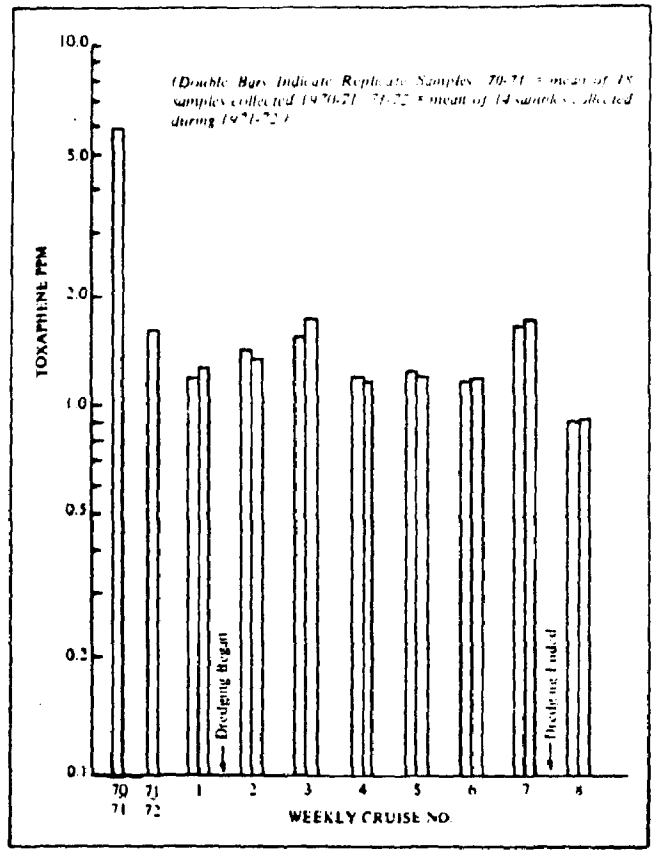


FIGURE 2.—*Toxaphene concentration, ppm, in oysters* (Crassostrea virginica) *from Back River Bridge, Terry Creek, Brunswick, Ga., 1972*

REF. NO.: 75 - R - 1

SUBSTANCES: chlorinated hydrocarbons

Reference: Reimold, R. J. 1975. Chlorinated hydrocarbon pesticides and mercury in coastal biota, Puerto Rico and the U.S. Virgin Islands--1972-74. Pest. Monit. J. 9:39-43.

Organisms: Crassostrea gigas
Crassostrea rhizophorae
Argopecten irradians

Date of Sample Collection: 1972-74

Location: St. John, St. Croix

Analytical Technique: Gas-liquid chromatography

Analytical Data:

TABLE 1. *Chlorinated hydrocarbon concentrations in biota, U.S. Virgin Islands and Puerto Rico, 1972-74*

Date	Location	Common Name	Residues, ppb					
			Dieldrin	DDT	DDE	TDE	PCB's	Mercury
Spring '73	Coral Bay STJ	Mangrove oysters						58
Spring '74	Coral Bay STJ	Mangrove oysters					110	
Spring '73	Salt River STX	Mangrove oysters						39

NOTE: All residues are given on a whole-fish, wet-weight basis.
PR = Puerto Rico, STJ = St. John, STT = St. Thomas, STX = St. Croix.
Blank spaces indicate no residues detected.

REF. NO.: 77 - R - 1

SUBSTANCES: PCB, DDT, dieldrin

Reference: Riley, J. P. & S. Wahby. 1977. Concentrations of PCBs, dieldrin and DDT residues in marine animals from Liverpool Bay. Mar. Pollut. Bull. 8:9-11.

Organisms: Mytilus edulis
Mytilus sp.

Date of Sample Collection: 1974

Location: Liverpool Bay, England

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

TABLE 1
Concentrations of ΣDDT, dieldrin and PCBs in some marine animals (expressed as ng g^{-1} of wet tissue).

Organism	Length of organism (cm)	Lipid (%)	ΣDDT	Dieldrin	PCBs
Mollusca					
Mytilus edulis	—	3.5	2.0	—	20
Mytilus sp.	—	0.6	3.0	2.5	48
Buccinum undatum	—	nd	1.0	0.5	177

TABLE 2
Comparative data for chlorinated hydrocarbons in organisms from sea areas around British Isles. (in ng g^{-1} wet wt).

Organism	Sea area	Dieldrin	ΣDDT	PCB
Pleuronectes platessa (flesh)	Liverpool Bay	0.5	2	—
	East Coast*	1	7	40
Crangon crangon	Liverpool Bay	< 2	0.5	7
	East Coast*	< 1	10	20–80
Mytilus edulis	Liverpool Bay	< 2	2	20–40
	East Coast*	< 1	20	40–150
Odontogadus merlangus merlangus	Liverpool Bay	< 1	7	80
	Clyde§	$1–2 \times 10^1$	540–690	$4–8 \times 10^1$
	Minch§	$0.2–0.4 \times 10^1$	60–130	$0.7–3 \times 10^1$

*Average data for English stations from ICES (1974). §Holden (1972).

REF. NO.: 76 - R - 2

SUBSTANCES: PCB

Reference: Risebrough, R. W., B. W. De Lappe & T. T. Schmidt. 1976. Bioaccumulation factors of chlorinated hydrocarbons between mussels and seawater. Mar. Pollut. Bull. 7:225-228.

Organisms: Mytilus sp.

Date of Sample Collection: 1974

Location: Mediterranean coast of France and Los Angeles and San Francisco Bay, California

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 1
Bioaccumulation factors of chlorinated hydrocarbons between *Mytilus* spp. and seawater.

Location		Chlorinated hydrocarbon concentrations: Mussels (10^{-9} g/g) wet wt	Seawater (10^{-12} g/L)	Concentration factor
France				
Valras-Plage	PCB	250	0.94	270000
9 July 1974	*p,p'*-DDT	51	0.54	90000
Stes-Maries	PCB	450	0.95	470000
10 July 1974	*p,p'*-DDT	13	0.35	40000
Carro	PCB	200	0.68	300000
11 July 1974	*p,p'*-DDT	52	0.25	210000
Marseille	PCB	1100	1.6	690000
12 July 1974	*p,p'*-DDT	900	1.3	690000
California				
Royal Palms,	PCB	230 (*N* = 2)	1.2 (*N* = 4)	190000
Los Angeles	*p,p'*-DDE	1600 (*N* = 2)	5.1 (*N* = 4)	310000
19 September 1972				
San Francisco Bay	PCB	68 ± 24 (*N* = 47)	0.98 ± 0.47 (*N* = 26)	69000
Means ± SD	*p,p'*-DDE	5 ± 2 (*N* = 47)	0.11 ± 0.06 (*N* = 26)	45000
January–March 1975				

REF. NO.: 67 - R - 1 **SUBSTANCES:** DDE, HEOD

Reference: Robinson, J., A. Richardson, A. N. Crabtree, J. C. Coulson & G. R. Potts. 1967. Organochlorine residues in marine organisms. Nature 214:1307-1311.

Organisms: *Mytilus edulis*
Cardium edule

Date of Sample Collection: 1965-66

Location: East coast Britain, Northumberland

Analytical Technique: Gas-liquid chromatography

Analytical Data:

Table 1. CONCENTRATIONS OF ORGANOCHLORINE COMPOUNDS IN MARINE SAMPLES TAKEN OFF THE NORTHUMBERLAND COAST, 1965–1966

Species	Trophic level	Type of tissue and number of samples	Concentration of organochlorine compounds (p.p.m.) HEOD	pp'-DDE
Mussel (*Mytilus edulis*)	2	Pooled sample of flesh	0·023	0·024
Cockle (*Cardium edule*)	2	Pooled sample of flesh	0·018	0·012

REF. NO.: 70 - R - 1

SUBSTANCES: dieldrin, endrin

Reference:

Rowe, D. R., L. W. Canter, J. W. Mason. 1970. Contamination of oysters by pesticides. J. Sanit. Engin. Div., Proc. Amer. Soc. Civil Eng. 96(5A5): 1221-1234.

Organisms:

Crassostrea virginica

Date of Sample Collection: 1968-69

Location:

Grand Bayou, Hackberry Bay and Creole Bay, Louisiana

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 2.—PESTICIDE DETECTION IN ENVIRONMENTAL SAMPLES

Pesticide (1)	Medium (2)	Samples with positive concentration (3)	Samples with concentration less than a value (4)	Samples with trace amounts (5)	Total positive samples (6)	Total samples (7)	Percentage Positive (8)
Dieldrin	Water	o	2	2	4	148	3
	Sediment	o	8	1	9	45	20
	Oysters	93	20	o	113	113	100
Endrin	Water	2	2	4	8	148	5
	Sediment	o	7	1	8	44	18
	Oysters	3	62	12	77	111	69

TABLE 3.—DIELDRIN CONCENTRATIONS IN OYSTERS

Sampling Date (1)	Average Dieldrin Concentration, in parts per billion			
	Group A (2)	Group B (3)	Group C (4)	Group D (5)
10-21-68	0.8	1.0	1.0	—[b]
11-17-68	0.8	0.7	1.7	2.2
12-1-68	—[a]	—[a]	—[b]	—[b]
12-15-68	0.8	0.4	1.5	1.1
12-29-68	1.1	1.4	—[b]	—[b]
2-2-69	1.3	1.6	—[b]	—[a]
2-16-69	1.9	1.7	2.2	1.7
3-2-69	1.5	1.8	—[b]	1.2
3-24-69	1.9	1.8	1.1	1.5
4-14-69	2.0	2.0	2.2	2.7
5-11-69	1.1	1.1	—[b]	1.1

[a] Less than the detectable limit of 1 part per billion.
[b] No sample.

TABLE 7.—PESTICIDES IN OYSTERS

Survey (1)	Pesticides in Oysters, in parts per billion					
	Dieldrin			Endrin		
	Median (2)	High (3)		Median (4)	High (5)	
1964-1966 (7)	10	—		—	—	
1965-1966 (6)	< 10	90		< 10	70	
1968-1969	1.3	3.4		< 1	2.4	

REF. NO.: 71 - R - 1

SUBSTANCES: dieldrin, endrin

Reference: Rowe, D. R., L. W. Canter, P. J. Snyder & J. W. Mason. 1971. Dieldrin and endrin concentrations in a Louisiana estuary. Pest. Monit. J. 4:177-183.

Organisms: Crassostrea virginica

Date of Sample Collection: 1968-69

Location: Grand Bayou, Hackberry Bay and Creole Bay, Louisiana

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 2.—*Pesticide detection in environmental samples*

Pesticide	Medium	No. of samples with positive concentration	No. of samples with concentration less than a given value	No. of samples with trace amounts	Total no. of positive samples	Total no. of samples	Percent of positive samples
Dieldrin	Water	0	2	2	4	148	3
	Sediment	0	8	1	9	45	20
	Oysters	93	20	0	113	113	100
Endrin	Water	2	2	4	8	148	5
	Sediment	0	7	1	8	44	18
	Oysters	3	62	12	77	111	69

TABLE 3.—*Dieldrin concentrations in oysters*

Sampling Date	Average Dieldrin Concentration in PPB			
	Group A	Group B	Group C	Group D
10-21-68	0.8	1.0	1.0	—
11-17-68	0.8	0.7	1.7	2.2
12-1-68	*	*	—	—
12-15-68	0.8	0.4	1.5	1.1
12-29-68	1.1	1.4	—	—
2-2-69	1.3	1.6	—	*
2-16-69	1.9	1.7	2.2	1.7
3-2-69	1.5	1.8	—	1.2
3-24-69	1.9	1.8	1.1	1.5
4-14-69	2.0	2.0	2.2	2.7
5-11-69	1.1	1.1	—	1.1

NOTE: * = less than the detectable limit of 1 ppb; — = no sample.

TABLE 4.—*Pesticides in oysters*

Survey	Residues in PPB			
	Dieldrin		Endrin	
	Median	High	Median	High
1964-1966 (4)	10	—	—	—
1965-1966 (3)	<10	90	<10	70
1968-1969	1.3	3.4	<1	2.4

REF. NO.: 76 - S - 1

SUBSTANCES: HCB, PCB, DDE, DDT, DDD

Reference:

Schaefer, R. G., W. Ernst, H. Goerke & G. Eder. 1976. Residues of chlorinated hydrocarbons in North Sea animals in relation to biological parameters. Ber. dt. wiss. Kommn. Meeresforsch 24:225-233.

Organisms: Acanthocardia tuberculata

Date of Sample Collection: 1972

Location: North Sea

Analytical Technique: Gas chromatography/mass spectrometry

Analytical Data:

Table 4. Residue concentrations in invertebrates. VS = varying sections of body; MS = median section of body; AM = adductor muscle; F = foot; DG = digestive gland. Underlined values indicate wet weight basis, others lipid weight basis; n.d. = not detected; n.m. = not measured

Species	Average wet weight (g)	Tissue and no. of animals[a]		Lipid content (%)	Residue concentration (µg/g) HCB	PCB	DDE	DDD	DDT	ΣDDT[b]	PCB/ΣDDT[b]
Acanthocardia tuberculata (Bivalvia)	14.0	AM	5^2	0.17	n.m. n.m.	0.013 [illegible]	n.d. n.d.	n.d. n.d.	0.0007 [illegible]	0.0007 [illegible]	18
	7.1	F	3^2	0.26	n.m. n.m.	0.017 6.5	n.d. n.d.	n.d. n.d.	0.001 [illegible]	0.001 [illegible]	18
	9.6	F	2^1	0.08	n.m. n.m.	0.021 26	n.d. n.d.	n.d. n.d.	0.003 [illegible]	0.003 [illegible]	11
	14.0	F	5^2	0.27	n.m. n.m.	0.042 15	0.0007 0.24	n.d. n.d.	0.0009 [illegible]	0.002 [illegible]	27
	0.3	DG	20^1	4.0	n.m. n.m.	0.16 [illegible]	0.005 0.13	0.001 0.030	[illegible] [illegible]	0.018 [illegible]	8.4
	7.1	DG	3^2	2.5	n.m. n.m.	0.088 [illegible]	0.004 0.14	0.006 0.18	0.010 [illegible]	0.018 [illegible]	4.8
	9.6	DG	2^1	3.5	0.0035 0.099	0.20 5.6	0.007 0.19	0.006 0.16	0.015 0.44	0.028 [illegible]	7.3
	14.0	DG	5^2	6.2	0.0040 0.065	0.24 [illegible]	0.015 0.24	0.015 0.25	0.028 [illegible]	0.059 0.95	4.1

[a] Indices refer to station numbers of Table 1.

[b] Calculated before rounding of values.

Table 5. Residue concentrations in total animals of different trophic levels. Underlined values indicate dry weight basis, others lipid weight basis; n.d. = not detected; n.m. = not measured

Species	No. of pooled animals	Average wet weight (g)	Percentage of dry org. matter and lipid (%)	Residue concentration (µg/g) PCB	DDE	DDD	DDT	ΣDDT[a]	PCB/ΣDDT[a]
Acanthocardia tuberculata (Bivalvia)	5	14.0	18 1.1	0.68 11	0.015 0.24	0.0060 0.094	0.024 0.38	0.045 0.71	15

REF. NO.: 74 - S - 2

SUBSTANCES: fluorine

Reference: Stewart, D. J., T. R. Manley, D. A. White, D. L. Harrison & E. A. Stringer. 1974. Natural fluorine levels in the Bluff area, New Zealand. 1. Concentrations in wildlife and domestic animals. N. Zealand J. Sci. 17:105-113.

Organisms:
Venericardia purpurata
Chione stutchburyi
Ostrea angasi
Perna canaliculus

Date of Sample Collection: 1969-71

Location: New Zealand

Analytical Technique:

Analytical Data:

TABLE 3—Bone and flesh fluorine concentrations, diet, and habitat of fish

Species	No. of samples	Diet and habitat	Bone/shell fluorine concentration (ppm)*				Flesh fluorine concentration (ppm)**	
			Mean	Range	SD	CV	wet basis	dry basis
Purple cockle (*Venericardia purpurata*)	1	Similar to Cook's Turbanshell Filter plankton for food	151	—	—	—	—	—
Cockle (*Chione stutchburyi*)	2	Filter plankton for food	145	—	—	—	—	—
Paua (*Haliotis iris*)	3	Live in the sub-littoral zone in deep water on rocky coasts Eat marine weeds	101	58–153	44	43	—	—
Oyster (*Ostrea angasi*)	4	Live at or below low water level Filter feeder and lives on animals and plants from plankton	63	32–95	14	44	6	9·1
Mussell (*Perna canaliculus*)	4	Similar to the oyster	31	13–48	7	23	—	—

REF. NO.: 76 - T - 2

SUBSTANCES: PCBs

Reference: Takagi, M. H. Murayama & S. Soma. 1976. PCB contents in the muscle of marine animals collected in the sea near Hakodate. Bull. Jap. Soc. Sci. Fish. 42:589-594.

Organisms: Anadara (Scapharca) broughtonii
Patinopecten yessoensis
Corbicula japonica

Date of Sample Collection: 1973-75

Location: near Hakodate, Japan

Analytical Technique: Gas chromatography

Analytical Data:

Table 2. Crude fat and PCB concentrations in the muscle of numerous marine animals collected in the sea near Hakodate

Sample No.	Species		Crude fat (%)	PCB (ppm)
6	Hokkigai	*Anadara (Scapharca) broughtonii*	1.39	0.05
11	Akagai	*Anadara (Scapharca) broughtonii*	2.84	0.02
14	Hotategai	*Patinopecten yessoensis*	1.25	0.03
37	Yamatoshijimi	*Corbicula japonica*	1.18	0.02

REF. NO.: 76 - T - 1

SUBSTANCES: DDE, DDT, TDE, lindane, aldrin, heptachlor, dieldrin, chlordane

Reference:

Tanita, R., J. M. Johnson, M. Chun & J. Maciolek. 1976. Organochlorine pesticides in the Hawaii Kai Marina, 1970-74. Pest. Monit. J. 10:24-29.

Organisms: oysters (unspecified)

Date of Sample Collection: 1974

Location:

Oahu, Hawaii

Analytical Technique: Electron capture gas chromatography

Analytical Data:

TABLE 5. *Pesticide residues in oysters, Hawaii Kai Marina—April-June 1974* [1]

Pesticide	Range, ppb		Average ppb		Samples Containing Residue, %		Maximum Concentration in/on Food for Human Consumption, mg/kg body weight	FAO/WHO Acceptable Daily Intake, mg/kg body weight
	Small	Large	Small	Large	Small sample	Large sample		
Lindane	1,500-17,870	590-1,260	7,647	925	20.00	18.18	NS	0.0125
Aldrin	—	—	4,530	14,690	6.67	9.09	20,000-100,000	0.0001
Heptachlor	—	ND	4,770	ND	6.67	ND	10,000	0.0005
p,p'-DDE	2,190-7,860	340-4,610	5,025	3,624	13.33	45.45	NS	0.005
p,p'-TDE	ND	3,240-10,550	ND	6,895	ND	18.18	NS	0.005
o,p'-DDT	22,470-50,500	530-4,590	36,485	271	13.33	27.27	NS	0.005
p,p'-DDT	810-27,140	420-17,470	9,337	5,538	46.67	81.82	SD	0.005
Dieldrin	400-94,740	2,870-25,450	34,818	13,472	80.00	100.00	0.200	0.0001
α-Chlordane	2,340-57,640	1,590-22,990	18,640	8,277	33.33	100.00	0.05	0.001
γ-Chlordane	—	1,350-23,380	8,170	7,865	13.33	63.64	0.05	0.001

NOTE: — = residue detected in only one sample.
ND = not detected.
NS = no standards given for these residues.
SD = standard deleted by WHO/FAO.

[1] See Literature Cited, reference 3.

REF. NO.: 74 - T - 1

SUBSTANCES: organochlorines

Reference: Ten Berge, W. F. & M. Hillebrand. 1974. Organochlorine compounds in several marine organisms from the North Sea and the Dutch Wadden Sea. Netherlands J. Sea Res. 8:361-368.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1972

Location: North Sea

Analytical Technique: Electron-capture gas chromatography

Analytical Data:

TABLE II

Organochlorine content in ppb on wet weight basis, and in ppm on fat weight basis, for pentachlorobenzene, hexachlorobenzene, PCB's, α-BHC and γ-BHC (standard deviations in parentheses); n.d. means not detected.

Material	*Pentachloro-benzene*	*Hexachloro-benzene*	*PCB's*	*α-BHC*	*γ-BHC*
Mussel	0.40 (0.02)	0.53 (0.10)	237 (31)	4.7 (1.0)	3.2 (0.7
– Mussel	0.026 (0.001)	0.034 (0.005)	15.0 (1.2)	0.30 (0.05)	0.20 [illegible]

TABLE III

Organochlorine content in ppb on wet weight basis, and in ppm on fat weight basis, for dieldrin, endrin, p,p'-DDE, p,p'-DDD and p,p'-DDT (standard deviations in parentheses); n.d. means not detected.

Material	*Dieldrin*	*Endrin*	*p,p'-DDE*	*p,p'-DDD*	*p,p'-DDT*
Mussel	8.9 (1.9)	8.6 (1.4)	1.8 (0.1)	5.7 (1.5)	1.5 (0.4)
Mussel	0.56 (0.09)	0.55 (0.11)	0.11 (0)	0.36 (0.08)	0.09 (0.02)

REF. NO.: 72 - T - 1

SUBSTANCES: HCB, BHC, heptachlor epoxide, DDE, TDE, DDT, dieldrin, PCB

Reference:

Tuinstra, L. G. M. Th., & P. Hagel. 1972. Chlorinated aromatic hydrocarbon content of fishes, mussels and shrimps in the North Sea. Leiden, Netherlands, Government Dairy Station, Report 2nd ser. no. 95E:13p.

Organisms: mussels (unspecified)

Date of Sample Collection: 1972

Location: North Sea

Analytical Technique: Electron capture gas chromatography

Analytical Data:

Table 1 Chlorinated aromatic hydrocarbon content of fishes in ng/kg fishweight

Sample	Product	Place	HCB	α-BHC	β-BHC	γ-BHC	Heptachlor-epoxide	p,p'-DDE*	p,p'-TDE	p,p'-DDT	Dieldrin	PCB**	% fat	Remarks
22F31/32	Mussels	fig. 4B	0.002	0.011	n.d.	0.006	0.002	0.024	0.008	n.d.	0.010	0.350 0.326	4.5	Lenth 55-60 cm
22F33/34	Mussels	fig. 4A	0.002	0.013	n.d.	0.004	0.001	0.016	0.003	n.d.	0.006	0.270 0.095	4.6	" 55-60 cm

Remarks:

n.d. = not detectable See appendix A for detection limits.

* The p,p'-DDE content has not been corrected for the presence of PCB

** The PCB content has been calculated with the help of Arcolor 1254 on a 3% DEGS-1% phosphoric acid column by means of the peaks having a RRT 1,24 and 1,69 relative to p,p'-DDE=1,00

Table 2 Chlorinated aromatic hydrocarbon content of fishes in ng/kg fatbases

Sample No	Product	place	HCB	α-BHC	β-BHC	γ-BHC	Heptachlor-epoxide	p,p'-DDE *	p,p'-TDE	p,p'-DDT	Dieldrin	PCB**	% fat	Remarks
22F31/32	Mussels	fig. 4B	0.055	0.248	< 0.112	0.120	0.057	0.544	0.169	< 0.179	0.142	7.694 7.519	4.5	Length 55-60 cm
22F33/34	Mussels	fig. 4A	0.032	0.294	< 0.113	0.104	< 0.022	0.374	< 0.078	< 0.180	0.132	6.200 7.914	4.6	" 55-60 cm

Remarks:

n.d.= Not detectable See appendix A for the detection limits.

* The p,p'-DDE content has not been corrected for the presence of PCB.

** The PCB content has been calculated with the help of Arcolor 1254 on a 3% DEGS-1% phosphoric acid column by means of the peaks having a RRT 1,24 and 1,69 relative to p,p'-DDE= 1,00

REF. NO.: 67 - W - 1

SUBSTANCES: DDT, DDE, DDD

Reference: Woodwell, G. M., C. F. Wursten & P. A. Isaacson. 1967. DDT residues in an east coast estuary: a case of biological concentration of a persistent insecticide. Science 156:821-824.

Organisms: Mercenaria mercenaria

Date of Sample Collection: 1966

Location: Carmans River estuary and vicinity, Long Island, N.Y.

Analytical Technique: Electron capture gas chromatography; thin-layer chromatography

Analytical Data:

Table 2. DDT residues (DDT+DDE+DDD) (*1*) in samples from Carmans River estuary and vicinity, Long Island, N.Y., in parts per million wet weight of the whole organism, with the proportions of DDT, DDE, and DDD expressed as a percentage of the total. Letters in parentheses designate replicate samples.

Sample	DDT residues (ppm)	Percent of residue as		
		DDT	DDE	DDD
Mercenaria mercenaria, hard clam†	.42	71	17	12

† Composite sample of more than one individual.

REF. NO.: 74 - Y - 1

SUBSTANCES: DDT, PCB

Reference: Young, D. R. & T. C. Heesen. 1974. Contaminants in harbors. Southern California Coastal Water Research Project Ann. Rep. 1974, p. 105-108. El Segundo, Ca.

Organisms: Mytilus edulis

Date of Sample Collection: 1974?

Location: Southern California

Analytical Technique: Electron capture gas chromatography

Analytical Data:

Table 2. Summary of chlorinated hydrocarbon concentrations (μg/wet kg) in whole soft tissues of the bay mussel *Mytilus edulis* collected outside and within three major harbors

	Coastal		Harbor	
	Median	Range	Median	Range
Total DDT				
San Pedro	670	240 – 1,500	380	120 – 1,300
Newport	170	110 – 260	390	200 – 640
San Diego	60	50 – 110	30	5 – 60
PCB 1254				
San Pedro	100	90 – 140	150	85 – 480
Newport	70	50 – 100	210	90 – 880
San Diego	50	40 – 60	300	20 – 860

REF. NO.: 75 - Y - 3

SUBSTANCES: PCB

Reference:

Young, D. R., D. J. McDermott & T. C. Heesen. 1975. Polychlorinated biphenyls off Southern California. Proc. International Conference on Environmental Sensing and Assessment, Sept. 14-19, 1975, Las Vegas, Nev., v. 1, sect. 4-1, 5p.

Organisms:

Mytilus edulis
Mytilus californianus

Date of Sample Collection: 1974

Location: San Diego Bay and Palos Verdes, California

Analytical Technique: Electron capture gas chromatography

Analytical Data:

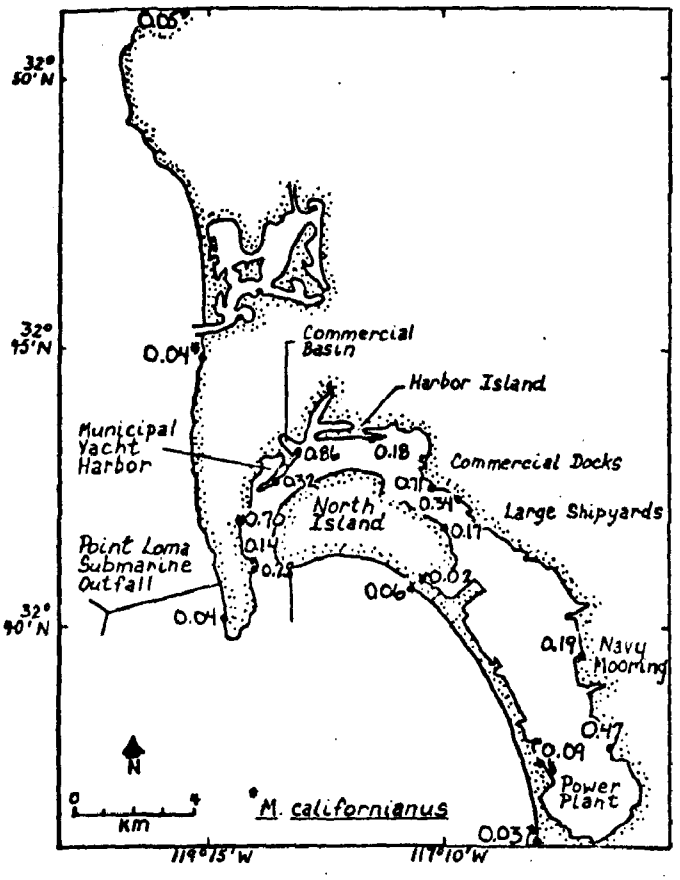


Figure 5. 1254 PCB concentrations (mg/wet kg) in whole soft tissues of the bay mussel, Mytilus edulis, collected in San Diego Bay, January 1974.

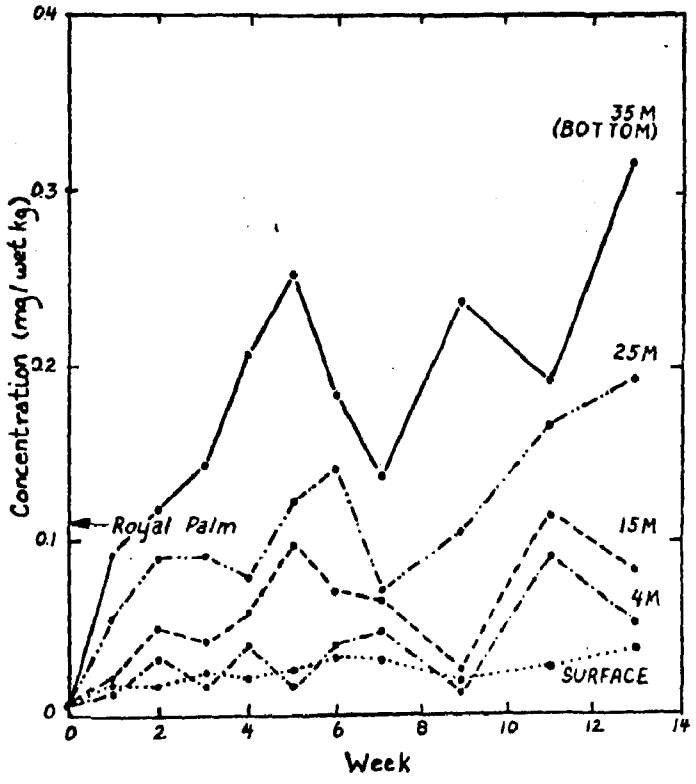


Figure 6. 1254 PCB concentrations in whole soft tissue composites of male intertidal mussels, Mytilus californianus, translocated from Point Sal to the taut line buoy system off Palos Verdes, June through September 1974.

REF. NO.: 76 - Y - 2

SUBSTANCES: PCB, DDT, DDE, DDD

Reference: Young, D. R., T. C. Heesen, D. J. McDermott. 1976. An offshore biomonitoring system for chlorinated hydrocarbons. Mar. Pollut. Bull. 7:156-159.

Organisms: Mytilus californianus

Date of Sample Collection: 1974

Location: Southern California

Analytical Technique: Electron capture gas chromatography

Analytical Data: (dry wt., dried at 60°C)

TABLE 1

Average chlorinated hydrocarbon concentrations (mg/dry kg) ± standard errors, for six male and six female soft-tissue composites of the mussel, *Mytilus californianus*, collected in June 1974 from the rocky intertidal zone at Royal Palm State Beach and Point Sal, California. Each composite consisted of five mussels, 4–6 cm in length.

	Royal Palm, 26 June (Outfall Region)		Point Sal, 25 June (Control Region)	
Compound	Male	Female	Male	Female
Total DDT	4.1 ±0.70	6.4 ±0.32	0.11 ±0.004	0.11 ±0.007
p,p'-DDT	0.04 ±0.005	0.06 ±0.005	0.008 ±0.0005	0.007 ±0.0006
o,p'-DDT	0.03 ±0.003	0.04 ±0.004	0.004 ±0.0001	0.004 ±0.0005
p,p'-DDE	3.5 ±0.64	5.4 ±0.28	0.077 ±0.003	0.067 ±0.003
o,p'-DDE	0.41 ±0.06	0.73 ±0.05	0.015 ±0.001	0.026 ±0.007
p,p'-DDD	0.11 ±0.01	0.18 ±0.007	0.009 ±0.0006	0.008 ±0.0004
Total PCB	0.64 ±0.06	0.94 ±0.04	0.044 ±0.006	0.054 ±0.002
1242 PCB*	0.12 ±0.01	0.19 ±0.01	0.016 ±0.003	0.019 ±0.001
1254 PCB§	0.53 ±0.06	0.76 ±0.04	0.028 ±0.004	0.035 ±0.003

*Mixture with gas chromatographic profile most closely resembling Aroclor 1242. §Mixture with gas chromatographic profile most closely resembling Aroclor 1254.

REF. NO.: 75 - Y - 2 **SUBSTANCES:** DDT, PCB

Reference: Young, D. R. & I. S. Szpila. 1975. Decreases of DDT and PCB in mussels. Southern California Coastal Water Research Project Ann. Rep. 1975, p.123-126.

Organisms: Mytilus californianus

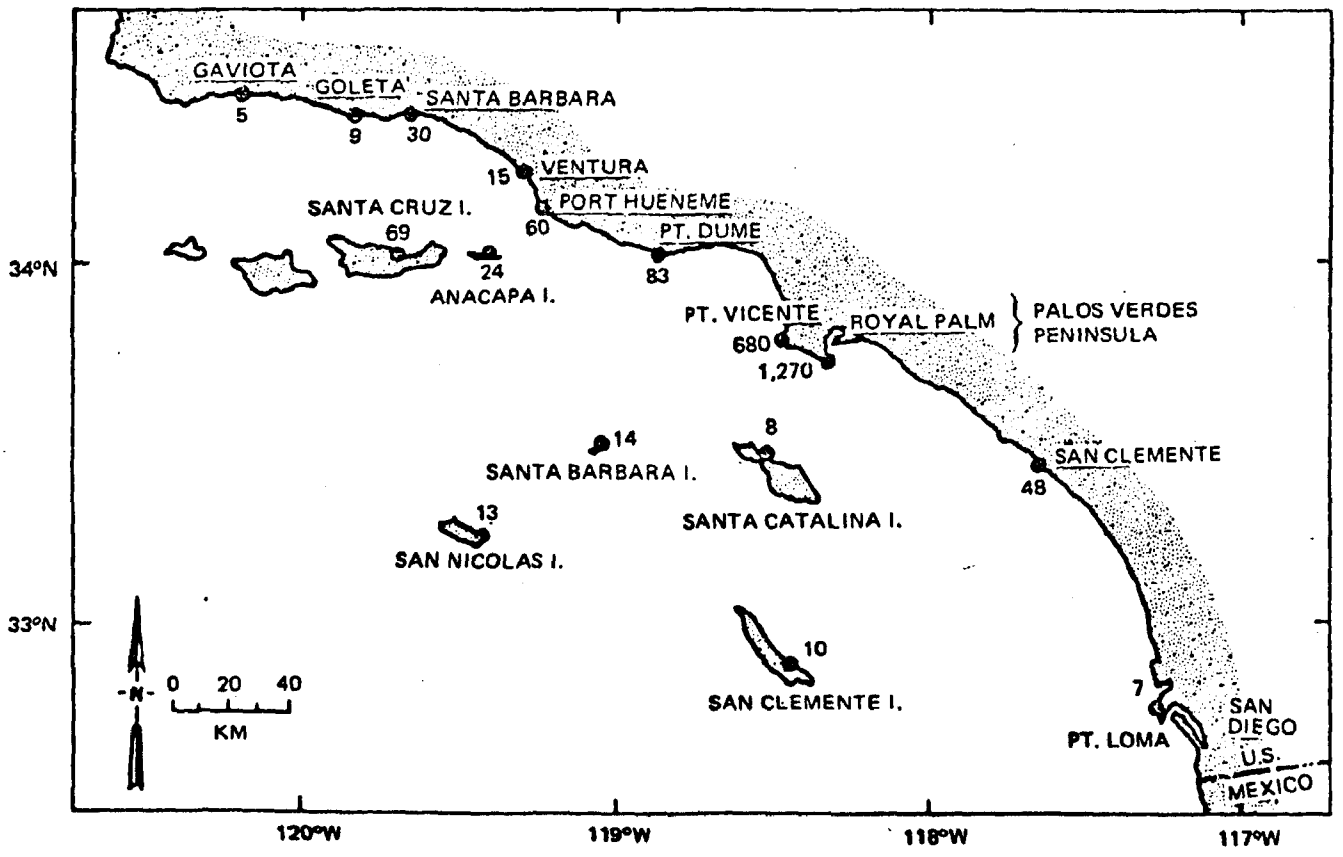
Date of Sample Collection: 1971-74

Location: Southern California

Analytical Technique: Electron capture gas chromatography

Analytical Data:

Figure 1. Concentrations of total DDT (ppb, wet weight) in whole soft tissues of the intertidal mussel, Mytilus californianus, collected during summer, 1974



Young, D. R. & I. S. Szpila. 1975.

Station	Total DDT	1254 PCB
Coastal		
Gaviota	94	79
Santa Barbara	22	25
Port Hueneme	85	69
Point Dume	70	55
Palos Verdes Peninsula		
Point Vicente	84	73
Royal Palm	68	73
San Clemente	79	58
Point Loma	90	54
Island		
Anacapa	66	29
Santa Barbara	95	89
Santa Catalina	89	98
San Nicolas	84	72
San Clemente	76	0
Median Decrease	84	69

Table 1. Percent decrease of chlorinated hydrocarbon concentrations between 1971 and 1974 in whole soft tissues of intertidal mussels (Mytilus californianus) collected from the southern California Bight

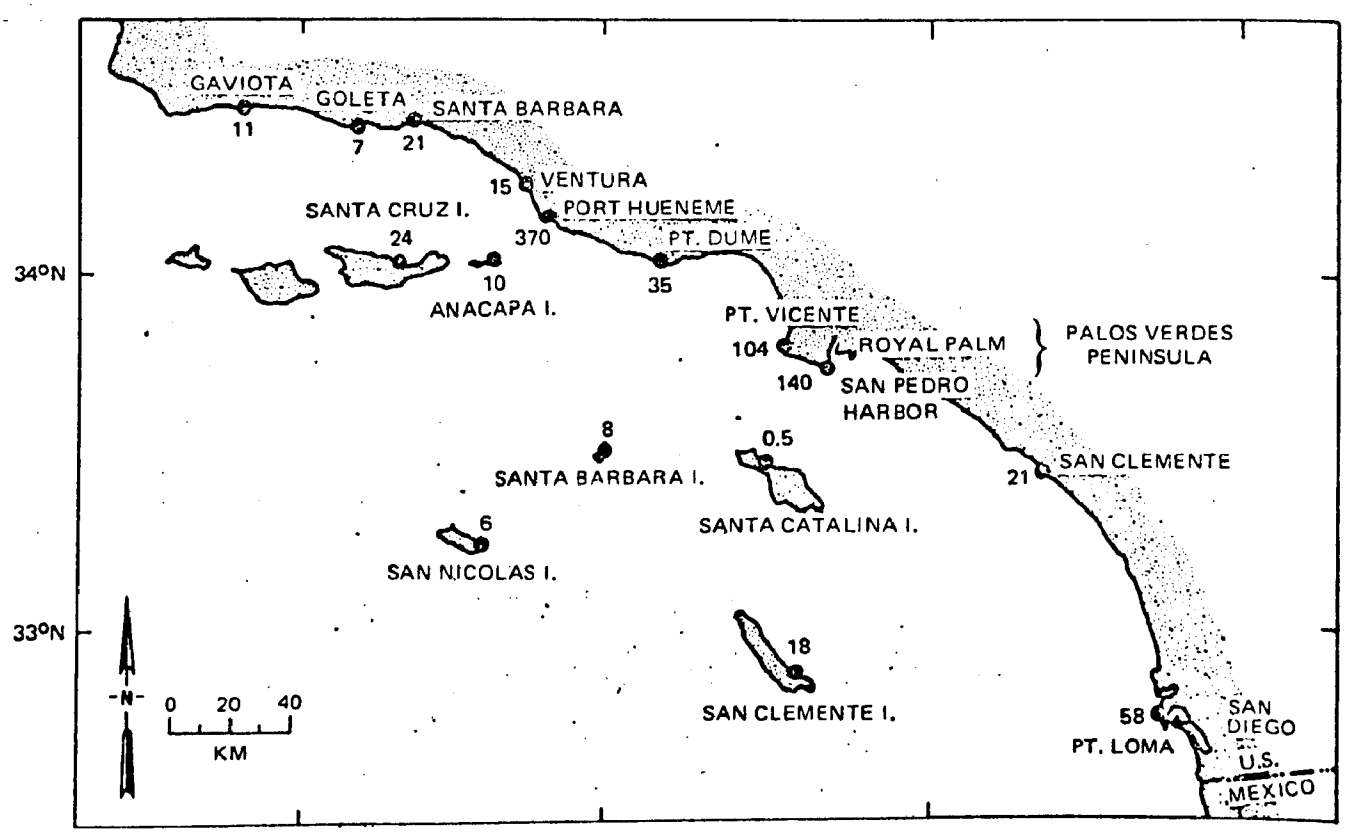


Figure 2. Concentrations of PCB 1254 (pub wet weight) in whole soft tissues of intertidal mussels collected during summer of 1974.

REF. NO.: 71 - Z - 1 **SUBSTANCES:** PCB, DDE

Reference: Zitko, V. & P. M. K. Choi. 1971. PCB and other industrial halogenated hydrocarbons in the environment. Fish. Res. Bd Can. Tech. Rep. 272: 55p.

Organisms: *Mytilus edulis*
Mya arenaria

Date of Sample Collection: 1971?

Location:
E. Canada, Northern Europe, Baltic Sea

Analytical Technique: Gas chromatography

Analytical Data:

Table I

Species	Location	PCB µg/g	p,p'-DDE µg/g	Other
Mussel (whole) *Mytilus edulis*	Swedish West Coast	0.08+	0.01+	
	Baltic Sea	0.03+	0.01+	
	Archipelago of Stockholm	0.04+	0.02+	
	Eastern Canada	0.14***	0.02***	
	Finland	0.06•	traces.	
	Holland	0.4•		
	Norway	traces		
	Sweden	0.03•		

Table X. Additional data on PCB and chlorinated hydrocarbon pesticides in aquatic animals.

Species	Location	PCB µg/g	p,p'-DDE µg/g	Other
Clam *Mya arenaria*	Bathurst, N. B.	0.09	traces	

RADIONUCLIDES

REF. NO.: 71 - A - 1 **SUBSTANCES:** Pu^{239}

Reference: Aarkrog, A. 1971. Radioecological investigations of plutonium in an arctic marine environment. Health Phys. 20:31-47.

Organisms:

Musculus laevigatus	*Clinocardium ciliatum*	*Serripes groenlandia*
Musculus niger	*Hiatella striata*	*Mytilus edulis*
Astarte montagui	*Macoma calcaria*	
Astarte borealis	*Chlamys islandica*	

Date of Sample Collection: 1968

Location: Thule, Greenland

Analytical Technique: Alpha spectrometry

Analytical Data:

REF. NO.: 66 - A - 1

SUBSTANCES: Zn, Zn^{65}, Cr, Cr^{51}, Mn, Mn^{54}

Reference: Alexander, G. V. & R. H. Rowland. 1966. Estimation of zinc-65 background levels for marine coastal waters. Nature 210:155-157.

Organisms: Mytilus californianus
Crassostrea virginica
Venus mercenaria
Crassostrea gigas

Date of Sample Collection: 1964-65

Location: Pacific coast U. S., Washington and California; Atlantic coast, Chesapeake Bay and Long Island Sound

Analytical Technique:

Analytical Data: (lyophilized wt.)

Table 1 COLUMBIA RIVER SAMPLES

Location	Animal	Concentration in dry tissue							
		Type of tissue	Zn p.p.m.	^{65}Zn pc./g	^{65}Zn/Zn pc./mg	Cr p.p.m.	^{51}Cr pc./g	^{51}Cr/Cr pc./mg	Dry/fresh wt. %
Beola Beach, Oregon	*Mitella polymerus*	Stems	270	30·0	111	—	1·21	—	25·0
		Bodies	1,490	142	96				14·7
		Embryos	1,190	206	173				6·9
	Pisaster ochraceus	HC	188	64·3	342	7·3	5·62	770	31·2
	Mytilus californianus	Soft	220	61·1	278	1·2	1·70	1,420	17·5
North Jetty, Ilwaco, Washington	*Pisaster ochraceus*	HC	168	92·9	553	10·0	20·1	2,000	27·4
		♀G	281	220	782	7·5	18·0	2,400	13·2
		♂G	68	38·6	567	12·3	34·4	2,810	13·5
North Head, Ilwaco, Washington	*Mitella polymerus*	Stems	670	129	192	3·6	6·98	1,940	20·8
		Bodies	2,090	395	189	14·0	17·0	1,200	17·4
		Embryos	800	227	284	—	—	—	23·1
	Pisaster ochraceus	HC	211	119	555	7·6	26·0	3,450	30·9
		♀G	450	230	512	4·3	14·6	3,390	17·7
		♂G	48	36	750	10·0	37·4	3,740	16·5
	Mytilus californianus	Soft	230	162	706	1·8	17·9	10,000	14·6
Willapa Bay, Washington	*Crassostrea gigas*	Soft	745	89·5	120	—	—	—	20·4

Stems, peduncle including skin and ovaries in various states of development. Bodies, digestive and male reproductive system excluding shell. HC, hepatic caecum. G, gonad male or female. Embryos, contents of the mantle cavity.

Table 2. 1964–65 BACKGROUND VALUES

Location	Animal	Concentration in dry tissues				
		Type of tissue	Zn p.p.m.	^{65}Zn pc./kg	^{65}Zn/Zn pc./mg	Dry/fresh wt.%
La Jolla, California	*Mitella polymerus*	Stems	150	92	0·61	30·2
		Bodies	910	684	0·75	18·4
	Mytilus californianus	Soft	91	35	0·39	23·1
Malibu, California	*Pisaster ochraceus*	HC	160	22	0·14	
Chesapeake Bay	*Crassostrea virginica*	Soft	10,200	458	0·05	7·60
Long Island Sound	*Venus mercenaria* "little neck"	Soft	214	276	1·29	20·4
Salton Sea	*Balanus amphitrite saltonensis*	Soft	193	516	2·68	18·6

Table 3. 1958–59 BACKGROUND VALUES

Food	Reference	Concentration in fresh tissue			
		^{65}Zn pc./kg	Zn p.p.m.	^{65}Zn/Zn pc./mg	Collection date
Cows milk	Murthy (ref. 10)	40	44	0·92	May '58
Oysters	Murthy (ref. 10), Perkins (ref. 9)	164	7·0	0·23	'58, '59
Eggs	Murthy (ref. 10)	6	13·5	0·44	Aug. '58
Milk	Murthy (ref. 10)	4	5·1	1·29	'59
Tomatoes	Perkins (ref. 9)	7·2	3·4	0·21	'59

Table 4. MANGANESE AND MANGANESE-54 IN DRY TISSUE

Location	Animal	Type of tissue	Mn p.p.m.	^{54}Mn pc./kg	^{54}Mn/Mn pc./mg
Beola Beach, Oregon	*Mitella polymerus*	Stems	114	1,700	14·9
North Head, Ilwaco, Washington	*Mitella polymerus*	Stems	154	2,230	14·5
Willapa Bay, Washington	*Crassostrea gigas*	Soft	59·1	1,060	18·0
La Jolla, California	*Mitella polymerus*	Stems	37·9	243	6·4

Table 7. ^{239}Pu *levels in bivalves collected in August* 1968 *at Thule, Greenland*

Location (cf. Fig. 1)	Sample depth (m)	Sampling date	pCi/g ash from soft tissue	pCi/kg soft tissue	^{238}Pu/^{239}Pu	Species
Zone II						
26	34	Aug. 9	0.16	5.6B		*Musculus laevigatus* and *Astarte montagui*
16	94	Aug. 14	3.3	170		*Clinocardium ciliatum*
16	94	Aug. 14	2.6	107		*Hiatella striata*
16	94	Aug. 14	27	1800		*Macoma calcaria*
17	172	Aug. 7 & 10	100 ± 100	3600 ± 3600	0.020	*Clinocardium ciliatum* & *Macoma calcaria*
30	250	Aug. 16	51	2300	0.014	*Macoma calcaria*
29	97	Aug. 11	0.23	10		*Chlamys islandica*
29	97	Aug. 11	0.90	64		*Clinocardium ciliatum*
29	97	Aug. 11	0.20	6.7		*Hiatella striata*
29	97	Aug. 11	29	1500	0.013	*Macoma calcaria*
29	97	Aug. 11	0.53	22		*Musculus laevigatus*, *Astarte borealis* & *Astarte montagui*
27	30	Aug. 10	0.30	11		*Chlamys islandica*
27	30	Aug. 10	0.32	10		*Astarte montagui*
18	70	Aug. 14	0.43	22		*Serripes groenlandia* & *Clinocardium ciliatum*
18	70	Aug. 14	36	1700		*Astarte montagui*, *Macoma clacaria* & *Hiatella striata*
34	140	Aug. 15	19	915	0.022	Varios species, *Chlamys astarte*, *macoma*, *hiatella*, *clinocardium*
20	22	Aug. 14	0.67	18		*Chlamys islandica*
20	22	Aug. 14	0.22	5.9		*Musculus laevigatus* & *Astarte montagui*
19	155	Aug. 13	0.75	40		*Clinocardium ciliatum*
19	155	Aug. 13	8.4	490	0.023	*Macoma calcaria*
32	195	Aug. 13	98 ± 45	5400 ± 2400	0.022	*Macoma calcaria*
15	105	Aug. 13	16 ± 9	770 ± 430		*Macoma calcaria*
14	210	Aug. 13	12	640		*Musculus niger* & *Macoma calcaria*
12	90	Aug. 12	1.15	110		*Chlamys islandica* & *Clinocardium ciltatum*
12	90	Aug. 12	1.44	96	0.026	*Macoma calcaria* & *Hiatella striata*
12	90	Aug. 12	0.27	13		*Serripes groenlandicus* & *Astarte borealis*
2	1	July 25	0.23	4.7		*Mytilus edulis*
2	1	July 27	0.36	16		*Mytilus edulis*
43	100	Aug. 20	0.50	32		*Chlamys islandica*
43	100	Aug. 20	0.26	9.5		*Clinocardium ciliatum*
43	100	Aug. 20	0.55	21		*Musculus niger*
43	100	Aug. 20	0.35	17A		*Hiatella strata*
43	100	Aug. 20	10.5	500		*Macoma calcaria*
Median			0.75	40		
Zone I						
52	188	Aug. 22	15	820		Mixed samples, mostly of *macoma*, *Musculus niger*, *hiatella*, & *astarte*
53	203	Aug. 22	7.1	340		
54	217	Aug. 22	5.2	960	0.032	
55	178	Aug. 22	220	21000	0.013	
56	178	Aug. 22	12	720		
57	185	Aug. 22	1000	76000	0.012	
58	188	Aug. 22	140	8600	0.016	
59	196	Aug. 22	32	8300		
60	198	Aug. 22	250	25000	0.015	
61	215	Aug. 22	53	7700	0.019	
Median			42	8000		

REF. NO.: 66 - A - 1

SUBSTANCES: Zn, Zn^{65}, Cr, Cr^{51}, Mn, Mn^{54}

Reference: Alexander, G. V. & R. H. Rowland. 1966. Estimation of zinc-65 background levels for marine coastal waters. Nature 210:155-157.

Organisms: Mytilus californianus
Crassostrea virginica
Venus mercenaria
Crassostrea gigas

Date of Sample Collection: 1964-65

Location: Pacific coast U. S., Washington and California; Atlantic coast, Chesapeake Bay and Long Island Sound

Analytical Technique:

Analytical Data: (lyophilized wt.)

Table 1 COLUMBIA RIVER SAMPLES

Location	Animal	Concentration in dry tissue						
		Type of tissue	Zn p.p.m.	^{65}Zn pc./g	^{65}Zn/Zn pc./mg	Cr p.p.m.	^{51}Cr pc./g	^{51}Cr/Cr pc./mg	Dry/fresh wt. %
Ecola Beach, Oregon	*Mitella polymerus*	Stems	270	30·0	111	—	1·21	—	25·9
		Bodies	1,490	142	96				14·7
		Embryos	1,190	206	173				8·9
	Pisaster ochraceus	HC	188	64·3	342	7·3	5·62	770	31·2
	Mytilus californianus	Soft	220	61·1	278	1·2	1·70	1,420	17·5
North Jetty, Ilwaco, Washington	*Pisaster ochraceus*	HC	168	92·9	553	10·0	20·1	2,000	27·4
		♀G	281	220	782	7·5	18·0	2,400	13·2
		♂G	68	38·6	567	12·3	34·4	2,840	13·5
North Head, Ilwaco, Washington	*Mitella polymerus*	Stems	670	129	192	3·6	6·98	1,940	20·8
		Bodies	2,090	395	189	14·0	17·0	1,260	17·4
		Embryos	800	227	284	—	—	—	23·1
	Pisaster ochraceus	HC	211	119	555	7·6	26·0	3,450	30·9
		♀G	450	230	512	4·3	14·6	3,390	17·7
		♂G	48	36	750	10·0	37·4	3,740	16·5
	Mytilus californianus	Soft	230	162	706	1·8	17·9	10,000	14·6
Willapa Bay, Washington	*Crassostrea gigas*	Soft	745	89·5	120	—	—	—	20·4

Stems, peduncle including skin and ovaries in various states of development. Bodies, digestive and male reproductive system (excluding shell. HC, hepatic caecum. G, gonad male or female. Embryos, contents of the mantle cavity.

Table 2. 1964-65 BACKGROUND VALUES

Location	Animal	Concentration in dry tissues				
		Type of tissue	Zn p.p.m.	^{65}Zn pc./kg	^{65}Zn/Zn pc./mg	Dry/fresh wt.%
La Jolla, California	*Mitella polymerus*	Stems	150	92	0·61	30·2
		Bodies	910	684	0·75	18·4
	Mytilus californianus	Soft	91	35	0·39	23·1
Malibu, California	*Pisaster ochraceus*	HC	160	22	0·14	
Chesapeake Bay	*Crassostrea virginica*	Soft	10,200	456	0·05	7·60
Long Island Sound	*Venus mercenaria* "little neck"	Soft	214	276	1·29	20·4
Salton Sea	*Balanus amphitrite californicus*	Soft	193	516	2·68	18·6

Table 3. 1958-59 BACKGROUND VALUES

Food	Reference	Concentration in fresh tissue			
		^{65}Zn pc./kg	Zn p.p.m.	^{65}Zn/Zn pc./mg	Collection date
Clams	Murthy (ref. 10)	40	34	0·92	May '58
Oysters	Murthy (ref. 10), Perkins (ref. 9)	164	7·0	0·23	Feb. '59
Eggs	Murthy (ref. 10)	6	13·5	0·44	Aug. '58
Milk	Murthy (ref. 10)	4	5·1	1·29	'59
Tomatoes	Perkins (ref. 9)	7·2	3·4	0·21	'59

Table 4. MANGANESE AND MANGANESE-54 IN DRY TISSUE

Location	Animal	Type of tissue	Mn p.p.m.	^{54}Mn pc./kg	^{54}Mn/Mn pc./mg
Ecola Beach, Oregon	*Mitella polymerus*	Stems	114	1,700	14·9
North Head, Ilwaco, Washington	*Mitella polymerus*	Stems	154	2,230	14·5
Willapa Bay, Washington	*Crassostrea gigas*	Soft	59·1	1,060	18·0
La Jolla, California	*Mitella polymerus*	Stems	37·9	243	0·4

REF. NO.: 75 - B - 2

SUBSTANCES: Cs^{137}, K

Reference: Brown, M. J., P. D. Grimwood & E. G. Bellinger. 1975. Caesium-137: its accumulation in a littoral community. Mar. Pollut. Bull. 6:24-26.

Organisms: Mytilus edulis

Date of Sample Collection: 1973

Location: Irish Sea, near Windscale nuclear plant, U.K.

Analytical Technique: gamma spectrometry

Analytical Data: (dry wt, dried at 110°C)

TABLE 1
Potassium content, concentration factors and discrimination factors for some members of a littoral community.

Material	K (mg/kg)	CF	DF
F. vesiculosus	10,140*	46	1.7
F. serratus	10,550*	46	1.7
Enteromorpha sp.	4900*	19	1.5
L. littorea soft tissues	3320*	43	4.9
shell		13	
M. edulis soft tissues	3040†	47	5.9
shell		9	
N. lapillus soft tissues	2890†	99	13.0
shell		31	

*From Vinogradov (1953).
†Derived from data given in Bryan (1963).

Results

The results of the analyses, presented in Table 1, are expressed in two ways:

(1) As concentration factors (CF) i.e.:

$$CF = \frac{\text{Concn of } ^{137}\text{Cs in sample (pCi/g wet wt)}}{\text{Concn of } ^{137}\text{Cs in sea water (pCi/ml)}}$$

(2) As discrimination factors (DF) i.e.:

$$DF = \frac{\text{pCi } ^{137}\text{Cs/g potassium in sample}}{\text{pCi } ^{137}\text{Cs/g potassium in sea water}}$$

REF. NO.: 58 - C - 1 **SUBSTANCES:** Zn^{65}

Reference: Chipman, W. A., T. R. Rice & T. J. Price. 1958. Uptake and accumulation of radioactive zinc by marine plankton, fish, and shellfish. U.S. NMFS Fish. Bull. 135, v. 58:279-292.

Organisms: Crassostrea virginica
Venus mercenaria
Pecten irradians

Date of Sample Collection: 1957?

Location: U.S., Atlantic and Gulf coasts

Analytical Technique: colorimetry

Analytical Data: (dry wt, dried at 70°C)

TABLE 1.—*Average of weekly observations of the zinc content of the sea water at Beaufort, N. C.*

Month	Zinc in micrograms (γ) per liter	Month	Zinc in micrograms (γ) per liter
November	9.7	May	13.2
December	2.8	June	14.1
January	3.5	July	12.4
February	5.4	August	[1] 14.6
March	5.0	September	12.1
April	12.1	October	11.6

[1] Before hurricane, 12.5; after hurricane, 19.6.

TABLE 3.—*Distribution of zinc in the oyster*

[Based on dried tissue]

Tissue	Zinc content (micrograms per milligram)
Mantle	6.91
Gills	8.02
Labial palps	9.58
Adductor muscle	.61
Remainder	6.69

TABLE 2.—*Zinc content of oysters and the surrounding sea water*

[Winter and early spring samples]

Locality	Zinc in oysters (micrograms per gram of fresh tissue)	Zinc in sea water (micrograms per gram)
Milford, Conn	3174	0.0188
Upper Chesapeake Bay	2933	.0240
Lower Chesapeake Bay:		
York River, Va	1295	
James River, Va	1484	.0079
Chincoteague Bay, Md	778	
Beaufort, N. C	1171	.0046
Brunswick, Ga	313	.0011
Gulf of Mexico:		
Pensacola, Fla	600	.0006
Galveston, Tex	391	(1)

[1] Trace.

REF. NO.: 66 - C - 1

SUBSTANCES: Na^{24}, Cr^{51}, Mn^{56}, Cu^{64}, Zn^{65}, La^{140}

Reference: Cushing, C. E. & D. G. Watson. 1966. Accumulation and transport of radionuclides by Columbia River biota. In Disposal of Radioactive Wastes into Seas, Oceans and Surface Waters, Proc. Symp., Vienna, May 1966, p. 551-570. IAEA, Vienna.

Organisms: Cyclas fluminea

Date of Sample Collection: 1964-65

Location: Columbia River

Analytical Technique: gamma-ray spectrometry

Analytical Data:

TABLE II. Concentration and per cent change, µCi/g wet wt., F-1 station, 1964-65.

		Net Plankton	Filamentous Algae[a]	Sponge[b]	Caddisfly Larvae[c]	Chironomids	Limpets[d] Soft Parts	Limpets Shell	Clam[e] Soft Parts	Clam Shell	Crayfish[f]
^{24}Na	1964	1,414	397	169	764	1,450	1,595	644	393	136	955
	1965	63	149	101	476	441	685	431	330	93	138
	%	-96	-63	-40	-38	-70	-57	-33	-16	-32	-86
^{51}Cr	1964	59,500	43,400	10,200	3,590	1,390	1,940	1,080	620	181	536
	1965	28,400	32,900	16,000	4,890	2,660	2,260	1,350	599	184	473
	%	-52	-24	+61	+36	+91	+16	+25	-3	+2	-12
^{56}Mn	1964	291,000	96,300	12,200	10,430	6,490	1,700	7,480	556	617	982
	1965	16,100	8,680	4,200	1,800	1,120	<1,190	689	<820	<168	77
	%	-94	-91	-65	-83	-83	--	-91	--	--	-92
^{64}Cu	1964	102,000	36,000	47,400	8,970	8,560	4,500	2,230	3,230	383	748
	1965	14,300	9,150	21,400	2,610	4,300	1,650	865	5,270	581	181
	%	-86	-75	-55	-71	-50	-63	-61	+63	+52	-76
^{65}Zn	1964	14,000	8,870	3,070	1,970	2,080	2,820	658	1,100	441	811
	1965	1,910	3,250	2,500	1,770	1,370	1,360	346	1,190	343	545
	%	-79	-63	-19	-10	-34	-52	-47	+8	-22	-33
^{140}La	1964	5,900	1,610	950	223	<97	73	113	47	5	12
	1965	2,010	1,760	1,325	322	212	107	107	89	12	20
	%	-66	+9	+39	+44	--	+48	-5	+89	+139	+64

[a] Stigeoclonium sp.
[b] Spongilla sp.
[c] Hydropsyche cockerelli Banks
[d] Fisherola nuttallii (Haldeman)
[e] Cyclas fluminea (Muller)
[f] Astacus trowbridgii Stimpson

REF. NO.: 58 - D - 1

SUBSTANCES: C^{14}

Reference: De Vries, H. 1958. Atomic bomb effect: variation of radiocarbon in plants, shells, and snails in the past 4 years. Science 128:250-251.

Organisms: Mytilus edulis

Date of Sample Collection: 1953

Location: Dutch Wadden Sea

Analytical Technique:

Analytical Data:

Ms53 = Mytilus shells
Mf53 = Mytilus flesh

Table 1. Summary of results. The notations for the samples are given in the text

Sample No.	δC^{14} (per mil)	δC^{13} (per mil)
P	*0*	*0*
*Ws*53	−11	+16
*Wf*53	−21	0
*Ws*56	−17	*
*Wf*56	+18	*
*Ws*57	−2	*
*Wf*57	+22	*
*Ms*53	−13	+19
*Mf*53	−50	+4
*Ls*53	−44	~+25
*Lf*53	−94	~0
*Lp*53	−82	~+8

* The various batches of *Helix pomatia* [illegible] gave the same concentration of C^{13}.

REF. NO.: 73 - D - 2

SUBSTANCES: Ru^{106}, Zr^{95}, Nb, Ce^{144}, Tc^{99}

Reference: Dutton, J. W. R. & R. B. Ibbett. 1973. The determination of technetium-99 in marine biological materials. Central Electricity Generating Bd, Symp. on the determination of radionuclides in environmental and biological materials, London, April 1973, Paper no. 20:6p.

Organisms: mussels, oysters (unspecified)

Date of Sample Collection: 1973?

Location: Irish Sea

Analytical Technique: Beta-counting

Analytical Data:

Table 1 Fission-product activities in biological materials

	Concentration of radioactivity, pCi/g (wet)			
	^{106}Ru	$^{95}Zr/Nb$	^{144}Ce	^{99}Tc*
St Bees, *Fucus vesiculosus*	37.1	59.2	11.7	≈ 500
" " *Porphyra*	159.1	67.3	17.7	< 10
Drigg, mussels	258.5	104.3	47.4	≈ 50
Irish Sea, oysters	10.2	1.0	6.2	> 5

* Estimated from the discrepancy between γ-spectrometric and "gross β" results, and other data.

Table 5 Typical ^{99}Tc results

	Concentration of radioactivity, pCi/g (wet)	
	^{106}Ru	^{99}Tc
St Bees, *Fucus vesiculosus*	37.1	439.9
" " *Porphyra*	159.1	0.7
Drigg, mussels	258.5	23.5
Irish Sea, oysters	10.2	1.0

REF. NO.: 73 - F - 4

SUBSTANCES: Zn^{65}

Reference: Essig, T. H., G. W. R. Endres, J. K. Soldat & J. [illegible] Honstead. 1973. Concentrations of ^{65}Zn in marine foodstuffs and Pacific coastal residents. In Radioactive Contamination of the Marine Environment, Proc. Symp., Seattle, 1972, p. 651-668. IAEA, Vienna.

Organisms: clams, oysters (unspecified)

Date of Sample Collection: 1973?

Location: Willapa Bay, Washington

Analytical Technique: ?

Analytical Data:

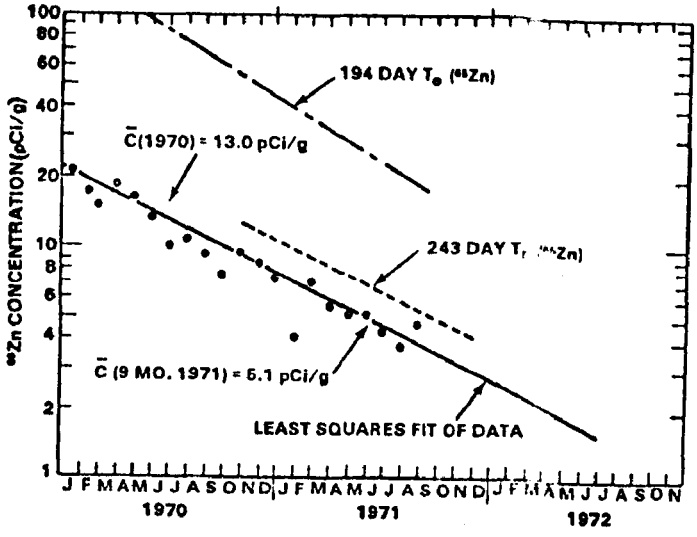


FIG. 5. ^{65}Zn concentration in Willapa Bay oysters.

TABLE III. CONCENTRATION OF ^{65}Zn IN SEAFOODS (Ilwaco)

Seafood	Concentration (pCi/g)	
	1970 (average)	October 1971
Clams	1.50	0.32
Crab	3.70	0.88
Oysters	10.70	2.34
Shrimp	0.48	0.11

REF. NO.: 63 - F - 1

SUBSTANCES: Zn^{65}

Reference: Fitzgerald, B. W. & D. M. Skauen. 1963. Zinc-65 in oysters in Fishers Island Sound and its estuaries. In Radioecology, Proc. 1st Nat. Symp. Radioecology, Colorado State Univ., Sept., 1961, V. Schultz & A. W. Klement, eds., p. 159-162. Reinhold Pub. Corp., N. Y., and Amer. Inst. Biological Sciences, Wash., D.C.

Organisms: Crassostrea virginica

Date of Sample Collection: 1960-61

Location: Thames River, Connecticut

Analytical Technique: Gamma spectroscopy

Analytical Data: (wet wt)

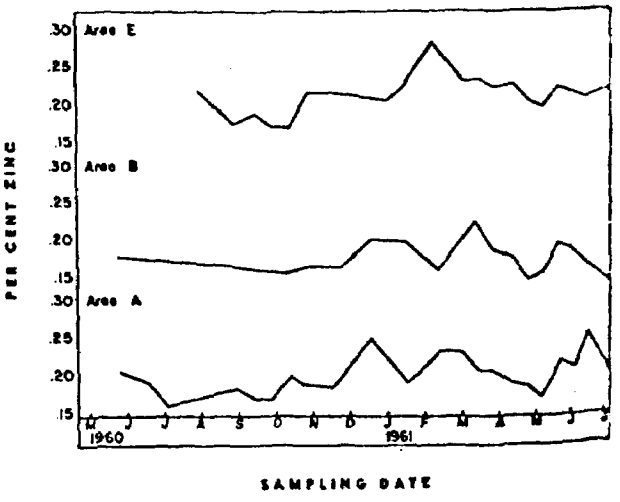


Figure 1. Percentages of zinc in oysters from three areas for a one-year period. Area A = Cow Point, Thames River; Area B = Mamakoke Island, Thames River; Area E = U. S. Coast Guard Academy. Each plotted point a single analysis of a composite sample of 45 oysters.

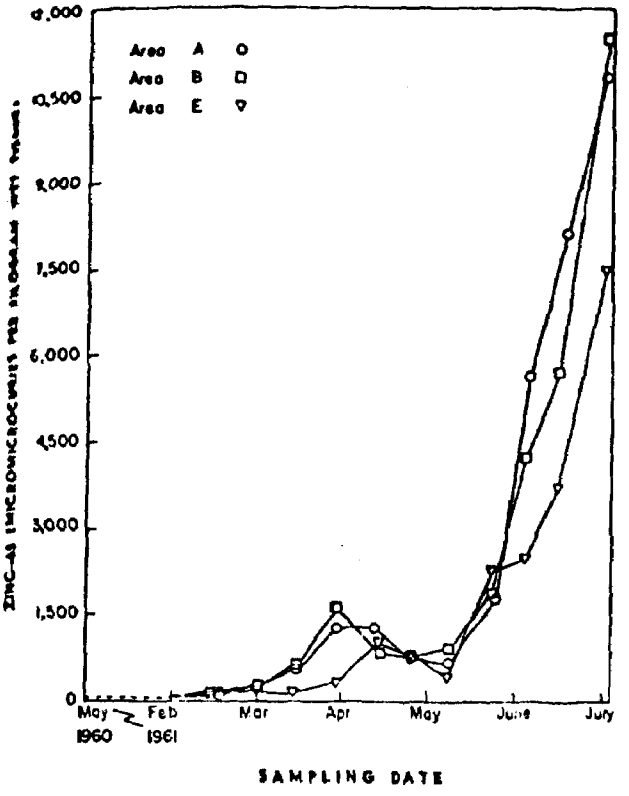


Figure 2. Zinc-65 in oysters from three areas for a one-year period. Area A = Cow Point, Thames River: Area B = Mamakoke Island Thames River; Area E = U. S. Coast Guard Academy. Each plotted point a single analysis of a composite sample of 45 oysters.

REF. NO.: 63 - F - 2

SUBSTANCES: K^{40}, Mn^{54}, Zn^{65}

Reference: Folsom, T. R., D. R. Young, J. N. Johnson & K. C. Pillai. 1963. Manganese-54 and zinc-65 in coastal organisms of California. Nature 200:327-329.

Organisms: Mytilus edulis
Mytilus californianus

Date of Sample Collection: 1963

Location: Southern California

Analytical Technique:

Analytical Data: (wet wt)

Table 2. CONCENTRATION OF MANGANESE-54 AND ZINC-65 BY COASTAL ORGANISMS (1963, SOUTHERN CALIFORNIA)

Date collected	^{40}K* μμc./l.	^{54}Mn μμc./l.	$^{54}Mn/^{40}K$	^{54}Mn in organisms/ ^{54}Mn in sea-water	^{65}Zn μμc./l.
Phytoplankton (mostly dinoflagellates, predominantly *Gonyaulax polyedra*)					
4/11	2,150	280	0·13	4,700	—
5/5	2,200	375	0·17	6,300	—
5/6–7	525	150	0·29	2,500	—
5/10–12	2,250	145	0·064	2,500	(< 10)
Sessile algae (from open areas off California coast)					
Green alga (*Enteromorpha* spp. from float 6 miles at sea)					
5/22	4,600	325	0·071	5,500	(< 10)
Green alga (*Ulva lactuca* from La Jolla rocks)					
8/8	2,450	(< 15)	(< 0·006)	(< 300)	(< 10)
Brown alga (blade pods of giant kelp *Macrocystis pyrifera* from La Jolla)					
8/6	16,200	40	0·002	680	(< 10)
Red alga (*Porphyra lanceolata* from Dillon Beach North of San Francisco)					
6/19	3,100	120	0·039	2,000	(< 10)
Zooplankton (mixed small surface plankters near Scripps Pier, La Jolla)					
4/19–20	500	100	0·200	1,700	(< 30)
5/9	350	20	0·057	340	(< 30)
Intertidal mussels from Scripps Pier, La Jolla†					
Mytilus edulis from Scripps Pier, La Jolla					
4/30	1,750	49	0·028	830	17
Mytilus californianus					
4/30	2,000	49	0·024	830	40
8/9	1,750	47	0·027	800	47
Barnacles, La Jolla					
Balanus tintinnabulum from float 6 miles at sea‡					
5/22	775	140	0·182	2,400	65
Gooseneck *Pollicipes polymerus*, Scripps Pier—necks only					
8/9	1,300	120	0·092	2,050	110
Gooseneck *Pollicipes polymerus*, Scripps Pier—heads only					
8/9	1,350	75	0·056	1,270	25
Fish					
Surface filter feeder, Grunion, *Leuresthes tenuis*, La Jolla, surface					
5/9	2,900	50	0·017	850	200
Deep scavenger, Hagfish, *Eptatretus stoutii*, 200 fathoms, San Diego					
3/28–29	1,730	(< 2)	(< 0·001)	(< 35)	45
Surface predator, Bonita, *Sarda lineolata*, 30 cm, La Jolla					
	2,600	14	0·005	240	155
Amphipods trapped at 200 fathoms off Pt. Loma					
3/28–29	1,100	55	0·050	930	65

* 1 g potassium contains about 850 μμc. ^{40}K (assuming 3·44 γ/sec/gK); the volumes are wet settled or drained volumes and usually approximated by weighing as kg.

† Shells removed.

‡ Shells removed excepting fragments of base.

REF. NO.: 65 - F - 1

SUBSTANCES: Ag^{110m}, Co^{60}

Reference: Folsom, T. R. & D. R. Young. 1965. Silver-110m and cobalt-60 in oceanic and coastal organisms. Nature 206:803-806.

Organisms: Mytilus californianus
Modiolus agripeta

Date of Sample Collection: 1964

Location: Near San Diego, California

Analytical Technique: Gamma spectrometry

Analytical Data: (wet wt)

Table 1. Concentrations of Silver-110m and Cobalt-60 in 'Liver' Tissue in Picocuries/Wet Kg

(Fig. 1)	Location	^{110m}Ag	^{60}Co
(A) Squid 'Livers'			
A	N.E. Pacific Oceanic	3,500 ± 150	3,800 ± 100
B	N.E. Pacific Oceanic	1,600 ± 100	—
C	N.E. Pacific Oceanic	4,200 ± 300	1,200 ± 100
D	N.E. Pacific Oceanic	1,400 ± 100	1,100 ± 100
F	Los Angeles Coast	200 ± 100	0 (3)
G	Monterey Coast	300 ± 100	0 (20)
H	Hawaiian Coast	1,400 ± 100	0 (30)
I	Okinawan Coast	1,500 ± 100	600 ± 40
J	W. Hokkaido Coast	750 ± 150	0 (30)
K	E. Hokkaido Coast	500 ± 100	0 (15)
L	Atlantic Grand Bank	150 ± 20	0 (3)
(B) Concentrations in 'Livers' of Other Organisms			
(1)	Byssal mussels, Scripps Pier*	4 ± 1	10 ± 1
(2)	Byssal mussels, Okinawa*	120 ± 10	40 ± 4
(3)	Albacore, N. Pacific population	80 ± 10	160 ± 20
(4)	Albacore, S. Pacific population	0 (10)	30 ± 5
(5)	Shark, Hawaii	0 (15)	0 (4)
(6)	Barnacles, N.E. Pacific gyral†	0 (20)	40 ± 4
(7)	Barnacles, N. of Borneo†	0 (2)	10 ± 4

* Whole soft tissue. † Whole organism.

Table 2. Description of Specimens

(Fig. 1)	Position	Collected	Species	Individuals‡	Liver-weight§
A	34 N, 135 W	7/8/64	*Stenoteuthis bartrami*	1	103
B	37 N, 155 W	7/9/64	*Stenoteuthis bartrami*	1	19
C	44 N, 155 W	31/8/64	*Stenoteuthis bartrami*	1	9
D	46 N, 155 W	29/8/64	*Stenoteuthis bartrami*	1	32
F	36 N, 122 W	Oct, '64	*Loligo opalescens*	30	19
G	34 N, 118 W	Spring '64	*Loligo opalescens*	30	24
H	21 N, 157 W	6/12/64	*Sepioteuthis* sp.	7	16
I	27 N, 128 E	9/2/64	*Symplectoteuthis oualaniensis*	6	26
J	43 N, 140 E	28/8/64	*Stenoteuthis bartrami*	6	26
K	43 N, 145 E	30/8/64	*Stenoteuthis bartrami*	6	32
L	47 N, 53 W	Fall '64	*Illex illecebrosus*	4	115
(1)	33 N, 117 W	15/8/64	*Mytilus californianus**	50	1,500
(2)	27 N, 128 W	9/2/64	*Modiolus agripeta**	80	600
(3)	33 N, 117 W	26/7/64	*Thunnus alalunga*	3	325
(4)	28 S, 164 W	Aug. '64	*Thunnus alalunga*	3	385
(5)	21 N, 157 W	4/11/64	*Galeocerdo cuvieri*	1	130
(6)	29 N, 140 W	25/9/64	*Lepas anatifera*†	30	132
(7)	4 N, 110 E	7/10/63	*Lepas anserifera*†	60	372

* Whole soft tissues.
† Whole organisms.
‡ Approximate No.
§ Wet wt. (g).

REF. NO.: 66 - F - 1

SUBSTANCES: Pu^{239}

Reference: Folsom, T. R. 1966. Studies of background radioactivity levels in the marine environment near Southern California. University of California, IMR-TR-922-66-A,B,C:43p.

Organisms: *Mytilus* sp.

Date of Sample Collection: 1964

Location: Saint Nicholas Island, off Southern California

Analytical Technique: ?

Analytical Data: 0.57 picocuries Pu^{239}/kg(wet)

REF. NO.: 73 - F - 4 **SUBSTANCES:** Po^{210}

Reference: Folsom, T. R. & T. M. Beasley. 1973. Contriubtions from the alpha-emitter, polonium-210, to the natural radiation environment of the marine organisms. In Radioactive Contamination of the Marine Environment, Proc. Symp., Seattle, 1972, p. 625-632.

Organisms: oysters (unspecified)

Date of Sample Collection: 1968

Location: Oregon coast

Analytical Technique: ?

Analytical Data:

TABLE I. SOME POLONIUM-210 CONCENTRATIONS FOUND IN SEAWATER AND MARINE ORGANISMS OF THE NORTHEAST PACIFIC (1965-1968)

Depth (meters)	Sample	Reference[a]	Concentration (dpm/Kg wet[b])	"Dose rate" added by ^{210}Po (mrads/year[c])
Selected Marine Organisms, Several Depths, Oregon Coast 1968				
<1	*Lepas sp.* (whole)	B	3490	160
0- 10	Oysters (soft tissue)	B	1040	47

[B= Beasley, T. M., 1968, Ph.D. thesis, Oregon State University, Corvallis, Ore.]

REF. NO.: 74 - F - 5 SUBSTANCES: Pu ^{239,240}

Reference:

Fukai, R., C. N. Murray, G. Statham & K. Asari. 1974. Radionuclide measurements of water, sediment and biota collected from the Ligurian Sea: $^{239,240}Pu$ ^{90}Sr and ^{137}Cs. In Activities of the International Laboratory of Marine Radioactivity, 1974 Report, Monaco, p. 134-138. Tech. Rep., IAEA, Vienna (IAEA-163).

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1974?

Location: Marseillie Harbour

Analytical Technique: Alpha spectrometry

Analytical Data:

Table 43. Plutonium-239,240 in mussels from Marseille Harbour (*Mytilus galloprovincialis*)

Tissue	$^{239,240}Pu$ (fCi/kg wet)*
Shell	610 ± 50
Soft parts	180 ± 30
Pallial fluid	190 ± 80

* 2σ propagated errors

REF. NO.: 66 - G - 1

SUBSTANCES: Mn^{54}

Reference: Gabay, J. J., J. A. Dapolito & N. I. Sax. 1966. ^{54}Mn in freshwater clams. Health Physics 12:968-970.

Organisms: Lampsilis sp.

Date of Sample Collection: 1965?

Location: Lake Ontario

Analytical Technique: Gamma-ray screening

Analytical Data:

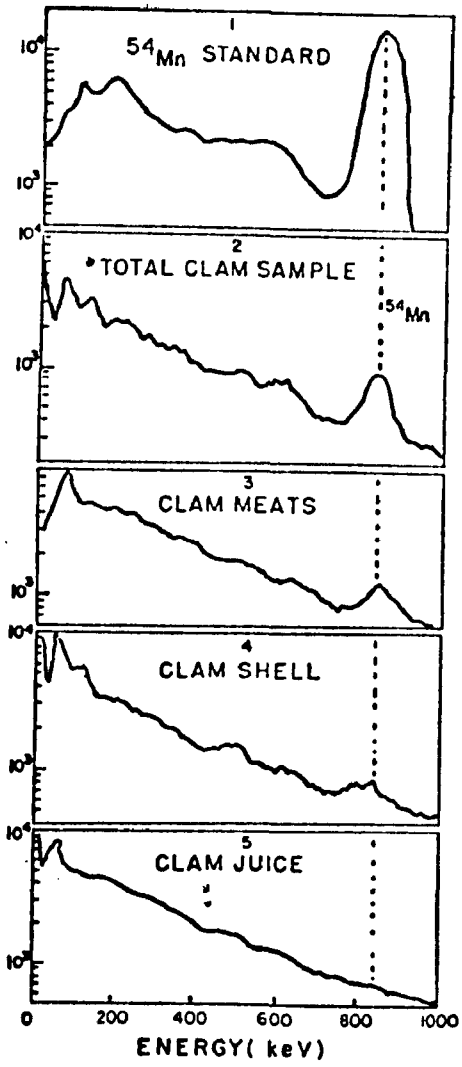


FIG. 1. ^{54}Mn in clams.

Table 1. Concentration of ^{54}Mn in clam fractions

Fraction	Weight as received (g)	Ash weight (g)	^{54}Mn (pc/g ± 2σ of ash weight)
Meat	66	1.6	99.9 ± 6.0
Shell	151	52.2	1.0 ± 0.2
Juice	211	1.1	Not detectable
Lake Ontario*	2000	—	Not detectable

* From lake surface taken weekly since early 1964.

REF. NO.: 64 - G - 1

SUBSTANCES: Mn^{54}

Reference: Gaglione, P. & O. Ravera. 1964. Manganese-54 concentration in fall-out water, and Unio mussels of Lake Maggiore, 1960-63. Nature 204:1215-1216.

Organisms: Unio mancus elongatulus

Date of Sample Collection: 1963

Location: Lake Maggiore, Northern Italy

Analytical Technique: Gamma spectrometry

Analytical Data:

Table 1. CONCENTRATION, CONTENT, PERCENTAGE AND SPECIFIC ACTIVITY OF ^{54}Mn CALCULATED FOR THE DIFFERENT PARTS OF *Unio mancus* VAR. *elongatulus* (ANGERA, DECEMBER, 1963)

Stable manganese data are from Merlini[3]

Part	μμc. ^{54}Mn/g Dry wt.	μμc. ^{54}Mn/g Wet wt.	μμc. ^{54}Mn Part	^{54}Mn as % of total	μμc. ^{54}Mn mg Mn
Total body	34·9	13·3	338·0	101	39
Extrapallial liquid	137·8	0·5	4·6	1	—
Shell	13·4	12·2	117·5	35	40
Total soft tissues	223·4	31·3	215·9	65	30
Gills	366·9	44·0	59·9	18	23
Mantle	280·1	44·0	127·1	38	31
Visceral sac	84·5	13·0	20·8	8	
Foot	32·9	4·0	2·1	1	21

REF. NO.: 75 - H - 3

SUBSTANCES: Mn^{54}, Co^{60}, Zn^{65}, Cs^{137}

Reference: Harrison, F. L., K. M. Wong & R. E. Heft. 1975. Role of solubles and particulates in radionuclide accumulation in the oyster Crassostrea gigas in the discharge canal of a nuclear power plant. University of California, Lawrence Livermore Lab., Biomedical Div., 35p.

Organisms: Crassostrea gigas

Date of Sample Collection: 1973

Location: Discharge canal, Humboldt Bay Power Plant, California

Analytical Technique:

Analytical Data:

Harrison, F. L. et al. 1975.

Table 6. Normalized radionuclide concentrations[a] in oysters maintained in the discharge canal of the Humboldt Bay Power Plant.

	^{54}Mn	^{60}Co	^{65}Zn	^{137}Cs
July 31, 1973				
Nonfiltered seawater				
Prerelease (pCi/kg)	ND[b]	ND	17	ND
Postrelease (pCi/kg)	28	20	83	0.76
Rate (pCi/hr)[c]	14	10	33	0.38
Filtered seawater				
Prelease (pCi/kg)	9.5	ND	22	ND
Postrelease (pCi/kg)	19.4	2.6	61	0.52
Rate (pCi/hr)	5.0	1.3	20	0.26
December 4, 1973				
Nonfiltered				
Prerelease (pCi/kg)	11	3.3[d]	40[d]	ND
Postrelease (pCi/kg)	9[d]	4.3[d]	67	1.1
Rate (pCi/hr)	-	0.3	9	0.37
Filtered seawater				
P Prerelease (pCi/kg)	13	ND	22[d]	ND
Postrelease (pCi/kg)	25	ND	67	1.1
Rate (pCi/hr)	4	-	15	0.37

[a]Measured concentration (pCi/kg) divided by expected water concentration in discharge canal (pCi/liter).

[b]Not detected.

[c]Amount accumulated per hour during the release.

[d]Fractional standard deviation > 0.2.

REF. NO.: 76 - H - 1

SUBSTANCES: Mn^{54}, Co^{60}, Zn^{65}, Cs^{137}

Reference: Harrison, F. L., K. M. Wong & R. E. Heft. 1976. Interactions of radionuclides in water, particulates, and oysters in the discharge canal of a nuclear power plant. Lawrence Livermore Laboratory, University of California, Livermore, Ca.: 43p. Nat. Tech. Inf. Serv.

Organisms: Crassostrea gigas

Date of Sample Collection: 1971-73

Location:
Humboldt Bay Power Plant discharge canal, California

Analytical Technique:
Atomic absorption spectrophotometry

Analytical Data:

Table 10. Normalized radionuclide concentrations[a] in oysters maintained in unfiltered water in the discharge canal of the Humboldt Bay Power Plant during a period of high biological productivity (July 31, 1973) and a period of low biological productivity (December 4, 1973).

	^{137}Cs		^{54}Mn		^{60}Co		^{65}Zn	
	Non-filtered	Filtered	Non-filtered	Filtered	Non-filtered	Filtered	Non-filtered	Filtered
	High biological productivity period (July 1973)							
Prerelease (pCi/kg)	ND[b]	ND	ND	9.5	ND	ND	17	22
Postrelease	0.76	0.52	28	19.4	20	2.6	83	61
Rate (pCi/hr)[c]	0.38	0.26	14	5.0	10	1.3	33	20
	Low Biological productivity period (December 1973)							
Prerelease (pCi/kg)	ND	ND	11	13	3.3[d]	ND	40[d]	22[d]
Postrelease (pCi/kg)	1.1	1.1	9[d]	25	4.3[d]	ND	67	67
Rate (pCi/hr)[c]	0.37	0.37	–	4.0	0.3[d]	–	9[d]	15[d]

[a]Normalized: measured concentration (pCi/kg) divided by expected concentration in discharge canal water (pCi/liter).

[b]Not detected.

[c]Amount accumulated per hour during the release.

Harrison, F. L. et al. 1976.

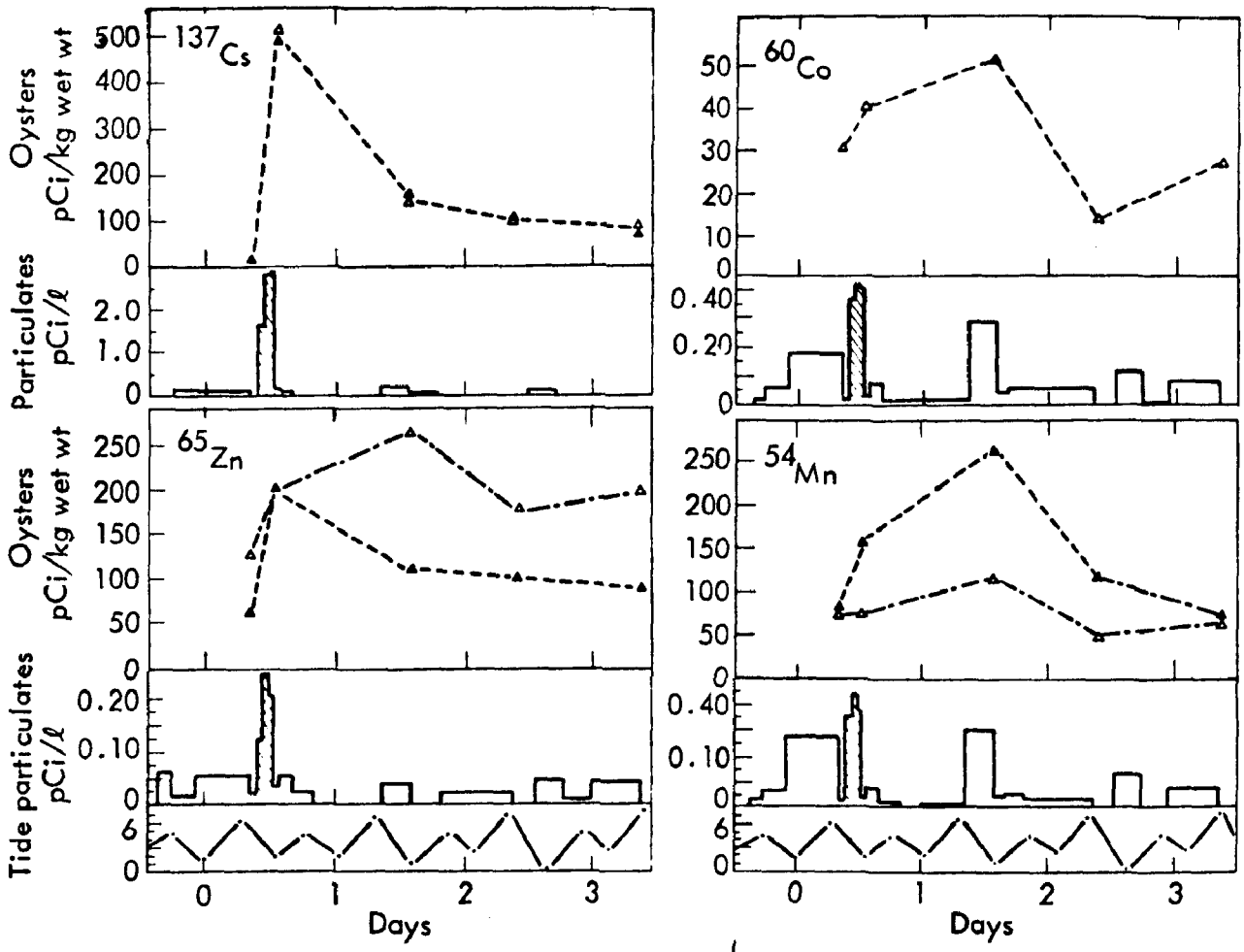


Fig. 7. Radionuclide concentrations in serial samples of oysters (pCi/kg wet wt) and suspended particulates (pCi/ℓ) collected during the December 1973 short-term experiment. Zero time, 1530 on December 3, is the time the oysters were placed in the discharge canal water. Solid triangles, oysters in filtered seawater; open triangles, oysters in unfiltered seawater. The first two sets of points are the prerelease and postrelease samples listed in Table 10. The shaded portions of the rectilinear curve (suspended particulates) indicate the release intervals.

Harrison, F. L. et al. 1976.

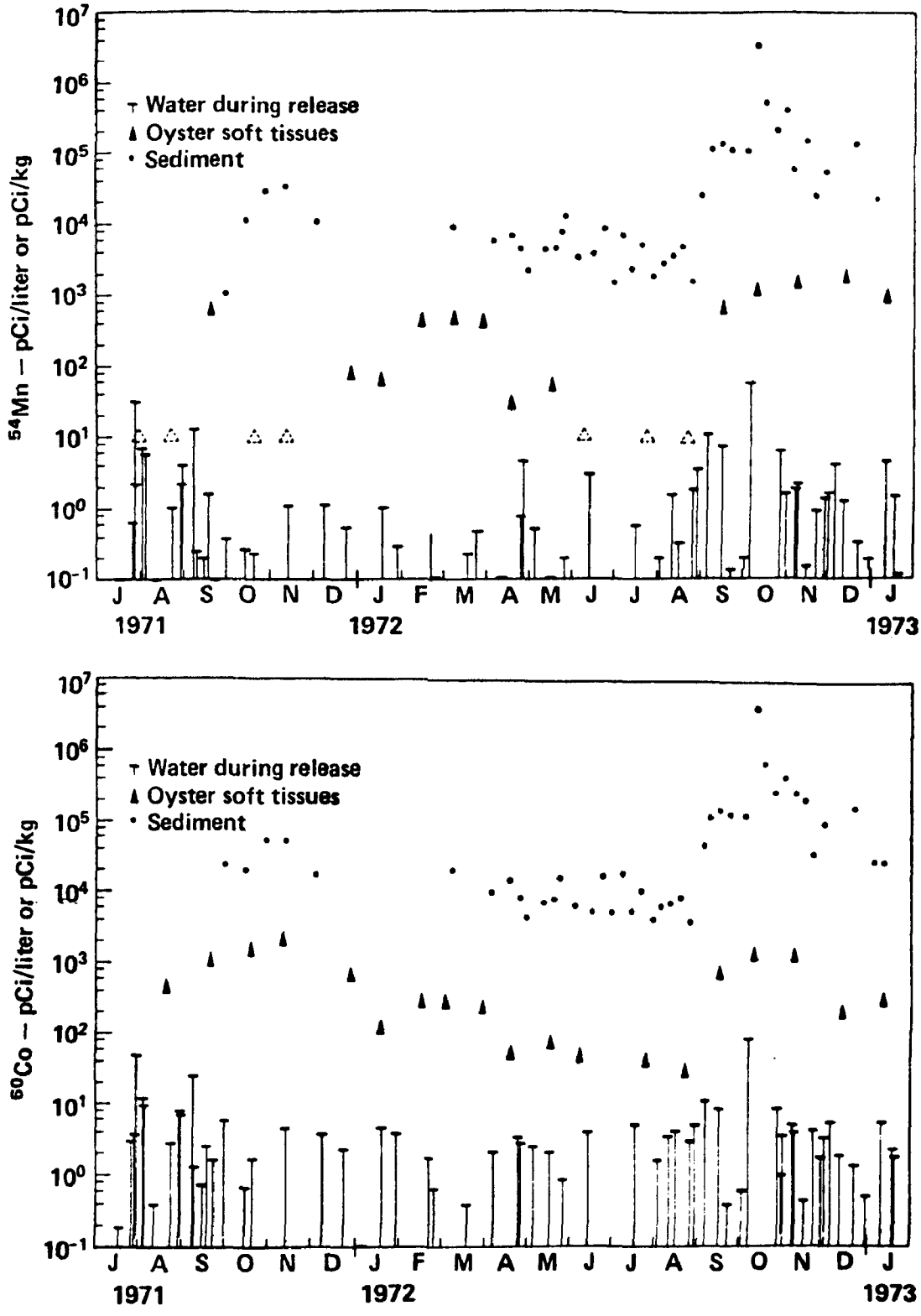


Fig. 5. Concentrations of ^{54}Mn, ^{60}Co, ^{65}Zn, and ^{137}Cs in serial samples of oyster soft tissues (closed triangles) and of particulates collected on suspended trays (circles) compared to expected concentrations in the water during releases (bars). Open triangles, concentrations in oysters were below detection levels.

Harrison, F. L. et al. 1976.

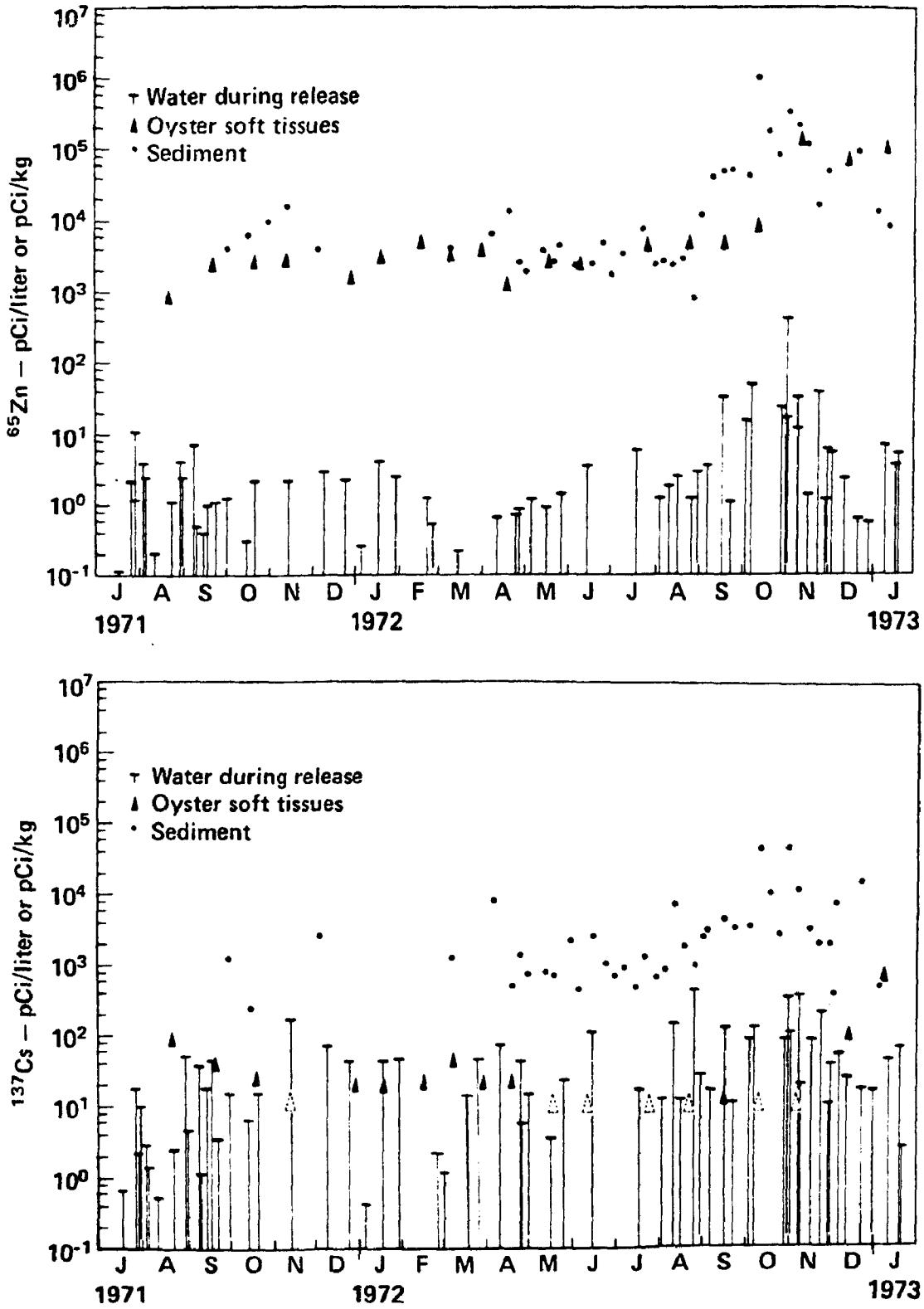


Fig. 5. (continued)

REF. NO.: 75 - H - 2

SUBSTANCES: Co^{58}

Reference: Hess, C. T., C. W. Smith & A. H. Price II. 1975. Model for the accumulation of radionuclides in oysters and sediments. Nature 258:225-226.

Organisms: Crassostrea virginica

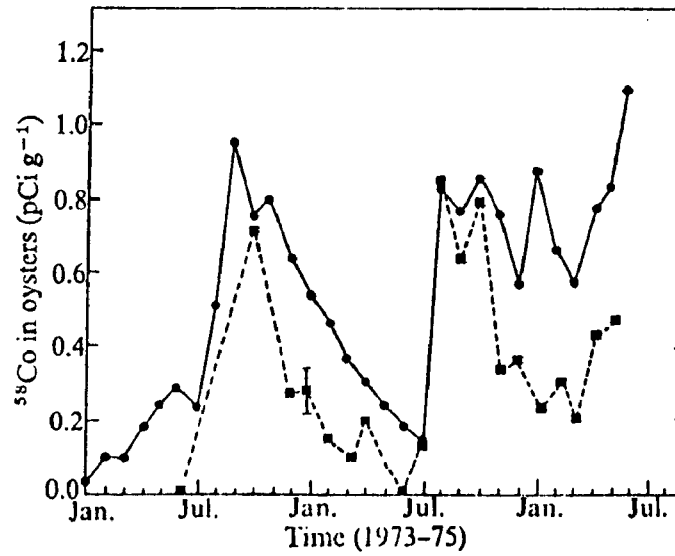
Date of Sample Collection: 1973-75

Location: Montsweag Estuary, Sheepscot River, Maine

Analytical Technique:

Analytical Data:

Fig. 2 ■, Measured ^{58}Co radionuclide concentration in oysters at the reactor outflow site. A typical 1σ error bar is shown. ●, Theoretical curve for ^{58}Co scaled by factor $U = 7.6 \times 10^{-12}$ g^{-1} against time in months for the years 1973–1975.



REF. NO.: 67 - H - 3

SUBSTANCES: Ra^{226}, Pb^{210}, Po^{210}

Reference: Holtzman, R. B. 1967. Concentrations of the naturally occurring radionuclides ^{226}Ra, ^{210}Pb and ^{210}Po in aquatic fauna. In Proc. 2nd Nat. Symp. Radioecology, Ann Arbor, Mich., May 1967.

Organisms: clams, oysters (unspecified, canned)

Date of Sample Collection: 1964

Location: Japan

Analytical Technique: Alpha-count

Analytical Data:

Table 1. Lead-210, ^{210}Po and ^{226}Ra in tissues of freshwater and marine animals

Sample (date of collection)	Hard Tissue (bone, tooth, shell)				Soft Tissue			
	^{210}Pb (pCi/100 g ash)	^{210}Po (pCi/100 g ash)	^{226}Ra (pCi/100 g ash)	Ratio $^{210}Po/^{210}Pb$	^{210}Pb (pCi/100 g wet)	^{210}Po (pCi/100 g wet)	^{226}Ra (pCi/100 g wet)	Ratio $^{210}Po/^{210}Pb$
Other sea animals								
Clams (canned) (Japan) (8/1/64)	4.13 ± 0.20	12.4 ± 0.4	3.77 ± 0.09	3.01				
Clams (juice) (8/1/64)	0.14 ± 0.04	0.03 ± 0.07	0.04 ± 0.02					
Oysters (canned, Japan) (7/20/65)	6.2 ± 0.2	21.2 ± 0.5	0.25 ± 0.03	3.43				

REF. NO.: 66 - J - 1

SUBSTANCES: Zn^{65}, Mn^{54}, Co^{60}

Reference: Johnson, V., N. Cutshall & C. Osterberg. 1966. Distribution of Hanford induced gamma emitters in a fresh water mollusc: Anodonta wahlamatensis. In Ecological studies of radioactivity in the Columbia River and adjacent Pacific Ocean, J. E. McCauley, ed., p. 105-109. Oregon State University, Dept. Oceanography, Progress Rep., 1966.

Organisms: Anodonta wahlamatensis

Date of Sample Collection: 1966?

Location: Columbia River, Oregon

Analytical Technique: Gamma-count radioanalysis

Analytical Data:

Table 2. Comparison of the order of distribution on a wet and dry weight basis (dry weights were obtained by oven drying at 80° C for five days).

	^{65}Zn, pCi/g	
Tissue	Wet Weight	Dry Weight
Gill	569.0±44.4	2845.1±222.0
Mantle	352.1±23.0	1247.7± 82.2
Viscera	57.5± 4.5	285.4± 22.5
Muscle	23.6± 0.9	

Table 1. ^{65}Zn, ^{54}Mn, and ^{60}Co levels in soft parts of *Anodonta wahlamatensis* collected from three different sites on the lower Columbia River. Data are given as picocuries per gram wet weight.

	Puget Island pCi/g			Harrington Point pCi/g			Astoria pCi/g		
	^{65}Zn	^{54}Mn	^{60}Co	^{65}Zn	^{54}Mn	^{60}Co	^{65}Zn	^{54}Mn	^{60}Co
Gills	484.2±25.7	29.2±4.2	1.4±0.7	316.0±13.1	21.2±2.2	6.8±0.9	569.0±44.4	40.8±10.5	2.1±3.9
Mantle	347.6±12.9	14.0±1.9	1.2±0.4	169.2±6.5	5.0±0.9	2.8±0.5	352.1±23.0	21.9±4.8	1.7±1.8
Viscera	102.2±11.5	0.9±1.6	1.4±0.5	42.2±1.4	1.4±0.2	1.6±0.1	57.5±4.5	3.6±0.9	0.7±0.4
Muscle	61.9±1.9	2.1±0.2	0.9±0.1	3.7±0.4	1.7±0.3	0.9±0.1	23.6±0.9	0.7±0.2	1.3±0.3

REF. NO.: 66 - M - 2

SUBSTANCES: Zn^{65}

Reference: Mellinger, P. J. 1966. The concentration of zinc-65 in *Mytilus californianus* as a function of distance from the Columbia River. *In* Ecological studies of radioactivity in the Columbia River and adjacent Pacific Ocean, J. E. McCauley, ed., p. 113-118. Oregon State University, Dept. Oceanography, Progress Rep., 1966.

Organisms: *Mytilus californianus*

Date of Sample Collection: 1966

Location: NE Pacific, Alaska to Oregon

Analytical Technique: Gamma ray spectrometry

Analytical Data:

Data represented in Figure 2.

Location	Post. adductor muscle	Foot	Remaining soft pts.
Auke Bay, Alaska	0*	0	0.82
Ruby Beach, Wash.	23.97	19.49	31.35
Pt. Grenville, Wash.	37.21	37.69	39.84
Pt. Chehalis, Wash.	59.28	42.85	70.78
North Jetty, Astoria	143.72	109.59	110.15
Tillamook Head, Ore.	39.58	27.16	49.27
Yaquina Head, Ore.	15.88	14.50	21.15
Coos Bay, Ore.	11.72	8.20	12.24

* All computations are based on picocuries/gm. dry wt.

REF. NO.: 66 - M - 1

SUBSTANCES: Mn, Mn^{54}

Reference: Merlini, M. 1966. The freshwater clam as a biological indicator of radiomanganese. In Radioecological Concentration Processes, proc. symp. Stockholm, April 25-29, 1966, B. Aberg & F. P. Hungate, eds, p. 977-982. Pergamon Press.

Organisms: Unio mancus elongatulus

Date of Sample Collection: 1964

Location: Lake Maggiore and Lake Varese, Northern Italy

Analytical Technique: Activation analysis

Analytical Data:

Table 1. The stable manganese content of different parts of Unio mancus *from the Lago di Varese and the Lago Maggiore. Results are given as µg/g dry weight, 100 C*

Collection site	Number of animals	Length class (cm)	Shell	Gills	Mantle	Visceral sac	Adductor muscle
Lago di Varese	18	5·1–6·0	762 ± 9·5	14185 ± 12	13088 ± 1470	3571 ± 835	2539 ± 411
	36	6·1–7·0	892 ± 13·0	18257 ± 1179	17765 ± 581	4308 ± 307	2565 ± 296
	20	7·1–8·0	956 ± 21·0	20737 ± 1972	19659 ± 984	5034 ± 622	3067 ± 319
Lago Maggiore	15	4·1–5·0	225 ± 5·6	11391 ± 649	4805 ± 489	1243 ± 155	1104 ± 115
	15	5·1–6·0	299 ± 64·0	12542 ± 1292	7576 ± 986	2154 ± 212	2008 ± 29
	24	6·1–7·0	378 ± 26·0	18154 ± 1562	15008 ± 1288	4964 ± 553	2056 ± 135
	12	7·1–8·0	515 ± 31·5	20279 ± 616	16316 ± 703	5070 ± 1095	2514 ± 504

Merlini, M. 1966.

Table II. Concentration factors for stable Mn *and* ^{54}Mn *in different parts of the bivalve* Unio *from the Lago di Varese and the Lago Maggiore. Results are based on grams wet weight per millilitre of water. Results are all* $\times 10^4$

Collection site	Size class (cm)	Shell Mn	Shell ^{54}Mn	Gills Mn	Gills ^{54}Mn	Mantle Mn	Mantle ^{54}Mn	Visceral sac Mn	Visceral sac ^{54}Mn	Adductor muscle Mn	Adductor muscle ^{54}Mn	Water content Mn	Water content ^{54}Mn
Lago di Varese	5·1–6·0	2·3	0·82	6·0	3·6	5·5	3·0	1·5	1·1	1·1	n.d.[a]	0·033 ppm	
	6·1–7·0	2·6	0·68	7·7	3·1	7·5	3·7	1·8	1·1	1·1	n.d.		0·0004 pCi/ml
	7·1–8·0	2·8	0·53	8·8	3·8	8·3	4·0	2·1	1·1	1·3	n.d.		
Lago Maggiore	4·1–5·0	1·1	1·9	8·0	43·0	3·4	22·0	0·87	5·6	0·77	n.d.	0·02	0·00015 pCi/ml
	5·1–6·0	1·5	1·6	8·7	35·0	5·3	26·0	1·5	9·5	1·4	n.d.		
	6·1–7·0	1·9	2·0	13·0	30·0	10·0	28·0	3·5	8·6	1·4	n.d.		
	7·1–8·0	2·5	1·8	14·0	30·0	11·0	23·0	3·5	7·6	1·8	n.d.		

[a] n.d. = not detectable.

Table III. Specific activities as atoms of ^{54}Mn *per* 10^{13} *atoms of stable* Mn *in the bivalve Unio from the Lago di Varese and the Lago Maggiore*

Collection site	Length class (cm)	Atoms of ^{54}Mn/10^{13} atoms Mn: Shell	Gills	Mantle	Visceral sac	Total soft tissues	Whole animal	H_2O
Lago di Varese	5·1–6·0	5·3	8·7	7·8	10·8	8·6	6·8	14·5
	6·1–7·0	3·8	6·6	7·2	9·2	7·3	5·5	
	7·1–8·0	2·6	6·2	6·9	6·1	6·8	4·9	
Lago Maggiore	4·1–5·0	15·8	49·5	58·5	56·6	51·7	95·2	9·0
	5·1–6·0	9·9	35·7	44·2	57·3	42·0	38·2	
	6·1–7·0	9·9	21·2	23·8	22·4	22·3	20·9	
	7·1–8·0	6·4	18·8	17·8	19·2	17·4	16·2	

REF. NO.: 68 - M - 2

SUBSTANCES: Mn, Mn^{54}

Reference: Merlini, M. 1968. Fallout ^{54}manganese and stable manganese in some freshwater lamellibranchs. In Proc. Symposium on Mollusca, Cochin, Jan. 12-16, 1968, p. 441-445. Marine Biological Association of India.

Organisms: Unio mancus elongatulus
Anodonta cygnea

Date of Sample Collection: 1961-66

Location: Lake Maggiore and Lake of Varese, Northern Italy

Analytical Technique: Activation analysis

Analytical Data:

Anodonta cygnea, collected in the fall of 1961 by this author from a river bed in Bologna (Italy), the Lago di Varese, and the Lago Maggiore, gave the following results:

		% Stable Mn	% Fallout ^{54}Mn
SHELL	..	34·4	35·0
SOFT TISSUES	..	65·6	65·0
Gills	..	23·6	18·0
Mantle	..	25·4	38·0
Visceral sac	..	16·6	8·7

Collection Site/Date		^{54}Mn, pCi/g dry weight Shell	Soft Tissues
River bed, Bologna, Nov. 13, 1961		not detected	1·12
Lago di Varese, Oct. 23, 1961	..	0·11	24·0
Lago Maggiore, Sept. 28, 1961	..	2·2	36·1

Merlini, M. 1968.

The difference in distribution of stable manganese in *Unio mancus* and *Anodonta cygnea* of Lago Maggiore collected from the same site, can be seen in the following table. The percentages reported for each organ are based on the total amount of stable Mn found in the soft tissues alone (Merlini, unpublished data):

Animal		Gills + Palps	Mantle	Visceral Sac	Adductor Muscle
Unio mancus	..	37·2%	36·2%	24·3%	2·2%
Anodonta cygnea	..	84·5%	10·0%	5·3%	0·2%

Although a direct comparison between *Anodonta* and *Unio*, based on the size or age of the animal, is not possible, it is still interesting to compare stable and fallout ^{54}Mn in certain organs of these bivalves for verification of what has already been discussed. Both species were collected from the Lago di Varese in May, 1964. The results are given for dry weights (Merlini, unpublished data for *Anodonta*; Merlini, 1966 for *Unio* results):

Length	Gills		Visceral Sac	
cm.	Mn, ppm	^{54}Mn, pCi/g	Mn, ppm	^{54}Mn, pCi/g
		Anodonta cygnea		
7·0–7·6	35,506	289	906	14
7·8–8·2	39,740	232	2167	21
8·5–9·0	39,204	211	2297	21
		Unio mancus		
5·8–6·0	14,185	103	3571	32
6·7–6·9	18,257	100	4308	33
7·2–7·5	20,737	108	5034	32

REF. NO.: 74 - M - 2 **SUBSTANCES:** Ru^{106}

Reference: Minamisako, Y. & T. Umezu. 1974. Ruthenium-106 concentration in marine organisms in the coastal waters of Tokai-mura. Bull. Tokai Reg. Fish. Res. Lab. 77:103-111.

Organisms: Mytilus edulis
Septifer virgatus

Date of Sample Collection: 1969-71

Location: Tokai-mura, Japan

Analytical Technique:

Analytical Data:

Table 1. Ruthenium-106 concentration in marine organisms in the coastal waters of Tokai-mura.

Marine organisms	Sampling date	Ash % on wet basis	$^{106}Ru+^{106}Rh$ pCi/kg, wet weight
Mollusca			
Kūroawabi, *Haliotis discus*	Sept. 1968	1.46	41.5± 8.9[a]
〃	〃	2.69	360 ±19[c]
Kotamagai, *Gomphina melanaegis*	Feb. 1969	3.54	66.4± 7.1[b]
〃	Apr. 1970	2.76	65.3± 3.2[b]
Murasakiigai, *Mytilus edulis*	Sept. 1969	2.28	94.4± 3.3[b]
Murasakiinko, *Septifer virgatus*	Apr. 1971	3.15	198 ±16[b]

REF. NO.: 59 - M - 1

SUBSTANCES: Zn^{65}

Reference: Murthy, G. K., A. S. Goldin & J. E. Campbell. 1959. Zinc-65 in foods. Science 130:1255-1266.

Organisms: oysters, clams (unspecified)

Date of Sample Collection: 1958-59

Location: Chesapeake Bay, E. coast U.S.

Analytical Technique: Gamma spectrometry

Analytical Data:

Table 1. Concentration of Zn^{65} in foods.

Sample	Date of sampling	Zn^{65} ($\mu\mu c/kg$)
Oysters (Chesapeake Bay)	Jan. 1959	178
Oysters (Chesapeake Bay)	Mar. 1958	124
Clams, hard-shelled (East Coast)	May 1958	40
Mixed Meats*	Sept. 1958	17
Mixed fresh leafy vegetables (washed)†	Aug. 1958	12
Mixed fresh root vegetables (washed)‡	Aug. 1958	10
Eggs	Aug. 1958	6
Mixed fresh legumes and corn (washed)§	Aug. 1958	4
Milk	Jan. 1959	4
Mixed fresh fruits (washed)‖	Aug. 1958	3

* Equal parts of chicken, lamb, beef, and pork; † equal parts of lettuce, cabbage, spinach, broccoli, celery, and cauliflower; ‡ equal parts of potatoes, sweet potatoes, carrots, beets, radishes, and turnips; § equal parts of shelled peas, string beans, shelled lima beans, and corn; ‖ equal parts of apples, grapes, grapefruit, oranges, peaches, plums, strawberries, and cantaloupe.

REF. NO.: 64 - N - 1

SUBSTANCES: Zn^{65}, Cs^{137}, Zr^{95}, Nb^{95}, K^{40}, Mn^{54}

Reference: Nagaya, Y. & T. R. Folsom. 1964. Zinc-65 and other fallout nuclides in marine organisms of the California coast. J. Rad. Res. 5:82-89.

Organisms: Mytilus californianus

Date of Sample Collection: 1963

Location: Southern California

Analytical Technique:

Analytical Data:

Table 1. The results of analysis of cesium-137, zinc-65 and zirconium-95/niobium-95 in hagfish, amphipods and mussels*

No.	Location	Depth (m)	Date of collection	Weight (kg-wet)	Cs137	Zn-65	Zr-95 or Nb-95**		K-40
					uuc/kg-wet				uuc/g-wet
					AMP	Sulfide	Insoluble	Soluble	
Mussels									
1	S.I.O. Pier	—	4/16/63	0.6	9.6±0.8	53.6±4.1	186±8	53.7±2.6	1.6±0.1
2	Santa Monica Pier	—	4/30/63	0.4	0±1.2	19.5±2.5	—	—	2.1±0.1
3	Pt. Loma	—	5/3/63	0.7	0±1.5	16.5±3.0	—	—	—
4	Pt. Banda, Baja Calif.	—	5/4/63	0.6	0±1.4	111±6	—	—	—
			Average		2.4±0.6	50.2±2.1			

* The precision criterion is the square root of the total count in a single peak channel.

** In Zr-95 or Nb-95 data, insoluble means the sum of acid insoluble and ethyl ether fractions, and soluble means the sum of AMP and sulfide fractions.

Table 2. Manganese-54 in *Mytilus californianus*

No.	Location	Date	Weight (kg-wet)	Mn-54 (uuc/kg-wet) Sulfide
1	S.I.O. Pier	4/16/63	0.6	24.6±1.7
2	Santa Monica Pier	4/30/63	0.4	26.6±1.7
3	Pt. Loma	5/3/63	0.7	18.0±1.8
4	Pt. Banda, Baja Calif.	5/4/63	0.6	28.5±1.6
			Average	24.5±0.9

REF. NO.: 62 - N - 1

SUBSTANCES: Sr^{90}

Reference: Nelson, D. J. 1962. Clams as indicators of strontium-90. Science 137:38-39.

Organisms: clams (unspecified, family Unionidae)

Date of Sample Collection: 1962?

Location: Tennessee River, Tennessee

Analytical Technique: Flame spectrophotometry

Analytical Data:

Table 1. Observed and expected specific activities (atoms of Sr^{90} per atoms of Sr) in clams as a function of the dilution of Clinch River water by Tennessee River water.

Collection site*	Distance (mi) from White Oak Creek	Dilution factor for Clinch River water	Specific activity (atoms × 10^{-11})		Shells analyzed (No.)
			Expected on the basis of dilution	Observed by stable chemistry and radiochemistry†	
CRM 47	26 upstream (control point)			1.67 ± 0.50	12
CRM 17–4.7	4–17 downstream (index point)	1	(130.8)‡	130.80 ± 22.7	12
TRM 521	68 downstream	5.6	23.4	25.74 ± 3.36	19
TRM 425	163 downstream	7.05	18.6	19.78 ± 1.71	19
TRM 100	489 downstream	12.3	10.6	10.14 ± 1.81	14

* *CRM*, Clinch River mile; *TRM*, Tennessee River mile; the Clinch River joins the Tennessee River at TRM 568 (*river miles are measured from the mouth of the river*). † All averages ± 1 standard error. ‡ The specific activity in clams from the index point is the basis for specific activities expected because of dilution.

REF. NO.: 74 - N - 2

SUBSTANCES: Zn^{65}, Mn^{54}, K^{40}, Cs^{137}, Co^{60}

Reference: Nishikawa K., K. & I. L. Larsen. 1974. Radioactividad en organismos marinos de la costa noroccidental de Baja California. In Estudios basicos de contaminacion marina, p. 14-20. Oregon State Univ., School of Oceanography, Marine Pollution Ecology Group.

Organisms: *Mytilus californianus*

Date of Sample Collection: 1974

Location: Punta Banda, Baja California, Mexico , plus composite of data from other locales, other sources

Analytical Technique: Gamma ray spectrometry

Analytical Data: (dry wt, dried at 110°C)

TABLA 1

Caracteristicas de las muestras

Muestra No.	Organismo	No. de Ejemplares	Talla Promedio	Talla Rango	Peso Promedio (g)	Tamano de la muestra (g)	Materia seca (%)	Ceniza (%)
35	Mejillon[1]	16	11.96 cm	13.75- 9.50	35.6275	570.04	16.688	2.244
36	Mejillon[2]	19	7.64 cm	8.80- 6.00	13.8663	263.46	18.204	2.359
37	Percebe-M[3]	124	25.83 cm	32.00-20.00	2.6238	325.35	21.408	2.294
38	Percebe-V[4]				1.9061	236.36	19.733	2.483

Nota:

[1] *Mytilus californianus*, grupo de ejemplares grandes.

[2] *Mytilus californianus*, grupo de ejemplares chicos.

[3] *Pollicipes polymerus*, muestra de tejido musculoso peduncular.

[4] *Pollicipes polymerus*, muestra de la masa visceral localizada dentro de las placas calcareas.

TABLA 2 I

Nivel de K-40 encontradas en las muestras

Muestra No.	pCi K-40/kg (materia humeda)
35	1643
36	2074
37	1819
38	1786

Nishikawa K., K. & I. L. Larsen. 1974.

TABLA 3

Punta Banda, B.C., México, 31° N

Referencia	Fecha de Muestreo	Organismo	Radionuclidos (pCi/kg-Tejido Humedo)*				
			Zn-65	Mn-54	K-40	Cs-137	Co-60
Nagaya y Folsom, 1964	5/63	Mejillón	111±6.0	28.5±1.6		0±1.4	-
Young y Folsom, 1972	2/64	Mejillón	95±13.0	46±6.6	-	-	15±1.2
[illegible], 1973	10/70	Mejillón	9.0±1.7	-	1280±30	52±0.6	12.7±0.4
Young y Folsom, 1972	11/71	Mejillón	6.9	3.1	-	-	3.3
Young y Folsom, 1972	11/71	Percebe	6.9	5.4	-	-	5.0
Nishikawa y Larsen, 1974	6/74	Mejillón	< 5	< 3	1643	< 3	< 5
Nishikawa y Larsen, 1974	6/74	Percebe	< 5	< 3	1786	< 3	< 5

* ± indica una desviacion estandar

TABLA 4

La Jolla, California, EUA, 33° N

Referencia	Fecha de Muestreo	Organismo	Radionuclidos (pCi/kg-Tejido Humedo)*			
			Zn-65	Mn-54	K-40	Cs-137
Young y Folsom, 1963	8/63	Mejillón	50	50	-	-
Young y Folson, 1963	8/63	Percebe	100	100	-	-
Alexander y Rowland, 1966	8/64	Mejillón	8.08	-	-	-
Alexander y Rowland, 1966	8/64	Percebe	27.8	73.4	-	-
Hodge V., 1973	1/73	Mejillón	2.0	-	1490±30	3.7±0.4
Hodge V., 1974	6/74	Mejillón	1.5	-	-	-

* ± indica una desviacion estandar

Nishikawa K., K. & I. L. Larsen. 1974.

TABLA 5

Yaquina Head, Oregon, EUA, 44° N

Referencia	Fecha de Muestreo	Organismo	pCi/kg-Tejido Humedo Zn-65	K-40
Seymour y Lewis, 1964	7/61	Mejillón	$9.4x10^3$	$2.5x10^3$
Seymour y Lewis, 1964	6/62	Mejillón	$1.1x10^4$	$2.6x10^3$
Seymour y Lewis, 1964	10/63	Mejillón	$6.9x10^3$	$1.9x10^3$
Larsen, 1971	3/64	Mejillón	$2.6x10^3$	-
Larsen, 1971	10/65	Mejillón	$8.3x10^3$	-
Mellinger, 1966	6/66	Mejillón	$3.7x10^3$	-
Larsen, 1971	7/67	Mejillón	$2.4x10^3$	-
Toombs, 1969	8/69	Mejillón	$2.2x10^3$	-
Toombs, 1972	7/70	Mejillón	$1.0x10^3$	-
Larsen, 1974	6/71	Mejillón	$3.9x10^2$	$1.4x10^3$
Larsen, 1974	6/72	Mejillón	$1.2x10^2$	$1.8x10^3$
Larsen, 1974	6/73	Mejillón	$3.1x10^1$	$1.4x10^3$
Larsen, 1974	6/74	Mejillón	$1.9x10^1$	$1.3x10^3$

REF. NO.: 72 - N - 2

SUBSTANCES: Pu^{239}, Cs^{137}, Sr^{90}

Reference: Noshkin, V. E. 1972. Ecological aspects of plutonium dissemination in aquatic environments. Health Physics 22:537-549.

Organisms:

Mytilus edulis
Modiolus modiolus
Mytilus californianus
Mya arenaria
Ostrea virginica
Pecten irradians

Date of Sample Collection: 1964, 1970

Location: California coast and Cape Cod, Massachusetts (data from other literature)

Analytical Technique: ?

Analytical Data:

Table 5. Plutonium-239 concentrations in marine invertebrates and algae. (^{238}Pu, ^{137}Cs and ^{90}Sr concentrations shown when given in reference indicated)

Organism	Tissue	Collection date	Location	Mean pCi/kg(wet)	$^{238}Pu/^{239}Pu$	$^{137}Cs/^{239}Pu$	$^{90}Sr/^{239}Pu$	Reference
Blue Mussel (Mytilus edulis)	body	1970	Cape Cod	0.26	0.099	18.3	2.1	5
	shell	1970	Cape Cod	0.42	0.088	1.1		5
Brown Mussel (Modiolus modiolus)	body	1970	Cape Cod	0.29	0.071	15.0	2.0	5
Mytilus californianis	body	1964	Calif. coast	0.22				12
Softshell Clam (Mya arenaria)	body	1970	Cape Cod	0.37		27.0		5
Oyster (Ostrea virginica)	body	1970	Cape Cod	0.11		20.0		5
Scallop (Pectem irradians)	adductor	1970	Cape Cod	0.02		600		5
	body	1970	Cape Cod	0.49	0.049	6		5
	shell	1970	Cape Cod	0.52	0.058			5

Table 6. Plutonium-239 concentration factors in marine invertebrates and algae

Organism	Tissue	Collection date	Location	Mean value	Range	Reference
Blue Mussel	body	1970	Cape Cod	300 (7)†	250-350	5
Mussel	body	1964	Calif. coast	260 (2)	230-290	12
Brown Mussel	body	1970	Cape Cod	340 (1)		5
Blue Mussel	shell	1970	Cape Cod	490 (3)		5
Soft Shell Clam	body	1970	Cape Cod	440 (1)		5
Oyster	body	1970	Cape Cod	130 (2)	100-160	5
Scallop	adductor	1970	Cape Cod	24 (2)	10-37	5
	body	1970	Cape Cod	520 (3)	410-690	5
	shell	1970	Cape Cod	600 (1)		5

REF. NO.: 73 - N - 1

SUBSTANCES: $Pu^{239, 240, 238}$, Cs^{137}, Sr^{90}

Reference:

Noshkin, V. E., V. T. Bowen, K. M. Wong & J. C. Burke. 1973. Plutonium in North Atlantic Ocean organisms; ecological relationships. In Radionuclides in ecosystems, proc. 3rd nat. symp. radioecology, 1971, vol. 2, D. J. Nelson, ed., p. 681-688. U.S. AEC.

Organisms: Mytilus edulis, Modiolus modiolus, Mya arenaria, Ostrea virginica, Pecten irradians

Date of Sample Collection: 1970

Location: Cape Cod, Massachusetts

Analytical Technique: alpha-counting

Analytical Data:

Table 1. Radioisotope data for marine organisms

Marine invertebrates	Map (Fig. 1) ref.	Collection date	Tissue: Analyzed	Tissue: Wet wt. (kg)	dpm/100 kg (wet weight) Pu^{239}	Pu^{238}/Pu^{239}	Cs^{137}/Pu^{239}	Sr^{90}/Pu^{239}
Blue mussel (*Mytilus edulis*)								
Cape Cod Canal, east end	1	6-70	Body	1.76	51 ± 19[a]	–	15 ± 6	0.8 ± 0.4
Cape Cod Canal, east end	1	6-70	Body	0.94	56 ± 8[a]	0.099	18 ± 3	1.4 ± 0.9
Woodneck Beach	2	3-70	Body	0.37	62 ± 11[a]	—	—	—
Woodneck Beach	2	6-70	Body	0.54	56 ± 8[a]	—	19 ± 3	2.1 ± 0.8
Dyers Dock	3	7-70	Body	0.75	36 ± 5[a]	—	21 ± 3	4.1 ± 1.5
Millstone Beach, Conn.		11-70	Body	0.63	97 ± 11	—	—	—
Plymouth Harbor	4	3-71	Body	0.43	55 ± 8	—	—	—
Woodneck Beach	2	3-70	Shell	0.48	89 ± 14[a]	—	—	—
Millstone Beach, Conn.		11-70	Shell	0.78	98 ± 8	0.081	—	—
Cape Cod Canal, west end	5	11-70	Shell	0.51	92 ± 14	0.095	1.1 ± 1.0	—
Brown mussel (*Modiolus modiolus*)								
Hadley Island	6	6-70	Body	0.97	64 ± 6[a]	0.071	15 ± 2	1.9 ± 0.8
Softshell clam (*Mya arenaria*)								
Hadley Island	6	6-70	Body	0.28	83 ± 17[a]	—	27 ± 6	—
Oyster (*Ostrea virginica*)								
Waquoit Bay	7	10-70	Body	0.52	19 ± 5	—	—	—
Waquoit Bay	7	10-70	Body	0.51	31 ± 5	—	20 ± 7	—
Scallop (*Pecten irradians*)								
Osterville	8	10-70	a.m.*	0.53	2 ± 1	—	600 ± 300	—
Waquoit	7	10-70	a.m.	0.61	7 ± 2	—	—	—
Tobey Island	9	10-70	Body	1.04	131 ± 6	0.041	—	—
Osterville	8	10-70	Body	0.63	87 ± 8	0.057	6 ± 1	—
Waquoit	7	10-70	Body	0.66	78 ± 8	—	—	—
Waquoit	7	10-70	Shell	0.51	115 ± 11	0.058	—	—

*a.m. = adductor muscle; a = corrected data from Wong et al. (1971); b = estimated wet weight from dry weight.

REF. NO.: 73 - P - 1

SUBSTANCES: Sn^{113}, Se^{75}

Reference: Patel, B. & A. K. Ganguly. 1973. Occurrence of ^{75}Se and ^{113}Sn in oysters. Health Physics 24:559-562.

Organisms: Crassostrea cucullata
Crassostrea gryphoides

Date of Sample Collection: 1972?

Location: West coast India

Analytical Technique: Gamma-counting analysis

Analytical Data:

Table 2. Values of ^{113}Sn and ^{75}Se in the soft tissues of two species of oysters from Tarapur waters

Species	Date	^{113}Sn pCi/g ash*	^{75}Se pCi/g ash*
Crassostrea cucullata	7.3.1970	42.24	13.57
	27.4.1970	12.11	5.40
Crassostrea gryphoides	27.4.1970	7.15	6.21

* 3.8% Ash (wet weight basis).

REF. NO.: 75 - P - 3

SUBSTANCES: Cs^{137}

Reference: Patel, B., C. D. Mulay & A. K. Ganguly. 1975. Radioecology of Bombay Harbour--a tidal estuary. Est. Coast. Mar. Sci. 3:13-42.

Organisms: Anadara granosa

Date of Sample Collection: 1968-71

Location: Bombay Harbour

Analytical Technique: Gamma-count analysis

Analytical Data:

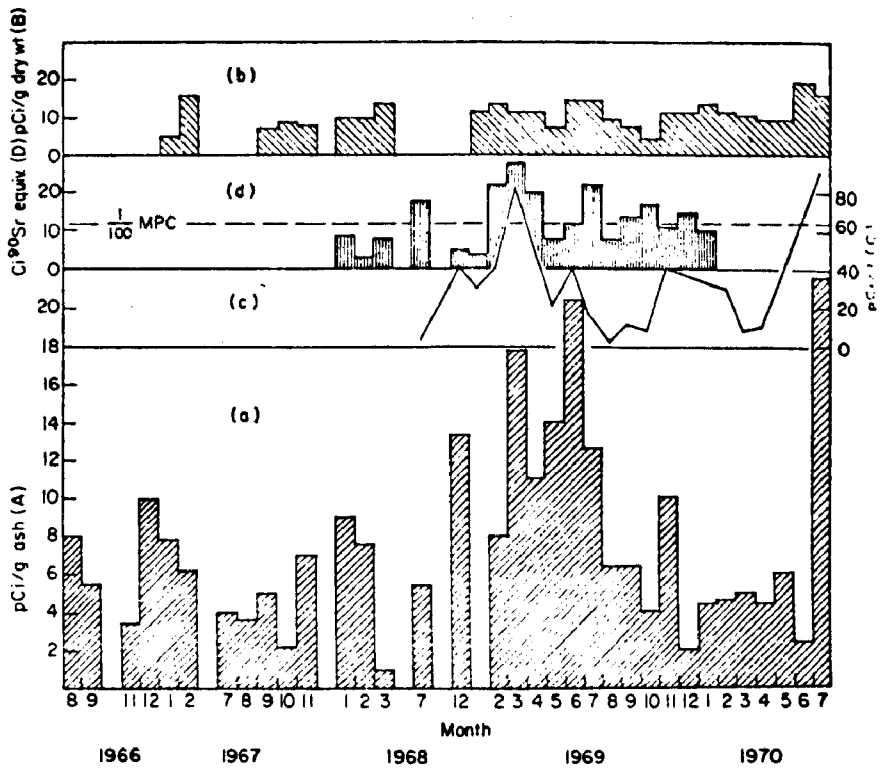


Figure 8. Temporal variations in concentration of cesium-137 in *Anadara granosa* (a) and in the sediment from Sewri clam bed (b), in sea water off CIRUS Jetty (c) and total radioactivity, expressed as Ci strontium-90 equivalent discharged during 1966–70 (d).

Patel, B. et al. 1975.

TABLE 9. Average concentration of Cesium-137 and $^{137}Cs/^{40}K$ ratio in *A. granosa*, *P. placenta*, *S. serrata* and *P. schlosseri* from the harbour during 1968–69

	A. granosa Sewri		*A. granosa* Belapur		*P. placenta*		*S. serrata*		*P. schlosseri*	
	^{137}Cs (pCi/g ash)	$^{137}Cs/^{40}K$	^{137}Cs (pCi/g ash)	$^{137}Cs/^{40}K$	^{137}Cs (pCi/g ash)	$^{137}Cs/^{40}K$	^{137}Cs (pCi/g ash)	$^{137}Cs/^{40}K$	^{137}Cs (pCi/g ash)	$^{137}Cs/^{40}K$
January	7·8	3·0	—	—	—	—	—	—	—	—
February	7·0	2·6	12·4	4·9	7·5	5·0	16·4	6·1	13·21	3·8
March	17·6	6·0	4·0	1·9	—	—	—	—	2·25	—
April	—	—	8·5	4·0	14·0	7·7	9·5	5·7	—	—
June	—	—	5·0	2·2	6·5	3·8	3·6	3·7	2·41	3·5
July	3·9	0·9	6·0	1·9	—	—	5·6	1·8	—	—
August	6·7	2·5	5·1	2·1	—	—	—	—	—	—
September	5·0	2·2	4·3	2·4	—	—	—	—	12·46	4·8
October	3·8	1·7	2·6	1·1	—	—	—	—	5·10	1·9
November	7·0	2·9	3·1	1·7	1·6	2·0	8·9	3·9	—	—
December	6·7	2·8	—	—	—	—	—	—	—	—

TABLE 10. Range of concentration factors (Cfs) observed for cesium-137 in the flesh of various species of fish and shell-fish from the Bombay harbour

Species	Cfs
Bivalves	
Blood clam *Anadara granosa*	500– 10^4
Oyster *Crassostrea cucullata*	20– 50
Windowpane oyster *Placenta placenta*	400–700
Clam—*Paphia malabarica*	500–800
Clam—*Meretrix meretrix*	200–400

TABLE 13. Distribution of Cesium-137 in *Anadara granosa* of various weight groups*

Date	Average wet wt of one animal (g)	Cesium-137 (pCi/g ash)
4 November 1970	4·0	17
	7·5	14
	10·0	15
4 February 1971	4·3	117
	11·3	107
	18·0	101
4 August 1971	7·0	84
	10·0	74

*Each weight-group comprised of soft parts from 35–40 animals of same size.

TABLE 12. Monthly variation of Cesium-137 in *Anadara granosa* from Trombay and Sewri, in surface sediment from Trombay and total radioactivity released (Ci strontium-90 equivalent)

Month	Effluent (^{90}Sr equivalent, Ci)	Sedimen (Trombay) Cesium-137 (pCi/g dry)	*Anadara granosa* Trombay Cesium-137 (pCi/g ash)	*Anadara granosa* Sewri Cesium-137 (pCi/g ash)
August 1970	12·4	207	38	10·0
November	55·5	57	11	4·0
December	17·7	452	67	10·4
February 1971	19 7	500	108	—
April	22·4	—	44	—
May	20·6	325	69	12·3
June	46·0	200	86	8·8
July	118·0	218	467	14·4
August	33·6	—	59	10·5
September	20·7	302	19	—

REF. NO.: 64 - P - 1 **SUBSTANCES:** Pu^{239}

Reference: Pillai, K. C., R. C. Smith & T. R. Folsom. 1964. Plutonium in the marine environment. Nature 203:568-571.

Organisms: Mytilus californianus

Date of Sample Collection: 1964

Location: Southern California

Analytical Technique: Alpha-counting analysis

Analytical Data:

Table 2. PLUTONIUM ACTIVITY IN MARINE ORGANISMS

Sample	Date of sampling	Wet weight (g)	Counting time (h)	Total ^{239}Pu activity (d.p.m.)	^{239}Pu (pc./kg)	Concentration factor
'Red tide' (dinoflagellates)	May 1964	127	95	0·075 ± 0·010	0·276 ± 0·037	660
Green alga (*Enteromorpha* spp.)	April 1964	218	112·75	0·316 ± 0·021	0·653 ± 0·042	1,570
Giant kelp (*Macrocystis pyrifera*)	April 1964	740	47·0	0·528 ± 0·041	0·321 ± 0·025	770
Palm kelp (*Eisenia arborea*)	April 1964	760	94·0	0·750 ± 0·058	0·450 ± 0·023	1,080
Plankton (mixed coastal zooplankton)	January 1950	71	122·0	0·0036 ± 0·0047	0·023 ± 0·030	—
Plankton (mixed coastal zooplankton)	March 1964	48	88·0	0·114 ± 0·015	1·08 ± 0·14	2,590
Mussels (*Mytilus californianus*)	January 1964	1,000	122·0	0·214 ± 0·016	0·096 ± 0·007	230
Mussels (*Mytilus californianus*)	April 1964	528	98·5	0·140 ± 0·014	0·120 ± 0·012	290
Fish (bonito) (*Sarda lineolata*)	May 1964	1,185	119·5	0·0037 ± 0·0048	0·0014 ± 0·0018	3

REF. NO.: 66 - P - 2 **SUBSTANCES:** Zn^{65}

Reference: Preston, A. 1966. The concentration of ^{65}Zn in the flesh of oysters related to the discharge of cooling pond effluent from the C.E.G.B. nuclear power station at Bradwell-on-sea, Essex. In Radioecological Concentration Processes, proc. internat. symp., Stockholm, 25-29 April, 1966, B. Aberg & F. P. Hungate, eds., p. 995-1004. Pergamon Press.

Organisms: Crassostrea angulata
Ostrea edulis

Date of Sample Collection: 1964-65

Location: Bradwell-on-sea, Essex, England

Analytical Technique: ?

Analytical Data:

Table II. The concentration of zinc in sea water and in oyster flesh; concentration factors for zinc in oyster flesh

	Zinc in sea water (ppm)		Zinc in oyster flesh (ppm)		Concentration factor
	Range	Mean	Range	Mean	
Ref. 2-11, 13	0·0006–0·015	0·0061 Geometric	99·3–1153	340·8 Geometric	$0·6 \times 10^5$
Ref. 12	0·0008–0·0240	0·0049 Geometric	313–3174	1202 Geometric	$2·4 \times 10^5$
M.A.F.F. observations in Blackwater Estuary[14]	0·0023–0·0026	0·0024 Arithmetic	361–863	610 Arithmetic	$2·5 \times 10^5$

Table III. The decrease in concentration of ^{65}Zn in wet oyster flesh with increasing distance from the Bradwell cooling water outfall (values normalized to 100 at 0·33 miles)

Distance from outfall (statute miles)	M.A.F.F. sampling position	Species of oyster	^{65}Zn concentration (pCi/g wet)
0·33	2	Native	100
1·0	3	Native	42
2·0	4	Native	33
2·75		(Native) (interpolated)	19
5·75	5	Native	9·1
6·75	6	Portuguese (Native estimated)	8·2 4·5
2·75 (across estuary)	7	Portuguese (Native estimated)	2·9 1·6

REF. NO.: 68 - P - 1

SUBSTANCES: Zn^{65}, Fe^{55}, Cs^{137}, Co^{60}

Reference: Preston, A. 1968. The control of radioactive pollution in a North Sea oyster fishery. Helgoländer wiss. Meeresunters. 17:269-279.

Organisms: oysters (unspecified)

Date of Sample Collection: 1963-67

Location: Blackwater Estuary, England

Analytical Technique: ?

Analytical Data:

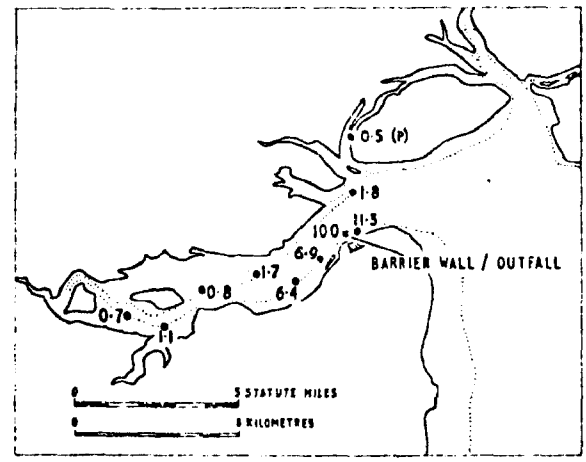


Fig. 2: Zinc-65 in native oyster flesh normalized to 100 at the cooling water outfall (pCi/g wet). P – Portuguese oysters

Table 3

The concentration of zinc-65 in native oysters at the commercial bed nearest to the outfall: mean of twelve observations October 1965 to September 1966, relative to 100 for the maximum

Organs	Concentration of ^{65}Zn pCi/g wet	pCi per organ
Mantle	64	20
Gills	100	48
Muscle	20	10
Rest	59	100

Table 4

The concentrations of iron-55, zinc-65, cobalt-60 and caesium-137 in oysters at the barrier wall layings and 0.33 miles from the barrier wall, the nearest commercial bed

Isotopes	Concentration (pCi/g wet) Barrier wall	0.33 miles	Barrier wall / 0.33 miles
^{55}Fe	0.79	0.067	12
^{65}Zn	43.1	4.44	9.7
^{60}Co	0.35	0.031	12
^{137}Cs	0.17	0.047	3.6

REF. NO.: 71 - P - 2

SUBSTANCES: Fe^{55}, Co^{60}, Zn^{65}, Ag^{110m}, Cs^{137}, P^{32}

Reference: Preston, A., D. F. Jeffries & N. T. Mitchell. 1971. Experience gained from the controlled introduction of liquid radioactive waste to coastal waters. In Nuclear Techniques in Environmental Pollution, proc. symp. Salzberg, 26-30 October 1970, p. 629-644. IAEA, Vienna.

Organisms: *Ostrea edulis*

Date of Sample Collection:

Location: Blackwater estuary, England

Analytical Technique:

Analytical Data:

TABLE IV. CONCENTRATIONS OF RADIONUCLIDES IN THE FLESH OF OYSTERS (*Ostrea edulis*) FROM THE BLACKWATER ESTUARY [11]

Radionuclide	Concentration, pCi/g wet		Outfall 0.5 km
	Power station outfall	0.5 km from outfall*	
^{55}Fe	0.79	0.067	12
^{60}Co	0.35	0.031	12
^{65}Zn	43.1	4.44	9.7
^{110m}Ag	0.38	0.070	5.4
^{137}Cs	0.17	0.041	3.6
^{32}P	0.33	0.12	2.8

*nearest commercial bed.

REF. NO.: 69 - P - 2

SUBSTANCES: Fe^{55}, Co^{60}, Zn^{65}, Ag^{110m}, Cs^{137}, P^{32}

Reference: Preston, A. & D. F. Jeffries. 1969. Aquatic aspects in chronic and acute contamination situations. In Environmental Contamination by Radioactive Materials, proc. seminar Vienna, 24-28 March 1969, p. 183-211. IAEA, Vienna.

Organisms: Ostrea edulis

Date of Sample Collection:

Location: Blackwater estuary, England

Analytical Technique:

Analytical Data:

TABLE X Concentrations of radionuclides in the flesh of oysters (Ostrea edulis) from the Blackwater Estuary[10]

Radionuclide	Concentration, pCi/g wet		Outfall / ⅓ mile
	Power station outfall	⅓ mile from outfall	
^{55}Fe	0.79	0.067	12
^{60}Co	0.35	0.031	12
^{65}Zn	43.1	4.44	9.7
^{110m}Ag	0.38	0.070	5.4
^{137}Cs	0.17	0.041	3.6
^{32}P	0.33	0.12	2.8

Discharges from nuclear-powered ships

REF. NO.: 61 - R - 2 **SUBSTANCES:** Mn^{54}

Reference: Ravera, O. & L. Vido. 1961. Misura del Mn-54 in popolazioni di Unio pictorum L. (Molluschi, Lamellibranchi) del Lago Maggiore. Mem. Ist. Ital. Idrobiol. 13:75-84.

Organisms: Unio pictorum

Date of Sample Collection: 1960

Location: Lake Maggiore, Northern Italy

Analytical Technique: Gamma spectrometry

Analytical Data:

Località e data di raccolta		Mn-54 mμc/kg	
Ispra	30.8.1960	1,10	Tessuti
Fondotoce	26.11.1960	2,50	
Arona	11.9.1960	3,00	
Angera	1.9.1960	4,00	
Ispra	30.8.1960	0,15	Conchiglia
Fondotoce	26.11.1960	0,14	
Arona	11.9.1960	0,15	
Angera	1.9.1960	0,13	

Tabella 1. - Concentrazioni di Mn-54, calcolate sul peso secco a 90°C, nelle conchiglie e nelle parti molli (tessuti) di *Unio pictorum* L.

REF. NO.: 62 - R - 1

SUBSTANCES: Mn^{54}

Reference: Ravera, O. & P. Gaglione. 1962. Concentrazione di Mn^{54} da fall-out in relazione all'eta' e all'organo di Unio mancus elongatulus (Molluschi, Lamellibranchi). Ist. Lombardo (Rend. Sc.) B 96:157-164.

Organisms: Unio mancus elongatulus

Date of Sample Collection: 1962

Location: Lake Maggiore, N. Italy

Analytical Technique: Gamma spectrometry

Analytical Data:

TABELLA 1. - *Concentrazione di Mn^{54} nei tessuti per chilogrammo di peso fresco e per individuo e ripartizione percentuale della quantità totale di Mn^{54} presente nella popolazione nelle diverse classi di lunghezza*

Classi di lunghezza in mm.	Numero di individui	% Mn^{54} nella popolazione	pc Mn^{54} / Kg. fresco	pc Mn^{54} / individuo
< 50	83	2 02	110	.48
50-59	308	17.11	160	1.09
60-69	358	30.68	160	1.68
70-79	264	43 82	180	3.26
> 79	28	6.36	230	4.46

TABELLA 2. - *Pesi freschi e secchi delle diverse parti di esemplari della classe 60-69 mm e relativi contenuti di Mn^{54}.*

Campione	Peso in grammi/individuo		pc/Kg. fresco
	fresco	secco a + 100° C	
Branchie	1.47	.22	500
Mantello	5.13	.58	190
Sacco Viscerale	3.91	.74	—
Conchiglia	10.89	9.40	—

REF. NO.: 64 - R - 1

SUBSTANCES: Mn^{54}

Reference: Ravera, O. 1964. Distribution of Mn^{54} from fall-out in population of freshwater lamellibranchs (Unio mancus elongatulus Pfeiffer). Verh. Internat. Verein. Limnol. 15:885-892.

Organisms: Unio mancus elongatulus

Date of Sample Collection: 1960

Location: Lake Maggiore, N. Italy

Analytical Technique: Gamma spectrometry

Analytical Data:

Table 1. Mn^{54} concentration calculated per 1 kg wet weight for the tissues (soft parts) and the shell.

Station	Mn^{54} pc/kg w. w. Soft parts	Shell
Ispra	110	150
Fondotoce	250	140
Arona	300	150
Angera	400	130

Table 3. Mn^{54} concentration for 1 kg (w. w.) and for individual and percentage distribution in the different length classes of the total Mn^{54}.

Classes of length in mm	pc Mn^{54} / kg w. w.	pc Mn^{54} / individual	pc Mn^{54} on the population
<50	110	.48	2.02
50—59	160	1.09	17.11
60—69	160	1.68	30.68
70—79	180	3.26	43.82
>79	230	4.46	6.36

REF. NO.: 71 - R - 3 SUBSTANCES: Pu^{239}

Reference: Robertson, D. E. 1971. Influence of the physico-chemical forms of radionuclides and stable trace elements in seawater in relation to uptake by the marine biosphere. In Marine Radioecology, the cycling of artificial radionuclides through marine food chains, p. 21-85. (2nd Seminar on Marine Radioecology, Hamburg, 1971.) OECD European Nuclear Energy Agency.

Organisms: mussels (unspecified)

Date of Sample Collection: 1964, 1970

Location: Atlantic and Pacific

Analytical Technique: ?

Analytical Data:

TABLE 15

Plutonium-239 Concentration in Marine Organisms

Organism	Location	^{239}Pu Concentration pCi/kg wet wt.	Concentration Factors
mussels	Atlantic,1970	0.10 - 0.26	160-290
mussels	Pacific,1964	0.096- 0.12	230-290

REF. NO.: 67 - S - 2

SUBSTANCES: Zn^{65}

Reference: Salo, E. O. & W. L.Leet. 1967. The concentration of ^{65}Zn by oysters maintained in the discharge canal of a nuclear power plant. Proc. 2nd Nat. Symp. on Radioecology, Ann Arbor, Mich., May 15-17, 1967, p. 363-371.

Organisms: Crassostrea gigas

Date of Sample Collection: 1965-66

Location: Humboldt Bay Power Plant, Eureka, California

Analytical Technique:

Analytical Data:

Table 1. The date of introduction, number of days of exposure to effluent waters and the ^{65}Zn activity of oysters by each sample

Group No.	Brood Year	Date Introduced	Days of Exposure	^{65}Zn Activity (pCi/g wt. weight)[a]
1	62	Jan. 29, 1965	15	0.99
1	64	Jan. 29, 1965	15	1.56
1	62	Jan. 29, 1965	29	0.95
1	64	Jan. 29, 1965	29	1.53
1	64	Jan. 29, 1965	43	2.57
1	62	Jan. 29, 1965	43	1.39
1	62	Jan. 29, 1965	57	1.90
1	64	Jan. 29, 1965	57	3.60
1	62	Jan. 29, 1965	71	3.14
1	64	Jan. 29, 1965	71	4.05
1	62	Jan. 29, 1965	84	3.24
1	64	Jan. 29, 1965	84	4.29
1	62	Jan. 29, 1965	94	2.20
1	64	Jan. 29, 1965	94	2.64
1	64	Jan. 29, 1965	113	6.90
1	62	Jan. 29, 1965	113	5.32
1	64	Jan. 29, 1965	127	6.68
1	62	Jan. 29, 1965	127	6.24
1	62	Jan. 29, 1965	141	5.04
1	64	Jan. 29, 1965	141	5.22
1	64	Jan. 29, 1965	313	59.70
1	64	Jan. 29, 1965	370	90.20
2	62	Feb. 3, 1965	158	3.25
2	64	Feb. 3, 1965	158	5.28
2	62	Feb. 3, 1965	185	5.75
2	64	Feb. 3, 1965	185	4.55
2	64	Feb. 3, 1965	280	9.18
2	64	Feb. 3, 1965	308	61.80
2	64	Feb. 3, 1965	343	106.80
2	64	Feb. 3, 1965	392	174.05

Table 1 (continued)

Group No.	Brood Year	Date Introduced	Days of Exposure	^{65}Zn Activity (pCi/g wt. weight)[a]
2	64	Feb. 3, 1965	412	90.37
2	64	Feb. 3, 1965	421	127.54
4	64	Feb. 26, 1965	70	3.18
4	62	Feb. 26, 1965	70	2.35
5	62	Mar. 12, 1965	120	3.73
5	64	Mar. 12, 1965	120	4.35
7	62	Apr. 9, 1965	215	14.30
7	64	Apr. 9, 1965	215	13.95
8	62	Apr. 23, 1965	106	3.03
8	64	Apr. 23, 1965	106	3.77
9	62	May 7, 1965	214	41.80
9	64	May 7, 1965	214	49.70
9	62	May 7, 1965	250	92.20
9	64	May 7, 1965	250	144.20
9	62	May 7, 1965	271	55.00
10	62	May 21, 1965	49	1.07
10	64	May 21, 1965	49	1.58
11	64	June 4, 1965	126	10.20
11	62	June 4, 1965	126	6.90
11	64	June 4, 1965	187	83.80
12	62	June 18, 1965	86	2.80
12	64	June 18, 1965	147	12.25
12	62	June 18, 1965	175	29.40
12	64	June 18, 1965	175	49.60
12	64	June 18, 1965	210	99.22
12	62	June 18, 1965	232	74.80
12	64	June 18, 1965	232	106.60
12	62	June 18, 1965	279	120.93
12	64	June 18, 1965	279	45.12
12	64	June 18, 1965	288	105.21
12	62	June 18, 1965	288	132.75
12	62	June 18, 1965	342	105.66
12	64	June 18, 1965	342	83.31
12	64	June 18, 1965	408	63.43
13	64	Feb. 3, 1966	25	9.63
13	64	Feb. 3, 1966	25	10.28
13	64	Feb. 3, 1966	46	16.13
13	64	Feb. 3, 1966	54	29.04
13	64	Feb. 3, 1966	108	30.60
13	64	Feb. 3, 1966	144	37.75
13	64	Feb. 3, 1966	174	35.94
13	64	Feb. 3, 1966	203	30.19

[a]The counts are on single samples. In most cases the counting error varied between 1 and 5% and with the exception of one case (sample 1809) was less than 10%. On all samples over 100 pCi/g the counting error was less than 1%.

REF. NO.: 66 - S - 3

SUBSTANCES: Mn^{54}

Reference: Schelske, C. L., W. D. C. Smith & J. Lewis. 1966. Radio-assay, in Ann. Rep. Bur. Comm. Fish. Radiobiological Lab., Beaufort, N.C., 1965. U.S. NMFS Fish & Wildlife Serv. Circ. 244, p. 12-14.

Organisms: Argopecten irradians

Date of Sample Collection: 1965

Location: Beaufort, North Carolina

Analytical Technique: Gamma-counting

Analytical Data:

Table 3.--Distribution of manganese 54 in bay scallops collected near Beaufort, N. C. Values are the average ± standard deviation[1]

Samples	Manganese 54	Manganese 54
	Pc./g.	Pc./animal
Jan. 1963 (8)		
Kidneys	30.8 ± 5.3	13.1 ± 3.6
Dec. 1963-June 1964 (15)		
Liquid	.28 ± .22	1.8 ± .98
Mantle	.25 ± .15	0.82 ± .32
Gonads	.44 ± .30	1.0 ± .50
Gills	.48 ± .27	1.6 ± .89
Muscle	.83 ± .36	5.5 ± 3.0
Visceral mass	1.4 ± .75	3.8 ± 2.2
Kidneys	97 ± 40	49 ± 32
Jan. 1965 (8)		
Kidneys	128 ± 35	52 ± 21

[1] Number in parentheses = number of samples.

Table 4.--Comparison of manganese 54, stable manganese, and specific activity in tissues of bay scallops collected near Beaufort, N. C., from December 1963 to June 1964. Concentration in tissues based on wet weights

Tissues	Manganese 54	Stable manganese	Specific activity
	Pc./g.	µg./g.	Pc./µg.
Mantle	0.25	3.87	0.065
Gills	.48	8.37	.057
Muscle	.83	2.28	.36[illegible]
Visceral mass	1.4	3.88	.361
Kidneys	97	983	.099

REF. NO.: 73 - S - 2

SUBSTANCES: K^{40}, Zn^{65}, Mn^{54}, Cs^{137}, Ru^{106}

Reference: Schelske, C. L. 1973. Ecological implications of fallout radioactivity accumulated by estuarine fishes and mollusks. In Radionuclides in ecosystems, D. J. Nelson, ed., p. 791-806. Proc. 3rd Nat. Symp. Radioecology, 1971, vol. 2. U.S. AEC.

Organisms:
Mercenaria mercenaria
Modiolus demissus
Crassostrea virginica
Argopecten irradians

Date of Sample Collection: 1963-64

Location: Beaufort, North Carolina

Analytical Technique: Gamma-counting

Analytical Data:

Table 5. Fallout radioactivity in mollusks collected near Beaufort, North Carolina

Species	Sample number	Sampling date	pCi/100 g wet weight				
			^{40}K	^{65}Zn	^{54}Mn	^{137}Cs	^{106}Ru
Clams	249	1/24/64	127	9.65	5.47	3.79	57.6
	299	5/26/65	218	-0-	5.81	**	**
Mussels	278	1/31/64	63.9	5.50	6.79	3.01	37.8
	122	10/1/63	57.4	5.54	1.75	**	33.9
Oysters	248	1/23/64	86.2	35.4	1.16	5.93	1.28
	761	5/26/65	116	6.26	4.79	2.22	20.0
Scallops	121	10/1/63	100	6.05	214	55.6	241
	490	10/20/64	302	16.5	745	-0-	221

Note: **below limit of detection; -0- denotes oversubtraction, negative counts.

Table 6. Concentration of iron and manganese and ratios of measurements of stable elements and fallout radioactivity in fishes collected near Beaufort, North Carolina. Data on radioactivity are from Table 5.

Species	Sample number	mg 100 g wet weight		Ratios					
		Fe	Mn	Fe/Mn	$^{54}Mn/Mn$	$^{137}Cs/^{54}Mn$	$^{137}Cs/^{40}K$	$^{54}Mn/^{40}K$	$^{54}Mn/^{65}Zn$
Clams	249	6.24	0.178	35.1	30.7	0.693	0.0298	0.0431	0.567
Mussels	278	7.27	0.232	31.3	29.3	0.443	0.0471	0.106	1.23
Oysters	248	5.78	0.144	40.1	8.06	5.11	0.0688	0.0135	0.0328
Scallops	121	6.98	5.47	1.28	39.1	0.260	0.556	2.14	35.4

REF. NO.: 73 - S - 5

SUBSTANCES: Mn^{54}, Mn, Zn

Reference: Schelske, C. L. 1973. Fallout ^{54}Mn accumulated by bay scallops Argopecten irradians (Lamarck) near Beaufort, North Carolina. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 10-14 July 1972, p. 331-346. IAEA, Vienna.

Organisms: Argopecten irradians

Date of Sample Collection: 1963-66

Location: Beaufort, North Carolina

Analytical Technique:

Analytical Data:

TABLE I

MANGANESE-54 IN SCALLOP TISSUES COLLECTED DECEMBER 1963 TO JUNE 1964.
DATA ARE MEANS ± ONE STANDARD DEVIATION.

Tissue	Number of Samples	pCi/animal		pCi/g wet weight	
		logarithmic	arithmetic	logarithmic	arithmetic
Liquid	15	0.1686 ± .3043	1.78 ± .98	-0.6811 ± 0.3605	0.28 ± .22
Gill	15	0.1824 ± .3261	1.57 ± .89	-0.3485 ± 0.3070	0.56 ± .27
Muscle	14	0.6865 ± .2238	5.50 ± 3.0	-0.1254 ± 0.2138	0.83 ± .36
Visceral Mass	15	0.5312 ± .1940	3.79 ± 2.2	0.1073 ± 0.1933	1.41 ± .75
Mantle	14	-0.1189 ± .1733	0.82 ± .32	-0.6695 ± 0.2499	0.25 ± .15
Kidney	15	1.6175 ± .2533	49 ±32	1.9537 ± 0.1707	97 ±40
Gonads	15	-0.04858 ± .2344	1.01 ± .50	-0.4302 ± 0.2561	0.44 ± .30
		Bartlett's test = 8.11 F = 84.6 (6,96 D.F.) LSD = T (.09466)		Bartlett's test = 11.08 F = 189 (6,96 D.F.) LSD = T (.09755)	

Schelske, C. L. 1973.

TABLE II

CONCENTRATIONS OF MANGANESE AND ZINC AND WET WEIGHTS OF SCALLOP TISSUES COLLECTED NEAR PIVERS ISLAND, AUGUST 4, 1965.

Sample	Kidney	Muscle	Gills	Gonads	Visceral Mass	Mantle
			μg Mn/g wet weight			
A	5080	34.5[a]	37.3	33.4	103	b
B	5090	11.4	b	72.0	29.0	4.10
C	7970	11.5	5.72	57.7	18.3	6.50
D	10060	14.3	60.6	49.3	51.2	3.92
Mean	7050	12.4	34.5	53.1	50.3	4.84
			μg Zn/g wet weight			
A	959	342[a]	119	22.4	163	b
B	1260	16.6	b	38.5	18.8	12.8
C	1640	14.4	22.0	26.9	419	11.3
D	1690	14.4	26.6	21.5	19.2	12.8
Mean	1390	15.1	55.9	27.3	155	12.3
			wet weight (g/tissue)			
A	0.32	5.68	3.24	2.72	2.29	3.03
B	0.29	4.62	2.07	2.73	2.09	2.99
C	0.39	7.17	1.37	2.79	2.21	3.75
D	0.29	6.80	1.58	2.15	2.91	3.13
Mean	0.32	6.07	2.07	2.60	2.38	3.23

[a] Value not used for calculation of the mean.
[b] Sample lost.

TABLE III

SPECIFIC ACTIVITY OF MN-54 AND CONCENTRATIONS OF MN-54 AND STABLE MANGANESE IN SCALLOP TISSUES. DATA ARE AVERAGES FROM TABLES I AND III.

Sample	Specific Activity pCi/mg Mn	Mn-54 pCi/g	Stable Mn μg Mn/g
Kidney	13.8	97	7050
Muscle	66.9	0.83	12.4
Gills	16.2	0.56	34.5
Gonads	8.3	0.44	53.1
Visceral Mass	28.0	1.41	50.3
Mantle	51.7	0.25	4.84

Schelske, C. L. 1973.

TABLE IV

DISTRIBUTION IN BAY SCALLOPS (ACTIVITY PER ANIMAL) OF MN-54 ORIGINATING FROM ENVIRONMENTAL ACCUMULATION OF FALLOUT AND FROM ACCUMULATION OF TRACER ACTIVITY IN THE LABORATORY. LABORATORY ANIMALS WERE HELD IN WATER CONTAINING ADDED MN-54 FOR 20 DAYS AND THEN PLACED IN RUNNING NON-RADIOACTIVE SEA WATER FOR AN ADDITIONAL 45 DAYS. DATA FOR ENVIRONMENTAL SAMPLES FROM TABLE I.

	Environment		Millipore-filtered water				Cotton-filtered water			
			After 3 days		After 65 days		After 3 days		After 65 days	
Sample	pCi	%	nCi	%	nCi	%	nCi	%	nCi	%
Liquid	1.8	2.8	.92	18	.34	1.8	.60	5.9	.86	3.4
Mantle	0.82	1.3	.34	6	.16	0.9	.45	4.5	.21	0.8
Gonads	1.01	1.6	.18	3	.03	0.1	.26	2.6	.33	1.3
Gills	1.57	2.5	.71	14	.38	2.0	1.22	12.1	.37	1.5
Visceral mass	3.79	6.0	.77	15	.30	1.6	1.07	10.6	.81	3.2
Muscle	5.50	8.6	.55	11	1.63	8.7	1.58	15.6	1.87	7.4
Kidney	49.1	77.2	1.71	33	15.9	85.0	4.90	48.5	20.8	82.2
Total	63.6		5.16		18.7		10.1		25.3	

REF. NO.: 63 - S - 3

SUBSTANCES: K^{40}, Mn^{54}, Co^{57}, Co^{60}, Zn^{65}, Zr^{95}, Ag^{110}

Reference:

Seymour, A. H. 1963. Radioactivity of marine organisms from Guam, Palau and the Gulf of Siam, 1958-1959. In Radioecology, proc. 1st Nat. Symp. Radioecology, Colorado State Univ., Fort Collins, Colorado, Sept. 10-15, 1961, V. Schultz & A. W. Klement Jr., eds, p. 151-157. Reinhold Pub. Corp., N. Y. & Amer. Inst. Biol. Sci., Washington D.C., 1963.

Organisms:

Tridacna elongata *Pteria* sp.
Tridacna sp.
Arca sp.
Pinna sp.

Date of Sample Collection: 1958-59

Location: Gulf of Siam, Guam, Palau

Analytical Technique: Beta-counting; gamma-counting; gamma spectrum analysis

Analytical Data:

Table 1. Nuclides identified by gamma spectrometry in single samples from Guam, Palau and Gulf of Siam, 1958-1959. (Values in terms of micromicrocuries per gram of wet weight and corrected to date of collection.)

Area	Sample type	Date collected	Number of specimens	Potassium -40	Manganese -54	Cobalt -57	Cobalt -60	Zinc -65	Zirconium -95	Silver -110m
Guam	(surgeonfish)									
	muscle	October 6, 1959	6	4 ± 1[1]						
	liver	April 4, 1959	3	28 ± 17		20 ± 2	2 ± 1	137 ± 12		
	(spider snail)									
	liver	January 8, 1959	4		180 ± 8	59 ± 5	4 ± 2			
	liver	July 29, 1959	6	79 ± 11	357 ± 5	231 ± 3	19 ± 1			
	liver	October 7, 1959	7	54 ± 13	207 ± 3	109 ± 2	10 ± 1	63 ± 5		
	(spiny lobster)									
	liver	November 3, 1959	6	91 ± 2	?	25	?	40	30	50[2]
	(*Tridacna* clam)									
	kidney	October 21, 1959	10		1003 ± 31	2340 ± 30	275 ± 19	22 ± 1		
Palau	(goatfish)									
	muscle	September 29, 1959	10	3 ± 1						
	(*Tridacna* clam)									
	kidney	September 29, 1958	7		12 ± 2	16 ± 1	57 ± 1			
	kidney	April 14, 1959	1		5 ± 1	11 ± 1	20 ± 1	30 ± 6		
	kidney	September 28, 1959	3		85 ± 20	294 ± 20	50 ± 7			
Gulf of Siam										

No gamma emitting nuclides other than potassium-40 identified in the six samples examined which included: fish muscle (*Epinephelus*), fish liver (*Katsuwonus*), clam kidney (*Tridacna*), clam soft parts (*Arca*), algae (*Dictyota*), and plankton.

[1] 95 per cent error in net count: $E_{95} = 1.96\ (Ns/t_s + Nb/t_b)^{1/2}$; from U. S. Public Health Service Radiological Health Handbook, 1960.

[2] Approximate value based upon decay scheme for silver-110m and efficiency factor for cesium-137. Without a standard for silver-110m Compton correction factors not calculated and therefore estimates of other radionuclides in sample also are approximate.

APPENDIX TABLE A. Average gross beta values, micromicrocuries per gram of wet tissue, of marine organisms collected at Guam, Palau, and Gulf of Siam, 1958 and 1959. Average based on three observations unless noted.

			Guam						Palau						Gulf of Siam			
			1958		1959				1958		1959				1958		1959	
Group	**Name**	**Tissue**	**June**	**October**	**January**	**April**	**June**	**October**	**June**	**October**	**January**	**April**	**June**	**October**	**June**	**October**	**January**	**April**
Molluscs	**Spider snail**	muscle	5±.90	5±.45	14±2.4	28±1.4	21±6.0	23±11.	4±.56	7±2.0	4±.21	4±.61	5±.21	4±.08				
		liver	61±13.	60±14.	356±54.	112±12.	224±27.	312±50.	9±1.5	7±.28	8±1.1	16±6.7	13±2.3	14±1.1				
	***Tridacna* clam**	muscle	4±.36	3±.24	6±.86	5±.64	4±.28	4±.46	2±.21	2±.42	3±.16	3±.21	3±.21	3±.10	3±.48			3±.31
		kidney	54±8.9	47±4.2	126±22.	122±3.7	204±29.	170±50.	50±13.	46±10.	45±7.0	84±13.	57±3.3	65±5.5	11±1.41			6±.55
	***Arca* clam**	foot															1±.66	2±.40
		soft parts													3±.43	2±.32	2±.29	3±.31
	***Pinna* pen shell**	muscle															2±.20	
		viscera															4±.41	
	***Pteria* oyster**	muscle															2[2]	
		viscera															3[2]	

REF. NO.: 73 - S - 4 **SUBSTANCES:** Zn^{65}

Reference: Seymour, A. H. & V. A. Nelson. 1973. Decline of ^{65}Zn in marine mussels following the shutdown of Hanford reactors. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 10-14 July 1972, p. 277-286. IAEA, Vienna.

Organisms: *Mytilus edulis*
Mytilus californianus

Date of Sample Collection: 1971-72

Location: Columbia River and Washington coast

Analytical Technique: Gamma spectrum analysis; atomic absorption spectrophotometry

Analytical Data:

TABLE I. ZINC-65 AND ZINC IN MUSSELS AND WATER NEAR MOUTH OF COLUMBIA RIVER, MARCH 1971 - MAY 1972

A. Mussels

Area	Species	Date	^{65}Zn pCi/g.dry	Zn µg/g.dry	Specific activity µCi ^{65}Zn/g Zn
North Jetty	*Mytilus edulis*	14 June 71	20	280	0.071
		14 July 71	23	340	0.068
		18 Sept. 71	13	260	0.050
		30 Nov. 71	8.7	300	0.029
		30 Dec. 71	9.7	320	0.030
		18 Feb. 72	6.2	240	0.026
		14 April 72	4.3	390	0.011
		30 May 72	3.4	340	0.010
	Average		11.7	310 ± 49	0.038
North Head	*Mytilus californianus*	23 Mar. 71	20	190	0.105
		14 June 71	12.5	160	0.078
		14 July 71	11	200	0.055
		18 Sept. 71	6.2	140	0.044
		30 Nov. 71	5.8	150	0.039
		18 Feb. 72	3.4	110	0.031
		14 April 72	3.6	230	0.016
		30 May 72	2.4	250	0.010
	Average		8.1	180 ± 47	0.045

B. Water

Area	Date	^{65}Zn pCi/litre	Zn µg/litre[a]	Specific activity µCi ^{65}Zn/g Zn	Sample vol. litres
North Jetty	14 July 71	0.543	13	0.0420	202
Baker Bay	30 Nov. 71	0.062	26	0.0024	154
" "	17 Feb. 72	0.041	4.6	0.0089	285
	Average		14.5		

[a] Particulate fraction, 0.3 µm and greater, only.

REF. NO.: 61 - S - 1

SUBSTANCES: Zn, Zn^{65}

Reference: Skauen, D. M. 1961. Radioactive zinc in marine organisms in Fishers Island Sound and its estuaries. Progress Report. U. S. Atomic Energy Commission, TID-13509, 33p.

Organisms: *Crassostrea virginica*
Mytilus edulis
Mercenaria mercenaria

Date of Sample Collection: 1960-61

Location: Thames River, Connecticut

Analytical Technique: Colorimetry

Analytical Data:

REF. NO.: 75 - U - 1

SUBSTANCES: Sr^{90}

Reference: Ueda, T., Y. Suzuki & R. Nakamura. 1975. Accumulation of Sr in marine organisms--II. The level of ^{90}Sr in marine organisms from the coastal sea of Japan. Bull. Jap. Soc. Sci. Fish. 41:691-698.

Organisms:
Tapes philippinarum
Crassostrea gigas
Mytilus edulis
Meretrix meretrix lamarckii

Date of Sample Collection: 1965-75

Location: Japan

Analytical Technique:

Analytical Data:

Table 3. The SU in the molluscan shell

District	Mollusc*	1965	1966	1967	1968	1969	1970
Niigata	Short-necked clam	0.4	0.2	0.2	0.1	—	—
	Oyster	0.2	0.1	—	—	—	—
	Abalone	0.3	—	0.2	—	—	—
	Topshell	—	0.6	—	—	—	—
Fukui	Mussel	—	0.1	0.2	—	—	0.1
	Topshell	0.3	0.1	0.2	—	—	0.1
Fukushima	Clam	0.3	0.1	0.2	0.1	—	—
	Abalone	0.3	0.1	0.2	0.1	—	—
Ibaraki	Clam	—	—	0.1	—	—	0.1
	Abalone	—	—	0.2	0.1	—	—
Hiroshima	Short-necked clam	0.2	0.2	0.1	—	—	—
	Oyster	0.2	0.1	0.1	0.1	—	—

* English, Japanese, and scientific names in Table 3 are as follows; Short-necked clam, Asari, *Tapes philippinarum*; Oyster, Magaki, *Crassostrea gigas*; Mussel, Murasakiigai, *Mytilus edulis*; Clam, Hamaguri, *Meretrix meretrix lamarckii*; Abalone, Kuroawabi, *Nordotis discus*; Topshell Sazae, *Turbo cornutus*.

REF. NO.: 61 - W - 1 **SUBSTANCES:** Zn^{65}

Reference: Watson, D. G., J. J. Davis & W. C. Hanson. 1961. Zinc-65 in marine organisms along the Oregon and Washington coasts. Science 133:1826-1828.

Organisms: *Mytilus* sp.
Crassostrea gigas
Siliqua patula

Date of Sample Collection: 1957-60

Location: Oregon and Washington coasts

Analytical Technique: Gamma counting

Analytical Data:

Watson, D. G. et al. 1961.

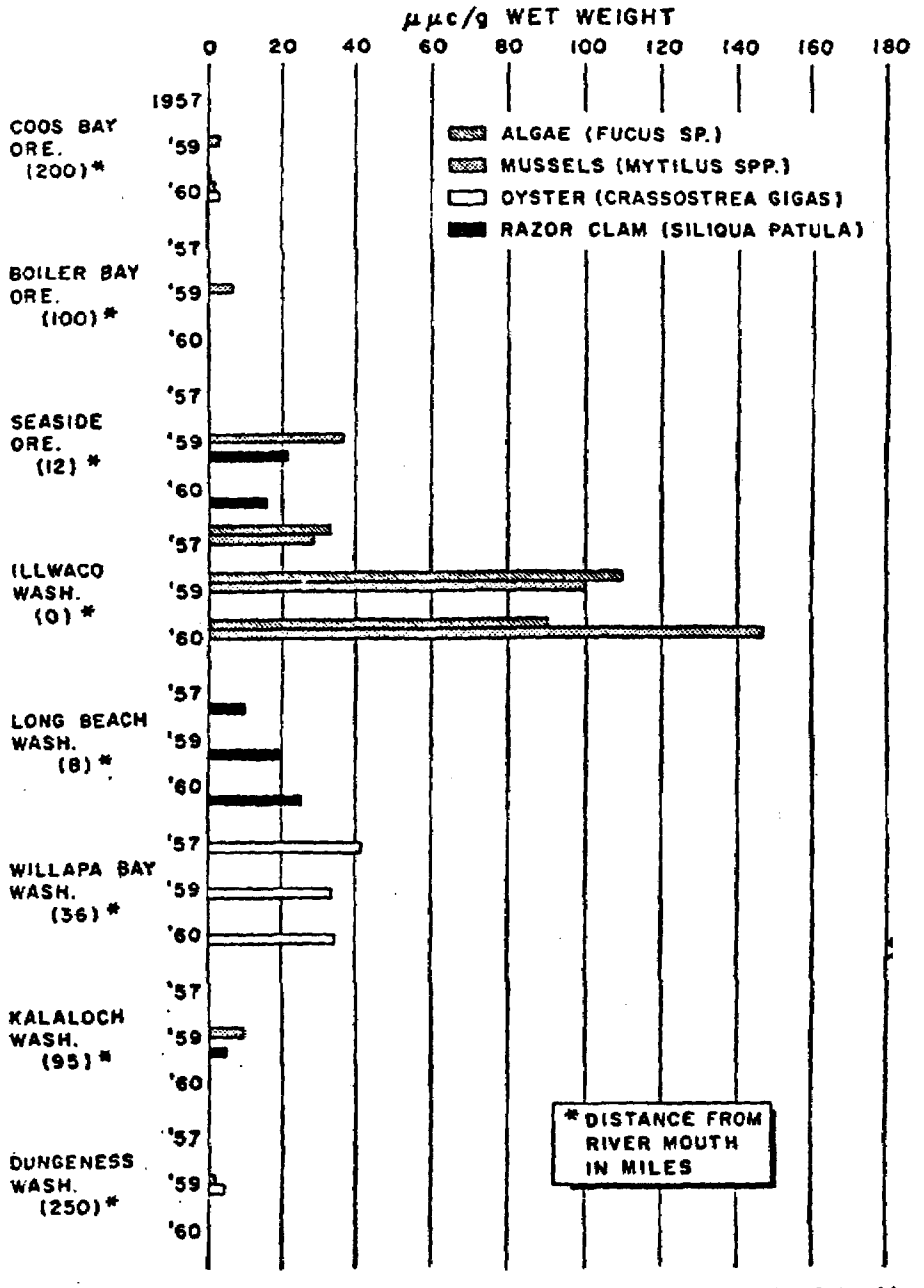


Fig. 1. Concentration of Zn^{65} in marine organisms near the mouth of the Columbia River.

REF. NO.: 57 - W - 1

SUBSTANCES: Co^{60}

Reference: Weiss, H. V. & W. H. Shipman. 1957. Biological concentration by killer clams of cobalt-60 from radioactive fallout. Science 125:695.

Organisms: *Tridacna gigas*

Date of Sample Collection: 1956

Location: Marshall Islands

Analytical Technique:

Analytical Data:

Table 1. Cobalt-60 and gross gamma activity in killer clams.

Specimen	Wet Wt. (g)	Gamma Activity		Co^{60}* (disintegration/min)†
		Gross count/min	Co^{60}* (count/min)	
A	1800	142,700	90,300	210,000
B	882	356,700	303,000	705,000

* Corrected for recovery.
† The disintegrations per minute were determined by comparison with a Co^{60} source obtained from the National Bureau of Standards.

REF. NO.: 67 - W - 2

SUBSTANCES: Zn^{65}, Mn^{54}, Cs^{137}, Ru^{106}, Ce^{144}, Zr^{95}, Nb^{95}, Ru^{103}, Ce^{141}, Ba^{140}, La^{140}

Reference:

Wolfe, D. A. & C. L. Schelske. 1967. Accumulation of fallout radioisotopes by bivalve molluscs from the Lower Trent and Neuse Rivers. In Proc. 2nd Nat. Symp. on Radioecology, Ann Arbor, Mich., May 15-17, 1967, p. 493-504.

Organisms: *Elliptio complanatus*
Rangia cuneata
Polymesoda caroliniana

Date of Sample Collection: 1966

Location:
Trent and Neuse Rivers, North Carolina

Analytical Technique:
Gamma spectrum analysis

Analytical Data:

Table 1. Long-lived gamma fallout radioisotopes in *Rangia cuneata*

Station	Number of samples	Picocuries per 100 grams wet weight of soft parts[1]					
		Zn^{65}	Mn^{54}	Cs^{137}	Ru^{106}	Ce^{144}	Total
Wilson Creek	11	1.27 ± 0.77	5.72 ± 1.77	4.38 ± 1.92	5.12 ± 1.41	11.4 ± 3.12	27.9 ± 4.37
Brice Creek	13	1.40 ± 0.95	7.89 ± 3.07	3.65 ± 1.47	5.36 ± 1.38	15.5 ± 4.41	33.8 ± 5.82
Lewis Ferry	12	1.04 ± 0.91	4.69 ± 2.67	2.74 ± 1.38	4.25 ± 2.11	20.3 ± 8.14	33.0 ± 8.98
Union Point	12	1.18 ± 1.46	5.82 ± 2.02	2.37 ± 1.07	3.97 ± 1.41	11.2 ± 4.70	24.5 ± 5.60
Pinecliff	12	0.72 ± 0.51	7.97 ± 3.86	1.71 ± 0.31	8.00 ± 3.08	11.4 ± 3.22	29.8 ± 5.93
Cedar Point	9	0.80 ± 0.68	7.93 ± 4.91	1.70 ± 0.53	8.16 ± 1.79	16.5 ± 3.86	35.1 ± 6.55
All Stations	69	1.08 ± 0.94	6.65 ± 3.15	2.79 ± 1.55	5.75 ± 2.51	14.2 ± 5.78	30.5 ± 7.27

[1] Means and standard deviations for all samples collected between September 1965 and February 1967.

Table 2. Fallout in *Rangia cuneata* after Chinese nuclear test - May 9, 1966

Isotope	Wilson Creek May 18	Brice Creek May 18	Lewis Ferry May 18	Union Point May 18	Pinecliff June 1	Cedar Point June 1	Means May 18	Means June 1	Means All
	Picocuries per 100 grams wet weight of soft parts[1]								
Zn^{65}	1.91 ± 0.46	1.77 ± 0.53	1.89 ± 0.25	4.96 ± 0.47	0.49 ± 0.41	1.94 ± 0.34	2.63 ± 1.55	1.22 ± 1.02	2.16 ± 1.48
Mn^{54}	5.27 ± 0.86	6.13 ± 0.94	7.77 ± 0.58	8.97 ± 0.58	11.5 ± 0.80	4.18 ± 0.28	7.04 ± 1.64	7.84 ± 5.18	7.30 ± 2.68
Zr^{95}-Nb^{95}	104 ± 8.40	251 ± 10.9	399 ± 6.54	572 ± 7.38	127 ± 7.54	463 ± 8.06	332 ± 200	295 ± 238	319 ± 189
Cs^{137}	8.33 ± 0.15	4.49 ± 0.16	4.55 ± 0.09	4.15 ± 0.09	2.13 ± 0.12	2.62 ± 0.12	5.38 ± 1.97	2.38 ± 0.35	4.38 ± 2.18
Ru^{103}	4.74 ± 1.87	13.2 ± 1.51	6.04 ± 0.99	12.6 ± 0.68	117 ± 1.22	87.1 ± 1.81	9.15 ± 4.37	102 ± 21.2	40.1 ± 66.6
Ru^{106}	5.67 ± 0.93	6.98 ± 1.08	4.66 ± 0.39	2.44 ± 0.54	13.1 ± 0.89	10.6 ± 0.77	4.94 ± 1.90	11.9 ± 1.77	7.24 ± 3.94
Ce^{141}	2.91 ± 2.54	19.4 ± 1.89	35.4 ± 2.11	29.1 ± 0.85	17.3 ± 1.01	60.2 ± 2.22	21.7 ± 13.5	38.8 ± 31.2	27.4 ± 19.5
Ce^{144}	11.3 ± 1.12	19.1 ± 1.31	26.2 ± 0.71	21.4 ± 0.70	15.0 ± 1.04	22.5 ± 0.93	19.5 ± 7.28	18.8 ± 5.30	19.3 ± 6.90
Ba^{140}-La^{140}	72.8 ± 3.92	95.6 ± 9.76	172 ± 6.43	124 ± 3.30	48.9 ± 2.33	55.7 ± 2.48	116 ± 42.7	52.3 ± 4.81	94.8 ± 45.8
Total	217 ± 9.95	418 ± 15.0	658 ± 9.52	780 ± 8.24	352 ± 8.22	708 ± 9.00	518 ± 247	530 ± 252	522 ± 224

[1] Deviations shown for individual stations (Columns 2-7) are one sigma counting errors based on the counting rates at the appropriate photopeak energies of the sample and background. Columns 8-10 show the means and standard deviations for the appropriate stations in Columns 2-7.

REF. NO.: 70 - W - 1

SUBSTANCES: Zn, Zn^{65}

Reference: Wolfe, D. A. 1970. Levels of stable Zn and ^{65}Zn in Crassostrea virginica from North Carolina. J. Fish. Res. Bd Can. 27:47-57.

Organisms: Crassostrea virginica

Date of Sample Collection: 1964-69

Location: Beaufort, North Carolina

Analytical Technique: Gamma spectrum analysis; atomic absorption spectrophotometry; neutron activation analysis

Analytical Data:

TABLE 1. Stable zinc in *Crassostrea virginica* from the Newport River (ppm on wet-weight basis).

Expression of concn	Feb. 1966[a]		Jan. 1969	
	Shells (18 samples)	Soft parts (12 samples)	Soft parts[b] (12 samples)	Soft parts[c] (20 samples)
Mean concn ± SD	24.75±9.67	159.4±77.6	245.1±63.5	213.5±83.4
Median value	22.15	136.7	228.7	210.5
Concn at mean log value	23.61	142.9	237.3	194.0

[a]Animals were resident in the laboratory seawater system for 4 months before analysis by atomic absorption.
[b]Analyzed by neutron activation, Puerto Rico Nuclear Center.
[c]Analyzed by atomic absorption.

TABLE 2. Percentages of total wet weight and total zinc contributed by different tissues of *Crassostrea virginica*, Newport River, April 1965.

Tissue	% of total wet wt	ppm zinc	% of total zinc
Mantle	16.5	135	26.1
Gills	7.6	182	16.1
Labial palps	3.6	123	5.2
Muscle	7.2	79	6.7
Digestive gland	8.0	260	24.5
Remainder	9.3	175	19.1
Extracellular fluid	27.5	6.5	2.1
Pallial fluid	20.3	1.2	0.3
Total	100.0	85.4	100.1
Less pallial fluid	79.7	106.7	99.8
Less extracellular fluid	52.2	162.7	97.7

TABLE 3. Percentages of total wet weight and total zinc contributed by different tissues of *Crassostrea virginica*, North River, November 1966.

Tissue	% of total wet wt	ppm zinc	% of total zinc
Mantle	14.8	450.6	30.6
Gills	8.8	508.1	20.4
Labial palps	3.4	501.2	7.7
Muscle	6.8	126.1	4.0
Digestive gland	12.0	491.8	27.1
Rectum	0.4	531.0	1.1
Pericardial sac	0.3	223.9	0.3
Gonad	2.7	435.9	5.3
Extracellular fluid	28.1	18.8	2.4
Pallial fluid	22.7	11.4	1.1
Total	100.0	218.5	100.0
Less pallial fluid	77.3	279.3	98.9
Less extracellular fluid	49.2	427.8	96.5

REF. NO.: 71 - W - 1

SUBSTANCES: Cs^{137}

Reference: Wolfe, D. A. 1971. Fallout cesium-137 in clams (Rangia cuneata) from the Neuse River estuary, North Carolina. Limnol. Oceanogr. 16:797-805.

Organisms: Rangia cuneata

Date of Sample Collection: 1965-67

Location: Trent-Neuse River estuary, North Carolina

Analytical Technique:

Analytical Data:

TABLE 1. *Concentration of ^{137}Cs in* Rangia cuneata *from the Trent-Neuse estuary, September 1965–July 1967*

Station	Samples analyzed (No.)	Cesium-137 (pCi/100 g wet wt)
Wilson Creek	15	5.1 ± 2.2
Brice Creek	12	4.0 ± 1.6
Lewis Ferry	11	3.3 ± 1.4
Union Point	15	2.8 ± 1.0
Pinecliff	16	1.9 ± 0.3
Cedar Point	8	1.9 ± 0.5
Total	77	Mean 3.2 ± 1.8

REF. NO.: 73 - W - 1

SUBSTANCES: Fe^{55}, Ru^{103}, Ru^{106}
Fe, Mn, Zn, Cu

Reference: Wolfe, D. A. & C. D. Jennings. 1973. Iron-55 and ruthenium-103 and -106 in the brackish-water clam Rangia cuneata. In Radionuclides in Ecosystems, proc. 3rd Nat. Symp. Radioecology, 1971, D. J. Nelson, ed., vol. 2, p. 783-790. U. S. AEC.

Organisms: Rangia cuneata

Date of Sample Collection: 1965-67

Location: Trent and Neuse Rivers, North Carolina

Analytical Technique: Gamma spectrometry; atomic absorption spectrophotometry

Analytical Data:

Table 1. Ruthenium-106 in *Rangia cuneata* from the Trent-Neuse Estuary, 1965–1967, expressed as mean pCi/100 g wet weight ± S.E. for each station

Station	Number of samples	^{106}Ru
Wilson Creek	15	4.18 ± 0.37
Brice Creek	13	4.91 ± 0.42
Lewis Ferry	12	3.97 ± 0.51
Union Point	16	3.43 ± 0.35
Pinecliff	16	6.38 ± 0.57
Cedar Point	9	7.58 ± 0.59
4 upstream stations	56	4.11 ± 0.22
2 downstream stations	25	6.72 ± 0.43

Table 3. Mean concentrations (ppm, wet weight basis) of Fe, Mn, Zn, and Cu (± S.E.) in *Rangia cuneata* from the Trent-Neuse Estuary. Samples were analyzed by atomic absorption spectrophotometry.

Station	Number of samples	Fe	Mn	Zn	Cu
Wilson Creek	9	58.9 ± 7.4	3.19 ± 0.52	9.35 ± 0.74*	0.70 ± 0.09††
Brice Creek	7	49.2 ± 3.9†	2.52 ± 0.54	7.99 ± 0.65	1.28 ± 0.13
Lewis Ferry	10	63.6 ± 6.2	3.60 ± 0.69	11.9 ± 0.80††	1.32 ± 0.12
Union Point	11	69.4 ± 6.9†	2.51 ± 0.64	13.3 ± 0.58††	1.13 ± 0.08
Pinecliff	8	55.8 ± 5.3	2.52 ± 0.78	7.42 ± 0.47	1.43 ± 0.13
Cedar Point	8	49.3 ± 7.0	4.86 ± 1.44	6.24 ± 0.63	1.24 ± 0.09
Overall mean	49	56.9 ± 2.7	3.24 ± 0.34	9.64 ± 0.45	1.17 ± 0.05

*For Zn, Wilson creek was significantly different (0.95) from all stations except Brice Creek.

†Different significantly at 0.95 level.

††Different significantly at 0.95 level from all means in column not marked similarly.

Wolfe, D. A. & C. D. Jennings. 1973.

Table 2. Iron-55 in *Rangia*

Date	^{55}Fe (pCi/100 g wet wt ± counting error)	Specific activity (pCi ^{55}Fe/g Fe)	$^{106}Ru/^{55}Fe$ (pCi/pCi)
	Union Point Station		
5/18/66	0.40 ± 0.10	85	5.1
7/5/66	0.72 ± 0.10	88	6.1
8/10/66	0.79 ± 0.11	76	7.1
9/26/66	0.32 ± 0.07	52	17
11/15/66	0.50 ± 0.08	82	3.9
1/11/67	0.77 ± 0.13	67*	5.7
2/23/67	0.44 ± 0.08	61*	13
	Pinecliff Station		
4/5/66	1.54 ± 0.20	340	3.3
6/1/66	1.52 ± 0.20	260	4.7
7/14/66	1.07 ± 0.11	260	5.0
8/10/66	0.88 ± 0.10	160	7.2
9/29/66	0.51 ± 0.07	160	10
11/16/66	2.03 ± 0.23	280	2.0
1/18/67	1.46 ± 0.20	220*	7.7
2/23/67	1.27 ± 0.17	170*	6.2

Station	Number of samples	^{55}Fe (pCi/100 g wet wt ± S.E.)	Specific activity (pCi ^{55}Fe/g Fe ± S.E.)	$^{106}Ru/^{55}Fe$ (pCi/pCi ± S.E.)
Union Point upstream	7	0.56 ± 0.07	73 ± 5	8.3 ± 1.8
Pinecliff downstream	8	1.29 ± 0.16	230 ± 23	6.1 ± 0.9
Probability level (upstream vs downstream)		$P < 0.002$	$P < 0.0001$	$P > 0.20$
All samples	15	0.95 ± 0.13	157 ± 24	7.1 ± 1.0

*Fe was estimated by atomic absorption immediately after dissolution of $Fe(OH)_3$ in 0.5 *N* HCl, during preparation of samples for ^{55}Fe analysis.

REF. NO.: 70 - W - 2 **SUBSTANCES:** Pu^{239}, Sr^{90}, Cs^{137}

Reference: Wong, K. M., J. C. Burke & V. T. Bowen. 1970. Plutonium concentration in organisms of the Atlantic Ocean. Proc. 5th Ann. Health Physics Soc. Midyear Topical Symp., Health Physics Aspects of Nuclear Facility Siting, Idaho Falls, Id., v. 2, p. 529-539

Organisms:
Mytilus edulis
Modiolus modiolus
Mya arenaria

Date of Sample Collection: 1970

Location: Cape Cod, Massachusetts

Analytical Technique: Alpha spectrometry

Analytical Data:

Table 2. Pu-239 concentration in shellfish and other marine organisms.

Organisms	Collection Site	Collection Date	Pu-239 concentration dpm/100 Kg wet wt.	Concentration factor	Ratios (%) Pu-239/Sr-90	Ratios (%) Pu-239/Cs-137
Blue mussel (Mytilus edulis)	Cape Cod Canal	6/70	33 ± 12	240	80 ± 30	4.3 ± 1.5
" "	"	"	36 ± 5	260	45 ± 34	3.7 ± 0.6
" "	Woodneck	3/70	40 ± 7	290	-	-
" "	"	7/70	36 ± 5	260	30 ± 14	3.3 ± 0.5
" "	Dyer's Dock	7/70	23 ± 3	160	16 ± 10	3.1 ± 0.8
" " (shell)	Woodneck	3/70	57 ± 9	410	-	-
Brown mussel (Modiolus modiolus)	Hadley	6/70	41 ± 4	290	35 ±18	4.2 ± 0.5
Soft shell clam (Mya arenaria)	Hadley	6/70	53 ± 11	380	-	2.3 ± 0.7

Wong, K. M. et al. 1970.

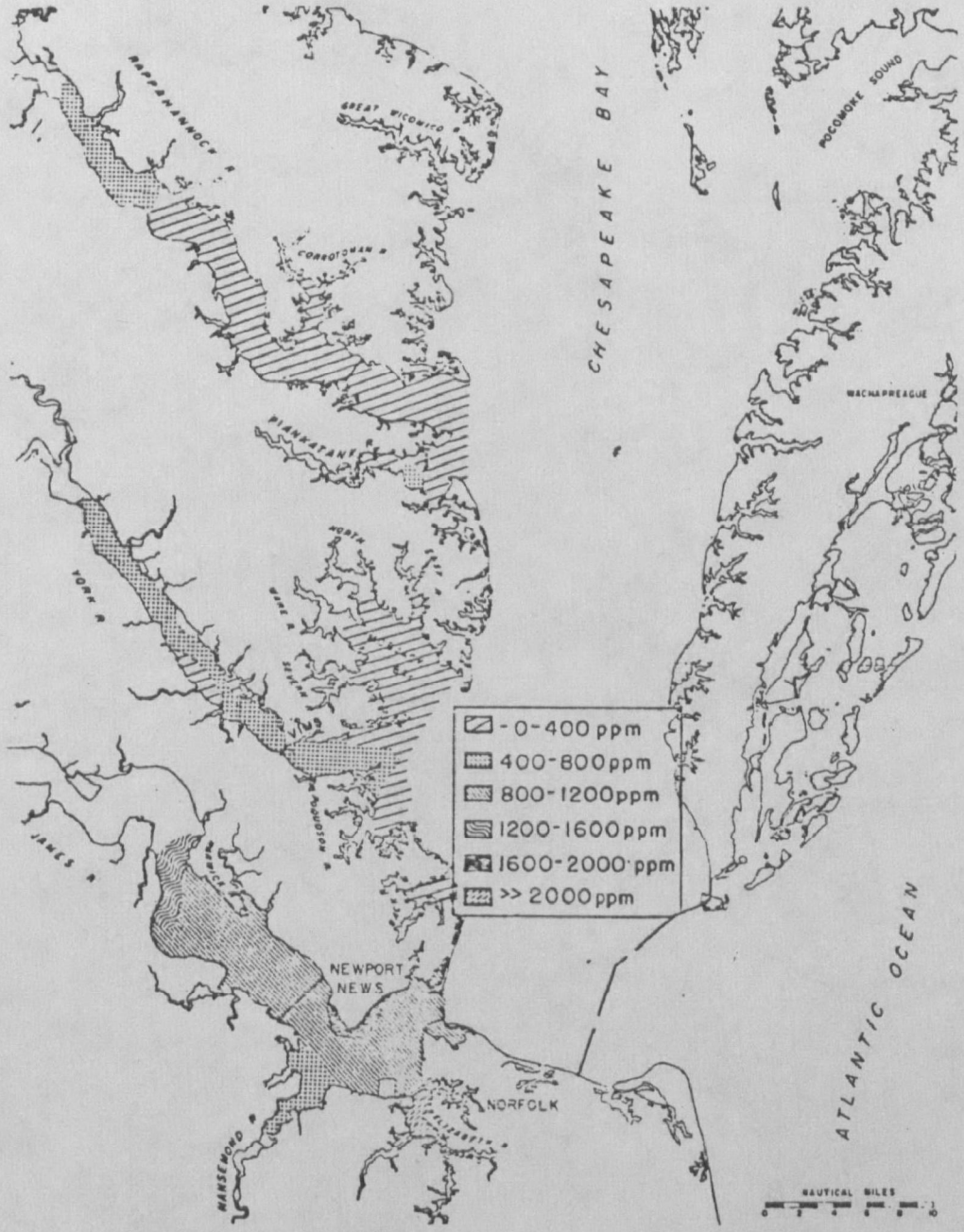


Fig. 4.–The distribution of zinc in oysters from Virginia's major rivers (from Proceedings of 7th ional Shellfish Sanitation Conference).

Wong, K. M. et al. 1970.

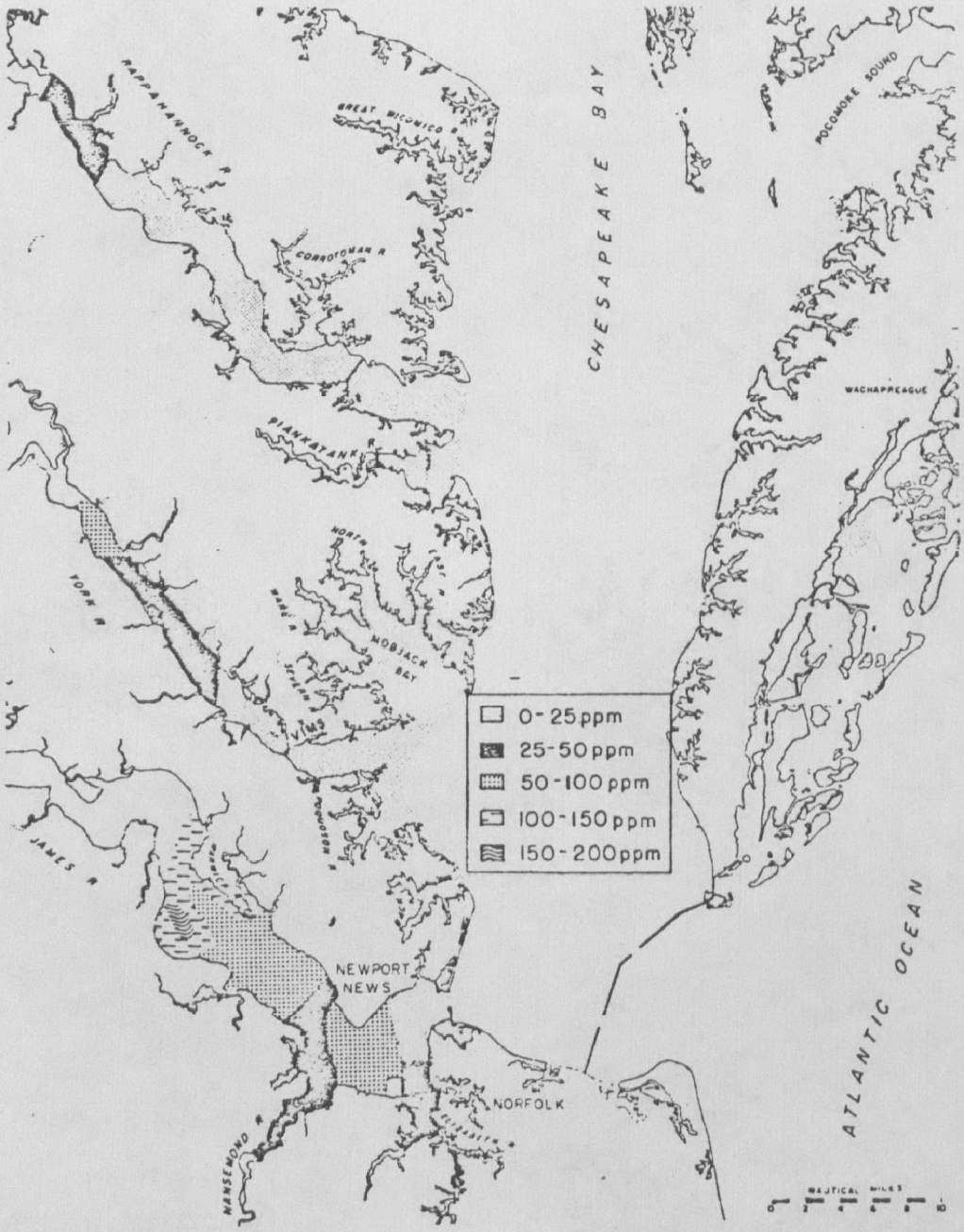


Fig. 5.–The distribution of copper in oysters from Virginia's major rivers (from Proceedings of 7th National Shellfish Sanitation Conference).

Wong, K. M. et al. 1970.

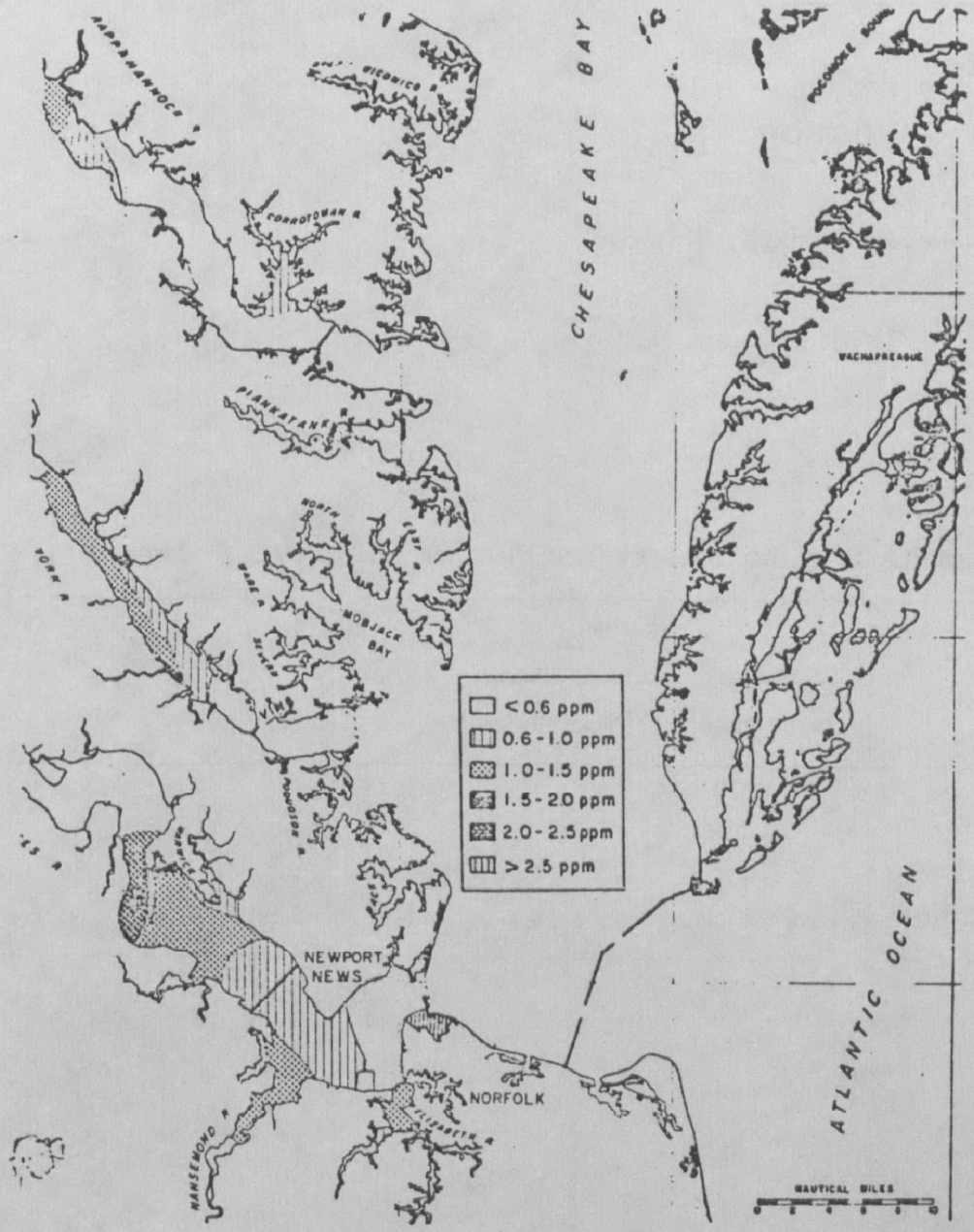


Fig. 6.–The distribution of cadmium in oysters from Virginia's major rivers (from Proceedings of 7th National Shellfish Sanitation Conference).

REF. NO.: 73 - W - 4

SUBSTANCES: P^{32}, Zn^{65}, Fe^{55}, Co^{60}, Ag^{110}, Cs^{137}, Cs^{134}

Reference:

Woodhead, D. S. 1973. Levels of radioactivity in the marine environment and the dose commitment to marine organisms. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 1972, p. 499-525. IAEA, Vienna.

Organisms: *Ostrea edulis*

Date of Sample Collection: 1968

Location: Blackwater estuary, Britain

Analytical Technique:

Analytical Data:

TABLE VIII. LEVELS OF RADIOACTIVITY (pCi g^{-1}) IN THE BLACKWATER ESTUARY, 1968

Material	^{32}P		^{65}Zn		^{55}Fe	^{60}Co	$^{110}Ag^{m}$	^{137}Cs	^{134}Cs
	Av	Range	Av	Range					
Sediment	-	-	-	-	-	0.1	-	2.2	1.0
Fucus vesiculosis	-	-	-	-	0.06	0.2	-	0.6	-
Oysters (*Ostrea edulis*)	0.25	0.1-0.3	7.6	5.4-12	0.28	0.28	0.38	1.4	0.6

REF. NO.: 73 - W - 2 **SUBSTANCES:** Cs^{137}, K^{40}

Reference: Wrenn, M. E., J. W. Lentsch, M. Eisenbud, G. J. Lauer & G. P. Howells. 1973. Radiocesium distribution in water, sediment, and biota in the Hudson River estuary from 1964 through 1970. In Radionuclides in Ecosystems, Proc. 3rd Nat. Symp. Radioecology, Oak Ridge, Tenn., 1971, vol. 1, D. J. Nelson, ed., p. 334-343. U. S. AEC.

Organisms: bivalves (unspecified)

Date of Sample Collection: 1970

Location: Hudson River

Analytical Technique:

Analytical Data:

Table 3. ^{137}Cs and ^{40}K concentrations in Hudson River samples at Indian Point June 1970

Sample	pCi/kg (wet)		
	^{137}Cs	^{40}K	Cs/K
Bivalves (whole)	80	850	0.094

REF. NO.: 73 - Y - 1 **SUBSTANCES:** Mn^{54}, Co^{60}, Zn^{65}

Reference: Young, D. R. & T. R. Folsom. 1973. Mussels and barnacles as indicators of the variation of ^{54}Mn, ^{60}Co and ^{65}Zn in the marine environment. In Radioactive Contamination of the Marine Environment, proc. symp. Seattle, 1972, p. 633-650. IAEA, Vienna.

Organisms: Mytilus californianus

Date of Sample Collection: 1963-64

Location: Pacific coast, U. S.

Analytical Technique: Gamma spectrum analysis

Analytical Data:

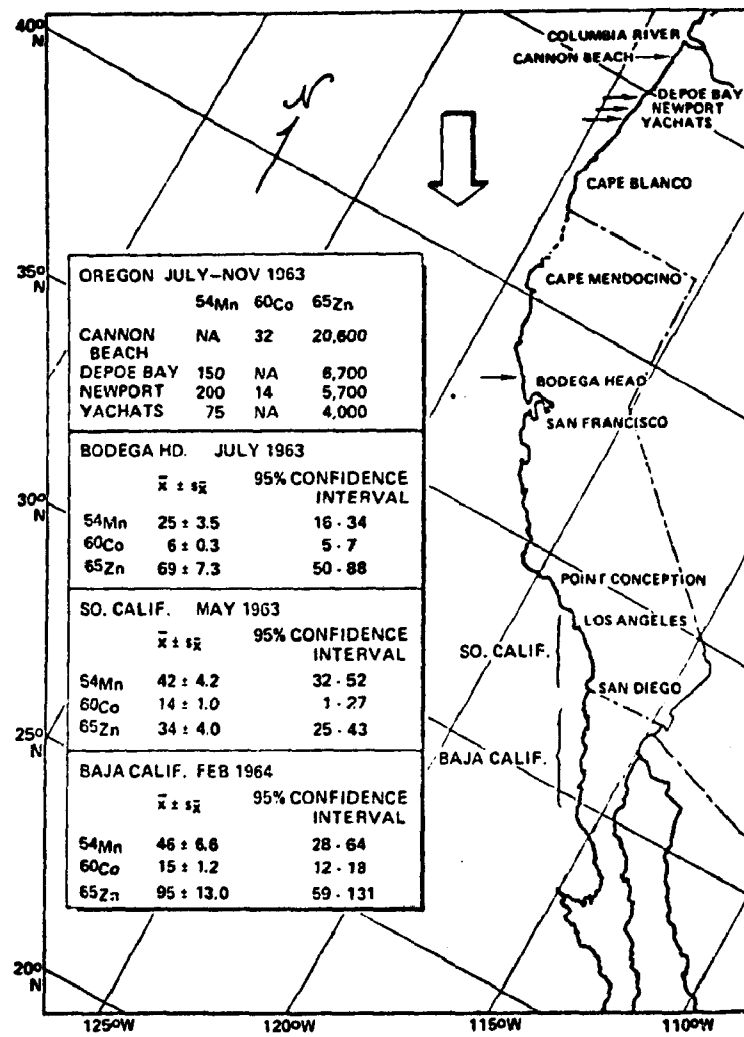


FIG. 2. Four regions studied, and representative values (pCi/wet kg soft tissue) of manganese-54, cobalt-60 and zinc-65 in Mytilus californianus from each region. The data for each station in the Oregon region are given so that possible coastal gradients can be examined.

Young, D. R. & T. R. Folsom. 1973.

TABLE I. UPPER LIMITS (WITH 95% CONFIDENCE) OF 1971 CONCENTRATIONS OF MANGANESE-54, COBALT-60, AND ZINC-65 IN *Mytilus californ.* SOFT TISSUES AND WHOLE *Pollicipes polymerus* FROM INTERTIDAL STATIONS IN CALIFORNIA AND BAJA CALIFORNIA

Collection			Nuclide Concentrations (pCi/wet kg)					
			^{54}Mn		^{60}Co		^{65}Zn	
Station	Lat. (°N)	Date	M. c.	P. p.	M. c.	P. p.	M. c.	P. p.
Bodega Hd.	38°15'	24 Jul	3.7	4.6	3.5	4.1	9.7	12.9
Pt. Sal	34°45'	23 Oct	-	7.7	-	8.3	-	17.3
San Miguel I.	34°00'	23 Jun	3.9	-	3.5	-	10.5	-
Anacapa I.	34°00'	21 Jun	4.3	4.4	3.5	3.5	11.1	11.0
Santa Monica	34°00'	10 Sep	3.1	3.8	3.0	3.7	6.1	9.7
Pt. Vincente	33°45'	6 Sep	3.1	-	3.0	-	6.1	-
Seal Bch.	33°45'	8 Sep	3.1	-	3.0	-	6.1	-
Newport Bch.	33°40'	25 Jun	-	7.2	-	6.4	-	19.3
Santa Barbara I.	33°30'	21 Jun	-	6.0	-	5.1	-	16.2
San Clem. Bch.[a]	33°30'	13 Jun	7.1	5.2	3.5	5.7	9.9	12.0
San Nicholas I.	33°15'	29 Jun	3.8	4.7	3.5	4.2	10.1	12.1
Oceanside	33°15'	22 Oct	-	5.1	-	5.7	-	12.1
San Clemente I.	33°00'	16 Jun	-	7.4	-	5.5	-	21.2
Punta Banda	32°00'	13 Nov	3.1	3.1	3.3	3.3	6.9	6.9
		Average	3.9	5.4	3.3	5.0	8.5	13.6

[a] San Clemente Beach *P. polymerus* collected 26 Oct 71.

PETROLEUM HYDROCARBONS

REF. NO.: 75 - A - 3

SUBSTANCES: petroleum hydrocarbons

Reference: Anderson, R. D. 1975. Petroleum hydrocarbons and oyster resources of Galveston Bay, Texas. Proc. 1975 Conference on Prevention and Control of Oil Pollution, March 25-27, 1975, San Francisco, Ca., p. 541-548.

Organisms: *Crassostrea virginica*

Date of Sample Collection: 1971

Location: Galveston Bay, Texas

Analytical Technique: Ultraviolet spectrophotometry and Gas chromatography

Analytical Data: greater than 160 ppm (wet wt.) total hydrocarbons in oyster tissues

REF. NO.: 70 - B - 1 **SUBSTANCES:** hydrocarbons

Reference: Blumer, M., G. Souza & J. Sass. 1970. Hydrocarbon pollution of edible shellfish by an oil spill. Mar. Biol. 5:195-202.

Organisms: Aequipecten irradians
Crassostrea virginica

Date of Sample Collection: 1969

Location: Buzzard's Bay, Massachusetts

Analytical Technique: Gas chromatography

Analytical Data:

Table 1. *Hydrocarbon content of scallops Aequipecten irradians and oysters Crassostrea virginica*

Number of sample and species	Location	Number of individuals	Wet weight (g)	Hydrocarbon content (mg/100 g wet weight)	Aliquot used for chromatograms 4B–4D (g)
1 scallop	West Falmouth Harbor	10	37	not determined	
2 scallop	West Falmouth Harbor	11	39	1.4	0.31
3 scallop	West Falmouth Harbor	10	60	1.1	
4 scallop	West Falmouth Harbor	10	60	0.74	
5 scallop	Waquoit Bay	11	91	0.55	5.2
6 scallop	Waquoit Bay	12	36	0.23	
7 oyster	Wild Harbor River	7	110	6.9	0.07

REF. NO.: 65 - B - 2

SUBSTANCES: petroleum hydrocarbons

Reference: Bourcart, J. & L. Mallet. 1965. Pollution marine des rives de la région centrale de la mer Tyrrhénienne (baie de Naples) par les hydrocarbures polybenzéniques du type benzo-3.4 pyrène. C. R. Acad. Sci. Paris 260:3729-3734.

Organisms: mussels (unspecified)

Date of Sample Collection: 1964

Location: Bay of Naples, Italy

Analytical Technique:

Analytical Data:

Récapitulation des dosages de benzo-3.4 pyrène effectués sur des échantillons provenant de la baie de Naples.

Pozzuoli	–	Coquilles de moules broyées	13-2-64	1,08	–
»	–	Corps de moules broyées	»	12,8	–
»	–	Coquilles de moules broyées	»	1,12	–
»	–	Corps de moules broyées	»	54,3	–

REF. NO.: 76 - B - 2

SUBSTANCES: petroleum hydrocarbons

Reference: Burns, K. A., J. Smith, A. Murrell & C. Haworth. 1976. Hydrocarbons in Westernport Bay. Interim Report to Environmental Studies Section, Ministry for Conservation, Victoria, Australia (Pub. no. 164), Section 10: 21p.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1974-76

Location: Westernport, Australia

Analytical Technique: Gas chromatography

Analytical Data:

Burns, K. A. et al. 1976.

TABLE 1: MUSSELS

Petroleum hydrocarbons in mussels, *Mytilus edulis*, collected from stations in Westernport Bay. (% unsaturated calculated as weight of column fractions (B/A+B)x100). Results were calculated from gas chromatograms of hydrocarbons in the C14 to C34 boiling range and expressed in amounts of hydrocarbons per gram tissue on both a dry and lipid weight basis. (UCM is unresolved complex mixture.)

STATION	DATE SAMPLED	PETROLEUM HYDROCARBONS µg/g dry	PETROLEUM HYDROCARBONS mg/g lipid	UCM C17/C28	QUALITATIVE DESCRIPTION BASED ON G.C. & FLUORESCENCE PATTERNS
Clean sites:					
14	15.10.75	0	0.0	1.0	Biogenic hydrocarbons mostly plant waxes and algal components. No fluorescence. UCM 3% to 5%. Unsaturates 26% to 41%.
	15.10.75	13	0.1	1.0	
	8. 6.76	23	0.2	1.0	
1	30. 6.75	0	0.0	1.0	
	31. 1.75	0	0.0	1.0	
13	1. 7.75	0	0.0	0.3	
	27.11.75	16	0.1	0.4	
Refinery and industrial outfall influenced sites:					
4	4. 7.75	735	4.4	8.0	High Chronic levels of light crude sometimes mixed with a heavier crude type oil. Some paraffins useful as markers. Biogenics usually not visible. UCM 50% to 90% of g.c. Unsaturates 30% to 40%.
	12.12.75	689	4.5	5.3	
	12. 2.76	570	3.8	3.3	
	28. 4.76	685	3.5	3.4	
	28. 4.76	1186	6.4	2.9	
5	4. 7.75	447	3.5	6.0	
	12.12.75	123	1.0	1.0	
	12. 2.76	133	1.1	1.5	
8	3. 7.75	342	2.0	4.8	
	28.11.75	370	3.4	1.8	
	10. 2.76	659	4.7	3.1	
6	15.10.75	472	3.8	3.4	
	3. 2.76	228	1.7	1.8	
9	16.10.75	468	4.6	0.6	
Boating sites:					
12	21. 7.74	160	1.1	0.8	Biogenics visible over degraded diesel and outboard fuel residues. UCM 20% to 80% of g.c. Fluorescence shows varying amounts of diesel contamination. Unsaturates @ 30%.
	30. 1.75	100	0.7	1.3	
	1. 7.75	162	0.9	1.1	
	27.11.75	126	1.1	0.5	
15	30. 6.75	98	0.6	2.7	
	25.11.75	119	0.8	1.2	
16	24. 7.74	75	0.9	5.3	
	31. 1.75	130	1.0	2.5	
	30. 6.75	630	3.3	6.7	
	25.11.75	283	2.4	1.2	
	9. 2.76	156	1.1	1.7	
18	25. 2.76	454	3.3	2.5	
11	17. 4.75	20	0.1	2.0	
	1. 7.75	12	0.1	1.0	
	27.11.75	21	0.2	0.6	
17	15.10.75	62	0.6	2.0	
	3. 2.76	60	0.3	0.6	
Mixed influence sites:					
2	15.10.75	72	0.6	1.8	
	3. 2.76	110	0.7	1.7	
3	3. 7.74	190	1.6	5.0	Degraded diesel oil.
	29. 1.74	215	1.1	2.9	Diesel/crude residues
	4. 7.75	843	9.7	3.4	Crude residue
	15.10.75	204	1.9	3.0	Degraded fuel oil
	28.11.75	113	1.1	2.0	Crude residue
	12. 2.76	3220	29.4	7.5	Fresh fuel oil
7	15.10.75	55	0.7	1.1	Crude under biogenics
	3. 2.76	49	0.4	0.6	
10	15.10.75	27	0.2	1.0	Crude under biogenics
	12. 6.75	0	0.0	0.5	
	5. 2.76	0	0.0	0.4	

REF. NO.: 57 - C - 1 **SUBSTANCES:** hydrocarbons

Reference: Cahnmann, H. J. & M. Kuratsune. 1957. Determination of polycyclic aromatic hydrocarbons in oysters collected in polluted water. Anal. Chem. 29:1312-1317.

Organisms: Crassostrea virginica

Date of Sample Collection: 1957?

Location: Norfolk, Virginia

Analytical Technique: ultraviolet spectrophotometry

Analytical Data: (wet wt)

Table II. Approximate Amounts of Polycyclic Aromatic Hydrocarbons in Extract from 5 Kg. of Shucked Oysters

Compound	Approximate Amount, γ
Benzo[*ghi*]perylene	5-25
Benzo[*a*]pyrene	10-30
Benz[*a*]anthracene	<50
Benz[*k*]fluoranthene	40-60
Benzo[*e*]pyrene	<100
Chrysene	100-200
Pyrene	500-800
Fluoranthene	3000-5000

REF. NO.: 73 - D - 1

SUBSTANCES: petroleum hydrocarbons

Reference: DiSalvo, L. H., H. E. Guard, L. Hunter & A. B. Cobet. 1973. Hydrocarbons of suspected pollutant origin in aquatic organisms of San Francisco Bay: methods and preliminary results. In The Microbial Degradation of Oil Pollutants, D. G. Ahearn & S. P. Meyers, eds, p. 205-220. Center for Wetland Resources, Louisiana State Univ., Baton Rouge, La., Pub. No. LSU-SG-73-01.

Organisms: Mytilus edulis
Mytilus californianus

Date of Sample Collection: 1973?

Location: San Francisco Bay

Analytical Technique: Gas chromatography; thin-layer chromatography

Analytical Data:

TABLE 2

Preliminary Densitometric Results from Thin Layer Chromatographic Determinations of Hydrocarbon Residues in Selected Marine Organisms

Sample No.	Species	Tissue Sampled	Tissue wet Weight g	Extract Weight g	Hydrocarbons % of Total Extract: Paraffinics	Hydrocarbons % of Total Extract: Aromatics[b]	Approx. total Hydrocarbons in Wet tissue sample ppm
Sponges							
26	*Ophlatispongia* sp	entire	75.9	0.610	0.704	1.310	158
39	*Tethya aurantia*	entire	95.0	1.526	<0.004	<0.004	<1
Mussels							
33	*Mytilus edulis*	(5) entire	46.4	1.375	1.545	1.183	850
32	*Mytilus californianus*	(3) entire	136.1	1.336	0.385	<0.02	<38
Crabs							
41	*Cancer antennarius*	(6) gonadal and digestive gland	45	3.505	1.332	0.351	106

[a]See Table 1. [b]Calculated as anthracene (see Fig. 2B).

REF. NO.: 75 - D - 2

SUBSTANCES: hydrocarbons

Reference: DiSalvo, L. H., H. E. Guard & L. Hunter. 1975. Tissue hydrocarbon burden of mussels as potential monitor of environmental insult. Envir. Sci Tech. 9:247-251.

Organisms: *Mytilus edulis*
Mytilus californianus

Date of Sample Collection: 1972-73

Location: San Francisco Bay, Drake's Bay

Analytical Technique: thin-layer chromatography

Analytical Data:

DiSalvo, L. H. et al. 1975.

Table III. Differential Hydrocarbon Content of Somatic (s) and Gonadal (g) Tissues of *Mytilus edulis* (ME) and *Mytilus californianus* (MC)

Expt.	Species	Condition	Station[a]	Date 1973	Tissue	Alkane	Aromatic	Total	Alk are
I	ME	P	NSC	6/24	g	57.5	81	138.5	0.7
	ME	P	NSC	6/24	s	125	90	220	1.4
					g/s	0.5	0.9	0.6	
II	ME	P,U_1	DE	9/4	g	65	35	100	1.9
	ME	P,U_1	DE	9/4	s	150	115	265	1.3
					g/s	0.4	0.3	0.4	
III	MC	P_2	NSC	6/24	g	53	83.5	136.5	0.6
	MC	P_2	NSC	6/24	s	183	72.5	255.5	2.5
					g/s	0.3	1.2	0.5	
IV	MC	P,U_3	DE	8/24	g	18.5	nd	18.5	...
	MC	P,U_3	DE	8/24	s	10	22.5	32.5	0.4
					g/s	1.9	...	0.6	0.4

[a] See Figure 2. P, polluted (presumptive); U, unpolluted (presumptive); 1, transferred from NSC to DE for 6 weeks, 2, held in NSC waters weeks; 3, transferred to DE waters for 6 weeks after 12 weeks in NSC water.

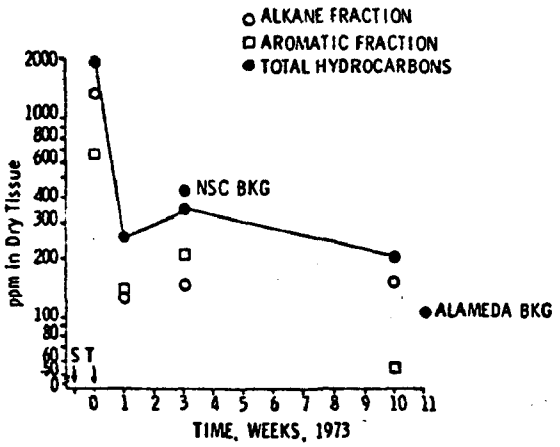


Figure 4. Hydrocarbon content of *Mytilus edulis* collected 5 days after an oil spill in the Oakland-Alameda Estuary on 19 Jan. 1973, and transferred to the Naval Supply Center station (NSC) S, date of spill occurrence; T, date of transfer. Background values (BKG) for mussels collected at the NSC and ALA stations from Table I are entered for reference

Table I. Hydrocarbon Content of *Mytilus edulis* from Several Stations in San Francisco Bay and Clean Water Coastal Inlets

Station[a]	Date, 1973	Hydrocarbons, ppm dry wt. Alkane	Aromatic	Total	Alkane aromatic
DE	3/18	7.5	nd[b]	7.5	...
BOL	3/18	13.5	nd	13.5	...
MEN[c]	4/22	6.0	nd	6.0	...
NSC	2/15	130	285	415	0.5
NSC	6/24	182.5	171	358.5	1.1
NSC	9/14	107.5	75	183	1.4
NSC	11/1	85	255	340	0.3
NSC	1/30/74	326.0	130.5	456.5	...
ALA	4/19	70	35	105	2.0
ALA	10/31	160	375	530	0.4
RAD	9/26	74.5	31.5	106	2.4
LSP	9/26	34	29	63	1.2

[a] Identified in Figure 2. [b] nd, not detected. [c] *Mytilus californianus*, Cape Mendocino.

Table II. Hydrocarbon Content of *Mytilus edulis* Transferred: (I) from San Francisco Bay (NSC) to Drakes Estero (DE) for 10 Weeks, Then Returned to NSC for 4 Weeks; (II) from NSC to DE for 10 Weeks; and (III) from Tomales Bay (TB) to NSC for 9 Weeks

Station	Date, 1973	Weeks post-transfer	Hydrocarbon content, ppm/g dry wt. Alkane	Aromatic	Total	Alk aro
		Trial I (P-U-P)				
NSC[b]	6/24	...	183	171	354	1.1
NSC[b]	7/27T	...	79	207	286	1.4
DE	9/4	6	108	75	183	1.4
DE	11/19T	10	234	61	295	3.9
NSC	12/16	4	169	248	417	0.7
NSC[b]	11/1	...	85	255	340	0.3
		Trial II (P-U)				
NSC[b]	11/19	...	234	61	295	3.9
DE	2/1/74	10	211	54	265	3.9
NSC[b]	1/25/74	...	326	131	457	2.5
		Trial III (U-P)				
TB	11/19T	...	51	27	78	1.9
NSC	12/16	4	119	290	409	0.4
NSC	1/23/74	9	250	275	525	0.9
NSC[b]	1/25/74	...	325	131	456	2.5

P, polluted water conditions; U, presumed clean water conditions; T, date of transfer; b, background value (Table I).

REF. NO.: 76 - D - 2

SUBSTANCES: benzo(a)pyrene

Reference: Dunn, B. P. & D. R. Young. 1976. Baseline levels of benzo(a)pyrene in Southern California mussels. Mar. Pollut. Bull. 7:231-234.

Organisms: *Mytilus californianus*
Mytilus edulis

Date of Sample Collection: 1974

Location: Southern California coast

Analytical Technique: Isotope dilution

Analytical Data:

TABLE 1
Levels of benzo(a)pyrene in mussels.

Map	Location	Date	Species*	B(a)P, µg/kg wet wt	Substrate
1	Bodega Head	Nov. 74	C	0.2	rocks
2	Gaviota State Beach	Oct. 74	C	0.1	rocks
3	Goleta	Oct. 74	C	0.2	rocks
4	Santa Barbara Harbour	Oct. 74	C	0.3	pilings
5	Emma Woods State Beach	Oct. 74	C	0.2	rocks
6	Point Hueneme Pier	Oct. 74	C	0.4	pilings
7	Point Dume	Nov. 74	C	<0.1	rocks
8	Redondo Beach	May 75	C	0.6	rocks
9	Point Vicente	Nov. 74	C	<0.1	rocks
10	Royal Palms	Nov. 74	C	0.5	rocks
11	W. Long Beach Breakwater	Nov. 74	C	1.4	rocks
12	E. Long Beach Breakwater	Nov. 74	C	0.6	rocks
13a	Seal Beach (pilings)	Dec. 74	E	8.2	pilings
13b	Seal Beach (rocks)	May 75	C	2.3	rocks
14	Newport Pier	Dec. 74	E	0.4	pilings
15	San Clemente Pier	Oct. 74	E	0.8	pilings
16	Oceanside	Dec. 74	E	2.3	pilings
17	Encinitas	Dec. 74	C	0.1	rocks
18	La Jolla	Nov. 74	C	< 0.1	rocks
19	Sunset Cliffs	Oct. 74	C	< 0.1	rocks
20	Santa Cruz Is.	Oct. 74	C	0.1	rocks
21	Anacapa Is.	Oct. 74	C	< 0.1	rocks
22	Santa Barbara Is.	Oct. 74	C	< 0.1	rocks
23	Santa Catalina Is.	Oct. 74	C	< 0.1	rocks
24	San Nicolas Is.	Oct. 74	C	< 0.1	rocks
25	San Clemente Is.	Jan. 75	C	0.2	rocks

*Species: C = *Mytilus californianus*, E = *Mytilus edulis*.

TABLE 2
Levels of benzo(a)pyrene in *Mytilus edulis* and *Mytilus californianus* from the same location.

Map	Location	B(a)P, µg/kg wet wt *M. calif.*	*M. edulis*
8	Redondo Beach	0.6	0.8
10	Royal Palms	0.5, 0.5	1.1, 1.0
13b	Seal Beach	2.3	3.0, 1.9

REF. NO.: 74 - E - 3

SUBSTANCES: petroleum hydrocarbons

Reference: Ehrhardt, M. & J. Heinemann. 1974. Hydrocarbons in blue mussels from the Kiel Bight. In Marine Pollution Monitoring (Petroleum), Proc. Symp. and Workshop held at NBS, Gaithersburg, Md., May, 1974, p. 221-225. (NBS Spec. Publ. 409)

Organisms: Mytilus edulis

Date of Sample Collection: 1973-74

Location: Kiel Bight

Analytical Technique: Column chromatography; thin layer chromatography; gas chromatography; mass spectrometry

Analytical Data: (freeze-dried)

Column chromatographic fractions No. 1 - 7

No.		mg/kg of wet tissue	mg/kg of dry tissue
1	6.16 mg	13.8	170
2	4.16 mg		
3	0.66 mg	10.8 (No. 2+3)	133(No.2+3)
4	29.06 mg	65.2	803
5	1397.0 mg	3135	38591
6	693.8 mg	1557	19166
7	49.9 mg	112	1278

total 2180.74 mg

recovery: 83.2 percent

TLC-fractions No. 2.1 - 2.4

No.		mg/kg of wet tissue		mg/kg of dry tissue	
2.1	1.662 mg	3.7	5.6	45.9	68.9
2.2	0.845 mg	1.8	2.8	23.3	35.1
2.3	0.297 mg	0.7	1.0	8.2	12.3
2.4	0.086 mg	0.3		3.6	

REF. NO.: 75 - E - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Ehrhardt, M. & J. Heinemann. 1975. Hydrocarbons in blue mussels from the Kiel Bight. Environ. Pollut. 9:263-282.

Organisms: Mytilus edulis

Date of Sample Collection: 1973-74

Location: Kiel Bight

Analytical Technique: Column chromatography; thin layer chromatography; gas chromatography; mass spectrometry

Analytical Data:

TABLE 1
Mytilus edulis

Date of collection: 6 April, 1973				25 January, 1974		
Freeze-drying and extraction						
Amount freeze-dried:		1410 g		445-6 g (22 animals)		
Water loss:		1227 g		409·4 g		
% loss:		87·02		91·8		
Amount extracted:		183·0 g		36·2 g		
extract produced:		9·52 g		2·62 g		
% extract relative to dry tissue:		5·2		7·2		
Column chromatography of aliquots of the extracts						
	Total (mg)	*µg/g of wet tissue*	*µg/g of dry tissue*	*Total (mg)*	*µg/g of wet tissue*	*µg/g of dry tissue*
Fraction No. 1:	4·2	3	23	6·16	13·8	170
Fraction No. 2:	11·2	7·9	60·9	4·16	9·3	114
Fraction No. 3:	5·2	3·8	29·3	0·66	1·5	19
Fraction No. 4:				29·06	65·2	803
Fraction No. 5:				1397·0	3135	38591
Fraction No. 7:				693·8	1557	19166
				49·9	112	1278
Total:	20·6					
recovery:				2180·7 83·2%		

Ehrhardt, M. & J. Heinemann. 1975.

TABLE 2
TLC-FRACTIONS NOS. 2·1–2·4

		µg/g wet tissue	µg/g dry tissue
No. 2.1	1·662 mg	5·6	68·9
No. 2.2	0·845 mg	2·8	35·1
No. 2.3	0·297 mg	1·0	12·3
No. 2.4	0·086 mg		

TABLE 3

	λ max	log ε		λ max	log ε
Acenaphthene MW: 154·21	227·5	4·86	Fluoranthene MW: 202·26	237	4·75
	289	3·80		254	4·22
	300	3·6		263	4·18
	321	3·19		277	4·41
Acenaphthylene MW: 152·21	276	3·48		288	4·73
	311	3·88	Fluorene MW: 166·23		
	323	3·98		266	4·3
	335	3·66		290	3·8
	340	3·67		301	4·0
Cholanthrene MW: 254·34	261·5	4·60	Phenanthrene MW: 178·24	187·5	4·48
	274	4·60		211·5	4·57
	284·5	4·80			
	295	4·90	Pyrene MW: 202·26	273	4·77
Chrysene MW: 228·30	222	4·55		306	5·07
	258	4·96		320	4·51
	268	5·20		335	4·78
	295	4·08			
	320	4·12			
	344	2·81			
	353	2·57			
	361	2·80			

TABLE 4
QUALITATIVE ANALYSES OF *Mytilus edulis* EXTRACTS

Date of collection: 6 April 1973	
Column chromatographic fractions	
1	normal plus branched aliphatics, olefins, benzene derivatives
2 and 3	olefins, alkylated benzenes, tetralins, naphthalene
Date of collection: 25 January 1974	
Column chromatographic fractions	
1	normal plus branched aliphatics, olefins, benzene derivatives
2 and 3	alkylated benzenes, naphthalenes, tetralins, biphenyls, fluorenes, phenanthrenes, dihydrophenanthrenes; possibly aromatic hydrocarbons with 4 condensed rings

REF. NO.: 73 - F - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Farrington, J. W. & J. G. Quinn. 1973. Petroleum hydrocarbons in Narragansett Bay. I. Survey of hydrocarbons in sediments and clams (Mercenaria mercenaria). Est. Coastal Mar. Sci. 1:71-79.

Organisms: Mercenaria mercenaria

Date of Sample Collection: 1969-70

Location: Narragansett Bay

Analytical Technique: Gas chromatography

Analytical Data:

TABLE 1. Hydrocarbon and organic carbon concentrations in sediments and hydrocarbon concentrations in *M. mercenaria* (clams)

(a) Sediments

Station	Average	I Hydrocarbon concn (mg/g dry wt) Range[a]	II Organic carbon concn[b] (mg/g dry wt)	I/II ($\times 10^5$)
F.P. (1)[c]	2·11	0·82–3·56	38·07	5·54
E_1 (3)	2·04	0·50–5·70	36·68	5·56
E_2 (2)	0·71	0·46–1·07	9·84	7·24
D (1)	0·40	0·35–0·44	12·62	3·13
C (2)	0·15	0·13–0·16	6·48	2·28
B (1)	0·15	—	7·41	1·90
A (1)	0·11	0·10–0·12	6·25	1·81
W.R. (1)	0·06	0·05–0·06	5·63	1·10

(b) *M. mercenaria* (clams)

Station	Concentration of hydrocarbons (µg/g dry wt)	(mg/100 g wet wt)
E_1 12/23/70 (4)[d]	160	1·60
5/12/71 (7)	163 (94·0)[e]	1·43 (0·82)[e]
C 12/23/70 (2)	74	1·01
5/12/71 (2)	35 (25·5)	0·41 (0·30)
A 5/12/71 (5)	26 (10·5)	0·29 (0·12)
Charlestown Pond 4/71 (4)	None detectable by our method	

[a] Range of analyses for the station. Duplicate or triplicate analyses for each date.
[b] Average of duplicate analyses which agreed within 10%.
[c] Number of sampling dates.
[d] Number of individuals per sample.
[e] Values in parenthesis based upon weighing hydrocarbons, all others by internal standard method (see text).

REF. NO.: 75 - F - 1

SUBSTANCES: hydrocarbons

Reference: Fossato, V. U. 1975. Elimination of hydrocarbons by mussels. Mar. Pollut. Bull. 6:7-10.

Organisms: *Mytilus galloprovincialis*

Date of Sample Collection: 1973-74

Location: Lagoon of Venice

Analytical Technique: Gas chromatography

Analytical Data:

"Mean hydrocarbon level in mussels native to the depuration zone [Lagoon of Venice] is equivalent to 0.8 $\pm$ 0.2 mg 100 g^{-1} [ww] (95% confidence interval), based on ten samples collected during the experimental period."

REF. NO.: 74 - F - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Fossato, V. U. & E. Siviero. 1974. Oil pollution monitoring in the Lagoon of Venice using the mussel Mytilus galloprovincialis. Mar. Biol. 25:1-6.

Organisms: Mytilus galloprovincialis

Date of Sample Collection: 1974

Location: Lagoon of Venice

Analytical Technique: Gas chromatography

Analytical Data:

Table 1. *Mytilus galloprovincialis. Aliphatic hydrocarbon content (mg/100 g wet weight) of mussels in the Lagoon of Venice*

Date (1973)	Stations A	B	C	D	E	F	G	H	I	L
19 Jan.	—	—	—	—	—	22.0	—	0.9	2.2	—
6 Feb.	—	—	—	—	—	—	7.2	—	—	1.0
22 Feb.	2.3	—	8.7	3.0	—	—	—	—	—	—
2 March	—	—	—	—	—	—	—	—	—	1.0
21 March	—	—	4.6	—	—	—	—	1.0	—	—
5 April	—	—	—	—	—	—	—	—	—	0.9
4 May	—	—	—	—	—	—	—	—	—	0.9
7 May	1.6	1.1	—	—	1.2	9.0	4.4	—	—	—
1 June	—	—	3.6	—	—	—	—	0.8	—	—
11 June	—	—	—	2.3	—	—	—	—	2.2	0.8
19 June	—	—	2.9	2.0	—	16.6	—	—	—	—

—: not determined.

REF. NO.: 76 - G - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Gilfallan, E. S., D. Mayo, S. Hanson, D. Donovan & L. C. Jiang. 1976. Reduction in carbon flux in *Mya arenaria* caused by a spill of No. 6 fuel oil. Mar. Biol. 37:115-123.

Organisms: *Mya arenaria*

Date of Sample Collection: 1972-73

Location: Casco Bay, Maine

Analytical Technique: Gas chromatography

Analytical Data: (dry wt, freeze-dried?)

Table 3. Concentration (in ppm) of petroleum in *Mya arenaria* and sediment samples. nd: No data

Date	Cow Island		Cousins Island	
	Sediment	Clam	Sediment	Clam
1972				
16 Nov.	39433	98	nd	73
15 Dec.	918	122	1	2
1973				
25 Jan.	1417	230	0	83
27 Feb.	24343	37	14	3
28 Mar.	9165	119	7	nd
1 May	1514	12	24	24
11 May	30023	9	nd	13
30 May	785	38	47	0
26 Jun.	845	33	14	6
24 Jul.	74	95	3	7
24 Aug.	53122	23	7	6
21 Sept.	484	47	3	5
23 Oct.	1598	29	42	7
19 Nov.	925	33	128	20
Mean	11760	66.1	24.17	19.15

REF. NO.: 67 - G - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Greffard, J. & J. Meury. 1967. Note sur la pollution en rade de Toulon par les hydrocarbures cancerigenes. Cah. Oceanogr., Bull. Inform. 19: 457-468.

Organisms: *Mytilus edulis*

Date of Sample Collection: 1967?

Location: Toulon, France

Analytical Technique: Gas chromatography

Analytical Data: (dry wt, dried at 80°C)

Greffard, J. & J. Meury. 1967.

2) Dans les tissus des Mytilus edulis

Nous avons fait des prélèvements d'environ un kilogramme de moules fraîches (avec coquilles) soit en moyenne 40 grammes de matière sèche.

a) Situation géographique des prélèvements

Echantillon	Provenance
1	Quai Noël
2	Eguillette
3	Brégaillon
4	Lazaret

b) Résultats

Evaluation de l'extrait sec, exprimé en grammes pour 100 grammes de poids sec

Echantillon	1	2	3	4
Poids en g %	0,338	0,108	0,300	0,300

Teneur en hydrocarbures cancérigènes, exprimée en µg pour 100 grammes de poids sec

Echantillon	1	2	3	4
Teneur en benzo 3-4 pyrène	2	2,2	1,6	2,1
benzo 8-9 fluoranthène	0,270	0,250	0,200	0,250
pérylène	0,270	0,200	0,150	0,200

REF. NO.: 74 - H - 3

SUBSTANCES: petroleum hydrocarbons

Reference: Hunter, L., H. E. Guard & L. H. DiSalvo. 1974. Determination of hydrocarbons in marine organisms and sediments by thin layer chromatography. In Marine Pollution Monitoring (Petroleum), Proc. Symp. Workshop, NBS, Gaithersburg, Md., May, 1974, p. 213-216.

Organisms: Mercenaria mercenaria
Aequipecten irradians
Mytilus edulis

Date of Sample Collection: 1974?

Location: San Francisco Bay and Northern California coast

Analytical Technique: Thin-layer gas chromatography

Analytical Data:

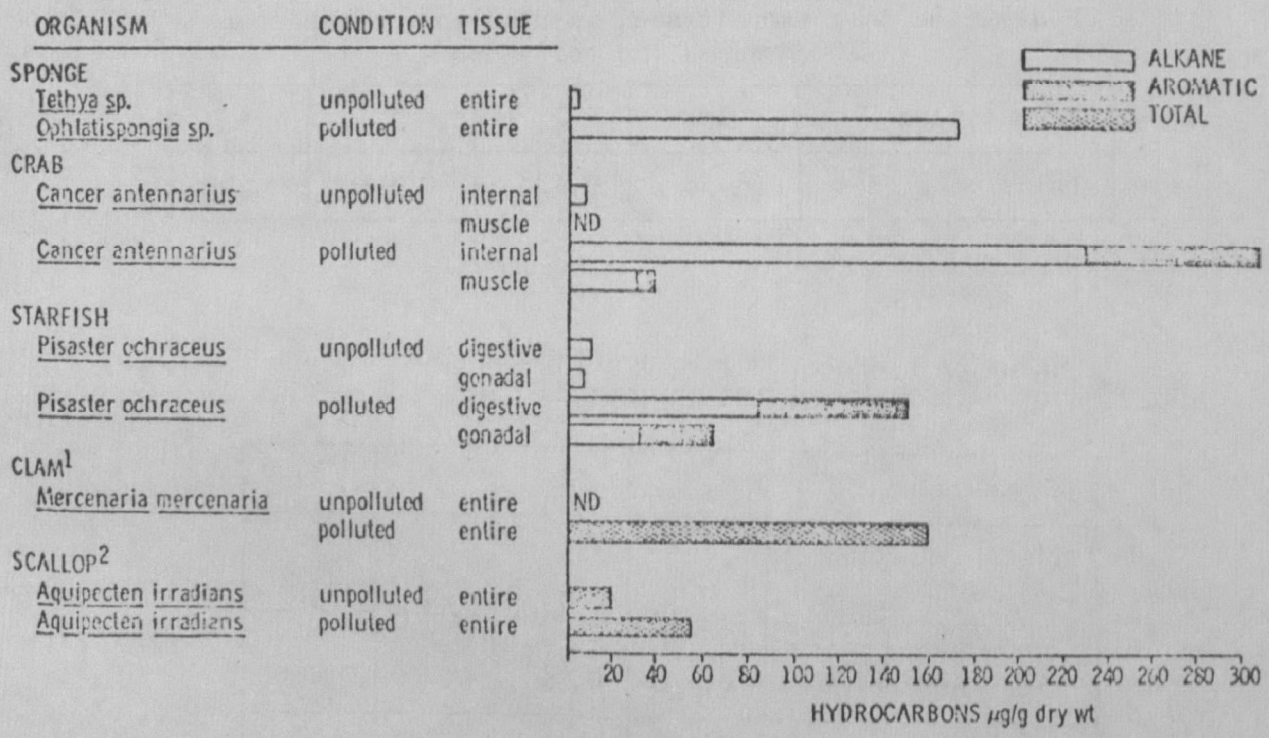


Figure 3. Comparative hydrocarbon burdens of selected organisms as determined by the TLC method. ND = not detected.

Hunter, L. et al. 1974.

Table I. Summarized results of hydrocarbon analyses of mussels using the TLC method and transferral of organisms.

Sample	Weeks Post-transfer	Alkane	Aromatic	FPNA
		μg/g dry wt		
bkg,u	-	9 (3)	nd	–
bkg,p	-	130 (9)	154 (9)	+
u→ p	11	230	40	+
p→ u	6	25	10	±
u→ p	9	250	275	+
p→ u	6	108	75	+
u→ p	4	169	248	+

( ) = no. of samples
FPNA = fluorescent polynuclear aromatic compounds
bkg = background
p = polluted water, SFO Bay
u = unpolluted water, Calif. coast
nd = not detectable

REF. NO.: 61 - M - 2

SUBSTANCES: petroleum hydrocarbons

Reference: Mallet, L. 1961. Recherche des hydrocarbures polybenzéniques du type benzo-3.4 pyrène dans la faune des milieux marins (Manche, Atlantique et Méditerranée. C. R. Acad. Sci. Paris 253:168-170.

Organisms:

Solen marginatus	Tapes decussatus
Ostrea edulis	?Chlamys sp.
Cardium edulis	Gryphoea angulata
Mytilus edulis	

Date of Sample Collection: 1961?

Location: Atlantic and Mediterranean, Europe

Analytical Technique: Gas chromatography

Analytical Data:

Référence des échantillons.	Recherche et teneur approximatives en benzo-3.4 pyrène (µg pour 100 g de matière sèche).	Autres hydrocarbures décelés.
Région de Roscoff et Finistère.		
Équilles ou Lançons (devant Roscoff).	0,15	Idem
Couteaux (*Solen marginatus*) (coquilles) (estuaire gauche de la Penzé).....	1,25	Bandes à 3 850 Å attribuable *au chrysène*. Courbe en cloche attribuable aux hydrocarbures contenus dans les goudrons obtenus à basse température comme ceux du pétrole
Couteaux (*Solen marginatus*) (corps).	Traces indosables	Néant
Huîtres (*Ostrea edulis*) (corps) (estuaire gauche de la Penzé).....	1,5	Néant
Coques (*Cardium edulis*) (coquilles) (Saint-Efflam).....	2,5	Courbe en cloche attribuable aux hydrocarbures contenus dans les goudrons obtenus à basse température comme ceux du pétrole

Mallet, L. 1961.

Référence des échantillons.	Recherche et teneur approximatives en benzo-3.4 pyrène (µg pour 100 g de matière sèche).	Autres hydrocarbures décelés.
Coques (*Cordium edulis*) (corps) (Saint-Efflam)	Non décelé après hydrolyse	Néant
Moules (*Mytilus edulis*) (corps) Saint-Efflam	Non décelé après hydrolyse	Courbe en cloche pouvant être attribuée à la présence d'hydrocarbures contenus dans les pétroles
Moules (*Mytilus edulis*) (coquilles) (Saint-Efflam)	0,3	Néant
Oursins (coquilles et corps) (Saint-Efflam)	Non décelé	Courbes en cloches interprétables par la présence d'hydrocarbures contenus dans les goudrons obtenus à basse température comme les goudrons de pétrole
Oursins (coquilles) (Morgat)	Traces indosables	Néant
Oursins (organes) (Morgat)	Non décelé après hydrolyse	Bandes assez étroites pouvant être attribuées à la présence d'hydrocarbures polycondensés
Pétoncles (*Clamys*) (organes) (Brest, banc de Saint-Marc)	9	Courbe en cloche pouvant être attribuée à des hydrocarbures contenus dans les pétroles
	Parc de Marennes.	
Huîtres (coquilles)	3,5	Hydrocarbures anthracéniques
Huîtres (corps)	0,4	
	Bassin d'Arcachon.	
Crabes	Non décelé	Courbe en cloche interprétable par la présence d'hydrocarbures contenus dans les goudrons obtenus à basse température comme les goudrons de pétrole
Huîtres plates (*Ostrea edulis*) (corps).	Traces indosables	Présence de goudrons basse et moyenne température
Huîtres portugaises (*Gryphæa angulata*) (corps)	Non décelé avant et après hydrolyse	Courbes interprétables par la présence d'hydrocarbures contenus dans des goudrons obtenus à des températures légèrement supérieures à 400°C
Moules (*Mytilus edulis*) (corps)	0,5	Spectre en forme de cloche interprétable par la présence d'hydrocarbures contenus dans les goudrons de basse température comme ceux du pétrole
Moules (*Mytilus edulis*) (coquilles).	Traces	Idem
Palourdes (*Tapes decussatus*) (corps).	Non décelé	Idem

REF. NO.: 63 - M - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Mallet, L., L. V. Perdriau & J. Perdriau. 1963. Pollution par les hydrocarbures polybenzéniques du type benzo-3.4 pyrène de la région occidentale de l'Océan Glacial Arctique. C. R. Acad. Sci. Paris 256: 3487-3489.

Organisms: mussels (unspecified)

Date of Sample Collection: 1962

Location: Faeringehavn (Arctic Ocean)

Analytical Technique:

Analytical Data:

Relevés des prélèvements.

4.....	Algue	Faeringehavn, 15 sept. 1962, à 18 h T. U., 63°42 N 51°25 W	Basse mer, rivage	+5	+4,5	6
5.....	Moules	»	»	»	»	Coquill. : 1,8 Corps : 5,5

REF. NO.: 76 - M - 2

SUBSTANCES: petroleum hydrocarbons

Reference: Michel, P. 1976. Cinetique d'epuration in-situ de moules contaminees par un gas-oil. Sci. Peche, Bull. Inst. Peches marit., no. 259:11p.

Organisms: mussels (unspecified)

Date of Sample Collection: 1975-76

Location: Baie de Saint Brieuc, Atlantic coast of France

Analytical Technique: Gas chromatography

Analytical Data:

Dates	Lieux de prélèvement					
	1	2	3	4	5	Divers
20.11.1975	505	44	192	31	16	
3.12.1975	312	217	198	165	236	218
18.12.1975	197	133	133	141	184	
5.01.1976	150	125	140	133	170	
19.01.1976	176	197	148	99	92	175, 244 151, 130
4.02.1976	119	98	96	105	102	100, 129, 105 99, 94
16.02.1976	95	73	71	81	75	
18.03.1976	53	36	46	34	43	33, 27

TABL. 1. — *Résultats des analyses exprimés en mg/kg de chair humide.*

REF. NO.: 75 - N - 1

SUBSTANCES: petroleum hydrocarbons

Reference: National Academy of Sciences. 1975. Petroleum in the marine environment. Proc. Wkshp inputs, fates, and effects of petroleum in the marine environment, May 21-25, 1973. Biological: 58-72. NAS, Ocean Affairs Bd., Washington, D.C.

Organisms:

Modiolus sp.
Mytilus sp.
Mya sp.
Pecten sp.
Mercenaria sp.
Crassostrea sp.

Date of Sample Collection: Composite of analyses from various literature sources, varied locales

Location:

Analytical Technique:

Analytical Data:

TABLE 3-6 Petroleum Hydrocarbon Levels in Marine Macroorganisms

Organisms	Area Type[a]	Hydrocarbon Type	Estimated Hydrocarbon Amount (μg/g)	Reference[b]
Molluscs				
Modiolus, mussel	4	No. 2 fuel oil	218 wet	Burns and Teal, 1971
Mytilus, mussel	4	No. 2 fuel oil[c]	36 dry	Clark and Finley, 1973a
Mytilus	4	Bunker C[c]	10 dry	Clark and Finley, 1973a
Mytilus	4	Bunker C, aromatics	74-100 wet	Zitko, 1971
Mytilus	3	n-C_{14}-C_{37}[c]	9 dry	Clark and Finley, 1973a
Mya, clam	4	No. 2 fuel oil	26 wet	Blumer *et al.*, 1970b
Pecten, scallop	4	No. 2 fuel oil	7 wet	Blumer *et al.*, 1970a
Littorina, snail	4	Bunker C, aromatics	46-220 wet	Zitko, 1971
Mercenaria, clam	3	C_{16}-C_{32} range	160 dry	Farrington and Quinn, 1973
Crassostrea, oyster	?	polycyclic aromatics	1 wet	Cahnmann and Kuratsune, 1957

[a] Area types: (1) oceanic; (2) chronic pollution, coastal; (3) chronic pollution, harbor; (4) single spill.
[b] See reference for method of distinguishing petroleum hydrocarbons from native biogenic hydrocarbons and discussions concerning techniqu
[c] n-Alkanes only.

REF. NO.: 64 - P - 2

SUBSTANCES: petroleum hydrocarbons

Reference: Perdriau, J. 1964. Pollution marine par les hydrocarbures cancerigenes - type benzo-3.4 pyrene - incidences biologiques. Cah. Oceanogr. 16:205-229.

Organisms: clams, oysters, mussels, cockles (unspecified)

Date of Sample Collection: 1964?

Location: France, Atlantic and Mediterranean

Analytical Technique:

Analytical Data:

Organisms listed in the following tables are in common names in French. A translation to English common names is given below:

corps - flesh or soft parts
coquilles - shells
huitres - oysters
couteaux - razor clams?
coques - cockles
moules - mussels
palourdes - clams
vigneux - clams?

Perdriau, J. 1964.

1°) Côtes de la Manche

Le Trieux	corps d'huitres coquilles d'huitres	non décelé 1
Baie de la Fresnaye	vase écume coques	0,5 traces traces
Saint Cast	sable - plage sable - 20 cm de profondeur sable - 30 cm de profondeur sable - grande marée sable - vase noire sable - de palourde balanes - rochers-plage algues - rochers moules	1 2 6 4 4 3,5 0,05 non décelé traces
Les Quatre Vaux	sable vaseux - près des supports de parc à moules fragment de bois de parc à moules moules	traces traces 0,1

REFERENCES DES ECHANTILLONS	BENZO-3.4 PYRENE en micro-grammes/100 g	AUTRES HYDROCARBURES DECELE[illegible]
Couteaux (coquilles)-estuaire gauche de la Penzé	1,25	Bande à 3850 Å, attribuable au chrysène. Courbe en cloche attribuable aux hydrocarbures contenus dans les goudrons obtenus à basse température comme les goudrons de pétrole.
Couteaux (corps)	traces indosables	néant
Huitres (corps)-estuaire gauche de la Penzé	1,50	néant
Coques (coquilles)-St-Efflam	2,50	Courbe en cloche attribuable aux hydrocarbures contenus dans les goudrons de pétrole
Coques (corps)	non décelé après hydrolyse	néant
Moules (coquille) - St-Efflam	0,30	néant
Moules -(corps) - St Efflam	non décelé après hydrolyse	Courbe en cloche pouvant être attribuée à la présence d'hydrocarbures contenus dans les pétroles

Perdriau, J. 1964.

(Côtes de la Manche)

B. Echantillons biologiques

Références des Echantillons	Benzo-3.4 Pyrène en micro-grammes/100 g	Autres Hydrocarbures décelés
Morgat Oursins (coquilles) Oursins (organes)	traces indosables non décelé après hydrolyse	néant bandes assez étroites pouvant être attribuées à la présence d'hydrocarbures polycondensés
Parc de Marennes Huitres (coquilles) Huitres (corps)	3,5 0,4	hydrocarbures anthracéniques -
Bassin d'Arcachon		
Crabes	non décelé	courbe en cloche interprétable par la présence d'hydrocarbures contenus dans les goudrons obtenus à basse température comme les goudrons de pétrole
Huitres plates (corps)	traces indosables	présence de goudrons basse et moyenne température
Huitres portugaises (corps)	non décelé après hydrolyse	courbes interprétables par la présence d'hydrocarbures contenus dans les goudrons obtenus à des températures légèrement supérieures à 400°C
Moules (corps)	0,5	spectre en forme de cloche interprétable par la présence d'hydrocarbures contenus dans les goudrons de basse température comme ceux du pétrole
Moules (coquilles)	traces	idem
Palourdes (corps)	non décelé	idem

Perdriau, J. 1964.

Région de Brest

- coquilles St Jacques . . . . . 0,4 micro-gramme
- araignée de mer . . . . . 0,35 micro-gramme
- algues ectocarpes . . . . . non décelé.

Estuaire de la Seine

Références des échantillons - animaux marins -	Benzo-3.4 pyrène en micro-grammes/100 g
N° 4. A quelques distances du précédent plus au large (49°30'40"N - 0°00'35"W)	
- coquilles	traces
N° 5. Extrémité Ouest de la digue du Ratier balise A	
- moules : coquilles	non décelé
corps	38
N° 6. Plage de Deauville	
- coques : coquilles	non décelé
corps	22
- palourdes : coquilles	non décelé
corps	28
N° 7 Villers - Plage	
- moules : coquilles	non décelé
corps	75
- palourdes : coquilles	traces
corps	10
- coques : coquilles	traces
corps	22
- vigneaux : coquilles	traces
corps	1
N° 8. Cabourg - Plage	
- moules : coquilles	non décelé
corps	non décelé
- palourdes: coquilles	non décelé
corps	55
- coques : coquilles	non décelé
corps	78
- vigneaux : coquilles	non décelé
corps	non décelé

../...

Perdriau, J. 1964.

4°) Région de Dunkerque

N° 3. Ecluse Trystram sur les bords à marée basse	
- crabes	1,3
- coquilles de moules	1,15
- corps de moules	3,2
N° 4. Pointe de la digue Est	
Niveau de la mer à marée basse	
- crabes	1,8
- étoiles de mer	12,6
N° 5. Pointe de la digue Est - Profondeur 1 m -	
Niveau de la mer à marée basse	
- moules en buisson	pas de traces
N° 6. Pointe de la digue Ouest - marée basse	
- 7 crabes	1,4
- 2 étoiles de mer	1,25
N° 7. Pointe de la digue Ouest - Marée basse	
- 1 étoile de mer	non décelé
N° 8. (51°04'20"N - 02°20'10"E) - profondeur 15 m	
- corps de moules	non décelé
- coquilles de moules	0,75
N° 9. (51°04'40"N - 02°24'40"E) - profondeur 10 m	
- soles	3,8
- moules	23
- étoile de mer	non décelé
N°10. (51°04'43"N - 02°27'22"E) - profondeur 18 m	
- corps de moules	4,5
- coquilles de moules	0,45
N° 11. (51°04'30"N - 02°28'30"E) - marée basse	
devant le sanatorium de Zuycoote	
- crabes	pas de traces
- crevettes	pas de traces

5°) Côte Ouest du Groenland

Références des échantillons	Benzo-3.4. pyrène en micro-grammes/100 g
N° 5. Moules - idem n° 4 - coquilles	1,8
- corps	5,5

REF. NO.: 72 - S - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Suess, M. J. 1972. Polynuclear aromatic hydrocarbon pollution of the marine environment. In Marine Pollution and Sea Life, M. Ruivo, ed., p. 568-570. FAO Tech. Conf. on marine pollution and its effects on living resources and fishing, Rome, 1970. Fishing News (Books) Ltd., London, 1972.

Organisms: oysters, mussels (unspecified)

Date of Sample Collection: (Data from various other literature)

Location: Atlantic: Virginia, U. S., France and W. coast Greenland; Mediterranean: France and Italy

Analytical Technique:

Analytical Data:

TABLE 1. SOME BP CONCENTRATIONS IN MARINE SAMPLES

Sea coast	*Sample*	*BP concentration in µg/kg of dry sample*	*Reference*
Virginia, U.S.A.	Oysters	2-6 (Carcinogenic PAH: 500) (Total PAH: 1,200)	Cahnmann and Kuratsune 1957
France (various)	Crab, shrimps, oysters, mussels and molluscs	Traces to 90	Mallet, 1961
—Channel	Plankton	400	Mallet and Sardou 1964
—Mediterranean	Sediments:		
	0 to 0.5 m deep	420-5,000	
	1 and 2 m deep	26 and 16	Lalou *et al.* 1962
	Sands and muds:		
	14 to 82 m deep	Traces to 1,500	Bourcart *et al.* 1961
—Toulon Harbour	Mussels	16-22 (Total PAH: 1,100-3,400)	Greffard and Meury 1967
Italy—Bay of Naples	Sardine, mussels, and molluscs	65, 130 and 540, and 2	
	Algae and plankton	2 and 6-21	
	Sand and muds:		
	2 to 120 m deep	1-3,000	Bourcart and Mallet 1965
Greenland—west coast	Cod fish, mussels and molluscs	15, 55 and 60	
	Algae and plankton	60 and 5	
	Sand: 0.2 m deep	5	Mallet *et al.* 1963

REF. NO.: 75 - Z - 1

SUBSTANCES: petroleum hydrocarbons

Reference: Zitko, V. 1975. Aromatic hydrocarbons in aquatic fauna. Bull. Envir. Contam. Toxicol. 14:621-631.

Organisms: Mytilus edulis
Mya arenaria

Date of Sample Collection: 1972-74

Location: New Brunswick, Canada

Analytical Technique: Fluorescence emission spectroscopy

Analytical Data:

TABLE 1.

Levels of petroleum hydrocarbons in aquatic fauna.

Organism	Petroleum hydrocarbons, µg/g lipid*	Reference
Mussel	13300 - 39900	GREFFARD and MEURY 1967
Oyster	605	SMITH Jr. 1954
Scallop	133 - 934	BLUMER et al. 1970
Oyster	4600	BLUMER et al. 1970
Oyster	15740	EHRHARDT 1972
Shellfish	193 - 1070	FARRINGTON and QUINN 1973
Clam	6670	ZITKO 1970

*The reported concentrations were expressed on lipid basis assuming a moisture content of 80% and lipid content of 1.5% of wet weight.

TABLE 2

Fluorescence emission of cleaned-up extracts of aquatic fauna.

Sample	Fluorescence emission at 370 nm, (pyrene units/µg/mℓ) x 10^6
Mussels	61.7
Clams	27.1

*Standard deviation

MIXED ANALYSES

REF. NO.: 75 - B - 4

SUBSTANCES: DDT, DDE, DDD, PCB, Hg

Reference: Bagge, P. 1975. Pesticide residues in some Baltic animals--a review of selected literature. Pure and Applied Chem. 42:129-137.

Organisms:
Mytilus edulis
Cardium edule
Macoma baltica
Mya arenaria
Cyprina islandica

Date of Sample Collection: 1967-72

Location: Baltic Sea

Analytical Technique: ?

Analytical Data:

Table 3. Levels of DDT, PCBs and mercury in mussels in different parts of the Baltic Sea (concentrations in ng/g wet tissues).

Area	Year	s. DDT	s. PCB	Mercury	Ref.
Gulf of Finland	1967	20	55	—	18
Gulf of Finland	1970	8-20	32	30-50	16
Arch. of Stockholm	1966-1967	10-60	37	—	11
Arch. of Stockholm	1970	15	17	30-80	14
Southern Baltic	1966-1967	30	30	—	11
Southern Baltic	1972	73	—	—	13

Table 4. Concentration of DDT and its metabolites (as per cent of s. DDT) in some benthic animals in the southern parts of the Baltic proper (Slacza, unpubl.)

	s. DDT (ng/g w.w.)	DDT	DDE (as % of s. DDT)	DDD
Mytilus edulis	73	42.7	9.9	47.1
Cardium edule	98	17.7	31.3	51.0
Macoma baltica	172	30.0	55.2	16.8
Mya arenaria	22	19.7	26.6	53.5
Cyprina islandica	257	17.8	0.8	81.3
Crangon crangon	167	35.9	33.6	30.5
Mesidotea entomon	562	12.3	9.1	78.6

REF. NO.: 73 - B - 3

SUBSTANCES: Hg, Cd, Pb, Cu, Ni, Zn, Cr, As, radioisotopes, hydrocarbons, pesticides, detergents

Reference:

Bernhard, M. & A. Zattera. 1973. Major pollutants in the marine environment. In Marine Pollution and Marine Waste Disposal, Proc. 2nd International Congress, San Remo, December, 1973, E. A. Pearson & E. de Fraja Frangipane, eds. Pergamon Press. pp. 195-300.

Organisms:

Pecten maximus	*Modiolus modiolus*	*Crassostrea gigas*
Pecten opercularis	*Cardium edule*	*Crassostrea virginica*
Pecten jacobaeus	*Clinocardium* sp.	*Crassostrea ostrea*
Pecten novae-zelandiae	*Paphia staminea*	*Crassostrea commercialis*
Mytilus edulis	*Tegula* sp.	*Venus japonica*
Mytilus galloprovincialis	*Aequipecten irradians*	*Venus verrucosa*
Mytilus californianus	*Ostrea edulis*	*Mercenaria mercenaria*
Mya arenaria	*Ostrea sinuata*	*Tapes decussatus*
Modiolus demissus	*Macoma* sp.	*Tapes semidecussata*
	Chlamys opercularis	*Gryphaea angulata*

Date of Sample Collection:

Summary of all literature and data pre-1973

Location:

Analytical Technique:

Analytical Data: 50 Tables

REF. NO.: 73 - I - 2 **SUBSTANCES:** Pb, DDT

Reference: Isaacs, J. D. 1973. Southern California Coastal Water Research Project findings. In Marine Pollution and Marine Waste Disposal, Proc. 2nd Internat. Congress, San Remo, Dec. 1973, E. A. Pearson & E. de Fraja Frangipane, eds., p. 463-471.

Organisms: Mytilus californianus

Date of Sample Collection: 1971

Location: Southern California

Analytical Technique:

Analytical Data:

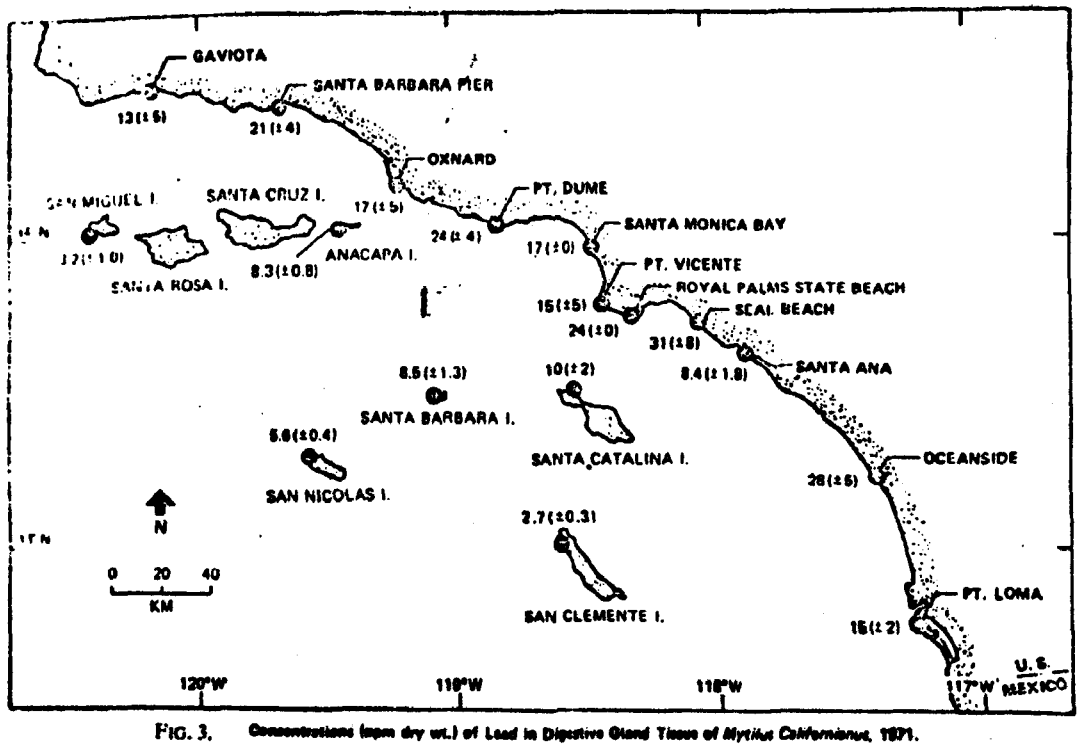


FIG. 3. Concentrations (ppm dry wt.) of Lead in Digestive Gland Tissue of *Mytilus Californianus*, 1971.

Isaacs, J. D. 1973.

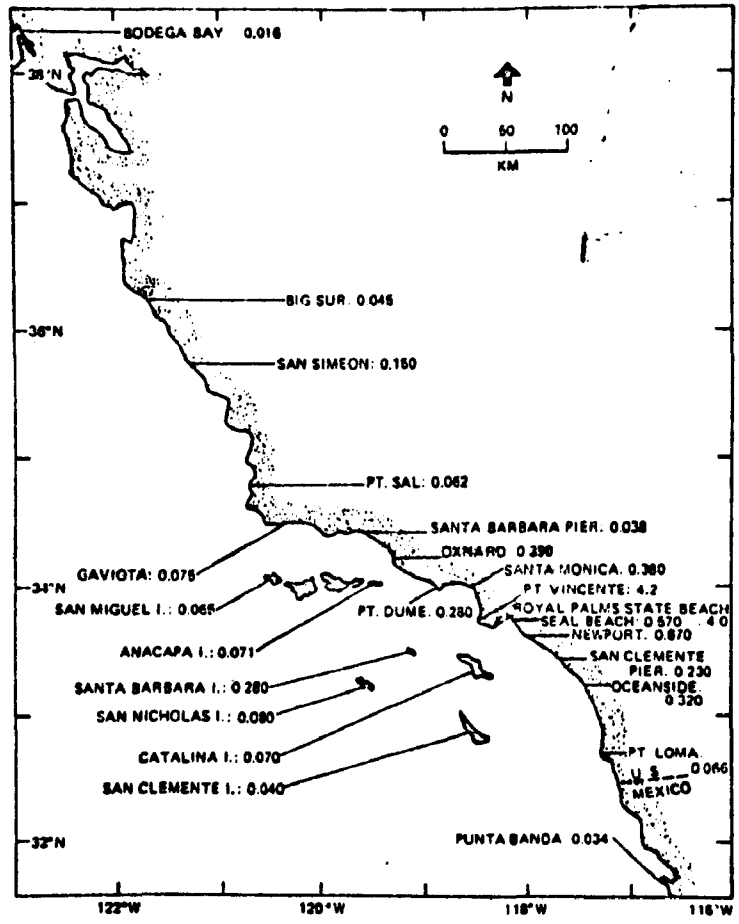


FIG. 5. Concentrations (ppm wet wt.) of total DDT in whole soft tissues of *Mytilus Californianus*, 1971.

REF. NO.: 74 - J - 2

SUBSTANCES: Zn, Cu, Ni, Cd, Pb, Hg, DDT, BHC, dieldrin

Reference: Jeng, S., Y. Huang & J. Lain. 1974. Effects of heavy metals and pesticides on the mass mortalities of cultured shellfishes along the southwest coast of Taiwan. J. Fish. Soc. Taiwan 3:35-39.

Organisms:
Crassostrea gigas
Crassostrea laperousei
Meretrix lusoria

Date of Sample Collection: 1973-74

Location: Southwest coast Taiwan

Analytical Technique: ?

Analytical Data:

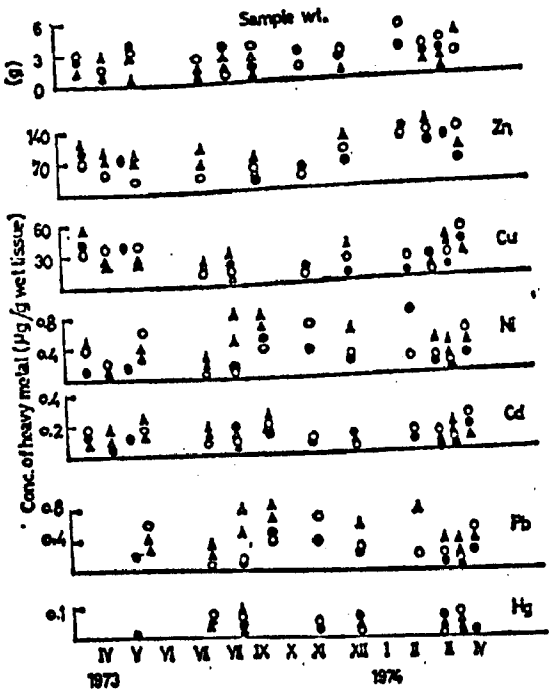


Fig. 2. Sample weight and heavy metal concentration in oysters collected from different stations (△ San-taio-lun; ▲ Chin-hu; Tung-Shih; ● Pu-tai)

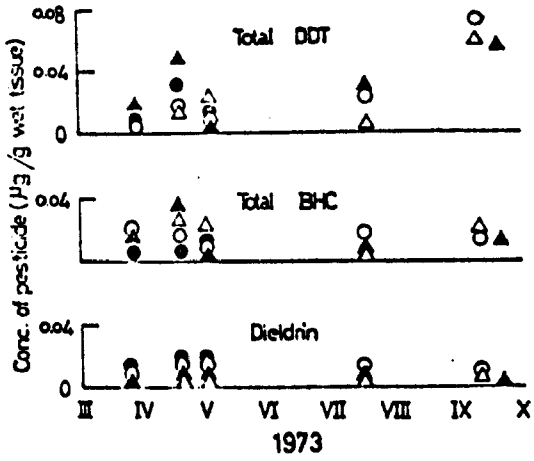


Fig. 3. Organochlorine pesticide residue of oysters collected from different stations (△ San-tiao-lun; ▲ Chin-hu; ○ Tung-Shih; ● Pu-tai)

REF. NO.: 68 - N - 1

SUBSTANCES: Zn, Zn^{65}, Fe, Cu, Mn

Reference: Naidu, J. R. & A. H. Seymour. 1968. Accumulation of zinc by oysters in Willapa Bay, Washington. Proc. Symp. on Mollusca, Cochin, Jan. 12-16, 1968, Pt. II, p. 463-474. Mar. Biol. Ass. India.

Organisms:

Crassostrea gigas
Crassostrea virginica
Crassostrea angulata
Crassostrea edulis
Ostrea edulis
Ostrea lurida

Date of Sample Collection: 1963, also 1936 from other lit

Location: Willapa Bay, Washington, plus composite of data from various locales, other sources

Analytical Technique: Colorimetry; gamma spectrum analysis

Analytical Data:

Galtsoff (1964) discusses the distribution of four metals, including zinc, in the body of adult oysters, *C. virginica*. The mean values of ten samples collected in early August, 1936, from Cape Cod waters, in terms of mg/kg (dry weight), are as follows:

Body portion		Iron	Copper	Zinc	Manganese
Gills	..	382	178	4,480	39
Muscle	..	136	65	1,420	4
Ovary	..	151	63	1,710	60
Spermary	..	136	65	1,420	4
Residue	..	252	153	4,630	9

TABLE I

Zinc content of oysters by species

Zinc %wet weight Mean	Max.	Min.	No. of analyses	Species	Location		Reference
·428	—	—	—	*C. virginica*	..	USA	Vinogradov, 1953[a]
·170[b]	—	—	—	,,	Chesapeake Bay	,,	Alexander, 1966
·159	·317	·031	7	,,	Atlantic Coast	,,	Chipman, 1958
·077[b]	—	—	10	,, (residue)	,, ,,	,,	Galtsoff, 1964
·069[d]	·230	·003	134[c]	,,	,, ,,	,,	Vinogradov, 1953
·050	·060	·039	2	,,	Gulf of Mexico	,,	Chipman, 1958
·086	—	—	—	*C. angulata*	United Kingdom		Bryan, 1966
·060	—	—	1[e]	,,	—	—	Vinogradov, 1953[a]
·037	·042	·031	—	*C. edulis* prereactor	Blackwater, England		Preston, 1967
·083	·123	·038	—	*C. edulis* postreactor	,,		Preston, 1967
·024[d]	—	—	6	*O. edulis*	—	—	Vinogradov, 1953[a]
·006	—	—	8	*O. lurida*	—	—	Vinogradov, 1953[a]
·015[b]	·016	·013	2	*C. gigas*	Puget Sound	USA	Naidu, 1963
·009[b]	·011	·005	6	,,	Willapa Bay	,,	Naidu, 1963
·012[b]	—	—	—	,,	,,	,,	Alexander, 1966
·160	—	—	—	Not identified	—	,,	Heinz, 1964
·034[e]	·115	·010	—	Mixed	—	—	Preston, 1967

a. Compiled by Vinogradov; not original source.
b. Wet weight-dry weight ratio assumed to be 6·0.
c. Data with obvious errors not included.
d. Calculated by authors from data compiled by Vinogradov.
e. Geometric mean; compiled from eleven references.

TABLE II

Zinc concentration factors for oysters

Concentration factor[a]	No. of samples	Species	Locality	Reference
$7{\cdot}5\times10^5$	1	*C. virginica*	Gulf of Mexico, USA	Chipman, 1958
$1{\cdot}4\times10^5$	5	,,	Atlantic Coast, USA	Chipman, 1958
$3{\cdot}3\times10^5$	—	—	United Kingdom	Bryan, 1966
$2{\cdot}5\times10^5$	—	—	Blackwater, England	Preston, 1967
$6{\cdot}0\times10^{4b}$	—	—	—	Peston, 1967
$4{\cdot}0\times10^{4c}$	—	*O. edulis*	—	Ichikawa, 1961
$3{\cdot}1\times10^{4d}$	—	,,	—	Polikarpov, 1966
$2{\cdot}0\times10^{4d}$	—	,,	—	Polikarpov, 1966
$1{\cdot}2\times10^4$	6	*C. gigas*	Willapa Bay, USA	Naidu, 1963

a. Mean value for zinc in oysters ÷ mean value for zinc in sea-water.
b. Calculated by geometric means with data from eleven references.
c. Vinogradov's values for zinc in oysters and Goldberg's value for zinc in sea-water.
d. Mauchline's calculation from Vinogradov's data as given by Polikarpov, 1966.

Naidu, J. R. & A. H. Seymour. 1968.

TABLE III

Zinc and zinc-65 values for Willapa Bay samples
Mean values ± standard deviation for six samples collected between February 11 and June 24, 1963

	Total zinc[a]		Zinc-65[b]	
Oysters ..	86 ± 21	10^{-6} g/g wet[c]	88 ± 11	10^{-12} Ci/g wet[c]
Oysters ..	515 ± 127	10^{-6} g/g dry	531 ± 64	10^{-12} Ci/g dry
Plankton, # 6 ..	239 ± 174	10^{-6} g/g ,,	219 ± 159	10^{-12} Ci/g ,,
Plankton, # 20 ..	232 ± 188	10^{-6} g/g ,,	126 ± 107	10^{-12} Ci/g ,,
Sediments ..	164 ± 52	10^{-6} g/g ,,	5·10 ± 1·68	10^{-12} Ci/g ,,
Filtered sea-water ..	7·37 ± 3·06	10^{-9} g/cc	9·32 ± 1·98	10^{-15} Ci/cc
Seston, etc. ..	8·47 ± 9·11	10^{-9} g/cc	Not detectable	

a. Grams of zinc per gram of oyster (or per cc of sea-water).
b. Curies of ^{65}Zn per gram of oyster (or per cc of sea-water).
c. Calculated on the assumption that wet weight-dry weight ratio is 6·0.

TABLE IV

Specific activity, zinc and zinc-65 concentration factors for Willapa Bay samples
(Values calculated from Table III data)

	Specific activity[a]	Concentration factors[b] Zinc	Concentration factors[b] Zinc-65
Oysters ..	1·04 ± 0·28	11,700 ± 5,600	9,400 ± 2,300
Plankton, #6[c]	0·92 ± 0·96	3,200 ± 2,700[c]	2,400 ± 1,800
Plankton, #20[c]	0·54 ± 0·64	3,100 ± 2,900[c]	1,400 ± 1,200
Sediments ..	0·031 ± 0·014	—	—
Sea-water ..	1·26 ± 0·59	—	—

a. pCi of ^{65}Zn per gram of zinc.
b. Zinc in organism ÷ zinc in sea-water.
Zinc-65 in organism ÷ zinc in sea-water.
c. Calculated on the arbitrary assumption that wet weight-dry weight ratio is 10·0.

REF. NO.: 63 - N - 1 **SUBSTANCES:** Sr, Sr^{90}

Reference: Nelson, D. J. 1963. The strontium and calcium relationships in Clinch and Tennessee River mollusks. In Radioecology, proc. 1st nat. symp. radioecology, Colorado State Univ., Ft. Collins, Colo., Sept. 10-15, 1961, V. Schultz & A. W. Klement Jr., p. 203-211. Reinhold Pub. Corp., N. Y. & Amer. Inst. Biol. Sci., Washington, D.C.

Organisms:
Anodonta corpulenta
Dromus dromas
Quadrula metanevra
Quadrula pustulosa
Elliptio dilatatus
Elliptio crassidens
Pleurobema cordatum
Fusconaia subrotunda
Amblema costata
Megalonaias gigantea
Cyclonaias tuberculata
Plagiola lineolata
Actinonaias carinata gibba
Ligumea recta latissima
Lampsilis ovata
Proptera alata

Date of Sample Collection: 1960

Location: Tennessee River, Tennessee

Analytical Technique: Flame photometry

Analytical Data:

Table 3. Age, growth rate, and strontium content of seven Anodonta corpulenta collected from Clinch River mile 4.7 to 14.5.

Age (years)	Growth rate (grams per year)	Strontium content (micrograms per gram)
2	3.6	232
4	6.6	387
4	9.0	426
7	9.8	238
7	12.4	434
11	11.2	441
13	8.3	518

Table 4. Age, growth rate, and strontium content of Pleurobema cordatum collected from Clinch River mile 47 (CRM 47) and Tennessee River mile 425 (TRM 425).

Age (years)		Growth rate (grams per year)		Strontium content (micrograms per gram)	
CRM 47	TRM 425	CRM 47	TRM 425	CRM 47	TRM 425
6	9	4.1	9.8	198	217
9	10	3.7	6.5	187	256
11	14	3.2	5.5	180	220
12	16	3.2	4.7	189	205
12	17	3.5	5.0	235	281
14	18	3.3	5.8	187	237
14	18	3.8	6.0	190	221
14	20	2.7	5.6	219	232
20	20	2.6	4.9	213	238
23	23	3.4	5.8	212	245
	24		4.9		258
Average		3.37	5.86	201	237.3
Standard error		0.149	0.427	5.63	6.60

Table 5. Age, growth rate, and strontium content of Elliptio crassidens collected from Tennessee River mile 521 (TRM 521) and E. dilatatus from Clinch River mile 47(CRM 47).

Age (years)		Growth rate (grams per year)		Strontium content (micrograms per gram)	
CRM 47	TRM 425	CRM 47	TRM 425	CRM 47	TRM 425
6	3	2.1	6.9	181	202
7	5	1.5	7.5	213	201
8	5	1.4	5.5	198	207
8	5	1.6	5.8	202	201
9	6	1.1	6.0	225	212
9	9	1.3	4.8	198	216
9	10	1.0	4.7	231	209
9	12	1.5	3.6	185	202
10		1.6		212	
11		1.0		217	
Average		1.41	5.60	206.2	206.2
Standard error		0.106	0.442	5.16	2.02

Table 6. Comparison of the frequency of strontium to calcium atom ratios for clam shells from this study with those reported by Odum (1957).

Strontium to[1] calcium atom ratio x 10^{-3}	This study		Odum (1957)	
	Number of occurrences	Per cent total	Number of occurrences	Per cent total
.00 to .25	142	70.0	3	7.7
.26 to .50	60	29.6	8	20.5
.51 to .75	1	0.5	9	23.1
.76 to 1.0			9	23.1
Greater than 1.0			10	25.6

[1] Includes end points of intervals.

Table 1. The strontium and strontium-90 content of Tennessee River system clams with calculated strontium-90 to strontium atom ratios and strontium to calcium atom ratios.

Specimens collected	Collection site [1]	Strontium: Number analyzed	Strontium: Average micrograms per gram of shell	Strontium: Average strontium to calcium atom ratio x 10^{-3}	Strontium-90: Number analyzed	Strontium-90: Average micromicrocuries per gram of shell	Strontium-90: Strontium-90 to strontium atom ratio x 10^{-11}
Unionidae							
Anodontinae							
Anodonta corpulenta	CRM 4.7-14.5	7	382 ±40.8[2]	0.435±0.046[3]	7	99.08±17.9	176.1 ±25.3
	Grassy Creek[4]	4	324.5±27.8	0.370±0.032	4		
Unioninae							
Dromus dromas	CRM 66	1	202	0.230			
	CRM 47	2	183 ± 6.00	0.208±0.007			
Quadrula metanevra	CRM 47	1	162	0.184			
	TRM 425	3	161.7± 1.22	0.184±0.001			
Quadrula pustulosa	CRM 47	2	186.0± 6.00	0.212±0.007	2	1.214± 0.249	4.45 ± 1.05
	CRM 17	9	155.9± 2.19	0.178±0.002	5	15.18 ± 2.57	67.5 ±10.8
	TRM 521	2	244.0±33.0	0.278±0.038	2	5.33 ± 0.923	15.4 ± 4.65
	TRM 425	3	202.7± 8.09	0.231±0.009	3	4.30 ± 0.801	14.3 ± 2.45
	TRM 100	8	199.5± 3.49	0.227±0.004	5	2.29 ± 0.182	7.74 ± 0.547
Elliptio dilatatus	CRM 66	2	222.0± 6.52	0.253±0.007			
	CRM 47	10	206.2± 5.16	0.235±0.006	2	0.39 ± 0.42	0.99 ± 1.75
	TRM 425	1	218	0.248	1	4.16	12.9
Elliptio crassidens	CRM 47	10	260.9± 5.00	0.297±0.006			
	TRM 521	15	211.4± 3.66	0.241±0.004	10	24.9 ± 2.39	36.5 ± 3.78
	TRM 425	7	196.4± 6.40	0.224±0.007	7	7.00 ± 0.742	24.6 ± 2.78
	TRM 100	5	228.2±15.5	0.260±0.018	5	3.96 ± 1.52	12.5 ± 5.05
Pleurobema cordatum	CRM 47	10	201.0± 5.63	0.229±0.006	2	0.185± 0.184	0.525± 0.620
	TRM 425	11	237.3± 6.60	0.270±0.007	2	4.24 ± 3.21	13.8 ±10.1
Fusconaia subrotunda	CRM 47	9	184.3± 2.18	0.210±0.002			
Amblema costata	CRM 47	2	184.5± 0.707	0.210±0.001			
	TRM 425	3	201.7±10.4	0.230±0.012	2	12.6 ± 0.089	22.2 ± 1.28
Megalonaias gigantea	TRM 425	3	188.7± 2.97	0.215±0.003			
Cyclonaias tuberculata	CRM 47	2	213.5± 3.54	0.243±0.004	2	0.714± 0.621	1.25 ± 0.952
	TRM 521	10	242.6± 5.51	0.276±0.006	7	4.81 ± 0.488	12.3 ± 1.42
	TRM 425	4	203.8±10.4	0.232±0.012	4	5.70 ± 0.737	16.9 ± 2.07
	TRM 100	5	208.8± 6.43	0.238±0.007	4	3.13 ± 0.341	10.2 ± 1.16
Lampsilinae							
Plagiola lineolata	TRM 425	3	199.7± 4.06	0.227±0.005			
Actinonaias carinata gibba	CRM 47	7	185.7± 5.55	0.211±0.006			
Ligumea recta latissima	CRM 47	6	182.2± 3.28	0.208±0.004			
	TRM 425	1	191	0.218			
Lampsilis ovata	CRM 66	7	231.1± 7.33	0.263±0.008	2	0.790± 0.045	1.15 ± 0.039
	CRM 47	6	224.0±11.2	0.255±0.013	2	0.392± 0.397	1.32 ± 1.47
Proptera alata	Grassy Creek	4	220.5±11.3	0.251±0.013			
	TRM 521	1	248	0.282			
	TRM 425	1	190	0.216			

[1] White Oak Creek flows into the Clinch River at CRM 20.8 at a distance of 2.5 miles below Oak Ridge National Laboratory; CRM = Clinch River mile; TRM = Tennessee River mile.

[2] All averages ± one standard error of the mean.

[3] Calcium was not determined for all specimens (see text).

[4] Grassy Creek joins the Clinch River at CRM 14.5.

Table 8. Observed and expected strontium-90 to stable strontium atom ratios (x 10^{-11}) in clams as a function of the dilution of Clinch River water.

Collection site	Dilution factor for Clinch River water	Expected on the basis of dilution	Number analyzed	Observed average	Atoms of fallout strontium-90: laboratory released strontium-90
CRM 47[1] (upstream from White Oak Creek)			12	1.67±0.50[2]	
CRM 17 to 4.7 (downstream from White Oak Creek)	1	130.8[3]	12	130.8±22.7	1:78
TRM 521[1]	5.6	23.4	19	25.74±3.36	1:15
TRM 425	7.05	18.6	19	19.78±1.71	1:12
TRM 100	12.3	10.6	14	10.14±1.81	1:6

[1] CRM = Clinch River mile; TRM = Tennessee River mile; the Clinch River joins the Tennessee River at TRM 568 (river miles measured from mouth of the river).

[2] All averages ± one standard error of the mean.

[3] Strontium-90 to strontium atom ratio in clams from the Clinch River downstream from White Oak Creek is the basis for the atom ratios expected because of dilution.

REF. NO.: 76 - R - 1

SUBSTANCES: Fe, Mn, Co, Ni, Cd, Cu, Pb, Zn, Ag, Cr, Al, V, Mo, DDT, PCB, HEOD, endrin, telodrin

Reference:

Roberts, D. 1976. Mussels and pollution. In Marine mussels: their ecology and physiology, B. L. Bayne, ed., p. 67-80. Cambridge University Press.

Organisms: *Mytilus edulis*

Date of Sample Collection:

Location: (Data from various locales, other literature)

Analytical Technique:

Analytical Data:

Table 3.3. *Organochlorine residues in the soft parts of mussels* (M. edulis) *from different areas*

Locality and date of sampling	Concentration in mussels (μg per g fresh wt)						Author
	HEOD	DDT	DDE	Telodrin	Endrin	PCBs	
Northumberland coast, England, 1965	0.023	—	0.024	—	—	—	Robinson *et al.* (1967)
North Sea, 1966	0.01–0.1	—	0.01–0.04	0.001–0.004	0.01–0.36	—	Koehman *et al.* (1968)
Clyde, Scotland, 1966	0.1–0.3		—	—	—	0.2–0.8	Holdgate (1971)
West coast, Scotland 1966	0.08–0.1		—	—	—	0.1	Holdgate (1971)
East coast, Scotland, 1966	0.06–0.16		—	—	—	0.01–0.3	Holdgate (1971)
East coast, England, 1968	0.02–0.14		—	—	—	0.01–0.2	Holdgate (1971)
California, 1967–72	0.005–0.031	0.833–3.97	—	—	Detected	Detected	Butler (1973)
Maine, 1965–70	—	0.064–0.359	—	—	—	—	Butler, (1973)
New York, 1966–72	0.075–0.104	0.112–0.588	—	—	—	—	Butler (1973)
Canadian Atlantic coast, 1967	—	0.01–0.04	0.05–0.06	—	—	—	Sprague & Duffy (1971)

Table 3.2. *Concentrations of metals in mussels* (M. edulis) *from different areas*

Locality of sampling	Concentration ($\mu g\ g^{-1}$ dry wt)													Tissue	Author
	Fe	Mn	Co	Ni	Cd	Cu	Pb	Zn	Ag	Cr	Al	V	Mo		
South coast, England	290	3.6	0.15	2.1	0.95	2.0	0.4	0.04	0.1	—	76.0	—	—	Shell	Segar *et al.* (1971)
South coast, England	1700	3.5	1.6	3.7	5.1	9.6	9.1	91.0	0.03	1.5	1230	—	—	Soft parts	
South coast, England	—	—	—	—	—	5–26	—	60–81	—	—	—	—	—	Soft parts	B. Brown (personal communication)
East coast, England	—	—	—	—	—	9.50	—	167–312	—	—	—	5.0	—	Soft parts	
New Zealand	1960	27.0	—	7.0	10	9.0	12	91.0	1.0	16.0	—	—	0.6	Soft parts	Brooks & Rumsby (1965)
California	—	6–28	—	—	3–7	5–11	2–8	204–341	1–1.3	2.8	—	—	—	Soft parts	Graham (1972)
California	—	9.3–45.8	—	—	2.5–5.8	5.8–8.6	9–21.2	6.9–14.2	4.4–6.3	5–7	—	—	—	Shell	Graham (1972)
California	—	5.9–7.8	—	—	2.0–4.9	9.0–303	2.2–23.4	164–310	1–5.5	1.5–7.8	—	—	—	Soft parts	Graham (1972)
California	—	8.4–14.2	—	—	2.5–9.2	8.1–18.6	9–19.4	8.6–26.5	5.0–7.9	5.7–14.2	—	—	—	Shell	Graham (1972)

REF. NO.: 76 - Y - 3

SUBSTANCES: DDT, Cu, Pb, Ag, Cd, Cr, Ni, Zn

Reference: Young, D. R. & D. J. McDermott. 1976. Trace element anomalies in marine organisms off Southern California. Rep. California Coop. Ocean. Fish. Invest. 18:162-166.

Organisms: Mytilus californianus

Date of Sample Collection: 1971

Location: Southern California Bight

Analytical Technique:

Analytical Data:

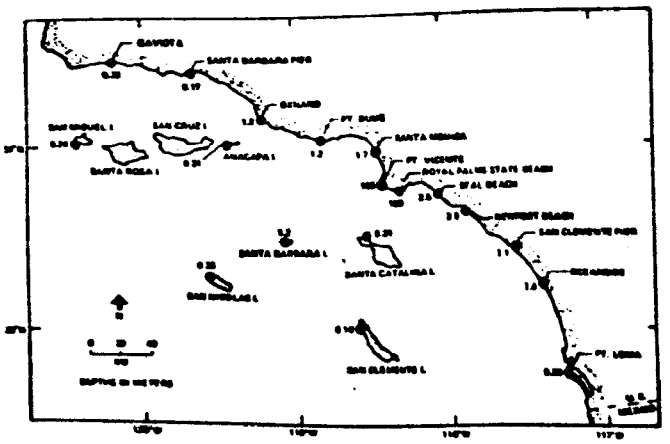


FIGURE 2. Total DDT concentrations (mg/dry kg) in whole soft tissues of California seamussel, *Mytilus californianus*, 1971. Average wet to dry weight ratio for these samples was 4.4 (Analyses by B. de Loppe and R. Risebrough).

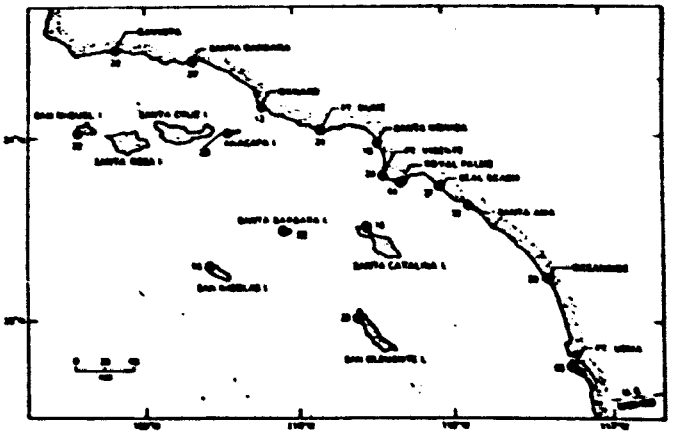


FIGURE 3. Copper concentrations (mg/dry kg) in digestive gland tissue of California seamussel, *Mytilus californianus*, 1971. Average wet to dry weight ratio for these samples was 3.8 (Analyses by G. Alexander).

TABLE 2

Average trace element concentrations (mg/dry kg) in digestive glands of the California seamussel, *Mytilus californianus*, showing significant regional differences * off southern California.

Trace element	Urban vs Island	Urban vs Rural	Rural vs Island
Silver	U > I (26) (10)	--	--
Cadmium	U < I (14) (21)	U < R (14) (26)	--
Chromium	--	U < R (8) (16)	R > I (13) (2)
Copper	U > I (36) (30)	U > R (36) (22)	--
Nickel	--	--	--
Lead	U > I (18) (6)	--	R > I (21) (6)
Zinc	--	--	--

* 95% Confidence limit.