

## CHAPTER 8

### TISSUE CHEMISTRY

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#### INTRODUCTION

The Terminal Island Water Reclamation Plant (TIWRP) NPDES permit requires an annual Los Angeles Harbor fish survey to assess the levels of contamination of fishes in the vicinity of the TIWRP discharge area. This chapter of the assessment report addresses the following two management questions: “Is fish tissue contamination in the vicinity of the outfall changing over time?” and “Are seafood tissue concentrations below levels that will ensure public safety?”

To address the first question, this report provides the analyses results and an assessment of the temporal trends of priority pollutants in muscle and liver tissues of white croaker (*Genyonemus lineatus*) collected in the vicinity of TIWRP discharge area.

To answer the second question, the NPDES permit requires annual monitoring and review of pollutant bioaccumulation in sportfish other than white croaker. The contamination levels in fish muscle tissues are compared with the results from previous years, with the PCB trigger levels in the California OEHHA (Office of the Environmental Health Hazard Assessment) fish consumption advisories, and with the DDT Screening Values (SV) proposed by the USEPA as a Guidance Tissue Level (GTL) for screening surveys to determine whether any contaminant in fish is a potential human health concern.

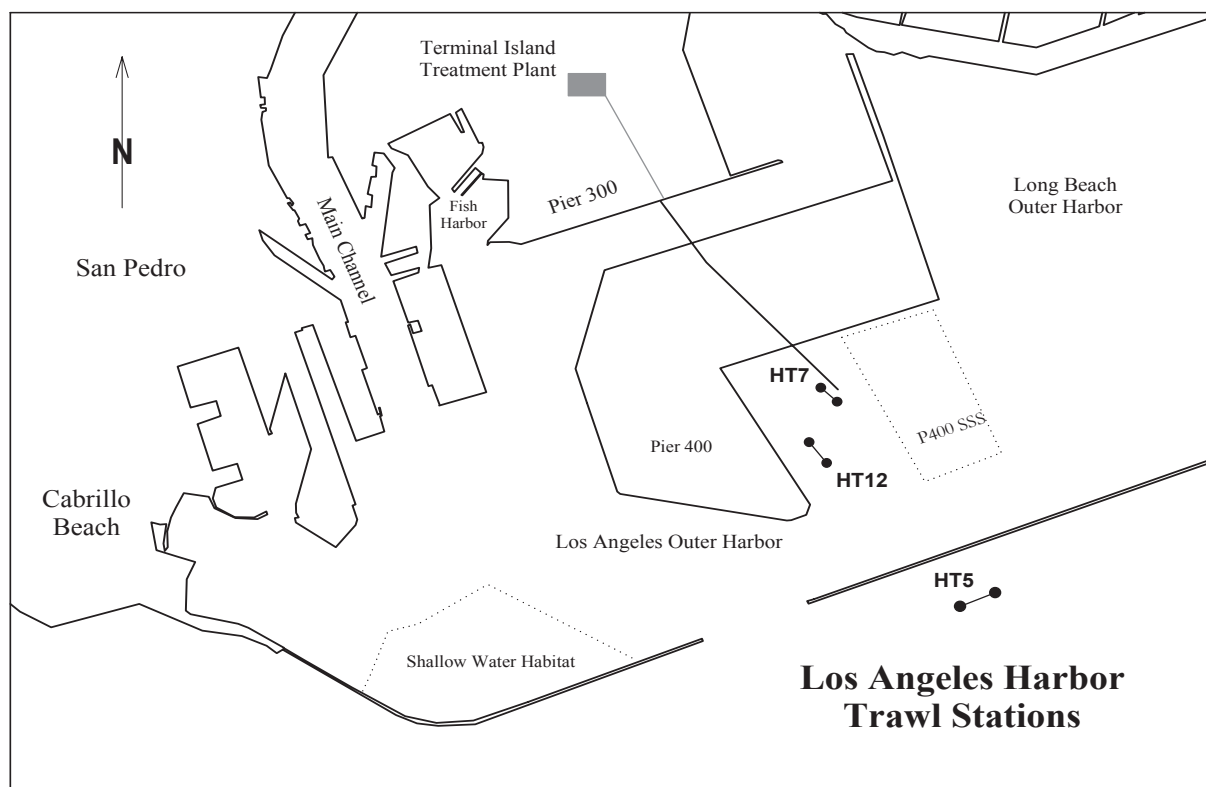
Until July 1996, secondary treated effluent was discharged from TIWRP through a six-meter deep outfall into the Outer Harbor south of Pier 300. Fishes were collected from stations at Cabrillo Pier and Horseshoe Kelp from 1993 to 1996. The construction of Pier 400 in the mid-90’s required relocation of the outfall. A new outfall, extending from TIWRP to the area of the Outer Los Angeles Harbor between Pier 400 and the breakwaters at a depth of 10 meters (Figure 8-1), was placed in service in late July 1996. TIWRP has annually discharged about 15 MGD of tertiary treated wastewater through the new outfall beginning in 1997. In order to compare the pollutant concentrations in fishes from different areas within and outside the Los Angeles Harbor, the surveys were conducted in three different monitoring stations (Figure 8-1).

In 2003, the City of Los Angeles participated in the Southern California Bight Regional Monitoring Survey (Bight’03). All of the required NPDES permit tissue sampling in L.A. Harbor (LAH) was suspended in order to exchange the resources for the Bight’03 Survey.

#### MATERIALS AND METHODS

##### FIELD SAMPLING

In 2006, ten white croaker and eight white surfperch



**Figure 8-1.** Fish tissue collection sites in Los Angeles Harbor.

samples were collected by trawling at station HT7 (Figure 8-1). In 2007, two white croaker samples were collected at HT7, eight were collected at HT12, and ten queenfish samples were collected at HT12. No tissue samples were collected at station HT5 (reference site outside of the breakwater) during either of the 2006 and 2007 surveys. For a detailed description of the trawling procedure, see Chapter 7 (Trawl-Caught Fish and Invertebrates). The number of tissue samples collected is shown in Table 8-1. The liver tissues from five white croakers were composited into one liver sample thus a total of two liver composite samples were collected each year.

Upon capture, each fish was examined for abnormalities, measured, and weighed. The selected fish specimens were frozen prior to dissection.

## DISSECTION

Dissections were performed in the laboratory

following the method of Lauenstein and Young (1986). Muscle and liver tissues collected were individually transferred to methylene chloride-rinsed glass containers for analysis of organic priority pollutants. Samples were kept frozen until analysis.

## LABORATORY ANALYSIS

Specific details regarding tissue priority pollutant analyses are provided in Appendix C. For organic analyses, liver and muscle tissues were solvent extracted and the extracts were concentrated prior to analysis. Dichlorodiphenyltrichloroethane (DDT) derivatives and polychlorinated biphenyls (PCBs) were analyzed using a Gas Chromatograph (GC) with Electron Capture Detectors (ECD). Laboratory analyses results were reported in mg/kg wet-wt. Total percent lipid was analyzed by solvent extraction followed by gravimetric analysis of the residue.

**Table 8-1.** Location and number of trawl and sportfish samples collected during 2006 and 2007.

	<i>Station</i>	<i>2006 Summer</i>	<i>2007 Summer</i>
<b>Trawl fish (white croaker)</b>	<b>HT7</b>	<b>10</b>	<b>2</b>
	<b>HT12</b>	<b>0</b>	<b>8</b>
<b>Sport fish (white surfperch)</b>	<b>HT7</b>	<b>8*</b>	<b>0</b>
<b>Sport fish (queenfish)</b>	<b>HT12</b>	<b>0*</b>	<b>10</b>

\* Total of ten individual sport fish required, but not achieved.

## RESULTS

All muscle and liver tissue samples were analyzed for total DDT, six DDT derivatives, total PCB, seven PCB Aroclors, and percent lipids.

P,p'-DDE was detected in 100% and o,p'-DDE in 90% and 70% of the ten white croaker muscle samples in 2006 and 2007, respectively. P,p'-DDT was detected in one of ten white croaker muscle samples in both 2006 and 2007, while p,p'-DDD was detected in one sample in 2007. In 2007, one white croaker sample contained p,p'-DDE in excess of the screening value (SV) of 0.560 mg/kg set by the USEPA (Table 8-2). PCB 1260, was detected in 90 and 80% of the samples tested 2006 and 2007, respectively. PCB 1254 was detected in one sample in 2006. Except as described above, DDT derivatives and PCB Aroclors were not detected in white croaker muscle tissue.

P,p'-DDE was detected in all white surfperch during the 2006 survey and all in queenfish muscle samples during the 2007 survey (Table 8-3). The average concentrations were 0.064 and 0.042 mg/kg wet-wt in 2006 and 2007, respectively. Low levels of p,p'-DDD were detected in four of ten queenfish muscle samples in 2007. PCB 1254 and PCB 1260 were detected in one of eight white surfperch muscle tissue in 2006 and in seven (1254) and nine (1260) of ten queenfish samples in 2007. In 2006, the PCB 1254 concentration of one white surfperch sample

and PCB 1260 concentration of one white surfperch sample exceeded the OEHHA fish consumption advisory value of 0.1 mg/kg.

O,p'-DDE, p,p'-DDE, and PCB 1260 were detected in all white croaker liver tissues in 2006 and 2007 (Table 8-4). PCB 1254 was detected in one of two liver tissue composite samples in 2006 and p,p'-DDT was detected in one of two liver tissue composite samples in 2007. During 2006 and 2007, the liver tissue concentrations of p,p'-DDE and PCB 1260 exceeded their respective EPA screening and OEHHA fish consumption advisory values in all samples tested. Additionally, in 2006 the PCB 1254 concentrations of both liver samples exceeded the fish consumption advisory value.

The 2006 and 2007 average total DDT concentrations in white croaker liver samples, 1.046 mg/kg and 1.685 mg/kg; were about ten times higher than the muscle sample average concentrations, 0.142 mg/kg and 0.271 mg/kg, respectively, for the same period (Tables 8-2 and 8-4). The total PCB data followed a similar pattern. The average percent lipid levels in liver tissues of white croaker in the two years of survey were consistently about 7% higher than in muscle tissues.

As shown in Table 8.5, the total PCB concentration in white croaker muscle tissue was 0.064 mg/kg and 0.039 mg/kg in 2006 and 2007 respectively; whereas no PCB Aroclor was detected in sediments in 2006 or 2007. Total DDT in muscle tissue for

2006 and 2007 were 0.142 mg/kg and 0.271 mg/kg, respectively; whereas the levels in sediment were 0.0736 mg/kg and 0.100 mg/kg in 2006 and 2007, respectively.

## DISCUSSION

The TIWRP outfall was extended to its present place and the plant started discharging secondary effluent into the Outer Los Angeles Harbor near the southwest corner of Pier 400 (Figure 8-1) in 1996. Since then, the receiving water monitoring program has been modified including changes in field sampling sites and testing requirements. The recent renewal (2005) of TIWRP's NPDES permit eliminated metals, cyanide, total halides, and semi-volatile organics in the required survey. DDT and PCB data of tissues collected from 2002 to present are used for the 5-year temporal trend assessment (Figure 8-2). Since no samples could be collected at HT5 (reference site outside the breakwater) during the 2006 and 2007 surveys, no spatial trend assessment could be conducted.

### LOCAL BIOACCUMULATION TRENDS

To address the question: "Is fish tissue contamination in the vicinity of the outfall changing over time?", Figure 8-2 shows the temporal trend of selected pollutants and percent lipid from 2002 to 2007 at the plant outfall (HT7). The data collected were from white croaker (*Genyonemus lineatus*) muscle tissues. Samples were not collected in 2003 due to resource exchange for the Bight'03 Regional Monitoring Program. No clear patterns were observed. Total DDTs range from 0.108 mg/kg wet-wt in 2004 to 0.80 mg/kg wet-wt in 2005. Total PCBs range from 0.010 mg/kg wet-wt in 2002 to 0.099 mg/kg wet-wt in 2004. Percent lipid levels were relatively stable during the five-year period.

Figure 8-3 shows the levels of selected pollutants in muscle and liver tissue of white croaker in 2006 and 2007. It shows that the liver tissues not only accumulate more pollutants than muscle tissues but

its pollutant levels increase with lipid content.

### IMPACT FROM SEDIMENT POLLUTION

To assess the impact of sediment pollution on the targeted fish, the pollutant concentrations in muscle tissues of white croaker collected at the outfall (HT7) are compared with the pollutant concentrations in sediments near the outfall, HM3, (see Chapter 5) during 2006 and 2007 surveys (Table 8-5).

This two-year survey indicates little relationship between the DDT and PCB levels in fish tissue and in sediment. Based on the five-year spatial and temporal patterns of the pollutants in fish tissues and the relationship with sediment pollutants (CLA, EMD 2000 to 2005), the impact of the TIWRP wastewater discharge on the fish bioaccumulation is not clear.

### SEAFOOD SAFETY

Table 8-3 contains the concentrations of detected pollutants in sport-caught fishes, white surfperch, and queenfish, in 2006 and 2007 surveys to address the question: "Are seafood tissue concentrations below levels that will ensure public safety?" The DDT concentrations of these two fishes have not exceeded the USEPA SV.

Only one DDT derivative (p,p' DDE) was detected in white surfperch, while two derivatives (o,p' DDD and p,p' DDE) were detected in queenfish. The total DDT levels detected in sport-caught fishes (both white surfperch and queenfish) were lower than the EPA screening value of 0.560 mg/kg.

For trawl caught fish, the total PCB Aroclor concentrations were lower than California OEHHA's trigger level of 0.1 mg/kg for fish consumption advisory in white croaker muscle tissue but higher than the OEHHA level in liver tissues.

**Table 8-2.** Total DDT, DDT Derivatives, Total PCB, PCB Aroclors, and % Lipid found in muscle tissues of white croaker at HT7 in Los Angeles Harbor during 2006 to 2007 period. Bold numbers indicate DDT and PCB levels are greater than the California OEHHA fish advisory trigger level of 0.100 mg/kg for PCB Aroclors and the USEPA screening value of 0.560 mg/kg for DDT.

Constituents Detected	Muscle Tissues of White Croaker HT7 (Outfall) n= 10, September 2006			Muscle Tissues of White Croaker HT7* (Outfall) n= 10, August 2007		
	Frequency %	Average (mg/kg)	Range (mg/kg)	Frequency %	Average (mg/kg)	Range (mg/kg)
<b>Total DDT</b>		0.142	ND, 0.055		0.271	ND, <b>1.36</b>
<b>DDT Derivatives:</b>						
O, P'- DDD	0	ND	ND	0	ND	ND
P, P'- DDD	0	ND	ND	10	0.0002	ND, 0.002
O, P'- DDE	90	0.012	ND, 0.025	70	0.011	ND – 0.041
P, P'- DDE	100	0.13	0.055, 0.25	100	0.26	0.039, <b>1.36</b>
O, P'- DDT	0	ND	ND	0	ND	ND
P, P'- DDT	10	0.0001	ND, 0.001	10	0.00011	ND, 0.0011
<b>Total PCB</b>		0.064	ND, <b>0.85</b>		0.039	ND, <b>0.13</b>
<b>PCB Derivatives:</b>						
PCB 1016	0	ND	ND	0	ND	ND
PCB 1221	0	ND	ND	0	ND	ND
PCB 1232	0	ND	ND	0	ND	ND
PCB 1242	0	ND	ND	0	ND	ND
PCB 1248	0	ND	ND	0	ND	ND
PCB 1254	10	0.015	ND, <b>0.15</b>	0	ND	ND
PCB 1260	90	0.049	ND, <b>0.85</b>	80	0.039	ND, <b>0.130</b>
<b>% Lipid</b>	100	2.26	1.18, 3.57	100	3.02	1.41, 4.20

\*Sampling stations are H7 and H12

n: Number of samples analyzed

ND : Below Detection Limit

Total means the sum of the average concentrations of the derivatives

**Table 8-3.** Total DDT, DDT Derivatives, Total PCB, PCB Aroclors, and % Lipid found in muscle tissues of white surfperch and queenfish at HT12 in Los Angeles Harbor during 2006 to 2007 period. Bold numbers indicate DDT and PCB levels are greater than the U.S. EPA/ OEHHA Screening Value of 0.560 mg/kg for DDT and the California OEHHA Fish Consumption Advisories trigger level of 0.100 mg/kg for PCB Aroclors.

Constituents Detected	Muscle Tissues of White Surfperch n= 8, September 2006			Muscle Tissues of Queenfish n = 10, August 2007		
	Frequency %	Average (mg/kg)	Range (mg/kg)	Frequency %	Average (mg/kg)	Range (mg/kg)
<b>Total DDT</b>		0.064	ND, 0.27		0.0427	ND, 0.14
<b>DDT Derivatives:</b>						
O,P'- DDD	0	ND	ND	0	ND	ND
P,P' - DDD	0	ND	ND	40	0.0007	ND, 0.003
O,P'- DDE	0	ND	ND	0	ND	ND
P,P' - DDE	100	0.064	0.022, 0.27	100	0.042	0.014, 0.14
O,P'- DDT	0	ND	ND	0	ND	ND
P,P' - DDT	0	ND	ND	0	ND	ND
<b>Total PCB</b>		0.039	ND, <b>0.21</b>		0.040	ND, 0.083
<b>PCB Derivatives:</b>						
PCB 1016	0	ND	ND	0	ND	ND
PCB 1221	0	ND	ND	0	ND	ND
PCB 1232	0	ND	ND	0	ND	ND
PCB 1242	0	ND	ND	0	ND	ND
PCB 1248	0	ND	ND	0	ND	ND
PCB 1254	12.5	0.026	ND, <b>0.21</b>	70	0.024	ND, 0.083
PCB 1260	12.5	0.013	ND, <b>0.11</b>	90	0.016	ND, 0.051
<b>% Lipid</b>	100	2.03	0.79, 2.72	100	5.09	1.41, 21.7

n: Number of samples analyzed

ND : Below Detection Limit

Total means the sum of the average concentrations of the derivatives

**Table 8-4.** Total DDT, DDT Derivatives, Total PCB, PCB Aroclors, and % Lipid found in liver tissues of white croaker at HT7 in Los Angeles Harbor during 2006 to 2007 period. Bold numbers indicate DDT and PCB levels are greater than the U.S. EPA/ OEHHA Screening Value of 0.560 mg/kg for DDT and the California OEHHA Fish Consumption Advisories trigger level of 0.100 mg/kg for PCB Aroclors.

Constituents Detected	Liver Tissues of White Croaker n= 2*, September 2006			Liver Tissues of White Croaker n= 2*, August 2007		
	Frequency %	Average (mg/kg)	Range (mg/kg)	Frequency %	Average (mg/kg)	Range (mg/kg)
<b>Total DDT</b>		<b>1.046</b>	ND, <b>1.04</b>		<b>1.6848</b>	ND, 2.02
<b>DDT Derivatives:</b>						
O, P'- DDD	0	ND	ND	0	ND	ND
P, P'- DDD	0	ND	ND	0	ND	ND
O, P'- DDE	100	0.076	0.067, 0.085	100	0.142	0.55, 0.229
P, P'- DDE	100	<b>0.97</b>	<b>0.903, 1.04</b>	100	<b>1.54</b>	<b>1.07, 2.02</b>
O, P'- DDT	0	ND	ND	0	ND	ND
P, P'- DDT	0	ND	ND	50	0.0028	ND, 0.0057
<b>Total PCB</b>		<b>0.608</b>	ND, <b>0.62</b>		<b>0.296</b>	ND, <b>0.41</b>
<b>PCB Derivatives:</b>						
PCB 1016	0	ND	ND	0	ND	ND
PCB 1221	0	ND	ND	0	ND	ND
PCB 1232	0	ND	ND	0	ND	ND
PCB 1242	0	ND	ND	0	ND	ND
PCB 1248	0	ND	ND	0	ND	ND
PCB 1254	50	<b>0.31</b>	ND, <b>0.62</b>	0	ND	ND
PCB 1260	100	<b>0.295</b>	<b>0.29, 0.30</b>	100	<b>0.296</b>	<b>0.18, 0.41</b>
<b>% Lipid</b>	100	16.3	12.6, 19.9	100	21.5	21.3, 21.7

\* Each sample is a composite of liver samples from 5 white croakers (only two values, range shows both)

n: Number of samples analyzed

ND : Below Detection Limit

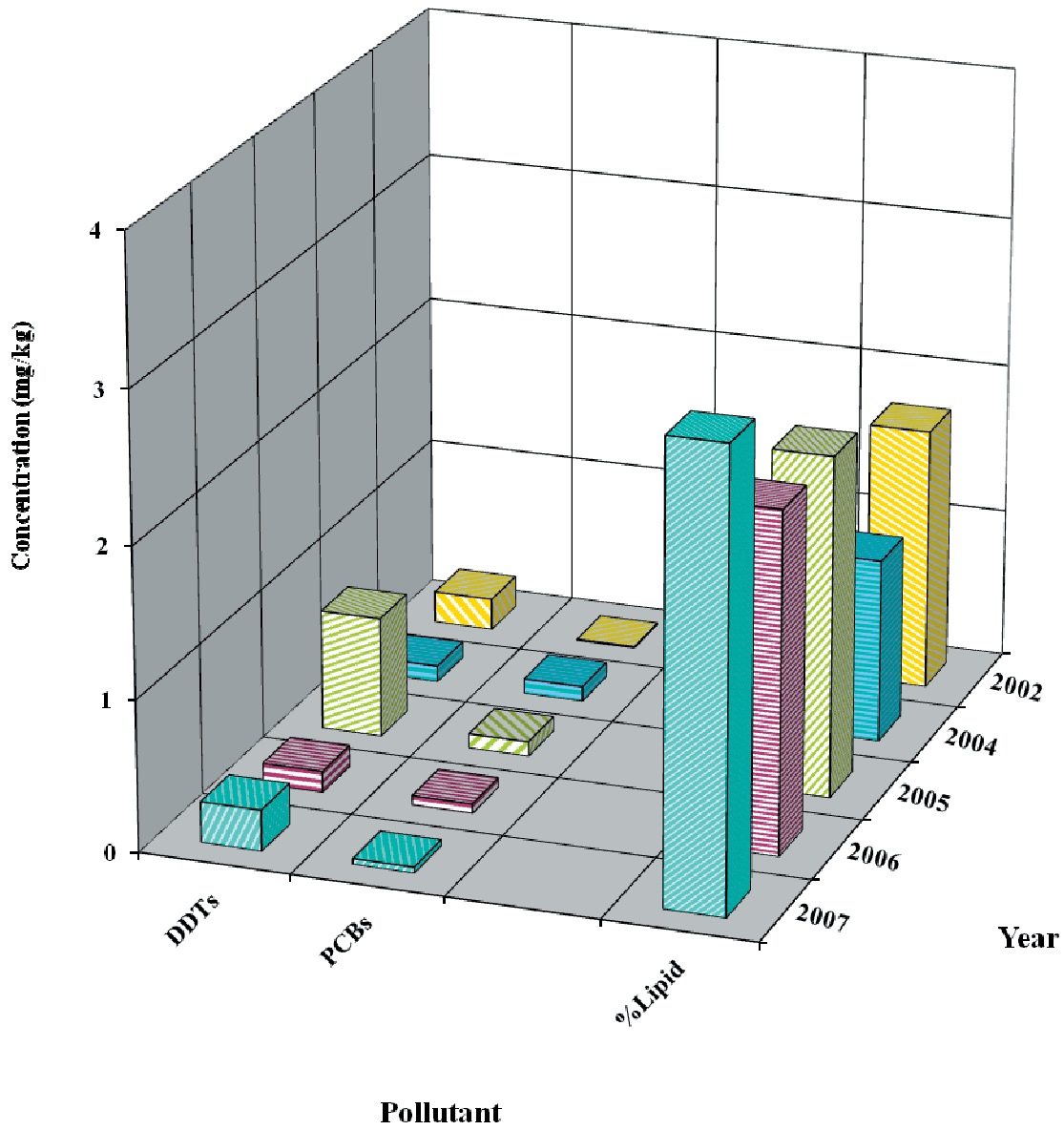
**Table 8-5.** Total DDT, DDT Derivatives, Total PCB, PCB Aroclors, and % Lipid found in muscle tissues of white croaker and in sediment samples near the TIWRP outfall, stations HT7 and HM3, respectively, in Los Angeles Harbor during 2006 to 2007 period. Bold numbers indicate DDT and PCB levels are greater than the U.S. EPA/ OEHHA Screening Value of 0.560 mg/kg for DDT and the California OEHHA Fish Consumption Advisories trigger level of 0.100 mg/kg for PCB Aroclors.

Constituents	Muscle Tissue at HT7		*Sediment at HM3	
	2006 (mg/kg)	2007 (mg/kg)	2006 (mg/kg)	2007 (mg/kg)
<b>Total DDT</b>	0.142	0.2713	0.0736	0.1003
<b>DDT Derivatives:</b>				
O, P'- DDD	ND	ND	ND	ND
P, P'- DDD	ND	0.0002	0.0053	ND
O, P'- DDE	0.012	0.011	0.0117	0.018
P, P'- DDE	0.13	0.26	0.0566	0.0823
O, P'- DDT	ND	ND	ND	ND
P, P'- DDT	0.0001	0.00011	ND	ND
<b>Total PCB</b>	0.064	0.039	ND	ND
<b>PCB Derivatives:</b>				
PCB 1016	ND	ND	ND	ND
PCB 1221	ND	ND	ND	ND
PCB 1232	ND	ND	ND	ND
PCB 1242	ND	ND	ND	ND
PCB 1248	ND	ND	ND	ND
PCB 1254	0.015	ND	ND	ND
PCB 1260	0.049	0.039	ND	ND
<b>% Lipid</b>	2.26	3.02	NA	NA

ND : Below Detection Limit

NA: Not Applicable

\*Data from Chapter 5 Table 5-4



**Figure 8-2.** Temporal trends of selected pollutants and % lipid in muscle tissue of white croaker at the TIWRP outfall (HI7) from 2002 to 2007. Metals assessment is not required starting in 2005.

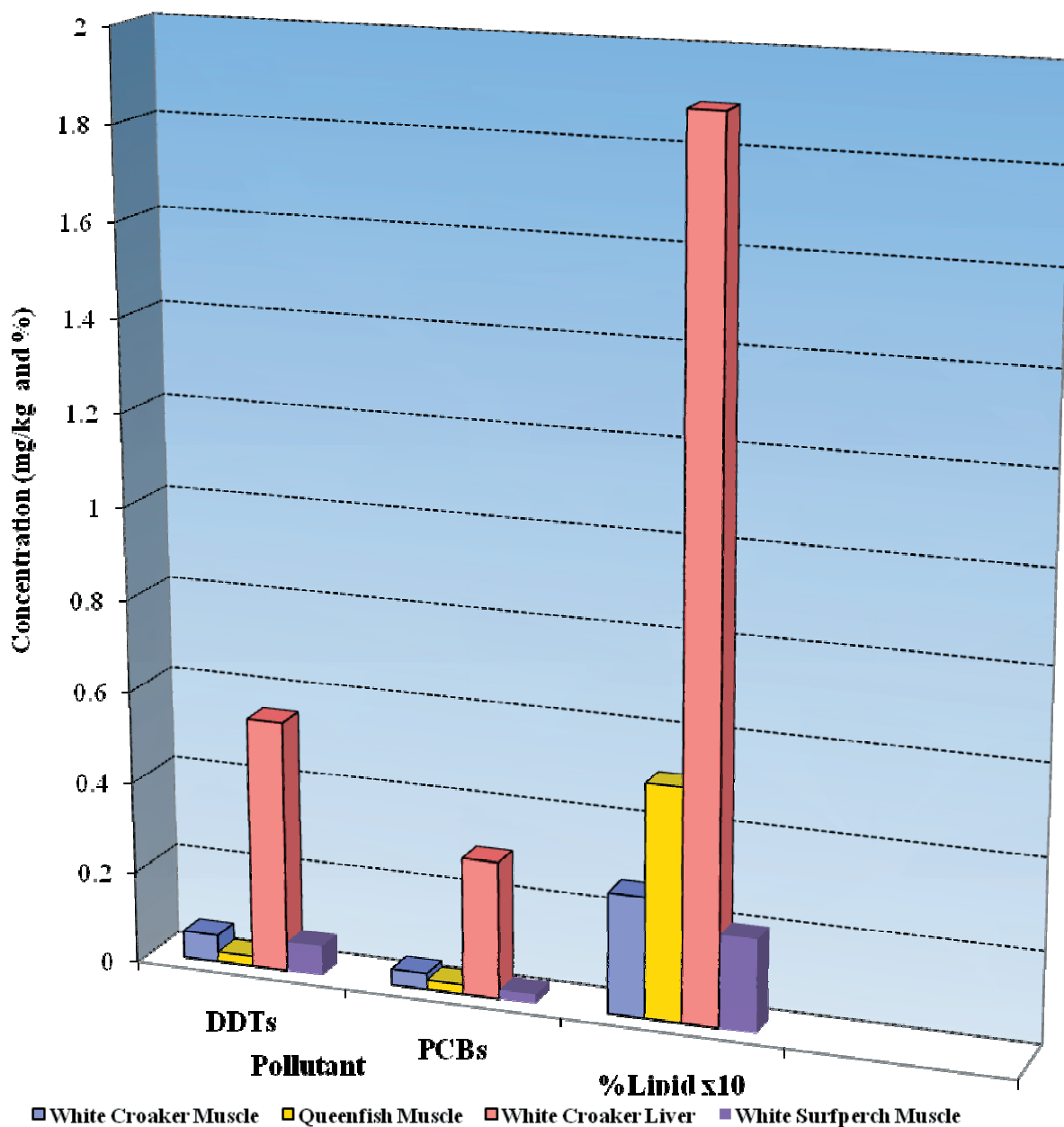


Figure 8-3. Average concentrations of selected pollutants in muscle and liver tissues near the TIWRP outfall during the 2006 and 2007 sampling seasons.

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