9/15/05

LANL General/Offsite [Congener/PCB study]

Polychlorinated Biphenyls in the Upper Rio Grande Watershed 2000-2003 Surface Water, Soils, and Sediment Sampling

A Cooperative Study

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Abstract

From 2000 to 2003 researchers from Los Alamos National Laboratory, New Mexico Environment Department, San Ildefonso Pueblo, and Los Alamos County determined levels of polychlorinated biphenyls in ambient water, storm water, background soils, and sediments in the upper Rio Grande watershed. All samples were analyzed using EPA method 1668A, a high-resolution method, for the determination of PCB congener concentrations. PCB concentrations in stream channel sediments ranged from 0.03 pg/g to 2,500 pg/g (1). We found levels of PCBs in the upper Rio Grande watershed soils ranging from 5 pg/g to 253 pg/g with a mean concentration of 45.4 pg/g (1). This likely represents background concentrations in soils from atmospheric deposition. The New Mexico Water Quality Control Commission (NMWQCC) has established the Wildlife Habitat Standard to protect aquatic organisms and wildlife that consume fish. Levels of Total PCBs in storm runoff in tributaries to the Rio Grande ranged from 1.4 ng/L to 925 ng/L (mean 226 ng/L) and often exceeded the Wildlife Habitat Standard of 14 ng/L (2). Levels of Total PCBs in the Rio Grande ranged from 0.03 ng/L to 12.8 ng/L (mean 2.57 ng/L) and often exceed the NMWQCC Human Health Standard of 0.64 ng/L (2). The Human Health Standard represents a level in water where PCBs may accumulate in fish and pose an unacceptable health risk for people who eat the fish. This finding is consistent with previous studies of fish in the Rio Grande that show concentrations of PCBs in tissues of some fish species exceed EPA recommendations for fish consumption and may warrant fish consumption advisories (3). Levels of PCBs in the Rio Grande did not at any time exceed the EPA drinking water standard for PCBs (500 ng/L). Semi-permeable membrane devices (SPMDs) were also deployed at four locations along the Rio Grande from Embudo through Albuquerque to provide a measure of dissolved PCB concentrations. The levels of dissolved PCBs in the Rio Grande, based on SPMD data, increase below Cochiti Reservoir and remain elevated through Albuquerque (4). This may indicate conversion to lesser chlorinated and more soluble PCB congeners due to anaerobic de-chlorination in bottom sediments of Cochiti reservoir. The level of dioxin-like congeners in SPMDs increases from the Cochiti reservoir outlet to our most downstream sample below Albuquerque (5). This may indicate additional industrial sources of PCBs below Cochiti reservoir and through Albuquerque.

(1) PCB Sediment and Regional Soil Summary;
(2) 2000 – 2003 Total PCB in Water Data;
(3) PCB Concentrations in Fish From the Upper Rio Grande and Potential Fish Consumption Limits;
(4) Total PCBs in Semi-Permeable Membrane Devices (SPMDs)
(5) Rio Grande SPMD Homologue Distributions

13950

Table 1. PCB Congener Sediment and Regional Soil Data				
Media	Date	Location	Total PCB Concentration (ng/kg)	Comment
Stream Sediment				
	1/23/2001	LANL - Graduation Canyon	723,032.2	Pueblo Canyon tributary
	1/23/2001	LANL - Graduation Canyon	309,852.0	Pueblo Canyon tributary
	6/10/2000	LANL - Pueblo Canyon	8878.9	
	12/12/2000	Rio Grande Sediment - 56-64 in.	273.7	Rio Grande bank sediment depth sample
	12/12/2000	Rio Grande Sediment - 84-90 in.	392.1	Rio Grande bank sediment depth sample
	8/14/2000	Viveash Cow Creek 01	871.4	Post-Viveash Fire sediment sample
	8/14/2000	Viveash Cow Creek 02	1061.7	Post-Viveash Fire sediment sample
	8/14/2000	Viveash Cow Creek 03	1020.6	Post-Viveash Fire sediment sample
	8/14/2000	Viveash Cow Creek 04	665.3	Post-Viveash Fire sediment sample
	8/14/2000	Viveash Canon de Tijeras 05	1410.6	Post-Viveash Fire sediment sample
	3/11/2003	Rio Grande at Pilar	369.0	Upstream of LANL
	3/25/2003	Rio Chama at Chamita	88.7	Upstream of LANL
	4/1/2003	Rio Grande at Otowi Bridge	27.1	Upstream of LANL
	4/1/2003	Rio Grande near White Rock	140.5	Downstream of LANL
	6/20/2003		153.1	Downstream of LANL
	6/16/2003	Santa Fe River near Santa Fe	602.9	
	3/24/2003	Rio Grande at Pena Blanca	1005.5	Downstream of Cochiti Reservoir
	3/13/2003	Rio Grande at Angostura Diversion	726.8	Downstream of Cochiti Reservoir
	6/10/2003	San Jose Drain	196,140.2	Albuquerque Tributary Runoff Treatment
	6/10/2003	ABQ South Flood Control Diversion	4252.9	Albuquerque Tributary
	6/10/2003	Rio Grande below Albuquerque	789.4	Downstream of Albuquerque
Farm Soil				
	9/26/2000	Ranchitos	2294.0	Farm soil sample
	9/26/2000	Chimayo	280.2	Farm soil sample
	9/26/2000	Alcalde	304.2	Farm soil sample
Regional Soil				
	7/18/2002	Rio Chama, CO to NM	14.8	Composite Soil Sample
	7/18/2002	Rio Chama (SR84), El Vado to Abiquiu	9.2	Composite Soil Sample
	7/18/2002	Rio Ch. (SR 84), Abiquiu to San Juan Pueblo	31.2	Composite Soil Sample
	7/18/2002	RG, CO to NM Border - REPLICATE	9.1	Composite Soil Sample
	7/18/2002	Rio Grande, NM Border to San Cristobal	23.1	Composite Soil Sample
	7/18/2002	Rio Grande, San Cristobal to Pilar	256.3	Composite Soil Sample
	7/18/2002	Rio Grande, Pilar to Otowi Bridge	72.9	Composite Soil Sample
	7/19/2002	Rio Grande, Otowi Bridge to Cochiti	3.9	Composite Soil Sample
	7/18/2002	Rio Chama (SR84), Chama to El Vado	35.9	Composite Soil Sample
PCB Cleanup Site Confirmation Sampling by NMED				
	1/10/2001	ENSYS-373-SC-01 3-056 (C)	611,471.2	Confirmation sample after LANL PCB cleanup
	1/10/2001	RE-03-01-0079 3-056 (C)	2,464,497.4	Confirmation sample after LANL PCB cleanup
	1/10/2001	RE-03-01-0078 3-056 (C)	1,783,076.7	Confirmation sample after LANL PCB cleanup
	1/10/2001	RE-03-01-0080 3-056 (C)	1,764,126.9	Confirmation sample after LANL PCB cleanup
Screening Values				
	LANL Screening Action Level		1,000,000	
	EPA Residential Soil Screening Level		222,000	
	EPA Industrial Outdoor Worker Screening Level		830,000	

Note: All Data From EPA Method 1668A analyses

Table 2. 2000- 2003 Total PCB in Water Data

	NM WQCC Wildlife Habitat Standard	NM WQCC Human Health Standard	EPA Tap Water Screening Level	EPA Drinking Water MCL	NM Groundwater limit
	14	0.64	34	500	1,000
	ng/L	ng/L	ng/L	ng/L	ng/L
All Data From EPA Method 1668A analyses					
Date	Location	Value Detected			
		ng/L			
9/10/2003	Rio Chama at Chamita	4.69	Rio Chama at Chamita (above Española; 2003 - storm water)		
9/6/2003	Rio Grande at Española	1.00	Rio Grande Below Española (2003 - storm water)		
9/10/2003		8.29			
	Mean	4.65			
	n	2			
8/7/02	Rio Grande at Otowi	1.29	Rio Grande at Otowi Bridge, above LANL and at San Ildefonso Pueblo (2002 - Ambient water; 2003 - storm water)		
8/7/02		0.68			
8/7/02		0.48			
8/21/02		0.35			
8/28/02		0.07			
8/9/2003		1.23			
8/25/2003		10.53			
9/6/2003		1.27			
	Median	0.96			
	Mean	1.99			
	n	8			
8/6/02	Rio Grande below Ancho & Rio Grande at White Rock	1.16	Rio Grande below most of the LANL Tributaries & downstream from San Ildefonso Pueblo (2002 - Ambient water; 2003 - storm water)		
8/6/02		1.37			
8/6/02		1.17			
8/19/02		0.03			
9/5/02		0.15			
9/6/2003		0.89			
8/25/2003		12.77			
	Median	1.16			
	Mean	2.50			
	n	7			
8/29/2003	Rio Grande below ABQ	1.42	Rio Grande below Albuquerque and upstream from Isleta Pueblo (2003 - storm water)		

Table 2. 2000- 2003 Total PCB in Water Data

All Data From EPA Method 1668A analyses					
Date	Location	Value Detected			
		ng/L			
8/29/2003	Santa Fe River	925.02	Santa Fe River Storm Water		
8/19/2003	San Jose Drain	15.07	San Jose Drain in Albuquerque (storm water)		
	San Jose Drain 8/29	27.96			
	Average	21.52			
	n	2			
8/30/2003	ABQ SFCD	1.36	South Flood Control Drain in Albuquerque (storm water)		
9/10/02	Pueblo above SR-502	92.94	Pueblo Canyon below burned Los Alamos Townsite and at Los Alamos National Laboratory (all storm water)		
9/8/2000	Pueblo Canyon near Bayo Treatment Plant	821.70			
9/8/2000	Pueblo Canyon North Tributary	520.80			
	Median	520.80			
	Average	478.48			
	n	3			
8/8/02	Sandia below Wetlands	230.98	Sandia Canyon at Los Alamos National Laboratory (all storm water)		
8/8/02		252.64			
8/8/02		212.20			
8/20/02		169.41			
8/28/02		75.34			
10/28/2000	Sandia Canyon near TA-53 Entrance	224.63			
	Median	218.42			
	Average	194.20			
	n	6			
8/28/02	Pajarito above SR-4	5.36	Pajarito Canyon at Los Alamos National Laboratory (all storm water)		
08/05/01	Pajarito Canyon @ TA-18	298.18			
	Average	151.77			
9/10/02	Water below SR-4	30.46	Water Canyon at Los Alamos National Laboratory (all storm water)		
9/10/02		36.87			
08/03/01	Water Canyon@ SR-4	120.65			
	Median	36.87			
	Average	62.66			
	n	3			

Table 3. PCB Concentration In Fish From the Upper Rio Grande and Potential Fish Consumption Limits

Location of Sample	Fish Type	Data Type	1993	1996	1997	1997	1999	1999	2000	2000	2002	2002	Risk-Based Consumption Limits **	
				Aroclor (8081)	Aroclor (8081)	Aroclor (8081)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)		
		Aroclor	Total PCB	1260	1260	1254	Total PCB	TEQ (PCBs)	Total PCB	TEQ (PCBs)	Total PCB	TEQ (PCBs)		
			ug/kg-ww	ug/kg-ww	ug/kg-ww	ug/kg-ww	ug/kg-ww	pg/g (ppt)	ug/kg-ww	pg/g (ppt)	ug/kg-ww	pg/g (ppt)		
Rio Grande at State Highwway 44 Bridge, near Bernalillo	Common Carp (whole-body)		100										Based on Total PCB	No consumption recommended for children; (1) 4 oz. meal per month for Women of Reproductive age; (1) 4 oz. meal per month for general population
Rio Grande at Isleta	Common Carp (whole-body)		410											
		Average	255											
Cochiti Reservoir (Rio Grande)	Northern Pike (skin off filette)			46(j)									Based on Total PCB	(2) 3 oz. meal per month for children; (7) 4-oz meals per month fo general population and women of reproductive age
Cochiti Reservoir (Rio Grande)	Small Catfish (whole gutted Fish)			100									Based on Total PCB	(1) 3 oz. meal per month for children; (3) 4-oz meals per month fo general population and women of reproductive age
RG @ confluence of Frijoles	Carp (portions of muscle sample)					170							Based on Total PCB	No consumption recommended for children; (1) 4 oz. meal per month for Women of Reproductive age; (1) 4 oz. meal per month for general population
RG @ confluence of Frijoles	Carp (portions of muscle sample)					86								
RG @ confluence of Frijoles	Carp (portions of muscle sample)					300								
RG @ confluence of Mortandad	Carp (portions of muscle sample)					100								
RG @ confluence of Pajarito	Carp (portions of muscle sample)					610								
RG @ San Ildefonso Pueblo	Carp (portions of muscle sample)					230								
					Average	249								
RG @ confluence of Frijoles	Catfish (portions of muscle sample)				170								Based on Total PCB	(1) 3 oz. meal per month for children; (1) 4-oz meals per month for general population and women of reproductive age
RG @ confluence of Mortandad	Catfish (portions of muscle sample)					83								
RG @ confluence of Mortandad	Catfish (portions of muscle sample)					86(j)								
					Average	113								
Cochiti Reservoir (Rio Grande)	Whole Carp (with internal organs)						88.5	2.0						
Cochiti Reservoir (Rio Grande)	30 cm Carp (whole-gutted fish)								8.53	0.318			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(1) 4 oz meal per month for the general population
Cochiti Reservoir (Rio Grande)	31 cm Carp (Whole-gutted fish)								10.95	0.492				
							Average		35.99	0.949				
Cochiti Reservoir (Rio Grande)	Whole Channel Catfish (with internal organs)						34.2	1.8						
Cochiti Reservoir (Rio Grande)	31 cm Channel Catfish (whole-gutted fish)								39.59	2.071			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(6) 4 oz. Meals per year for the general population
Cochiti Reservoir (Rio Grande)	29 cm Channel Catfish (whole-gutted fish)								16.48	1.013				
							Average		30.09	1.635				
Cochiti Reservoir (Rio Grande)	9-10 lb Northern Pike (skin-on fillet)								24.26	1.046			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(6) 4 oz. Meals per year for the general population

Table 3. PCB Concentration In Fish From the Upper Rio Grande and Potential Fish Consumption Limits

Location of Sample	Fish Type	Data Type	1993	1996	1997	1997	1999	1999	2000	2000	2002	2002	Risk-Based Consumption Limits **	
				Aroclor (8081)	Aroclor (8081)	Aroclor (8081)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)		
		Aroclor	Total PCB	1260	1260	1254	Total PCB	TEQ (PCBs)	Total PCB	TEQ (PCBs)	Total PCB	TEQ (PCBs)		
			ug/kg-ww	ug/kg-ww	ug/kg-ww	ug/kg-ww	ug/kg-ww	pg/g (ppt)	ug/kg-ww	pg/g (ppt)	ug/kg-ww	pg/g (ppt)		
Cochiti Reservoir (Rio Grande)	4-6 lb Walleye Pike (skin-on fillet)								6.23	0.205			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(2) 4 oz. Meals per month for the general population
Cochiti Reservoir (Rio Grande)	4 to 6 lb Walleye Pike (skin-on fillet)								6.24	0.245				
Cochiti Reservoir (Rio Grande)	Two 16cm White Bass (whole-gutted fish) - Composited								4.99	0.209				
							Average		5.820	0.220				
Abiqui Reservoir (Chama River)	Smallmouth Bass Skin-on Fillets (5 fish)								2.19	0.139			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(5) 4 oz. Meals per month for the general population
Abiqui Reservoir (Chama River)	Walleye Pike Skin-on Fillets (2 fish)								1.13	0.068			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(17) 4 oz. Meals per month for the general population
Abiqui Reservoir (Chama River)	Dressed Catfish (2 fish composite)								27.52	1.909			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(6) 4 oz. Meals per year for the general population
Abiqui Reservoir (Chama River)	1.2 kg Carpsucker (Dressed)								9.83	0.556			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(1) 4 oz. Meals per month for the general population
Abiqui Reservoir (Chama River)	750 gm Carpsucker (Dressed)								12.71	0.674			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(1) 4 oz. Meals per month for the general population
McAllister Lake (Playa lake near Las Vegas, NM)	21 inch Rainbow Trout (Steaks from anterior 1/3)								6.55	0.069			Based on Dioxin TEQ and 10^{-5} Cancer Risk	(17) 4 oz. Meals per month for the general population
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										45.4	0.97	Based on Dioxin TEQ and 10^{-5} Cancer Risk	(2) 4 oz. Meals per month for the general population
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										9.99	0.19		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										11.4	0.22		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										9.67	0.14		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										8.5	0.12		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										9.86	0.15		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										20.6	0.57		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										18.2	0.33		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										9.85	0.08		
Rio Grande (Downstream from Otowi Bridge)	Catfish fillets (skin-on)										6.79	0.15		
										Mean	15.026	0.292		
										STD	10.93077509			

Table 3. PCB Concentration In Fish From the Upper Rio Grande and Potential Fish Consumption Limits

Location of Sample	Fish Type	Data Type	1993	1996	1997	1997	1999	1999	2000	2000	2002	2002		
				Aroclor (8081)	Aroclor (8081)	Aroclor (8081)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Congener (1668A)	Risk-Based Consumption Limits **	
		Aroclor	Total PCB	1260	1260	1254	Total PCB	TEQ (PCBs)	Total PCB	TEQ (PCBs)	Total PCB	TEQ (PCBs)		
			ug/kg-ww	ug/kg-ww	ug/kg-ww	ug/kg-ww	ug/kg-ww	pg/g (ppt)	ug/kg-ww	pg/g (ppt)	ug/kg-ww	pg/g (ppt)		
Rio Grande (Upstream from Otowi Bridge)	Catfish fillets (skin-on)										30.4	1.89	Based on Dioxin TEQ and 10^{-6} Cancer Risk	(6) 4 oz. Meals per year for the general population
Rio Grande (Upstream from Otowi Bridge)	Catfish fillets (skin-on)										13.6	0.26		
Rio Grande (Upstream from Otowi Bridge)	Catfish fillets (skin-on)										37.5	1.9		
Rio Grande (Upstream from Otowi Bridge)	Catfish fillets (skin-on)										30.4	1.69		
Rio Grande (Upstream from Otowi Bridge)	Catfish fillets (skin-on)										27.9	2.01		
										Mean	27.96	1.55		
										STD	8.79107502			
Rio Grande (Downstream from Otowi Bridge)	Carp Fillets (skin-on)										34.4	0.41	Based on Dioxin TEQ and 10^{-6} Cancer Risk	NONE - No consumption recommended
Rio Grande (Downstream from Otowi Bridge)	Carp Fillets (skin-on)										31.4	0.375		
Rio Grande (Downstream from Otowi Bridge)	Carp Fillets (skin-on)										10.5	0.17		
Rio Grande (Downstream from Otowi Bridge)	Carp Fillets (skin-on)										243	9.64		
										Mean	79.825	2.64875		
										STD	109.3014905			
Rio Grande (Upstream from Otowi Bridge)	Carp Fillets (skin-on)										20.2	2.88	Based on Dioxin TEQ and 10^{-6} Cancer Risk	NONE - No consumption recommended
Rio Grande (Upstream from Otowi Bridge)	Carp Fillets (skin-on)										86.6	9.8		
Rio Grande (Upstream from Otowi Bridge)	Carp Fillets (skin-on)										13.4	1.4		
Rio Grande (Upstream from Otowi Bridge)	Carp Fillets (skin-on)										17.3	1.56		
										Mean	34.375	3.91		
										STD	30.24850203			

* = From Water-Quality Assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas– Organic compounds and trace elements in bed sediment and fish tissue, 1992-1993; U.S. Geological Survey Report 97-4002

** = FromEPA Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 2 Risk Assessment and Fish Consumption Limits Second Edition EPA 823-B-97-009, July 1997

j = value less than normal reporting limit but above instrument dection limit

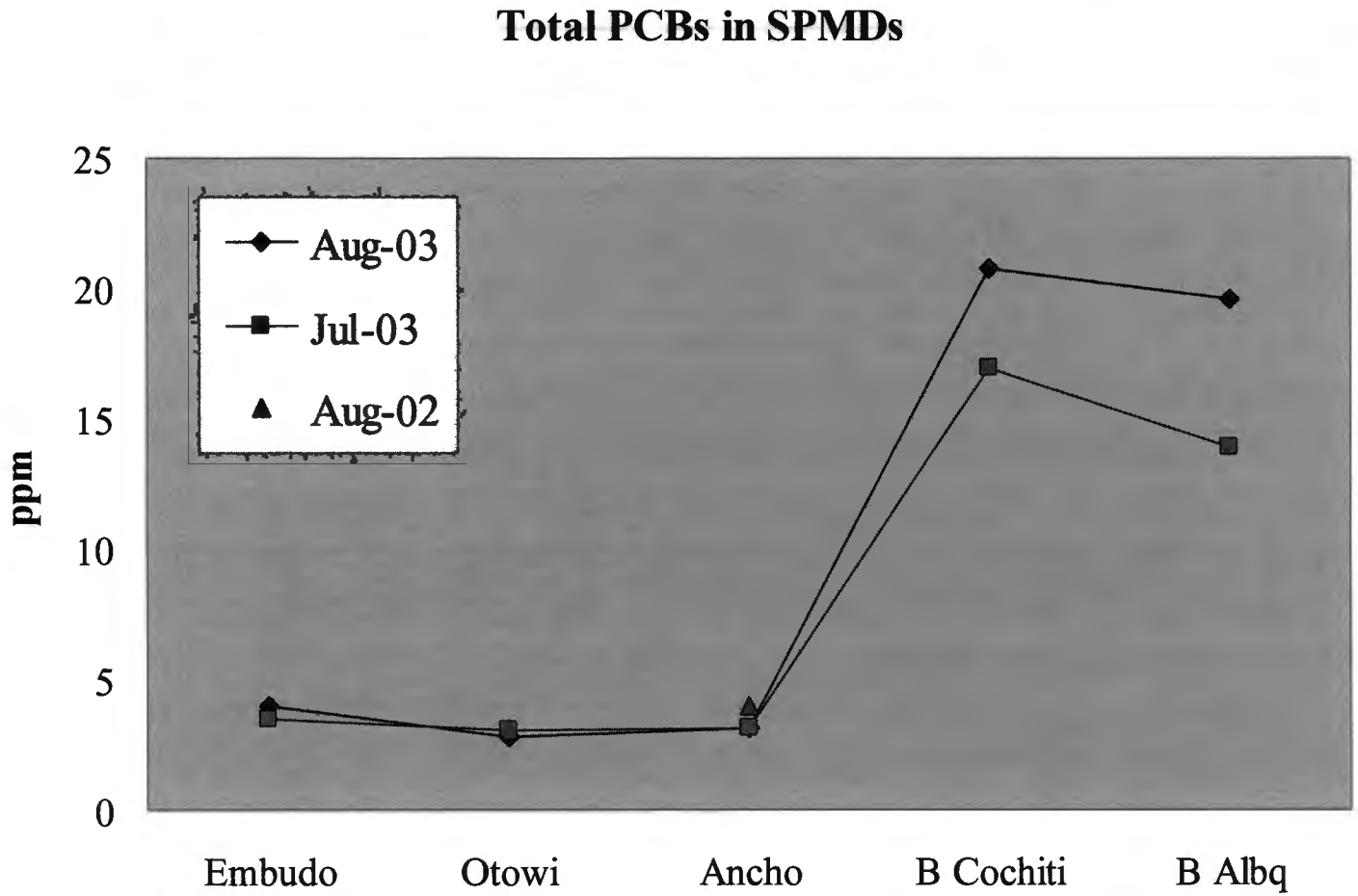
Total PCB = Sum of all congeners, homologs, or Aroclors

Total Dioxin-like Congeners = Sum of the 12 Dioxin-like congeners

TEQ (PCBs) = SUM (TEF X Concentration of the 12 Dioxin-like congeners detected)

TEFs from "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife Environmetal Health Perspectives" Volume 106, Number 12, December 1998 (Van den Berg, et al., 1998)

Figure 4. Total PCBs in Semi-Permeable Membrane Devices (SPMDs)



SPMDs in Sandia Canyon- August 2002

Sandia Above Wetland- 674 ppm

Sandia Below Wetland- 890 ppm

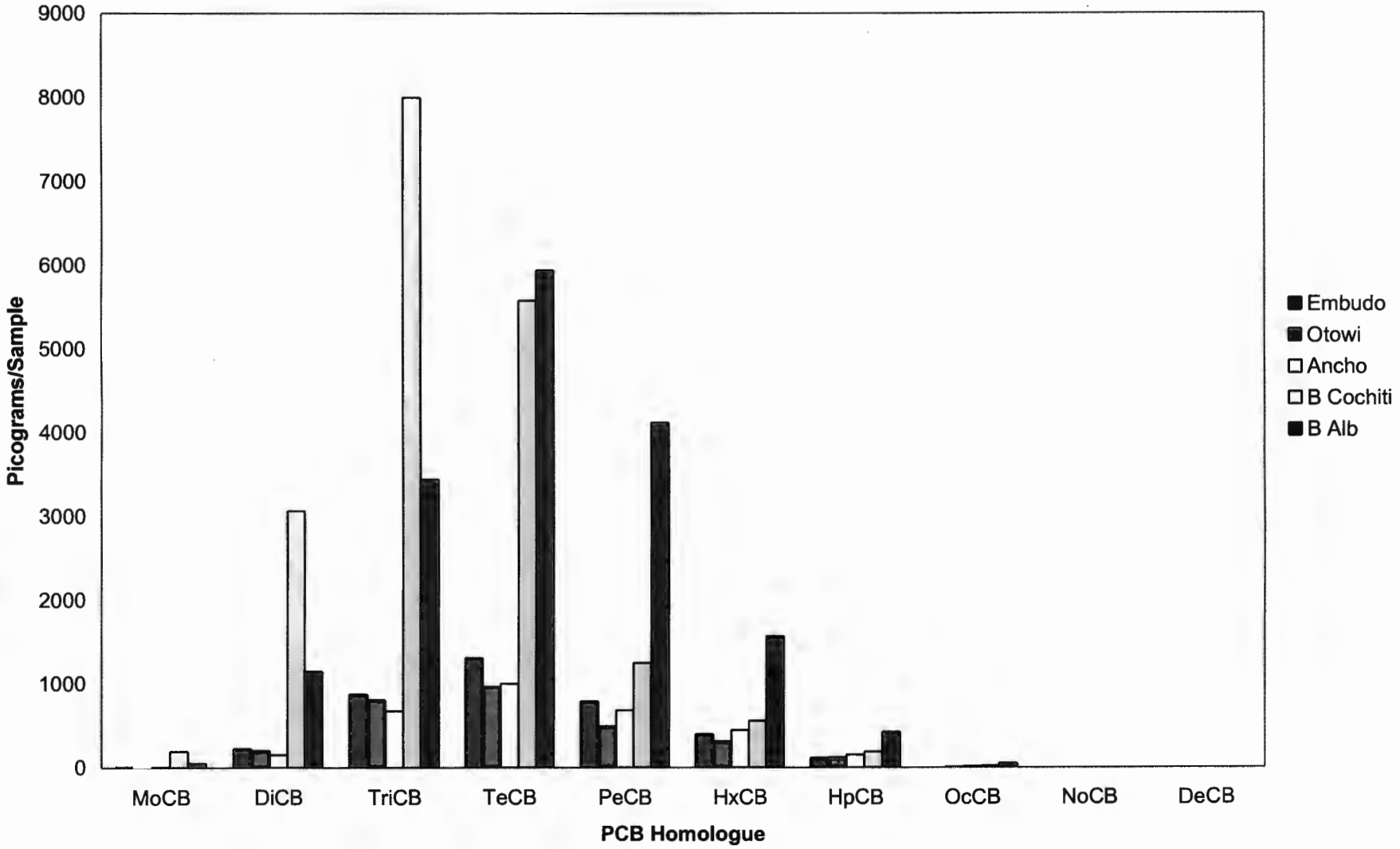



Figure 5. Rio Grande SPMD Homologue Distributions