http://dx.doi.org/10.7773/cm.v7i1.357

PCB IN MUSSELS *Mytilus californianus* FROM THE NORTHERN BAJA CALIFORNIA COAST

by

E.A. Gutierrez-Galindo
Instituto de Investigaciones Oceanológicas
Apartado Postal 453
Ensenada, Baja California, México

y

R. Cajal Medrano
(Consejo Nacional de Ciencia y Tecnología en México)
Department of Oceanography
Southampton University
20 St. Margaret's House
Hulse Rd. SO12JX
Southampton, England

ABSTRACT

As part of a study monitoring marine pollution along the northern Baja California coast (from the U.S.-Mexican border south to Bahia de San Quintin, approximately 350 km), we sampled specimens of the California mussel *Mytilus californianus*. We measured the concentrations of PCB in the soft body tissue of *M. californianus* in transplanted and resident samples to determine differences in contamination levels along the north-south coastline and between offshore and intertidal locations. The results suggest that there is not much PCB contamination in this region. We found the highest values at the study sites closest to the dense population centers of the U.S.-Mexican border.

RESUMEN

Como parte de un estudio de monitoreo de contaminación marina a lo largo de la costa norte de Baja California (desde la frontera E.U.- México hasta la Bahía de San Quintín al sur, aproximadamente 350 km) se tomaron especímenes del mejillón californiano *Mytilus californianus*. Se midieron las concentraciones de PCB en el tejido corporal suave de mejillones transplantados y residentes, para determinar las diferencias en niveles de contaminación a lo largo de la costa y en localidades entre la zona de entremareas y playa afuera. Los resultados sugieren que no hay mucha contaminación por PCB en esta región. Los valores más altos se encontraron en los sitios de estudio más cercanos a los densos centros de población de la frontera E.U.-México.

INTRODUCTION

Considerable evidence suggest that PCB's are globally distributed throughout the aquatic environment by a number of modes of transport (Risebrough et al., 1968; Sodergren, 1972). Polychlorinated biphenyls comprise a group of chlorinated hydrocarbons which are only slightly soluble in sea water and posses marked affinities for particular matter (Haque et al., 1974; Lawrence and Tosine, 1976). These compounds are liphophilic and extremely long-lived in the environment, properties which have resulted in their accumulation in marine organisms (Peakall and Lincer, 1970; Hammond et al., 1972; Young et al., 1976). Mussels have been included in marine pollution surveys (Koeman et al., 1969), because of their suitability as an indicator species. They have a sedentary adult life style, widespread availability in large numbers, and an ability to concentrate pollutants to a detectable level from the surrounding sea-water (Goldberg, 1975).

A seasonal survey was carried out to measure existing concentrations of polychlorinated biphenyls in the coast, at 0.5 m, 5 m, 10 m and 15 m depths in the water column. The organism selected for this study was the intertidal mussel *Mytilus californianus*.

MATERIALS AND METHODS

Specimens of mussels, 5 cm in length, were collected in September 22, 1977 from Bahia Papalote (Punta Banda) B.C., Mexico, a relatively uncontaminated region approximately 100 km south of the U.S.A. border. Following the system described by Young et al., (1976), they were transported alive to a taut-line buoy system (Fig. 1) that had been installed 2 km from the coast in Isla Todos Santos, Erendira and Bahia San Quintin (Fig. 2). From this system, four nylon-mesh cages, each containing about 100 mussels were suspended at each of four depths below the surface. Ten specimens were collected monthly from September 22, 1977 through January 6, 1978, from each level of the buoy system at each location. At the same time that the collections were made from these three locations, ten resident samples of 5 cm long *M. californianus* also were obtained from the rocky intertidal zones at Popotla, Bahia Papalote, Punta China and Erendira (Fig. 2).

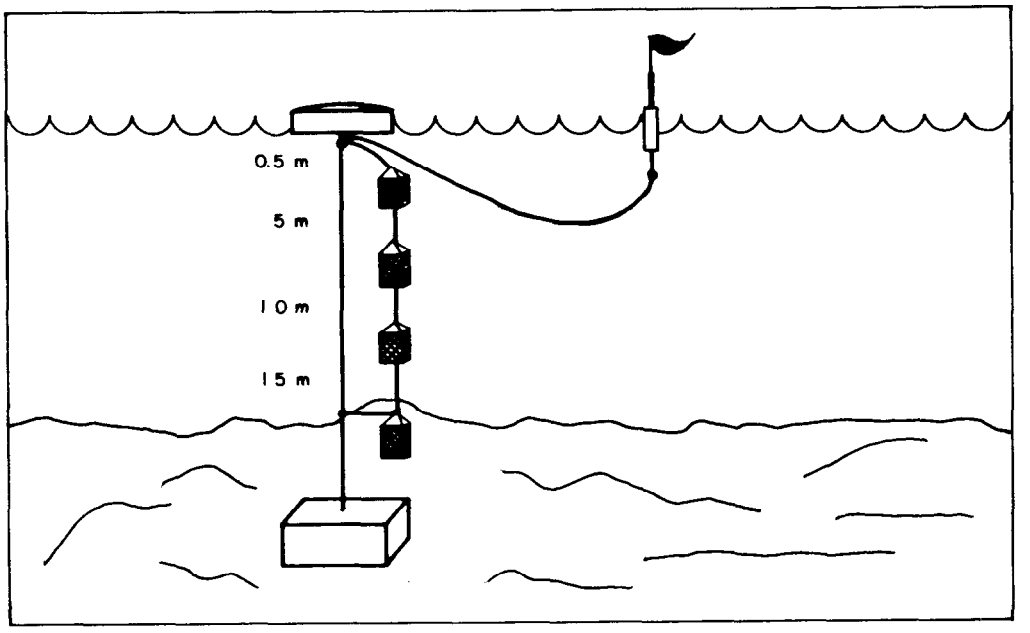

Fig. 1 - TAUT-LINE BUOY SYSTEM USED IN SURVEY OF PCB OFF NORTHERN BAJA CALIFORNIA. MUSSELS WERE KEPT IN CAGES AT VARIOUS DEPTHS.

The whole soft tissues (excluding byssal threads) of 5 organisms were analysed individually, following the procedure employed by Young et al., (1976). The analysis was carried out with a gas chromatograph (Hewlett Packard model 5700A) equipped with a glass column (6 mm O.D., 4 mm I.D. packed with 1.5% SP 2250/1.95% SP 2401 on 100/120 mesh) under the following conditions: carrier gas; a mixture of 5% methane and 95% argon, flow rate of 30 ml/min. The injector, column and detector temperatures were 250° 200° and 300°C, respectively. Calculations were made by comparing the peak hight of the samples to the peak hight of the standards.

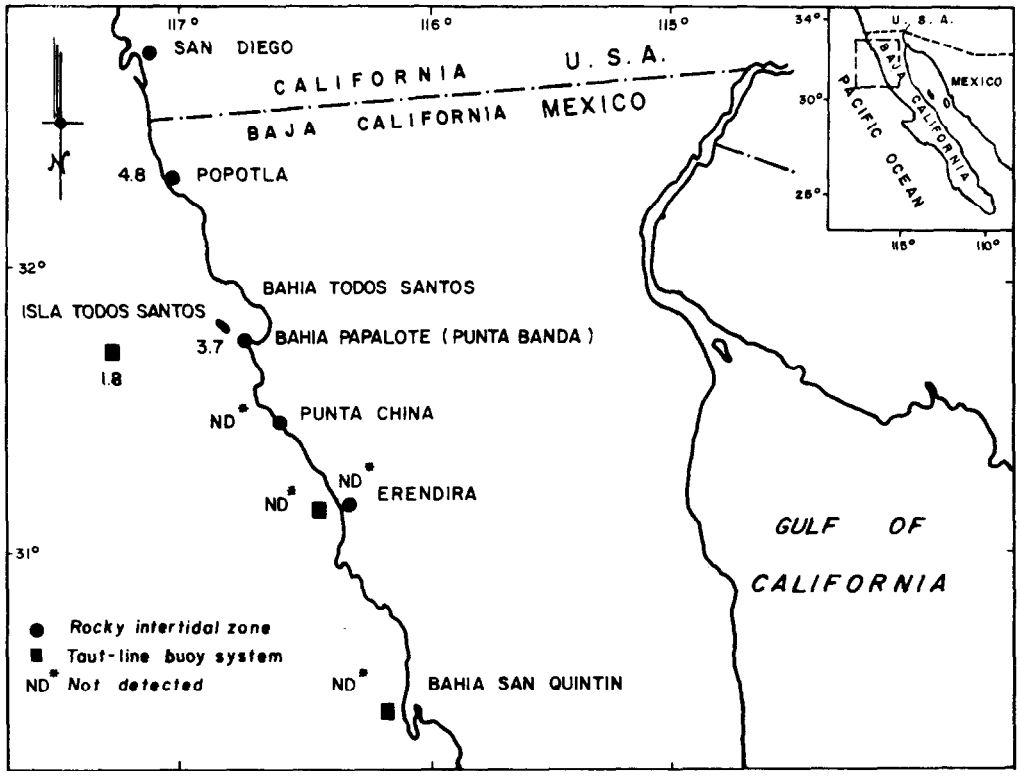

Fig. 2 - DISTRIBUTION OF TOTAL AROCLOR 1254 AVERAGE CONCENTRATION IN WHOLE SOFT TISSUE OF *Mytilus californianus* (PPB EXPRESSED IN ng/g WET WEIGTH).

RESULTS AND DISCUSSION

The PCB concentration in whole soft tissue of *M. californianus* in the rocky intertidal zone did not change markedly in the north region of our study. The mean values (in wet weight basis) ranged from 3.7 ng/g at Bahia Papalote (Punta Banda) to 4.8 ng/g in Popotla (Table 1) (Fig. 2). For Bahia Papalote, detectable traces existed from September through October, after which the concentrations rose steadily from November 2.8 ng/g to January 4.6 ng/g (Table 1). For Popotla the PCB concentration rose steadily from September 3.1 ng/g to December 7.3 ng/g (Table 1). For Punta China and Erendira locations, PCB contamination was not detected.

In the mussels from the taut-line buoy system in Isla Todos Santos was found 1.8 ng/g (no definite pattern was discernible in the results) (Table 2). PCBs were not detectable after the first month in the transplanted mussels in the southern region (Erendira and Bahia San Quintin).

For Popotla, Bahia Papalote and Isla Todos Santos a possible continued input in the water or in the food web may be responsible for the observed concentrations. Martin et al., (1980) has shown Aroclor 1254 concentrations in *Mytilus edulis* of 1700 ng/g in 1978 and 1400 ng/g (dry weight) in 1979 for the San Diego Harbor, California, U.S.A. For *M. californianus*, the same authors observe 85 ng/g in 1978 and 37 ng/g in 1979 for La Jolla, California, U.S.A. These concentration levels are far grater than what we found in our more southernly study sites. Our results indicate that waters closer to the U.S.A. border were slightly polluted with PCB, while the most distant waters toward the south were not. This suggests that there may be a relationship between the concentration of PCB detected in this northern region and its proximity to the southern California U.S. coastline, the most polluted site on the west coast of North America (Young et al., 1976). Popotla, Bahia Papalote and Isla Todos Santos are characterized by low urban populations and no industrial activity. Thus only an insignificant level of PCB contamination from local input would seem probable. It is difficult to determine the reason for the decline of PCB (traces not detectable) in the transplanted mussels from September to October in the locations of Erendira and Bahia San Quintin. However, the reproduction of mussels can be suggested as possible mechanism of loosing these compounds. It has been seen that the lipid concentrations in mussels decrease during the reproduction cycle of the organism (Marchand et al., 1976). Young (1946), indicate that lipid reserves in *M. californianus* increase during the summer and decrease when the organisms start their reproductive cycle.

CONCLUSIONS

Our survey of mussels has shown that PCB contamination is not widespread along the Pacific North West coast of Baja California. Polychlorinated biphenyls were not detectable in all samples. Generally PCB concentrations tended to decrease from northern to southern locations, falling ultimately to non detectable levels.

Location	September	October	November	December	January	Mean value
Popotla	3.1	3.9	4.8	7.3	---	4.8
Bahia Papalote	Traces	Traces	2.8	---	4.6	3.7
Punta China	ND*	ND*	ND*	---	ND*	---
Erêndira	ND*	ND*	ND*	ND*	---	---

* Not Detected

Table 1.- Monthly changes in concentrations of Aroclor 1254 in whole soft tissue of *Mytilus californianus* in the rocky intertidal zone. Results are expressed as average values in ppb/wet weight.

Location	Month	Water Column Depths				Mean values	
		0.5 m	5 m	10 m	15 m		
Isla Todos Santos	September*	Traces	Traces	Traces	Traces	Traces	1.8
	October	1.5	1.8	1.9	1.8	1.8	
	November	1.5	2.0	1.0	1.3	1.5	
	January	Traces	Traces	2.2	2.1	2.1	
Erêndira	September*	Traces	Traces	Traces	Traces	Traces	---
	October	ND**	ND**	ND**	ND**	---	
Bahia San Quintin	September*	Traces	Traces	Traces	Traces	Traces	---
	October	ND**	ND**	ND**	ND**	---	
	November	ND**	ND**	ND**	ND**	---	
	December	ND**	ND**	ND**	ND**	---	

* Initial value at the moment of transplant

** Not Detected

note: each value corresponds to the mean value of five individual analysis

Table 2. Monthly changes in concentrations of Aroclor 1254 in whole soft tissue of *Mytilus californianus* transported from Bahia Papalote (Punta Banda) to the taut-line buoy system. Results are given as average values in ppb/wet weight.

ACKNOWLEDGMENTS

We are greatful to Dr. Willard Bascom, Dr. David R. Young and M.S. Theodore C. Heesen of the Southern California Coastal Water Research Project, El Segundo, Calif., U.S.A. for helpful discussion and excellent technical assistance. We thank especially Dr. Andrew Benson and Mr. George W. Rommel of Scripps Institution of Oceanography, La Jolla, Calif., U.S.A. for allowing us to use his laboratory for analysis.

BIBLIOGRAPHY

GOLDBERG, E.D., 1975. The mussel watch a first step in global marine monitoring. Mar. Pollut. Bull., 6, 111-114.

HAMMOND, P.B., I.C.T. Nisbet, A.F. Sarofim, W.H. Drury, N. Nelson and D.P. Rall, 1972. PCBs environmental impact. Envir Res. 5, 249-362.

HAQUE, R., D.W. Schmedding and V.H. Freed, 1974. Aqueous solubility, adsorption and vapor behavior of polychlorinated biphenyl Aroclor 1254. Sci. Techn. 8, 139-142.

KOEMAN, J.H., M.C. Noever de Brauw and R.H. Vos. 1969. Chlorinated biphenyls in fish, mussels and birds from the River Rhine and Neatherlands coastal area. Nature, Lond, 221, 1126-1128.

LAWRENCE, J. and H.M. Tosine, 1976. Adsorption of polychlorinated biphenyls from aqueous solution and sewage. Envir. Sci. Techn. 10, 381-383.

MARCHAND, M, D. Vas and E.K. Duursma, 1976. Levels of PCBs and DDT in mussels from the NW Mediterranean. Mar. Pollut. Bull. 7, 4-7.

MARTIN, M., D. Crane. T. Lew and W. Seto, 1980. Synthetic organic compounds in mussels, *Mytilus californianus* and *M. edulis*, along the California coast and selected harbors and bays. California mussel watch 1979-1980 Part II. Water Quality Monitoring Report. 80-8, 1-49.

PEAKALL, D.B. and J.L. Lincer, 1970. Polychlorinated biphenyl another long life widespread chemical in the environment. Biosci. 20, 958-964.

RISEBROUGH, R.W., P. Reiche, D.B. Peakall. S.G. Herman and M.N. Kirven, 1968. Polychlorinated biphenyls in the global ecosystem. Nature, Lond. 220, 1098-2005.

SODERGREN, A., 1972. Chlorinated hydrocarbons residues in airborne fallout. Nature, Lond. 236, 395-400.

YOUNG, D.R., T.C. Heesen and D.J. McDermott, 1976. An offshore biomonitoring system for chlorinated hydrocarbons. Mar. Pollut. Bull., 4, 156-159.

YOUNG, R. 1946. Spawning and setting season of the mussel *Mytilus californianus*. Ecol. 27 (4), 354-363.