

## **PCB Concentrations in Winter Flounder from Long Island Sound, 1984-1986**

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PCBs (polychlorinated biphenyls) pollutants of concern in Long Island Sound have been studied previously. Initial studies at this laboratory focused on levels of PCBs and metals in tissues from windowpane flounder (Scophthalmus aquosus) collected from various stations in the Sound (Greig et al., 1983). The purpose of that study was to determine whether there was a relationship between station location and concentration of metals and PCBs in flounder tissue. In that study, PCBs in livers of windowpane flounder were measurable but not significantly different for the three stations sampled even though the sediments differed in contaminant loading. In the present study, winter flounder (Pseudopleuronectes americanus) were collected from several stations in Long Island Sound and the gonads and livers analyzed for PCBs. Winter flounder were selected because they are both commercially and recreationally important in northeast Atlantic waters, including Long Island Sound.

There are no major sources of PCBs for Long Island Sound; rather the sources appear to be small accidental spills, especially into rivers (Charles Fredette, DEP of Connecticut, personal communication). It is well-known, however, that the Housatonic River (Connecticut) is polluted with PCBs in its upper reaches. How much of the PCBs reach the Sound is not known; most of the PCBs are tied up in the sediments, and several dams along the river prevent much of the sediment from traveling downstream (Bieber, 1983).

### **MATERIALS AND METHODS**

Winter flounder were collected by otter trawl at three locations during the winter of 1984-85; Morris Cove (New Haven, CT), Station 90 (off Roanoke Pt., NY), and just off Hempstead Harbor, NY. Four stations were sampled during the winter of 1985-86, these were: Black Rock Harbor (Bridgeport, CT), Station 90, Niantic, CT, and Morris Cove, CT. Only Station 90 and Morris Cove were sampled in

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both years. Gonads and livers from freshly caught flounder were removed with stainless steel tools and placed in glass jars, pre-cleaned with glass-distilled hexane and covered with hexane-cleaned aluminum foil and a screw top lid. Samples were frozen at -20°C and analyzed within three months.

PCB analyses were conducted by the saponification procedure described by Stout and Beezhold (1979), followed by gas liquid chromatography (G.L.C.) using a packed column of 3% OV17 on gas chrom WHP (100-120 mesh). An Arochlor 1254 standard was used for comparison since the chromatograms from these samples closely matched it.

## RESULTS AND DISCUSSION

Table 1. Levels of PCBs in ovaries and livers of winter flounder from Long Island Sound - 1984-85

Sample Location/Date	Length cm (mean/range)	Levels of PCBs, ppm wet wt. (mean/SD)		
		Ovary	Liver	N <sup>a</sup>
Morris Cove/October	34.3	0.36/0.129	2.1/1.187	5
	31.1-37.0			
Morris Cove/November	31.8	0.67/0.273	2.3/0.734	5
	26.5-37.3			
Morris Cove/December	29.7	0.73/0.351	1.1/0.476	5
	25.8-38.8			
Morris Cove/March	29.2	0.66/0.437	0.60/0.323	8
	21.5-38.2			
Sta. 90/October	24.9	0.056/0.046	1.4/0.955	6
	23.1-27.3			
Sta. 90/December	32.2	0.16/0.064	0.42/0.32	5
	28.0-36.2			
Sta. 90/February	33.9	0.25/0.11	0.33/0.261	8
	27.8-38.6			
Sta. 90/April	33.8	0.03 <sup>b</sup> /0.015	1.1/0.410	5
	32.2-37.5			
Hempstead Harbor/February	24.6	0.61/0.341	0.57/0.465	7
	21.0-28.5			
Hempstead Harbor/March	--	0.08 <sup>c</sup> /0.046	0.45/0.302	4

<sup>a</sup> N equals number of individuals analyzed.

<sup>b</sup> All these fish had spent gonads.

<sup>c</sup> Four fish had spent gonads; one additional fish had a fully developed gonad with a PCB level of 1.1 ppm (not included in mean).

Winter flounder spawn primarily in February and March, with some spawning in April. Ovaries are not well developed in October and there were lower PCB levels in gonads from fish collected at Morris Cove and Sta. 90 as compared to the months just before spawning when the gonads were well developed (Table 1). After spawning, PCB concentrations in gonad tissue decrease to very low levels as seen at Sta. 90 (April, 1985) and Hempstead Harbor (March, 1985). Liver values for PCBs declined somewhat from October through the March and April spawning months in fish from both Morris Cove and Sta. 90. PCBs returned to a higher level in October in livers of Sta. 90 fish. There were only two sampling periods, February and March, for Hempstead Harbor and the PCBs in livers were quite similar, thus indicating that PCBs did not return to a hypothetical October level. Even though there are limited data on testes in 1984-85, it is apparent that PCB levels were, in most cases, substantially lower in testes than in ovaries (Table 2).

Table 2. Levels of PCBs in testes of male winter flounder from Long Island Sound - 1984-85

Sample Location/Date	Levels of PCBs, ppm wet wt. individual animals	Mean levels of PCBs in ovaries
Morris Cove/October	0.18,0.07	0.36
Morris Cove/November	0.19,0.31	0.67
Morris Cove/December	0.62	0.73
Morris Cove/March	0.13,0.07	0.66
Sta. 90/October	0.07	0.06
Sta. 90/December	0.05,0.05	0.16
Sta. 90/February	0.10,0.06	0.25
Hempstead Harbor/February	0.10,0.25	0.61

The data collected in 1985-86 on flounder gonads generally followed the same pattern observed in the 1984-85 samples (Tables 3, 4). Only two locations were sampled both years, i.e. Sta. 90 and Morris Cove. Morris Cove was sampled only once in 1985-86 and this was after spawning had ceased. This low value follows well the previous year trend of lowered PCBs after the spawning season. Sta. 90 was sampled in December of both years and with similar results. Ovaries contained a mean value of 0.16 ppm in 1984 and 0.26 ppm in 1985, whereas, livers contained 0.42 ppm in 1984 and 0.30 ppm in 1985. Two new stations were added in 1985-86, these were: Black Rock Harbor (Bridgeport, CT) and Niantic, CT. Black Rock Harbor is considered a polluted area, whereas, Niantic is considered relatively clean. PCB levels in flounder gonads and livers from these two stations support that consideration (Table 3).

Table 3. Levels of PCBs in ovaries and livers of winter flounder from Long Island Sound - 1985-86

Sample Location/Date	Fish length (cm) (mean/range)	Levels of PCBs, ppm wet wt. (mean/SD)		
		Ovaries	Liver	N <sup>a</sup>
Black Rock Harbor/October	26.2	0.10/0.108	2.4/1.98	3
	25.6-28.5			
Black Rock Harbor/November	27.3	0.36/0.152	2.1/0.68	7
	22.7-31.5			
Black Rock Harbor/December	31.3	0.43/0.173	1.2/0.33	9
	29.3-33.9			
Black Rock Harbor/April	31.5	0.14 <sup>b</sup> /0.087	2.7/1.48	10
	29.5-34.6			
Sta. 90/November	34.3	0.21/0.084	0.54/0.131	5
	28.3-37.7			
Sta. 90/December	31.7	0.26/0.117	0.30/0.324	6
	27.0-42.0			
Sta. 90/April	37.5	0.03 <sup>b</sup> /0.019	0.86/0.561	6
	32.3-43.9			
Niantic/November	33.3	0.14/0.043	0.53/0.277	3
	31.0-35.5			
Niantic/April	33.5	0.04 <sup>b</sup> /0.046	1.3/0.89	6
	32.1-37.7			
Morris Cove/April	32.4	0.06 <sup>b</sup> /0.071	1.0/0.59	9
	28.8-36.7			

<sup>a</sup> N equals number of individuals analyzed.

<sup>b</sup> All these fish had spent gonads.

Other investigators have measured PCBs in livers or ovaries of fishes and are reported below on a wet weight basis. Giam et al. (1972) examined a variety of fish from the Gulf of Mexico and Caribbean Sea. King mackerel had 0.083 ppm in its liver, whereas, red snapper had only 0.018 ppm. The liver of yellow-tailed snapper contained 0.043 ppm. All of these samples were calculated as Aroclor 1260. A sample of parrot fish was calculated as Aroclor 1254, the Aroclor used in the present study, and the level reported in liver was 0.284 ppm. In comparison, livers of winter flounder in this study had PCB levels that ranged from 0.30 to 2.7 ppm for various locations in Long Island Sound. Duke et al. (1970) measured PCBs (as Aroclor 1254) in livers of flounder (*Paralichthys* sp.) from Florida. Single fish samples were found to contain 76 ppm and 184 ppm from Mulatto Bayou and northern Escambia Bay, two sampling sites in Escambia Bay. These data may indicate unusual pollution of PCBs in Escambia Bay. Butler and Schutzmann (1979) examined livers from about 20 different species

Table 4. Levels of PCBs in testes of male winter flounder from Long Island Sound - 1985-86

Sample Location/Date	Levels of PCBs, ppm wet wt. individual animals	Mean levels of PCBs in ovaries
Black Rock Harbor/October	<0.1,0.37,<0.1	0.10
Black Rock Harbor/November	0.07,0.04,0.15	0.36
Black Rock Harbor/December	0.22	0.43
Black Rock Harbor/April	all females	
Sta. 90/November	0.06,0.06,0.03	0.21
Sta. 90/December	0.02,0.06	0.26
Sta. 90/April	0.22,0.16,0.08	0.03
Niantic/November	0.03,0.04,0.06,0.03,0.02	0.14
Niantic/April	<0.1,0.02,0.10,0.05	0.04
Morris Cove/April	0.47	0.06

of fish obtained from the north Atlantic Ocean for PCBs and found that six of the species had more than 1.0 ppm PCBs (little skate, silver hake, cod, pollock, goosefish and spiny dogfish). Yellow-tail flounder and fourspot flounder averaged PCB levels of 0.13 ppm and 0.28 ppm, respectively; levels substantially lower than those reported here.

Livers of 12 Atlantic tomcod contained an average of 37.52 ppm of PCBs (Klauda et al., 1981). Even though this is a relatively high level for PCBs in livers of fish, as compared to most data given above, the ovaries were found to contain an average of only 0.28 ppm and in testes the average was 1.61 ppm. Spies et al. (1985) studied the relationship between pollutant body burdens and reproduction in starry flounder from San Francisco Bay and reported that nearly 30 female flounder had between 0.04 and 0.19 ppm in spawned eggs. These are below those levels found in winter flounder eggs obtained near spawning time. Levels in these were on the order of 0.14 to 0.73 ppm.

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