

**Polychlorinated Biphenyls and Organochlorine Pesticide Concentrations in Whole
Body Mummichog and Banded Killifish from the Anacostia River Watershed**

Data Report

Prepared for

**National Park Service
Washington, DC**

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INTRODUCTION

Background

The Anacostia River is one of three Chesapeake Bay Regions of Concern due to contamination of water, sediment, and biota. The major chemicals of concern are polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and organochlorine (OC) pesticides such as chlordane (Velinsky et al. 2011). Within the District of Columbia, fish advisories warn the public to restrict their consumption, largely due to PCB contamination

(https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/Fish%20Advisory%202-2-2016.pdf; Pinkney, 2014, 2018). The elevated prevalence of liver tumors in brown bullhead catfish (*Ameiurus nebulosus*) has been linked with exposure to polycyclic aromatic hydrocarbons (PAHs) as initiators and possibly PCBs and DDT compounds as promoters (Pinkney et al. 2019).

As part of the Anacostia River Sediment Project (ARSP) the District of Columbia Department of Energy and Environment (DOEE) is conducting a Remedial Investigation/Feasibility Study (RI/FS) (Tetra Tech 2019). The purpose of the RI is to assess the nature and extent of pollution in the tidal river by sampling river sediment and fish for a wide variety of chemicals. The FS will evaluate potential remedial actions (<https://doee.dc.gov/publication/cleaner-anacostia-river-anacostia-river-sediment-project>).

Additional DOEE-funded are quantifying contaminant loading from the watershed into the tidal river. Such data are critical to ensure that cleanup actions taken in the tidal river are long-lasting and not subject to re-contamination from tributary loadings. The U.S. Geological Survey (USGS) measured tributary loadings of contaminants during high and low flow periods over the course of a year (Wilson 2019). The focus was on the Northwest Branch, Northeast Branch, Lower Beaverdam Creek, Watts Branch, and Hickey Run. The total estimated PCB loads in 2017 were estimated to be 810 grams, with 75 percent (610 grams from Lower Beaverdam Creek, 12 percent (95 grams) from Northwest Branch, 7 percent (60 grams) from Northeast Branch, 3 percent (25 grams) from Watts Branch, and 2.5% (19 grams) from Hickey Run. Loadings were also estimated for PAHs and OC pesticides.

Ghosh et al. (2020) reported on a joint project by the U.S. Fish and Wildlife Service (Service) Chesapeake Bay Field Office (CBFO), University of Maryland College Park (UMCP), and University of Maryland Baltimore County (UMBC) focused on tributary loadings of PCBs, OC pesticides, and PAHs. Passive samplers and freshwater mussels (*Elliptio complanata*) were deployed in the major Anacostia tributaries to evaluate and compare the freely dissolved and bioavailable concentrations of these contaminants. The authors reported that Lower Beaverdam Creek contributed 401 grams of PCBs per year (69 % of the total load of 580 grams/year) with the remainder coming primarily from the

Northeast and Northwest Branches..They stated that Lower Beaverdam Creek not only contributes the bulk of the PCB load, but also delivers PCBs in the freely dissolved form that leads to bioaccumulation in the food web.

Approach

For the current project, we targeted forage fish from locations in the tidal Anacostia, Kingman Lake, Anacostia tributaries, and Potomac River for whole body analysis of PCB congeners and OC pesticide concentrations (Table 1, Figure 1). The two target species are the mummichog (*Fundulus heteroclitus*) and the banded killifish (*F. diaphanus*). The presence of both species in these watersheds is supported by monitoring data from DOEE, Metropolitan Washington Council of Governments (MWCOCG), and Maryland Department of Natural Resources. Because of their site fidelity, these species have been widely used in contaminant and pathology monitoring studies (e.g., Pinkney and Harshbarger (2006); Pinkney and McGowan (2006); Vogelbein et al. (1990), Vogelbein and Unger (2006)). In addition, the life span of these species is 3 to 4 years, which is advantageous in that new cohorts are representative of recent exposure, which facilitates before and after studies.

In a study of mummichog in a tidal creek in Delaware, Lotrich (1975) reported a summer home range of 36 m, with a few fish moving 375 m (Lotrich 1975, Abraham 1985). .Teo and Able (2003) estimated a home range of 15 hectares in an April to November study of a tidal marsh in New Jersey. For banded killifish, Pinkney and McGowan (2006) studied contaminant concentrations in the tidal 78 hectare Quantico embayment of the Potomac River and nearby creeks. They found a unique ratio of DDT isomers in the banded killifish from the embayment and concluded that fish showed site fidelity for the embayment. Based on these studies, we mapped each location as a site as a circle with a diameter of 0.804 km (0.5 miles), an approximately 50 hectare (124 acre) area (Figure 1).

Objectives

The objectives were to: 1) determine and compare concentrations of PCBs and OC pesticide concentrations at various locations in the mainstem Anacostia, Kingman Lake, Anacostia tributaries, and Potomac River; and 2) use the results to form the basis for a pre-remedial baseline that can be repeated as part of a long term monitoring plan for the Anacostia River Sediment Project.

METHODS

Project phases

Fish were collected in two phases: October 2018, and May through October 2019. All sampling was collected under permits provided by DOEE, Maryland DNR, and the National Park Service.

Site selection and sampling methods

Sampling locations were chosen to establish baseline concentrations in tributaries, Kingman Lake, main stem areas near and remote from Potential Environmental Cleanup Sites (PECS), and the area of the Potomac River from Key Bridge to Chain Bridge (used in the RI/FS as a background location for sediment contamination; Tetra Tech 2019).. Fifteen locations were targeted (Table 1, Figure 1). In the tidal Anacostia, the locations are: at the northern edge of Bladensburg Waterfront Park (BL), Kingman Lake (KL) between the footbridge and East Capitol Bridge; the mainstem north of the CSX Bridge (A2), Pepco Cove (PC), Poplar Point (A1), and between the 11th Street and Souza Bridges (11A). Five locations are near USGS gages in Anacostia tributaries: Hickey Run (HR), Watts Branch (WB), Northwest Branch (NW), Northeast Branch (NE), and Lower Beaverdam Creek (LB1). In Lower Beaverdam Creek, we sampled an upstream location starting at the confluence with Cattail Branch just below Route 202 (LB2). In the Potomac River we collected from three locations: near the upstream edge of Theodore Roosevelt Island (P3), about 0.805 km (0.5 mi) upstream of Key Bridge on both sides of the Potomac (KB); and at the outer edge of Fletcher's Cove (P4). The Anacostia tributary locations match those used in Ghosh et al. (2020). Four of the locations were seining stations regularly sampled by DOEE—A1 and A2 in the Anacostia and P3 and P4 in the Potomac.

Fish from five locations (A1S, A2S, P3S, P4S, and KB) were collected with a 100 foot beach seine by DOEE. CBFO used 25 and 100 foot seines to collect additional fish from A1S and P4S, and from BL, 11A, KL, PC, and HR. All other locations were collected by CBFO using minnow traps that were fished overnight and, in the tributaries, with backpack electroshocking.

Fish processing

Euthanasia was conducted by immersing the fish in a >1.0 mg/L solution of tricaine methanesulfonate (MS-222), as recommended by the American Veterinary Medical Association (AVMA 2013). Fish were double wrapped in aluminum foil and stored in plastic bags in a freezer. They were labelled with the species and date.

At the CBFO laboratory, the fish from a single location were thawed, unwrapped, rinsed with deionized water, blotted dry, weighed to the nearest 0.1 gram, and measured for total length to the nearest millimeter. Species identifications were confirmed with field guides. Three target size classes were set. For mummichogs, the small size class was 45 to 65 mm, the large size class was 66 to 84 mm, and the jumbo size class was ≥ 85 mm. The same classes were used for banded killifish except the small class was from 50 to 65 mm. To the extent possible, composite samples had at least 20 grams of wet tissue to allow the laboratory to meet its detection limits. Frequently, the composite samples consisted of ~10-18 small-sized fish, ~6-8 large sized fish, and ~2 -4 jumbo sized fish

Chemical analyses

A contract was established with SGS AXYS Analytical Services, Ltd. (Sidney, British Columbia, Canada) through the Service's Analytical Control Facility (ACF) which also performs a Quality Assurance (QA) review. Samples were shipped on dry ice and documented with chain of custody forms. Fish samples were analyzed for lipid and moisture content, organochlorine pesticides, total PCBs, and 209 PCB congeners (see Table 2, for list of analytes and detection limits). PCB congeners (n=209), alpha BHC, alpha chlordane, beta BHC, cis-nonachlor, gamma BHC, gamma chlordane, HCB, mirex, o,p'-DDD, o,p'-DDE, o,p'-DDT, oxychlordane, p,p'-DDD, p,p'-DDE, p,p'-DDT, toxaphene, and trans-nonachlor were analyzed by Low Resolution Gas Chromatography/Mass Spectrometry (LRGC/MS) according to AXYS method MLA-007. Dieldrin, endrin, and heptachlor epoxide were analyzed by GC with an Electron Capture Detector according to AXYS method MLA-007. See Appendix A for the Analytical Laboratory Report which includes the method description, results, and quality assurance review.

Quality Assurance

A Quality Assurance Project Plan (Pinkney 2018b) was prepared according to U.S. Environmental Protection Agency (USEPA 2001, 2002) guidance. Quality control/quality assurance procedures included the analysis of laboratory duplicates, internal standards, and matrix spikes. A QA review of the data was performed by ACF chemists, Brenda Montgomery and Steve Boateng (Appendix A). A full data validation (EPA Stage 4) was conducted by EcoChem, Inc. (Seattle, WA) (Appendix B) according to U.S. EPA Region 3 guidance (Chris Ransom, EcoChem, pers. Comm.).

Data analysis

All data are reported as wet weight in parts per billion (ppb). PCBs were calculated as the sum of the congeners. Total DDT was determined as the sum of all six o,p'- and p,p'-DDD, DDE, and DDT isomers. Total chlordane was determined as the sum of alpha- and gamma-chlordane, cis- and trans-nonachlor, and oxychlordane (U.S. EPA 2000). For calculating these totals, non-detects were considered to be zeros. A median concentration for each species at each location was calculated for these three contaminant groupings.

RESULTS

Samples were collected and shipped to the analytical laboratory. The mean, standard deviation, median, 25th, and 75th percentile concentrations of total PCBs, total DDT, and total chlordane were calculated (Table 3), along with the lipid content, sample weight, number of individuals in the composite sample, and median length. Catalogs 5020158 and 5020159 are attached and provide all analytical results.

DISCUSSION

Graphs, statistical analyses, and interpretation of the results will be provided in the final report to be delivered to DOEE and uploaded to NPS (expected in April 2020).

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TABLES

Table 1. Fish sampling locations.

Waterbody, Location	ID	Description	Methods	Range description					
					Latitude	Longitude		Latitude	Longitude
2018 Collections									
Anacostia R., Bladensburg, MD	BL	Gravel bar north of Boat Ramp + inlet	Seine, traps	gravel bar (seining)	38.93630	-76.94038	inlet (traps)	38.93734	76.94042
Anacostia trib, Northwest Branch, MD	NW	Downstream of USGS gage	Shock	Start east (downriver)	38.95095	-76.96091	End west (upriver)	38.95341	-76.96163
Anacostia trib, Northeast Branch, MD	NE	Downstream of USGS gage	Shock	Start south (downriver)	38.95541	-76.9287	End north (upriver)	38.95694	-76.92790
Anacostia trib, Watts Branch, DC	WB	Upstream of USGS gage	Shock	Start east (upriver)	38.89886	-76.9403	End west (downriver)	38.89919	-76.94049
Anacostia trib, Hickey Run, DC	HR	Downstream of USGS gage	Shock, traps	Start east (downriver)	38.91148	-76.9639	End west (upriver)	38.91222	-76.96530
Anacostia trib, Lower Beaverdam Creek, MD	LB1	Near USGS gage; Route 201	Shock, traps	Start east (upriver)	38.91612	-76.93181	End west (downriver)	38.91628	-76.93389
Anacostia trib, Lower Beaverdam Creek, MD	LB2	Downstram of Route 202	Shock, traps	Start east (upriver)	38.9283	-76.8942	End west (downriver)	38.9271	-76.89760
Kingman Lake, DC	KL	E. Capitol Br. north to footbridge	Seine, traps	North (upriver) seining	38.89403	-76.9659	End south (downriver)	38.89019	-76.96567
Anacostia R., DC	A2	Above CSX Bridge	Seine	Single area-- seining	38.88432	-76.96668			
Anacostia R., DC	PC	Pepco Cove (above Benning Road)	Seine	Single area-- seining	38.90124	-76.96044			
Anacostia R., DC	A1	Near Poplar Point	Seine	Single area-- seining	38.86929	-76.997			

Table 1 (continued)									
Waterbody, Location	ID	Description	Methods	Range description					
					Latitude	Longitude		Latitude	Longitude
2019 Collections									
Anacostia R., DC	11A	Between 11th St. and Sousa Br. (11A)	Seine	Single area--seining	38.87324	-76.98543			
Potomac R., DC	P3	Theo Roosevelt I. (Potomac)	Seine	Single area--seining	38.89985	-77.0662			
Potomac R., DC	P4	Fletcher's Cove (Potomac)	Seine	Single area--seining	38.91847	-77.1031			
Potomac R., DC	K	Key Bridge (Potomac)	Seine	VA side of river	38.90238	-77.0794	DC side of river	38.90488	-77.07908

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Table 2. Analytes and detection limits.

PCBs: Individual and Co-Eluting Congeners						
1	30	58	95/93	129	156	184
2	31	74/61	94	130	157	185
3	35	65/62	96	131/142	158/160	186
4/10	36	63	98/102	132/168	159	188
8/5	37	66/80	99	133	161	189
6	38	67	100	134/143	162	191
7/9	39	69	103	144/135	165	193
11	40	70/76	104	136	166	194
12/13	41/71/64/68	72	105/127	137	167	195
14	42/59	77	118/106	138/163/164	169	196/203
15	49/43	78	107/109	149/139	170/190	197
16/32	44	79	110	140	171	198
17	45	81	111/117	141	172/192	199
18	46	82	112	145	173	200
19	47/48/75	83/108	113	146	174/181	201
33/20/21	50	84	114	147	175	202
22	51	85/120	119	148	176	204
34/23	52/73	97/86	122	150	177	205
24/27	53	87/115/116	123 ¹	151	178	206
25	54	88/121	124	152	179	207
26	55	90/101/89	125	153	180	208
28	56/60	91	126	154	187/182	209
29	57	92	128	155	183	
<i>E1 Pesticides</i>			<i>E2 Pesticides</i>			
Hexachlorobenzene	Nonachlor, cis-		HCH, delta			
HCH, alpha	2,4'-DDD		Heptachlor Epoxide			
HCH, beta	4,4'-DDD		alpha-Endosulphan			
HCH, gamma	2,4'-DDE		Dieldrin			
Heptachlor	4,4'-DDE		Endrin			
Aldrin	2,4'-DDT		beta-Endosulphan			
Chlordane, oxy-	4,4'-DDT		Endosulphan Sulphate			
Chlordane, gamma (tr)	Mirex		Endrin Aldehyde			
Chlordane, alpha (cis)	Technical Toxaphene		Endrin Ketone			
Nonachlor, trans-			Methoxychlor			

Detection limits: Approximately 0.00001–0.0002 wet weight ppm (0.01–0.2 wet weight ppb) for PCB congeners and OC pesticides

Table 3. List of samples and summary concentration data (parts per billion wet weight) for samples collected in 2018. BK: Banded killifish; MC: Mummichog. See Table 1 for location descriptions and abbreviations.

Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
A1	BK	A1BKL01	9/18/2018	2	3.32	475	227	75.9	69	6	19.77
A1	BK	A1BKS01	9/18/2018		3.65	444	210	73.2	58.5	8	14.8
			mean		3.49	460	218	74.6	63.8		
			stdev		0.23	21	12	1.9	7.4		
			median		3.49	460	218	74.6	64		
			25th		3.40	452	214	73.9	61		
			75th		3.57	467	223	75.2	66		
A2	BK	A2BKL01	9/18/2018	4	2.4	223	84.1	40.6	69	9	30.28
A2	BK	A2BKS01	9/18/2018		3.93	366	132	69.7	62	13	26.72
A2	BK	A2BKS02	9/18/2018		3.65	334	121	62.4	55	18	28.9
A2	BK	A2BKS03	9/18/2018		4.23	360	141	65.2	60	18	32.46
			mean		3.55	321	120	59.5	61.5		
			stdev		0.80	66	25	12.9	5.8		
			median		3.79	347	127	63.8	61		
			25th		3.34	306	112	57.0	59		
			75th		4.01	362	135	66.3	64		
BL	BK	BLBKJ01	10/18/2018		2.22	65.7	95.3	17.1	88	4	23.65
BL	BK	BLBKJ02	10/18/2018		1.76	47.7	55.4	13.1	87.5	4	24.74
BL	BK	BLBKL01	10/18/2018		1.81	140	91.4	26.4	73	7	25.8
BL	BK	BLBKL02	10/18/2018		1.69	152	88.2	27.0	75	7	26.63
BL	BK	BLBKS01	10/18/2018		3.66	161	134	30.6	55.5	18	29.41
BL	BK	BLBKS02	10/18/2018	6	3.43	155	132	33.9	57	18	29.53

Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
			mean		2.43	120	99.4	24.7	72.7		
			stdev		0.89	49.9	29.7	8.0	14.1		
			median		2.02	146	93.3	26.7	74.0		
			25th		1.77	84	89.0	19.4	61.0		
			75th		3.13	154	123.1	29.7	84.4		
KL	BK	KLBKS01	9/18/2018	1	3.98	378	116	60.5	58	9	14.95
LB1	BK	LB1BKL01	10/18/2018	3	2.32	1055	81.5	22.8	69	7	24.2
LB1	BK	LB1BKL02	10/18/2018		3.48	1019	122	27.3	71.5	4	14.25
LB1	BK	LB1BKS01	10/18/2018		3.13	1263	110	21.4	55	10	16.05
			mean		2.98	1112	105	23.8	65.2		
			stdev		0.60	132	21	3.1	8.9		
			median		3.13	1055	110.3	22.8	69.0		
			25th		2.73	1037	95.9	22.1	62.0		
			75th		3.31	1159	116.2	25.1	70.3		
LB2	BK	LB2BKL01	10/18/2018	5	3.19	902	161	11.2	68	9	25.14
LB2	BK	LB2BKL02	10/18/2018		2.57	924	130	6.68	70	9	24.52
LB2	BK	LB2BKL03	10/18/2018		3.23	923	138	7.83	70	9	26.98
LB2	BK	LB2BKL04	10/18/2018		2.03	716	94.3	4.78	79	7	24.31
LB2	BK	LB2BKS01	10/18/2018		3.38	1121	206	11.3	60	16	26.31
			mean		2.88	917	146	8.4	69.4		
			stdev		0.57	144	41	2.9	6.8		
			median		3.19	923	138.3	7.83	70		
			25th		2.57	902	129.8	6.68	68		

			75th		3.23	924	160.8	11.24	70		
Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
NE	BK	NEBKJ01	10/18/2018	3	4.12	87.6	198	17.5	88	5	30.49
NE	BK	NEBKJ02	10/18/2018		2.68	74.6	130	13.5	87	5	28.81
NE	BK	NEBKJ03	10/18/2018		2.59	69.1	152	12.3	90	4	26.45
			mean		3.13	77	160	14.4	88.3		
			stdev		0.86	10	35	2.7	1.5		
			median		2.68	75	151.6	13.5	88.0		
			25th		2.64	72	140.8	12.9	87.5		
			75th		3.40	81	175.0	15.5	89.0		
NW	BK	NWBKL01	9/18/2018	4	2.46	48.8	127	23.2	79	7	26.49
NW	BK	NWBKS01	9/18/2018		2.78	55.6	155	22.0	55	15	19.83
NW	BK	NWBKS02	9/18/2018		2.57	59.3	156	22.0	55	17	21.83
NW	BK	NWBKS03	9/18/2018		3.38	53.6	220	21.9	56	17	23.59
			mean		2.80	54.3	165	22.3	61.3		
			stdev		0.41	4.4	39.5	0.6	11.8		
			median		2.675	55	156	22.0	56		
			25th		2.54	52	148	21.9	55		
			75th		2.93	57	172	22.3	62		
WB	BK	WCBKL01	10/18/2018	2	3.48	300	117	54.5	82	4	17.34
WB	BK	WCBKL02	10/18/2018		2.49	246	86.2	36.8	83	3	16.57
			mean		2.99	273	102	45.6	82.5		
			stdev		0.70	39	22	12.5	0.7		
			median		2.99	273	101.6	45.6	82.5		
			25th		2.74	259	93.9	41.2	82.3		

			75th		3.23	287	109.3	50.0	82.8		
Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
A2	MC	A2MCL01	9/7/2018	4	2.83	179	51.3	40.1	71	5	22.92
A2	MC	A2MCL02	9/7/2018		3.46	180	58.2	40.6	70	5	22.35
A2	MC	A2MCS01	9/7/2018		3.57	232	69.4	52.5	56	10	23.97
A2	MC	A2MCS02	9/7/2018		3.62	234	64.5	51.9	57	14	28.73
			mean		3.37	206.4	61	46.3	63.5		
			stdev		0.37	30.6	7.8	6.9	8.1		
			median		3.515	206	61	46.3	64		
			25th		3.30	180	56	40.5	57		
			75th		3.58	232	66	52.1	70		
BL	MC	BLMCL01	10/15/2018	4	3.15	68.8	49.6	13.9	69	5	25.24
BL	MC	BLMCL02	10/15/2018		3.24	59.3	45.7	13.7	82	3	22.22
BL	MC	BLMCS01	10/15/2018		3.75	100	95.1	26.6	57	9	23.42
BL	MC	BLMCS02	10/15/2018		3.95	85.1	73.6	20.9	58	11	24.46
			mean		3.52	78.2	66	18.7	66.5		
			stdev		0.39	17.8	23.0	6.2	11.7		
			median		3.50	77	62	17.4	64		
			25th		3.22	66	49	13.8	58		
			75th		3.80	89	79	22.3	72		
HR	MC	HRMCJ01	10/18/2018	5	5.11	115	58.2	41.2	85	3	29.14
HR	MC	HRMCJ02	10/18/2018		4.73	173	77.0	50.2	88.5	2	21.56
HR	MC	HRMCL01	10/18/2018		4.47	132	60.4	37.6	73	6	39.58
HR	MC	HRMCL02	10/18/2018		3.94	98.6	53.2	46.1	72.5	6	34.23
HR	MC	HRMCS01	10/18/2018		3.04	164	64.6	32.1	59.5	10	25.88

Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
			mean		4.26	137	62.7	41.4	75.7		
			stdev		0.80	32	9.00	7.08	11.5		
			median		4.47	132	60.4	41.24	73		
			25th		3.94	115	58.2	37.63	72.5		
			75th		4.73	164	64.6	46.07	85		
KL	MC	KLMCL01	10/15/2018	3	2.36	197	40.3	29.8	69	4	16.54
KL	MC	KLMCS01	10/15/2018		2.64	263	57.2	31.9	55.5	10	20.09
KL	MC	KLMCS02	10/15/2018		2.56	241	63.4	28.8	54	10	19.58
			mean		2.52	234	54	30.2	59.5		
			stdev		0.14	33	12	1.6	8.3		
			median		2.56	241	57.2	29.8	55.5		
			25th		2.46	219	48.8	29.3	54.8		
			75th		2.60	252	60.3	30.9	62.3		
LB1	MC	LB1MCL01	10/18/2018	5	2.57	759	51.0	20.9	72	5	24.79
LB1	MC	LB1MCS01	10/18/2018		2.29	677	29.2	10.2	60.5	6	16.83
LB1	MC	LB1MCS02	10/18/2018		3.45	846	86.4	32.6	51	11	17.42
LB1	MC	LB1MCS03	10/18/2018		2.51	719	54.5	21.8	47	9	15.96
LB1	MC	LB1MCS04	10/18/2018		2.57	643	49.7	19.8	51.5	8	15.35
			mean		2.68	729	54.1	21.0	56.4		
			stdev		0.45	79	20.6	7.95	10.0		
			median		2.57	719	51.0	20.89	51.5		
			25th		2.51	677	49.7	19.80	51		
			75th		2.57	759	54.5	21.77	60.5		
LB2	MC	LB2MCL01	10/18/2018	5	3.18	891	99.0	5.85	68	7	27.51

Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
LB2	MC	LB2MCL02	10/18/2018		2.72	577	90.6	7.80	71.5	6	25.66
LB2	MC	LB2MCL03	10/18/2018		2.68	784	86.5	6.50	70	7	28.66
LB2	MC	LB2MCL04	10/18/2018		3.31	783	112	14.5	69	7	27.3
LB2	MC	LB2MCS01	10/18/2018		3.53	599	98.7	6.81	58.5	10	20.46
			mean		3.08	727	97.3	8.29	67.4		
			stdev		0.37	134	9.76	3.53	5.14		
			median		3.18	783	98.7	6.81	69		
			25th		2.72	599	90.6	6.50	68		
			75th		3.31	784	99.0	7.80	70		
NE	MC	NEMCL01	10/18/2018	2	2.61	53.3	80.4	9.65	77	5	30.75
NE	MC	NEMCL02	10/18/2018		2.54	43.4	124	8.34	77	5	31.37
			mean		2.58	48	102	9.0	77.0		
			stdev		0.05	7	31	0.9	0.0		
			median		2.58	48	102.0	9.0	77		
			25th		2.56	46	91.2	8.7	77		
			75th		2.59	51	112.8	9.3	77		
PC	MC	PCMCS01	10/15/2018	4	2.99	417	58.8	26.8	57	9	18.9
PC	MC	PCMCS02	10/15/2018		2.76	375	53.4	26.0	58	8	21.38
PC	MC	PCMCS03	10/15/2018		2.2	472	45.9	21.9	62	6	17.01
PC	MC	PCMCS04	10/15/2018		2.22	618	78.0	38.9	64.5	6	15.61
			mean			470					
			stdev								
			median		2.49	444	56	26.4	60		
			25th		2.22	406	52	25.0	58		

			75th		2.82	508	64	29.8	63		
Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
WB	MC	WCMCJ01	10/18/2018	3	4.16	272	75.7	53.7	90.5	2	20.93
WB	MC	WCMCL01	10/18/2018		4.44	407	94.1	78.2	80	2	16.21
WB	MC	WCMCL02	10/18/2018		2.67	268	88.0	35.6	73	3	17.84
			mean		3.76	315	86	55.8	81.2		
			stdev		0.95	79	9	21.4	8.8		
			median		4.16	272	88.0	53.7	80.0		
			25th		3.42	270	81.8	44.6	76.5		
			75th		4.30	339	91.0	65.9	85.3		
11A	BK	11ABKJ01	6/27/2019	13	2.23	166	57.99	31.08	86.5	4	27.13
11A	BK	11ABKJ02	6/27/2019		2.38	158	57.84	33.06	85.5	4	29.04
11A	BK	11ABKL01	6/27/2019		2.63	204	78.58	36.27	74	6	27.71
11A	BK	11ABKL02	6/27/2019		2	193	70.74	37.14	72.5	6	26.67
11A	BK	11ABKL03A	6/27/2019		2.35	178	77.12	37.21	78	6	30.06
11A	BK	11ABKL03B	6/27/2019		2.32	171	73.63	35.49	dup	dup	30.06
		dup mean				174.5	75.4	36.3			
11A	BK	11ABKL04	6/27/2019		2.5	211	80.4	33.66	71	6	25.25
11A	BK	11ABKL05	6/27/2019		2.18	146	55.84	23.77	74	6	28.82
11A	BK	11ABKL06	6/27/2019		2.44	181	70.37	29.09	71.5	6	26.1
11A	BK	11ABKL07	6/27/2019		1.91	127	51.29	24.58	73	6	26.41
11A	BK	11ABKL08	6/27/2019		2.31	250	85.49	37.95	73.5	6	27.14
11A	BK	11ABKL09	6/27/2019		2.62	196	79.71	34.44	75	6	28.75
11A	BK	11ABKL10	6/27/2019		2.37	244	96.02	48.01	73.5	6	29.34
11A	BK	11ABKS01	6/27/2019		2.41	255	93.57	36.64	65	10	26.93
			mean		2.33	193	73.3	34.0	74.6		

Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor-dane	tDDT	Median length	# in composite	sample wet wt (g)
			stdev		0.20	38	13.3	5.8	5.7		
			median		2.36	193	73.9	34.0	73.8		
			25th								
			75th								
KEY BR	BK	K19BKL01	8/6/2019	8	1.65	36.8	19.3	12.91	67	6	20.17
KEY BR	BK	K19BKL02	8/6/2019		1.63	32.7	11.9	8.27	72	4	14.5
KEY BR	BK	K19BKS01	8/6/2019		2.48	39.1	26.8	14.16	60	10	21.42
KEY BR	BK	K19BKS02	8/6/2019		2.76	40.1	30.9	13.18	60.5	10	20.9
KEY BR	BK	K19BKS03	8/6/2019		2.81	98.7	24.5	15.78	59	10	20.07
KEY BR	BK	K19BKS04	8/6/2019		3.01	37.1	29.9	12.21	56	12	20.43
KEY BR	BK	K19BKS05	8/6/2019		3.02	66	26.4	14.84	57	12	22.58
KEY BR	BK	K19BKS06	8/6/2019		2.8	39.5	22.8	12.44	58	13	24.96
			mean		2.52	48.8	24.1	13.0	61.2		
			stdev		0.53	21.2	5.75	2.12	5.15		
			median		2.78	39.3	25.5	13.04	59.5		
			25th		2.76	39.1	24.5	12.91	59.0		
			75th		2.86	46.6	27.6	14.33	62.1		
TR ISLAND	BK	P319BKL01	8/8/2019	1	1.89	89.5	28.7	17.87	71.5	4	14.32
FLETC H	BK	P419BKL01	8/8/2019	3	1.88	13.5	13.679	11.17	76	3	14.94
FLETC H	BK	P419BKS01	8/8/2019		2.84	45.6	42.08	27.98	61	10	22.8

FLETC H	BK	P419BKS02	8/8/2019		3.16	28.9	37.41	28.09	57	10	21.15
Site	Species	Sample ID	Date	N	% lipid	Total PCBs (sum congeners)	tChlor- dane	tDDT	Median length	# in composite	sample wet wt (g)
			mean		2.63	29	31	22.4	64.7		
			stdev		0.67	16	15	9.7	10.0		
			median		2.84	29	37.4	28.0	61.0		
			25th		2.36	21	25.5	19.6	59.0		
			75th		3.00	37	39.7	28.0	68.5		
PEPCO	BK	PC19BKL01	7/19/2019	4	2.58	345	80.49	30.00	70	5	17.01
PEPCO	BK	PC19BKL02	7/19/2019		3.04	422	93.18	33.51	70.5	4	20.2
PEPCO	BK	PC19BKS01	7/19/2019		2.9	399	63.86	25.37	53.5	10	20.2
PEPCO	BK	PC19BKS02	8/6/2019		2.66	84.7	40.83	20.36	63	10	17.79
			mean		2.80	313	70	27.3	64.3		
			stdev		0.21	155	22.6	5.7	7.9		
			median		2.78	372	72	27.7	67		
			25th		2.64	280	58	24.1	61		
			75th		2.94	405	84	30.9	70		
PEPCO	MC	PC19MCL01	7/19/2019	3	1.78	205	40.45	15.7	72.5	4	21.3
PEPCO	MC	PC19MCL02	7/19/2019		2.19	223	43.9	17.6	70	3	16.88
PEPCO	MC	PC19MCS01	7/19/2019		2.58	329	51.88	20.6	48	11	17.05
			mean		2.18	252	45	18.0	63.5		
			stdev		0.40	67	6	2.4	13.5		
			median		2.19	223	43.9	17.6	70.0		
			25th		1.99	214	42.2	16.7	59.0		
			75th		2.39	276	47.9	19.1	71.3		

FIGURES

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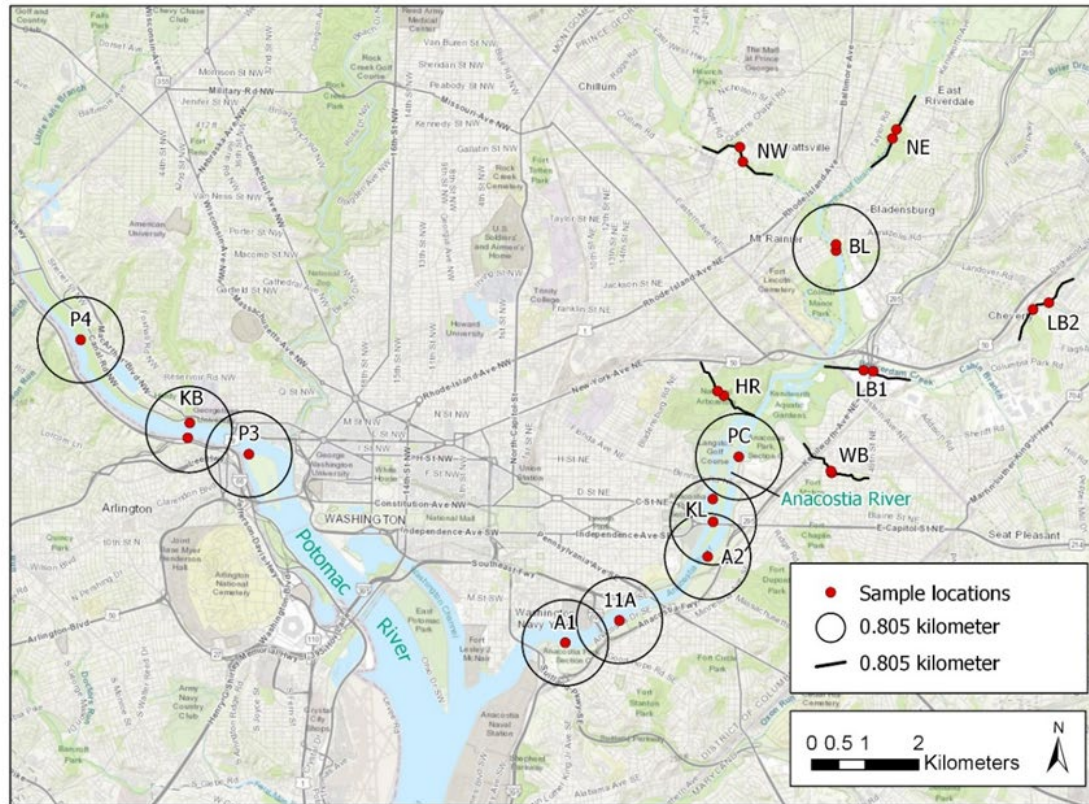


Figure 1. Locations for the 2018 (all Anacostia mainstem and tributaries except 11A) and 2019 (all Potomac locations, 11A, additional PC samples) collections. See Table 1 for descriptions.