CONTAMINANTS IN HARBORS

David R.Young and Theadore C. Heesen

The numerous harbors and marinas along the southern California coastline may be important sources of certain contaminants to the coastal waters. Two types of chlorinated hydrocarbon contaminants that are of particular interest to us are the industrial compound PCB and the pesticide DDT. PCB has been used in past years in vessel paints and hydraulic fluids; this substance and DDT may also reach harbors through industrial and municipal treatment plant effluents, surface runoff, and aerial fallout directly to the water surface.

Each of the three largest harbors on the southern California coast is located relatively close to a major municipal wastewater discharge site:

- The Los Angeles Long Beach Harbor is located in San Pedro Bay; just northwest of the northern entrance to this harbor are the outfalls of the Los Angeles County Sanitation Districts.

- The Newport Harbor is located to the south of the Orange County Sanitation Districts outfall system.

- The mouth of San Diego Harbor is iust to the south of the Point Loma Treatment Plant and outfalls, which are operated by the City of San Diego. Similar situations exist elsewhere along the coast, such as in Ventura County.

The proximity of harbors and wastewater discharge sites makes it difficult to pinpoint the sources of the anomalous chlorinated hydrocarbon distributions in the three coastal areas. Undoubtedly, the substances enter the marine environment through the outfalls. But what are the inputs to the ocean via the nearby harbors? We have investigated this question in several projects during the past year.

Our survey of chlorinated hydrocarbon inputs (described elsewhere in this report) yielded estimates of the annual input rates of DDT and its residues and PCB 1254 to the three harbors via five potential routes of entry. The results are presented in Table 1.

In addition, we also made use of the proven ability of the intertidal mussel *Mytilus* to indicate space and time changes in contamination levels of DDT and PCB compounds. We made composites of the whole soft tissue (excluding byssal threads) of ten bay mussels (*M. edulis*) randomly selected from collections of S cm specimens taken at numerous stations within each harbor; these composites were analyzed for their synthetic organic content by Project chemists using electron capture gas chromatography. At least three coastal sites near each of the harbor entrances were also sampled for this species. The results are summarized in Table 2.

INPUTS OF DDT

The input data indicate that negligible quantities of DDT are now entering Newport and San Diego Bays via the five major routes under study. Because of the large contribution of stormwater from the Los Angeles River, surface runoff is the dominant source of DDT to San Pedro Harbor; however, the estimated total annual input of about 100 kg/yr through runoff is insignificant relative to the 3,200 kg discharged through the outfalls at Whites Point, just northwest of the harbor, during 1973. (The 1971 DDT input via this municipal wastewater discharge was approximately 19,000 kg, and previous annual inputs may have been considerably higher.)

The distribution pattern of total DDT concentrations in the intertidal mussels generally supports the hypothesis that the Palos Verdes submarine outfall system has been the dominant source of DDT to the coastal and harbor zones investigated. A maximum tissue concentration of 1,500 ppb (wet weight) occurred on the coast near Whites Point, at base of the outfalls. The median value for samples from inside San Pedro Harbor was approximately half that for the samples collected outside the harbor between Point Vicente and Seal Beach.

In general, the DDT values in mussels decrease with distance from Palos Verdes. The median value for the coastal specimens outside Newport Harbor, 40 km to the south, was one fourth that for the San Pedro region. However, samples from inside Newport Harbor contained roughly twice as much DDT as did those from the adjacent coast. As the present known input rates of DDT to Newport Bay are negligible, these higher values in the harbor mussels may be due to recycling of past accumulations of DDT within the restricted waters there.

The San Diego mussels showed the lowest DDT concentrations: The median coastal value was 58 ppb, compared to the median harbor values of 32 ppb. These levels, which are not significantly different, were approximately 30 times lower than the concentration observed at the base of the Whites Point outfalls, 150 km to the north.

INPUTS OF PCB

The data of Table 2 indicate an important difference between the relative distribution of PCB and those of DDT. The coastal PCB medians decrease by a factor of two from San Pedro to San Diego, but the harbor medians increase by a factor of two. This pattern indicates that, in contrast to the case for DDT, there appears to be more than one important source of PCB to nearshore waters of the region.

Our estimates for 1973 mass emission rates of PCB 1254 from the outfall systems off Palos Verdes Peninsula, Newport Beach, and Point Loma are 800, 300, and 70 kg/yr, respectively. We therefore would expect coastal mussels off San Pedro and Newport Bays to be more influenced by PCB from the ocean outfalls than are those off San Diego and the median PCB concentrations just presented are consistent with this expectation. However, in all three regions, the values of PCB in mussels from inside the harbors

exceed those in coastal specimens, implying that a specific harbor related source may have been a dominant, ubiquitous source of PCB to the coastal waters in recent years. The harbor source may well have contributed to the PCB levels measured in the mussels collected from outside the three harbors.

Although the data of Table 1 do not indicate which of the potential sources investigated is most likely to have been the dominant one, the fact that the high PCB concentrations are found wherever there is intense vessel activity suggests that this may well be the key. In all three harbors, the values are highest in the confined regions where recreational or commercial and naval vessels are present. This conclusion is strengthened particularly by the fact that some of the highest PCB concentrations observed occurred in Newport Harbor, an anchorage with a high density of recreational craft and with no significant discharge of industrial, municipal, or surface runoff wastewater.

We conducted an extensive sampling and analysis program on antifouling paints applied during 1973 and found no significant PCB concentrations in any of the samples. However, a few samples of older paints removed from vessel bottoms in 1973 did contain up to 10 percent PCB. We are now seeking samples of pre 1970 antifouling paints to further investigate the possibility that antifouling paints were once an important source of PCB. If the tentative conclusions attributing the relatively high PCB concentrations in harbor mussels to past inputs from antifouling paints are confirmed, it could mean that the prohibition of "open" use of PCB, such as in paints, has decreased the application of PCB to vessel bottoms by up to 10,000 kg/yr in the largest harbors of the Bight. Nevertheless, the restricted circulation in these harbors, and the proximity of harbor intertidal organisms to potential PCB sources, have resulted in significantly higher contamination levels of PCB in harbor mussels than in coastal mussels near present major submarine discharges of these chlorinated hydrocarbons.

The results of this study have been presented at the Fourth Technical Conference on Estuaries of the Pacific Northwest, Corvallis, Oregon and will be published in the proceedings volume. The study has also been published in our Technical Memorandum 214.

TABLES

Table 1.
Estimated typical annual mass emission rates of total DDT and PCB 1254 (kg/yr) to three southern California harbors.

	San Pedro Harbor	Newport Harbor	San Diego Harbor
Municipal Wastewater			
DDT	4	~0	~0
PCB	2	~0	~0
Direct Industrial Discharge			
DDT	17	~0	--
PCB	51	~0	--
Surface Runoff			
DDT	96	0.7	2
PCB	96	0.4	3
Aerial Fallout			
DDT	7	0.3	0.6
PCB	2	0.2	0.8
Antifouling Paints			
DDT*			
PCB	0.1		

*p,p' -- DDT only.

Table 2.
Summary of chlorinated hydrocarbon concentrations (ug/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