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PCB Residues in *Mercenaria mercenaria* from New Bedford Harbor, 1978

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GIGER & BLUMER (1974) first reported about PCB's in Buzzards Bay. According to data report sheets supplied by the MASSACHUSETTS DIVISION OF MARINE FISHERIES (1977), blue mussels (Mytilus edulis) from New Bedford Harbor contained 110 mg/kg PCB's (dry weight, Aroclor 1242) in 1976, whereas soft shell clams contained 21 - 53 mg/kg PCB's (wet weight, Aroclor 1254). Decreasing amounts of residues were found in quahogs sampled at various distances to the harbor indicating that the outfall was located in the harbor area. The PCB's reached the harbor with effluents coming from two plants manufacturing electronic parts. PCB's in the effluents were ordered eliminated in 1976.

The study was done in 1978/79 to determine PCB levels in quahogs from the outer harbor after PCB's in plant effluents were eliminated. A depuration study under field conditions was included to determine the rate of decline of high residue levels over one year in contaminated quahogs transplanted to areas with no detectable contamination.

MATERIALS AND METHODS

Quahogs larger than 5 cm were collected on October 12, 1978 from six locations (Fig. 1). The individuals were sealed in aluminum foil and stored at -20°C.

For the depuration study 600 quahogs more than 2 years old were transplanted on November 20, 1978, from site D to a location approximately 14 km from the contaminated area by water. The new site was chosen after analyses of sediments had shown no measurable amounts of PCB's.

A random duplicated sample from the 600 quahogs was analyzed before they were transplanted. Samples were then taken as shown in Table 2. Quahogs survived well after the transplant and throughout the experiment maintaining adequate numbers for samples of 20 quahogs

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each.

For chemical analysis, approximately 300 g tissue and liquor were homogenized for two minutes in a Waring blender at low speed. Residues were extracted from 50 g aliquots using the PAM (1977) multiresidue method for non-ionic chlorinated compounds in fat free tissue.

Aliquots of the first four samples were saponified to verify the absence of interfering compounds. These extracts were analyzed by GLC on 10% DC-200 and 5% OV-17. Since there were no detectable interferences, no further confirmatory tests were performed.

The remaining extracts were analyzed by GLC on a Varian 2700 equipped with a ^{63}Ni detector and 2 m x 2 mm I.D. Chromatoglass column packed with 1.5% OV-17/1.95% QF-1 on 100/110 Anakrom Q. The following operating parameters were used: Injector 205°C, column 195°C, detector 250° C, carrier gas N_2 at 30 ml/min, electrometer 1 x 10^{-9} amp/mv. With these settings peak patterns and relative peak heights were obtained comparable with those reported by THOMPSON (1977).

The peak pattern of Aroclor 1254 (tech.) was evident in all extracts. R_T and relative heights of peaks emerging during the first three minutes were similar to Aroclor 1248 (EPA Code 5701, Lot #7370), not to Aroclor 1242 (EPA Code 5703, Lot #7352) or Aroclor 1221 (EPA Code 5701, Lot #7311). Aroclor 1016 was not tested. Peaks with R_T 0.83, 0.74 and 0.63 rel. to aldrin (THOMPSON 1977) of Aroclor 1248, and peaks with R_T 3.16, 3.60 and 4.08 rel. to aldrin (THOMPSON 1977) of Aroclor 1254 were used for quantitation. These peaks did not overlap in mixtures.

PCB's are reported as Aroclors 1254 and 1242. Aroclor 1242 was chosen because Aroclor 1248 is out of production.

Recovery at 0.1 ppm was 88 (85 - 89) percent. Quantity estimates are reported uncorrected and relative to wet weight.

RESULTS

Specimens from locations A and G had the lowest levels (Table 1), whereas those from location F had the highest. Of the remaining locations only the smaller individuals from location D showed residue levels exceeding the 95% confidence interval for both chemicals.

Statistical evaluation of data presented in Table 2 suggests that there was no significant change in the residue levels of specimens sampled in the outer harbor

area in 1976 and 1978.

The depuration study (Table 3) showed a more rapid decline of Aroclor 1242 than of Aroclor 1254.

DISCUSSION

The peak patterns obtained were not identical with peak patterns of Aroclor mixtures then in use. Degradation may alter the composition of PCB mixtures in environmental samples (CAREY & HARVEY 1978, MIEURE, 1975). Selective uptake by bivalves (COURTNEY & DENTON 1976) or different solubility in water (MIEURE et al. 1975) may also affect the peak patterns of industrial PCB mixtures.

Predominance of Aroclor 1242 confirmed the results by COURTNEY & DENTON (1976) that accumulation of PCB's in M. mercenaria decreased with increasing chlorination of the isomers.

Total residues ranged from 0.35 to 6.93 µg/g with a mean of 2.86 ± 0.73 µg/g. The 95% confidence intervals singled out the highly contaminated (F) and least contaminated samples (A and G). D and E were contaminated from a source farther upstream. According to the data sheets (1977) sediment samples from these two locations analyzed in 1976 had 74.8 µg/g (D) and 61.3 µg/g (E) PCB's rel. to dry weight. This may explain the difference in the residue levels in quahogs from both locations in 1978.

Compared to PCB levels in M. mercenaria reported by STAINKEN & ROLLWAGEN (1979) and COURTNEY & DENTON (1976), the residue levels were high. Comparisons with other bivalves were not made because of different rates of accumulation due to differences in the water-clearance rates and, possibly, biological properties (LANGSTON 1978).

Although the amounts of Aroclor 1242 follow the pattern described for the total amounts, they vary more than the Aroclor 1254 residues. The higher the total residues, and the closer to the source of contamination in the samples were taken, the higher the Aroclor 1242 levels (Table 1).

The low losses of PCB during the first six months of the depuration experiment are in agreement with an earlier report (COURTNEY & DENTON 1976). A rapid decrease occurred in May or early June 1979. Decreases at this time of year were also observed with oysters (Crassostrea virginica) contaminated with Aroclor 1254 (WILSON & FORESTER 1978) and were associated with the

TABLE 1. PCB levels in quahogs sampled on Oct. 12, 1978: Means of two analyses.

Location	Size in mm	1242	1254	Total
A	70 - 80	0.26	0.09	0.35
	90 - 100	0.43	0.09	0.52
C	60 - 70	2.00	0.49	2.49
	90 - 100	1.67	0.62	2.29
D	40 - 50	4.16	0.70	4.86
	65 - 75	3.29	0.62	3.91
E	70 - 75	1.89	0.61	2.50
F	60 - 70	5.65	0.87	6.52
	90 - 100	3.87	1.06	6.93
G	70 - 80	0.27	0.19	0.46
	100 - 110	9.39	0.32	0.61
Mean		2.35	0.51	2.86
Standard Error		0.64	0.1	0.73
95% Confidence Interv.		1.11-3.60	0.31-0.69	1.43-4.28

TABLE 2. Comparison of residue levels in quahogs collected in 1976 and 1978 in the outer harbor area.

1976	Total PCB's	1978	Total PCB's
1	3.30	A	0.35
2	0.70		0.52
3	1.81	C	2.49
4	1.30		2.29
5	0.44	F[1)]	6.52
6	0.41		6.93
7	0.32	G	0.46
			0.61
Mean	1.18		2.52
Standard Error of Mean		1.1037	
t Statistic		1.2127	
d.f.		13	
t 0.50		2.160	

1) This location was not sampled in 1976.

Table 3. Depuration of PCB's.

Date	Aroclor 1242	Aroclor 1254	Total
10-12-78[1)]	4.16	0.70	4.86
10-12-78[1)]	3.29	0.62	3.91
12-06-78	2.69	0.70	3.39
12-20-78	2.32	0.58	2.90
01-17-79	2.35	0.56	2.91
03-28-79	2.14	0.61	2.75
05-04-79	1.73	0.54	2.27
06-06-79	0.39	0.21	0.60
07-16-79	0.19	0.02	0.21
09-10-79	0.30	T	0.30
10-16-79[2)]	0.42	0.14	0.56

1) Individuals of different sizes prior to the transfer from site D.
2) Individuals from site D one year later.

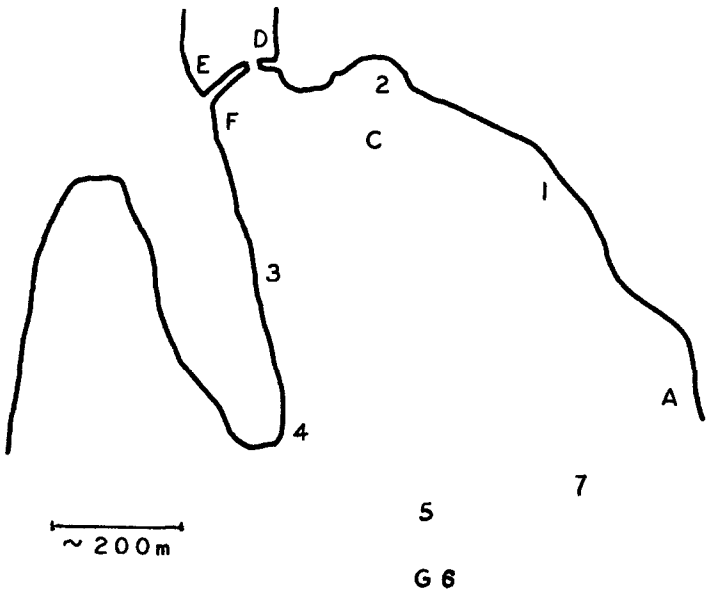

Figure 1. New Bedford harbor. Locations of sampling sites.

lipid metabolism prior to and during the spawning period.

The results of this study show the expected correlation between residue levels and distance to the sources of contamination. A statistical comparison of the 1978 with the 1976 data suggests no significant difference in residues of specimens taken in the outer harbor (Fig. 1). There were sufficient amounts of PCB's in the sediments to maintain similar residue levels in shellfish.

The depuration study suggests that the rate of depuration depends on physiological processes as well as on the availability of the contaminant.

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