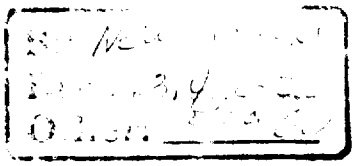

PCB Congeners in American Lobster, *Homarus americanus*, and Winter Flounder, *Pseudopleuronectes americanus*, from New Bedford Harbor, Massachusetts

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Introduction

PCBs are a group of 209 different compounds. The physical, chemical, and toxicological properties vary depending on the amount and position of chlorine substitution on the biphenyl molecule[1]. PCBs were produced and sold as complex mixtures of congeners which in the United States were marketed under the trademark of Aroclors (Monsanto Co.). However, once these commercial mixtures of PCBs are released to the environment their compositions can change due to the differential behaviors of the compounds.

Since the properties of PCB congeners differ depending on the chlorine substitution, environmental alterations may influence the toxicological significance of PCB mixtures. In order to better define the potential significance of the PCBs found in edible marine tissues from New Bedford Harbor, we have applied methods adapted from Stalling et al. (1979) which allowed us to better define the PCB mixtures in these samples. These techniques specifically focus on PCB congeners known to produce biological effects in some species. This report presents the results of analyses conducted on the edible tissues of lobster and flounder collected from New Bedford Harbor.

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[1] Certain PCB congeners have been shown to induce enzyme systems (e.g., Aryl Hydrocarbon Hydroxylase or AHH) in a manner similar to 3-methylcholanthrene and 2,3,7,8-tetrachlorodibenzo-p-dioxin. These congeners are of particular interest since the enzyme induction has been correlated with some toxic effects such as thymic atrophy (see Safe, 1987 and Duinker, 1988 for more detail). In this report, these congeners, which include 77, 81, 105, 114, 118, 126, 156, 157, 167, 169 and 189 are referred to as non- and mono-ortho substituted congeners or AHH inducers.

Materials and Methods

Sample collection

Lobsters (legal size) were collected with lobster pots by the Cat Cove Marine Laboratory of the Massachusetts Division of Marine Fisheries. The five lobsters that were analyzed were taken from Closure Area 3 (Figure 1). Station locations and collection dates for these samples are listed in Table 1. Also listed in this table are the weights of the whole lobsters and the amounts of muscle and hepatopancreas tissues found in each lobster. The flounder samples were collected by otter trawl on January 9, 1987 from just inside of the New Bedford Harbor Hurricane Barrier. All of the samples were frozen until analyzed.

Sample analysis

A flow chart of the analysis procedures is shown in Figure 2 and the techniques that were utilized are described in detail below. Tissue samples were homogenized using a Polytron (Brinkman Corp.) and then 2 to 5 grams of each homogenate was weighed into an acetone rinsed 100 ml centrifuge tube. Octachloronaphthalene (OCN) and PCB congener 100 (Ballschmiter and Zell, 1980) were added as internal standards along with 25 ml of acetone and the mixture was agitated using a Polytron for 20 seconds. The sample was centrifuged for 15 minutes at 25000 rpm at 4°C and then the supernatant poured into a separatory funnel containing 150 ml of water. This procedure was repeated two more times and the extracts combined in the separatory

funnel. The acetone/water mixture in the separatory funnel was then extracted three times with 25 ml of freon each time. These were combined, treated with sodium sulfate and volume reduced using a heating mantle and a Kuderna-Danish evaporator with a 3-ball Snyder column. The extract was volume reduced and solvent exchanged to 10 ml of hexane. One ml was removed for a lipid weight determination and the remaining 9 ml was treated with concentrated sulfuric acid. This involved adding 5 ml of acid to the conatiner, shaking gently and allowing the mixture to sit for two hours.

After the acid treatment, the extract was volume reduced and then analyzed for PCBs as Aroclors. Sample extracts were analyzed as Aroclor 1242 and 1254 using capillary gas chromatography (GC). For these analyses, 1 ul of each sample was injected splitless into a Hewlett Packard 5890 gas chromatograph equipped with a 30 m DB-5 fused silica capillary column (J + W Scientific) and an electron capture detector. Helium was used as the carrier gas at a flow rate of about 1.5 ml/min and the flow of a 95:5 mixture of argon:methane to the detector was 35 ml/min. The oven temperature was held at 60°C for 1 min and then programmed from 60 to 315°C at 10°C/min. The injector temperature was 270°C and the detector was maintained at 325°C.

Aroclor determinations were made by comparing the summed heights of two peaks in each Aroclor with the heights of the same peaks in the samples. The peaks used for Aroclor 1242 were mixed peaks while congeners 138 and 180 (Ballschmiter and Zell,

1980) were measured for the quantification of Aroclor 1254. OCN was used as an internal standard for these determinations.

After the PCB concentrations were measured as Aroclors, the extracts were split and each portion was separated into fractions using carbon/silica columns. Individual PCB congeners were quantified in the fractions from these columns. These separations allowed the quantification of congeners that could not be separated by GC using the chromatographic conditions that we employed. Two columns were required because it was not possible to make the required separations in one step. The carbon/silica columns consisted of 2 cm of a carbon/silica gel mixture in a disposable pipette. This mixture was composed of 5 % Super-A Activated Carbon AX-21 with silica gel (Bio-Sil A, Bio-Rad Laboratories) that had been activated at 150°C for 24 hours.

Both carbon columns were rinsed with 15 ml of toluene, 15 ml of methylene chloride and 10 ml of hexane before the extracts were added. The elution schemes used are shown in Figure 2. The first column was eluted with 15 ml of hexane which was collected as the F1 fraction. The column was inverted and then eluted with 15 ml of toluene which was collected as the F2 fraction. Congeners containing 2, 3 or 4 ortho substituted chlorines elute in the F1 fraction. These compounds were quantified against the congener 100 internal standard. Several congeners containing 1 ortho substituted chlorine were quantified in the F2 fraction. The concentrations of these compounds were calculated using the OCN internal standard which

eluted into this fraction.

The second column was first eluted with 15 ml of methylene chloride which was discarded. The column was inverted and then eluted with 5 ml of toluene which was collected as the F3 fraction. Three congeners containing 0 ortho chlorines (77, 126 and 169) were quantified against OCN in this fraction.

Standards were obtained for all of the congeners that were quantified. These were purchased from Ultra Scientific and the National Research Council of Canada. Congener analyses were done on a Hewlett Packard 5890 GC as described earlier; except, a 60 m DB-5 fused silica column was used. The oven temperature was held at 150°C for 1 min and then programmed from 150 to 315°C at 1°C/min.

Since not all 209 PCB congeners could be obtained as standards it is possible that some of the congeners that were quantified occur as mixed peaks. This is more likely to be a problem for congeners quantified in the fraction containing compounds with 2,3 and 4 ortho chlorines. Fewer compounds are found in the fractions containing compounds with 0 and 1 ortho chlorines and most of these compounds were obtained as authentic standards. Therefore, the identification and quantification of these compounds are more definitive.

Quality Assurance

A spike and recovery study was conducted as a measure of the accuracy of the analytical procedure. Thirteen PCB congeners representing compounds containing 4-10 chlorines and OCN were spiked into three aliquots of a homogenate of mussel (Mytilus edulis) tissue. The recoveries ranged from 78 to 84 % for the 13 PCB congeners and the recovery of OCN averaged 77 %.

Triplicate analyses for individual congeners were conducted on Aroclor 1242 as a measure of the precision of the method. The results of these analyses are presented in Table 5. The relative standard deviations for most of the congeners were less than 1 %. Blank analyses were conducted with each sample set which generally consisted of 5 samples. No significant interferences were found in the blanks. Values of 0.00 in the tables indicate levels below the analytical detection limits.

Results and Discussion

Total PCB concentrations (on a dry weight basis) measured as the sum of Aroclors 1242 and Aroclor 1254 are shown in Table 2. The PCB concentrations on a wet weight basis in these samples are shown in Table 3. Also included in Table 3 are PCB concentrations calculated for the combined tissues of lobsters. PCB concentrations and total tissue weights were used for these calculations. These data can be compared with the FDA Tolerance Level of 2 ug/g for PCBs.

The PCB concentrations in the five lobster samples were similar and all were above the 2 ug/g FDA Tolerance Level (3.14 - 8.79 ug/g). The concentrations found in the flounder, however, showed a wide range (0.10 - 7.05). Three of the five flounder contained PCB levels above the FDA Tolerance Level. This wide range of concentrations may indicate that some of these organisms had only been in New Bedford Harbor for a short period of time.

The Massachusetts Division of Marine Fisheries (MDMF) has monitored PCB concentrations in lobster and several other species from New Bedford Harbor since 1977 (Kolek and Ceurvels, 1981; MDMF, unpublished data). Their data for lobsters from Closure Area 3 indicate that the PCB levels remained relatively constant between 1977 and 1985. Considerable variations were observed in the average seasonal values (1.0 - 8.8 ug/g); however, there did not appear to be a major trend in the data. This is demonstrated by the fact that the average level for 1977 was 3.9 ug/g and the Fall 1985 mean concentration was 4.2 ug/g. The present study reported a concentration mean of 4.97 ug/g for lobsters collected during 1987.

The methods used in the present study to quantify PCBs were different from those used by MDMF. However, a recent intercalibration between the EPA - Narragansett and MDMF laboratories on the measurement of PCBs in composite lobster samples indicated that the values generated by the two laboratories differ by less than a factor of 2 (Pruell et al., 1988). EPA reported slightly higher levels which probably

indicates that the total PCB levels measured in the present study are very similar to those that have been previously found in New Bedford Harbor Area 3 lobsters (MDMF, 1981). This indicates that the PCB levels found in lobsters from Closure Area 3 have remained remarkably constant for the past 10 years.

Forty-five PCB congeners were quantified in Aroclors 1016, 1242 (analyzed in triplicate), 1254 and 1260, in 5 lobster muscle and hepatopancreas samples, and 5 flounder muscle samples. The names and numbers of the congeners that were quantified are listed in Table 4. The results of the congener analyses are reported in Tables 5, 6, 7 and 8. The congeners that were quantified were selected for several reasons. These included the potential to induce AHH (Safe, 1987), the relative abundance in environmental samples and the availability of the standards. All of the congeners listed by Duinker et al. (1988) as "toxic congeners" were quantified except congener 123 which was not available to us as a pure standard.

The congener mixtures found in the various Aroclors (Table 5) agree well with what has been previously reported (Albro et al., 1981; Capel et al., 1985). The sums of the congeners measured for each Aroclor indicate that the congeners that we quantified represented about 22 % of Aroclor 1016, 25 % of Aroclor 1242, 50 % of Aroclor 1254 and 63 % of Aroclor 1260.

The patterns of PCBs seen in the lobster samples (Tables 6 and 7) were very similar to those previously reported in lobsters from New Bedford Harbor by Farrington et al. (1986).

Congeners found in the highest concentrations included numbers 105, 118, 128, 138, 153 and 180. These 6 compounds accounted for about 80 % of the mass of the individual congeners that were quantified in both the muscle and hepatopancreas samples. These compounds were found to be the major components of Aroclors 1254 and 1260 (Table 5).

The flounder samples (Table 8) showed a different PCB pattern than those of the lobster samples. In general more congeners were found in significant amounts in the fish samples. The most prominent compounds in flounder included congeners 105, 118, 138 and 153. Maack and Sonzogni (1988) reported that these were also some of the major components of the PCB mixtures seen in several freshwater fish species from Wisconsin. A similar PCB pattern was also seen in the livers of Atlantic cod from the North Sea (de Boer, 1988).

Several non- and mono-ortho congeners were found in the lobster and flounder samples. These included congeners 37, 77, 81, 105, 114, 118, 126, 156, 157, 167, 169 and 189. Considering the concentrations and relative enzyme inducing potencies of the compounds (Safe, 1987), those that may be the most toxicologically important in these samples are congeners 77, 105 and 126.

REFERENCES

Albro, P.W., J.T. Corbett and J.L. Schroeder. 1981. Quantitative characterization of polychlorinated biphenyl mixtures (Aroclors 1248, 1254 and 1260) by gas chromatography using capillary columns. Journal of Chromatography 205: 103-111.

Ballschmiter, K. and M. Zell. 1980. Analysis of polychlorinated biphenyls (PCB) by glass capillary gas chromatography. Fresenius Z. Anal. Chem. 302:20-31.

Capel, P.D., R.A. Rapaport, S.J. Eisenreich and B.B. Looney. 1985. PCBQ: Computerized quantification of total PCB and congeners in environmental samples. Chemosphere 14: 439-450.

de Boer, J. 1988. Trends in chlorobiphenyl contents in livers of Atlantic cod (Gadus morhua) from the North Sea, 1979-1987. Chemosphere 17: 1811-1819.

Duinker, J.C., D.E. Schultz and G. Petrick. 1988. Multidimensional gas chromatography with electron capture detection for the determination of toxic congeners in polychlorinated biphenyl mixtures. Analytical Chemistry 60: 478-482.

Farrington, J. W., A.C. Davis, B.J. Brownawell, B.W. Tripp, C.H. Clifford and J.B. Livramento. 1986. Some aspects of the biogeochemistry of polychlorinated biphenyls in the Acushnet River Estuary, Massachusetts, U.S.A. Symposium on Estuarine and Marine Chemistry: Organic Geochemistry. (M. Sohn Ed.), American Chemical Society Symposium Series.

Kolek, A. and R. Ceurvels. 1981. Polychlorinated Biphenyl (PCB) Analyses of Marine Organisms in the New Bedford Area, 1976-1980. Commonwealth of Massachusetts Division of Marine Fisheries Publ. #12265-36-100-1-81-CR, 11p.

Maack, L and W.C. Sonzogni. 1988. Analysis of polychlorobiphenyl congeners in Wisconsin fish. Archives of Environmental Contamination and Toxicology 17: 711-719.

Pruell, R.J., Donald Young and Jack P. Schwartz. 1988. Intercalibration of PCB measurements in lobsters, Homarus americanus. Unpublished report.

Safe, S. 1987. Determination of 2,3,7,8-TCDD toxic equivalent factors (TEFs): Support for the use of the in vitro AHH induction assay. Chemosphere 16: 791-802.

Stalling, D.L., J.N. Huckins, J.D. Petty, J.L. Johnson and H.O. Sanders. 1979. An expanded approach to the study and measurement of PCBs and selected planar halogenated aromatic environmental pollutants. Annals of the New York Academy of Sciences 320: 48-59.

Table 1. Sample information and tissue weights (grams) of lobster from Area III of New Bedford Harbor.

Sample #	CC-#*	Station	Date	Whole Lobster	Muscle Tissue	Hepatopancreas
902177	P1503	MMM	12/18/87	545.	152.	14.8
902178	P1529	UU	12/22/87	385.	136.	12.6
902179	P1506	YY	12/18/87	452.	185.	12.9
902180	P1418	UU	07/06/87	612.	179.	12.3
902181	P1426	MMM	07/01/87	405.	128.	19.2

* - Cat Cove Marine Laboratory Sample Number.

Table 2. Total PCB concentrations in lobster and flounder from New Bedford Harbor.

Concentrations as ug/g dry weight

Sample #	Organism	Muscle	Hepatopancreas
902177	Lobster	5.48	148
902178	Lobster	3.61	204
902179	Lobster	3.95	345
902180	Lobster	4.00	251
902181	Lobster	6.93	114

Sample #	Organism	Muscle
399568	Flounder	37.0
399569	Flounder	15.1
399572	Flounder	0.563
399574	Flounder	1.64
399575	Flounder	29.8

Table 3. Total PCB concentrations in lobster and flounder from New Bedford Harbor.

Concentrations as ug/g wet weight

Sample #	Species	Muscle	Hepatopancreas	Combined *
902177	Lobster	0.63	29.0	3.14
902178	Lobster	0.53	51.7	4.89
902179	Lobster	0.77	55.2	4.32
902180	Lobster	0.48	50.9	3.73
902181	Lobster	0.77	62.4	8.79

Sample #	Species	Muscle
399568	Flounder	7.05
399569	Flounder	3.35
399572	Flounder	0.10
399574	Flounder	0.31
399575	Flounder	6.49

* - Calculated using the weights and PCB concentrations of the muscle and hepatopancreas tissues.

Table 4. Numbers and names of the congeners that were quantified (Ballschmiter and Zell, 1980).

CONGENER NUMBER	NUMBER ORTHO CL *	CONGENER NAME
15	0	4,4'- dichlorobiphenyl
18	2	2,2',5 - trichlorobiphenyl
37	0	3,4,4'- trichlorobiphenyl
44	2	2,2',3,5'- tetrachlorobiphenyl
47	2	2,2',4,4'- tetrachlorobiphenyl
49	2	2,2',4,5'- tetrachlorobiphenyl
52	2	2,2',5,5'- tetrachlorobiphenyl
60	1	2,3,4,4'- tetrachlorobiphenyl
72	1	2,3',5,5'- tetrachlorobiphenyl
77	0	3,3',4,4'- tetrachlorobiphenyl
78	0	3,3',4,5 - tetrachlorobiphenyl
79	0	3,3',4,5'- tetrachlorobiphenyl
81	0	3,4,4',5 - tetrachlorobiphenyl
86	2	2,2',3,4,5 - pentachlorobiphenyl
101	2	2,2',4,5,5'- pentachlorobiphenyl
105	1	2,3,3',4,4'- pentachlorobiphenyl
114	1	2,3,4,4',5 - pentachlorobiphenyl
118	1	2,3',4,4',5 - pentachlorobiphenyl
119	2	2,3',4,4',6 - pentachlorobiphenyl
126	0	3,3',4,4',5 - pentachlorobiphenyl
128	2	2,2',3,3',4,4'- hexachlorobiphenyl
137	2	2,2',3,4,4',5 - hexachlorobiphenyl
138	2	2,2',3,4,4',5'- hexachlorobiphenyl
141	2	2,2',3,4,5,5'- hexachlorobiphenyl
143	3	2,2',3,4,5,6'- hexachlorobiphenyl
153	2	2,2',4,4',5,5'- hexachlorobiphenyl
156	1	2,3,3',4,4',5 - hexachlorobiphenyl
157	1	2,3,3',4,4',5'- hexachlorobiphenyl
158	2	2,3,3',4,4',6 - hexachlorobiphenyl
166	2	2,3,4,4',5,6 - hexachlorobiphenyl
167	1	2,3',4,4',5,5'- hexachlorobiphenyl
169	0	3,3',4,4',5,5'- hexachlorobiphenyl
170	2	2,2',3,3',4,4',5 - heptachlorobiphenyl
180	2	2,2',3,4,4',5,5'- heptachlorobiphenyl
183	3	2,2',3,4,4',5',6 - heptachlorobiphenyl
185	3	2,2',3,4,5,5',6 - heptachlorobiphenyl
189	1	2,3,3',4,4',5,5'- heptachlorobiphenyl
191	2	2,3,3',4,4',5',6 - heptachlorobiphenyl
194	2	2,2',3,3',4,4',5,5'- octachlorobiphenyl
201	3	2,2',3,3',4',5,5',6 - octachlorobiphenyl
204	4	2,2',3,4,4',5,6,6'- octachlorobiphenyl
205	2	2,3,3',4,4',5,5',6 - octachlorobiphenyl
206	3	2,2',3,3',4,4',5,5',6 - nonachlorobiphenyl
207	4	2,2',3,3',4,4',5,6,6'- nonachlorobiphenyl
209	4	Decachlorobiphenyl

* - Number of chlorines substituted in ortho positions.

Table 5. PCB congener concentrations in Aroclor mixtures.

Concentrations as mg/g

	Aroclor					
Congener	1016	1242A	1242B	1242C	1254	1260
15	13.4	16.2	16.6	16.7	0.00	0.00
18	72.1	68.1	70.2	70.0	0.90	1.06
37	13.8	17.2	17.7	17.7	0.24	0.45
44	38.9	31.7	32.5	31.8	29.3	0.49
47	12.0	9.93	10.1	9.93	1.39	0.12
49	30.9	25.9	26.5	26.1	15.9	0.37
52	36.7	31.0	32.0	31.6	52.4	2.03
60	1.10	23.2	22.0	21.7	5.60	3.00
72	0.15	0.10	0.09	0.12	0.00	0.00
77	0.03	2.86	3.00	3.07	0.22	0.01
78	0.00	0.00	0.00	0.00	0.52	0.00
79	0.00	0.00	0.00	0.00	0.00	0.00
81	0.00	0.24	0.27	0.25	0.44	0.00
86	0.11	3.54	3.46	3.53	0.54	0.94
101	0.76	6.20	6.22	6.00	71.1	27.0
105	0.09	4.10	4.27	4.17	54.9	0.28
114	0.00	0.25	0.27	0.27	1.70	0.00
118	0.10	4.22	4.56	4.43	66.4	2.62
119	0.00	0.11	0.11	0.13	0.79	0.05
126	0.00	0.05	0.03	0.02	0.03	0.00
128	0.00	0.19	0.26	0.23	17.2	3.28
137	0.00	0.08	0.08	0.06	6.12	0.25
138	0.07	0.55	0.59	0.53	69.3	76.3
141	0.00	0.12	0.14	0.11	14.8	33.4
143	0.00	0.05	0.04	0.05	5.66	4.03
153	0.17	0.47	0.55	0.46	42.7	85.4
156	0.00	0.06	0.07	0.06	7.92	2.68
157	0.00	0.00	0.00	0.05	2.86	0.14
158	0.00	0.09	0.08	0.07	10.1	6.74
166	0.67	0.84	1.81	1.31	0.61	2.76
167	0.00	0.00	0.03	0.00	2.85	1.13
169	0.00	0.00	0.00	0.00	0.00	0.00
170	0.00	0.02	0.02	0.03	3.54	28.2
180	0.00	0.00	0.00	0.00	10.5	141.
183	0.12	0.14	0.28	0.21	2.77	39.6
185	0.00	0.05	0.13	0.09	0.37	8.83
189	0.00	0.00	0.00	0.00	0.38	1.35
191	0.00	0.00	0.00	0.00	0.25	2.24
194	0.00	0.00	0.00	0.00	0.49	28.9
201	0.00	0.17	0.17	0.00	0.37	43.9
204	0.00	0.08	0.03	0.04	0.00	2.97
205	0.00	0.00	0.00	0.00	0.00	1.46
206	0.00	0.00	0.00	0.00	0.08	6.19
207	0.11	0.00	0.10	0.00	0.00	1.00
209	0.00	0.11	0.14	0.12	0.26	0.15
Sum	222	248	254	251	502	630

Table 6. PCB congener concentrations in the muscle of lobster from New Bedford Harbor.

Concentrations as ng/g dry weight

Congener	Sample # 902177	902178	902179	902180	902181
15	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00
37	4.98	2.23	2.08	2.99	7.09
44	0.00	0.00	0.00	0.00	2.66
47	13.1	8.68	7.80	11.2	24.7
49	0.00	4.80	0.00	0.00	12.7
52	4.32	4.32	0.00	2.9	13.8
60	9.70	10.3	5.92	9.70	27.4
72	0.50	0.50	0.40	0.40	1.00
77	9.52	3.82	3.91	4.99	7.09
78	0.00	0.24	0.00	0.00	0.00
79	0.00	0.00	0.00	0.00	0.00
81	0.53	0.00	0.00	0.00	0.69
86	0.30	1.95	0.20	0.40	6.50
101	14.6	24.6	8.24	13.8	78.7
105	61.5	32.2	31.8	39.4	63.6
114	1.92	1.05	0.95	1.60	2.76
118	237.	124.	120.	146.	220.
119	2.75	3.45	2.57	2.83	11.5
126	1.80	0.42	0.69	0.91	1.13
128	56.3	33.6	39.1	41.7	88.5
137	11.8	6.94	7.15	9.67	19.2
138	186.	127.	142.	127.	271.
141	0.00	3.18	0.00	0.00	6.72
143	0.00	0.00	0.00	0.00	3.46
153	332.	164.	189.	196.	359.
156	15.8	7.93	8.37	9.03	13.7
157	8.97	4.27	4.69	4.89	8.51
158	10.6	8.72	8.62	9.59	17.9
166	0.00	0.00	2.40	0.00	0.00
167	12.9	5.91	6.21	6.75	11.4
169	0.59	0.00	0.27	0.00	0.00
170	11.1	5.09	6.38	6.12	9.84
180	42.4	21.5	24.2	25.8	50.7
183	8.09	7.45	6.89	5.8	15.2
185	0.00	0.00	1.77	0.00	5.15
189	1.15	0.54	0.79	0.77	1.08
191	0.00	0.00	0.20	0.00	3.43
194	3.74	2.98	3.40	0.80	10.6
201	9.60	5.13	5.87	8.18	14.4
204	0.00	0.97	1.10	2.40	2.96
205	0.00	0.00	1.76	0.50	5.43
206	0.00	0.00	0.00	0.00	0.00
207	0.00	2.05	0.00	3.66	5.70
209	0.00	0.00	0.00	0.00	0.00
Sum	1070	630	645	696	1410

Table 7. PCB congener concentrations in the hepatopancreas of lobster from New Bedford Harbor.

Concentrations as ng/g dry weight

	Sample #				
Congener	902177	902178	902179	902180	902181
15	0.00	0.00	0.00	0.00	64.3
18	0.00	93.8	0.00	0.00	50.5
37	223.	176.	316.	361.	209.
44	0.00	75.8	0.00	0.00	47.1
47	692.	834.	1544	1560	672.
49	55.2	424.	40.4	113.	324.
52	180.	363.	80.8	285.	355.
60	506.	876.	1030	1230	696.
72	22.4	66.7	91.6	70.9	55.1
77	356.	283.	585.	550.	191.
78	0.00	0.00	0.00	0.00	13.9
79	0.00	0.00	0.00	0.00	0.00
81	0.00	17.4	41.0	0.00	13.3
86	0.00	149.	39.8	0.00	142.
101	712.	2250	1460	1700	1780
105	3350	3110	5930	6080	2300
114	114.	96.8	182.	201.	76.9
118	11600	9420	18800	18900	6920
119	134.	301.	455.	308.	254.
126	79.7	63.1	126.	116.	34.9
128	1980	1900	4920	2800	1170
137	586.	534.	1160	783.	304.
138	10900	12000	26100	15400	6810
141	31.0	251.	67.1	92.7	137.
143	0.00	75.1	0.00	0.00	25.1
153	17400	14000	29600	20400	7920
156	830.	760.	1550	1350	505.
157	537.	444.	986.	777.	301.
158	552.	750.	1510	982.	445.
166	84.0	79.7	150.	107.	45.1
167	781.	642.	1360	1110	415.
169	8.24	3.56	7.34	0.00	1.77
170	601.	482.	1300	644.	287.
180	2400	2110	5110	2860	1370
183	428.	643.	1130	652	378.
185	0.00	0.00	0.00	0.00	19.1
189	71.2	54.5	118.	114.	33.0
191	49.8	41.3	111.	123.	24.9
194	242.	213.	447.	340.	128.
201	372.	382.	698.	361.	236.
204	30.6	34.1	63.6	45.4	8.05
205	0.00	22.3	0.00	68.5	0.00
206	105.	84.6	180.	79.4	60.4
207	0.00	0.00	0.00	0.00	0.00
209	0.00	0.00	0.00	0.00	25.2
Sum	56000	54100	107000	80600	34900

Table 8. PCB congener concentrations in the muscle of flounder from New Bedford Harbor.

Concentrations as ng/g dry weight

	Sample #				
Congener	399568	399569	399572	399574	399575
15	8.42	1.65	0.00	0.00	0.00
18	24.7	31.2	4.10	12.6	40.2
37	53.8	22.0	1.39	2.36	6.96
44	26.5	20.5	1.99	6.90	21.2
47	145.	107.	1.79	6.92	195.
49	151.	237.	5.79	20.4	220.
52	118.	215.	6.45	21.9	115.
60	105.	70.2	2.02	10.2	156.
72	8.69	6.08	0.00	0.30	11.3
77	73.1	36.5	0.73	1.27	44.2
78	0.00	0.00	0.00	0.00	0.00
79	0.00	0.00	0.00	0.00	0.00
81	6.82	4.37	0.00	0.00	5.52
86	1.23	1.04	2.00	4.03	21.1
101	187.	237.	6.76	19.4	255.
105	420.	175.	3.52	12.1	406.
114	19.8	7.06	0.00	0.75	15.1
118	1100	390.	8.05	33.9	1010
119	38.7	15.5	1.12	1.90	37.0
126	6.02	2.52	0.00	0.14	4.46
128	55.8	37.4	2.63	3.57	149.
137	48.7	19.3	0.00	1.83	49.0
138	698.	302.	9.39	32.7	850.
141	51.7	21.1	0.00	2.32	53.0
143	9.92	8.43	0.00	1.14	11.4
153	895.	357.	12.9	45.0	1050
156	70.9	19.9	0.00	2.58	56.4
157	29.3	9.34	0.00	1.57	28.1
158	85.9	34.1	1.08	2.76	83.8
166	4.64	3.58	0.00	0.00	0.00
167	53.7	14.9	0.00	1.98	41.5
169	0.56	0.00	0.18	0.00	0.00
170	30.7	8.90	0.00	1.00	30.5
180	134.	41.4	2.46	6.53	131.
183	45.1	18.4	1.36	2.35	42.7
185	1.99	1.93	0.00	1.31	3.29
189	3.85	1.00	0.00	0.00	3.42
191	3.23	1.58	1.87	1.10	5.58
194	10.5	3.12	0.00	2.71	10.6
201	10.5	4.58	3.23	2.73	13.6
204	2.14	1.58	0.72	1.42	3.68
205	1.15	0.97	0.00	2.30	3.30
206	4.37	3.18	0.00	0.00	6.38
207	1.67	1.17	0.00	1.21	4.45
209	0.94	0.00	0.00	0.00	0.00
Sum	4740	2490	81.5	273.	5190

Figure 1. Map showing the lobster sampling locations.

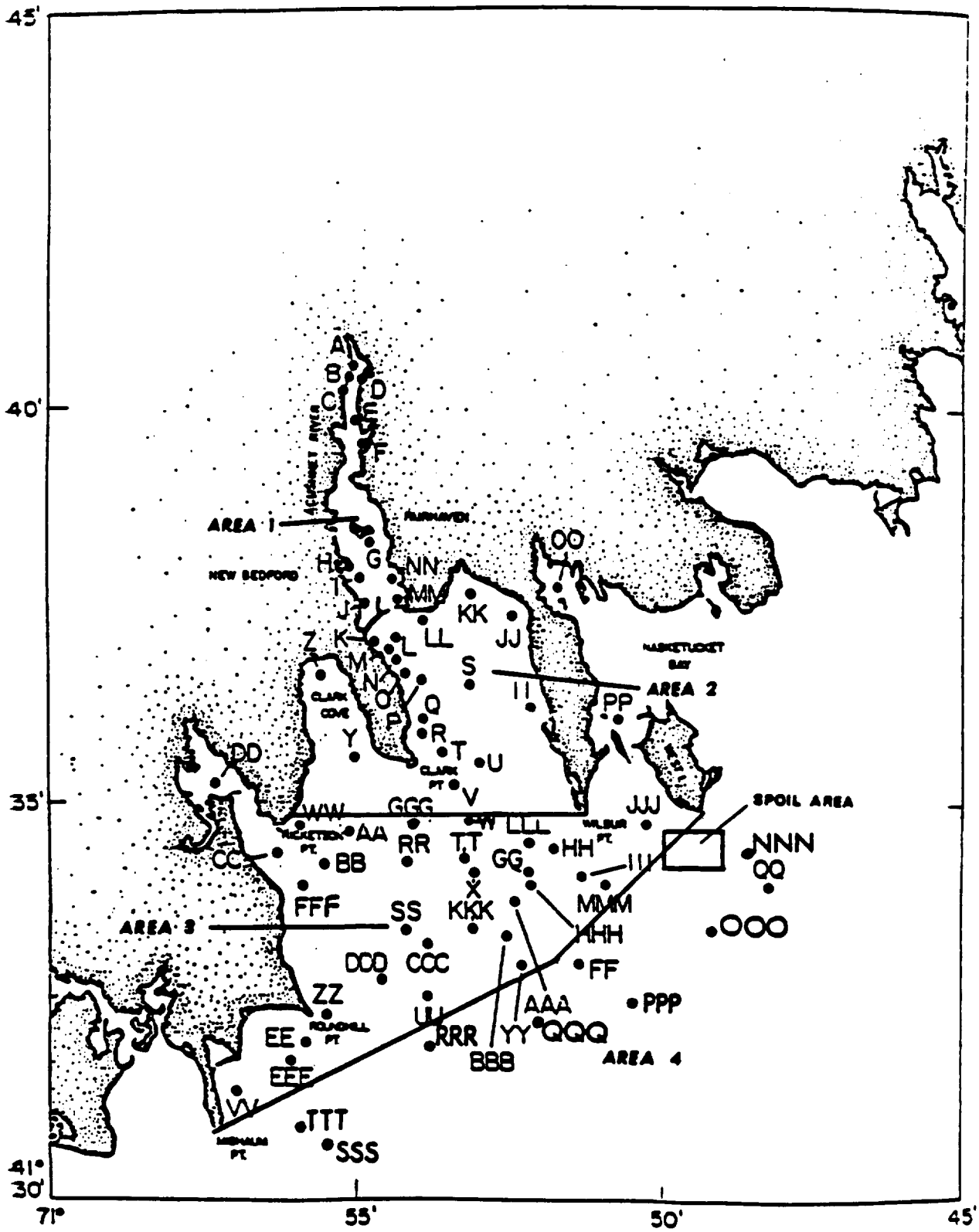

Figure 2. Flow chart of the sample analysis techniques.