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PCB's in Fish from Selected Waters of New York State [1]

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ABSTRACT

PCB residues in fish from 41 stations throughout New York State were monitored in 1975. Nearly all fish contained PCB's in detectable amounts although the levels of contamination and specific Aroclor varied. The Hudson River contained the highest known PCB concentrations within the United States, levels often exceeded 100 ppm. Other waters and fish which were significantly contaminated include Lake Ontario salmonids and Cayuga Lake lake trout. Onondaga Lake, previously closed to fishing because of mercury contamination, also appears to have abnormally high levels of PCB's approaching in some instances the action level of the Food and Drug Administration, U.S. Department of Health, Education, and Welfare. Samples from marine waters generally have contaminant levels substantially below 5.0 ppm.

A summary of PCB data collected during 1970-75 is presented.

Introduction

The Division of Fish and Wildlife, New York State Department of Environmental Conservation, began analyzing fish flesh for DDT in the early 1960's. This work was conducted in response to data suggesting that chlorinated hydrocarbons may interfere with reproduction of fish and wildlife resources. Results of the investigation led to State restrictions on use of DDT in 1965. During this time, research indicated that DDT analyses could be biased through sample contamination with similar compounds, polychlorinated biphenyls (PCB's) (*8*). To minimize errors in future work, both DDT and PCB's were extracted and analyzed to obtain separate values. From 1971 through 1975 PCB's were evaluated in all fish flesh analyses as a part of DDT monitoring.

The recent concern over the impact of PCB's on human health and their possible effect on New York's natural resources as well as reports of their ubiquitous nature (*6, 13, 20*) precipitated a shift from low-level monitoring to the statewide monitoring described in this report. The new program promulgated by the Department of Environmental Conservation in August 1975 revised all existing directions. Specific fish species and desired sizes were defined (Table 1). Stations were located in most large waterways throughout the State where PCB contamination could occur (Figure 1, Table 2) and, when possible, where earlier samples had been taken. Several Adirondack streams were included to ascertain statewide ambient conditions. Where contamination was known to exist sampling was intensified. This was the case of the Hudson River where inordinately high concentrations of the contaminant in fish were reported by the U.S. Environmental Protection Agency (EPA (*16*).

The objectives of this program were to determine the level and extent of PCB contamination in fish inhabiting or migrating through major waterways in New York State and to isolate contaminated portions or reaches of waterways, thereby identifying specific areas to be addressed by agencies which control water pollution.

TABLE 1. *Desired species and size distribution of fish from New York waters analyzed for PCB content, 1975.*

Species	Small [2]	Medium [3]	Large [4]
	Length, in		
Smallmouth bass	5-7	10-12	14-16
Largemouth bass	5-7	10-12	14-16
Walleye	7-9	11-13	19-21
Bullheads	4-6	8-10	11-13
Carp	5-7	13-15	23-25
Goldfish	4-6	7-9	10-12
Suckers	6-8	10-12	17-19
Striped bass	11-13	16-18	28-32
	Weight, lb [5]		
Salmon (coho)	1-2	4-6	8-12
(chinook)	3-5	8-12	15-20
Rainbow or steelhead trout	1-2	3-5	5-8
Lake trout	1-2	4-6	8-12

[2] Minimum number of fish per sample was 6.
[3] Average number of fish per sample was 5.
[4] Maximum number of fish per sample was 5.
[5] Minimum number of fish per sample was 3.

[1] New York State Department of Environmental Conservation, Bureau of Environmental Protection, 50 Wolf Road, Albany, N.Y. 12233.

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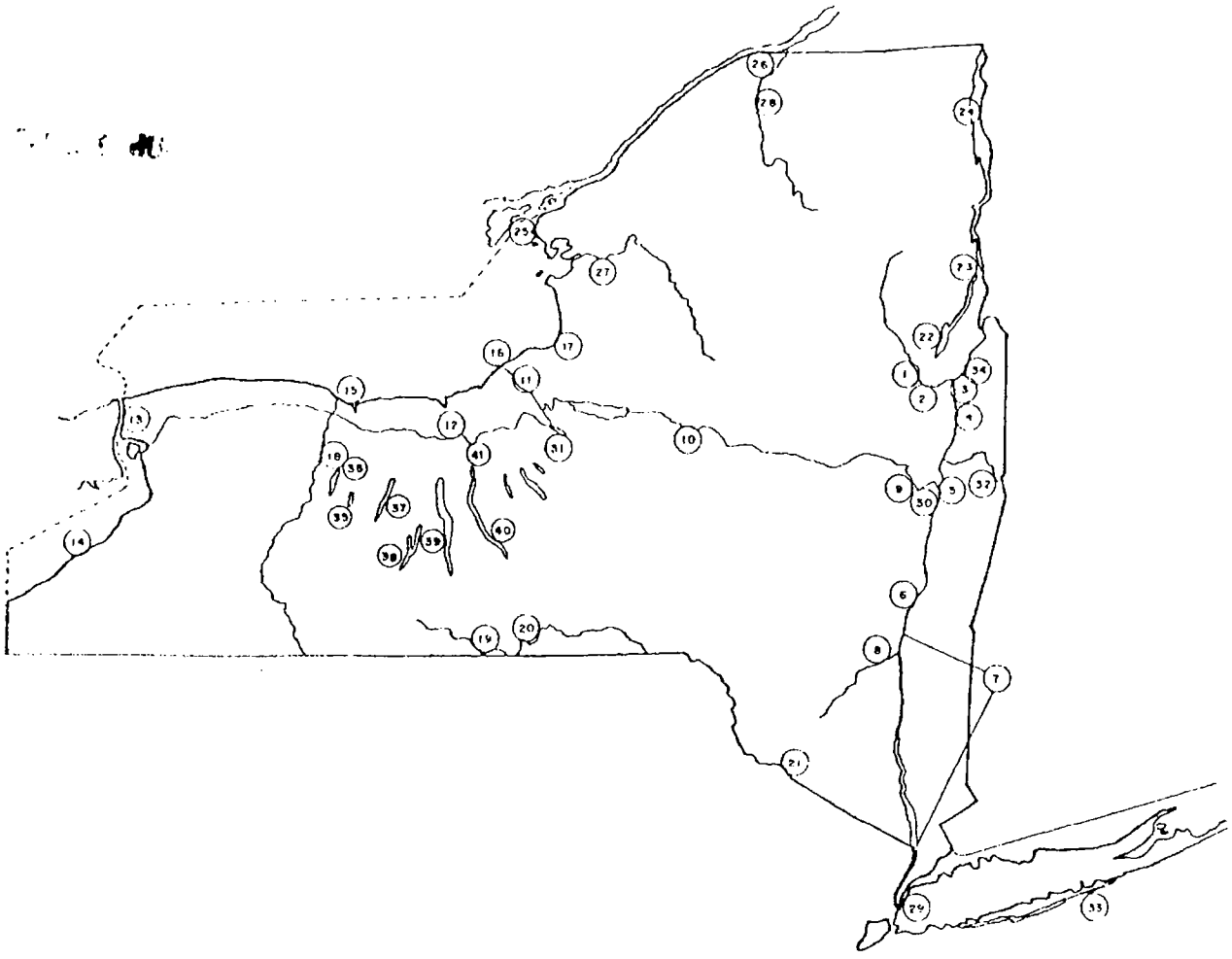


FIGURE 1. *Fish collection stations for PCB studies, New York State- 1975*

Stations selected for fish sampling were included in a major water column and sediment monitoring program conducted by the State Division of Pure Waters. Data from all sources are being used to track down sources of PCB contamination and to recommend remedial action.

Fish Collections

Regional Fish and Wildlife personnel were instructed on specific species and sizes of fish desired, general location of the stations, and timetable for collections. Sampling methods were primarily gill nets and electrofishing; angling and rotenone were used when other techniques were inadequate. On occasion, fish were donated by or purchased from commercial and recreational anglers.

The composition of the fish samples directed to the laboratories varied slightly, depending on the success of the collection teams. Specifications in Table 1 were flexible in order to accommodate a sampling program involved with diverse waters. Specific instructions requested that at each location members of two trophic levels, predators and forage species, be sampled in three size categories: small or sublegal, medium or minimally legal, and large.

The collection team chose the representative species and followed the length and number specifications in Table 1. In those areas where a commercial species is harvested, representative specimens were included.

All specimens were individually tagged, measured and weighed, placed by groups in polyethylene bags, and deposited in a cooler or freezer for shipment to a laboratory

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TABLE 2. *Statewide sampling stations for PCB analysis, New York—1975*

Station No.[1]	Watershed	Waterway	Location
1	Upper Hudson River	Hudson River	Above Corinth
2			Above Glens Falls
3			At Fort Edward
			below General Electric Co
4			5 miles below Fort Edward
5			Waterford area
6	Lower Hudson River		Coxsackie/Catskill area
7			Lower Hudson
			Mouth of Rondout Creek
			Mouth of Wappingers Creek
			Mouth of Esopus Circle
			Kingston/Rhinecliff Bridge
			Tappan Zee Bridge area
			West Point
			George Washington Bridge area
			Highland/Poughkeepsie area
8		Rondout River	Rondout River above first dam
9	Mohawk River	Mohawk River	Below Schenectady
10			Below Oriskany
11	Seneca Oneida Oswego Rivers	Seneca Oneida/Oswego Rivers	Below Fulton
12		Erie Canal	Below Clyde
13	Lake Erie/Niagara River	Niagara River	Below Lewiston
14	Lake Erie Niagara River	Lake Erie	Dunkirk
15	Lake Ontario	Lake Ontario	Off Rochester
16			Oswego
17			Pulaski (salmonids)
18	Genesee River	Genesee	Below Industry
19	Chemung River	Chemung	Chemung
20	Susquehanna River	Susquehanna	Smithboro
21	Delaware River	Delaware	Below Pt. Jervis
			(State line)
22	Lake Champlain	Lake George	Bolton Landing
23		Lake Champlain	Ticonderoga
24			Plattsburg
25	St. Lawrence River	St. Lawrence	Cape Vincent
26			Massena
27	Black River	Black River	Watertown
28	St. Lawrence River	Raquette River	Norfolk
29		Fulton Fish Market	
30		Albany Fish Market	
31	Seneca Oneida Oswego Rivers	Onondaga Lake	
32	Upper Hudson River	Walloomsac/Hoosick Rivers	
33	Long Island	Marine Waters	
34	Upper Hudson River	Champlain Canal	Lock 8
35	Genesee River	Hemlock Lake	
36		Canadice Lake	
37	Seneca Oneida Oswego Rivers	Canandaigua Lake	
38		Keuka Lake	
39		Seneca Lake	
40		Cayuga Lake	
41		Seneca River	Montezuma National Wildlife Refuge

[1] See map, figure 1

of storage center. Common names of fishes used throughout this report are those adopted by the American Fisheries Society (*1*) and are presented with their scientific nomenclature in Table 3.

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TABLE 3. *Common and scientific names of fish and shellfish species analyzed for PCB's--1975*

Common Name	Scientific Name
Spiny dogfish	*Squalus acanthias*
Atlantic sturgeon	*Acipenser oxyrhynchus*
American eel	*Anguilla rostrata*
Blueback herring	*Alosa aestivalis*
Alewife	*Alosa pseudoharengus*
American shad	*Alosa sapidissima*
Atlantic menhaden	*Brevoortia tyrannus*
Cisco or lake herring	*Coregonus artedii*
Coho salmon	*Oncorhynchus kisutch*
Chinook salmon	*Oncorhynchus tshawytscha*
Rainbow trout	*Salmo gairdneri*
Atlantic salmon	*Salmo salar*
Brown trout	*Salmo trutta*
Lake trout	*Salvelinus namaycush*
Rainbow smelt	*Osmerus mordax*
Chain pickerel	*Esox niger*
Northern pike	*Esox lucius*
Goldfish	*Carassius auratus*
Carp	*Cyprinus carpio*
White sucker	*Catostomus commersoni*
Silver redhorse	*Moxostoma anisurum*
Shorthead redhorse	*Moxostoma macrolepidotum*
Brown bullhead	*Ictalurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Goosefish	*Lophius americanus*
Atlantic cod	*Gadus morhua*
Atlantic tomcod	*Microgadus tomcod*
Mummichog	*Fundulus heteroclitus*
Atlantic silverside	*Menidia menidia*
White perch	*Morone americana*
White bass	*Morone chrysops*
Striped bass	*Morone saxatilis*
Rock bass	*Ambloplites rupestris*
Redbreast sunfish	*Lepomis auritus*
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Smallmouth bass	*Micropterus dolomieui*
Largemouth bass	*Micropterus salmoides*
Black crappie	*Pomoxis nigromaculatus*
Yellow perch	*Perca flavescens*
Walleye	*Stizostedion vitreum*
Bluefish	*Pomatomus saltatrix*
Weakfish	*Cynoscion regalis*
Scup	*Stenotomus chrysops*
Tautog	*Tautoga onitis*
Freshwater drum	*Aplodinotus grunniens*
Atlantic mackerel	*Scomber scombrus*
Bluefin tuna	*Thunnus thynnus*
Grubby	*Myoxocephalus aenaeus*
Summer flounder	*Paralichthys dentatus*
Winter flounder	*Pseudopleuronectes americanus*
Northern puffer	*Sphoeroides maculatus*
SHELLFISH	
Blue claw crab	*Callinectes sapidus*
Northern lobster	*Homarus americanus*
Hard clam	*Mercenaria mercenaria*
Surf clam	*Spisula solidissima*
American oyster	*Crassostrea virginica*
Common mussel	*Mytilus edulis*

Laboratory Analyses

Four State laboratories collaborated in the analysis of fish flesh: Department of Environmental Conservation Laboratories at Rome and Stony Brook, Department of Agriculture and Market Food Laboratory in Albany, and the Department of Health Griffin Laboratory in Guilderland. Limited analyses were conducted in the Buffalo, N.Y., laboratory of the Food and Drug Administration, U.S. Department of Health, Education, and Welfare. Specific analytical techniques have been described (*5, 9, 10, 14, 15, 17, 21*).

Frozen fish samples were defrosted, generally prepared as described below, ground three times, and blended.

FISH SIZE	PREPARATION
Very small: less than 100 g	Whole fish composites, see Table 4
Small: 100–150 g	Head and viscera removed. Individuals composited.
Medium: 25–61 cm	Head and viscera removed. Composite if needed
Large: 61–76 cm	Left fillet or anterior half of left fillet with skin intact. Composite if needed
Jumbo: over 76 cm	Anterior third of left fillet with skin intact

Brown bullhead, American eel, and Atlantic Ocean fish were the only species skinned before grinding; this is the common method of preparing them for consumption. Composites of medium through jumbo fish were made of ground and blended flesh; total weight of each individual was proportional to the total weight of the composite.

Laboratories performing analyses are noted in Tables 4 and 5. Recoveries by the analytical techniques cited above are 85 percent or more. Data were not adjusted to reflect recovery rate. Each procedure has a sensitivity of 0.01 ppm although two laboratories reported results only as low as 0.1 ppm. Very limited numbers of fish from Lake Ontario were subjected to mass spectrometry for confirmation of analytical results.

A quality assurance program was implemented to assure that results from the various laboratories were comparable. Table 6 shows that none of the participating laboratories had contamination problems; all reported zero for sample A. At the level of approximately 1 μg/ml of extract, which corresponds to the action level of 5 μg/g in fish, precision among the laboratories was remarkably good. No gross bias existed, although the laboratories had standard Aroclor mixtures obtained at different times and one laboratory used Aroclor 1242 for quantitation instead of Aroclor 1016. Results at higher concentrations indicate similar agreement.

In Table 6, the two sets of results from Griffin Laboratory illustrate the effects of using separate standards to quantitate the two Aroclor types and of using a mixed standard. Although all laboratories used individual standards, Table 6 results indicate basic similarity to results obtained for a mixed standard, Aroclors 1242 and 1254. This is probably due to differing gas chromatograph column conditions, and differing techniques of measuring the various Aroclors. To measure check samples such as these the use of individual Aroclors is the most desirable, but for environmental samples which are nearly always mixtures, use of mixed standards is analytically faster and probably more accurate. Table 7 supports this contention; some laboratories used mixed standards and some used indi-

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TABLE 4. *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory [1]	Species	Arocl or	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight [2] Weighted Average	High	Low
Hudson River	1, 7	DEC-R	Smallmouth bass	1242/1016	26	12	0	0	
				1254			TR	TR	0
			Walleye	1242/1016	2	2	0	0	
				1254			TR	TR	0
			Yellow perch	1242/1016	15	11	0	0	
				1254			TR	TR	0
			White sucker	1242/1016	4	4	0	0	
				1254			TR	TR	0
Hudson River (Fort Edward below Oriental Electric Company)	3	DEC-R	Walleye						
			Whole fish	1242/1016	14	2	91.01	104.21	81.12
				1254			36.01	41.80	28.29
			Edible flesh	1242/1016	4	1	9.88	9.88	-
				1254			8.31	8.31	
			Yellow perch						
			Whole fish	1242/1016	30	2	164.36	236.40	129.33
				1254			37.14	62.88	24.27
			Edible flesh	1242/1016	10	1	61.10	61.10	-
				1254			18.24	18.24	-
			Rock bass	1242/1016	2	1	27.35	27.35	
				1254			ND		
			Alewife	1242/1016	1	1	20.35	20.35	
				1254			ND		
			White sucker	1242/1016	9	2	41.76	82.86	8.8
				1254			23.09	47.57	2.72
Hudson River (5 miles below Fort Edward)	4	DEC-R	Smallmouth bass	1242/1016	1	1	100.27	100.27	-
				1254			22.64	22.64	-
			Walleye	1242/1016	3	3	56.73	157.27	5.19
				1254			16.67	29.74	5.56
			Yellow perch						
			Whole fish	1242/1016	26	2	87.29	88.18	32.31
				1254			30.69	34.21	18.95
			Edible flesh	1242/1016	3	1	35.54	35.54	
				1254			15.61	15.61	
			White sucker [3]	1242/1016	10	5	47.30	78.60	28.03
				1254			19.82	41.10	8.13
			Brown bullhead	1242/1016	5	2	77.01	85.30	71.24
				1254			37.23	38.52	36.35
Hudson River (Schuylerville)	4A	DEC-R	Largemouth bass						
			Whole fish	1242/1016	8	2	11.65	14.31	8.99
				1254			8.42	9.84	6.99
			Edible flesh	1242/1016	4	1	19.25	24.85	12.40
				1254			10.59	15.97	4.58
			American eel [4]	1242/1016	2	2	207.33	403.48	11.25
				1254			83.47	155.87	11.07
			Brown bullhead	1242/1016	1	1	4.66	4.66	
				1254			7.99	7.99	
			White sucker	1242/1016	6	2	58.32	154.29	10.35
				1254			15.23	35.92	3.93
Hudson River (Waterford)	5	DAM	Smallmouth bass	1242/1016	10	2	30.60	36.0	23.0
				1254			15.70	17.5	13.5
			Walleye	1242/1016	2	1	23.30	23.3	
				1254			9.10	9.1	
			White sucker	1242/1016	11	2	27.44	36.0	20.3
				1254			10.15	12.9	7.9
Hudson River (below Troy Dam)	6, 7a-b	DEC-R	Striped bass						
			Whole fish	1242/1016 [5]	21	2	0.10	2.69	0
				1254			1.75	1.96	1.66
				1242/1016	42	31	12.95	56.42	0
			Edible flesh	1254	48	37	17.91	50.66	1.66

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TABLE 4 (cont'd.). *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory [1]	Species	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight [2] Weighted Average	High	Low
			Smallmouth bass	1242/1016	2	2	8.05	13.76	2.34
				1254 [6]	1	1	2.18	2.18	
			Largemouth bass	1242/1016	10	10	5.43	19.73	0
				1254			4.62	7.65	1.73
			Yellow perch	1242/1016	7	2	1.19	4.18	0
				1254 [7]	5	1	5.28	5.28	
			White perch	1242/1016	30	9	9.00	30.67	0
				1254 [8]	18	4	6.98	9.65	4.14
			Chain pickerel	1242/1016	1	1	8.68	8.68	
				1254			ND		
Hudson River (Below Troy Dam)	6, 7a, b	DEC R	Atlantic tomcod Whole fish	1242/1016	47	2	6.49	6.68	6.27
				1254			7.75	9.85	5.37
			Edible flesh	1242/1016	6	2	1.50	2.07	0.93
				1254			1.32	1.63	1.00
			American shad	1242/1016	15	6	1.35	9.00	0
				1254			1.14	1.88	0
			Blueback herring Whole fish	1242/1016	4	4	0.72	1.85	0
				1254			1.41	4.69	0
			Edible flesh	1242/1016	2	1	0	0	
				1254			5.13	5.13	
			American eel	1242/1016	11	7	53.34(25.61) [9]	186.22	0
				1254			27.20(19.15)	57.20	3.00
			Atlantic sturgeon	1242/1016	20	5	7.69	13.48	0
				1254			8.15	9.84	6.28
			Brown bullhead	1242/1016	1	1	0	0	
				1254			3.58	3.58	
			Atlantic menhaden	1242/1016	8	2	0	0	
				1254			1.67	1.83	1.41
Rondout Creek	8	DAM	Largemouth bass	1242/1016	7	2	0	0	
				1254			1.39	1.97	1.16
			White sucker	1242/1016	5	1	0	0	
				1254			1.60	1.60	
			Carp	1242/1016	3	1	0	0	
				1254			1.50	1.50	
Mohawk River (Schenectady)	9	DAM	Smallmouth bass	1242/1016	3	1	0.70	0.7	
				1254			1.50	1.5	
			White sucker	1242/1016	5	1	0.80	0.8	
				1254			1.90	1.9	
			Black crappie	1242/1016	9	2	1.13	1.6	0.5
				1254			1.13	1.4	0.8
			Largemouth bass	1242/1016	8	2	0.95	1.2	0.7
				1254			3.40	4.7	2.1
			Blueback herring	1242/1016	6	1	2.10	2.1	
				1254			1.60	1.6	
Mohawk River (Little Falls)	10	DAM	Walleye	1242/1016	10	2	4.45	4.9	4.0
				1254			9.25	9.5	9.0
			Smallmouth bass	1242/1016	2	1	3.90	3.9	
							9.50	9.5	
Mohawk River (Little Falls)	10	DAM	White sucker	1242/1016	11	2	0	0	
				1254			2.79	4.2	1.1
			Brown bullhead	1242/1016	5	1	2.70	2.7	
				1254			11.30	11.3	
Seneca Oswego Canal	11	DH	Smallmouth bass	1242/1016	14	3	2.29	4.4	0
				1254			1.13	2.5	0.7

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TABLE 4 (cont'd.). *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory[1]	Species	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight[2]		
							Weighted Average	High	Low
			Carp	1242/1016	10	2	2.00	4.0	0
				1254			5.60	7.2	4.0
Erie Canal	12	DH	Largemouth bass	1242/1016	1	1	0	0	
				1254			0.80	0.8	
			Northern pike	1242/1016	1	1	2.00	2.0	
				1254			1.30	1.3	
			Carp	1242/1016	8	2	0.60	1.6	0
				1254			0.30	0.8	0
Niagara River	13	DEC R	Goldfish	1242/1016	5	1	0	0	
				1254			TR	TR	
			Largemouth bass	1242/1016	1	1	0	0	
				1254			3.10	3.10	
			Smallmouth bass	1242/1016	1	1	0	0	
				1254			3.30	3.30	
			White bass	1242/1016	1	1	0	0	
				1254			11.31	11.31	
Lake Erie	14	DEC R/DAM	Smallmouth bass	1242/1016	19	4	0.19	0.4	0
				1254			0.72	1.0	0.6
			Walleye	1242/1016	19	9	0.19	0.6	0
				1254			0.70	1.45	TR
			Yellow perch	1242/1016	10	2	0.40	0.4	0.4
				1254			0.60	0.6	0.6
			Goldfish	1242/1016	4	1	1.00	1.0	
				1254			1.40	1.4	
			Brown trout	1242/1016	20	9	0.23	2.4	0
				1254			1.60	3.23	0.57
Lake Erie	14	DEC R	Rainbow trout	1242/1016	10	9	0	0	
				1254			2.03	3.77	0.76
			Chinook salmon	1242/1016	8	8	0	0	
				1254			1.71	2.71	0.98
			Coho salmon	1242/1016	15	4	0	0	
				1254			2.36	5.06	0.68
Lake Ontario	15, 16	DEC R	Coho salmon	1242/1016	23	15	0	0	
				1254			8.05	18.65	2.09
			Chinook salmon	1242/1016	29	17	0.21	6.07	0
				1254			14.48	24.57	4.67
			Rainbow trout	1242/1016	9	9	0	0	
				1254			5.76	12.35	1.47
			Brown trout	1242/1016	12	12	0	0	
				1254			5.25	16.76	0.96
			Lake trout	1242/1016	19	14	0	0	
				1254			9.38	14.62	1.35
			White perch	1242/1016	27	5	0	0	
				1248			0.05	0.48	
				1254			4.12	12.06	2.14
			Yellow perch	1242/1016	25	4	0.38	0	
				1254			0.38	0.69	
			Northern pike	1242/1016	17	10	0	0	
				1254			1.79	4.02	0.96
			Largemouth bass	1242/1016	5	5	0	0	
				1254			1.79	4.25	0.42
			Smallmouth bass	1242/1016	7	2	0	0	
				1254			1.81	2.69	1.13
			Rock bass	1242/1016	11	2	0	0	0
				1254			0.83	3.58	0.55
			Brown bullhead	1242/1016	10	2	0	0	
				1254			0.57	0.75	0.39

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TABLE 4 (cont'd.). *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory[1]	Species	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight[2] Weighted Average	High	Low
			Pumpkinseed	1242/1016	19	4	0	0	-
				1254			0.01	0.26	0
			Walleye	1242/1016	8	4	0	0	
				1254			2.87	7.39	0.33
			Rainbow smelt	1242/1016	10	4	0	0	-
				1254			2.10	4.55	1.16
			American eel	1242/1016	2	2	0	0	-
				1254			6.28	10.74	1.82
			Black crappie	1242/1016	8	6	0	0	-
				1254			1.35	2.07	0.20
			White sucker	1242/1016	5	5	0	0	
				1254			3.39	7.90	1.38
Lake Ontario (Salmon River: Pulaski West)	17	DEC-R	Coho salmon	1242/1016	9	20	0	0	-
				1254			9.31	12.67	4.48
			Chinook salmon	1242/1016	21	15	0.11	2.28	0
				1254			6.98	17.01	2.84
Genesee River	18	DH	Smallmouth bass	1242/1016	13	3	1.77	4.0	0.5
				1254			2.23	5.6	0.5
			Silver redhorse	1242/1016	14	3	1.55	3.0	1.0
				1254			1.45	2.4	0.5
Chemung River	19	DAM	Smallmouth bass	1242/1016	12	3	0	0	-
				1254			0.88	1.5	0.6
			Rock bass	1242/1016	2	1	0.40	0.4	-
				1254			0.40	0.4	-
			White sucker	1242/1016	13	3	0.29	0.5	0
				1254			0.55	0.9	0.2
Susquehanna River	20	DH	Smallmouth bass	1242/1016	12	2	0.20	0.2	0.2
				1254			0.45	0.5	0.4
			Walleye	1242/1016	6	2	0.13	0.3	0.1
				1254			0.75	0.7	1.0
			White sucker	1242/1016	18	3	0.20	0.2	0.2
				1254			0.80	0.8	0.8
			Carp	1242/1016	11	2	0.41	0.5	0.3
				1254			1.25	1.3	1.2
Delaware River	21	DH	Smallmouth bass	1242/1016	3	2	1.33	1.6	0.8
				1254			0.67	0.8	0.6
			White sucker	1242/1016	5	1	0.40	0.4	-
				1254			0.50	0.5	
			American eel	1242/1016	9	3	1.24	2.8	0
				1254			0.36	0.8	0
Lake George	22	DH & DEC-R	Lake trout	1242/1016	10	5	0.71	2.0	0
				1254			3.94	15.0	0
			Rainbow trout	1242/1016	6	6	0	0	-
				1254			<1.00	<1.00	<1.00
			Smallmouth bass	1242/1016	14	5	0.29	1.0	0
				1254			0.27	1.0	0
			Yellow perch	1242/1016	15	3	0.57	1.2	0
				1254			0.31	0.8	0
			Cisco	1242/1016	10	2	0.50	0.6	0.4
				1254			3.95	4.7	3.2
Lake Champlain	23, 24	DH	Smallmouth bass	1242/1016	29	6	0.75	3.0	0
				1254			1.21	3.5	0
			Walleye	1242/1016	5	1	0.30	0.3	
				1254			0.20	0.2	
			Northern Pike	1242/1016	4	2	0.2	0.3	0.1
				1254			0.4	0.6	0.2

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TABLE 4 (cont'd.). *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory[1]	Species	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight: Weighted Average	High	Low
			Yellow perch	1242/1016	17	3	0.40	0.4	0
				1254			0.59	0.8	0.2
			Brown bullhead	1242/1016	13	3	0.34	0.7	0
				1254			0.45	1.2	0
St. Lawrence River	25, 26	DEC R	Smallmouth bass	1242/1016	16	9	0	0	-
				1254			4.58	6.85	1.62
			Walleye	1242/1016	11	3	0	0	
				1254			1.83	2.05	1.58
Black River	27	DH	Walleye	1242/1016	8	2	1.25	2.0	0
				1254			3.11	4.5	0.8
			Brown bullhead	1242/1016	10	2	0.95	1.5	0.4
				1254			2.50	4.0	1.0
Raquette River	28	DH	Smallmouth bass	1242/1016	15	4	0.30	0.4	0.2
				1254			0.90	1.7	0.3
			Shorthead redhorse	1242/1016	14	3	0.32	0.4	0.2
				1254			0.44	0.6	0.3
Onondaga Lake	31	DEC R	Smallmouth bass	1242/1016	9	3	1.82	1.9	1.2
				1254			3.13	4.0	1.7
			Walleye	1242/1016	1	1	3.10	3.1	
				1254			2.50	2.5	
			White perch	1242/1016	11	2	2.28	4.3	0.6
				1254			2.33	4.9	0.2
			White sucker	1242/1016	3	1	0.70	0.7	
				1254			0.20	0.2	
			ntp	1242/1016	7	2	2.20	3.0	0.2
				1254			6.04	7.5	2.4
			Brown bullhead	1242/1016	5	1	3.10	3.1	
				1254			5.30	5.3	
Wallkoomsack Hoosic River	32	DH	Largemouth bass	1242/1016	5	2	2.62	2.8	2.5
				1254			2.98	3.5	2.2
			Yellow perch	1242/1016	4	1	2.00	2.0	0
				1254			3.40	3.4	0
			White sucker	1242/1016	7	3	1.73	2.9	0.7
				1254			1.58	2.9	0.6
Atlantic Ocean	33	DEC SB	Bluefish	1242/1016	26	15	0	0	
				1248			0	0	
				1254			1.43	8.39	0.21
			Striped bass	1242/1016	29	17	0	0	
				1248			0	0	
				1254			1.05	3.59	18
			Porgy	1242/1016	12	2	0	0	
				1248			0	0	
				1254			0.29	0.32	0.25
			Atlantic menhaden	1242/1016	18	7	0	0	
				1248			0	0	
				1254			1.07	1.53	0.44
			Spiny dogfish	1242/1016	60	4	0	0	
				1248			0	0	
				1254			0.25	0.27	0.22
			Bluefin tuna	1242/1016	1	1	0	0	
				1248			0	0	
				1254			1.42	6.68	0.19
			Atlantic mackerel	1242/1016	5	5	0.46	0.52	0.31
				1254					
			Weakfish	1242/1016	1	1	0	0	
				1248			0	0	
				1254			0.21	0.21	

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TABLE 4 (cont'd.). *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory[1]	Species	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight[2] Weighted Average	High	Low
			Summer flounder	1242/1016	1	1	0	0	
				1248			0	0	
				1254			0.56	0.56	
			Winter flounder	1242/1016	16	10	0	0	-
				1248			0	0	-
				1254			0.09	0.36	TR
			Atlantic cod	1242/1016	9	9	0	0	
				1248			0	0	
				1254			0.18	0.34	TR
			Tautog	1242/1016	3	3	0	0	-
				1248			0	0	-
				1254			TR	TR	TR
			Scup	1242/1016	1	1	0	0	-
				1248			0	0	-
				1254			0.33	0.33	
			White perch	1242/1016	2	2	0	0	-
				1248			0	0	-
				1254			3.11	5.19	1.02
			Atlantic silversides Whole fish	1242/1016	50	2	0	0	
				1248			0	0	
				1254			0.98	1.51	0.45
			American eel	1242/1016	1	1	0	0	-
				1248			0	0	
				1254			3.75	3.75	-
			Goosefish	1242/1016	1	1	0	0	
				1248			0	0	-
				1254			TR	TR	-
			Northern puffer	1242/1016	1	1	0	0	
				1248			0	0	
				1254			TR	TR	
			Hard clam	1242/1016	36	3	0	0	
				1248			0.23	0.36	0.01
				1254			0	0	
			Surf clam	1242/1016	6	1	0	0	
				1248			0.36	0.36	
				1254			0	0	
			Blue claw crab	1242/1016	14	2	0	0	
				1248			0.32	0.44	TR
				1254			0	0	
			Northern lobster	1242/1016	1	1	0	0	
				1248			0.13	0.13	
				1254			0	0	
			American oyster	1242/1016	48	4	0	0	
				1248			0	0	
				1254			TR	0.15	TR
			Common mussel	1242/1016	36	3	0	0	
				1248			0	0	
				1254			TR	TR	TR
Champlain Canal	34	DLCR	Rock bass Whole fish	1242/1016	1	1	4.40	4.40	
				1254			7.78	7.78	
			Freshwater drum Whole fish	1242/1016	2	1	0	0	
				1254			1.36	2.31	0.38
			Edible fish	1242/1016	2	2	0	0	
				1254			TR	TR	
			Yellow perch Whole fish	1242/1016	4	1	0	0	
				1254			0.92	0.92	
			Alewife	1242/1016	100	1	0	0	
				1254			1.60	1.60	

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TABLE 4 (cont'd.). *Concentrations of PCB's in fish and shellfish in New York State, 1975*

Water	Station	Laboratory*	Species	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight: Weighted Average	High	Low
			White sucker Whole fish	1242/1016	5	3	0	0	
				1254			0.59	0.92	TR
			Pumpkinseed Whole fish	1242/1016	5	1	0	0	
				1254			2.00	2.00	
Hemlock Lake	35	DEC R	Lake trout	1242/1016	10	10	TR	TR	0
				1254			TR	TR	0
			Rainbow trout	1242/1016	2	2	0	0	
				1254			0	0	
			Chain pickerel	1242/1016	9	5	0	0	
				1254			0	0	
			White sucker	1242/1016	3	1	TR	TR	
				1254			0	0	
			Carp	1242/1016	4	1	0	0	
				1234			0	0	
			Cisco	1242/1016	3	1	TR	TR	
				1254			0	0	
			Alewife	1242/1016	5	1	0	0	
				1254			0	0	
			Rainbow smelt	1242/1016	5	1	TR	TR	
				1254			0	0	
			Yellow perch	1242/1016	7	2	TR	TR	
				1254			0	6	
Canadice Lake	36	DEC R	Lake trout	1242/1016	7	7	0	0	
				1254					
			Rainbow trout	1242/1016	5	5	0	0	
				1254					
Canandaigua Lake	37	DEC R	Lake Trout	1242/1016	17	12	3.11	25.78	0
				1254			5.38	21.69	1.12
			Brown trout	1242/1016	1	1	0	0	
				1254			2.58	2.58	
Keuka Lake	38	DEC R	Lake trout	1242/1016	18	8	TR	TR	0
				1254			0.09	1.77	0
			Rainbow smelt	1242/1016	6	1	0	0	
				1254			0	0	
			Alewife	1242/1016	9	2	0	0	
				1254			0	0	
Seneca Lake	39	DEC R	Lake trout	1242/1016	10	10	0	0	
				1254			6.42	15.99	2.62
Cayuga Lake	40	DEC R	Lake trout	1242/1016	7	7	0	0	
				1254			6.15	8.23	1.76
Montezuma National Wildlife Refuge	41	DEC R	Carp	1242/1016	3	3	0.66	1.59	TR
							3.67	3.51	0.29

* Laboratory code: DEC R — Department of Environmental Conservation, Rome Laboratory, New York State
DAM — Department of Agriculture and Markets, Food Laboratory, New York State
DH — Department of Health, Griffin Laboratory, New York State
DEC SB — Department of Environmental Conservation, Stony Brook Laboratory, New York State

† *Indicates absence of data or no value less than 0 was reported in column titled "High."*
TR — trace
ND — not determined

‡ Includes only fish analyzed for both aroclors. 3 fish not included
§ Sample includes one highly contaminated specimen
¶ Sample does not include 6 fish for which Aroclor 1242/1016 was not determined
# Sample does not include 1 fish for which Aroclor 1254 was not determined
** Sample does not include 2 fish for which Aroclor 1254 was not determined
†† Sample does not include 12 fish for which Aroclor 1254 was not determined
‡‡ Data in parentheses are weighted average PCB concentrations excluding two fish with exceptionally high concentrations

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TABLE 5. *Concentrations of PCB's in fish, 1970–74*

Water	Species	Year Collected	Aroclor	No. Fish Analyzed[1]	Number of Analyses	Concentration of PCB's, ppm wet weight: Weighted Average	High	Low
Hudson River (Warrensburg)	Smallmouth bass	1970	1254	1	1	0.18	0.18	
Hudson River (Below Troy Dam)	Largemouth bass	1970–72	1254	20(19)	19(18)	6.58(4.09)	53.81	0.66
	Smallmouth bass	1970–72	1254	4(3)	4(3)	6.42(2.70)	17.58	2.56
	Striped bass	1970–72	1254	3	3	4.75	10.48	1.67
		1973	1254	22	22	14.75	49.63	3.70
	Atlantic sturgeon	1970–72	1254	4	4	6.71	7.03	5.73
	Northern pike	1972	1254	1	1	17.78	17.78	
	Yellow perch	1972	1254	13	2	0.79	0.92	0.79
	White perch	1972	1254	39	31	4.79	15.81	0.38
	Black crappie	1970–72	1254	3	2	0.78	1.42	0.46
	Pumpkinseed	1972	1254	21	3	0.47	0.64	0.46
	Bluegill	1972	1254	4	1	0.52	0.52	–
	Redbreast sunfish	1972	1254	12	1	0.75	0.75	
Roeliout Creek	Smallmouth bass	1970	1254	2	2	14.23	17.58	10.88
	Largemouth bass	1970	1254	7	7	5.05	9.52	2.60
Rampo River	Largemouth bass	1971	1254	1	1	0.57	0.57	
Lake Champlain	Smallmouth bass	1971	1242/1016	1	1	0.80	0.80	
	Largemouth bass	1971	1242/1016	1	1	4.21	4.21	
	Walleye	1971	1242/1016	2	2	28.15	55.46	0.84
	Northern pike	1971	1242/1016	1	1	0.80	0.80	
	Chain pickerel	1971	1242/1016	1	1	0.15	0.15	
	Atlantic salmon	1971	1242/1016	1	1	0.98	0.98	
	Black crappie	1971	1242/1016	1	1	1.45	1.45	
	Channel catfish	1971	1242/1016	2	2	7.00	7.85	6.15
	Brown bullhead	1971	1242/1016	1	1	0.68	0.68	
	Freshwater drum	1971	1242/1016	1	1	0.70	0.70	
	Carp	1971	1242/1016	1	1	1.94	1.94	
	White sucker	1971	1242/1016	1	1	0.50	0.50	
	Yellow perch	1971	1254	1	1	TR	TR	
	White fish (species not known)	1971	1254	1	1	0.87	0.87	
Lake Erie	Coho salmon	1973	1254	13	13	1.30	2.91	0.60
		1974	1254	26	26	1.74	5.88	TR
	Chinook salmon	1973	1254	4	4	1.48	1.89	1.20
		1974	1254	4	4	2.98	4.92	2.24
	Smallmouth bass	1971	1254	1	1	0.42	0.42	
	Freshwater drum	1971	1242/1016	1	1	1.72	1.72	
Niagara River	Smallmouth bass	1971	1242/1016	2	2	11.30	20.27	2.32
	Walleye	1971	1242/1016	1	1	1.02	1.02	
	Freshwater drum	1971	1242/1016	2	2	16.54	23.52	9.53

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TABLE 5 (cont'd.). *Concentrations of PCB's in fish, 1970-74*

Water	Species	Year Collected	Aroclor	No. Fish Analyzed[1]	Number of Analyses	Concentration of PCB's, ppm wet weight: Weighted Average	High	Low
Lake Ontario	Coho salmon	1971	1254	9	9	6.67	21.97	0.66
		1973	1254	29	29	6.26	10.77	2.00
	Chinook salmon	1971	1254	12	12	21.45	34.48	9.21
		1974	1254	9	9	7.15	14.77	1.54
Lake Ontario	Rainbow trout	1974	1254	3	3	1.97	2.81	1.45
	Brown trout	1974	1254	4	4	7.69	14.50	2.70
	Northern pike	1970	1254	4	4	5.32	12.86	1.38
	Smallmouth bass	1970	1242/1016	3	3	7.11	8.81	4.38
			1254	2	2	3.88	4.52	3.24
	Largemouth bass	1970	1254	1	1	2.84	2.84	
	Rock bass	1970	1254	2	2	0.49	0.59	0.40
	White bass	1970	1254	3	3	10.26	15.46	6.37
	White perch	1970	1254	3	3	3.42	5.15	2.12
	Carp	1970	1254	1	1	0.71	0.71	
	Rainbow smelt							
	Whole	1972	1254	10	10	4.02	7.12	2.26
	Edible	1972	1254	11	11	2.16	3.42	1.15
Lake Ontario (Salmon River Pulaski Weir)	Coho salmon	1970	1254	17	17	7.92	12.10	5.01
		1971	1254	20	20	10.35	21.43	0.83
		1972	1254	20	20	4.65	13.29	0.82
		1974	1254	5	5	7.05	11.29	3.48
Lake Ontario (Salmon River Pulaski Weir)	Chinook salmon	1971	1242/1016	2	2	19.38	28.11	10.65
			1254	4	4	9.37	12.10	5.98
		1973	1254	51	51	5.81	13.14	1.45
	Rainbow trout	1971	1254	3	3	7.24	8.38	5.76
Lake Ontario (Little Salmon River)	Coho salmon	1971	1254	3	3	2.60	6.10	0.76
	Chinook salmon	1971	1254	4	4	15.75	29.36	4.68
Lake Ontario (Spring Brook)	Coho salmon	1972	1254	1	1	6.81	6.81	
St. Lawrence River	Smallmouth bass	1971	1254	7	7	5.35	9.76	1.31
	Walleye	1971	1242/1016	1	1	3.42	3.42	
	Sturgeon (species not known)	1971	1242/1016	1	1	11.89	11.89	
	Channel catfish	1971	1242/1016	2	2	65.85	81.79	49.91
Allegheny River	Smallmouth bass	1971	1242/1016	2	2	2.21	2.36	2.06
	Muskellunge	1970	1242/1016	1	1	2.21	2.21	
Genesee River Lower portion	Smallmouth bass	1971	1254	2	2	7.36	10.59	4.12
	White bass	1971	1254	1	1	7.76	7.76	
Chemung River	Smallmouth bass	1971	1254	3	3	0.46	0.62	0.23
	Walleye	1971	1254	2	2	1.02	1.09	0.94
	Yellow perch	1971	1254	2	2	0.14	0.26	TR
Cohocton River (above Bath)	Smallmouth bass	1971	1254	1	1	0.90	0.90	
	Brown trout	1971	1254	1	1	2.80	2.80	

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TABLE 5 (cont'd.). *Concentrations of PCB's in fish, 1970–74*

Water	Species	Year Collected	Aroclor	No. Fish Analyzed	Number of Analyses	Concentration of PCB's, ppm wet weight: Weighted Average	High	Low
Mohawk River	Smallmouth bass	1971	1254	3	3	3.57	4.03	2.73
Barge Canal (Spencerport Holley)	Smallmouth bass	1971	1254	1	1	2.41	2.41	
	Largemouth bass	1971	1254	1	1	1.48	1.48	
Hoosic River	Smallmouth bass	1971	1254	2	2	2.49	2.62	2.35
	Largemouth bass	1971	1254	3	3	2.70	4.39	0.57
Raquette River	Smallmouth bass	1970	1254	1	1	0.32	0.32	
	Yellow perch	1970	1254	1	1	0.27	0.27	-
	Pumpkinseed	1970	1254	1	1	0.81	0.81	-
Oswegatchie River	Smallmouth bass	1970	1254	7	7	1.51	4.85	0
	Largemouth bass	1970	1254	1	1	4.17	4.17	-
	Northern pike	1970	1254	5	5	0.9	0.46	0
	Yellow perch	1970	1254	9	9	0.12	1.07	0
	Pumpkinseed	1970	1254	1	1	TR	TR	
	White sucker	1970	1254	1	1	20.92	20.92	-
Black Lake	Smallmouth bass	1971	1254	1	1	0.13	0.13	-
Brant Lake	Largemouth bass	1971	1254	1	1	TR	TR	
Cannonsville Reservoir	Brown trout	1971	1254	6	6	0.75	1.65	0
Chautauqua Lake	Smallmouth bass	1971	1254	1	1	0.16	0.16	-
	White sucker	1971	1254	1	1	TR	TR	
Conesus Lake	Largemouth bass	1971	1254	1	1	0.34	0.34	
Keuka Lake	Largemouth bass	1971	1254	1	1	0.54	0.54	
	Rainbow trout	1971	1254	1	1	1.33	1.33	
Lake George	Lake trout	1971	1254	6	6	4.74	6.07	2.77
Onondaga Lake	Smallmouth bass	1972	1254	14	14	0.71	2.08	TR
	White perch	1972	1254	7	7	1.58	2.62	0.70
	Yellow perch	1972	1254	4	4	0.31	0.68	0
	Northern pike	1972	1254	1	1	1.75	1.75	
	Black crappie	1972	1254	4	4	0.98	1.54	0.49
	Freshwater drum	1972	1254	4	4	1.17	1.78	0.37
	Brown bullhead	1972	1254	4	4	0.44	0.89	0.12
	Channel catfish	1972	1254	3	3	8.39	16.53	1.40
	American eel	1972	1254	2	2	5.44	6.97	3.91
Oneida Lake	Smallmouth bass	1971	1254	1	1	0.80	0.80	
Pepacton Reservoir	Brown trout	1971	1254	7	7	0.74	2.62	TR
Saratoga Lake	Smallmouth bass	1971	1254	1	1	1.16	1.16	
Schoharie Reservoir	Walleye	1971	1254	3	3	0.05	0.16	0
	Brown trout	1971	1254	3	3	0	0	
Waneta Lake	Chain pickerel	1971	1254	3	3	TR	TR	TR
Whitney Point Reservoir	Largemouth bass	1971	1254	1	1	0	0	
	Walleye	1971	1254	5	5	TR	TR	0

(Continued next page)

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TABLE 5 (cont'd.). *Concentrations of PCB's in fish, 1970-74*

Water	Species	Year Collected	Aroclor	No. Fish Analyzed[1]	Number of Analyses	Concentration of PCB's, ppm wet weight: Weighted Average	High	Low
	Black crappie	1971	1254	3	3	TR	TR	0
Atlantic Ocean	Striped bass	1972	1254	5	2	0.57	0.59	0.57
	Bluefish	1972	1254	5	5	1.82	8.49	0.07
	Winter flounder	1973-74	1254	180	9	0.13	0.26	0
	Atlantic silverside	1973-74	1254	900	9	0.16	0.30	0
	Mummichog	1973	1254	11	1	0.30	0.30	
	Grubby	1973	1254	20	1	0.19	0.19	
	Spiny dogfish	1972	1254	4	4	0.25	0.27	0.21
	Northern lobster	1974	1254	1	1	0.15	0.15	
	Oyster	1974	1254	36	3	0.34	0.75	0.12

NOTE: Results tabulated only for those fish for which the specific PCB was reported. All analyses conducted by Department of Environmental Conservation Laboratory, Rome, N.Y., except Atlantic Ocean analyses which were conducted by the Stony Brook Laboratory.
- indicates absence of data
TR = trace
[1] Parenthetic numbers exclude one individual fish with high PCB concentration

TABLE 6. *Laboratory comparisons of single aroclors in hexane and iso-octane solutions*

Solvent Solution	Aroclor	Known Standard	Residues, μg ml⁻¹: DAM	DEC SB	DEC R	DH	EPA
Hexane	1016	0	0	0	0	0	NS
	1242	0	0	0	0	0	NS
	1254	0	0	0	0	0	NS
Hexane	1016	0.80	0.89	1.09[2]	1.15	0.71	NS
	1254	0	NV	NV	NV	NV	NS
Hexane	1016	0	NV	NV	NV	NV	NS
	1254	0.95	0.92	1.32	1.01	0.97	NS
Iso-octane (combined standards)	1016	55.5	73.3[3]	NV	39.8[4]	54.2(43.8)	26
	1254	72.0	92.8	NV	90.4	72.2(90.0)	91
	1016+1254	127.5	166.1	177[3]	130.2	126.4(133.8)	117
Iso-octane (combined standards)	1016	61.0	70.0	NV	NV	NV (103.4)	38
	1242	64.5	50.0	NV	70.3	125 NV	60
	1016+1242	125.5	120.0	145[4]			98

[1] Laboratory code: DAM = Department of Agriculture and Markets, Food Laboratory, New York State
DEC SB = Department of Environmental Conservation, Stony Brook Laboratory, New York State
DEC RE = Department of Environmental Conservation, Rome Laboratory, New York State
DH = Department of Health, Griffin Laboratory, New York State
EPA = U.S. Environmental Protection Agency Laboratory, Region II, New York City
NV = no value reported for this Aroclor
NS = no sample sent to this laboratory
[2] Residue reported as Aroclors 1242 and 1254
[4] Residue reported as Aroclor 1242

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TABLE 7. *Laboratory comparison of PCB's in fish*

Sample ID	Aroclor	Residues, ppm[1,2] DAM	DEC-SB	DEC-R	DH	FDA	SD, %[3]
F4830	1016	NS	NS	NV[4]	NS	2.32	
	1254			3.69		4.37	
F4831	1016	NV	NV	NV	4.3	NS	
	1254	3.3		2.58	6.0		45
	1242-1254		2.03[4]				
F4832	1016	NV	NS	NV	1.0	4.34	
	1254	8.4		7.16	9.5	8.49	11
F4844	1016	NV	NV	NV	NS	NA	
	1254	6.6		5.55			
	1242-1254		2.63[4]				
F4845	1016	NV	NV	NV	NS	NA	
	1254	4.2		6.34			
	1242-1254		2.23[4]				

[1] Laboratory code: DAM = Department of Agriculture and Markets, Food Laboratory, New York State.
DEC-SB = Department of Environmental Conservation, Stony Brook Laboratory, New York State.
DEC-R = Department of Environmental Conservation, Rome Laboratory, New York State.
DH = Department of Health, Griffin Laboratory, New York State.
FDA = Food and Drug Administration Laboratory, New York, N.Y.

[2] NV = no value reported for this Aroclor.
NS = no sample sent to this laboratory.
NA = sample not analyzed.

[3] SD = standard deviation, determined when there were sufficient analyses for comparison.

[4] Reported as Aroclors 1242 and 1254.

vidual standards, but the agreement for Aroclor 1254 is reasonable. Unfortunately, no split samples contained much Aroclor 1016 but from the synthetic check samples there is no reason to believe that agreement would be different for this mixture.

Results

Tables 4 and 5 summarize results of the 1975 PCB analyses and compilation of earlier results. For the purpose of the discussion concentrations as a function of fish length are not discussed. Data are being compiled for use as a resource management tool wherein harvest of specific lengths may be regulated to protect the consumer while using the resource. Furthermore, concentration/length/species correlations may shift preferred species management in contaminated waters to favor that group of fish with a low propensity for PCB accumulation. Whole fish analysis results have been separated from flesh analysis results. The data are offered as a weighted average of each individual analyzed from a composite sample and are derived using the following formula.

$$\frac{({}^{x}n\,{}^{y}n + {}^{x}n+1\,{}^{y}n+1 + {}^{x}n+2\,{}^{y}n+2 + \ldots)}{({}^{x}n + n+1 + {}^{x}n+2 + \ldots)} = \text{Weighted average (concentration of PCB's)}$$

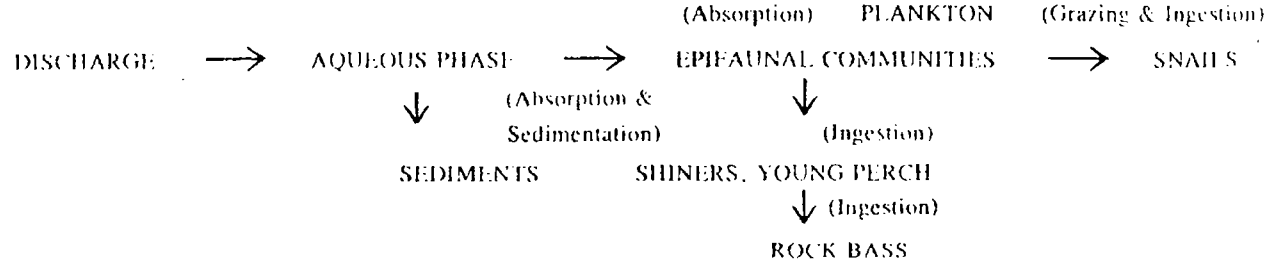
Where, for each species of fish:

n, $n+1$, $n+2$, etc.	= individual or group of fish analyzed.
${}^{x}n$, ${}^{x}n+1$, ${}^{x}n+2$, etc.	= number of fish in group n, $n+1$, $n+2$, etc.
${}^{y}n$, ${}^{y}n+1$, ${}^{y}n+2$, etc.	= concentration of PCB of group n, $n+1$, $n+2$, etc.

Zero concentrations were included in the weighted average. High and low individual readings in each sample are included to indicate end points of the data.

Discussion

PCB's are a ubiquitous contaminant of most environments. The source of this manufactured compound varies but appears to be primarily industries, open burning or incineration of solid wastes and waste oils, or migration from disposal sites (*13*). Once in the environment, PCB's, like organochlorine insecticides, are readily available for biomagnification since they are fat soluble compounds absorbed and stored in animal lipids. Nadeau (*16*) suggests a hypothetical transfer model for the biomagnification of PCB's in the Hudson River:



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This model can be modified to show direct uptake by each biotic community from the aqueous phase (*11, 18, 19*). Through this avenue, a steady state may be achieved within a short period of time (±30 days) in highly contaminated waters (*23, 24*). Therefore, monitoring fish populations and analyzing properly composited samples for PCB contamination can indicate whether it is safe to consume fish flesh based on the Food and Drug Administration action level of 5 ppm, and to what degree a waterway is contaminated by PCB's. Indirectly, monitoring studies can show the need for specific studies to address the impact of PCB's on natural communities and/or populations, and the need to re-evaluate existing discharge permit limits.

The 1975 analyses confirmed that PCB's expressed as Aroclor 1016/1242 and/or 1254 were present in detectable amounts in most fish sampled. The level of contamination and specific Aroclor vary according to waterway size, location, and peripheral land use. Table 4 summarizes the data for edible flesh except in the cases indicated. Following is a general discussion of the findings in each waterway.

HUDSON RIVER; Stations 1-8, 32, 34. This major river system contains fish with the highest average concentration of total PCB's of any waterway sampled. Sampling nearly the entire extent of the river shows that contamination is widespread from Hudson Falls to the mouth of the river. The average level of contamination decreases in the lower reaches of the Hudson, perhaps through dilution from tributary waters, deposition in the sediments and aquatic organisms, and the effects of marine waters. Similar results occurred in fish collected from 1970 and 1973 (Table 5).

MOHAWK RIVER; Stations 9 and 10. Concentrations in 5 of 13 analyses in 1975 exceed the Food and Drug Administration action level of 5 ppm. Highest average concentrations appear upstream at the Little Falls station rather than at Schenectady, indicating a source of contamination above the town of Little Falls. The problem appears localized and does not affect the entire waterway as indicated by the Schenectady samples.

Earlier samples (Table 5) were either absent or too small to be compared.

SENECA/ONEIDA/OWSEGO RIVERS; Stations 11 and 12. PCB's are present, averaging 4 ppm. Concentrations are lowest at the Clyde station.

NIAGARA RIVER; Station 13. Largemouth and smallmouth bass have concentrations below 5 ppm; one white bass had levels above 10 ppm. The station was located below Lewiston, thus indicating no major source of PCB contamination from the Buffalo/Niagara Falls industrial complex. Earlier data are too sparse for direct comparison. However, additional study is warranted based on the 1971 analytical results and the single white bass noted above.

LAKE ERIE; Station 14. Samples from Lake Erie were taken at two locations, Dunkirk and the mouth of Cattaraugus Creek at Irving. The several species of fish contained levels of total PCB's well below 5 ppm. This is consistent with the 1973–74 data which indicated the presence of the contaminant at low concentrations.

LAKE ONTARIO; Stations 15–17. Generally, low levels of PCB's were found in warm water species, in contrast to the elevated concentrations commonly found in three species of salmonids taken from the lake proper. However, reduced levels were noted in the salmon that had migrated upstream in one major tributary, the Salmon River (Station 17). A reduction of the body fat through metabolic activities such as spawning and migration apparently caused the loss or displacement of some of the PCB burden in the edible flesh.

Comparison of the 1975 data with earlier findings is difficult. General trends indicate that concentrations similar to the present levels existed as early as 1970.

GENESEE RIVER; Station 18. Analysis of fish taken from the lower portion of the river below the village of Industry indicates a potential PCB problem in large fish. In two samples, one each of smallmouth bass and silver redhorse, levels were noted at or near 5 ppm. However, the 1971 samples, which were analyzed only for Aroclor 1254, indicate levels higher than those found in 1975. Due to the size of the earlier samples no trends can be identified except that PCB's (Aroclor 1254) are still present in substantial concentrations.

CHEMUNG/SUSQUEHANNA/DELAWARE RIVERS; Stations 19–21. These three independent river systems have been grouped for discussion since they reflect low levels of contamination, averaging 1 ppm or less. These figures are comparable to the samples collected in 1971 in the Chemung River.

LAKE GEORGE; Station 21. The larger, fatty lake trout of Lake George contain levels of PCB's (primarily Aroclor 1254) above 5.0 ppm. Lake George lake trout are known to have elevated levels of DDT (*4*). The analytical methodology used converted only DDT metabolites to dichlorobenzophenone rather than DDT itself. Therefore, PCB levels in lake trout and other species in Lake George, particularly ciscos, may be overstated. Further study of the lake is warranted.

LAKE CHAMPLAIN; Stations 23 and 24. These stations were located at Ticonderoga and Plattsburgh, respectively.

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Reflected in the sampling are species in both the summer and winter fisheries as well as the limited commercial fishery. In all species sampled, total PCB's did not exceed 5 ppm although smallmouth bass from Plattsburgh approached that limit. These data are consistent with those obtained in 1971.

ST. LAWRENCE RIVER; Stations 25 and 26. Fish were collected from two stations, Massana (26) and Cape Vincent (25). Aroclor 1254 occurred but Aroclor 1242 did not. Walleye averaged about 1.8 ppm; smallmouth bass ranged from 1.62 to 6.85 ppm. Earlier data are consistent for the bass but suggest higher levels in lake sturgeon and catfish, species not sampled in 1975.

BLACK RIVER AND RAQUETTE RIVER; Stations 27 and 28. Fish from both the Black and Raquette Rivers had generally low levels of PCB contamination. These results were expected since the rivers are located in remote areas of the State away from industrial waters.

ONONDAGA LAKE; Station 31. Several species of fish, notably brown bullhead, white perch, smallmouth bass, and walleye, have concentrations of PCB's near or exceeding the FDA action level of 5 ppm. The lake has been closed to fishing since 1970 because of mercury pollution.

MARINE WATERS; Station 33. All species of fish and shellfish tested generally have total concentrations of PCB's less than 1 ppm. On rare occasions large oily fish such as bluefish have elevated levels; in one case the level exceeded 5 ppm.

CHAMPLAIN CANAL; Station 34. Fish from this waterway indicate the presence of PCB's, primarily Aroclor 1254, at low levels. A single individual rock bass, suspected to be a migrant from the Hudson River in the vicinity of Fort Edward, had levels above 5 ppm.

HEMLOCK, CANADICE, AND KEUKA LAKES, AND MONTEZUMA NATIONAL WILDLIFE REFUGE; Stations 35, 36, 38, and 41. These four waters have been grouped because they reflect low levels of PCB contamination.

CANANDAIGUA LAKE; Station 37. Chromatograms obtained for fish from this water were atypical; however, results are initially reported as PCB's. No use or spills of PCB's is known in the watershed.

SENECA AND CAYUGA LAKES; Stations 39 and 40. Previous use of small amounts of PCB's by local industry may have contaminated the fisheries. Results for Cayuga Lake (Station 40) generally confirm the findings of Bache et al. (*2*). Chromatograms for Seneca Lake display an atypical PCB pattern which is being investigated.

Conclusions

Nonindustrialized or lightly industrialized watersheds in New York State (Chemung, Susquehanna, Delaware, Black, and Raquette) contain fish with low levels of PCB's. Detectable amounts may result from atmospheric fallout, accidental spills, or land fill leachate. Several waterways have PCB's in amounts exceeding the action level of 5 ppm established by the Food and Drug Administration.

Rivers or waterways receiving contributions from industrialized watersheds contain organisms with high levels of PCB's. Hesse (*12*), Bremer et al. (*3*), and Veith (*22*) have indicated that levels in fish from the Great Lakes exceeded 5 ppm and that this level has not declined during the past five years. Information derived during the New York State 1975 study (Table 4) confirms these high concentrations in Lake Ontario. Large, long-lived, or fatty fish such as coho and chinook salmon, brown trout, and lake trout appear to bioaccumulate PCB's, generally above 5 ppm. A recent study (*2*) indicates that in salmonids the PCB level is directly and proportionally related to the age and oil of the fish. Findings in the present study generally support this premise.

The Hudson River below Hudson Falls contains fish with the highest level of total PCB's of any waterway sampled. Results above 50 ppm are not uncommon in the larger oilier fish; the highest individual concentration recorded was 559.25 ppm in a large eel. Comparison of the stations above Fort Edward with those immediately below indicates that a substantial PCB load is added to the river. This total loading probably does not emanate from atmospheric fallout or from other nondescript sources but rather from a major source of contamination or storage. Studies of water and sediment (*7*) have isolated industrial sources that are the subject of legal proceedings.

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