Spring, 1973. Concentrations in parts per billion dry weight.

ITY	DATE	PCB's		
		1242	1254	1242:1254
drian	3/7			0.26
lbion	2/22		0.34	
nn Arbor	3/1		0.25	
y City	3/1	3.20		
attle Creek	2/28		<0.10	
enton Harbor- St. Joseph	2/28		0.20	
righton	3/1			0.33
dillac	3/28		0.53	
harlotte	5/1		0.34	
onstantine	2/28		0.46	
etroit	2/28	2.15		
xter	3/1		0.23	
ast Lansing	5/2		0.18	
scanaba	3/28			0.28
ssexville	3/1		0.10	
lint	2/22		<0.10	
ladstone	3/28		0.44	
and Haven	2/21		<0.10	
and Rapids	2/21		1.05	
olland	2/21		<0.10	
ughton- lancock	3/27		0.18	
on Mountain- ingsford	3/28		0.69	
	3/27			0.23
ckson	2/22		<0.1	
alamazoo	2/29			1.12
'Anse	3/27			0.31
ansing	4/18		0.22	
anistique	3/28		0.63	
arquette	3/27		0.29	
arshall	2/22		0.15	
enominee	2/28		0.57	
idland	3/1		<0.10	
ilford	3/8			2.20
onroe	5/4		<0.10	
t. Clemens	3/8			2.90
t. Pleasant	3/28		0.29	
uskegon	2/28		0.88	
uskegon Heights	2/28		0.18	
ines	2/20		0.48	
orway	3/28		<0.10	
osso	2/21		0.12	
ontiac (Auburn)	3/12			0.60
ontiac (E. Blvd.)	3/12			0.54
ort Huron	3/8			1.80
ginaw	3/1			0.77
ault Ste. Marie	3/28		0.73	

ITY	DATE	PCB's		
		1242	1254	1242:1254
t. Ignace	3/28		0.31	
Three Rivers	2/21		<0.10	
Traverse City	3/7		<0.10	
Trenton	2/28		<0.10	
Warren	2/27		<0.10	
Wayne County	2/28		0.40	
Wyoming	2/21		0.22	
Ypsilanti	2/28			
Ypsilanti Twp #1	3/1		<0.10	0.31
Ypsilanti Twp #2	3/1		<0.10	

Concentrations based on best fit of 3 standards: Aroclor 1242, Aroclor 1254, or a mixture of Aroclor 1242 and 1254 in a 1:1 ratio.

Table 6. Concentrations of PCB's in the sludge from fifty-seven municipal wastewater treatment plants in Michigan, Spring 1973. Concentrations in parts per million, dry weight.

City	Date	PCB's* 1242	1254	1242:1254
Adrian	3/ 7			24.0
Albion	2/22		1.5	
Ann Arbor	3/1		1.1	
Bay City	3/1	352.0		
Battle Creek	2/28		2.8	
Benton Harbor-St. Joseph	2/28		13.8	
Brighton	3/1		<0.1	
Cadillac	3/28		<0.1	
Charlotte	5/1		6.8	
Constantine	2/28		2.1	
Detroit	2/28	32.1		
Dexter	3/1		3.2	
E. Lansing	5/2		4.6	
Escanaba	3/28		5.9	
Essexville	3/1		3.9	
Flint	2/22		6.3	
Gladstone	3/28		4.1	
Grand Haven	2/21		4.1	
Grand Rapids	2/21		11.8	
Holland	2/21		0.8	
Howell	4/26		15.0	
Houghton-Hancock	3/27		5.5	

City	Date	PCB's 1242	1254	1242:1254
Iron Mountain - Kingsford	3/28		9.5	
Ironwood	3/27		5.2	
Jackson	2/22		3.0	
Kalamazoo	2/29	23.3		
L'Anse	3/27		4.4	
Lansing	4/18		5.3	
Manistique	3/28		1.5	
Marquette	3/27		2.8	
Marshall	2/22		3.9	
Menominee	2/28		4.2	
Midland	3/1		2.9	
Milford	3/8			50.5
Monroe	5/4		3.3	
Mt. Clemens	3/8	175.0		
Mt. Pleasant	3/28		6.5	
Muskegon	2/28		12.7	
Muskegon Heights	2/28		11.0	
Niles	2/20		7.8	
Norway	3/28		<0.1	
Owosso	2/21		2.0	
Pontiac (Auburn)	3/12			12.1
Pontiac (E. Blvd.)	3/12			9.2
Port Huron	3/8			9.2

Table 7. Polychlorinated biphenyls (PCB's) in composite water samples from the Saginaw River at Bay Harbor Marina, March 1971 - May 1973.

Collection Date	Concentration in parts per billion
3-9-71	0.450
6-10-71	0.560
8-27-71	2.900
10-26-71	1.100
6-8-72	0.640
10-13-72	0.360
10-29-72	<0.020
10-30-72	<0.020
11-1-72	0.091
11-2-72	0.031
11-4-72	<0.020
11-6-72	0.022
1-26-73	<0.100
5-24-73	0.210

le 8. Concentrations of polychlorinated biphenyls (PCB's) found in fish species taken from Michigan waters of Lake Michigan during 1972*.

cies	PCB's by District** in ppm (sample size in parenthesis) MM3	MM4	MM5	MM6	MM7	MM8	Total # Fish Sampled	Mean Concentrati
wife	1.7 (3)			2.3 (1)	2.7 (6)	2.7 (6)	16	2.4 ± 0.6
p					3.9 (6)		6	3.9 ± 2.0
p				3.2 (2)	8.5 (8)	6.5 (9)	19	7.0 ± 4.2
minee				0.8 (1)	1.2 (2)		3	1.1
h				0.5 (1)	0.4 (5)	0.5 (11)	17	0.4 ± 0.4
Salmon			11.2 (3)				3	11.2
ook almon				12.4 (10)			10	12.4 ± 5.0
ers	0.8 (6)			0.7 (2)	1.5 (3)	1.1 (6)	17	1.0 ± 0.7
lhead			6.0 (2)				2	6.0
Trout	11.1 (3)	6.4 (3)		3.2 (2)	5.7 (6)	9.2 (6)	20	7.4 ± 4.0
sfish		0.6 (3)		0.8 (2)	1.1 (1)		6	0.7 ± 0.3

a from Michigan's Great Lakes Environmental Contaminant Survey, 1972.
nes of Lake Michigan within Michigan Boundaries
M3 - Northern Basin
M4 - Grand Traverse Bay
M5 & MM6 - Central Basin
M7 & MM8 - Southern Basin

MONS 041442

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Exhibit 40

Measurements of PCB (Aroclor 1254) in Lake Superior Diluent Water During a Brook Trout Chronic Exposure

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MONS 041443

Concommitant with the need to investigate the chronic effects and bioconcentration factor of PCBs with fish is the need to measure the concentration of PCBs in the water. Brook trout are being exposed to Aroclor® 1254 at NWQL at nominal concentrations ranging from 0.01 µg/l to 1.0 µg/l. Water samples were taken daily from each tank and weekly composites were made using formalin to minimize microbial activity. Reagent blanks and recovery experiments using water from the control tanks spiked with 0.01 µg/l, 0.10µg/l, and 1.0 µg/l Aroclor® 1254 were conducted each week. In addition, estimates of PCBs in the Lake Superior water used in the exposure were made by perchlorinating the PCBs to decachlorobiphenyls.

Water samples (4 liters from each tank and 20 liters from Lake Superior water supply) were passed through glass columns packed with polyurethane foam after the extraction systems were exhaustively extracted with solvent to remove impurities which could interfere in the analysis. The PCBs were removed from the columns with acetone (50 ml) and hexane (225 ml). The extracts were dried over anhydrous Na_2SO_4 and concentrated to 5 ml in a Kuderna-Danish evaporative concentrater. The concentrates were transferred to one gram Florisil columns (prewashed with hexane) and the PCBs were eluted with 75 ml of hexane. The eluant was collected in a Kuderna-Danish concentrator and reduced to about 5 ml for GLC analysis.

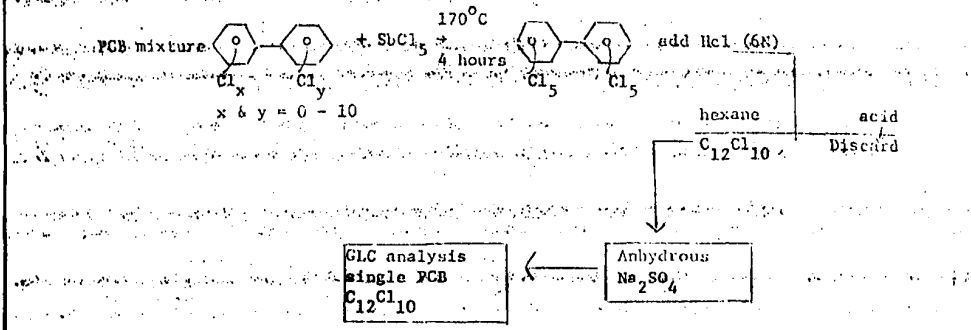
The results of the recovery experiments are presented in Table 1.

The data show that the mean recovery of PCBs from spiked Lake Superior water was greater than 60 percent over the range from 0.01 µg/l to 1.0 µg/l. The data also demonstrate that the standard deviation of the analyses using the four liter water samples increased from ± 14 percent at the 1 µg/l concentration to ± 59 percent at the 0.01 µg/l concentration.

Table 1. Recovery of Aroclor® 1254 Added to Water From NWQL Control Tanks

Quantity of PCBs added per liter	Number of recovery experiments	Recovery of PCBs (percent) Mean ± Standard Deviation
1.00	59	62 ± 14
0.10	58	62 ± 21
0.01	57	79 ± 59

The extracts of the 20 liter water samples were analyzed for PCBs by perchlorinating the samples with $SbCl_5$. Briefly, the analytical scheme is as follows:



The increased sensitivity of this method is due to the conversion of all PCBs to a single compound and the greater sensitivity of the more highly chlorinated $C_{12}Cl_{10}$ to electron capture.

The GLC response is linear up to 0.2 ng $C_{12}Cl_{10}$ and the detection limit is about 0.005 to 0.01 ng $C_{12}Cl_{10}$. It is commonly observed that commercially available $SbCl_5$ produces a blank in this analysis, and both the $SbCl_5$ and reagent blanks generally limit the determinable limit in these analyses.

The experiment to measure the PCBs in Lake Superior water consisted of two perchlorination blanks, three reagent blanks which includes the extraction through the perchlorination steps, three replicate samples of Lake Superior water, and three replicate samples from the control tanks in the PCB bioassay system. The results of these analyses are summarized in Table 2. Since the perchlorination blanks were essentially the same as the overall reagent blank, the major source of PCBs is assumed to be the perchlorination step and all blanks were grouped together. The Lake Superior water samples contained approximately 0.8 ng/l PCBs as Aroclor 1254. However, the variability of the measurements (more than 50 percent) at this concentration does not permit precise estimates to be made. The estimated concentration of PCBs in the control tanks was approximately 3 ng/l.

Table 2. PCBs in Lake Superior Water and Control Bioassay Tanks

Sample Origin	Number	Volume (liters)	Total ng $C_{12}Cl_{10}$ Mean	±	S. E.	Estimated PCB concentration (ng/l as Aroclor 1254)
Reagent blanks	5	--	44	±	12	--
Lake Superior	3	20.3 ± 0.02	62	±	6	0.8 ± 0.4
Brook trout control tanks	3	21.1 ± 0.05	132	±	11	3.2 ± 0.5

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