Statewide Investigation of Persistent Organic Contaminants in North Carolina Freshwater Fish, 2003 – 2008

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List of Acronyms and Abbreviations

Acronym or Abbreviation	Definition
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DHHS	Department of Health and Human Services
DWQ	Division of Water Quality
EPA	Environmental Protection Agency
ESS	Environmental Sciences Section
FDA	Food and Drug Administration
HUC	Hydrologic Unit Code
MDL	Method Detection Limit
NC	North Carolina
NCDENR	North Carolina Department of Environment and Natural Resources
PBDE	polybrominated diphenyl ethers
PCB	polychlorinated biphenyls
ppb	part per billion
ppm	part per million
PQL	Practical Quantitation Limit
SOP	Standard Operating Procedure
US	United States
USGS	United States Geological Survey

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Summary

From 2003 to 2008, the North Carolina Division of Water Quality conducted a statewide screening of organic contaminants in freshwater fish tissues with the primary goals of 1) determining the occurrence and general distribution of selected organic contaminants in North Carolina's inland fish and 2) identifying key waterbodies in the state where organic contaminants exceed human health criteria established for edible fish tissues. Fish were collected from 41 riverine and lake sites located close to the flow exit points or outlets of North Carolina's eight-digit hydrologic units. Fifty one organic compounds, most of which are listed by the U.S. Environmental Protection Agency as priority pollutants, were tested in fish fillets including 29 pesticides, 19 polychlorinated biphenyls (PCBs), and 3 polybrominated diphenyl ethers (PBDEs, fire retardants).

Study results showed that 18 of the 55 targeted organic contaminants were detected in fish, primarily among benthic dwelling species such as catfish, carp and suckers. At least one of these 18 contaminants was detected at 76% (n=31) of the selected test sites across the state. The most commonly detected contaminants were DDE (a metabolite of DDT), PCBs, chlordane, and dieldrin. Exceedances of the U.S. Environmental Protection Agency's health safety criteria for anglers and North Carolina's fish consumption advisory levels were limited to these same legacy pollutants. However, no U.S. Food and Drug Administration action levels were exceeded. Neither of North Carolina's fish consumption action levels for total DDT or total PCBs were exceeded in this survey and only one fish fillet sample exceeded NC's fish consumption advisory level for PBDEs.

Overall, this survey demonstrates that persistent organic pollutants remain bioavailable in North Carolina's freshwater ecosystems several decades after their discontinued use, but at concentrations that pose few health concerns for humans who consume fish.

Introduction

DWQ Fish Tissue Contaminant Program

The North Carolina Division of Water Quality (DWQ) initiated a fish tissue contaminant monitoring program in the mid-1980s that is used by the North Carolina Department of Health and Human Services (DHHS) for fish consumption risk assessments and support for fish advisories. The DWQ fish tissue database contains nearly 12,000 records, most of which represent mercury and other heavy metals. However, only about 5% of the records in the database represent organic contaminants because of high analytical costs and limited state resources. Nevertheless, upgrades in recent years at the DWQ Laboratory Section have made fish tissue organics analysis possible on the scale required for a statewide screening survey.

Fish Consumption Advisory Action Levels

Following USEPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (USEPA 2000), the DHHS has adopted fish consumption advisory action levels that are used as guides to determine the need for fish consumption advisories in North Carolina. NC action levels are concentrations of specific pollutants in fish tissues below which there should be negligible health risks for human consumption. The following three DHHS advisory action levels for organic contaminants apply to the fish tissue data collected in this survey:

- Total DDT (1.0 ppm),
- Total PCBs (0.5 ppm),
- Total PBDEs (0.5 ppm).

Organochlorine Pesticides

Pesticide use in the US has greatly enhanced crop and urban horticulture production, but has raised concerns about potentially harmful effects on humans and the environment. Water represents a primary pathway by which pesticides are transported from their site of application to other parts of the environment. Legacy pesticides are still frequently detected in streams and ground water, but seldom at

levels that are likely to affect humans (USGS, 2007) because of their hydrophobic and lipophilic characteristics (i.e., they have low solubility and they concentrate in lipids or fats).
Studies have demonstrated that chlorinated pesticides and their metabolites such as DDT, chlordane and dieldrin are found in fish and sediments collected from most US streams occurring in agricultural, urban and mixed use watersheds (USGS, 2006). However, environmental residues of the well known legacy pesticides have declined nationally in freshwater fish since agricultural uses were discontinued decades ago (Nowell et al. 2009).

Polychloronated Biphenyls (PCBs)
PCBs are closely related to many chlorinated hydrocarbon pesticides (e.g. DDT, dieldrin, and aldrin) in their chemical, physical, and toxicological properties, and in their widespread occurrence in the aquatic environment (USEPA, 2000). Prior to being banned in the US in 1979, PCBs were widely used throughout the United States, primarily as dielectric lubricants and coolants in transformers, capacitors, and other electrical equipment because of their insulating capacity and resistance to combustion and breakdown. Once released into the environment, these same properties enable PCBs to persist for long periods of time (i.e., decades). Upon entering surface waters, they become attached to soil and sediment particles and eventually settle out in bottom sediments. As benthic dwelling organisms feed, they ingest PCB-laden sediments and subsequently pass them up the food chain. This progressive concentration or bioaccumulation of PCBs in aquatic systems is especially prominent within the fatty tissues of fish. Since PCBs are no longer used in the US, contaminated fish represent a foremost exposure route for anglers who consume them.

Polybrominated Diphenyl Ethers (PBDEs)
PBDEs are flame retardant compounds that are incorporated into a wide variety of everyday use products such as plastics, foams, fabrics, textiles and other materials. They are structurally similar to PCBs in that they consist of two halogenated aromatic rings and they are lipophilic. The pathways in which PBDEs enter the environment are not well understood, but may include releases of chemicals during product manufacturing, aging and wear of end consumer products, and direct exposure during use. There is growing evidence that PBDEs are persistent and bioaccumulative, especially within personnel associated with manufacturing of PBDE-containing products. PBDEs are currently being phased out in the US amid growing evidence of their toxicity and persistence.

Study Design and Methods

Objective
This study represents a statewide screening survey with the objectives of 1) identifying mainstem inland freshwater catchments across NC where organic contaminants exist in fish tissues and 2) where their concentrations exceed human health screening values set by state and federal agencies. If warranted, more intensive follow up sampling could occur at sites where contaminants are identified at levels that exceed NC's fish consumption advisory levels.

Site Selections
The US Geological Survey (USGS) has delineated watersheds (hydrologic units) in the United States using a hierarchical numbering system consisting of two to twelve digits called a hydrologic unit code (HUC). Freshwater fish sampling locations for this study were selected to be as close as possible to the flow exit points of 41 eight-digit HUCs. North Carolina has a total of 55 eight-digit HUCs, however eight of these are located in salt water. Six of the freshwater eight-digit HUCs were not accessible. Choosing HUCs greater than eight-digits would have increased the number of sample units to an unmanageable number (Figure 1, Table 1).

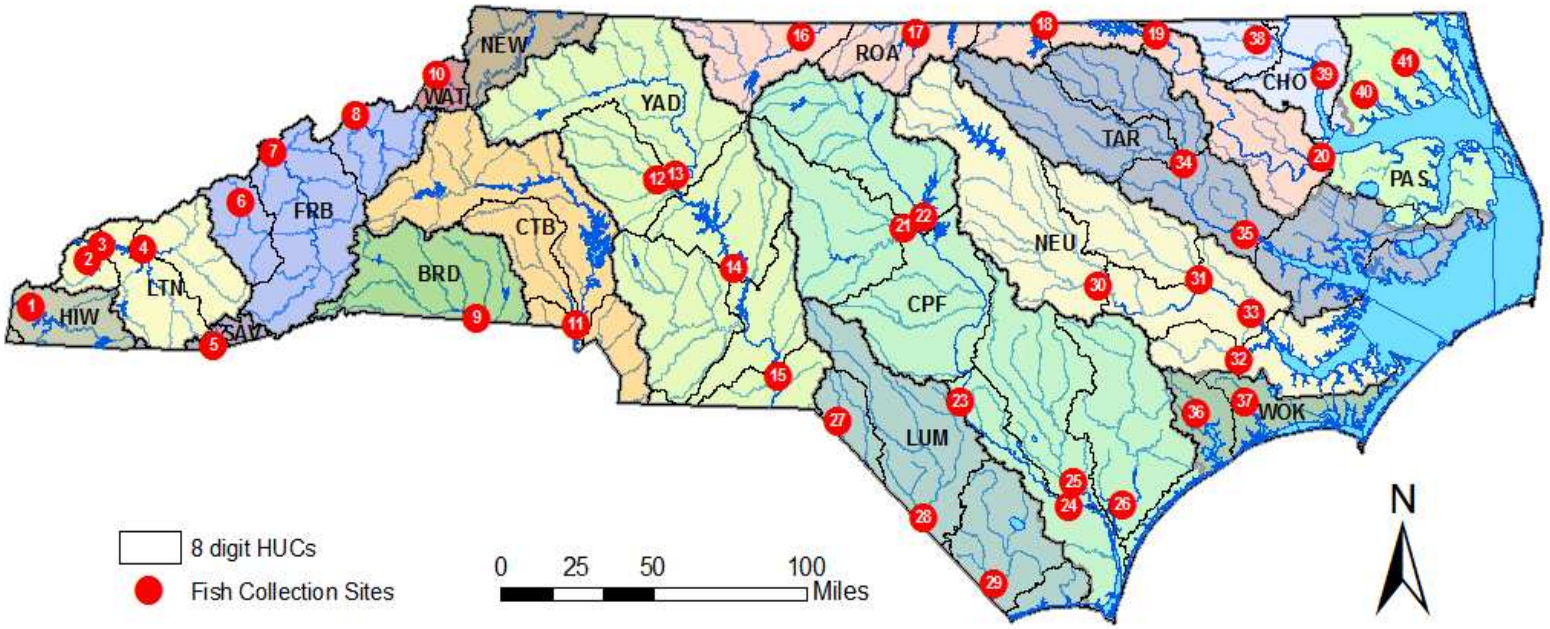

Figure 1. **Fish collection sites selected for organic contaminants analysis (2003 – 2008). See Table 1 for three letter basin codes. Site numbers 1 through 41 correspond to those listed in Table 1.**

Table 1. Watersheds targeted for organic contaminants analysis in fish tissues (2003-2008), and their land use.

Site # [a]	Site Description	Basin [b]	County	Date	8 Digit HUC [c]	Latitude	Longitude	D.A. (mi^2) [d]	Land Use [e]					
									% Agr.	% Barren	% Devel.	% For./Wetl.	% Grass/Past.	% Water
1	Hiwassee River below dam	HIW	Cherokee	8/15/06	06020002	35.146667	-84.180278	626.3	0.3	0.3	5.2	84.8	7.2	2.2
2	Santeetlah Lake near Cheoah Point	LTN	Graham	8/16/06	06010204	35.373889	-83.869444	274.2	0.1	0.0	3.2	93.3	1.7	1.7
3	Fontana Lake at Cable Cove	LTN	Graham	8/16/06	06010202	35.441389	-83.790833	789.3	0.2	0.2	4.5	87.9	5.4	1.9
4	Fontana Lake - Tuckaseegee Arm	LTN	Swain	8/17/06	06010203	35.438611	-83.549167	733.6	0.1	0.1	5.0	90.2	4.0	0.7
5	Chatooga River near Highlands	SAV	Macon	9/11/08	03060102	35.016170	-83.126590	72.8	0.0	0.4	5.4	92.2	1.9	0.1
6	Pigeon River at Hepco (Waterville Lake)	FRB	Haywood	11/8/06	06010106	35.666111	-82.994722	535.8	0.6	0.0	7.4	81.4	10.3	0.2
7	French Broad River at Hot Springs	FRB	Madison	9/11/06	06010105	35.894444	-82.823056	1663.4	1.1	0.1	11.1	71.9	15.5	0.3
8	Nolichucky River at Poplar	FRB	Mitchell	9/12/06	06010108	36.074167	-82.345278	629.6	0.2	0.1	4.9	84.2	10.5	0.1
9	Broad River near Gaffney	BRD	Cleveland	11/1/05	03050105	35.180556	-81.616111	1513.3	0.3	0.7	8.9	62.7	26.8	0.5
10	Watauga River near Beech Cr	WAT	Watauga	11/29/07	06010103	36.269167	-81.884167	204.8	0.2	0.4	8.6	78.2	12.6	0.0
11	South Fork Catawba River	CTB	Gaston	10/3/05	03050102	35.166389	-81.037778	660.7	0.6	0.1	17.8	48.8	32.3	0.4
12	South Yadkin River near Cooleemee	YAD	Davie	8/20/04	03040102	35.822778	-80.586667	906.4	0.8	0.1	9.1	48.6	41.2	0.2
13	Yadkin River near Mocksville	YAD	Davie	9/5/04	03040101	35.843056	-80.476111	2336.4	0.8	0.1	12.1	59.0	27.6	0.4
14	Badin Lake	YAD	Stanly	8/27/04	03040103	35.427222	-80.137222	1189.6	0.8	0.1	11.2	55.7	29.8	2.5
15	Blewett Falls Lake	YAD	Anson	9/5/04	03040104	34.945278	-79.870278	861.9	2.5	0.3	3.9	70.2	21.4	1.6
16	Dan River near Eden	ROA	Rockingham	8/20/04	03010103	36.479167	-79.750833	914.6	1.1	0.1	6.4	63.3	28.2	0.9
17	Hyco Lake	ROA	Person	8/16/04	03010104	36.495278	-79.077500	716.0	1.3	0.2	4.5	65.1	26.7	2.2
18	Kerr Lake - Nutbush Creek Arm	ROA	Vance	8/21/03	03010102	36.526667	-78.330833	298.2	1.6	0.2	6.0	65.4	21.5	5.3
19	Roanoke Rapids Lake at Dam	ROA	Northampton	10/22/03	03010106	36.477500	-77.675556	254.4	3.0	0.2	5.7	62.4	18.7	10.0
20	Roanoke River at Plymouth	ROA	Washington	10/19/05	03010107	35.913333	-76.722500	1309.6	25.0	1.0	3.1	62.0	7.8	1.1
21	Deep River at Moncure	CPF	Lee	8/20/03	03030003	35.616389	-79.087222	1449.8	1.6	0.2	10.6	59.1	28.1	0.5
22	Lake Jordan near Dam	CPF	Chatham	8/20/03	03030002	35.658333	-79.071667	1707.5	1.4	0.2	17.6	50.6	28.0	2.3
23	Cape Fear River at Lock and Dam 3	CPF	Bladen	11/5/03	03030004	34.833056	-78.822500	1629.6	10.5	1.2	13.3	52.8	20.8	1.4
24	Cape Fear River at Riegelwood	CPF	Columbus	10/29/03	03030005	34.356389	-78.208333	1062.1	11.1	0.3	6.1	65.3	12.5	4.8
25	Black River near Longview	CPF	Bladen	11/5/03	03030006	34.466111	-78.180556	1573.6	29.8	0.0	4.9	52.5	12.2	0.5
26	Northeast Cape Fear at Castle Haynes	CPF	New Hanover	10/13/04	03030007	34.363889	-77.897222	1741.0	24.6	0.1	3.7	61.5	9.8	0.3
27	Gum Swamp Creek (Lytch's Pond)	LUM	Scotland	10/20/04	03040204	34.744722	-79.528611	393.0	27.3	0.3	7.9	48.6	15.5	0.4
28	Lumber River at Fair Bluff	LUM	Columbus	10/13/04	03040203	34.313056	-79.038611	1631.0	27.7	0.0	7.1	49.7	15.1	0.4
29	Waccamaw River at NC-904 Pireway	LUM	Columbus	7/10/03	03040206	34.014444	-78.633056	1053.1	20.4	0.0	4.3	62.0	11.9	1.4
30	Neuse River at Goldsboro	NEU	Wayne	10/16/03	03020201	35.348270	-78.024000	2405.8	14.4	0.2	16.4	47.7	19.6	1.7
31	Contentnea Creek at Grifton	NEU	Pitt	9/30/04	03020203	35.370833	-77.444444	1008.4	39.8	0.1	6.3	38.5	14.5	0.8
32	Trent River at Pollocksville	NEU	Jones	9/22/04	03020204	35.009722	-77.218611	1582.8	13.7	0.1	4.3	48.8	6.7	26.4
33	Neuse River at Spring Garden Landing	NEU	Craven	10/4/04	03020202	35.218333	-77.145278	1065.2	34.2	0.1	6.2	46.9	11.8	0.8
34	Tar River at Tarboro	TAR	Edgecombe	10/23/03	03020101, 03020102	35.894444	-77.525556	2205.0	16.1	0.2	6.4	56.6	20.2	0.6
35	Tar River at SR-1565 near Grimesland	TAR	Pitt	10/5/04	03020103	35.573611	-77.175278	960.1	38.0	0.0	6.1	43.1	12.3	0.5
36	New River at Tar Landing	WOK	Onslow	10/8/04	03020302	34.775278	-77.471389	624.2	13.2	1.4	11.9	55.4	9.5	8.6
37	White Oak River near Haywood Landing	WOK	Jones	10/5/04	03020301	34.819722	-77.186667	757.3	11.2	1.3	7.2	53.4	7.4	19.5
38	Meherrin River at US-258	CHO	Hertford	10/18/05	03010204	36.446944	-77.084722	496.7	33.2	1.3	1.2	55.2	8.9	0.1
39	Chowan River at Holiday Island	CHO	Chowan	10/17/05	03010203	36.283333	-76.690000	800.3	22.1	1.7	1.3	59.7	9.4	5.7
40	Perquimans River at Hertford	PAS	Perquimans	9/23/05	03010205	36.194722	-76.461389	3366.5	13.3	1.5	1.8	37.5	9.1	36.8
41	Pasquotank River at Elizabeth City	PAS	Pasquotank	8/25/05	03010205	36.333333	-76.218611	3366.5	13.3	1.5	1.8	37.5	9.1	36.8

[a] Sites are grouped by basin. 41 of 47 planned sites could be sampled during this study; six sites were inaccessible and not listed. [b] Basin codes: HIW=Hiwassee, LTN=Little Tennessee, SAV=Savannah, FRB=French Broad, BRD=Broad, CTB=Catawba, WAT=Watauga, YAD=Yadkin, ROA=Roanoke, CPF=Cape Fear, LUM=Lumber, NEU=Neuse, TAR=Tar/Pamlico, WOK=White Oak, CHO=Chowan, and PAS=Pasquotank. [c] Site # 34 captures two targeted 8 digit HUCs (03020101, and 03020102). [d] D.A. = drainage area. [e] Land Use determinations were calculated using the 2001 National Land Cover Data Set (Homer et al. 2004).

Sampling Timeframe
Fish were collected over a period of five years (2003 to 2008) during the months of August, September, October, and November. As a general rule, the most desirable time to collect fish samples for organics analysis is from late summer to early fall (i.e., August to October) when the lipid content of many fish species (a reservoir for organic pollutants) is generally highest (USEPA, 2000).

Sampling
The procedures used to collect fish for contaminant analysis are described in the DWQ Fish Tissue Contaminant SOP (NCDENR 2011) and are based on EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (USEPA 2000). All fish sample collections were performed using standard electrofishing techniques including boat mounted electrofishers on non-wadeable lakes and rivers and battery powered backpack electrofishers in smaller wadeable stream sites.

Targeted fish species at each site included one predator and one bottom feeder, both considered good indicators of persistent pollutants in aquatic ecosystems (USEPA 2000). A total of 309 individual fish were collected from the 41 survey sites. An average of eight fish (ranging from 1 to 14 individuals) was collected at each sample location. Although relatively small, this sample size was considered to be appropriate for a screening survey of this type and within DWQ's laboratory resources for contaminant analysis. Once collected, fish specimens were sorted by species and temporarily stored on ice before being transferred to the Division's Environmental Sciences Section (ESS) Laboratory where they were stored at -20°C until processing. On average, three samples per site were analyzed for organic contaminants, for a total of 116 samples.

Processing
The procedures used to process fish for contaminant analysis are described in the DWQ Fish Tissue Contaminant SOP (NCDENR 2011) and are based on EPA's Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (USEPA 2000). Prior to handling and processing of each fish sample, all equipment and surfaces in the fish tissue processing laboratory were prepared using the appropriate methods to ensure a contaminant-free environment. Frozen fish were partially thawed overnight before processing and homogenate preparation. Taxonomic verification of each fish was performed according to regional identification manuals and other suitable taxonomic literature (e.g. Menhinick 1991). Total lengths to the nearest millimeter and wet-weights to the nearest 0.1 gram were then recorded for each fish.

All subsequent processing steps to produce fish tissue homogenates for contaminant analysis (scaling, filleting, skinning of catfish, blending of fillets, and sample homogenate portioning) were performed consistent with standard methods to ensure the prevention of cross contamination between samples (NCDENR 2011). For quality control purposes, blind laboratory duplicate samples were also prepared with "dummy" sample ids for 10% of the homogenized samples. All of the prepared samples were then re-frozen at -20°C before being delivered to the DWQ Laboratory Section for analysis.

Sample Types
Composite samples, or homogeneous mixtures of two or more individuals of the same species, were the preferred sample type for this screening survey because they are the most cost effective for estimating average concentrations of target analytes. Individual fillet samples were processed for contaminant analysis when fillet compositing was not possible. The following compositing strategy used in this survey is consistent with EPA guidance (USEPA, 2000) in that composites are:

- Comprised of individual fish of the same species that were collected from a site on the same day;
- Comprised of individual fish that are of consumable size;
- Comprised of individual fish such that the smallest fish length is at least 75% of the maximum fish length, and;
- Of sufficient mass to provide an adequate amount of tissue for sample analysis.

Laboratory Analysis of Fish Tissue Contaminants

Fifty one organic compounds, most considered as EPA priority pollutants, including 28 organochlorine pesticides, 1 organophosphate pesticide, 19 PCBs, and 3 PBDEs were targeted in fillet fish tissues (Table 2). The DWQ Laboratory Section in Raleigh, North Carolina performed all analyses using EPA gas chromatography methods (USEPA, 2007). EPA solid waste method 3541 (automated soxhlet) was used for all fish tissue sample extractions prior to analysis; method 8081B was used to determine pesticide concentrations in fish tissues, and method 8082A was used to determine PCB and PBDE concentrations in fish tissues.

Table 2. Targeted organic contaminants in North Carolina fish tissues including pesticides, PCBs and PBDEs. Total analytes = 51[a]. Analytes that were detected in fish during this survey are bolded (n=18).

Pesticide (n=29) [b]	Congener #	PCB as Congener (n=19)
Aldrin *(no longer registered)*	1	Chlorobiphenyl
BHC-Alpha *(isomer of lindane)*	5	Dichlorobiphenyl
BHC-Beta *(isomer of lindane)*	18	Trichlorobiphenyl
BHC-Gamma *(primary form of lindane, no longer registered)*	31	Trichlorobiphenyl
BHC-Delta *(isomer of lindane)*	44	Tetrachlorobiphenyl
Chlordane, Technical *(no longer registered)*	**52**	**Tetrachlorobiphenyl**
Cis-Chlordane (Alpha) *(isomer of chlordane)*	66	Tetrachlorobiphenyl
Trans-Chlordane (Gamma) *(isomer of chlordane)*	87	Pentachlorobiphenyl
Trans-Nonachlor *(metabolite of chlordane)*	101	Pentachlorobiphenyl
Chlorpyrifos[c] *(currently registered for use in NC)*	**110**	**Pentachlorobiphenyl**
DDD, 2,4' *(no longer registered, but also a metabolite of DDT)*	**138**	**Hexachlorobiphenyl**
DDD, 4,4' *(no longer registered, but also a metabolite of DDT)*	141	Hexachlorobiphenyl
DDE, 2,4' *(metabolite of DDT)*	151	Hexachlorobiphenyl
DDE, 4,4' *(metabolite of DDT)*	**153**	**Hexachlorobiphenyl**
DDT, 2,4' *(no longer registered)*	170	Heptachlorobiphenyl
DDT, 4,4' *(no longer registered)*	180	Heptachlorobiphenyl
Dieldrin *(no longer registered)*	183	Heptachlorobiphenyl
Endosulfan I *(no longer registered)*	**187**	**Heptachlorobiphenyl**
Endosulfan II *(no longer registered)*	**206**	**Nonachlorobiphenyl**
Endosulfan Sulfate *(metabolite of endosulfan)*		
Endrin *(no longer registered)*	**Congener #**	**PBDE as Congener (n=3)**
Endrin Aldehyde *(metabolite of endrin)*	**47**	**Tetrabromodiphenyl Ether**
Endrin Ketone *(metabolite of endrin)*	**99**	**Pentabromodiphenyl Ether**
Heptachlor *(no longer registered)*	153	Hexabromodiphenyl Ether
Heptachlor Epoxide *(presumed metabolite of heptachlor)*		
Hexachlorobenzene *(no longer registered)*		
Methoxychlor *(no longer registered)*		
Mirex *(no longer registered)*		
Pentachloranisole *(metabolite of pentachlorophenol, which is no longer registered)*		

[a]This list includes all organic analytes currently tested for in fish tissues by the DWQ Laboratory Section. Pesticide status information was provided by the NC Department of Agriculture and Consumer Services. [b]All of the pesticides listed are organochlorine pesticides, except Chlorpyrifos, (an organophosphate pesticide). [c]Chlorpyrifos is the only listed pesticide that is currently registered for use in NC.

Data Reporting and Evaluation

Results for all of the persistent organic contaminants detected in fish during this survey can be found in Appendices 1 and 2. Many of these data are reported between the NC Laboratory Section's method detection limit (MDL) and practical quantitation limit (PQL) and are considered to be present in the sample with 99% certainty, but not accurately measurable. Therefore, concentrations between the MDL and PQL are reported as positively detected, but are not used for comparisons to any established risk assessment criteria due to their uncertainty of quantity.

Contaminant data above the laboratory PQL were compared to the risk assessment criteria listed in Table 3. These criteria have been developed to protect the public from harmful exposures to pollutants found in edible fish tissues. Although the data in this survey were compared to the established federal criteria, the DHHS fish consumption advisory action levels for total DDT, total PCBs, and total PBDEs are the primary criteria for which fish contaminant data in this survey were evaluated. Fish contaminants that meet or exceed the listed NC action levels may warrant additional studies to further characterize the level and geographic extent of contaminants found in their respective watersheds.

Table 3. Fish fillet tissue risk-assessment criteria applied to the organic contaminants detected by DWQ (2003 – 2008). All wet weight concentrations are reported in parts per million (µg/g). Exceeded screening values and action levels in this survey are bolded.

Contaminants	US FDA Action Levels for Commercially Caught Fish	NC DHHS Fish Consumption Advisory Action Levels	US EPA Screening Values	
			Recreational Fishers	Subsistence Fishers
Organochlorine Pesticides				
Total Chlordane [a]	0.3	.	0.114	**0.014**
Total DDT [b]	5.0	1.0	**0.117**	**0.0144**
Dieldrin	0.3	.	0.0025	$3.07x10^{-4}$
Endosulfan (I and II)	.	.	24	2.949
Total PCBs [c]	.	0.05	**0.02**	**0.00245**
Total PBDEs [d]	.	**0.5**	.	.

[a, b] Totals include the sum of all isomers and metabolites.
[c] Total PCBs include the sum of congeners or Aroclors.
[d] Totat PBDEs includes the sum of congeners.

Results

Seventy six percent (76%) of the sites in this survey showed detections of one or more organic compounds in fish tissue samples. Overall, 18 of the 51 targeted contaminants were detected in fish fillets including 10 chlorinated pesticides, 6 PCB congeners, and 2 PBDE congeners (Figure 2). Results for the 33 contaminants that were below laboratory levels of detection in this survey represent approximately 3,500 data points and are not reported here. However, all data from this survey can be found at: http://portal.ncdenr.org/web/wq/ess/bau/fish-tissue-data.

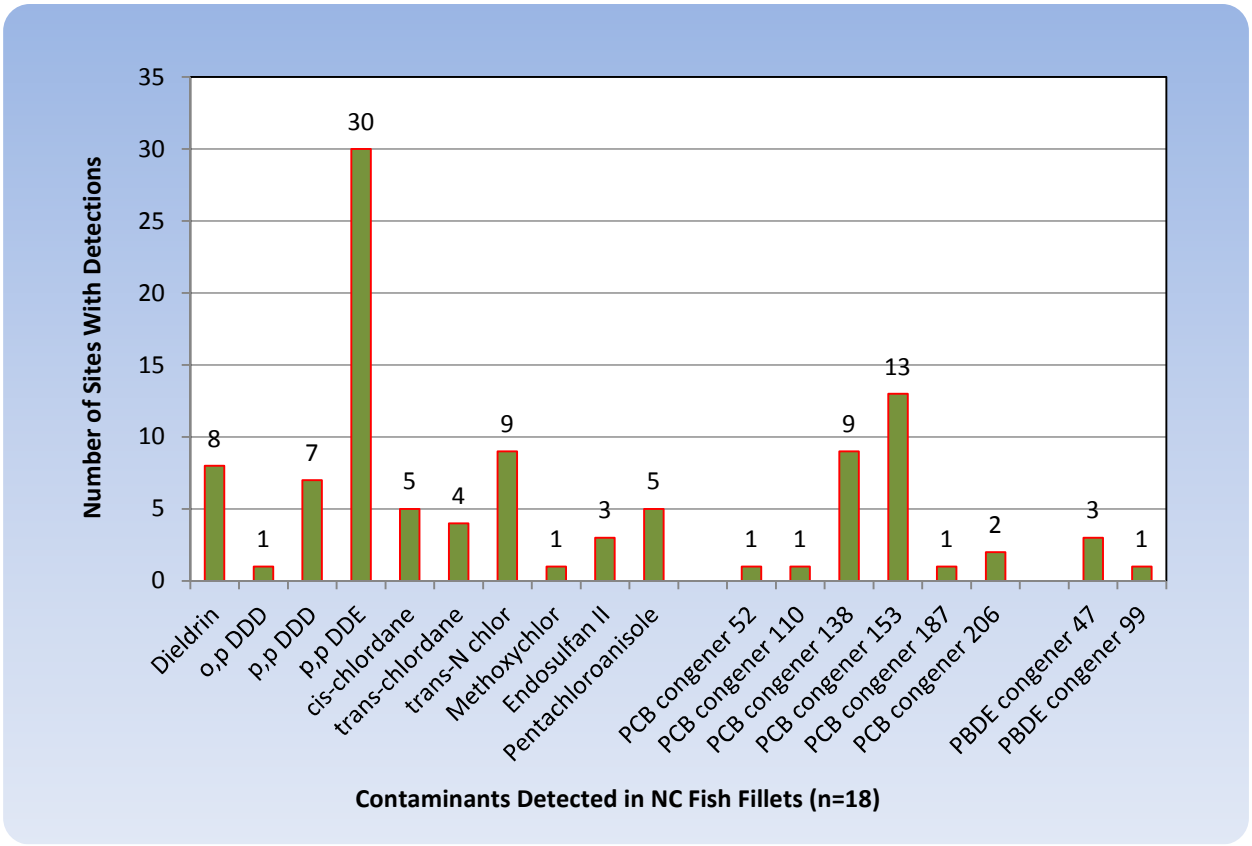

Figure 2. **Eighteen persistent organic contaminants detected in fish tissue fillets from 41 sites across North Carolina (2003-2008).**

Pesticides

Chlorinated pesticides were detected in fish at 73% (n=30) of the sites in this screening survey. Ten of the detected compounds occurred among persistent legacy pesticides that are no longer registered or banned for use in NC (see Table 2 for status of all targeted analytes). The four most commonly detected pesticides were p,p DDE (the primary persistent aerobic metabolite of DDT; detected at 73% of the sites), trans-N-chlor (a chlordane metabolite; detected in 22% of the sites), dieldrin (a metabolite of aldrin; detected at 20% of the sites), and p,p DDD (another DDT metabolite; detected at 17% of the sites). A variety of different fish species were observed with detectable levels of these four pesticides in their tissues, but the majority of observations occured among benthic dwelling species including carp, catfish, and suckers.

Pesticide data in exceedance of the federal and state criteria are presented in Table 4; site locations with pesticide exceedances are shown in Figure 3. Although the FDA's action levels for pesticides were not exceeded by any of the fish tissues in this survey, USEPA criteria were exceeded among observations of total chlordane and total DDT. Observations of total chlordane showed exceedances of the EPA's lower screening value for subsistence fishers in carp samples from the following two locations: Yadkin River near Mocksville (site 13), and Cape Fear River at Riegelwood (site 24) (Figure 1).

DDT is the only pesticide for which four different risk assessment criteria exist in North Carolina. Accordingly, p,p DDE was detected in 50% of the fish tissue samples collected, the most of any targeted organic contaminant in this survey. In fact, 21 fish samples collected from 13 sites across the state showed total DDT concentrations in catfish, carp, suckers, and largemouth bass that exceeded the EPA screening value for subsistence fishers. One of these fish also exceeded the EPA's total DDT screening value for recreational fishers [i.e., carp from the Northeast Cape Fear River at Castle Haynes (site 26) (Figure 1)].

These pesticide results agree with previous findings that recognize DDT and its metabolites, and chlordane as some of the most persistent organic pollutants found in fish throughout the US (USGS, 2007). This study also confirms that DDT metabolites are persisting in aquatic environments across North Carolina's some 30 years after being banned in the U.S. However, it appears that these legacy pesticides may no longer pose widespread health threats as they continue to degrade in aquatic environments.

PCBs

PCBs were detected in fish tissues from 14 of the 41 stations (34%) sampled during this survey. Overall, 6 of the 19 targeted PCB congeners were detected, mostly among bottom dwelling species including catfish, carp, and suckers. The most common of these observations were for PCB congeners 153 and 138, detected at 32% and 22% of the sample sites, respectively (Figure 2).

Observations of total PCBs that were in exceedance of federal risk-assessment criteria are presented in Table 5; site locations with PCB exceedances are shown in Figure 4. A total of 4 fish exceeded the EPA's PCB screening values for subsistence and recreational fishers; one brown trout from the Chatooga River near Highlands (site 5), two flathead catfish from Badin Lake (site 14), and one carp from the Cape Fear River at Riegelwood (site 24) (Figure 1). No exceedances of the NCDHHS fish consumption action level for total PCBs (0.05 ppm) were observed during this survey.

These PCB results for fish tissues are consistent with findings from two national studies indicating that mean total PCB concentrations are typically highest among bottom feeders such as carp, white sucker, and channel catfish, as compared to predator species such as largemouth bass (Kuehl et al., 1994; EPA, 2009). These results may also reflect the presence of PCBs in sediments at or near the survey sites. Since this screening survey, the DHHS conducted a more intensive study of fish PCBs in Badin Lake that resulted in a PCB fish consumption advisory for channel catfish in 2009.

PBDEs

PBDEs were detected in five fish including carp (n=3), channel catfish (n=1), and a largemouth bass (n=1) from three of the 41 sites in this survey (7%). Of the three targeted PBDEs, Tetrabromodiphenyl ether (congener 47) was the most commonly detected (Figure 2). Although no federal risk assessment criteria exist for PBDEs, the DHHS fish consumption advisory action level for total PBDEs (0.5 ppm) was exceeded during this survey in one individual carp fillet collected from the Cape Fear River at Riegelwood (Table 5, Figure 4).

Conclusions and Recommendations

This screening survey of organic residues in fish tissues demonstrates a widespread occurrence of pesticides, PCBs, and PBDEs throughout North Carolina's inland waterbodies. Detections of organic contaminants occurred in several fish species, but most commonly in benthic dwelling fish such as catfish, carp and suckers. Most noteworthy, persistent legacy contaminants such as DDT and PCBs are still detectable in North Carolina fish tissues several decades after being banned from use in the United States; a trend that has been demonstrated in several national studies (USGS 2006 and 2007). However, most concentrations of total DDT, total PCBs and total PBDEs in this survey occurred below the NCDHHS fish consumption action levels for these contaminants. Based on these results, no further investigations of organic contaminants in fish tissues from these locations are recommended. Instead, investigations of organic fish contaminants in North Carolina's inland waterbodies should continue to be conducted as needed where specific human health concerns are identified.

Table 4. Risk assessment criteria exceedances for pesticides in fish tissues collected in NC (2003-2008). All wet weight concentrations for results and risk assessment criteria are reported in parts per million (µg/g).

						Total Chordane Exceedances				Total DDT Exceedances				
Site	Date	Common Name	Ave. LG (mm)	Ave. WT (g)	Sample Type[a]	DWQ Result	FDA Action Level 0.3	EPA Rec. Fishers 0.114	EPA Subs. Fishers 0.014	DWQ Result	FDA Action Level 5.0	NCDHHS Action Level 1.0	EPA Rec. Fishers 0.117	EPA Subs. Fishers 0.0144
1	8/15/06	Carp	653	4834	F					0.020				X
7	9/11/06	Smallmouth Buffalo	321	1649	FC3					0.030				X
		Quillback	437	1146	FC2					0.023				X
		Channel Catfish	457	801	FC3					0.032				X
9	11/1/05	Redhorse Sucker	365	557	FC4					0.037				X
		Channel Catfish	465	921	F					0.070				X
11	10/3/05	Largemouth Bass	342	539	FC5					0.023				X
13	9/5/04	Carp	524	2631	FC6	0.03			X	0.036				X
14	8/27/04	Flathead Catfish	800	7456	F					0.081				X
		Flathead Catfish	662	3947	F					0.023				X
		Flathead Catfish	765	6614	F					0.081				X
19	10/22/03	Carp	628	3395	FC3					0.036				X
24	10/29/03	Carp	571	3140	FC3					0.028				X
		Carp	560	2550	F	0.02			X	0.052				X
26	10/13/04	Carp	622	3742	F					0.161			X	X
28	10/13/04	Flathead Catfish	720	6036	F					0.029				X
33	10/4/04	Blue Catfish	580	2158	F					0.023				X
		Flathead Catfish	641	3356	FC3					0.021				X
35	10/5/04	Redhorse Sucker	480	1117	FC3					0.020				X
39	10/17/05	Redhorse Sucker	396	603	FC5					0.025				X
		Redhorse Sucker	372	540	F					0.053				X

[a]Sample Type = sample type prepared for analysis: individual fillet = F, fillet composites = FC (followed by number of fish in composite).

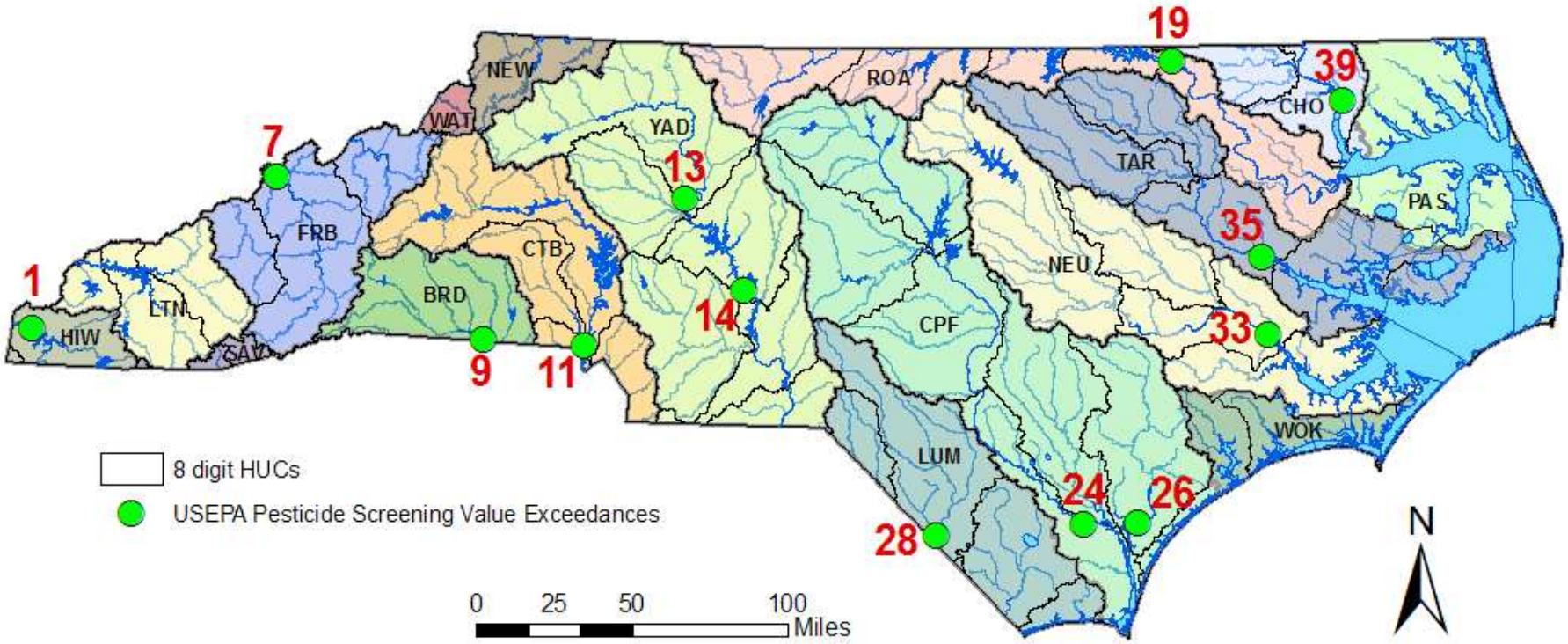

Figure 3. **Fish tissue collection sites (2003-2008) with observations that exceed USEPA screening values for pesticides. Site numbers correspond to those listed in Table 1. See Table 1 for three letter basin codes. See Table 4 for pesticide concentrations.**

Table 5. Risk assessment criteria exceedances for PCBs and PBDEs in fish tissues collected in NC (2003-2008). All wet weight concentrations for results and risk assessment criteria are reported in parts per million (µg/g).

						Total PCB Exceedances				Total PBDE Exceedances	
							NCDHHS Action Level	EPA Rec. Fishers	EPA Subs. Fishers		NCDHHS Action Level
Site	Date	Common Name	Ave. Lg. (mm)	Ave. Wt. (g)	Sample Type	DWQ Result	0.05	0.02	0.00245	DWQ Result	0.5
5	9/11/08	Brown Trout	242	157	F	0.026		X	X		
14	8/27/04	Flathead Catfish	800	7456	F	0.041		X	X		
		Flathead Catfish	765	6614	F	0.043		X	X		
24	10/29/03	Carp	560	2550	F	0.045		X	X	0.68	X

[a]Sample Type = sample type prepared for analysis: individual fillet = F.

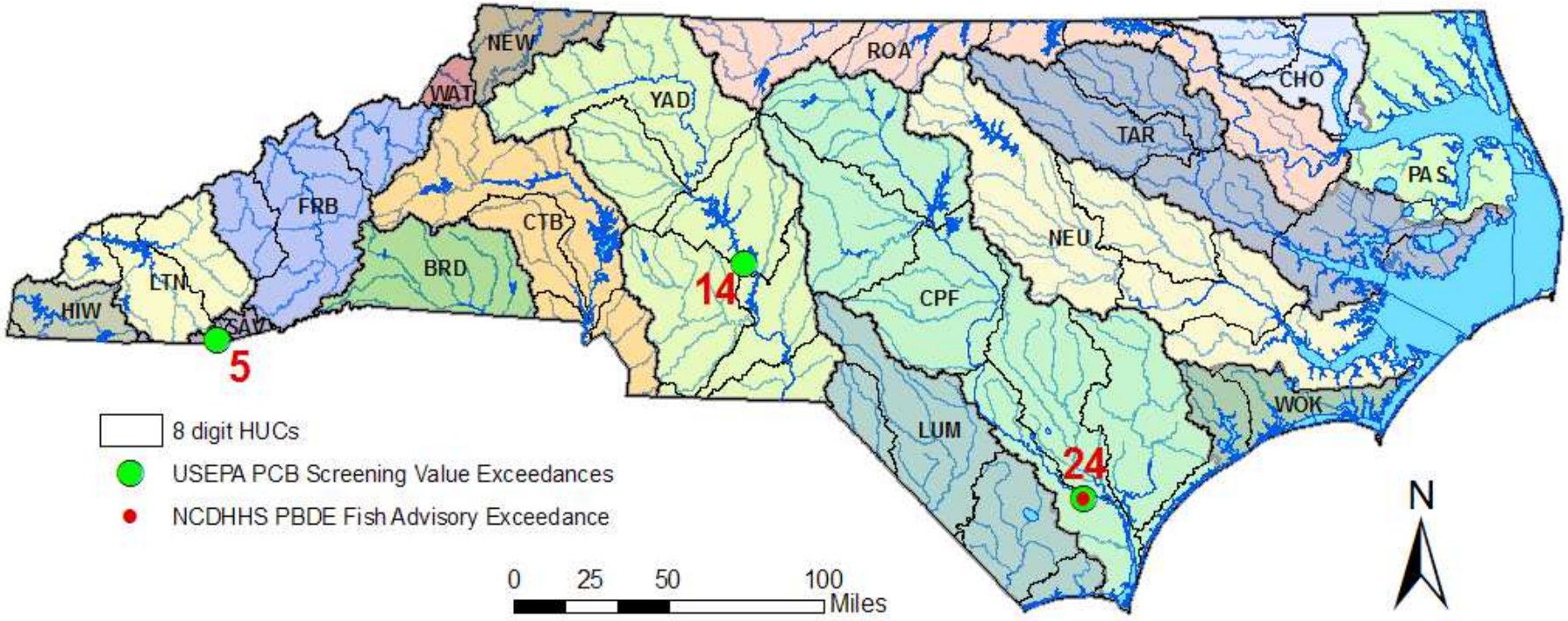

Figure 4. **Fish tissue collection sites (2003-2008) with observations that exceed USEPA screening values for PCBs and one observation that Exceeds the NCDHHS fish consumption advisory level for PBDEs. Site numbers correspond to those listed in Table 1. See Table 1 for three letter basin codes. See Table 5 for PCB and PBDE concentrations.**

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Appendix 1. Raw data for pesticides detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Pesticide detections above the lab's PQLs are bolded; non-detections (ND) are reported with PQLs shown in parenthesis.

Site [a]	Date	Species	Avg Length (mm)	Avg Weight (g)	Sample Type [b]	Dieldrin	o,p DDD	p,p DDD	p,p DDE	cis-Chlordane	trans-Chlordane	trans-N Chlor	Methoxychlor	Endosulfan II	Pentachloroanisole
1	8/15/06	Carp	667.5	5311.0	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	0.004	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	653.0	4834.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.020**	ND (0.006)	ND (0.005)	0.004	ND (0.029)	ND (0.015)	0.004
		Largemouth Bass	448.2	1337.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
2	8/16/06	Largemouth Bass	440.0	1285.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	360.3	590.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
3	8/16/06	Smallmouth Bass	269.8	270.5	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	351.0	597.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
4	8/17/06	Golden Redhorse	480.0	1111.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	395.0	845.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Bluegill Sunfish	188.0	139.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
5	9/11/08	Brown Trout	242.0	157.0	F	ND (0.012)	ND (0.020)	ND (0.012)	ND (0.012)	ND (0.012)	ND (0.012)	ND (0.020)	ND (0.020)	ND (0.012)	ND (0.016)
6	11/8/06	Channel Catfish	555.0	1897.0	F	0.004	ND (0.019)	ND (0.010)	0.019	ND (0.006)	0.005	0.005	ND (0.029)	ND (0.015)	0.001
		Channel Catfish	520.0	1296.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.015	ND (0.006)	0.003	0.004	ND (0.029)	ND (0.015)	ND (0.008)
		Channel Catfish	491.0	1103.0	FC2	ND (0.020)	ND (0.019)	ND (0.010)	0.016	0.006	**0.005**	**0.007**	ND (0.029)	ND (0.015)	0.002
		Channel Catfish	465.0	902.0	FC2	0.002	ND (0.019)	ND (0.010)	0.016	ND (0.006)	0.002	0.005	ND (0.029)	ND (0.015)	ND (0.008)
7	9/11/06	Smallmouth Buffalo	321.0	1649.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	**0.030**	ND (0.006)	ND (0.005)	0.002	ND (0.029)	ND (0.015)	ND (0.008)
		Quillback	437.0	1146.0	FC2	0.005	ND (0.019)	ND (0.010)	**0.023**	ND (0.006)	**0.006**	0.005	ND (0.029)	ND (0.015)	ND (0.008)
		Spotted Bass	276.0	309.0	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Channel Catfish	457.0	801.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	**0.032**	ND (0.006)	0.002	0.005	ND (0.029)	0.006	ND (0.008)
8	9/12/06	Smallmouth Bass	304.0	382.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.005	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Smallmouth Bass	239.0	187.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	0.004	ND (0.015)	ND (0.008)
		Rock Bass	174.0	115.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Golden Redhorse	397.0	759.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.005	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
9	11/1/05	Redhorse Sucker	365.0	557.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	**0.037**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	326.0	490.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.019	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Channel Catfish	465.0	921.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.070**	ND (0.006)	0.002	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
10	11/29/07	Northern Hog Sucker	281.0	245.0	FC2	ND (0.040)	ND (0.038)	ND (0.020)	0.022	ND (0.012)	ND (0.010)	ND (0.014)	ND (0.058)	ND (0.030)	ND (0.016)
		Redhorse Sucker	436.0	698.0	F	ND (0.040)	ND (0.038)	ND (0.020)	0.013	ND (0.012)	ND (0.010)	ND (0.014)	ND (0.058)	ND (0.030)	ND (0.016)
		Smallmouth Bass	374.0	686.0	F	ND (0.040)	ND (0.038)	ND (0.020)	0.006	ND (0.012)	ND (0.010)	ND (0.014)	ND (0.058)	ND (0.030)	ND (0.016)
		Rock Bass	217.0	178.0	F	ND (0.040)	ND (0.038)	ND (0.020)	ND (0.040)	ND (0.012)	ND (0.010)	ND (0.014)	ND (0.058)	ND (0.030)	ND (0.016)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).

Appendix 1 (cont). Raw data for pesticides detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Pesticide detections above the lab's PQLs are bolded; non-detections (ND) are reported with PQLs shown in parenthesis.

Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	Dieldrin	o,p DDD	p,p DDD	p,p DDE	cis-Chlordane	trans-Chlordane	trans-N Chlor	Methoxychlor	Endosulfan II	Pentachloroanisole
11	10/3/05	Largemouth Bass	342.0	539.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	**0.023**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		White Catfish	234.0	156.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
12	8/20/04	Largemouth Bass	377.0	882.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Snail Bullhead	303.5	382.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
13	9/5/04	Carp	524.0	2631.4	FC6	0.014	ND (0.019)	0.008	**0.036**	**0.016**	ND (0.005)	**0.014**	ND (0.029)	ND (0.015)	ND (0.008)
		Channel Catfish	372.0	456.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
14	8/27/04	Largemouth Bass	416.0	1278.5	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.006	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Flathead Catfish	800.0	7456.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.081**	ND (0.006)	ND (0.005)	0.005	ND (0.029)	ND (0.015)	ND (0.008)
		Flathead Catfish	662.0	3947.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.023**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	0.004	ND (0.008)
		Flathead Catfish	765.0	6614.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.081**	0.002	ND (0.005)	0.005	ND (0.029)	ND (0.015)	ND (0.008)
15	9/5/04	Largemouth Bass	316.0	470.5	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Smallmouth Buffalo	417.0	1039.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.005	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
16	8/20/04	Largemouth Bass	420.0	1187.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		White Catfish	255.0	276.2	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
17	8/16/04	Largemouth Bass	315.0	410.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	471.0	1745.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.001	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	552.0	2646.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	0.001	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
18	8/21/03	Shorthead Redhorse	380.0	886.6	FC3	ND (0.020)	ND (0.019)	ND (0.010)	0.011	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	0.002
		Largemouth Bass	379.0	765.5	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.008	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
19	10/22/03	Largemouth Bass	347.0	606.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	471.0	1659.5	FC2	ND (0.020)	ND (0.019)	ND (0.010)	0.010	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	628.0	3395.0	FC3	ND (0.020)	ND (0.019)	0.008	**0.036**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	610.0	3032.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.013	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
20	10/19/05	Carp	498.0	2006.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.005	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	470.0	1690.0	F	ND (0.020)	ND (0.019)	0.006	0.017	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	279.0	351.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Redear Sunfish	267.0	386.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
21	8/20/03	Largemouth Bass	357.0	640.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Channel Catfish	605.0	2448.5	FC2	ND (0.020)	ND (0.019)	ND (0.010)	0.010	0.001	ND (0.005)	0.001	ND (0.029)	ND (0.015)	ND (0.008)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).

Appendix 1 (cont). Raw data for pesticides detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Pesticide detections above the lab's PQLs are bolded; non-detections (ND) are reported with PQLs shown in parenthesis.

Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	Dieldrin	o,p DDD	p,p DDD	p,p DDE	cis-Chlordane	trans-Chlordane	trans-N Chlor	Methoxychlor	Endosulfan II	Pentachloroanisole
22	8/20/03	Largemouth Bass	457.0	1686.3	FC4	0.004	ND (0.019)	ND (0.010)	0.007	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	473.0	1521.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.00427	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
23	11/5/03	Channel Catfish	484.0	1093.5	FC2	0.005	ND (0.019)	0.005	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	0.003
		Largemouth Bass	332.0	613.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	442.0	1459.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.014	ND (0.006)	ND (0.005)	0.006	ND (0.029)	ND (0.015)	ND (0.008)
24	10/29/03	Carp	571.0	3140.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	**0.028**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	0.001
		Carp	560.0	2550.0	F	0.017	0.014	ND (0.010)	**0.052**	**0.007**	0.001	**0.008**	ND (0.029)	ND (0.015)	0.002
		Largemouth Bass	367.0	690.7	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
25	11/5/03	Bowfin	561.0	2065.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Spotted Sucker	429.0	1152.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
26	10/13/04	Largemouth Bass	332.0	553.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	622.0	3742.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.161**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Redear Sunfish	221.0	210.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
27	10/20/04	Spotted Sucker	349.0	512.7	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.009	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Spotted Sucker	453.0	839.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	346.0	545.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	251.0	216.5	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
28	10/13/04	Flathead Catfish	720.0	6036.0	F	ND (0.020)	ND (0.019)	ND (0.010)	**0.029**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Flathead Catfish	750.0	5586.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.018	ND (0.006)	ND (0.005)	0.004	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	249.0	236.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	380.0	930.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
29	7/10/03	Spotted Sucker	440.0	1339.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	520.0	2685.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
30	10/16/03	Largemouth Bass	452.0	1496.5	FC2	0.003	ND (0.019)	ND (0.010)	0.004	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	289.0	366.3	FC3	ND (0.020)	ND (0.019)	ND (0.010)	0.002	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
31	9/30/04	Largemouth Bass	420.0	1231.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	472.0	2037.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.017	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Black Crappie	270.0	426.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Bluegill Sunfish	195.0	180.5	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).

Appendix 1 (cont). Raw data for pesticides detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Pesticide detections above the lab's PQLs are bolded; non-detections (ND) are reported with PQLs shown in parenthesis.

Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	Dieldrin	o,p DDD	p,p DDD	p,p DDE	cis-Chlordane	trans-Chlordane	trans-N Chlor	Methoxychlor	Endosulfan II	Pentachloroanisole
32	9/22/04	Redear Sunfish	241.0	277.8	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	314.0	472.6	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Chain Pickerel	411.0	446.0	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
33	10/4/04	Blue Catfish	580.0	2158.0	F	0.015	ND (0.019)	ND (0.010)	**0.023**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Flathead Catfish	641.0	3356.0	FC3	0.014	ND (0.019)	ND (0.010)	**0.021**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	320.0	522.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
34	10/23/03	Largemouth Bass	266.0	261.5	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.004	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		White Catfish	373.0	659.7	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.008	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
35	10/5/04	Largemouth Bass	445.0	1306.2	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.007	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Redhorse Sucker	480.0	1117.0	FC3	ND (0.020)	ND (0.019)	0.003	**0.020**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
36	10/8/04	Largemouth Bass	493.0	1866.0	F	ND (0.020)	ND (0.019)	**0.010**	0.016	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Redear Sunfish	213.0	214.0	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Creek Chubsucker	251.0	271.0	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
37	10/5/04	White Catfish	333.0	489.6	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	370.0	788.0	F	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Chain Pickerel	385.0	348.5	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
38	10/18/05	Largemouth Bass	390.0	930.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	0.006	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Carp	517.0	2134.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	0.010	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
39	10/17/05	Redhorse Sucker	396.0	603.0	FC5	ND (0.020)	ND (0.019)	ND (0.010)	**0.025**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Redhorse Sucker	372.0	540.0	F	ND (0.020)	ND (0.019)	0.009	**0.053**	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	0.004	ND (0.008)
		Chain Pickerel	368.0	322.0	FC4	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Largemouth Bass	402.0	939.0	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
40	9/23/05	Largemouth Bass	209.0	136.5	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Chain Pickerel	357.0	264.5	FC2	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
41	8/25/05	Brown Bullhead	290.0	335.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.004	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		White Catfish	365.0	679.0	F	ND (0.020)	ND (0.019)	ND (0.010)	0.016	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		White Catfish	229.0	131.6	FC3	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)
		Chain Pickerel	280.0	136.5	FC5	ND (0.020)	ND (0.019)	ND (0.010)	ND (0.020)	ND (0.006)	ND (0.005)	ND (0.007)	ND (0.029)	ND (0.015)	ND (0.008)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).

Appendix 2. Raw data for PCBs and PBDEs detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Detections above the lab's PQL are bolded; non-detections (ND) are reported with PQLs in parenthesis.

Site [a]	Date	Species	Avg Length (mm)	Avg Weight (g)	Sample Type [b]	PCB Congener 52	PCB Congener 110	PCB Congener 138	PCB Congener 153	PCB Congener 187	PCB Congener 206	Tetrabromodiphenyl ether	Pentabromodiphenyl ether
1	8/15/06	Carp	667.5	5311.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	0.018	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Carp	653.0	4834.0	F	ND (0.050)	ND (0.050)	ND (0.040)	0.018	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	448.2	1337.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
2	8/16/06	Largemouth Bass	440.0	1285.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	360.3	590.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
3	8/16/06	Smallmouth Bass	269.8	270.5	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	351.0	597.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
4	8/17/06	Golden Redhorse	480.0	1111.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	395.0	845.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Bluegill Sunfish	188.0	139.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
5	9/11/08	Brown Trout	242.0	157.0	F	**0.026**	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.020)	ND (0.010)	ND (0.010)
6	11/8/06	Channel Catfish	555.0	1897.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	520.0	1296.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	491.0	1103.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	465.0	902.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	0.007	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
7	9/11/06	Smallmouth Buffalo	321.0	1649.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Quillback	437.0	1146.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Spotted Bass	276.0	309.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	457.0	801.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
8	9/12/06	Smallmouth Bass	304.0	382.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Smallmouth Bass	239.0	187.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Rock Bass	174.0	115.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Golden Redhorse	397.0	759.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	0.002	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
9	11/1/05	Redhorse Sucker	365.0	557.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	326.0	490.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	465.0	921.0	F	ND (0.050)	ND (0.050)	0.009	0.006	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).

Appendix 2 (cont). Raw data for PCBs and PBDEs detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Detections above the lab's PQL are bolded; non-detections (ND) are reported with PQLs in parenthesis.

Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	PCB Congener 52	PCB Congener 110	PCB Congener 138	PCB Congener 153	PCB Congener 187	PCB Congener 206	Tetrabromodiphenyl ether	Pentabromodiphenyl ether
10	11/29/07	Northern Hog Sucker	281.0	245.0	FC2	ND (0.100)	ND (0.100)	ND (0.080)	ND (0.080)	ND (0.100)	ND (0.100)	ND (0.020)	ND (0.040)
		Redhorse Sucker	436.0	698.0	F	ND (0.100)	ND (0.100)	ND (0.080)	ND (0.080)	ND (0.100)	ND (0.100)	ND (0.020)	ND (0.040)
		Smallmouth Bass	374.0	686.0	F	ND (0.100)	ND (0.100)	ND (0.080)	ND (0.080)	ND (0.100)	ND (0.100)	ND (0.020)	ND (0.040)
		Rock Bass	217.0	178.0	F	ND (0.100)	ND (0.100)	ND (0.080)	ND (0.080)	ND (0.100)	ND (0.100)	ND (0.020)	ND (0.040)
11	10/3/05	Largemouth Bass	342.0	539.0	FC5	ND (0.050)	ND (0.050)	0.007	0.005	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		White Catfish	234.0	156.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
12	8/20/04	Largemouth Bass	377.0	882.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Snail Bullhead	303.5	382.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
13	9/5/04	Carp	524.0	2631.4	FC6	ND (0.050)	ND (0.050)	0.017	0.011	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	372.0	456.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
14	8/27/04	Largemouth Bass	416.0	1278.5	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Flathead Catfish	800.0	7456.0	F	ND (0.050)	ND (0.050)	0.037	**0.041**	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Flathead Catfish	662.0	3947.0	F	ND (0.050)	ND (0.050)	0.017	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Flathead Catfish	765.0	6614.0	F	ND (0.050)	ND (0.050)	0.038	**0.043**	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
15	9/5/04	Largemouth Bass	316.0	470.5	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Smallmouth Buffalo	417.0	1039.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
16	8/20/04	Largemouth Bass	420.0	1187.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		White Catfish	255.0	276.2	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
17	8/16/04	Largemouth Bass	315.0	410.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	471.0	1745.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	552.0	2646.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
18	8/21/03	Shorthead Redhorse	380.0	886.6	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	379.0	765.5	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
19	10/22/03	Largemouth Bass	347.0	606.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	471.0	1659.5	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Carp	628.0	3395.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Carp	610.0	3032.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).

Appendix 2 (cont). Raw data for PCBs and PBDEs detected in North Carolina fish tissues (2003-2008). All wet wt. concentrations are reported in parts per million (µg/g). Detections above the lab's PQL are bolded; non-detections (ND) are reported with PQLs in parenthesis.

Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	PCB Congener 52	PCB Congener 110	PCB Congener 138	PCB Congener 153	PCB Congener 187	PCB Congener 206	Tetrabromodiphenyl ether	Pentabromodiphenyl ether
20	10/19/05	Carp	498.0	2006.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Carp	470.0	1690.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	279.0	351.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Redear Sunfish	267.0	386.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
21	8/20/03	Largemouth Bass	357.0	640.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Channel Catfish	605.0	2448.5	FC2	ND (0.050)	ND (0.050)	0.011	0.016	ND (0.050)	ND (0.050)	**0.117**	ND (0.020)
22	8/20/03	Largemouth Bass	457.0	1686.3	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	**0.134**	**0.030**
		Carp	473.0	1521.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	**0.104**	ND (0.010)
23	11/5/03	Channel Catfish	484.0	1093.5	FC2	ND (0.050)	ND (0.050)	0.014	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	332.0	613.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	442.0	1459.0	F	ND (0.050)	ND (0.050)	0.013	0.015	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
24	10/29/03	Carp	571.0	3140.0	FC3	ND (0.050)	ND (0.050)	0.024	0.030	ND (0.050)	0.009	**0.183**	ND (0.020)
		Carp	560.0	2550.0	F	ND (0.050)	0.011	**0.045**	0.026	0.013	ND (0.050)	**0.683**	ND (0.020)
		Largemouth Bass	367.0	690.7	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
25	11/5/03	Bowfin	561.0	2065.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Spotted Sucker	429.0	1152.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
26	10/13/04	Largemouth Bass	332.0	553.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Carp	622.0	3742.0	F	ND (0.050)	ND (0.050)	ND (0.040)	0.013	ND (0.050)	0.003	ND (0.010)	ND (0.020)
		Redear Sunfish	221.0	210.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
27	10/20/04	Spotted Sucker	349.0	512.7	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Spotted Sucker	453.0	839.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	346.0	545.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	251.0	216.5	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
28	10/13/04	Flathead Catfish	720.0	6036.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Flathead Catfish	750.0	5586.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	249.0	236.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	380.0	930.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
29	7/10/03	Spotted Sucker	440.0	1339.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	520.0	2685.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)

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Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	PCB Congener 52	PCB Congener 110	PCB Congener 138	PCB Congener 153	PCB Congener 187	PCB Congener 206	Tetrabromodiphenyl ether	Pentabromodiphenyl ether
30	10/16/03	Largemouth Bass	452.0	1496.5	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	289.0	366.3	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
31	9/30/04	Largemouth Bass	420.0	1231.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	472.0	2037.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Black Crappie	270.0	426.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Bluegill Sunfish	195.0	180.5	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
32	9/22/04	Redear Sunfish	241.0	277.8	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	314.0	472.6	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Chain Pickerel	411.0	446.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
33	10/4/04	Blue Catfish	580.0	2158.0	F	ND (0.050)	ND (0.050)	0.021	0.034	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Flathead Catfish	641.0	3356.0	FC3	ND (0.050)	ND (0.050)	0.021	0.025	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	320.0	522.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
34	10/23/03	Largemouth Bass	266.0	261.5	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		White Catfish	373.0	659.7	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
35	10/5/04	Largemouth Bass	445.0	1306.2	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Redhorse Sucker	480.0	1117.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
36	10/8/04	Largemouth Bass	493.0	1866.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Redear Sunfish	213.0	214.0	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Creek Chubsucker	251.0	271.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
37	10/5/04	White Catfish	333.0	489.6	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	370.0	788.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Chain Pickerel	385.0	348.5	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
38	10/18/05	Largemouth Bass	390.0	930.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Carp	517.0	2134.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
39	10/17/05	Redhorse Sucker	396.0	603.0	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Redhorse Sucker	372.0	540.0	F	ND (0.050)	ND (0.050)	ND (0.040)	0.017	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Chain Pickerel	368.0	322.0	FC4	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Largemouth Bass	402.0	939.0	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)

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Site [a]	Date	Species	Avg Lg (mm)	Avg Wt (g)	S Type [b]	PCB Congener 52	PCB Congener 110	PCB Congener 138	PCB Congener 153	PCB Congener 187	PCB Congener 206	Tetrabromodiphenyl ether	Pentabromodiphenyl ether
40	9/23/05	Largemouth Bass	209.0	136.5	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Chain Pickerel	357.0	264.5	FC2	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
41	8/25/05	Brown Bullhead	290.0	335.0	F	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		White Catfish	365.0	679.0	F	ND (0.050)	ND (0.050)	0.004	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		White Catfish	229.0	131.6	FC3	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)
		Chain Pickerel	280.0	136.5	FC5	ND (0.050)	ND (0.050)	ND (0.040)	ND (0.040)	ND (0.050)	ND (0.050)	ND (0.010)	ND (0.020)

[a] Refer to Table 1 in report for site names. [b] S Type = sample type prepared for analysis: individual fillets = F, fillet composites = FC (followed by number of fish in composite sample).