

**Analysis of Polychlorinated Biphenyl (PCB) Residues  
in Fish Collected March 21-23, 2005  
from the Bayou Creek System**

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**DRAFT REPORT**

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**Submitted to**

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## INTRODUCTION

Fish were collected on March 21-23, 2005 from our series of sampling stations on Big and Little Bayou Creeks and the reference station on the west fork of Massac Creek (MC). Fillet samples were analyzed for Aroclors 1248, 1254, and 1260. A total of 65 fish were analyzed from Big and Little Bayou Creeks and Massac Creek. This included 43 fish from Big Bayou Creek, 18 fish from Little Bayou Creek, and 4 fish from Massac Creek. The fish from Big Bayou Creek consisted of 15 green sunfish (*Lepomis cyanellus*) (GS), 22 longear sunfish (*Lepomis megalotis*) (LS), 3 largemouth bass (*Micropterus salmoides*) (LMB), 2 yellow bullhead catfish (*Ictalurus natalis*) (YBH), and 1 crappie (*Pomoxis annularis*) (CRA). Fish collected from Little Bayou Creek consisted of 1 bluegill sunfish (*Lepomis macrochirus*) (BG), 8 green sunfish, 8 longear sunfish, and 1 yellow bullhead catfish. From Massac Creek, fish consisted of 2 green sunfish and 2 longear sunfish.

## METHODS

### Fish collection

Fish were collected by UK personnel by use of back-pack shocker and seining. Fish that did not meet our requirements were returned to the stream. Collected fish were wrapped in aluminum foil, tagged, bagged in plastic containers by collecting station, and placed on ice (4 °C) for transport to the laboratory. Fish species were identified and stored in the freezer (-15 °C) until extraction.

## **Tissue extraction**

Fish were measured for length and whole body weight, and fillets were taken with solvent-cleaned surgical instruments. The fillets were then weighed and macerated as described below. Otoliths (sagittae) were removed from each specimen for age determinations (Boxrucker, 1986). PCBs in fish tissues were extracted and analyzed as described by Birge and Price (2001), using standard U.S. EPA methods (Watts, 1980; U.S. EPA, 1997; Erickson, 1997).

## **Analysis by Gas Chromatography**

Samples were analyzed for Aroclors 1248, 1254, and 1260 according to SW-846 Method 8082 (U.S. EPA, 1997) and previously described by Birge and Price (2001).

## **Quality Assurance**

Permanent bench records were kept of all assays and annotated as required under Good Laboratory Practices (*Federal Register*, 40 CFR, Part 160, August 17, 1989). All printouts and graphic recordings were filed and are open for inspection. These bench records will be archived within two years after the close of the project but retrievable upon request.

## **RESULTS**

A total of 65 fish were analyzed during this survey, which included 2 GS and LS from Massac Creek; 15 GS, 22 LS, 3 LMB and 2 YBH from Big Bayou Creek; and 8 GS, 8 LS, 1 BG, and 1 YBH from Little Bayou Creek (Tables 1 and 2). Once again, the fish from Big Bayou creek ranged in age from <1 to 2+ years old, with the exception of the crappie at 3+ years of age. During the March 2004 collection 84% of fish from Big Bayou creek were in the same range. Similar young fish were found in Little Bayou

creek, where 22% of the fish were 2+ years old. During the March 2004 collection, 41% of fish were <1 to 1+ year old; 41% were 2 to 2+ years old; and no fish collected was over 3 years old.

PCB concentrations for fish from Big and Little Bayou creeks are presented in Tables 1 and 2, respectively. The means  $\pm$  standard deviations for length, whole body weight, lipid, and Aroclor concentrations for both streams are given in Table 3. Mean PCBs in longear and green sunfish are represented graphically in Figures 1 through 8. In Big Bayou Creek, Aroclor 1248 was quantifiable in 2 of 43 fish collected (5%), Aroclors 1254 and 1260 were found in 27 fish and 25 fish out of 43 (63% and 58%), respectively (Table 1). Highest Aroclor 1248 concentrations were detected in a longear sunfish from Big Bayou Creek (BB6-LS1) at 0.22  $\mu\text{g/g}$ ; and highest 1254 and 1260 were found in a green sunfish at station BB1 (GS2) at 0.98 and 0.64  $\mu\text{g/g}$ , respectively. The green sunfish from BB1 had the highest total PCBs at 1.61  $\mu\text{g/g}$ . This green sunfish may have migrated to the reference site, which may account for the higher values as compared to other fish collected. Three fish from Big Bayou creek had total PCBs higher than 0.50  $\mu\text{g/g}$ . Of the 43 fish analyzed from Big Bayou Creek, 29 contained fillet total PCB values at or above the lowest action level in Kentucky (0.05  $\mu\text{g/g}$ ).

For Little Bayou Creek, Aroclor 1248 was quantifiable in 14 of 18 fish (78%); Aroclor 1254 was found in 16 of 18 fish (89%); and Aroclor 1260 was found in all fish (100%) (Table 2). Mean PCB concentrations from selected species from Little Bayou Creek are represented graphically in Figures 5 through 8. Highest Aroclor 1248 concentrations were found for a green sunfish (GS2) from LB3 at 0.22  $\mu\text{g/g}$ . Highest Aroclor 1254 and 1260 were found in longear sunfish from LB2 (LS3 and LS1), with

values of 0.22 and 0.37  $\mu\text{g/g}$ , respectively. A total of 4 fish of 18 analyzed from Little Bayou creek contained total PCBs in fillet that were at or above 0.5  $\mu\text{g/g}$ , and no fish tested contained total PCBs above 1.0  $\mu\text{g/g}$ . In comparison, for the March 2004 collection 13 of 22 fish contained total PCBs in fillet that were at or above 0.5  $\mu\text{g/g}$ , and 4 fish tested contained total PCBs above 1.0  $\mu\text{g/g}$ .

## DISCUSSION

It is important to note that, as with previous collections, younger fish (i.e. <1 to 1+ years) tended to predominate both stream systems. In Little Bayou Creek, no fish over 3 years old were collected. The lack of older fish may account in part for the lower PCB concentrations found in both streams, as the fish may have not had time to bioaccumulate significant PCB concentrations. PCBs are still being detected in fish from the effluent receiving zone (i.e. BB4-BB7) in Big Bayou creek (Figures 1 and 2). Highest Aroclor concentrations ( $\mu\text{g/g}$ ) in fish fillet were 0.22, 0.34, and 0.25 for stations BB6, BB6, and BB4, respectively.

Concerning Little Bayou Creek, Aroclor 1248 occurred in fillets for 78% of fish tested and Aroclor 1260 was detected in all fish analyzed. Highest total PCB concentrations ( $\mu\text{g/g}$ ) were 0.79, 0.58, and 0.37 at stations LB2, LB3, and LB4, respectively. As with Big Bayou creek, age of fish collected may account in part for decreased PCB concentrations. Additional fish sampling will be conducted during the late summer in order to compare values obtained during low-flow conditions.

## REFERENCES

Birge, W.J. and D.J. Price. 2001. Analysis of Polychlorinated Biphenyl (PCB) Residues in Fish Collected July 27, 2000 from Little Bayou Creek. August 28, 2001. Submitted to Jon Maybriar, Division of Waste Management.

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Table 1. PCB concentrations in fish from Massac Creek and Big Bayou Creek collected March 21-23, 2005.

Station	Date	Type	Length (mm)	Age (Years)	Whole Body Wt. (g)	Fillet Wt. (g)	mg fat /g tissue	Aroclor Conc. ( $\mu\text{g/g}$ )			
								1248	1254	1260	Total
MC	03/22/05	LS1	135	2	48.300	6.334	3.97	<0.032	<0.032	<0.032	<0.032
MC	03/22/05	LS2	110	2	29.796	4.193	5.10	<0.048	<0.048	<0.048	<0.048
MC	03/22/05	GS1	103	1+	20.754	2.496	4.77	<0.080	<0.080	<0.080	<0.080
MC	03/22/05	GS2	101	1+	20.763	2.972	7.72	<0.067	<0.067	<0.067	<0.067
BB1A	03/21/05	LS1	93	1	15.698	2.374	7.39	<0.084	<0.084	<0.084	<0.084
BB1A	03/21/05	LS2	93	2	17.101	2.614	9.47	<0.077	<0.077	<0.077	<0.077
BB1A	03/21/05	GS1	119	2+	27.849	3.510	5.21	<0.057	<0.057	<0.057	<0.057
BB1A	03/21/05	GS2	116	1+	26.738	3.580	4.59	<0.056	<0.056	<0.056	<0.056
BB1	03/21/05	LS1	93	2	14.654	1.690	5.47	<0.118	<0.118	<0.118	<0.118
BB1	03/21/05	LS2	86	<1	9.778	1.184	7.77	<0.169	<0.169	<0.169	<0.169
BB1	03/21/05	GS1	110	1+	24.001	2.907	3.96	<0.069	<0.069	<0.069	<0.069
BB1	03/21/05	GS2	91	1	14.073	1.619	6.73	<0.124	0.977	0.635	1.613
BB1	03/21/05	YBH1	116	---	17.947	1.282	5.03	<0.156	<0.156	<0.156	<0.156
BB2	03/22/05	GS1	77	<1	8.505	1.058	8.70	<0.189	<0.189	0.185	0.185
BB3	03/21/05	LS1	125	1+	42.479	5.798	4.14	<0.034	0.123	0.098	0.220
BB3	03/21/05	LS2	98	<1	16.801	2.592	6.96	<0.077	0.106	0.085	0.191
BB3	03/21/05	LS3	85	<1	11.563	1.821	7.77	<0.110	0.144	<0.110	0.144
BB3	03/21/05	GS1	94	1	13.897	1.967	5.87	<0.102	0.145	0.121	0.266

Table 1, continued. PCB concentrations in fish from Massac Creek and Big Bayou Creek collected March 21-23, 2005.

Station	Date	Type	Length (mm)	Age (Years)	Whole Body Wt. (g)	Fillet Wt. (g)	mg fat /g tissue	Aroclor Conc. ( $\mu\text{g/g}$ )			
								1248	1254	1260	Total
BB4	03/21/05	LS1	111	<1	29.333	4.436	2.98	<0.045	0.206	0.135	0.341
BB4	03/21/05	LS2	91	<1	15.756	2.100	3.36	<0.095	0.247	0.168	0.415
BB4	03/21/05	LS3	90	<1	13.156	1.916	5.56	<0.104	0.180	0.119	0.299
BB4	03/21/05	GS1	130	2+	34.327	5.025	3.95	<0.040	0.206	0.248	0.455
BB4	03/21/05	GS2	112	1+	25.476	4.022	4.77	<0.050	0.128	0.079	0.207
BB4	03/21/05	GS3	110	1+	22.515	3.098	5.39	<0.065	0.098	0.075	0.173
BB4	03/21/05	GS4	83	<1	9.081	1.050	5.00	<0.190	0.179	<0.190	0.179
BB4	03/21/05	YBH1	157	---	53.293	3.569	5.30	<0.056	0.177	0.099	0.276
BB5	03/21/05	LS1	90	1	12.319	1.595	5.77	<0.125	0.218	0.161	0.380
BB5	03/21/05	GS1	77	1	8.410	0.952	7.25	0.145	<0.210	<0.210	0.145
BB6	03/22/05	LS1	112	1	27.139	3.409	4.46	0.221	0.343	0.142	0.706
BB6	03/22/05	LS2	104	<1	23.762	3.350	4.49	<0.060	0.324	0.244	0.568
BB6	03/22/05	LS3	96	<1	18.124	2.875	7.11	<0.070	0.176	0.129	0.305
BB6	03/22/05	GS1	100	2+	17.391	2.266	5.32	<0.088	<0.088	<0.088	<0.088



Table 1, continued. PCB concentrations in fish from Massac Creek and Big Bayou Creek collected March 21-23, 2005.

Station	Date	Type	Length (mm)	Age (Years)	Whole Body Wt. (g)	Fillet Wt. (g)	mg fat /g tissue	Aroclor Conc. ( $\mu\text{g/g}$ )			
								1248	1254	1260	Total
BB7	03/22/05	LS1	111	1	28.104	3.559	5.00	<0.056	0.136	0.069	0.205
BB7	03/22/05	LS2	97	<1	18.856	2.617	6.00	<0.076	0.177	0.104	0.281
BB7	03/22/05	LS3	110	---	24.186	2.588	3.71	<0.077	0.316	0.159	0.475
BB7	03/22/05	LS4	94	1+	16.539	1.985	4.86	<0.101	0.128	0.115	0.243
BB7	03/22/05	GS1	144	2+	64.390	8.261	4.15	<0.024	0.067	0.039	0.106
BB8	03/22/05	LS1	116	2+	33.541	3.825	4.92	<0.052	<0.052	<0.052	<0.052
BB8	03/22/05	LS2	118	<1	38.300	4.067	6.81	<0.049	0.049	0.044	0.093
BB8	03/22/05	LS3	106	1+	26.975	3.973	5.81	<0.050	0.048	0.045	0.093
BB8	03/22/05	LS4	98	1	21.326	2.367	5.79	<0.084	<0.084	<0.084	<0.084
BB8	03/22/05	LMB1	109	<1	15.962	2.660	6.71	<0.075	0.089	<0.075	0.089
BB9	03/22/05	CRA1	140	3+	57.036	4.879	3.21	<0.041	<0.041	<0.041	<0.041
BB9	03/22/05	LMB1	216	---	160.110	10.251	3.50	<0.020	0.105	0.057	0.162
BB9	03/22/05	LMB2	120	1	21.883	3.722	4.37	<0.054	0.079	0.052	0.131

Table 2. PCB concentrations in fish from Little Bayou Creek collected March 22-23, 2005.

Station	Date	Type	Length (mm)	Age (Years)	Whole Body Wt. (g)	Fillet Wt. (g)	mg fat /g tissue	Aroclor Conc. ( $\mu\text{g/g}$ )			
								1248	1254	1260	Total
LB2	03/23/05	LS1	99	<1	23.012	3.402	6.04	0.175	0.214	0.367	0.755
LB2	03/23/05	LS2	93	<1	18.204	2.191	6.73	0.141	0.131	0.203	0.476
LB2	03/23/05	LS3	83	1+	12.687	1.748	5.92	0.217	0.217	0.354	0.788
LB2	03/23/05	GS1	106	2	25.889	3.902	3.79	0.162	0.164	0.160	0.486
LB3	03/23/05	LS1	103	1+	28.217	3.605	6.01	0.089	0.081	0.100	0.270
LB3	03/23/05	LS2	101	<1	24.818	3.216	5.64	0.131	0.146	0.195	0.472
LB3	03/23/05	LS3	80	<1	10.032	1.247	8.26	0.134	0.104	0.175	0.414
LB3	03/23/05	GS1	102	2+	21.974	3.346	6.81	0.134	0.109	0.120	0.362
LB3	03/23/05	GS2	93	2	16.768	2.288	8.72	0.222	0.175	0.184	0.581
LB3	03/23/05	GS3	95	1+	16.680	2.866	3.98	0.129	0.105	0.126	0.360
LB3	03/23/05	GS4	91	1+	15.079	1.704	6.63	0.152	0.116	0.125	0.392
LB3	03/23/05	YBH1	141	---	35.275	2.366	4.99	0.210	0.168	0.203	0.581
LB4	03/22/05	LS1	95	2+	16.282	1.857	6.30	<0.108	<0.108	0.076	0.076
LB4	03/22/05	LS2	92	1+	13.871	1.425	5.40	0.085	<0.140	<0.140	0.085
LB4	03/22/05	GS1	120	2+	29.775	3.601	4.28	<0.056	0.104	0.157	0.261
LB4	03/22/05	GS2	90	1+	13.493	1.984	6.50	0.126	0.104	0.137	0.367
LB4	03/22/05	GS3	107	2+	20.543	1.781	5.70	<0.112	0.088	<0.112	0.088
LB4	03/22/05	BG1	91	<1	13.390	1.836	7.24	<0.109	0.074	0.108	0.182

Table 3. Means  $\pm$  standard deviations for measured parameters of fish from the Bayou Creek system, collected March 21-23, 2005.

System	Fish Type	Length (mm)	Whole Body Wt. (g)	Lipid (mg/g)	Mean Aroclor Conc. ( $\mu\text{g/g}$ )			
					1248	1254	1260	Total
MC	GS	133 $\pm$ 7	43.40 $\pm$ 6.29	2.91 $\pm$ 0.16	N.D.	N.D.	N.D.	N.D.
MC	LS	123 $\pm$ 18	39.05 $\pm$ 13.08	4.54 $\pm$ 0.80	N.D.	N.D.	N.D.	N.D.
MC	GS	102 $\pm$ 1	20.76 $\pm$ 0.01	6.24 $\pm$ 2.09	N.D.	N.D.	N.D.	N.D.
BB1A	LS	93 $\pm$ 0.0	16.40 $\pm$ 0.99	8.43 $\pm$ 1.47	N.D.	N.D.	N.D.	N.D.
BB1A	GS	118 $\pm$ 2	27.29 $\pm$ 0.79	4.90 $\pm$ 0.44	N.D.	N.D.	N.D.	N.D.
BB1	LS	90 $\pm$ 5	12.22 $\pm$ 3.45	6.62 $\pm$ 1.62	N.D.	N.D.	N.D.	N.D.
BB1	GS	101 $\pm$ 13	19.04 $\pm$ 7.02	5.34 $\pm$ 1.96	N.D.	0.98	0.64	1.61
BB1	YBH	34	17.95	5.03	N.D.	N.D.	N.D.	N.D.
BB2	GS	34	8.51	8.70	N.D.	N.D.	0.19	0.19
BB3	LS	103 $\pm$ 20	23.61 $\pm$ 16.55	6.29 $\pm$ 1.91	N.D.	0.12 $\pm$ 0.02	0.09 $\pm$ 0.01	0.19 $\pm$ 0.04
BB3	GS	34	13.90	5.87	N.D.	0.15	0.121	0.27
BB4	LS	97 $\pm$ 12	19.42 $\pm$ 8.69	3.96 $\pm$ 1.39	N.D.	0.21 $\pm$ 0.03	0.14 $\pm$ 0.03	0.35 $\pm$ 0.06
BB4	GS	109 $\pm$ 19	22.85 $\pm$ 10.46	4.78 $\pm$ 0.61	N.D.	0.15 $\pm$ 0.05	0.13 $\pm$ 0.10	0.25 $\pm$ 0.14
BB4	YBH	34	53.29	5.30	N.D.	0.18	0.10	0.28
BB5	LS	34	12.32	5.77	N.D.	0.22	0.16	0.38
BB5	GS	34	8.41	7.25	0.145	N.D.	N.D.	0.15

Table 3, continued. Means  $\pm$  standard deviations for measured parameters of fish from the Bayou Creek system, collected March 21-23, 2005.

System	Fish Type	Length (mm)	Whole Body Wt. (g)	Lipid (mg/g)	Mean Aroclor Conc. ( $\mu\text{g/g}$ )			
					1248	1254	1260	Total
BB6	LS	104 $\pm$ 8	23.01 $\pm$ 4.55	5.35 $\pm$ 1.52	0.22	0.28 $\pm$ 0.09	0.17 $\pm$ 0.06	0.537 $\pm$ 0.20
BB6	GS	34	17.39	5.32	N.D.	N.D.	N.D.	N.D.
BB7	LS	103 $\pm$ 9	21.92 $\pm$ 5.22	4.89 $\pm$ 0.94	N.D.	0.19 $\pm$ 0.09	0.11 $\pm$ 0.04	0.30 $\pm$ 0.12
BB7	GS	34	64.39	4.15	N.D.	0.07	0.04	0.106
BB8	LS	110 $\pm$ 9	30.04 $\pm$ 7.43	5.83 $\pm$ 0.77	N.D.	0.05 $\pm$ 0.001	0.04 $\pm$ 0.001	0.09 $\pm$ 0.0003
BB8	LMB	34	15.96	6.71	N.D.	0.09	N.D.	0.09
BB9	CRAPPIE	34	57.04	3.21	N.D.	N.D.	N.D.	N.D.
BB9	LMB	168 $\pm$ 68	91.00 $\pm$ 97.74	3.93 $\pm$ 0.61	N.D.	0.09 $\pm$ 0.02	0.06 $\pm$ 0.003	0.15 $\pm$ 0.02
LB2	LS	92 $\pm$ 8	17.97 $\pm$ 5.17	6.23 $\pm$ 0.44	0.18 $\pm$ 0.04	0.19 $\pm$ 0.05	0.31 $\pm$ 0.09	0.67 $\pm$ 0.17
LB2	GS	34	25.89	3.79	0.16	0.16	0.16	0.49
LB3	LS	95 $\pm$ 13	21.02 $\pm$ 9.67	6.64 $\pm$ 1.42	0.12 $\pm$ 0.03	0.11 $\pm$ 0.03	0.16 $\pm$ 0.05	0.39 $\pm$ 0.10
LB3	GS	95 $\pm$ 5	17.63 $\pm$ 3.00	6.54 $\pm$ 1.95	0.16 $\pm$ 0.04	0.13 $\pm$ 0.03	0.14 $\pm$ 0.03	0.42 $\pm$ 0.11
LB3	YBH	34	35.28	4.99	0.21	0.17	0.20	0.58
LB4	LS	94 $\pm$ 2	15.08 $\pm$ 1.70	5.85 $\pm$ 0.63	0.09	N.D.	0.08	0.08 $\pm$ 0.01
LB4	GS	106 $\pm$ 15	21.27 $\pm$ 8.17	5.49 $\pm$ 1.13	0.13	0.10 $\pm$ 0.01	0.15 $\pm$ 0.01	0.24 $\pm$ 0.14
LB4	BG	34	13.39	7.24	N.D.	0.07	0.11	0.18

Figure 1. Mean PCB concentrations in longear sunfish from Big Bayou Creek, collected March 21-23, 2005.

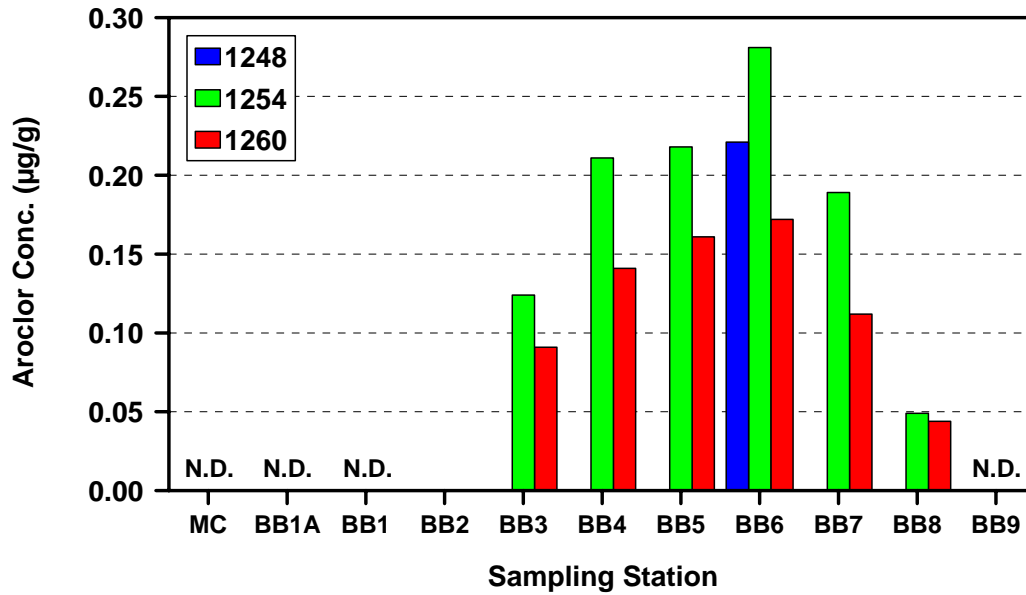


Figure 2. Mean total PCB concentrations in longear sunfish from Big Bayou Creek, collected March 21-23, 2005.

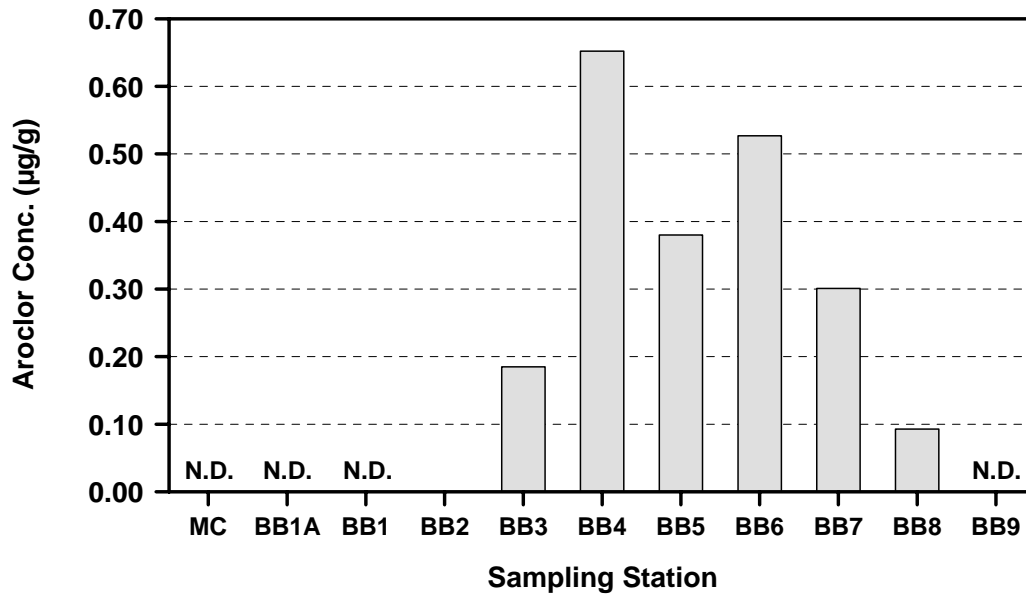


Figure 3. PCB concentrations in green sunfish from Big Bayou Creek, collected March 21-23, 2005.

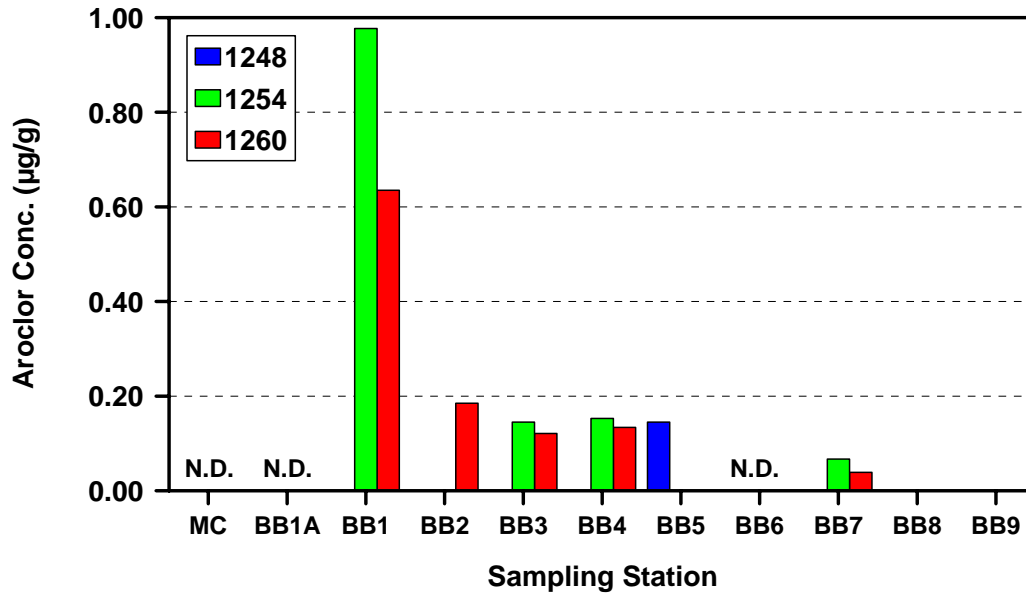


Figure 4. Mean total PCB concentrations in green sunfish from Big Bayou Creek, collected March 21-23, 2005.

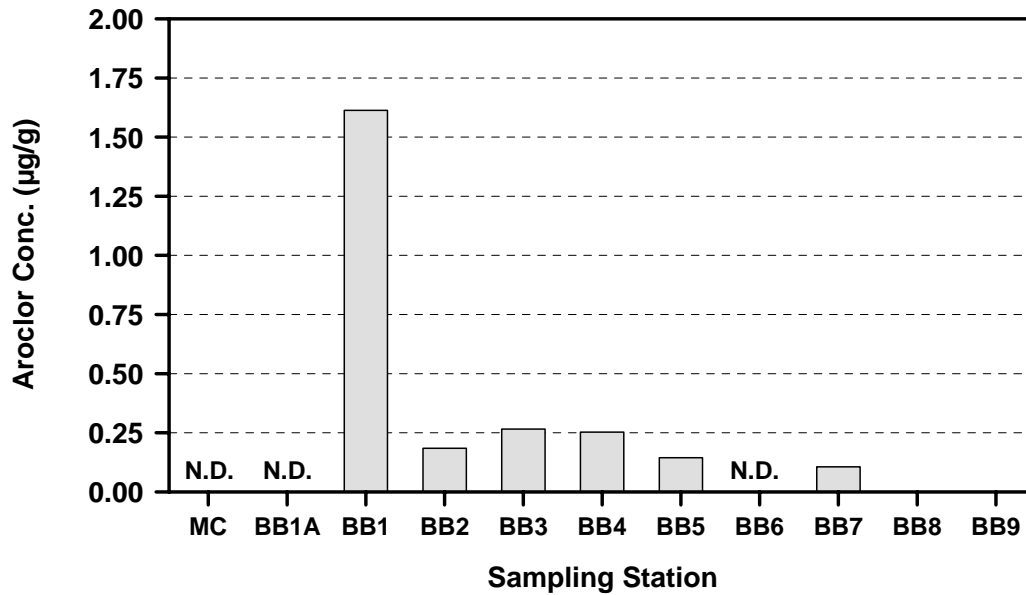


Figure 5. Mean PCB concentrations in longear sunfish from Little Bayou Creek, collected March 21-23, 2005.

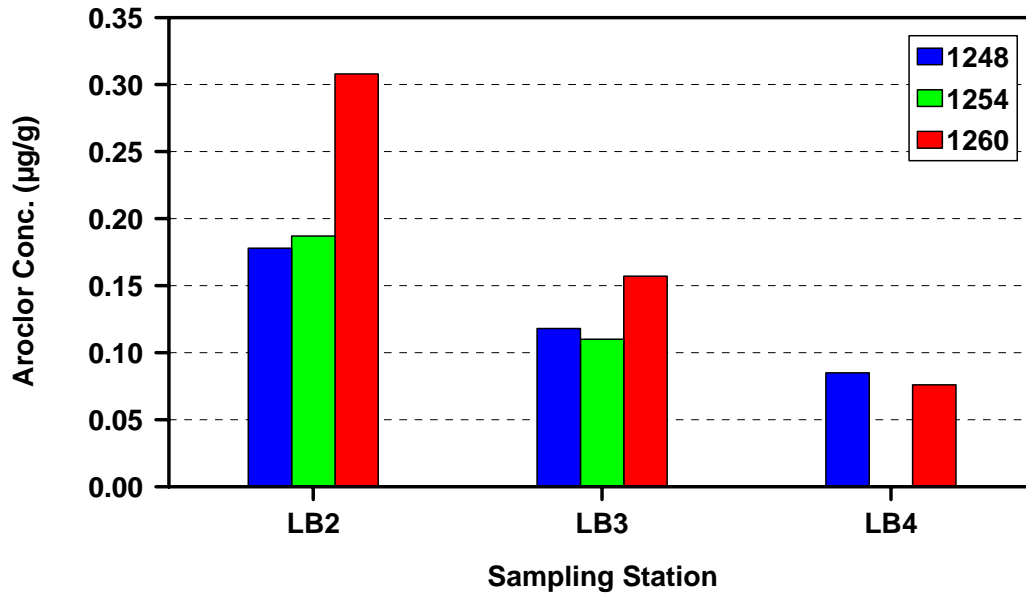


Figure 6. Mean total PCB concentrations in longear sunfish from Little Bayou Creek, collected March 21-23, 2005.

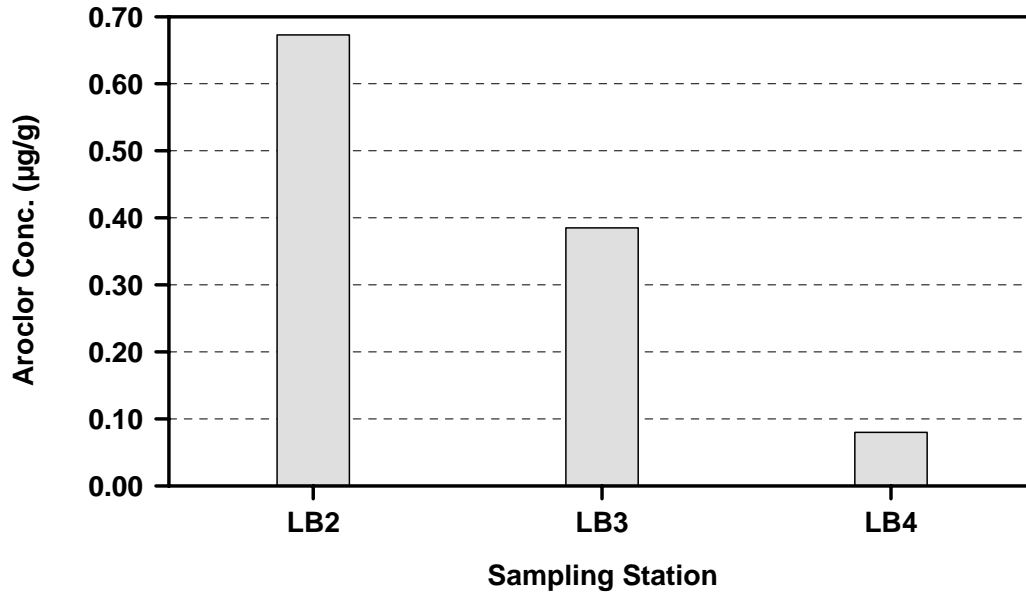


Figure 7. PCB concentrations in green sunfish from Little Bayou Creek, collected March 21-23, 2005.

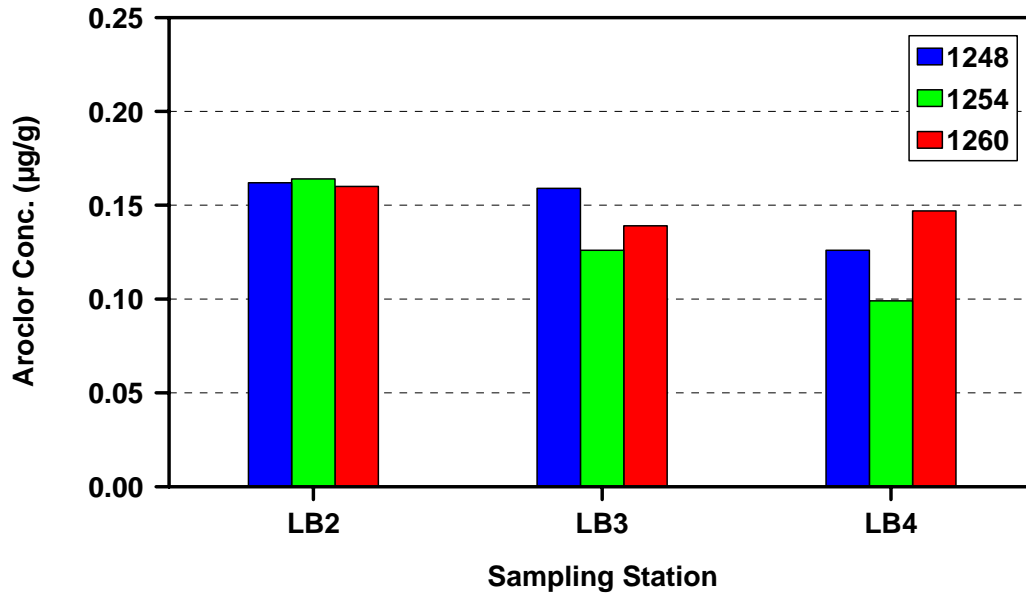


Figure 8. Mean total PCB concentrations in green sunfish from Little Bayou Creek, collected March 21-23, 2005.

