APPENDIX I

of the

ASSESSMENT AND CONTROL OF

BIOCONCENTRATABLE

CONTAMINANTS IN SURFACE WATERS:

FIELD EVALUATION OF RESIDUE

PREDICTION PROCEDURES

1993 Draft

U.S. Environmental Protection Agency
Office of Research and Development
Office of Water

FIELD EVALUATION OF RESIDUE PREDICTION PROCEDURES

USED IN EPA'S GUIDANCE:

"ASSESSMENT AND CONTROL OF BIOCONCENTRATABLE CONTAMINANTS

IN SURFACE WATERS":

THE FIVE MILE CREEK STUDY

1993 DRAFT FOR APPENDIX I

Lawrence P. Burkhard[1]
Barbara Riedel Sheedy[2,3]
Nelson A. Thomas[1]

[1]U.S. Environmental Protection Agency
Environmental Research Laboratory-Duluth
6201 Congdon Boulevard
Duluth, MN 55804

[2]AScI Corporation
6201 Congdon Boulevard
Duluth, MN 55804

[3]Current Address:
    Computer Sciences Corporation, 394 South Lake Avenue, Duluth, MN 55802

On March 29, 1991, the U.S. Environmental Protection Agency announced the availability of the draft guidance document "Assessment and Control of Bioconcentratable Contaminants in Surface Waters" for review and comment in a *Federal Register* notice (56 FR 13150). This 1991 draft bioconcentration factor guidance (the "draft BCF [guidance]") did not contain Appendix I, the field evaluation studies of the residue prediction procedures.

This draft Appendix I contains two field evaluation reports: the Louisiana study and the Five Mile Creek Study. The two draft reports contain summary tables of the field data, such as in-stream concentrations of the chemicals, tissue residues, and predicted vs. measured tissue concentrations. Each study is followed by an appendix of individual or raw field data, which were included for comment and review. The final BCF guidance will not include the two field data appendices, so the reviewer is encouraged to keep these sections for future reference.

At this time EPA is <u>not</u> asking for additional comments on the entire contents of the 1991 guidance document, since EPA requested comments on the draft BCF (56 FR 13150) and extended the comment period to July 26, 1991 (56 FR 26411). Comments on the draft BCF were taken into account when EPA applied its methodology in the Great Lakes proposal. For instance, on page II-5 of the draft BCF, EPA recommended use of BCF values calculated from the log P values preferentially over measured BCF values. Commenters suggested that measured BAFs and BCFs take precedence over calculated values, and EPA modified the BCF approach used in the Great Lakes proposal (58 FR 20802) to reflect these comments. Finally, EPA will evaluate comments received on the bioaccumulation methodology in the Water Quality Guidance for the Great Lakes System before preparing the final BCF document.

Common and Scientific Names of Some of the Organisms

Collected in Field Studies

Common Name	Scientific Name[a]
Sea Catfish (hardhead)	Arius filus
Gulf Menhaden	Brevoortia patronus
Blue Crab	Callinectes sapidus
Crayfish	Decapoda sp.
Banana Fish (Lady Fish)	Elopes saurus
Marsh Killifish	Fundulus confluentus
Cockahoo (mummy chog)	Fundulus heteroclitus
Channel catfish	Ictalarus punctatus[b]
Butterfish (spot)	Leiostomus xanthurus
Sunfish	Lepomis sp.
Atlantic Croaker	Micropogan undulus
Striped Mullet	Mugil cephalus
Fiddler Crab	Uca pugilator

[a] Scientific names of fishes taken from: Common and Scientific Names of North American Fishes. American Fisheries Society. 1970.

[b] Spelled I. puctatus [sic] in the report

Foreword

Recent advances in environmental sciences, analytical chemistry, and toxicology have permitted the development of a systematic and scientifically defensible procedure for identifying, assessing, and controlling chemicals which form residues in fish and/or shellfish. This procedure is descrbied in the guidance document "Assessment and Control of Bioconcentratable Contaminants in Surface Waters" and is applicable to nonpolar organic chemicals which bioconcentrate and/or bioaccumulate in aquatic organisms.

Because the regulatory application of this procedure will direct regulatory decisions on the control of pollutants, EPA has designed and implemented field studies to establish the validity of the approach. These field validation studies are designed to show that the procedures can reliably use effluent data to identify the presence and quantify the concentration of bioconcentratable contaminants in receiving water organisms. The reasonable demonstration of accurate predictions in several situations will be considered to establish this correlation.

This report presents results of the first field study conducted on a freshwater site to determine how well tissue residue concentrations can be predicted in field discharge situations using the guidance residue prediction procedure. Further work on the samples from this field site are planned and these efforts will examine a much larger set of chemicals. A report on the field study for another site will be published separately.

Disclaimer

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

ACKNOWLEDGEMENTS

Contents

Figures

Tables

8

9

Executive Summary

This report describes an investigation to determine how well tissue residue concentrations can be predicted in field discharge situations using the EPA's residue prediction procedure. This procedure is used in EPA's guidance document entitled "Assessment and Control of Bioconcentratable Contaminants in Surface Waters" to predict residues in receiving water organisms.

The study consisted of measuring and predicting tissue residue concentrations for receiving water organisms for a segment of Five Mile Creek, Birmingham, Alabama. Two point source discharges, both from coke manufacturing facilities, were included in the field site and five chemicals were studied, i.e., biphenyl, phenanthrene, anthracene, fluoranthene, and pyrene. Effluent composites, receiving water organisms (*Decapoda* and *Lepomis* sp.), and flow data were collected in April, 1990. Data from these samples were used to predict receiving water tissue concentrations and then, to evaluate the guidance residue prediction procedure.

This investigation demonstrated that tissue residues in field discharge situations can be predicted within a factor of 3 for "non-metabolizable" chemicals using the guidance residue prediction procedure. When metabolism is important, residues predicted using the guidance procedure will be too large. In these cases, the guidance document recommends the use of measured bioconcentration/bioaccumulation factors which includes the effects of metabolism in the residue prediction.

Results from this investigation and from another yet to be completed will demonstrate the predictive ability of EPA's residue prediction procedures.

INTRODUCTION

The Environmental Protection Agency has developed a guidance procedure, "Assessment and Control of Bioconcentratable Chemicals in Surface Waters" (1), to control bioconcentratable chemicals in effluents. This guidance consists of a number of technical procedures that have been developed during the past several years. The principle components of the guidance approach are: 1) analytical procedures for detecting and identifying bioconcentratable chemicals in effluents or receiving water organisms, 2) prediction of the bioconcentration factor (BCF) from the n-octanol water partition coefficient (P) using quantitative structure activity relationships (QSAR), 3) prediction of the bioaccumulation factor (BAF) from the chemical's BCF and log P, and the trophic status of the organism of concern, 4) prediction of residues in aquatic organisms using the BCF or BAF and concentration of the chemical in the receiving water, and 5) calculation of allowable ambient water or tissue residue concentrations for bioconcentratable chemicals based upon human consumption of contaminated fish and shellfish. The guidance protocol combines these procedures to arrive at discharge concentrations for bioconcentratable chemicals which will limit residues in aquatic organisms used for human consumption.

The guidance approach provides two alternatives for assessing point source discharges for bioconcentratable chemicals, the effluent and tissue alternatives (component 1). With these alternatives, **either** effluent from a point source discharge **or** indigenous receiving water organisms are analyzed. Results from the analytical methods for the both alternatives are listings of bioconcentratable chemicals. These results are evaluated further using components 2 through 5, to determine if development of permit limits are needed for any of the identified bioconcentratable chemicals.

With the tissue alternative, the analytical results provide information for the entire receiving water since the aquatic organisms provide an integrated assessment of all point and nonpoint sources of bioconcentratable chemicals. When an unallowable tissue residue is found, additional chemical analyses are required to determine the source(s) of the residue forming chemical to the receiving water. In contrast, with the effluent alternative, point source discharges are examined individually. The inclusion of both alternatives in the guidance provides greater flexibility and usefulness for the guidance approach since neither alternative by itself is useful in all permitting situations.

1.1 Site Study Objective

The objective of the site study was to determine how well tissue residue concentrations can be predicted in field discharge situations using the guidance procedures, i.e., components 2, 3, and 4.

This validation effort was not designed to verify a) the accuracy of the allowable tissue residues, b) the analytical procedures associated with the tissue alternative, c) the prediction of residues where exposure is intermittent, d) the prediction of residues where exposure is difficult to estimate, or e) the derivation of acceptable human uptake levels.

1.2 Constraints

In order to predict residues in receiving water organisms, the concentration of the chemicals in the receiving water must be known and these concentrations (in the receiving water) must be relatively constant for a 20 to 40 day period. Without these conditions, successful evaluation of the field data will be nearly impossible since the indigenous organisms will never come to steady-state conditions with the receiving water.

These characteristics, in general, are associated with sites which: a) have reasonably simple hydrodynamics so that receiving water concentrations can be determined and/or calculated, b) have short hydraulic resident times so that fate and halflife considerations are minimized for the discharged chemicals, c) have effluent discharges with relatively constant concentrations of bioconcentratable chemicals, and d) have limited sources of the bioconcentratable chemicals under investigation.

SITE SELECTION AND DESCRIPTION

This report details the validation study performed on Five Mile Creek, Birmingham, Alabama in April, 1990. This field site was selected because a) the effluent upon assessment on several different occasions with the effluent alternative analytical method contained bioconcentratable chemicals in relatively constant concentrations, b) the flow regime of the site was reasonably simple and had short flow times, and c) native populations of fish and shellfish were available. Furthermore, preliminary calculations suggested that concentrations of the chemicals in the effluents after dilution in the receiving water were high enough to result in measurable tissue residues in the indigenous organisms.

2.1 Description of Five Mile Creek, Birmingham, Alabama

The site selected for the validation study was a 5.3 km stretch of Five Mile Creek near Birmingham, Alabama (Figure 2-1). Within the study area, Five Mile Creek receives discharges from two coking operations, Coke Plant 1 and Coke Plant 2, and runoff from a railroad maintenance facility and Coke Plant 1 grounds. Five Mile Creek originates within a residential and commercial area of Birmingham. A United States Geological Service (USGS) stream flow gauge was located 14.4 km downstream of the study site at Mineral Springs Republic Road (Figure 2-1).

Indigenous organisms were sampled at four stations in this study. Station 1 was located immediately upstream of the Coke Plant 1 effluent discharge. This station was a small pool located behind a low head dam. The Coke Plant 1 discharge pipe entered Five Mile Creek at the base of the dam downstream from this site. Because of the dam, this station was deeper (over 3 m deep) and wider than the other three stations. 140 m upstream of Station 1 on the Coke Plant 1 side of Five Mile Creek, a drainage ditch for runoff from the parking lots and grounds of Coke Plant 1 entered the reservoir behind the dam. 40 m upstream of Station 1 on the Coke Plant 1 creek bank, the water intake for Coke Plant 1 was located. Under typical flow conditions, water flowed over the dam, across its entire width, at a level of 2.5 to 5.0 cm above the dam, and this dam was approximately 15 m in width. Large rocks (rip-rap) lined the edges of the pool, and the bottom was not visible from shore. Organic sediments were scarce; the bottom substrate consisted primarily of sand or gravel.

Station 2 was located 1.3 km downstream from the Coke Plant 1 effluent discharge and immediately upstream of the Coke Plant 2 discharge. The creek was nearly 9 m wide at this point, and depth ranged from relatively shallow on one side to approximately 1.5 m on the other. At this site, the bottom consisted of bedrock with large rocks scattered throughout the creek. A fine layer of white sediment lined all substrates, and any disturbance caused the white, chalky substance to increase turbidity in the creek. This substance was most likely the result of runoff from a nearby limestone quarry.

13

Figure 2-1. Map of sampling stations for aquatic organisms, sediment, and caged organisms on Five Mile Creek.

14
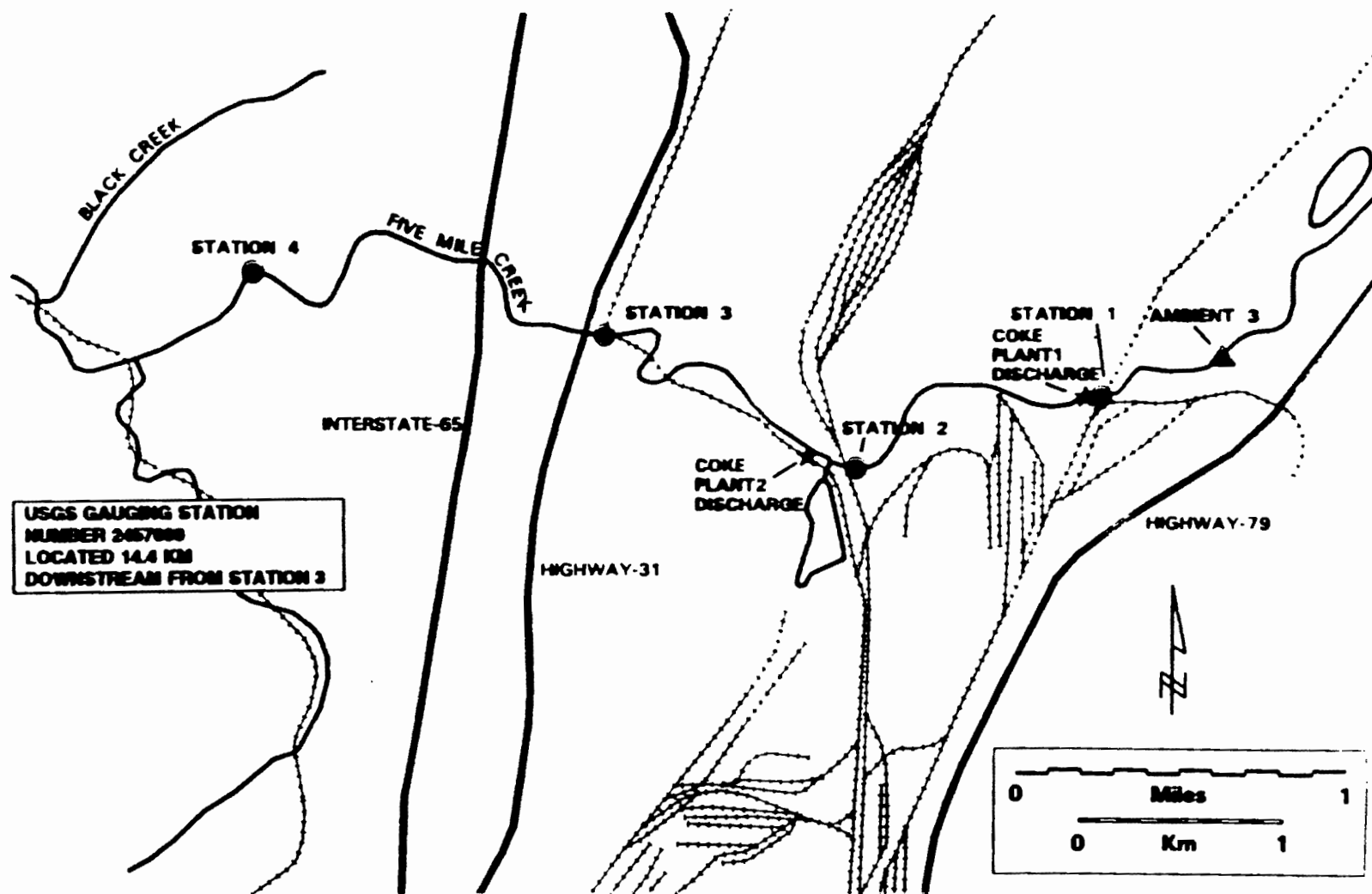
Station 3 was located at the US 31 bridge, 3.2 km downstream from the Coke Plant 1 effluent discharge and 1.8 km downstream from the Coke Plant 2 effluent discharge. The stream was 9 m wide at this point and 0.3 to 1.3 m deep. The bottom consisted of bedrock, with many large scattered rocks. The sediments were limited to a gravel substrate with little organic material.

Station 4 was located in an isolated wooded area 5.3 km downstream from the Coke Plant 1 effluent discharge and 3.9 km downstream from the Coke Plant 2 effluent discharge. The creek bottom consisted of large boulders on a bedrock sheet, with sandy substrate material and organic sediments. The creek was about 4.6 m wide and ranged in depth from 0.3 to 1.8 m.

In addition to Stations 1, 2, 3, and 4, six ambient water sampling locations were used in the study. Ambient (station) 1 was located at the site of the caged *Ictalarus puctatus* exposure at Station 1. Ambient 2 was located 40 m upstream of Station 1 at the water intake for Coke Plant 1 and downstream of the runoff ditch for Coke Plant 1 grounds on the Coke Plant 1 side of the creek. Ambient 3 was located far upstream of the Station 1 at Springdale Road (see Figure 2-1). Ambient 4 was the runoff ditch itself from Coke Plant 1. Ambient 5 was located in the reservoir upstream of the dam and upstream of the runoff ditch for Coke Plant 1 grounds on the Coke Plant 1 side of the creek. Ambient 6 was the same as Station 3, above.

2.2 Screening of the Effluents

Prior to as well as during the site study, the effluent analytical method was performed on composites and grab effluent samples. These samples consisted of a) pre-site study grab samples, and b) samples from the composites taking during the fourth week of the study. This method detected numerous chemicals: polycyclic aromatic hydrocarbons (PAHs), alkyl PAHs, and some hetero-PAHs. All of the effluents contained the same types of chemicals, but the concentrations in the effluents were quite different between the two dischargers. Data illustrative of all samples are reported in Appendix A (Tables A-1 through A-5) for grab samples from Coke Plant 1 (collected on 2/9/90), and Coke Plant 2 (collected on 2/28/90) during the pre-site study time period. (For Coke Plant 1, data from fraction three are not presented since interferences from the hydrocarbon "hump" during the GC/MS analysis prevent successful analysis.)

2.3 Selection of Target Chemicals

For this study, five chemicals, identified with the effluent analytical procedure, were chosen: biphenyl, phenanthrene, anthracene, fluoranthene, and pyrene. These chemicals were selected in part since they were typical of all of the chemicals from the coke plant effluents. Their calculated BCFs ranged from 608 to 3240, and these chemicals were available in both natural and stable isotope form, i.e., deuterated.

15

With the stable isotopes, recoveries for each chemical through the analytical procedure can be determined for each sample.

Selection of the PAHs for this study did cause some concern since PAHs are metabolized by some aquatic species (7). Metabolism of the chemicals would cause the predicted residues to be too high in comparison to the measured residues. However, James (7) has reported that invertebrates metabolize PAHs very slowly, if at all, and that vertebrates metabolize PAHs easily. Consequently, it was concluded that if a successful validation was to be performed, the study design must include both invertebrates and vertebrates. By sampling both phylum of organisms, the importance of metabolism could possibly be detected as well as addressed.

METHODS

3.1 Site Study Plan

Measured residue levels in indigenous organisms and caged organisms placed *in situ* from Five Mile Creek were compared to residue concentrations predicted for these organisms.

Residue levels in the organisms were predicted by estimating the in-stream chemical concentrations and using this data in the residue prediction procedure. In-stream chemical concentrations were determined by collecting and analyzing four, seven-day effluent composites taken consecutively over a 28 day period. During this 28 day period, stream and discharge flows were measured. With the flow and concentration data, the receiving water concentrations were estimated for each chemical. Subsequently, these concentrations were used in the residue prediction procedure.

Indigenous and caged organisms were collected at the end of the 28 day period at sampling stations above and below the discharges. Residue analyses and lipid content determinations for the resident and caged organisms were performed.

Replicate chemical analyses were performed on the weekly effluent composites by two analytical laboratories. These analyses included both inter- and intra-replication for each weekly composite. For the organism samples, duplicate analyses were performed on selected samples by each laboratory when enough tissue mass was available. Four replicate samples for each organism collected were assembled in the field at each sampling station and each laboratory received and analyzed two of the four replicates.

3.2 Estimation of Residues in Aquatic Organisms

Only a brief description of the residues prediction technique is presented here. The reader is referred to EPA 1991 (1) for further details.

3.2.1 Prediction of Bioconcentration Factors for Aquatic Organisms

Bioconcentration factors for aquatic organisms are estimated using the multi-species log BCF-log P correlation developed by Veith and Kosian (2). This correlation is:

$$\log BCF = 0.79 \log P - 0.40 \qquad n = 112 \qquad r^2 = 0.86$$

This correlation, derived from a data set consisting of 122 BCF values for 13 freshwater and marine species, is typical of all log BCF-log P correlations (3). The above equation has 95% prediction intervals (note, confidence intervals are much

smaller) of approximately one order of magnitude, and the predicted BCF values are for organisms with 7.6% lipid content.

The predicted BCF values must be corrected to the appropriate lipid content before prediction of the tissue residues since numerous fishes and shellfishes have lipid contents differing from 7.6%. The BCF is directly proportional to lipid content, and corrections for lipid content are done using a simple proportionality.

3.2.2 Prediction of Bioaccumulation Factors for Aquatic Organisms

Bioaccumulation factors are derived by "adjusting" the BCF using a food chain multiplier (FM) for the organism of concern (1). In equation form,

$$BAF = FM * BCF$$

The FM is dependent upon the log P of the chemical and the structure of the organism's food chain (4-6).

In this site study, the FMs for all of the chemicals under investigation are equal to 1.0 due to their relatively low log P values and consequently, the BAF and BCF are equal for this site study. For different chemicals, readers should consult EPA 1991 (1) to obtain the appropriate FM value.

3.2.3 Prediction of Residues in Aquatic Organisms

The tissue residues for a chemical are calculated by multiplying the BAF, the product of the BCF and FM terms, after correction for lipid content, by the concentration of the chemical in the water. In equation form,

$$[Fish] = BAF * [Water] = BCF * FM * [Water]$$

where [Fish] and [Water] are the concentration of the chemical in the aquatic organism, and in the receiving water, respectively. Residue concentrations predicted using the BCF or BAF are for steady state conditions which implies that the concentration of a chemical in the receiving water is at steady state also.

3.2.4 Metabolism and Prediction of Residues in Aquatic Organisms

The tissue residues predicted using the procedure outlined in Sections 3.2.1 through 3.2.3 assumes that metabolism in vivo does not occur. When metabolism does occur, the predicted residues will be, in general, larger than those measured in the organisms since metabolism of a chemical in vivo reduces the concentration of the chemical in the organism.

18

The difference between the actual and predicted tissue residue due to metabolism is dependent upon the rate of metabolism for each chemical. For chemicals with slow rates of metabolism, the differences between the predicted and measured tissue residues will be small, and for chemicals with fast rates of metabolism, the differences between the predicted and measured tissue residues will be large.

3.3 Sampling Procedures

3.3.1 Field Sampling Procedures for Effluents

A series of four, seven-day composite effluent samples from both Coke Plant 1 and Coke Plant 2 were collected and sample collection was initiated on March 26 and 27, 1990, respectively. Samples were collected in an iced ISCO sampler equipped with teflon tubing and a glass collection vessel. The samplers were inspected every other day, at which time the ice was replenished and the effluent samples were removed and taken to refrigerated storage. At the end of each seven-day period, the individual 48-hour samples from each coke plant were composited and immediately mixed in a Nalgene® carboy. Replicate four liter subsamples were drawn from the two seven-day composite samples, put on ice, and shipped to the analytical laboratories. The last seven-day composite samples were collected on April 23rd at Coke Plant 1 and April 24th at Coke Plant 2.

3.3.2 Field Sampling Procedures for Ambient Grab Samples

Ambient water samples were collected from Five Mile Creek on December 4, 1990. Two 4 liter grab samples were collected at six different locations, put on ice, and shipped to one of the analytical laboratories using overnight delivery.

3.3.3 Field Procedures for Measuring Stream Flows

Stream flow at two points on Five Mile Creek were measured at various times during the study by measuring stream velocity and depth at 30 cm (1 foot) intervals across the creek. Total stream flow was calculated by summing the surface area velocities across the stream. Stream flows were measured at the US 31 overpass (Station 3) and approximately 50 meters downstream of Station 1 (near Coke Plant 1). These sites were selected to provide an approximation of stream flow below the two discharges included in this study. USGS flow data from Five Mile Creek at Republic (14.4 km downstream from the US 31 overpass) were acquired for the time period of the study.

3.3.4 Field Procedures for Sampling Indigenous Organisms

19

Resident organisms were collected on April 25-26 at four stations by electroshocking the creek for approximately one hour at each site. Shocked organisms were collected using dip nets and were placed into a cooler containing ice. Separate coolers were used during field sampling for each station to prevent mixing of the organism from the different stations. After collection of the organisms, four replicate samples (when possible) containing a minimum of 30 grams of body mass were assembled for each type of organism. The only criteria for compositing the organisms was the minimum amount of mass. Compositing based on sex, size, reproductive state, age of the organism, etc. was not done. The number of organisms per sample varied from 1 to 6 organisms. *Lepomis* sp. (sunfish) and *Decapoda* (crayfish) samples were assembled for all stations. *Campostoma* sp., *Hybopsis* sp., and *Notropis hudsonius* samples were assembled for some of the stations. All tissue samples were placed in methanol-rinsed aluminum foil, double wrapped, and labeled. The samples were immediately frozen in a cooler filled with dry ice, and were held frozen during transport and storage until analysis.

For Station 1, the *Lepomis* sp. were collected from the Coke Plant 1 side of the creek in an area extending from the dam to 50 meters upstream of the dam. The *Decapoda* were collected at the base (upstream side) of the dam on the gradual drop off which leads into the deeper water behind the dam.

For Stations 2, 3, and 4, all organisms were collected in and around the rip-rap and rubble on both edges of the creek. Approximately 25 meters of shoreline on both sides were sampled. None of the organisms were collected from open pools or basins for these stations.

3.3.5   Field Procedures for the Caged *Ictalarus puctatus* Exposures

Caged *Ictalarus puctatus* exposures were performed during this study by placing the caged organisms into Five Mile Creek at Stations 1 and 3. These cages were constructed out of 20 L Nalgene® carboys as described in Jones and Sloan (8).

At Station 1, four cages were placed on the Coke Plant 1 side of the creek in 1 m of water in a rectangular area ranging from 1 to 2 m from the dam and 1 to 2 m from the shore. At Station 3, four cages were placed in approximately 1 m of water at the 1/3 point of the stream from the Coke Plant 1 side of the creek.

Ictalarus puctatus were obtained from a commercial catfish supplier, Pettit Farms, Dlountsville, Alabama and were 4-6 grams in size. On April 5th, eight cages containing 20 to 30 fish each were placed into Five Mile Creek at Stations 1 and 3. At this time, a group of *Ictalarus puctatus* was retained for background analysis. These cages were monitored and fed daily with commercial catfish food obtained from Pettit Farms. A fair amount of daily mortality was noted, and on each day, all dead fish were removed. On April 15th, all surviving fish died in all cages.

New fish were obtained from Pettit Farms and the eight cages were put back into Five Mile Creek on April 18th at Stations 1 and 3. These cages were monitored and fed daily. On April 28th, the Station 1 cages were removed from the stream. Because of increased stream turbidity and flow due to a overnight storm, the Station 3 cages were impossible to locate on the 28th of April. On May 2nd, these cages were found and removed from the stream.

For the background and the Station 1 *Ictalarus puctatus (taken from the cages on April 28th)*, two and four replicate samples containing a minimum of 30 grams of body mass were prepared, respectively. These tissue samples were placed in methanol-rinsed aluminum foil, double wrapped, and labeled. The samples were immediately frozen in a cooler filled with dry ice, and were held frozen during transport and storage until analysis.

For the Station 3 *Ictalarus puctatus* (taken from the cages on May 2nd), all of the organisms were wrapped together in methanol-rinsed aluminum foil and were frozen and shipped to Battelle-Great Lakes on dry-ice. Upon arrival, this sample was partially thawed and then subdivided into four samples consisting of a minimum of 30 grams per sample. These subsamples were placed in methanol-rinsed aluminum foil, double wrapped, and labeled. The samples were frozen and were held frozen during transport and storage until analysis.

3.4 Analytical Procedures

3.4.1 Effluent Analysis Procedure

Only a brief account of the procedure for detecting and identifying bioconcentratable chemicals in effluents will be present here. Readers are referred to Appendix B of EPA's guidance (1) for further details.

A 10 L effluent sample is spiked with three surrogate compounds, d_{10}-biphenyl, $^{13}C_6$-1,2,4,5-tetrachlorobenzene, and $^{13}C_6$-hexachlorobenzene, and extracted with hexane. The hexane extract is subsequently cleaned up using sulfuric acid, and concentrated to a volume of 0.50 mL. The extract is chromatographed using reverse phase HPLC, and three fractions are collected. The fractions are extracted, concentrated to 0.10 mL, and spiked with the internal standard, d_{12}-chrysene. The fraction extracts are analyzed using capillary gas chromatography with full scan electron impact ionization mass spectrometry (GC/MS).

Each chromatographic peak in the GC/MS chromatograms is quantified using the response factor calculated from its appropriate surrogate. For fractions one, two, and three, the quantification surrogates are d_{10}-biphenyl, $^{13}C_6$-1,2,4,5-tetrachlorobenzene, and $^{13}C_6$-hexachlorobenzene, respectively.

For each fraction, all chromatographic peaks are reverse-searched against (compared with) the Chemicals of Highest Concern (CHC) mass spectral library. Those chemicals not identified with the CHC search with effluent concentrations above 100 ng/L, are then reversed-searched against the EPA/NIH/NBS mass spectral library. Peaks with fits of greater than 70% are considered tentatively identified. For each tentatively identified component, a list of the best mass spectral library identifications (up to a total of ten identifications) is reported along with the percent fit values.

3.4.2 Weekly Effluent Composite Analysis

The weekly effluent composite samples were analyzed at two different laboratories in this study, Battelle-Columbus and Environmental Research Laboratory-Duluth (ERL-D). The analytical methods used at both laboratories were very similar, and the concentrations reported for the five target chemicals were nearly identical for the two laboratories. Comparable data between the two laboratories was obtained by the use of an internal standard quantification method, deuterated surrogates for determining compound recoveries, and reporting of the data after recovery correction. The chemicals used for recovery correction were the deuterated form of the target chemical, e.g., for biphenyl, recovery corrections were based upon d_{10}-biphenyl.

The analytical procedures for both labs consisted of spiking a known volume of effluent, i.e., 1 L or 900 mL, with d_{10}-biphenyl, d_{10}-phenanthrene, d_{10}-anthracene, d_{10}-fluoranthene (Battelle only), and d_{10}-pyrene at concentrations similar to the target chemical concentrations. In general, for the effluents from Coke Plants 1 and 2, spike concentrations of 0.1 and 1.0 ug/L were used, respectively. The spiked effluents were extracted three times using hexane, 60 mL per extraction. The hexane was dried using sodium sulfate, concentrated using a Kuderna-Danish concentrator (KD) to ca. 10 mL and reduced to 1.0 or 0.10 using a gentle stream of nitrogen. These extracts were spiked with the internal standard, d_{12}-chrysene, at a 10 mg/L concentration.

GC/MS analysis using selected ion monitoring (SIM) was performed, and quantifications were performed using an internal standard method with a 4 or 5 point calibration curve using the M^+ ion for each chemical. Quantification standards contained the internal standard d_{12}-chrysene and both the deuterated and native forms of the five target chemicals except for ERL-D's standards which did not contain d_{10}-fluoranthene. For biphenyl, phenanthrene, anthracene, fluoranthene and pyrene, recovery corrections were made using the recoveries of d_{10}-biphenyl, d_{10}-phenanthrene, d_{10}-anthracene, d_{10}-fluoranthene (Battelle) or d_{10}-pyrene (ERL-D), and d_{10}-pyrene, respectively.

3.4.3 Ambient Water Samples Analysis

Ambient water samples were analyzed at ERL-D with the same procedure used for the weekly effluent composite samples, see Section 3.3.

3.4.4   Tissue Analysis

Tissue samples were analyzed at two different laboratories in this study, Battelle-Columbus and ERL-D. As with the procedures used for the analysis of weekly effluent composites, the analytical methods used at both laboratories were very similar and the concentrations of the five target chemicals were not significantly different between the two laboratories. Comparable data was obtained due to the use of appropriate analytical techniques as described in Section 3.4.2.

Battelle: The thawed whole organisms were finely chopped with a Hobart mincer, and a 20-gram aliquot of tissue was transferred to a centrifuge bottle containing magnesium sulfate and methylene chloride. The tissue was spiked with the deuterated compounds used for the effluent analyses and extracted with a Polytron® tissue homogenizer for two minutes. The extract was then transferred to an alumina column, and the homogenate was extracted twice more by shaking with additional methylene chloride. Each extract was passed through the alumina column, and the methylene chloride eluate was concentrated by using a Kuderna-Danish (K-D) concentrator to a volume of 2.0 mL.

One mL of the concentrated extract was injected onto a gel permeation chromatograph (GPC) to remove lipids. The collected fraction was concentrated to about 10 mL by K-D, exchanged to hexane, and reduced to 100 μL by natural evaporation. The prepared samples were analyzed using the GC/MS procedures used for the effluent analysis.

Lipid contents were determined by extracting known amount of tissue (1 to 2 grams) with methylene chloride, evaporating the solvent, placing the extract into an oven at 130°C for 60 minutes, and after cooling, weighing the extract. Lipid content was calculated by dividing the extracted mass by the mass of the extract tissue.

ERL-Duluth: The frozen whole organisms, consisting of one to six animals per sample, were finely chopped and mixed together using a Waring blender. A 20-gram aliquot of tissue was mixed with sodium sulfate, spiked with the deuterated compounds used for the effluent analyses, and extracted using methylene chloride:hexane (1:1) with a Soxhlet extractor. The extract was concentrated to 10 mL using a K-D concentrator and then, to dryness with a gentle stream of nitrogen gas. The K-D lower tubes with extract were weighed and then diluted with methylene chloride for GPC to remove the lipids. After GPC, the extract was concentrated and subjected to silica gel chromatography to remove cholesterol-like compounds. The extract was concentrated to a volume less than 1 mL and spiked with d_{12}-chrysene. The prepared samples were analyzed using the same GC/MS procedures used for the effluent analysis.

23

The lipid content for each analysis was determined by dividing the lipid mass measured during the analysis by the tissue sample mass placed into the Soxhlet extractor.

RESULTS AND DISCUSSION

4.1 Expected Tissue Residues Trends

Since the technique used for predicting residues in aquatic organisms does not account for metabolism, the following general statements about the comparison of the measured and predicted tissue residues for the five PAHs can be made prior to examination of any of the data.

a) Evidence on the metabolic abilities of aquatic invertebrates and vertebrates for PAHs suggests that the agreement between the measured and observed tissue residues should be better for the *Decapoda* than for the *Lepomis* sp. organisms collected in the site study. James (7) has reported for aquatic species that invertebrates do not (or very slowly) metabolize PAHs, and that vertebrates metabolize PAHs fairly easily.

b) The residues predicted for the *Lepomis* sp. should be larger than the measured residues due to metabolism. For the *Decapoda*, this bias should not exist due to the limited metabolic ability of the organisms.

c) Evidence on the relative rates of metabolism for the five chemicals under investigation suggest that with increasing size, poorer agreement between the measured and predicted tissue residues should exist for the *Lepomis* sp. than for with *Decapoda* (10). The rate of metabolism for PAHs in fishes appears to increase with increasing size of the molecule (10).

These general statements assume that the residue prediction technique is valid and provides reliable predictions, and that the metabolic behavior of PAHs in both of the evaluated species occurs as stated above.

4.2 Flow Data for Five Mile Creek and Effluents

The stream flows were measured on Five Mile Creek at Station 3 and 50 meters downstream of Station 1 five or six times during the study and these values are reported in Table A-6. (Note, Tables A-# are in Appendix A of this report.) Daily flows for the USGS gauge at Mineral Springs-Republic Road, 14.4 km downstream from Station 3, were measured, and these flows are reported in Table A-6 for the length of the study, March 26 through April 26, 1990. With the measured flows, two regression models were constructed (y=mx+b) to estimate the stream flows at Stations 1 and 3 from the USGS daily flows at Republic (Table A-7).

The use of these equations for estimating stream flows at Stations 1 and 3 assumes that flows at Stations 1 and 3 were directly proportional to the measured flows at the Republic gauge. However, this proportionality was not always true. Other streams enter Five Mile Creek between Station 3 and the USGS gauge at Republic, and due to differences in watershed areas and hydraulics as well as differences in

25

rainfall during storm events, the assumption of direct proportionality was not always valid. The flows estimated using the derived equations are our best estimate for the average daily flows for Stations 1 and 3. To obtain some estimate of the error associated with the predicted flows, confidence and prediction intervals for the estimated flows were determined using the regression statistics for both equations. In Table A-7, the estimated flow and the 95% confidence and prediction intervals for measured flows of 1.00, 1.25, 1.50, 1.75, 2.00, and 2.25 m^3/s for both Stations 1 and 3 are reported. The 95% prediction intervals for the estimated flows ranged from ±24 to $\pm42\%$ and ±25 to $\pm39\%$ of the estimated flows at Stations 1 and 3, respectively.

In Figure 4-1, the estimated and measured daily flows have been plotted for the time period of the study. During the time period of the site study, daily flows decreased by approximately a factor of 2 and short term increases in flow due to storm events were observed five or six times. The average daily stream flows for Stations 1 and 3, computed from the estimated flows, were 0.748 and 0.981 m^3/s with coefficients of variation of 13.7% and 10.9%, respectively (Tables 4-1 and A-6).

The daily discharge flows for both dischargers are reported in Table A-8 and are plotted in Figures 4-2 and 4-3 for the time period of the study. These flows were measured and reported to the State of Alabama by each discharger as part of their NPDES permit. In Table 4-1, the flow data are summarized for each discharger.

For Coke Plant 2, the average discharge flow and its coefficient of variation were 0.184 m^3/s and 8.16%, respectively. For Coke Plant 1, the average discharge flow and its coefficient of variation were 0.00478 m^3/s and 42.1%, respectively. The larger coefficient of variation for Coke Plant 1 was caused by the stoppage of discharge flow on 2 days during the site study.

4.3 In-Stream Effluent Concentrations

In 1983, Mount et al. (9) performed dye studies on Five Mile Creek to determine mixing characteristics for the discharges from both coking operations. For Coke Plant 1, dye studies were performed in February and October of 1983 and complete mixing of the effluent with Five Mile Creek occurred 762 m and 15 m downstream of the discharge, respectively. These dye studies were performed with stream flows of 1.95 and 0.292 m^3/sec at 500 m below the discharge and with discharge flows of 0.008 and 0.009 m^3/sec, respectively. For Coke Plant 2, one dye study was performed in October, 1983, and complete mixing of the effluent with Five Mile Creek occurred 457 m downstream of the discharge with stream and discharge flows of 0.527 and 0.120 m^3/sec.

Stations 2 and 3 for this study were 1300 and 1800 m downstream of the discharge points for Coke Plants 1 and 2, respectively. These distances well exceed those, i.e., 752 and 457 m, determined with the dye studies for complete mixing in the

Figure 4-1.   Measured and Predicted Flows on Five Mile Creek.
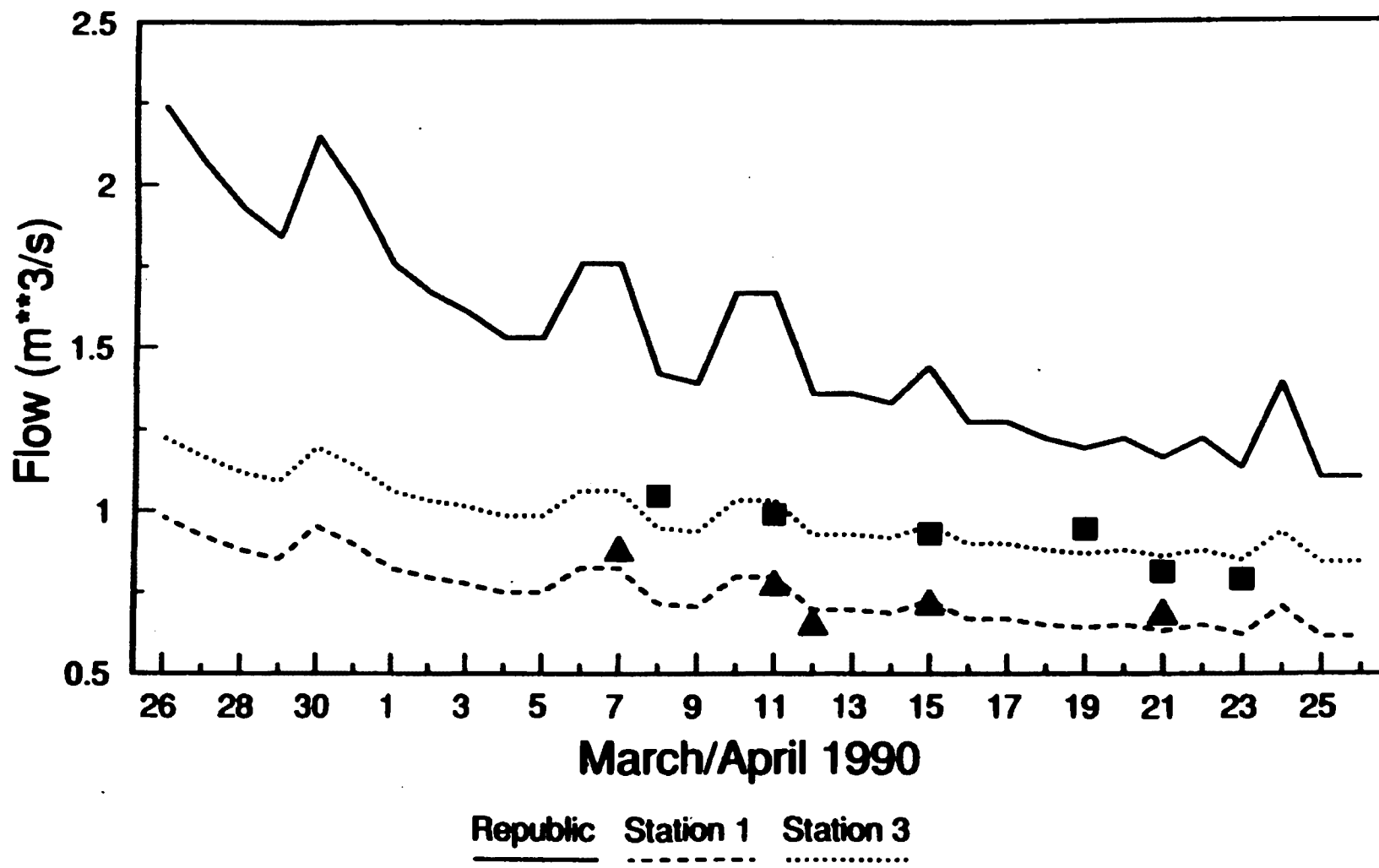
Figure 4-2.   Measured Discharge Flow for Coke Plant 1.
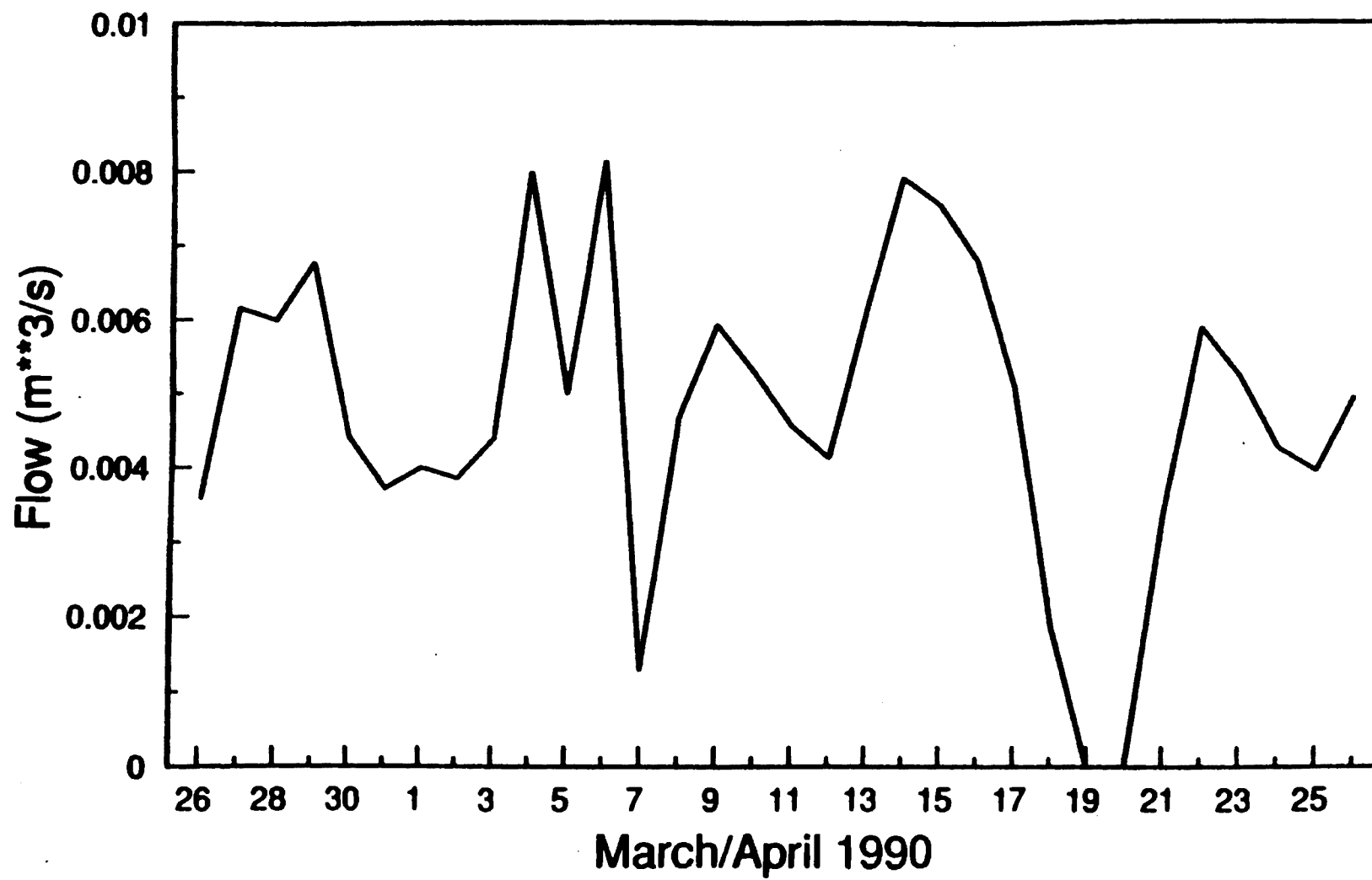
Figure 4-3.   Measured Discharge Flow for Coke Plant 2.
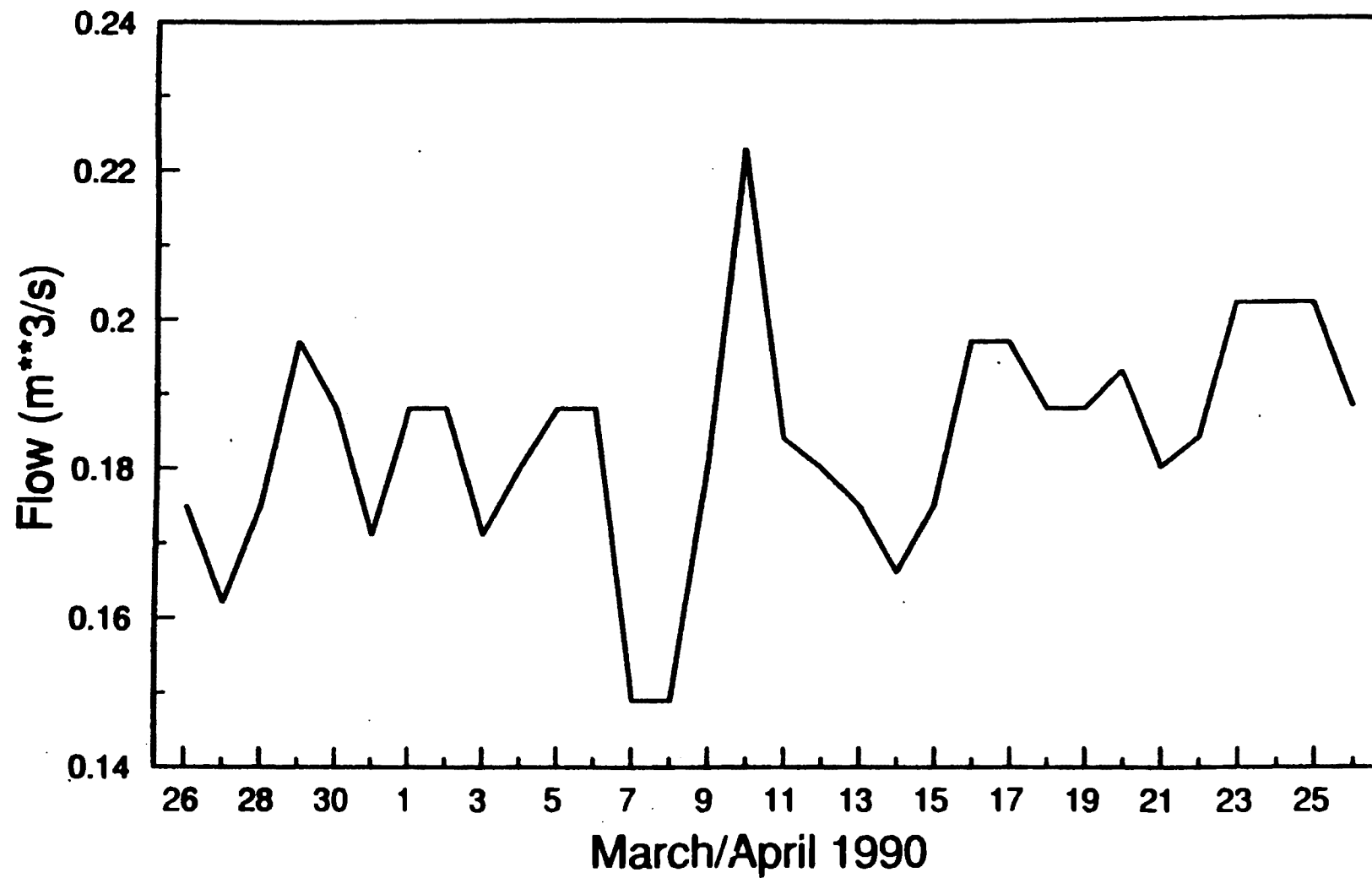
Table 4-1. Average Predicted Stream Flows, Average Discharge Flows, and Average In-Stream Effluent Concentration for Two Coking Plants on Five Mile Creek for March 26, 1990 - April 26, 1990.

Average Flows

	Average (m³/s)	Standard Deviation	n	Coefficient of Variation (%)	Range (m³/s)
Station 1[a]	0.748	0.102	32	13.7	0.613-0.979
Station 3	0.981	0.107	32	10.9	0.840-1.223
Coke Plant 1 Effluent	0.00478	0.00201	32	42.1	0.00-0.00814
Coke Plant 2 Effluent	0.184	0.0150	32	8.16	0.149-0.223

In-Stream Effluent Concentration

	Average (%)	Standard Deviation	n	Coefficient of Variation (%)	Range (%)
Station 1 (Station 2)	0.644	0.282	32	43.9	0.00-1.153
Station 3	19.0	2.80	32	15.8	13.9-24.0

[a] Approximately 50 m downstream of Station 1.

creek. These results suggest that the effluents from Coke Plants 1 and 2 are completely mixed with Five Mile Creek at Stations 2 and 3 for this study, respectively.

Daily in-stream effluent concentrations for the discharges from Coke Plants 1 and 2, assuming complete mixing, were calculated using the predicted stream and measured discharge flows for Stations 2 and 3 (Table A-9, Figures 4-4 and 4-5). For Station 2, flows predicted for 50 m downstream of Station 1 and measured discharge flows for Coke Plant 1 were used. For Station 3, flows predicted for Station 3 and measured discharge flows for Coke Plant 2 were used. For both discharges, a gradual increase in the in-stream effluent concentration occurred during the study period as illustrated in Figures 4-4 and 4-5. For the effluents from Coke Plants 1 and 2, the coefficients of variation for the in-stream effluent concentrations were 43.9% and 15.8% at Stations 2 and 3, respectively (Tables 4-1 and A-9).

4.4   Analysis of the Weekly Effluent Composites for the Five Target Chemicals

Replicate analyses were performed on each weekly effluent composite for the five target chemicals. The individual determinations are reported in Tables A-10 through A-19. In Table 4-2, the average weekly and grand mean concentrations for the five target chemicals are reported for both effluents for the period of the study. For each chemical, effluent concentrations were relatively constant over the 4 week study period for both effluents (Table 4-2).

4.5   In-Stream Chemical Concentrations for the Five Target Chemicals

The daily in-stream concentrations for each chemical in Five Mile Creek were computed for Stations 2 and 3 using the estimated daily stream flows, the daily discharge flows, and the chemical concentrations in the weekly effluent composite samples (Tables A-20 through A-24). The concentrations for biphenyl, phenanthrene, anthracene, fluoranthene, and pyrene are plotted in Figures 4-6, 4-7, 4-8, 4-9, and 4-10 and are summarized in Table 4-3.

For all five chemicals, their coefficients of variation for the in-stream chemical concentrations at both Stations 2 and 3 were approximately 40%, except for biphenyl at Station 2. These coefficients of variation include variability due to changes in discharge and stream flows, to changes in chemical concentrations in the discharge, and to analytical measurement. Most of the variability in the in-stream chemical concentrations was due to the large variability in discharge flow from Coke Plant 1. The only chemical with substantially larger variability than that observed for the discharge flow for Coke Plant 1 was biphenyl, and its variability was due largely to analytical measurement since it was not detected in two of the effluent composite samples.

4.6   Indigenous Organisms

31

4.6.1 Tissue Data

Two species of resident organisms, *Lepomis* sp. and *Decapoda*, were analyzed for the five target chemicals by two laboratories. These results are reported in Tables A-25, A-26, A-27, and A-28 and are summarized in Table 4-4.

For the *Lepomis* sp., inter- and intra-laboratory agreement was good for phenanthracene, anthracene, fluoranthene, and pyrene. However, for biphenyl, there was a substantial difference in reported residue concentrations between the laboratories for all four sampling Stations. Examination of the procedural blanks performed with these analyses revealed that one laboratory had very high background concentrations which suggests that the difference in reported residue concentrations was due to in-house background contamination. Consequently, all of the biphenyl tissue data for both resident organisms from this laboratory were not used in the analysis of the data for the site study.

For the *Decapoda*, inter- and intra-laboratory agreement was good for phenanthracene, anthracene, fluoranthene, and pyrene. However, one *Decapoda* sample, which was analyzed in duplicate, for Station 3 had residue concentrations for all five target chemicals which were much higher than the other replicates samples analyzed for that Station, e.g., for phenanthrene, residue concentrations of 39.4, 48.1, 64.6, and 2720 µg/kg were determined. Because this one sample was so different from the three replicate samples, we believe that this sample was an outlier and was not representative of resident organisms for this Station. Consequently, in the summary data in Table 4-4 and in the analysis of the data for the site study, this sample was not included.

4.6.2 Residue Trends

The average tissue residue concentrations for four of the target chemicals, biphenyl, anthracene, fluoranthene, and pyrene, followed the same general trend from Station 1 to Station 4 for the *Lepomis* sp. and *Decapoda* (Table 4-4). The average residue levels in the organisms from Station 1 (the reservoir upstream of the Coke Plant 1 discharge) were relatively low, and at Station 2, which is 1300 m downstream of the discharge point for Coke Plant 1, the average tissue residues were much higher than at Station 1. At Station 3, which is 1800 m downstream of the discharge from Coke Plant 2, the average residues were higher than Station 1 but slightly less than Station 2. At Station 4, the average residue concentrations were similar to those determined for the organisms from Station 3.

For the fifth target chemical, phenanthrene, the average residue concentrations for Station 1 were much higher than those determined for the other 4 target chemicals.

Table 4-2. Concentration of Target Chemicals in Weekly Effluent Composite Samples from Two Coking Plants on Five Mile Creek, Birmingham, Alabama.

			Concentration in Effluent, ppb[a]				
	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %
Coke Plant 1 Effluent[b]							
Biphenyl	0	0	1.88	0.34	0.56	(0.91)	162
Phenanthrene	16.6	12.7	15.6	15.5	15.1	(1.68)	11.1
Anthracene	7.26	4.45	6.68	7.22	6.40	(1.33)	20.8
Fluoranthene	21.1	17.4	21.4	21.4	20.3	(1.95)	9.62
Pyrene	14.4	12.0	15.7	17.4	14.9	(2.28)	15.3
Coke Plant 2 Effluent[c]							
Biphenyl	0	0.04	0.04	0.06	0.04	(0.03)	71.9
Phenanthrene	0.02	0.03	0.07	0.20	0.08	(0.08)	104
Anthracene	0.02	0.02	0.02	0.02	0.02	(0.00)	0.0
Fluoranthene	0.19	0.23	0.23	0.28	0.23	(0.04)	15.8
Pyrene	0.10	0.12	0.12	0.13	0.12	(0.01)	10.7

[a]   Recovery and blank corrected.
[b]   The reported values for the weekly composites are the average of the replicate analyses. Number of replicate analyses performed for weeks 1, 2, 3, and 4 were 2, 2, 4, and 4, respectively.
[c]   The reported values for the weekly composites are the average of the replicate analyses. Number of replicate analyses performed for weeks 1, 2, 3, and 4 were 4, 4, 6, and 4, respectively.

Figure 4-4. In-Stream Effluent Concentration for Coke Plant 1.
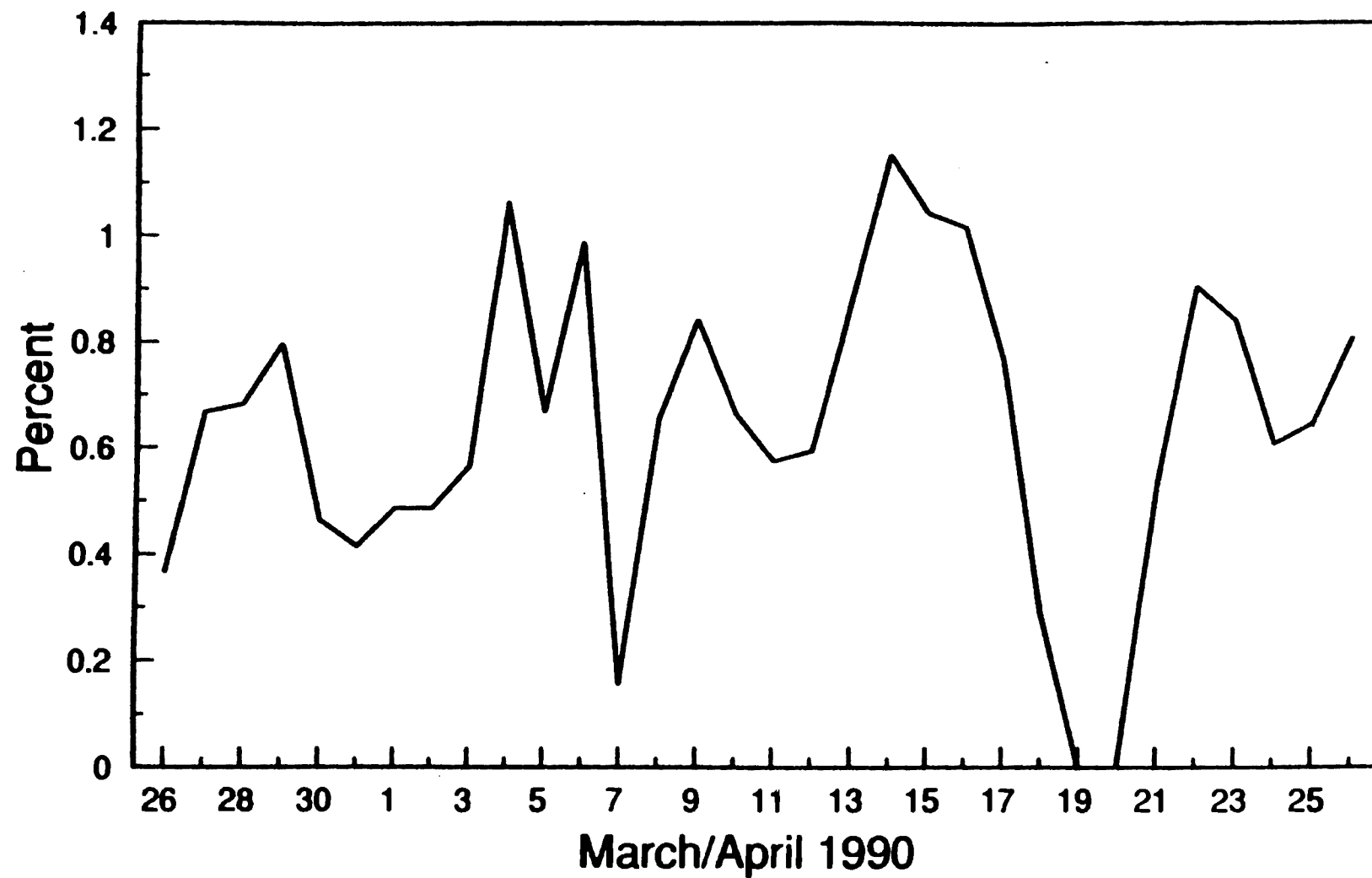
Figure 4-5. In-Stream Effluent Concentration for Coke Plant 2
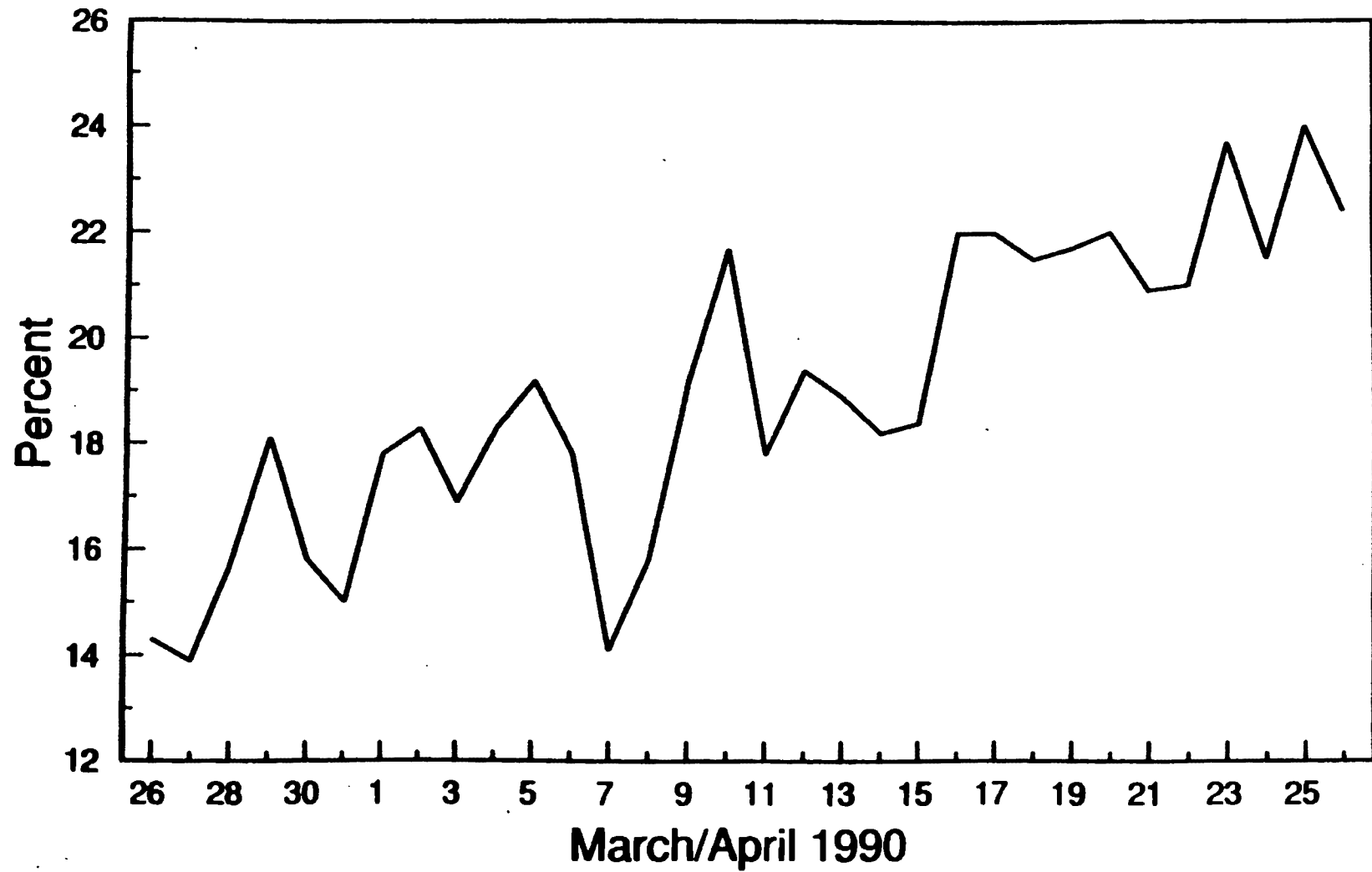
Figure 4-6.   In-Stream Concentration for Biphenyl.

Station 2   Station 3
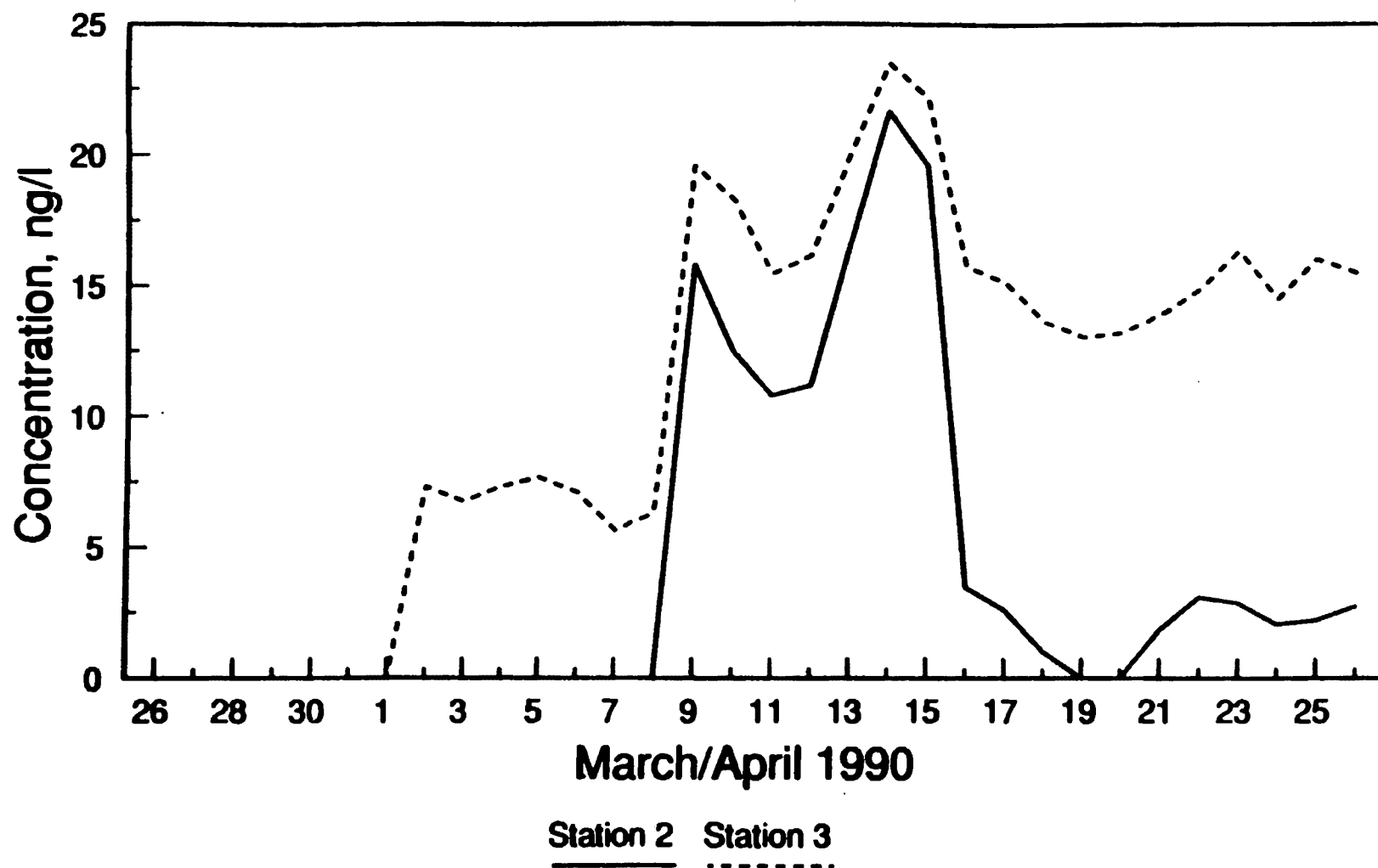
Figure 4-7.   In-Stream Concentration for Phenanthrene.
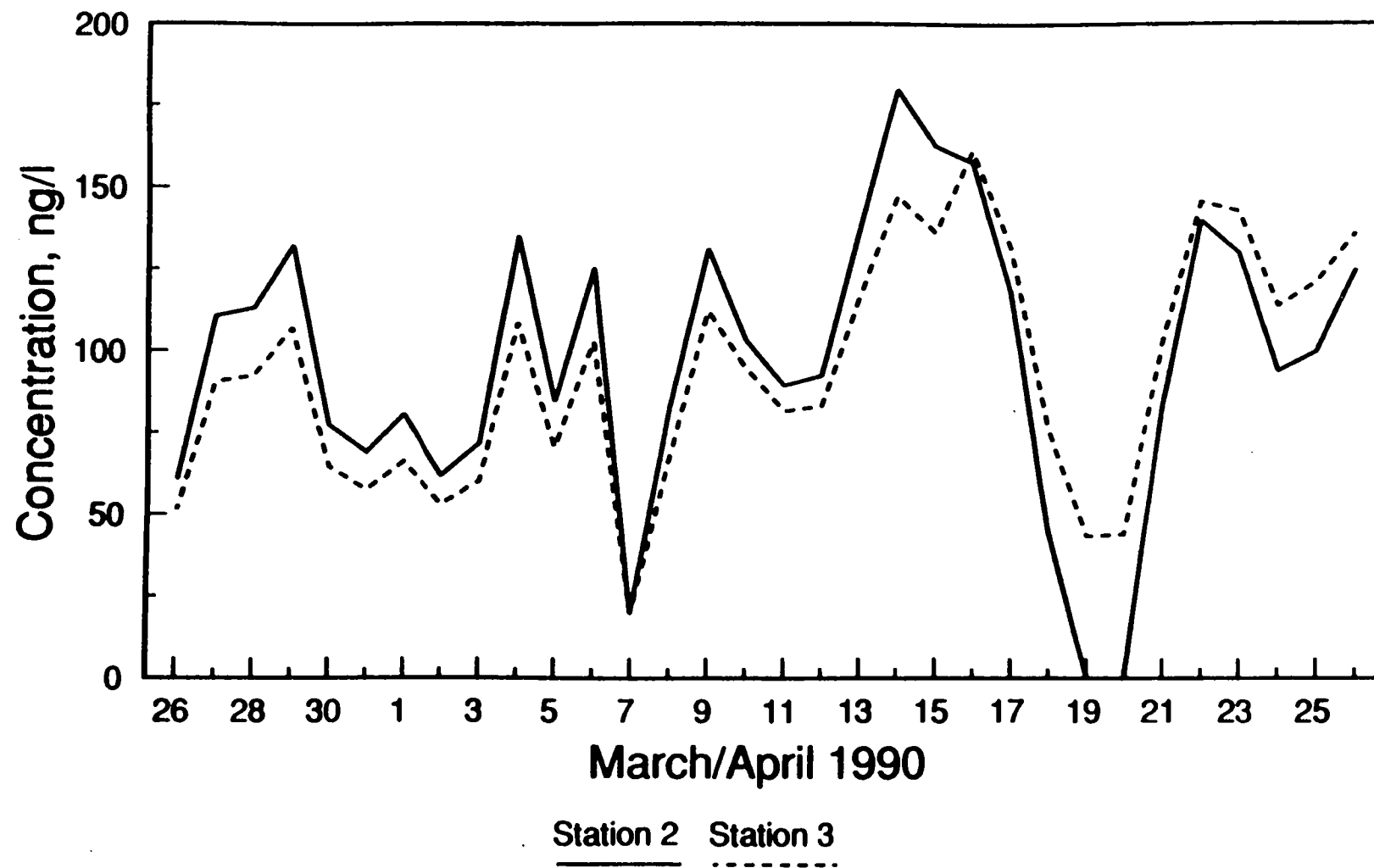
Figure 4-8.   In-Stream Concentration for Anthracene.
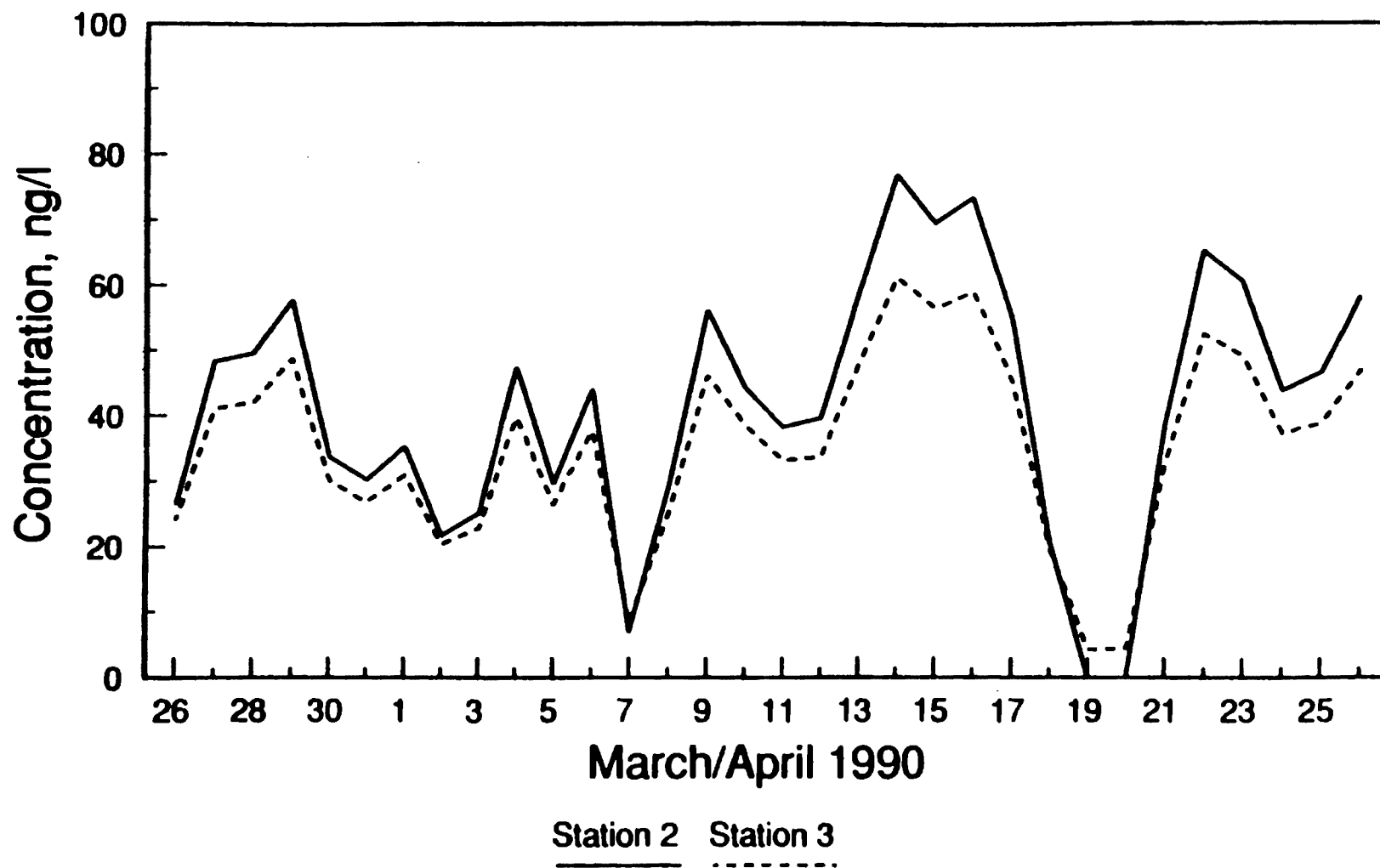
Figure 4-9. In-Stream Concentration for Fluoranthene.
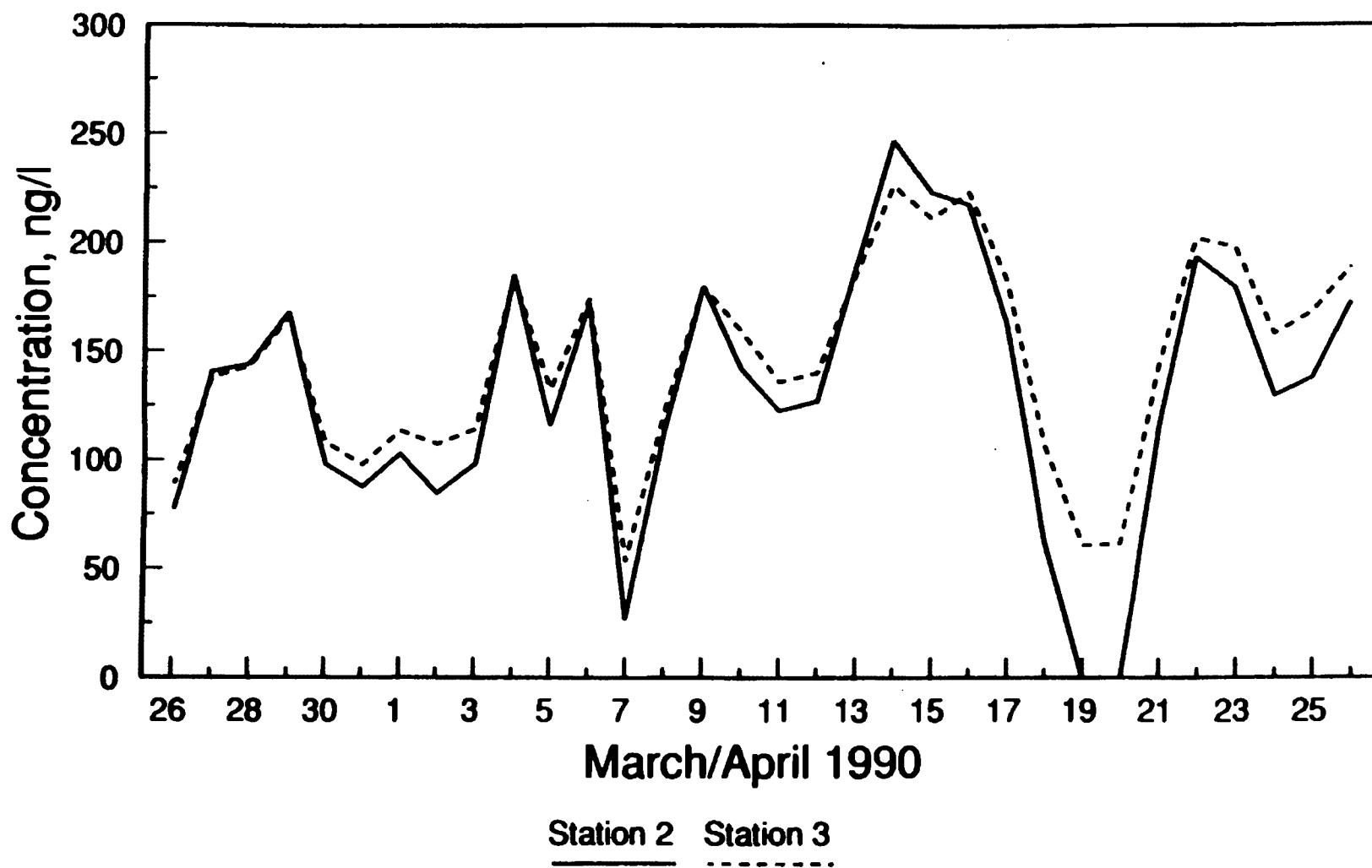
Station 2   Station 3

Figure 4-10. In-Stream Concentration for Pyrene.

Concentration, ng/l

March/April 1990
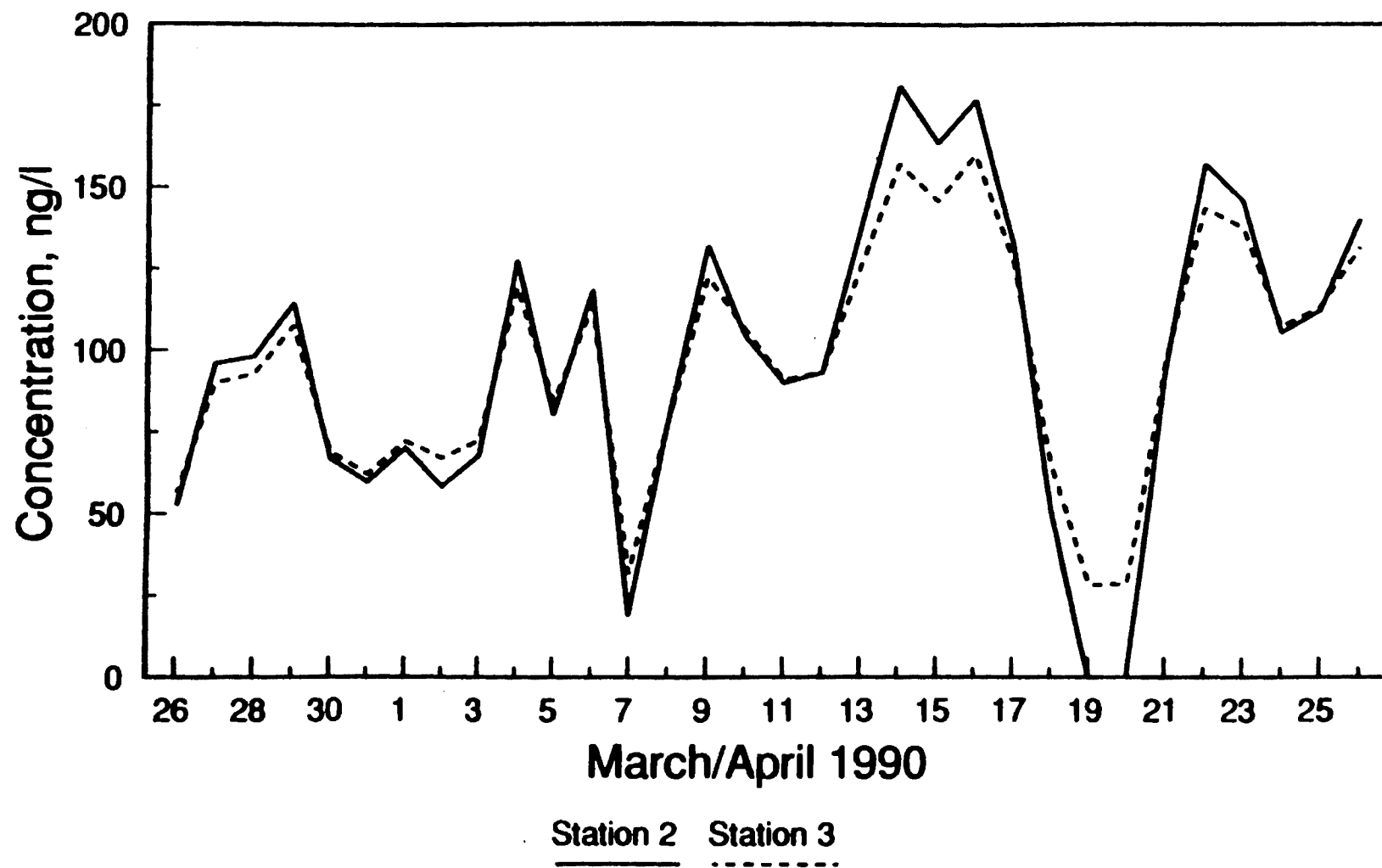
Station 2   Station 3

Table 4-3. Grand Mean Daily In-Stream Concentration of the Five Target Chemicals for Stations 2 and 3 for Five Mile Creek.

	Average (ng/l)	Standard Deviation	Coefficient of Variation (%)
Station 2			
Biphenyl	4.06	6.39	157.
Phenanthrene	97.3	42.8	44.0
Anthracene	41.6	19.3	46.4
Fluoranthene	132.	59.0	44.8
Pyrene	97.6	45.8	47.0
Station 3			
Biphenyl	10.8	7.22	67.0
Phenanthrene	93.8	35.4	37.7
Anthracene	35.3	14.5	41.0
Fluoranthene	146.	46.1	31.6
Pyrene	96.8	35.4	36.5
Anthracene	35.3	14.5	41.0

Table 4-4. Average Tissue Residues (ppb) in Two Species of Resident Organisms for Five Mile Creek.

	Station 1	Station 2	Station 3	Station 4
Decapoda (Crayfish)				
Biphenyl	1.16 (2)[a]	16.7# (2)	3.13[b] (1)	2.97 (2)
Phenanthrene	54.9 (4)	171.* (5)	50.7[b] (3)	41.9 (4)
Anthracene	3.40 (4)	55.3* (5)	21.4[b] (3)	15.6 (4)
Fluoranthene	23.4 (4)	228.* (5)	68.6[b] (3)	65.9 (4)
Pyrene	16.6 (4)	207.* (5)	50.3[b] (3)	53.2 (4)
Lepomis sp. (Sunfish)				
Biphenyl	6.34 (2)	7.15 (3)	9.60 (2)	5.37 (3)
Phenanthrene	77.0 (4)	65.1 (5)	57.9 (4)	27.7 (5)
Anthracene	8.33 (4)	18.2* (5)	18.1* (4)	13.4 (5)
Fluoranthene	19.2 (4)	27.2 (5)	32.8 (4)	22.3 (5)
Pyrene	9.86 (4)	10.2 (5)	13.3 (4)	13.2 (5)

[a] Number of different organism samples analyzed for that station are in parentheses.

[b] Outlier not used in calculating average residue concentration, see Section 4.5.1.

* Significantly greater than residue levels for Station 1, Dunnett's test, 95% confidence level.

\# Significantly greater that residue levels for Station 1, one way analysis of variance, 95% confidence level.

In addition, for nearly all sampling stations, average tissue residues for phenanthrene for Station 1 were much higher than those determined for Stations 2, 3, and 4 for both species of organisms. We cannot explain this anomaly of having higher upstream, Station 1, residue concentrations for phenanthrene. However, this trend suggests that in-stream concentrations for phenanthrene might have been higher at Station 1 than at Stations 2, 3, and 4. Higher concentrations for phenanthrene could possibly occur if a point and/or nonpoint source containing phenanthrene was discharged into Five Mile Creek upstream of Station 1 during the site study. Ambient water samples, taken after the site study, suggest that a point source of phenanthrene might exist upstream of station 1, see Section 4.7.

The increase in residue concentrations at Stations 2 and 3 for both species of organisms demonstrates that accumulation of the chemicals discharged does occur in the receiving water organisms for Five Mile Creek. In the 30 residues determined for Stations 2, 3, and 4, 80% of the measured residues were greater than their corresponding residues at Station 1. Excluding phenanthrene, 95.8% (23 out of 24) of the measured residues were greater than their corresponding residues at Station 1.

4.6.3 Significance Testing of Residues

To further evaluate the increases in tissue concentrations, an analysis of variance and then Dunnett's test was performed for each chemical to determine if the residues in the *Lepomis* sp. and *Decapoda* from the downstream stations (Stations 2, 3, and 4) were significantly greater than residues measured in the upstream organisms at Station 1 (Table 4-4). (Note, for the *Decapoda* biphenyl data, Dunnett's test could not be performed due to the limited number of samples, and thus, a simple t-test using the pooled standard deviation was used).

For the *Decapoda*, the tissue concentrations for biphenyl, phenanthrene, anthracene, fluoranthene, and pyrene, at Stations 2 were significantly greater, 95% confidence level, than those determined for the upstream site, Station 1. For stations 3 and 4, none of the residue levels for the *Decapoda* were significantly greater, 95% confidence level, than those determined for Station 1. For the *Lepomis* sp., one chemical, anthracene, at Stations 2 and 3 was significantly greater than the residues measured for Station 1. For the other four target chemicals, none of the *Lepomis* sp. tissue residues for Stations 2, 3, and 4 were significantly greater than the tissue residues measured for Station 1.

The number of residues which were significantly greater than Station 1 was much smaller than the number of residues which were just greater than the residues for Station 1, i.e., 23% (7 of 30) vs. 80% (24 of 30), respectively. The lack of statistically significant increases in tissue residues for the stations downstream of Station 1 may have been due to the limited number of tissue samples analyzed and/or to the organism compositing technique which did not consider the size of the individuals in the samples. If larger numbers of sample analyses had been performed and/or larger as well as consistent numbers of organisms used for each species, the variances of the measured tissue residues at each Station might have been smaller.

Smaller variances would allow smaller differences between Station 1 and the other sampling Stations to be statistically significant. Even so, the combination of having 80% of the residues downstream of Station 1 higher than the residues for Station 1 and that 23% of these residues were statistically significant, strongly suggests that the accumulation of these chemicals from the effluents is occurring with the resident organisms in Five Mile Creek.

4.6.4 Comparison of Predicted and Observed Residues

To evaluate the residue prediction procedure, residues were predicted and then compared to the measured residues for the indigenous organisms. By using the residue prediction procedures, values for the log P, BCF, FM, and BAF were derived for each chemical (Table 4-5). Subsequently, residues for the *Lepomis* sp. and *Decapoda* organisms were predicted for Stations 2 and 3 on Five Mile Creek by using the derived BAFs (Table 4-5), the average in-stream chemical concentrations (Table 4-3), and the average lipid content for each species (Table A-28). To these values, the average residue levels for the upstream site, Station 1, were added and these predictions are reported in Tables 4-6 and 4-7.

For the *Decapoda* organisms, the predicted tissue residues were, in general, within a factor of 3 or less of the measured tissue residues for Stations 2 and 3, and the predicted residues tended to be slightly lower and higher at Stations 2 and 3, respectively (Table 4-6). The ratio of the observed to predicted tissue residues ranged from 0.39 to 8.57 (Table 4-6).

For the *Lepomis* sp., the predicted tissue concentrations were, in general, higher than the observed values for both Stations 2 and 3. The ratio of the observed to predicted ranged from 0.05 to 0.96 for both Stations 2 and 3. With increasing BCF value for the five target chemicals, wider disagreement between the measured and predicted values was observed (Table 4-7).

The better agreement between the predicted and observed tissue residues for the *Decapoda*, in comparison to the *Lepomis* sp., was expected for this study (Section 4.1). The predicted BCF values for the five target chemicals assumes that metabolism does not chemical occur. However, polycyclic aromatic hydrocarbons are metabolized by vertebrates such as fish and are slowly (if at all) metabolized by invertebrates such as arthropods (7). Furthermore, studies have shown that for unsubstituted polycyclic aromatic hydrocarbons, their rate of metabolism is dependent upon the size, e.g., number of aromatic rings or molecular weight. In general, larger unsubstituted polycyclic aromatic hydrocarbons tend to have faster rates of metabolism than smaller polycyclic aromatic hydrocarbons (10).

When a chemical is metabolize in an aquatic organism, the true BAF value for the chemical will be lower than the BAF predicted using the residue prediction procedure (which assumes no metabolism). Consequently, the predicted tissue concentrations will be larger than those measured in the indigenous organisms. In this study, the ratios of the observed to predicted tissue residues were lower for the

44

Table 4-5. Residue Prediction Parameters.

Compound	Log P	BCF	FM	BAF
Biphenyl	4.03	608	1	608
Phenanthrene	4.49	1400	1	1400
Anthracene	4.49	1400	1	1400
Fluoranthene	4.95	3240	1	3240
Pyrene	4.95	3240	1	3240

Table 4-6. Predicted and Measured *Decapoda* Tissue Concentrations for Five Mile Creek.

	QSAR BCF	Target Compound	Predicted Conc. in Tissue (ppb)	Observed Conc. in Tissue (ppb)	Ratio of Observed to Predicted Conc. in Tissue
Station 2	608	Biphenyl	1.95	16.7	8.57
	1400	Phenanthrene	89.6	171.	1.74
	1400	Anthracene	22.0	55.3	2.51
	3240	Fluoranthene	160.	228.	1.42
	3240	Pyrene	118.	207.	1.76
Station 3	608	Biphenyl	3.26	3.13	0.96
	1400	Phenanthrene	97.0	50.7	0.52
	1400	Anthracene	19.2	21.4	1.11
	3240	Fluoranthene	175.	68.6	0.39
	3240	Pyrene	117.	50.3	0.43

Predicted Tissue Concentration = BCF x FM x *Decapoda* lipid/QSAR lipid x (In-stream Chemical Concentration) + Upstream (Station 1) Tissue Concentration. All values corrected for recoveries. *Decapoda* lipid content 2.43%, QSAR lipid 7.6%.

Table 4-7. Predicted and Measured *Lepomis* sp. Tissue Concentrations for Five Mile Creek.

	QSAR BCF	Target Compound	Predicted Conc. in Tissue (ppb)	Observed Conc. in Tissue (ppb)	Ratio of Observed to Predicted Conc. in Tissue
Station 2	608	Biphenyl	7.71	7.15	0.93
	1400	Phenanthrene	153.	65.1	0.43
	1400	Anthracene	40.8	18.2	0.45
	3240	Fluoranthene	257.	27.2	0.11
	3240	Pyrene	186.	10.2	0.05
Station 3	608	Biphenyl	9.99	9.60	0.96
	1400	Phenanthrene	150.	32.8	0.39
	1400	Anthracene	35.9	18.1	0.50
	3240	Fluoranthene	282.	32.8	0.12
	3240	Pyrene	184.	13.3	0.07

Predicted Tissue Concentration = BCF x FM x *Lepomis* sp. lipid/QSAR lipid x (In-stream Chemical Concentration) + Upstream (Station 1) Tissue Concentration. All values corrected for recoveries. *Lepomis* sp. lipid content 4.23%, QSAR lipid 7.6%.

Lepomis sp. than for the *Decapoda*. These results are consistent with the expected metabolic abilities of the species, i.e., low or almost nonexistent metabolic activity for the *Decapoda* and higher (or substantial) metabolic activity for the *Lepomis* sp. (Tables 4-6 and 4-7).

Considering the rates of metabolism for the five target chemicals, one would expect that the rates of metabolism should follow the general order of biphenyl < phenanthrene ≅ anthracene < fluoranthene ≅ pyrene for the five chemicals in this study. (Note, the number of aromatic rings in the five target chemicals are 2, 3, 3, 4, and 4, respectively.) In this study, the *Lepomis* sp. residue data mimics this expected metabolic behavior, i.e., with increasing size of the chemical, the differences between the measured and observed tissue residues increases. In addition, for the *Decapoda* where metabolism is expected to be low or almost nonexistent, this metabolic behavior is not observed.

Overall, the agreement between the measured and predicted tissue residues were quite reasonable for both species of organisms considering that metabolism of the chemicals was ignored in the residue prediction procedure. In this study, the ratios of the observed to predicted tissue residues were lower for the *Lepomis* sp. than for the *Decapoda* which suggests that metabolism was occurring with the *Lepomis* sp. The differences between the measured and predicted tissue residues were consistent with the expected differences in the species metabolic activity and in the rates of metabolism for the parent chemicals.

4.6.5 Comparison of Measured and Predicted Residues: Error Analysis

To further evaluate the predicted tissue residues, a propagation of error analysis was performed for the predicted tissue concentrations for each chemical for Stations 2 and 3 so that confidence limits could be derived for the predicted values. The derived 95% and 99% confidence limits for each chemical residue are reported in Tables 4-8 and 4-9 for the *Decapoda* and *Lepomis* sp., respectively.

The error analysis was performed by using the mean and standard deviations for the in-stream and Station 1 tissue concentrations from Tables 4-3 and 4-4 for each chemical. The predicted logarithm of the BCF and its standard deviation (for the predicted value) were obtained from the regression equation and data of Veith and Kosian (2). The mean lipid content and its standard deviation for each species were taken from Table A-28. With these values, a Monte Carlo analysis was performed to derive the error estimates for the predicted the tissue concentrations. Note, the predicted tissue concentrations have a lognormal like distribution which is caused by the antilog transformation for the BCF parameter.

The 95% confidence limits for both species for all chemicals are approximately one order of magnitude. This large uncertainty is caused mostly by the variability associated with the predicted BCF. We estimate that more than 95% of the total uncertainty in the predicted tissue residues is due to the predicted BCF.

48

Table 4-8. Confidence Limits for the Predicted *Decapoda* Tissue Concentrations for Five Mile Creek.

	Tissue Concentration		95% Confidence Limits		99% Confidence Limits	
	Predicted (ppb)	Observed (ppb)				
Station 2						
Biphenyl	1.95	16.7	0.00	13.1	0.00	30.9
Phenanthrene	89.6	171.	49.4	492.	41.4	1038.
Anthracene	22.0	55.3	3.28	194.	0.00	418.
Fluoranthene	160.	228.	26.3	1394.	5.96	3066.
Pyrene	118.	207.	17.8	1047.	0.00	2277.
Station 3						
Biphenyl	3.26	3.13	0.51	24.2	0.00	53.2
Phenanthrene	97.0	50.7	50.6	465.	44.0	966.
Anthracene	19.2	21.4	3.54	161.	1.85	353.
Fluoranthene	175.	68.6	32.2	1471.	22.7	3101.
Pyrene	117.	50.3	21.7	992.	14.7	2167.

49

Table 4-9. Confidence Limits for the Predicted *Lepomis* sp. Tissue Concentrations for Five Mile Creek.

	Tissue Concentration		95% Confidence Limits		99% Confidence Limits	
	Predicted (ppb)	Observed (ppb)				
Station 2						
Biphenyl	7.71	7.15	0.00	27.1	0.00	56.7
Phenanthrene	153.	65.1	57.5	820.	38.7	1646.
Anthracene	40.8	18.2	6.17	332.	0.23	685.
Fluoranthene	257.	27.2	28.5	2342.	0.00	4870.
Pyrene	186.	10.2	16.4	1778.	0.00	3695.
Station 3						
Biphenyl	9.99	9.60	3.17	45.9	0.00	91.7
Phenanthrene	150.	57.9	59.2	772.	42.4	1555.
Anthracene	35.9	18.1	6.46	272.	2.00	564.
Fluoranthene	282.	32.8	41.3	2468.	27.7	5163.
Pyrene	184.	13.3	24.3	1669.	14.2	3505.

For the *Decapoda* and *Lepomis* sp., 95%, i.e., 19 of 20, of the measured tissue concentrations at Station 2 and 3 were within the 99% confidence limits for the predicted residues, Table 4-8 and 4-9. For the 95% confidence limits, 90% and 50% of the observed residues for the *Decapoda* and *Lepomis* sp., respectively, were within their corresponding prediction limits. For the *Lepomis* sp., chemicals not within their 95% confidence limits were lower than the lower bounds on their confidence limits and having measured residues lower than the predicted residues is consistent with the metabolic abilities of these organisms.

4.7 Caged Organisms

The caged organisms, *Ictalarus puctatus*, were analyzed for the five target chemicals (Table A-29). Average tissue concentrations for each species were calculated for Stations 1 and 3 (Table 4-10).

Comparison of the Station 1, upstream of Coke Plant 1, and Station 3, downstream of Coke Plants 1 and 2, residue concentrations for the caged *Ictalarus puctatus* reveals that upstream organisms had higher residue concentrations than the downstream organisms for the five target chemicals. Also, the tissue concentrations for the *Lepomis* sp. and *Ictalarus puctatus* were quite similar for Station 3 (after correction for lipid content) and very different for Station 1 (after correction for lipid content). These results suggested that the upstream cages at Station 1 were contaminated, had different exposure conditions than the indigenous organisms, and/or possibly, were mislabeled.

After careful evaluation, no evidence for mislabeling the samples in either the field or the analytical procedure could be found. In addition, the same type of cages were used at Stations 1 and 3 which suggests that the cage design was not a factor for the higher residue concentrations at Station 1.

To evaluate if the different exposure conditions existed at the location of the cages at Station 1, a set of ambient water samples were collected in December 1990. Target chemical analyses were performed on the six ambient water samples (Table A-30). One of the ambient samples, Ambient 4, was taken from a runoff/drainage ditch which was 140 meters upstream of the dam at Station 1. This ditch and the cages were on the same creek bank of Five Mile Creek.

The runoff ditch, Ambient 4, contained the highest concentrations for the five target chemicals all of the ambient water samples, Table A-30. In general, the ambient water concentrations increased with increasing distance downstream, i.e., Ambient 3 < Ambient 5 < Ambient 2 < Ambient 1 < Ambient 6. The ambient concentrations downstream of the runoff/drainage ditch, Ambients 1 and 2, had higher concentrations than the upstream stations, Ambients 3 and 5. Note, Ambient 6 was taken at Station 3 of the site study.

While at the site, we observed that the discharge from the ditch did not mix well with the reservoir behind the dam. This discharge hugged the creek bank and flowed

Table 4-10. Average Tissue Residues (ppb) in Caged *Ictalarus puctatus* for Five Mile Creek.

	Station 1	Station 2	Station 3	Station 4
Ictalarus puctatus (Catfish)				
Biphenyl	16.3 (2)[a]		3.84 (2)	
Phenanthrene	109. (2)		13.3 (2)	
Anthracene	12.0 (2)		7.11 (2)	
Fluoranthene	33.0 (2)		16.2 (2)	
Pyrene	16.4 (2)		9.72 (2)	

[a] Number of different organism samples analyzed for that station are in parentheses.

towards the dam following the shore. The cages at Station 1 were near the shore and in the incompletely mixed water from the ditch. Visual observation of the flow regime in the creek and conductivity measurements performed on Five Mile Creek were used to determine that incomplete mixing of the ditch water and reservoir had occurred at the location of the Station 1 caged exposures.

Further evaluation of the *Ictalarus puctatus* data was not done due to the lack of uncontaminated measured tissue residues for Station 1.

The occurrence of the contaminated caged *Ictalarus puctatus* at Station 1 in the site study leads to the natural question of "Were the *Lepomis* sp. and *Decapoda* contaminated at Station 1?". For both organisms, we believe that the tissue residues measured for the organisms for Station 1 were not strongly influenced by the discharge from the drainage ditch. The *Decapoda* were sampled at the base of the dam in much deep water and away from the discharge flow from the ditch. The *Lepomis* sp. were sampled away from the shore in deeper water and not in the incompletely mixed water from the drainage ditch. In addition, the *Lepomis* sp. were free ranging and their exposure to the discharge from the ditch would be small since the near shore part of the reservoir was quite shallow and had no vegetation or cover for the *Lepomis* sp. organisms.

4.8 Comparison of the Measured and Predicted Tissue Residues: Unaddressed Variables

The comparison of the measured and predicted tissue residues in this study could be influenced by a number of unaddressed variables. In selecting the study site, a "simple" site was chosen which minimized many of the variables in the study (section 2). However, some variables and implicit assumptions were beyond control, e.g., stream and discharge flows. For most of these variables, their importance in the comparison of the measured and predicted residues was difficult, if not impossible, to assess.

Probably the most important unaddressed variable in the study was that the predicted tissue residues were derived by using a model developed from steady-state exposure conditions. However, **the daily in-stream chemical concentrations varied significantly during the study**. For example, anthracene in-stream concentrations ranged from 0.0 to 77 and 4.3 to 61 ng/l at Stations 2 and 3, respectively, and changed abruptly 4 or 5 times during the site study. To predict the tissue residues in the study, the grand means of the daily in-stream concentrations for the length of the study were used as the best estimator for the exposure concentration for the receiving water organisms. Other estimators could have been used in this study such as a time weighted exposure concentration. These estimators might have provided better predictions with the widely changing exposure concentrations. The exposure conditions strongly effect the residues predicted and this variable is a source for error.

The measured residue data for the aquatic organisms were implicitly assumed to be at steady-state/equilibrium with the receiving water. With the dramatic changes in

the daily in-stream concentrations, steady-state conditions were not likely to have been achieved by the receiving water organisms. The use of tissue data from receiving organisms not at steady-state conditions is a source of error in this evaluation.

The residue prediction procedure does not address bioavailability issues associated with the bioconcentration/bioaccumulation process. At the study site, a discharge of fines from a upstream quarrying operation was very conspicuous. These fines may have had an effect on the availability of these chemicals for uptake by the receiving water organisms. If a significant portion of the chemical was not bioavailable, the actual exposure conditions would be different than those based on dilution only.

All of these issues influence the predicted and/or measured tissue residues in the *Decapoda* and *Lepomis* sp. for this study and the importance of each issue is difficult to evaluate. The most important, possibly, are the issues associated with the steady-state exposure conditions used in the predictive technique and its relationship to the widely changing exposure concentrations.

Field studies by their inherent nature can not be controlled like laboratory studies. Field studies include variables such as those discussed above and allow their importance/effect in predicting receiving water tissue concentrations to be assessed.

SUMMARY

The objective of the site study was to determine how well tissue residues could be predicted in field discharge situations using the guidance procedures. For the *Decapoda* organisms from Five Mile Creek, the observed and predicted residues differed by no more than a factor 3 for 9 of the 10 predicted residues. All of the measured *Decapoda* tissue residues were within the bounds of the 99% confidence limits for the predicted residues. For the *Lepomis* sp., the observed and predicted residues differed by no more that a factor of 3 for 6 of the 10 predicted residues. For each chemical, similar agreement between the measured and predicted *Lepomis* sp. tissue residues was observed for both sampling stations on Five Mile Creek. For the caged *Ictalarus puctatus*, data from these exposures could not be used to evaluate the residue prediction procedure due to experimental problems.

The chemicals under investigation in this study can be metabolized by aquatic vertebrates such as fishes. The observed residues in the *Lepomis* sp. were consistent with this process. The observed residues were lower than predicted and the more easily metabolized chemicals had lower observed residues than the less easily metabolized chemicals. For aquatic invertebrates, metabolism of the five chemicals under investigation was (or should have been) essentially nonexistent. The data for the *Decapoda* organisms were consistent with this metabolic behavior as similar differences between the measured and predicted residues were observed for all chemicals at each sampling station.

This study demonstrates that tissue residue concentrations in field discharge situations can be predicted within a factor of 3 using the developed residue prediction procedure provided the chemicals are not easily metabolized. When metabolism is important, residues predicted using the guidance procedure will be too large. The rate of metabolism will directly influence the difference between the measured and predicted residues.

The prediction of tissue residues within a factor of 3 for "non-metabolizable" chemicals, in field discharge situations strongly demonstrates the validity of the developed residue prediction procedure. Field studies, by their inherent nature, include the dynamics and variabilities associated with natural aquatic systems. The predictive ability demonstrated in this site study when considering the variabilities associated with study, e.g., the widely changing daily in-stream chemical concentrations, further underscores the capabilities of the prediction technique.

REFERENCES

1. United States Environmental Protection Agency, Office of Water Enforcement and Permits. Assessment and control of bioconcentratable contaminants in surface waters. Public Comment Draft (Fed. Regist. 1991, 56, 13150-13151), March 1991.

2. Veith, G.D. and P. Kosian. 1982. Estimating bioconcentration potential from octanol/water partition coefficients, in Physical Behavior of PCBs in the Great Lakes, MacKay, Paterson, Eisenreich, and Simmons, Eds., Chapter 15, Ann Arbor Science, Ann Arbor, MI.

3. Schuurmann, G. and W. Klein. 1988. Advances in bioconcentration prediction. Chemosphere. 17(8): 1551-1574.

4. Thomann, R.V. 1989. Bioaccumulation model of organic chemical distribution in aquatic food chains. Environ. Sci. Technol. 23:699-707.

5. Thomann, R.V. 1987. A statistical model of environmental contaminants using variance spectrum analysis. Report to National Science Foundation. August 1987. NTIS #: PB88-235130/A09.

6. Rasmussen, J.B., D.J. Rowan, D.R.S. Lean, and J.H. Carey. 1990. Food chain structure in ontario lakes determines PCB levels in lake trout (*Salvelinus namaycush*) and other pelagic fish. Can. Journal of Fish. Sci. 47:2030-2038.

7. James, M. O. 1989. Biotransformation and disposition of PAH in aquatic invertebrates, in Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment (Varanasi, U., Ed.), CRC: Boca Raton, Florida. Chap 3.

8. Jones, P.A. and R.J. Sloan. 1989. An in situ river exposure vessel for bioaccumulation studies with juvenile fish. Environ. Toxicol. and Chem. 8:151-155.

9. Mount, D.I., A.E. Steen, and T.J. Norberg-King. 1985. Validity of effluent and ambient toxicity testing for predicting biological impact on Five Mile Creek, Birmingham, AL. EPA/600/8-85/015. U.S. Environmental Protection Agency. Environmental Research Laboratory, Duluth, MN.

10. Varanasi, U., J.E. Stein, and M. Nishimoto. 1989. Biotransformation and disposition of polycyclic aromatic hydrocarbon (PAH) in fish, in Metabolism of Polycyclic Aromatic Hydrocarbons in the Aquatic Environment (Varanasi, U., Ed.), CRC: Boca Raton, Florida. Chap 4.

APPENDIX A

Table A-1. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Coke Plant 1, Fraction 1.

```
        NBS/EPA/NIH TENTATIVE IDENTIFICATIONS      /chem/msd/90a530901011.d

Peak RT         Height        Amount (ng/L)
    (Fit)       (Name)

    6.132       183520            185.95
         83     1,3-Cyclopentadiene, 5-(1-methylethylidene)- (9CI)
         80     Benzene, 1,2-dimethyl- (9CI)
         72     Benzene, ethyl- (8CI9CI)

    9.402       287010            336.59
         94     Benzene, 1-propynyl- (9CI)
         91     Benzene, 1-ethynyl-4-methyl- (9CI)
         91     Benzene, 1,2-propadienyl- (9CI)
         90     1H-Indene (9CI)

   11.944      1704130           2699.71
         97     Azulene (8CI9CI)
         90     Naphthalene (ACN)(DOT)(8CI9CI)
         83     1H-Indene, 1-methylene- (9CI)

   13.673       537907            718.99
         90     Naphthalene, 1-methyl- (8CI9CI)
         87     Naphthalene, 2-methyl- (8CI9CI)
         83     1,4-Methanonaphthalene, 1,4-dihydro- (8CI9CI)
         72     1H-Indene, 1-ethylidene- (9CI)

   13.921       280745            327.04
         93     1H-Indene, 1-ethylidene- (9CI)
         91     Naphthalene, 1-methyl- (8CI9CI)
         91     Naphthalene, 2-methyl- (8CI9CI)
         87     1,4-Methanonaphthalene, 1,4-dihydro- (8CI9CI)

   14.889       232018            252.77
         90     1,1'-Biphenyl (9CI)
         87     Naphthalene, 2-ethenyl- (9CI)

   15.888       648837            888.06
         91     Acenaphthylene (8CI9CI)

   16.682       901367           1311.00
         94     Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl- (9CI)

   16.780       810408           1153.65
         83     Dibenzofuran (8CI9CI)

   17.709      1122900           1694.24
         87     9H-Fluorene (9CI)
         80     9H-Fluorene-9-carboxylic acid (9CI)

   18.270       119301            123.96
         72     9H-Fluorene-9-carboxylic acid (9CI)

   18.394       130809            135.07
         94     Dibenzofuran, 4-methyl- (8CI9CI)
```

Table A-1. continued.

```
20.737      1914910          3064.34
      97      9H-Fluorene, 9-methylene- (9CI)
      91      Benzene, 1,1'-(1,2-ethynediyl)bis- (9CI)
      87      Anthracene (8CI9CI)
      78      2-Cyclopropen-1-one, 2,3-diphenyl- (9CI)
      74      Phenanthrene (8CI9CI)

20.839      1159380          1757.34
      94      9H-Fluorene, 9-methylene- (9CI)

20.169      447845            581.72
      72      1,1'-Biphenyl, 2-methoxy- (9CI)

20.737      1914910          3064.34
      97      9H-Fluorene, 9-methylene- (9CI)
      91      Benzene, 1,1'-(1,2-ethynediyl)bis- (9CI)
      87      Anthracene (8CI9CI)
      78      2-Cyclopropen-1-one, 2,3-diphenyl- (9CI)
      74      Phenanthrene (8CI9CI)

20.839      1159380          1757.34
      94      9H-Fluorene, 9-methylene- (9CI)
      91      Benzene, 1,1'-(1,2-ethynediyl)bis- (9CI)
      72      2-Cyclopropen-1-one, 2,3-diphenyl- (9CI)

22.606      113068            117.94
      97      9H-Fluorene-2-carbonitrile (9CI)

25.679      123128            127.65
      95      9-Anthracenecarbonitrile (9CI)

26.090      181249            183.76
      91      Heptadecanoic acid, 15-methyl-, methyl ester (9CI)
      83      Octadecanoic acid, methyl ester (9CI)
      81      Pentadecanoic acid, methyl ester (8CI9CI)
      72      9-Octadecenoic acid, 12-(acetyloxy)-, methyl ester, [R-(Z)]- (9CI)
      72      2-Naphthalenol, 8-amino- (9CI)
```

Table A-2. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Coke Plant 1, Fraction 2.

Peak RT (Fit)	Height (Name)	Amount (ng/L)
15.261	143304	211.62
97	Naphthalene, 1,7-dimethyl- (8CI9CI)	
97	Naphthalene, 2,6-dimethyl- (8CI9CI)	
96	Naphthalene, 1,6-dimethyl- (8CI9CI)	
96	Naphthalene, 1,8-dimethyl- (8CI9CI)	
95	Naphthalene, 1,3-dimethyl- (8CI9CI)	
95	Naphthalene, 1,5-dimethyl- (8CI9CI)	
95	Naphthalene, 2,7-dimethyl- (8CI9CI)	
95	Naphthalene, 2,3-dimethyl- (8CI9CI)	
91	Naphthalene, 1,2-dimethyl- (8CI9CI)	
90	Naphthalene, 1,4-dimethyl- (8CI9CI)	
15.472	126182	187.ð6
97	Naphthalene, 1,6-dimethyl- (8CI9CI)	
96	Naphthalene, 2,3-dimethyl- (8CI9CI)	
96	Naphthalene, 1,8-dimethyl- (8CI9CI)	
95	Naphthalene, 1,4-dimethyl- (8CI9CI)	
94	Naphthalene, 1,7-dimethyl- (8CI9CI)	
93	Naphthalene, 1,2-dimethyl- (8CI9CI)	
93	Naphthalene, 1,3-dimethyl- (8CI9CI)	
87	Naphthalene, 2-ethyl- (8CI9CI)	
76	Naphthalene, 1,5-dimethyl- (8CI9CI)	
72	Naphthalene, 1-ethyl- (8CI9CI)	
70	Naphthalene, 2,6-dimethyl- (8CI9CI)	
70	Naphthalene, 2,7-dimethyl- (8CI9CI)	
15.516	88561	135.66
93	Naphthalene, 2,7-dimethyl- (8CI9CI)	
89	Naphthalene, 1,6-dimethyl- (8CI9CI)	
89	Naphthalene, 2,6-dimethyl- (8CI9CI)	
89	Naphthalene, 1,7-dimethyl- (8CI9CI)	
76	Naphthalene, 1,5-dimethyl- (8CI9CI)	
70	Naphthalene, 1,3-dimethyl- (8CI9CI)	
16.100	194957	312.30
99	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)- (9CI)	
16.680	679136	1429.58
96	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl- (9CI)	
16:890	66374	104.87
93	Naphthalene, 1,4,6-trimethyl- (8CI9CI)	
93	Naphthalene, 1,6,7-trimethyl- (8CI9CI)	
93	Naphthalene, 2,3,6-trimethyl- (8CI9CI)	
91	Naphthalene, 1,4,5-trimethyl- (8CI9CI)	
16.953	90725	138.66
91	Naphthalene, 2,3,6-trimethyl- (8CI9CI)	
90	Naphthalene, 1,4,5-trimethyl- (8CI9CI)	
90	Naphthalene, 1,6,7-trimethyl- (8CI9CI)	
87	Naphthalene, 1,4,6-trimethyl- (8CI9CI)	

```
17.173          83064          128.03
     98          Naphthalene, 1,4,6-trimethyl- (8CI9CI)
     98          Naphthalene, 1,4,5-trimethyl- (8CI9CI)
     97          Naphthalene, 1,6,7-trimethyl- (8CI9CI)
     95          Naphthalene, 2,3,6-trimethyl- (8CI9CI)

17.407          64300          102.00
     97          Naphthalene, 1,4,6-trimethyl- (8CI9CI)
     97          Naphthalene, 1,6,7-trimethyl- (8CI9CI)
     97          Naphthalene, 2,3,6-trimethyl- (8CI9CI)
     96          Naphthalene, 1,4,5-trimethyl- (8CI9CI)

18.208          240205          414.20
     90          Dibenzofuran, 4-methyl- (8CI9CI)

18.401          207488          340.52
     94          Dibenzofuran, 4-methyl-  8CI9CI)

18.912          74735          116.48
     93          Azulene, 7-ethyl-1,4-dimethyl- (8CI9CI)
     91          Naphthalene, 1-methyl-7-(1-methylethyl)- (9CI)

19.350          275378          493.41
     93          9H-Fluorene, 2-methyl- (9CI)
     93          9H-Fluorene, 1-methyl- (9CI)
     80          9H-Fluorene, 4-methyl- (9CI)
     74          Benzene, 1,1'-(1,2-ethenediyl)bis- (9CI)
     72          Benzene, 1,1'-(1,2-ethenediyl)bis-, (Z)- (9CI)

20.591          202913          330.22
     97          Phenanthrene (8CI9CI)
     94          9H-Fluorene, 9-methylene- (9CI)
     93          Benzene, 1,1'-(1,2-ethynediyl)bis- (9CI)
     81          Anthracene (8CI9CI)

20.759          463151          916.27
     95          9H-Fluorene, 9-methylene- (9CI)
     93          Anthracene (8CI9CI)
     81          Benzene, 1,1'-(1,2-ethynediyl)bis- (9CI)

21.123          133089          197.45
     90          9H-Fluorene, 2,3-dimethyl- (9CI)

21.349          151597          223.13
     94          9H-Fluorene, 2,3-dimethyl- (9CI)
     91          Benzene, 1-methyl-2-(2-phenylethenyl)- (9CI)

21.544          98748          149.80
     81          9H-Fluorene, 2,3-dimethyl- (9CI)

21.754          249444          435.01
     90          Dibenzothiophene, 4-methyl- (8CI9CI)
     90          Dibenzothiophene, 3-methyl- (8CI9CI)

21.811          194489          311.25
     70          1H-Indene, 1-(phenylmethylene)- (9CI)
```

```
22.070          180863          280.56
    93          Dibenzothiophene, 3-methyl- (8CI9CI)
    83          Dibenzothiophene, 4-methyl- (8CI9CI)

22.441          494623          987.14
    93          Anthracene, 1-methyl- (8CI9CI)
    93          Phenanthrene, 4-methyl- (8CI9CI)
    87          1H-Indene, 1-phenyl- (9CI)
    87          Anthracene, 2-methyl- (8CI9CI)
    87          Phenanthrene, 1-methyl- (8CI9CI)
    80          9H-Fluorene, 9-ethylidene- (9CI)
    80          1H-Indene, 2-phenyl- (9CI)
    80          Phenanthrene, 3-methyl- (8CI9CI)
    80          Phenanthrene, 9-methyl- (8CI9CI)

22.551          639218          1328.64
    93          Anthracene, 2-methyl- (8CI9CI)
    87          1H-Indene, 1-phenyl- (9CI)
    83          Phenanthrene, 4-methyl- (8CI9CI)
    81          Phenanthrene, 3-methyl- (8CI9CI)
    81          Phenanthrene, 1-methyl- (8CI9CI)
    76          1H-Indene, 2-phenyl- (9CI)

    72          9H-Fluorene, 9-ethylidene- (9CI)

22.703          203799          332.21
    96          Phenanthrene, 4-methyl- (8CI9CI)
    91          Anthracene, 1-methyl- (8CI9CI)
    90          Phenanthrene, 2-methyl- (8CI9CI)
    90          Anthracene, 2-methyl- (8CI9CI)
    87          Phenanthrene, 3-methyl- (8CI9CI)
    87          Phenanthrene, 1-methyl- (8CI9CI)
    80          1H-Indene, 2-phenyl- (9CI)
    74          1H-Indene, 1-phenyl- (9CI)
    72          Phenanthrene, 9-methyl- (8CI9CI)

22.959          472102          936.43
    94          Anthracene, 1-methyl- (8CI9CI)
    90          Anthracene, 2-methyl- (8CI9CI)
    87          Phenanthrene, 3-methyl- (8CI9CI)
    81          1H-Indene, 1-phenyl- (9CI)
    80          1H-Indene, 2-phenyl- (9CI)
    74          Phenanthrene, 4-methyl- (8CI9CI)
    72          Phenanthrene, 2-methyl- (8CI9CI)

23.394          166108          247.33
    78          Naphtho[2,3-b]thiophene, 4,9-dimethyl- (8CI)

23.665          473879          940.43
    80          Naphthalene, 2-phenyl- (8CI9CI)

24.238          110229          165.73
    91          Phenanthrene, 2,3-dimethyl- (8CI9CI)
    90          Phenanthrene, 4,5-dimethyl- (8CI9CI)
    81          Phenanthrene, 2-ethyl- (8CI9CI)
    76          Phenanthrene, 2,5-dimethyl- (8CI9CI)
```

A-5

```
24.408          156439          229.85
    91          Phenanthrene, 2,5-dimethyl- (8CI9CI)
    86          Phenanthrene, 3,6-dimethyl- (8CI9CI)
    70          Phenanthrene, 2,7-dimethyl- (8CI9CI)

24.478          104224          157.39
    81          Phenanthrene, 2,7-dimethyl- (8CI9CI)

24.794          177122          272.14
    83          Phenanthrene, 2,7-dimethyl- (8CI9CI)

25.495          1903910         4526.76
    93          Fluoranthene (8CI9CI)

25.694          507242          1015.56
    95          Fluoranthene (8CI9CI)
    80          Benzene, 1,1'-(1,3-butadiyne-1,4-diyl)bis- (9CI)
    74          Pyrene (8CI9CI)

26.458          1867360         4434.33
    94          Pyrene (8CI9CI)
    76          Fluoranthene (8CI9CI)

26.594          385418          741.22
    81          Benzo[b]naphtho[2,3-d]furan (8CI9CI)

26.822          530465          1067.86
    96          Benzo[b]naphtho[2,3-d]furan (8CI9CI)

27.315          650297          1356.65
    90          11H-Benzo[b]fluorene (8CI9CI)
    87          11H-Benzo[a]fluorene (8CI9CI)

27.943          915614          2027.58
    81          11H-Benzo[a]fluorene (8CI9CI)
    78          11H-Benzo[b]fluorene (8CI9CI)

28.145          761893          1638.85
    81          Pyrene, 4-methyl- (8CI9CI)
    81          11H-Benzo[a]fluorene (8CI9CI)
    81          Pyrene, 1-methyl- (8CI9CI)
    74          Pyrene, 2-methyl- (8CI9CI)

28.258          935136          1824.07
    81          Pyrene, 2-methyl- (8CI9CI)
    76          Pyrene, 1-methyl- (8CI9CI)
    70          Pyrene, 4-methyl- (8CI9CI)

28.605          694607          1468.70
    89          Pyrene, 2-methyl- (8CI9CI)
    81          Pyrene, 1-methyl- (8CI9CI)
    76          Pyrene, 4-methyl- (8CI9CI)

28.721          584954          1191.42
    87          11H-Benzo[b]fluorene (8CI9CI)
    87          Pyrene, 1-methyl- (8CI9CI)
    81          11H-Benzo[a]fluorene (8CI9CI)
```

Table A-2. continued.

```
29.265          104178              157.33
      93        1,1':2',1''-Terphenyl (9CI)
      72        Pyrene, 1,3-dimethyl- (9CI)

29.425          80283               124.17
      78        Pyrene, 1,3-dimethyl- (9CI)

30.532          489954              976.63
      96        Benzo[b]naphtho[2,1-d]thiophene (8CI9CI)
      94        Benzo[b]naphtho[1,2-d]thiophene (8CI9CI)

30.798          1068460             2414.09
      93        Benzo[ghi]fluoranthene (8CI9CI)

30.901          361217              686.72
      98        Benzo[b]naphtho[2,1-d]thiophene (8CI9CI)
      96        Benzo[b]naphtho[1,2-d]thiophene (8CI9CI)

31.152          176891              271.62
      97        Benzo[b]naphtho[1,2-d]thiophene (8CI9CI)
      94        Benzo[b]naphtho[2,1-d]thiophene (8CI9CI)

31.227          361056              686.35
      90        Benzo[b]naphtho[2,1-d]thiophene (8CI9CI)
      81        Benzo[b]naphtho[1,2-d]thiophene (8CI9CI)

32.059          1393330             3235.62
      97        Triphenylene (8CI9CI)
      93        Benzo[c]phenanthrene (8CI9CI)
      91        Chrysene (8CI9CI)
      76        Naphthacene (8CI9CI)

32.313          144968              213.93
      90        Benzo[a]pyrene, 4,5-dihydro-
      81        1,2'-Binaphthalene (9CI)
      81        Anthracene, 9-phenyl- (8CI9CI)
      74        1,1'-Binaphthalene (9CI)

32.677          575109              1168.40
      70        Benz[a]anthracene, 4-methyl- (8CI9CI)
      70        Benz[a]anthracene, 9-methyl- (8CI9CI)
      70        Benz[a]anthracene, 10-methyl- (8CI9CI)
      70        Benz[a]anthracene, 11-methyl- (8CI9CI)

33.407          176196              270.05
      93        Benz[a]anthracene, 1-methyl- (8CI9CI)

      91        Chrysene, 5-methyl- (8CI9CI)
      91        Chrysene, 4-methyl- (8CI9CI)
      89        Benz[a]anthracene, 12-methyl- (8CI9CI)
      81        Benz[a]anthracene, 7-methyl- (8CI9CI)
      81        Triphenylene, 2-methyl- (8CI9CI)
```

```
33.639          615697          1269.16
     98         Benz[a]anthracene, 1-methyl- (8CI9CI)
     97         Benz[a]anthracene, 12-methyl- (8CI9CI)
     97         Chrysene, 5-methyl- (8CI9CI)
     96         Triphenylene, 2-methyl- (8CI9CI)
     95         Chrysene, 4-methyl- (8CI9CI)
     91         Chrysene, 6-methyl- (8CI9CI)
     90         Benz[a]anthracene, 2-methyl- (8CI9CI)
     89         Benz[a]anthracene, 8-methyl- (8CI9CI)
     89         Chrysene, 3-methyl- (8CI9CI)
     89         Benz[a]anthracene, 7-methyl- (8CI9CI)
     89         Chrysene, 1-methyl- (8CI9CI)
     81         Benz[a]anthracene, 5-methyl- (8CI9CI)
     81         Benz[a]anthracene, 6-methyl- (8CI9CI)
     81         Benz[a]anthracene, 3-methyl- (8CI9CI)
     81         Benz[a]anthracene, 4-methyl- (8CI9CI)
     76         Benzo[c]phenanthrene, 6-methyl- (8CI9CI)
     76         Benzo[c]phenanthrene, 5-methyl- (8CI9CI)
     76         Benz[a]anthracene, 11-methyl- (8CI9CI)
     70         Benzo[c]phenanthrene, 3-methyl- (8CI9CI)

33.791          431246          844.42
     92       · Benz[a]anthracene, 1-methyl- (8CI9CI)
     86         Chrysene, 4-methyl- (8CI9CI)
     83         Benzo[c]phenanthrene, 6-methyl- (8CI9CI)
     83         Benzo[c]phenanthrene, 5-methyl- (8CI9CI)
     70         Chrysene, 5-methyl- (8CI9CI)
     70         Benz[a]anthracene, 7-methyl- (8CI9CI)

34.627          246755          428.95
     87         2,2'-Binaphthalene (9CI)

34.802          79481           123.06
     87         2,2'-Binaphthalene (9CI)

35.111          72493           113.36
     93         Benzo[a]pyrene, 4,5-dihydro-
     89         9H-Fluorene, 9-(phenylmethylene)- (9CI)
     76         1,1'-Binaphthalene (9CI)

36.735          1330180         3075.93
     98         Benzo[j]fluoranthene (8CI9CI)
     98         Benz[e]acephenanthrylene (8CI9CI)
     95         Benzo[e]pyrene (8CI9CI)
     94         Benzo[k]fluoranthene (8CI9CI)
     94         Benzo[a]pyrene (8CI9CI)

37.041          796934          1727.47
     94         Benzo[e]pyrene (8CI9CI)
     89         Benz[e]acephenanthrylene (8CI9CI)
     83         Benzo[k]fluoranthene (8CI9CI)
     76         Benzo[j]fluoranthene (8CI9CI)
     70         Benzo[a]pyrene (8CI9CI)
```

Table A-2. continued.


```
37.188          161686              237.38
     78         1,1'-Binaphthalene, 3,3',4,4'-tetrahydro- (9CI)

37.871          1200820             2748.80
     98          Benzo[e]pyrene (8CI9CI)
     96          Benzo[j]fluoranthene (8CI9CI)
     96          Benz[e]acephenanthrylene (8CI9CI)
     86          Benzo[a]pyrene (8CI9CI)
     76          Benzo[k]fluoranthene (8CI9CI)

38.044          973206              2173.22
     95          Benzo[j]fluoranthene (8CI9CI)
     94          Benzo[a]pyrene (8CI9CI)
     93          Benzo[e]pyrene (8CI9CI)

38.253          318810              591.22
     95          Benzo[j]fluoranthene (8CI9CI)
     95          Benzo[k]fluoranthene (8CI9CI)
     95          Benz[e]acephenanthrylene (8CI9CI)
     93          Benzo[e]pyrene (8CI9CI)
```

Table A-3. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Coke Plant 2, Fraction 1.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90a780901009.d

Peak RT (Fit)	Height (Name)	Amount (ng/L)
16.279	596946	195.69
94	Acenaphthene (8CI)	
16.610	2768910	1103.14
96	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl- (9CI)	
16.696	495917	164.57
72	Benzenemethanol, 3,4-dimethoxy- (9CI)	
17.599	730106	242.22
90	9H-Fluorene-9-carboxylic acid (9CI)	
90	9H-Fluorene (9CI)	
25.986	592929	194.45
94	Heptadecanoic acid, 14-methyl-, methyl ester, (.+-.)- (9CI)	
91	Heptadecanoic acid, 14-methyl-, methyl ester (9CI)	
87	Heptadecanoic acid, 15-methyl-, methyl ester (9CI)	
86	Pentadecanoic acid, methyl ester (8CI9CI)	
86	Heptadecanoic acid, 16-methyl-, methyl ester (8CI9CI)	
78	Heptadecanoic acid, 10-methyl-, methyl ester (9CI)	
78	Octadecanoic acid, methyl ester (9CI)	
32.802	290054	101.18
87	1,2-Benzenedicarboxylic acid, 3-nitro- (9CI)	

Table A-4. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Coke Plant 2, Fraction 2.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90a781001010.d

```
Peak RT       Height          Amount (ng/L)
    (Fit)     (Name)

8.996         361495             173.43
    87        Benzene, 1,2,3,5-tetramethyl- (8CI9CI)
    63        Benzene, 1-methyl-3-(1-methylethyl)- (9CI)
    83        Benzene, methyl(1-methylethyl)- (9CI)
    83        Benzene, 1-methyl-2-(1-methylethyl)- (9CI)
    78        1,4-Cyclohexadiene, 3-ethenyl-1,2-dimethyl- (9CI)
    72        Benzene, 2-ethyl-1,4-dimethyl- (9CI)
    72        Benzene, 1-ethyl-3,5-dimethyl- (9CI)
    72        Benzene, 2-ethyl-1,3-dimethyl- (9CI)
    72        Benzene, 1-ethyl-2,4-dimethyl- (9CI)
    72        Benzene, 4-ethyl-1,2-dimethyl- (9CI)

16.032        1050520            542.74
    99        2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)- (9CI)

16.608        1746700            962.22
    93        Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl- (9CI)

19.351        198626             100.63
    81        9H-Fluorene, 4-methyl- (9CI)
    76        9H-Fluorene, 1-methyl- (9CI)
    76        9H-Fluorene, 2-methyl- (9CI)
    70        9H-Fluorene, 9-methyl- (9CI)

22.663        472215             222.92
    80        4H-Cyclopenta[def]phenanthrene (8CI9CI)

25.041        1200400            633.05
    95        Fluoranthene (8CI9CI)

25.894        587394             274.40
    87        Fluoranthene (8CI9CI)
    81        Pyrene (8CI9CI)

25.982        279542             136.80
    83        Heptadecanoic acid, 14-methyl-, methyl ester, (.+-.)- (9CI)
    83        Heptadecanoic acid, 14-methyl-, methyl ester (9CI)
    80        Heptadecanoic acid, 16-methyl-, methyl ester (8CI9CI)
    74        Heptadecanoic acid, 15-methyl-, methyl ester (9CI)
```

Table A-5. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Coke Plant 2, Fraction 3.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90a781101011.d

Peak RT (Fit)	Height (Name)	Amount (ng/L)
16.597	3140390	1612.96
94	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl- (9CI)	
22.656	330255	121.45
83	Docosane (8CI9CI)	
80	Heptacosane (8CI9CI)	
80	Heptadecane, 9-octyl- (8CI9CI)	
72	Tetradecane, 2-methyl- (8CI9CI)	
32.805	640152	242.07
72	1,2-Benzenedicarboxylic acid, diisooctyl ester (9CI)	

Table A-6. Measured and Predicted Stream Flows at Three Locations on Five Mile Creek, Jefferson County, Alabama.

Date	Measured Flow (m^3/s) Station 1[a]	Station 3	Republic[b]	Predicted Flow (m^3/s) Station 1[a]	Station 3
March 26			2.24	0.979	1.223
27			2.07	0.924	1.165
28			1.93	0.879	1.117
29			1.84	0.851	1.089
30			2.15	0.952	1.194
31			1.98	0.897	1.137
April 1			1.76	0.824	1.060
2			1.67	0.796	1.031
3			1.61	0.778	1.012
4			1.53	0.750	0.983
5			1.53	0.750	0.983
6			1.76	0.824	1.060
7	0.872		1.76	0.824	1.060
8		1.045	1.42	0.714	0.945
9			1.39	0.705	0.935
10			1.67	0.796	1.031
11	0.767	0.988	1.67	0.796	1.031
12	0.646		1.36	0.696	0.926
13			1.36	0.696	0.926
14			1.33	0.686	0.916
15	0.708	0.929	1.44	0.723	0.955
16			1.27	0.668	0.897
17			1.27	0.668	0.897
18			1.22	0.650	0.878
19		0.943	1.19	0.641	0.868
20			1.22	0.650	0.878
21	0.677	0.813	1.16	0.631	0.859
22			1.22	0.650	0.878
23		0.790	1.13	0.622	0.849
24			1.39	0.705	0.935
25			1.10	0.613	0.840
26			1.10	0.613	0.840
Average Flow			1.52	0.748	0.981
Standard Deviation			0.316	0.102	0.107
Coefficient of Variation, %			20.8	13.7	10.9

[a] 50 m downstream of Station 1.
[b] USGS gage located at Republic, Alabama.

Table A-7. Regression Equations for Predicting Stream Flows at Stations 1 and 3 and Predicted Stream Flows with 95% Confidence and Prediction Intervals for Selected Flows for Stations 1 and 3 for Five Mile Creek.

Station 1

Predicted Flow = 0.2563 + 0.3232 (Measured Flow at Republic)

Standard Deviation of Slope =	0.1074
Standard Deviation of Constant =	0.2563
r^2 =	0.7512
degrees of freedom =	4

Measured Flow	Predicted Flow	95% Confidence Interval		95% Prediction Interval	
1.00	0.5795	0.4004	0.7585	0.3367	0.8222
1.25	0.6602	0.5533	0.7672	0.4646	0.8559
1.50	0.7410	0.6674	0.8147	0.5614	0.9207
1.75	0.8218	0.7035	0.9401	0.6197	1.0239
2.00	0.9026	0.7098	1.0954	0.6496	1.1556
2.25	0.9834	0.7097	1.2571	0.6644	1.3024

Station 3

Predicted Flow = 0.4663 + 0.3381 (Measured Flow at Republic)

Standard Deviation of Slope =	0.1627
Standard Deviation of Constant =	0.2196
r^2 =	0.5191
degrees of freedom =	5

Measured Flow	Predicted Flow	95% Confidence Interval		95% Prediction Interval	
1.00	0.8045	0.6295	0.9794	0.5283	1.0806
1.25	0.8890	0.7936	0.9844	0.6550	1.1230
1.50	0.9735	0.8589	1.0881	0.7311	1.2160
1.75	1.0581	0.8515	1.2646	0.7609	1.3553
2.00	1.1426	0.8299	1.4552	0.7639	1.5213
2.25	1.2271	0.8048	1.6494	0.7538	1.7004

Table A-8.   Daily Effluent Flow for Coke Plant 1 and Coke Plant 2.

Date	Flow (m³/s) Coke Plant 1	Flow (m³/s) Coke Plant 2	Date	Flow (m³/s) Coke Plant 1	Flow (m³/s) Coke Plant 2
March 26	0.00358	0.175	April 11	0.00457	0.184
27	0.00615	0.162	12	0.00413	0.180
28	0.00599	0.175	13	0.00612	0.175
29	0.00677	0.197	14	0.00792	0.166
30	0.00441	0.188	15	0.00755	0.175
31	0.00372	0.171	16	0.00680	0.197
April 1	0.00400	0.188	17	0.00509	0.197
2	0.00386	0.188	18	0.00188	0.188
3	0.00439	0.171	19	0.00000	0.188
4	0.00799	0.180	20	0.00000	0.193
5	0.00499	0.188	21	0.00338	0.180
6	0.00814	0.188	22	0.00587	0.184
7	0.00128	0.149	23	0.00522	0.202
8	0.00467	0.149	24	0.00426	0.202
9	0.00593	0.180	25	0.00395	0.202
10	0.00529	0.223	26	0.00493	0.188
			Average discharge flow	0.00478	0.184
			Standard Deviation	0.00201	0.0150
			Coefficient of Variation, %	42.1	8.16

Table A-9. In-stream Effluent Concentrations for Discharges from Coke Plants 1 and 2.

Date	Predicted Stream Flow Station 1 m³/s	Station 3 m³/s	Discharge Flow Plant 1 m³/s	Plant 2 m³/s	In-Stream Effluent Concentration Plant 1 %	Plant 2 %
March 26	0.979	1.223	0.00358	0.175	0.365	14.3
27	0.924	1.165	0.00615	0.162	0.666	13.9
28	0.879	1.117	0.00599	0.175	0.682	15.7
29	0.851	1.089	0.00677	0.197	0.795	18.1
30	0.952	1.194	0.00441	0.188	0.464	15.8
31	0.897	1.137	0.00372	0.171	0.414	15.0
April 1	0.824	1.060	0.00400	0.188	0.485	17.8
2	0.796	1.031	0.00386	0.188	0.485	18.3
3	0.778	1.012	0.00439	0.171	0.564	16.9
4	0.750	0.983	0.00799	0.180	1.064	18.3
5	0.750	0.983	0.00499	0.188	0.666	19.2
6	0.824	1.060	0.00814	0.188	0.988	17.8
7	0.824	1.060	0.00128	0.149	0.155	14.1
8	0.714	0.945	0.00467	0.149	0.654	15.8
9	0.705	0.935	0.00593	0.180	0.842	19.2
10	0.796	1.031	0.00529	0.223	0.664	21.7
11	0.796	1.031	0.00457	0.184	0.574	17.8
12	0.696	0.926	0.00413	0.180	0.594	19.4
13	0.696	0.926	0.00612	0.175	0.880	18.9
14	0.686	0.916	0.00792	0.166	1.153	18.2
15	0.723	0.955	0.00755	0.175	1.044	18.4
16	0.668	0.897	0.00680	0.197	1.017	22.0
17	0.668	0.897	0.00509	0.197	0.762	22.0
18	0.650	0.878	0.00188	0.188	0.290	21.5
19	0.641	0.868	0.00000	0.188	0.000	21.7
20	0.650	0.878	0.00000	0.193	0.000	22.0
21	0.631	0.859	0.00338	0.180	0.535	20.9
22	0.650	0.878	0.00587	0.184	0.903	21.0
23	0.622	0.849	0.00522	0.202	0.838	23.7
24	0.705	0.935	0.00426	0.202	0.605	21.5
25	0.613	0.840	0.00395	0.202	0.644	24.0
26	0.613	0.840	0.00493	0.188	0.805	22.4
average					0.644	19.0
standard deviation					0.282	2.80
coefficient of variation, %					43.9	15.8

Table A-10. Coke Plant 1 Weekly Effluent Composite for Target Analysis on Biphenyl.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			0.44	0.68
			0.40	0.66
ERL-D	0	0	3.34	0
	0	0	3.35	0
B. Blank Concentrations (ppb, recovery corrected)				
Battelle			0.02	0
ERL-D	0	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			66.0	44.4
			55.4	42.2
ERL-D	45.0	91.8	74.7	87.4
	48.3	97.3	73.4	88.7
Blank				
Battelle			82.0	64.0
ERL-D	74.0	102.8	76.9	98.3

Table A-11. Coke Plant 1 Weekly Effluent Composite for Target Analysis on Phenanthrene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			18.0	24.5
			14.9	20.3
ERL-D	15.9	12.0	15.9	10.1
	17.2	13.4	14.0	7.19
B. Blank Concentrations (ppb, recovery corrected)				
Battelle			0.12	0.14
ERL-D	0	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			56.0	46.7
			49.4	52.6
ERL-D	48.9	97.4	79.3	88.2
	54.4	96.7	80.1	89.4
Blank				
Battelle			86	74
ERL-D	76.6	106.2	84.9	99.0

Table A-12. Coke Plant 1 Weekly Effluent Composite for Target Analysis on Anthracene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			6.64 6.15	12.0 8.33
ERL-D	7.17 7.36	4.19 4.71	7.31 6.64	4.89 3.94
B. Blank Concentrations (ppb, recovery corrected)				
Battelle			0.01	0.14
ERL-D	0	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			66.0 53.0	55.6 74.1
ERL-D	53.7 57.6	95.5 92.2	75.3 79.1	88.2 90.0
Blank				
Battelle			88.0	84.0
ERL-D	70.0	103.9	74.2	95.3

Table A-13. Coke Plant 1 Weekly Effluent Composite for Target Analysis on Fluoranthene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			25.9	25.1
			22.1	28.2
ERL-D	19.7	16.4	20.5	18.9
	22.5	18.4	17.4	13.7
B. Blank Concentrations (ppb, recovery corrected)				
Battelle			0.08	0.05
ERL-D	0	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			66.0	86.7
			57.0	70.7
ERL-D	--[a]	--	--	--
	--	--	--	--
Blank				
Battelle			92.0	78.0
ERL-D	--	--	--	--

[a] d_{10}-Pyrene recoveries used for recovery correction.

Table A-14. Coke Plant 1 Weekly Effluent Composite for Target Analysis on Pyrene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			19.2 17.0	21.9 23.1
ERL-D	13.5 15.4	11.3 12.8	14.4 12.3	14.2 10.6
B. Blank Concentrations (ppb, recovery corrected)				
Battelle			0.03	0.03
ERL-D	0	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			68.0 56.7	82.2 70.0
ERL-D	64.9 71.5	102.8 98.6	84.8 87.5	96.9 98.4
Blank				
Battelle			94.0	74.0
ERL-D	79.7	109.2	79.5	100.1

Table A-15. Coke Plant 2 Weekly Effluent Composite for Target Analysis on Biphenyl.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			0.04	
			0.05	
	0	0.03	0.04	0.06
	0	0.05	0.05	0.09
ERL-D	0	0.0407	0.0567	0.0508
	0.00695	0.0410	0.0577	0.0508
B. Blank Concentrations (ppb, recovery corrected)				
Battelle	0.00	0.00	0.02	0.00
ERL-D	--	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			73.3	
			65.5	
	77.8	88.9	74.0	51.1
	78.3	71.6	59.2	63.7
ERL-D	102.2	93.4	102.2	84.6
	103.3	92.3	81.3	75.8
Blank				
Battelle	66.7	100.0	82.0	64.0
ERL-D	--	101.1	87.9	83.5

Table A-16. Coke Plant 2 Weekly Effluent Composite for Target Analysis on Phenanthrene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			0.14	
			0.13	
	0.08	0.09	0.19	0.14
	0.07	0.08	0.20	0.81
ERL-D	0.0208	0.0621	0.117	0.0588
	0.0214	0.0594	0.123	0.0670
B. Blank Concentrations (ppb, recovery corrected)				
Battelle	0.06	0.08	0.12	0.14
ERL-D	--	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			77.8	
			75.0	
	77.8	88.9	68.0	64.4
	84.9	85.1	65.8	88.9
ERL-D	94.5	98.9	105.5	95.6
	102.2	98.9	93.4	79.1
Blank				
Battelle	66.7	100.0	86.0	74.0
ERL-D	--	85.7	85.7	84.6

Table A-17. Coke Plant 2 Weekly Effluent Composite for Target Analysis on Anthracene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			0.02	
			0.03	
	0.02	0.03	0.04	0.04
	0.02	0.02	0.04	0.09
ERL-D	0.0180	0.0361	0.0310	0.0336
	0.0191	0.0327	0.0304	0.0349
B. Blank Concentrations (ppb, recovery corrected)				
Battelle	0.00	0.11	0.01	0.14
ERL-D	--	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			91.1	
			89.6	
	88.9	88.9	76.0	77.8
	98.9	89.2	75.4	104.4
ERL-D	84.3	92.8	114.5	92.8
	91.6	95.2	109.6	83.1
Blank				
Battelle	77.8	77.8	88.0	84.0
ERL-D	--	73.5	88.0	78.3

Table A-18. Coke Plant 2 Weekly Effluent Composite for Target Analysis on Fluoranthene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			0.29	
			0.29	
	0.18	0.25	0.35	0.31
	0.19	0.22	0.36	0.42
ERL-D	0.227	0.275	0.216	0.257
	0.228	0.280	0.219	0.247
B. Blank Concentrations (ppb, recovery corrected)				
Battelle	0.04	0.05	0.08	0.05
ERL-D	--	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			91.1	
			83.7	
	88.9	88.9	74.0	64.4
	90.6	81.8	71.5	90.7
ERL-D	--[a]	--	--	--
	--	--	--	--
Blank				
Battelle	77.8	111.1	92.0	78.0
ERL-D	--	--	--	--

[a] d_{10}-Pyrene recoveries used for recovery correction.

A-25

Table A-19. Coke Plant 2 Weekly Effluent Composite for Target Analysis on Pyrene.

	Week 1	Week 2	Week 3	Week 4
A. Effluent Concentrations (ppb, recovery corrected)				
Battelle			0.13	
			0.16	
	0.10	0.14	0.18	0.16
	0.10	0.13	0.18	0.20
ERL-D	0.128	0.134	0.108	0.100
	0.132	0.136	0.109	0.106
B. Blank Concentrations (ppb, recovery corrected)				
Battelle	0.03	0.03	0.03	0.03
ERL-D	--	0	0	0
C. Surrogate Recoveries				
Effluent				
Battelle			84.4	
			80.0	
	77.8	77.8	68.0	64.4
	86.0	74.6	68.4	86.7
ERL-D	100.0	100.0	123.9	100.0
	103.3	101.1	119.6	90.2
Blank				
Battelle	77.8	100.0	94.0	74.0
ERL-D	--	84.8	106.5	88.0

Table A-20. In-Stream Concentration of Biphenyl for Stations 2 and 3 on Five Mile Creek.

Date	Concentration in Discharge		In-Stream Chemical Concentration	
	Plant 1 µg/L	Plant 2 µg/L	Station 2 ng/L	Station 3 ng/L
March 26	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	0.00	0.04	0.00	7.31
3	0.00	0.04	0.00	6.75
4	0.00	0.04	0.00	7.31
5	0.00	0.04	0.00	7.66
6	0.00	0.04	0.00	7.11
7	0.00	0.04	0.00	5.62
8	0.00	0.04	0.00	6.30
9	1.88	0.04	15.83	19.61
10	1.88	0.04	12.49	18.31
11	1.88	0.04	10.79	15.47
12	1.88	0.04	11.17	16.15
13	1.88	0.04	16.54	19.99
14	1.88	0.04	21.68	23.51
15	1.88	0.04	19.62	22.20
16	0.34	0.06	3.46	15.76
17	0.34	0.06	2.59	15.12
18	0.34	0.06	0.99	13.60
19	0.34	0.06	0.00	13.02
20	0.34	0.06	0.00	13.17
21	0.34	0.06	1.82	13.89
22	0.34	0.06	3.07	14.85
23	0.34	0.06	2.85	16.33
24	0.34	0.06	2.06	14.48
25	0.34	0.06	2.19	16.00
26	0.34	0.06	2.74	15.46
Average			4.06	10.8
Standard Deviation			6.39	7.22
Coefficient of Variation, %157.			67.0	

Table A-21. In-Stream Concentration of Phenanthrene for Stations 2 and 3 on Five Mile Creek.

Date	Concentration in Discharge		In-Stream Chemical Concentration	
	Plant 1 μg/L	Plant 2 μg/L	Station 2 ng/L	Station 3 ng/L
March 26	16.60	0.02	60.7	51.4
27	16.60	0.02	110.5	90.4
28	16.60	0.02	113.1	92.1
29	16.60	0.02	132.0	106.8
30	16.60	0.02	77.0	64.5
31	16.60	0.02	68.8	57.3
April 1	16.60	0.02	80.5	66.1
2	12.70	0.03	61.6	53.0
3	12.70	0.03	71.6	60.1
4	12.70	0.03	135.2	108.6
5	12.70	0.03	84.5	70.3
6	12.70	0.03	125.5	102.9
7	12.70	0.03	19.7	19.5
8	12.70	0.03	83.0	67.4
9	15.60	0.07	131.4	112.4
10	15.60	0.07	103.6	95.2
11	15.60	0.07	89.5	81.6
12	15.60	0.07	92.7	83.2
13	15.60	0.07	137.2	116.3
14	15.60	0.07	179.9	147.5
15	15.60	0.07	162.8	136.2
16	15.50	0.20	157.7	161.4
17	15.50	0.20	118.2	131.9
18	15.50	0.20	44.9	76.2
19	15.50	0.20	0.0	43.4
20	15.50	0.20	0.0	43.9
21	15.50	0.20	82.9	102.8
22	15.50	0.20	139.9	145.5
23	15.50	0.20	129.9	142.7
24	15.50	0.20	93.8	113.7
25	15.50	0.20	99.8	120.9
26	15.50	0.20	124.7	135.9
Average			97.3	93.8
Standard Deviation			42.8	35.4
Coefficient of Variation, %	44.0		37.7	

A-28

Table A-22. In-Stream Concentration of Anthracene for Stations 2 and 3 on Five Mile Creek.

Date	Concentration in Discharge		In-Stream Chemical Concentration	
	Plant 1 μg/L	Plant 2 μg/L	Station 2 ng/L	Station 3 ng/L
March 26	7.26	0.02	26.5	24.1
27	7.26	0.02	48.3	41.1
28	7.26	0.02	49.5	42.0
29	7.26	0.02	57.7	48.7
30	7.26	0.02	33.7	30.0
31	7.26	0.02	30.1	26.7
April 1	7.26	0.02	35.2	30.9
2	4.45	0.02	21.6	20.3
3	4.45	0.02	25.1	22.7
4	4.45	0.02	47.4	39.8
5	4.45	0.02	29.6	26.4
6	4.45	0.02	44.0	37.7
7	4.45	0.02	6.9	8.2
8	4.45	0.02	29.1	25.1
9	6.68	0.02	56.2	46.2
10	6.68	0.02	44.4	38.6
11	6.68	0.02	38.3	33.2
12	6.68	0.02	39.7	33.7
13	6.68	0.02	58.8	47.9
14	6.68	0.02	77.0	61.3
15	6.68	0.02	69.7	56.5
16	7.22	0.02	73.5	59.1
17	7.22	0.02	55.0	45.4
18	7.22	0.02	20.9	19.8
19	7.22	0.02	0.0	4.3
20	7.22	0.02	0.0	4.4
21	7.22	0.02	38.6	32.6
22	7.22	0.02	65.2	52.4
23	7.22	0.02	60.5	49.1
24	7.22	0.02	43.7	37.2
25	7.22	0.02	46.5	38.7
26	7.22	0.02	58.1	46.9
Average			41.6	35.3
Standard Deviation			19.3	14.5
Coefficient of Variation, %	46.4		41.0	

Table A-23. In-Stream Concentration of Fluoranthene for Stations 2 and 3 on Five Mile Creek.

| Date | Concentration in Discharge | | In-Stream Chemical Concentration | |
	Plant 1 µg/L	Plant 2 µg/L	Station 2 ng/L	Station 3 ng/L
March 26	21.10	0.19	77.1	89.0
27	21.10	0.19	140.5	137.8
28	21.10	0.19	143.8	142.9
29	21.10	0.19	167.8	165.6
30	21.10	0.19	97.8	108.0
31	21.10	0.19	87.4	97.6
April 1	21.10	0.19	102.4	113.3
2	17.40	0.23	84.4	107.2
3	17.40	0.23	98.1	114.2
4	17.40	0.23	185.2	183.3
5	17.40	0.23	115.8	132.4
6	17.40	0.23	172.0	174.5
7	17.40	0.23	27.0	53.3
8	17.40	0.23	113.7	122.1
9	21.40	0.23	180.2	179.9
10	21.40	0.23	142.2	159.6
11	21.40	0.23	122.8	135.9
12	21.40	0.23	127.2	140.2
13	21.40	0.23	188.2	184.9
14	21.40	0.23	246.8	226.6
15	21.40	0.23	223.3	211.4
16	21.40	0.28	217.7	223.6
17	21.40	0.28	163.2	183.0
18	21.40	0.28	62.0	106.0
19	21.40	0.28	0.0	60.8
20	21.40	0.28	0.0	61.5
21	21.40	0.28	114.4	142.7
22	21.40	0.28	193.2	201.7
23	21.40	0.28	179.4	197.9
24	21.40	0.28	129.5	157.9
25	21.40	0.28	137.8	167.8
26	21.40	0.28	172.2	188.5
Average			132.	146.
Standard Deviation			59.0	46.1
Coefficient of Variation, %	44.8		31.6	

Table A-24. In-Stream Concentration of Pyrene for Stations 2 and 3 on Five Mile Creek.

| Date | Concentration in Discharge | | In-Stream Chemical Concentration | |
	Plant 1 µg/L	Plant 2 µg/L	Station 2 ng/L	Station 3 ng/L
March 26	14.40	0.10	52.6	56.5
27	14.40	0.10	95.9	89.9
28	14.40	0.10	98.1	92.8
29	14.40	0.10	114.5	107.6
30	14.40	0.10	66.8	69.0
31	14.40	0.10	59.7	62.1
April 1	14.40	0.10	69.9	72.1
2	12.00	0.12	58.2	66.8
3	12.00	0.12	67.7	72.3
4	12.00	0.12	127.7	119.4
5	12.00	0.12	79.9	83.9
6	12.00	0.12	118.6	113.5
7	12.00	0.12	18.6	31.3
8	12.00	0.12	78.4	78.2
9	15.70	0.12	132.2	122.6
10	15.70	0.12	104.3	106.5
11	15.70	0.12	90.1	91.0
12	15.70	0.12	93.3	93.4
13	15.70	0.12	138.1	126.4
14	15.70	0.12	181.0	157.4
15	15.70	0.12	163.9	146.1
16	17.40	0.13	177.0	160.4
17	17.40	0.13	132.7	127.4
18	17.40	0.13	50.4	65.2
19	17.40	0.13	0.0	28.2
20	17.40	0.13	0.0	28.5
21	17.40	0.13	93.1	95.6
22	17.40	0.13	157.1	143.5
23	17.40	0.13	145.8	137.7
24	17.40	0.13	105.3	107.3
25	17.40	0.13	112.0	113.0
26	17.40	0.13	140.0	131.4
Average			97.6	96.8
Standard Deviation			45.8	35.4
Coefficient of Variation, % 47.0			36.5	

Table A-25. Tissue Target Analysis for *Decapoda* From Four Stations on Five Mile Creek, Jefferson County, Alabama.

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4

Tissue Concentrations (ppb, recovery corrected)

Biphenyl

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Battelle		91.7 (78.4)[a]		
	67.5	19.9	41.9	67.0
	64.1	75.2	57.3	69.4
ERL-D	1.24	34.3 (6.81)	3.13	3.54
	1.07	12.8	140 (116)	2.40

Phenanthrene

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Battelle		294 (116)		
	55.6	247	39.4	57.6
	64.2	70.8	64.6	50.6
ERL-D	44.5	79.5 (69.5)	48.1	38.2
	55.3	260	2720 (2720)	21.1

Anthracene

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Battelle		78.5 (29.4)		
	3.82	144	16.8	25.2
	5.26	31.7	32.2	19.9
ERL-D	3.34	23.8 (19.7)	15.3	11.0
	1.91	25.2	366 (290)	6.47

Fluoranthene

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Battelle		440 (130)		
	18.4	537	48.3	89.7
	23.5	88.2	75.4	68.0
ERL-D	23.2	121 (115)	82.0	69.4
	28.4	112	2060 (1700)	36.6

Pyrene

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Battelle		393 (121)		
	17.4	491	40.3	75.3
	19.9	88.2	59.2	59.8
ERL-D	14.9	132 (91.3)	51.5	51.0
	14.3	87.4	1010 (812)	26.6

Table A-25. continued.

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Surrogate Recoveries for Tissues				
Biphenyl				
Battelle	67.0	42.0 (44.0)	51.0	37.0
	51.0	65.5	56.5	38.5
		45.5		
ERL-D	67.1	61.7 (61.2)	69.9	59.6
	62.6	53.8	37.0 (49.8)	53.7
				76
Phenanthrene				
Battelle	80.0	39.0 (41.0)	41.0	28.5
	55.5	35.5	33.0	40.5
		35.5		
ERL-D	78.5	72.8 (74.5)	65.1	69.9
	77.4	58.2	50.7 (48.2)	75.3
Anthracene				
Battelle	78.5	43.0 (44.0)	42.5	32.0
	60.5	38.5	31.0	43.0
		37.5		
ERL-D	78.7	74.3 (74.2)	64.1	68.2
	75.2	59.6	62.0 (74.6)	69.7
Fluoranthene				
Battelle	62.5	38.5 (41.5)	47.0	30.0
	47.5	36.0	37.5	43.5
		39.5		
ERL-D	--	--	--	-- (--)
	--	--	--	--
		--		--
Pyrene				
Battelle	57.0	40.0 (40.5)	49.0	32.0
	45.5	36.0	39.0	43.5
		40.5		
ERL-D	87.0	84 (82)	88.4	82.4
	86.3	89.1	61.7 (71.5)	83.4

a Duplicate analysis.

Table A-26. Tissue Target Analysis for *Lepomis* sp. From Four Stations on Five Mile Creek, Jefferson County, Alabama.

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4
Tissue Concentrations (ppb, recovery corrected)				
Biphenyl				
Battelle	63.0	56.9	74.7	68.7 (73.6)[a]
	61.0	65.2	69.9	57.0
ERL-D	4.93	12.5	7.29	6.38 (6.08)
	7.76	3.14	11.9	4.59
		5.81		5.29
Phenanthrene				
Battelle	95.0	55.6	48.4	29.2 (35.2)
	97.0	99.8	70.9	26.3
ERL-D	47.0	81.7	39.5	27.8 (26.5)
	69.0	34.3	72.6	26.3
		53.9		26.3
Anthracene				
Battelle	10.4	30.3	20.1	20.5 (24.4)
	14.2	28.5	21.6	13.47
ERL-D	5.19	15.5	10.2	11.6 (11.3)
	3.53	5.76	20.3	9.59
		8.84		10.1
Fluoranthene				
Battelle	18.8	29.1	19.0	18.5 (21.0)
	24.2	29.8	35.8	16.3
ERL-D	14.2	40.5	24.5	27.9 (27.6)
	19.6	12.4	51.7	22.2
		24.1		25.7
Pyrene				
Battelle	11.9	12.4	12.9	8.51 (9.47)
	17.4	14.9	15.2	7.67
ERL-D	9.52	10.1	8.85	52.8 (10.5)
	7.82	5.47	16.2	8.07
		8.31		9.83

Table A-26. continued.

	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4

Surrogate Recoveries for Tissues

Biphenyl
Battelle	51.0	42.5	42.0	45.0 (47.0)
	59.0	40.0	34.5	43.5
ERL-D	50.1	67.0	62.1	42.0 (40.8)
	68.3	46.2	54.7	56.7
		53.7		76.0

Phenanthrene
Battelle	59.5	43.5	42.5	47.0 (51.0)
	60.0	42.5	37.5	41.5
ERL-D	50.9	79.3	73.6	43.6 (39.3)
	76.2	58.0	66.7	52.8
		60.7		86.2

Anthracene
Battelle	51.5	31.0	41.0	37.0 (39.5)
	45.5	40.0	31.5	35.5
ERL-D	49.9	76.1	71.9	43.5 (38.2)
	73.7	55.6	64.0	53.6
		59.3		84.9

Fluoranthene
Battelle	53.0	50.5	43.5	47.0 (52.0)
	55.5	47.0	38.5	42.5
ERL-D	--	-- (--)	--	--
	--	--	--	--

Pyrene
Battelle	52.5	48.5	44.5	47.0 (52.0)
	56.5	47.0	39.5	42.0
ERL-D	68.7	81.0	76.8	58.5 (51.0)
	79.5	79.0	69.6	74.7
		66.3		86.8

[a] Duplicate analysis.

Table A-27. Blank Concentrations and Surrogate Recoveries for Tissue Analysis.

	Blank Concentrations (ppb, recovery corrected)	Surrogate Recoveries
Biphenyl		
Battelle	10.0	52.5
	24.1	45.0
ERL-D	0	53.5
	0.230	50.5
	0.242	53.7
Phenanthrene		
Battelle	2.10	52.0
	3.00	52.0
ERL-D	1.28	61.4
	1.51	47.7
	1.50	48.0
Anthracene		
Battelle	0.20	53.5
	0.20	52.5
ERL-D	0	59.4
	0	44.6
	0	45.6
Fluoranthene		
Battelle	0.80	56.0
	0.90	56.5
ERL-D	0.297[a]	--
	0	
	0	
Pyrene		
Battelle	0.45	54.0
	0.65	57.5
ERL-D	0.747	75.8
	0.565	75.0
	0.666	67.6

[a] d_{10}-Pyrene used for recovery correction.

Table A-28. Percent Lipid Content in Tissues From Four Stations on Five Mile Creek, Jefferson County, Alabama.

ERL-D	Upstream Station 1	Discharge Station 2	US31 Bridge Station 3	3mi Down Station 4	Background
Decapoda	3.50	2.24 (2.50)	2.83	3.00	
	3.15	2.08	1.80 (1.40)	0.893	
					Average (n = 8)
					2.43
Lepomis sp.	3.99	4.10	3.20	5.60 (6.13)	
	4.58	2.83	4.76	4.22	
		4.55		4.22	
					Average (n = 10)
					4.23
Ictalarus	2.24		1.95		3.46
puctatus	4.16		2.60		
					Average (n = 5)
					2.88

Battelle (no site indicated)

Decapoda	2.0	
Lepomis sp.	2.9	

Table A-29. Tissue Target Analysis for *Ictalarus puctatus* From Caged Exposures at Five Mile Creek, Jefferson County, Alabama.

	Upstream Station 1	US31 Bridge Station 3	Background
Tissue Concentrations (ppb, recovery corrected)			
Biphenyl			
ERL-D	15.2	3.36	1.44
	17.4	4.32	
Phenanthrene			
ERL-D	106	13.6	7.25
	112	13.0	
Anthracene			
ERL-D	12.4	6.73	0.00
	11.5	7.50	
Fluoranthene			
ERL-D	33.5	17.4	1.01
	32.6	14.9	
Pyrene			
ERL-D	16.9	11.0	1.26
	16.0	8.43	
Surrogate Recoveries for Tissues			
Biphenyl			
ERL-D	65.1	67.0	65.9
	56.3	61.6	
Phenanthrene			
ERL-D	72.7	79.3	79.4
	113.8	66.0	
Anthracene			
ERL-D	73.6	76.1	77.9
	117.3	63.7	
Fluoranthene			
ERL-D	--	--	--
	--	--	
Pyrene			
ERL-D	77.4	81.0	85.0
	79.5	85.3	

Table A-30. Ambient Water Samples for Target Chemical Analysis for Five Mile Creek, Birmingham, Alabama.

Ambient Station:	Blank	1	2	3	4	5	6
A. Ambient Concentrations (ng/L, recovery corrected)							
Biphenyl	0.460	6.52	2.11	1.95	710.	3.37	4.32
Phenanthrene	3.35	19.5	7.90	6.63	886.	12.7	43.5
Anthracene	2.72	6.91	3.96	3.35	188.	4.14	25.9
Fluoranthene	3.62	15.0	11.6	7.21	327.	10.4	167.
Pyrene	3.12	14.0	11.6	6.89	166.	10.4	154.
B. Surrogate Recoveries (%)							
Biphenyl	89.1	62.1	84.5	84.7	69.3	74.7	22.7
Phenanthrene	90.7	62.6	86.5	87.5	88.2	76.4	25.6
Anthracene	86.4	59.6	84.2	80.8	92.7	74.6	25.7
Fluoranthene[a]	-	-	-	-	-	-	-
Pyrene	89.9	70.2	97.9	91.1	97.3	79.5	29.6

[a] d_{10}-Pyrene recoveries used for recovery correction.

FIELD EVALUATION OF RESIDUE PREDICTION PROCEDURES

USED IN EPA'S GUIDANCE:

"ASSESSMENT AND CONTROL OF BIOCONCENTRATABLE CONTAMINANTS

IN SURFACE WATERS":

THE LOUISIANA STUDY

1993 DRAFT FOR APPENDIX I

Lawrence P. Burkhard[1]
Barbara Riedel Sheedy[2]
Nelson A. Thomas[1]

[1]U.S. Environmental Protection Agency
Environmental Research Laboratory-Duluth
6201 Congdon Boulevard
Duluth, MN 55804

[2]AScI Corporation
6201 Congdon Boulevard
Duluth, MN 55804

Foreword

Recent advances in environmental sciences, analytical chemistry, and toxicology have permitted the development of a systematic and scientifically defensible procedure for identifying, assessing, and controlling chemicals which form residues in fish and/or shellfish. This guidance procedure, "Assessment and Control of Bioconcentratable Contaminants in Surface Waters", is applicable to nonpolar organic chemicals which bioconcentrate and/or bioaccumulate in aquatic organisms.

The principal components of this newly developed guidance approach are: a) analytical procedures for detecting and identifying bioconcentratable chemicals in effluents or receiving water organisms, b) procedures to predict residues of bioconcentratable chemicals in aquatic organisms, c) procedures for deriving criteria for aquatic organisms and receiving waters for bioconcentratable chemicals, and d) permitting guidance for control of these pollutants from point sources. The guidance approach combines these procedures to arrive at discharge concentrations for bioconcentratable chemicals which limit residues in aquatic organisms used for human consumption.

This report presents results of a field study conducted on an estuarine bayou with one point source discharge. The objective of the study was to determine how well tissue residue concentrations can be predicted in field discharge situations using the guidance residue prediction procedure. Thirteen chemicals were studied.

Disclaimer

This document has been reviewed in accordance with U.S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Acknowledgements

3

Contents

4

Figures

Tables

Tables (continued)

8

Appendix A Tables

Table A-1. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Outfall, Fraction 1.

Table A-2. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Outfall, Fraction 2.

Table A-3. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Outfall, Fraction 3.

Table A-4. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Station 1, Fraction 1.

Table A-5. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Station 1, Fraction 2.

Table A-6. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Station 1, Fraction 3.

Table A-7. Concentrations of Hexachloroethane in Ambient Water Samples.

Table A-8. Concentrations of Tetrachlorobutadiene #1 in Ambient Water Samples.

Table A-9. Concentrations of Tetrachlorobutadiene #2 in Ambient Water Samples.

Table A-10. Concentrations of Pentachlorobutadiene #1 in Ambient Water Samples.

Table A-11. Concentrations of Pentachlorobutadiene #2 in Ambient Water Samples.

Table A-12. Concentrations of Hexachlorobutadiene in Ambient Water Samples.

Table A-13. Concentrations of 1,2,3-Trichlorobenzene in Ambient Water Samples.

Table A-14. Concentrations of 1,2,4-Trichlorobenzene in Ambient Water Samples.

Table A-15. Concentrations of 1,2,4,5- and 1,2,3,5-Tetrachlorobenzene in Ambient Water Samples.

10

11

INTRODUCTION

The Environmental Protection Agency has developed a guidance procedure, "Assessment and Control of Bioconcentratable Chemicals in Surface Waters" [1], to control bioconcentratable chemicals in effluents. This guidance consists of a number of technical procedures that have been developed during the past several years. The principal components of the guidance approach are: 1) analytical procedures for detecting and identifying bioconcentratable chemicals in effluents, receiving water, and organisms, 2) prediction of the bioconcentration factor (BCF) from the n-octanol water partition coefficient (P) using quantitative structure activity relationships (QSAR), 3) prediction of the bioaccumulation factor (BAF) from the chemical's BCF and log P, and the trophic status of the organism of concern, 4) prediction of residues in aquatic organisms using the BCF or BAF and concentration of the chemical in the receiving water, and 5) calculation of allowable ambient water or tissue residue concentrations for bioconcentratable chemicals based upon human consumption of contaminated fish and shellfish. The guidance protocol combines these procedures to arrive at discharge concentrations for bioconcentratable chemicals which will limit residues in aquatic organisms used for human consumption.

The guidance approach provides two alternatives for assessing point source discharges for bioconcentratable chemicals, the effluent and tissue alternatives (component 1). With these alternatives, either effluent from a point source discharge or indigenous receiving water organisms are analyzed. Results from the analytical methods for both alternatives are listings of bioconcentratable chemicals. These results are evaluated further using components 2 through 5, to determine if development of permit limits are needed for any of the identified bioconcentratable chemicals.

With the tissue alternative, the analytical results provide information for the entire receiving water since the aquatic organisms provide an integrated assessment of all point and nonpoint sources of bioconcentratable chemicals. When an unallowable tissue residue is found, additional chemical analyses are required to determine the source(s) of the residue forming chemical to the receiving water. In contrast, with the effluent alternative, point source discharges are examined individually. The inclusion of both alternatives in the guidance provides greater flexibility and usefulness for the guidance approach since neither alternative by itself is useful in all permitting situations.

1.1 Site Study Objective

" The objective of the site study was to determine how well tissue residue concentrations can be predicted in field discharge situations using the guidance procedures, i.e., components 2, 3, and 4.

This validation effort was not designed to verify a) the accuracy of the allowable tissue residues, b) the analytical procedures associated with the tissue alternative, c) the prediction of residues where exposure is intermittent, d) the prediction of residues where exposure is difficult to estimate, or e) the derivation of acceptable human uptake levels.

1.2   Constraints

In order to predict residues in receiving water organisms, the concentration of the chemicals in the receiving water must be known, and these concentrations (in the receiving water) must be relatively constant for a 20 to 40 day period. Without these conditions, successful evaluation of the field data will be nearly impossible since the indigenous organisms will never come to steady-state conditions with the receiving water.

These characteristics, in general, are associated with sites which: a) have reasonably simple hydrodynamics so that receiving water concentrations can be determined and/or calculated, b) have short hydraulic resident times so that fate and halflife considerations are minimized for the discharged chemicals, c) have effluent discharges with relatively constant concentrations of bioconcentratable chemicals, and d) have limited sources of the bioconcentratable chemicals under investigation.

SITE SELECTION AND DESCRIPTION

This report details the validation study performed on Bayou d'Inde, Calcasieu Parish, Louisiana in September and October, 1990. This field site was selected because a) the effluent upon assessment with the effluent alternative analytical method contained bioconcentratable chemicals, b) the flow regime of the site was reasonably simple and had short flow times, and c) native populations of fish and shellfish were available. Furthermore, preliminary calculations suggested that concentrations of the chemicals in the receiving water were high enough to result in measurable tissue residues in the indigenous organisms.

2.1 Description of Bayou d'Inde, Calcasieu Parish, Louisiana

The site selected for the validation study was a 1.6 km stretch of Bayou d'Inde and a 1.6 km length of an effluent/cooling water canal which flows in to the bayou (Figure 2-1). This site is located about 6.4 km west of Lake Charles, Louisiana and is in the lower Calcasieu River system (Figure 2-1). The effluent/cooling water canal receives a discharge from a chemical manufacturing plant which produces a variety of synthetic organic chemicals. The effluent/cooling water canal is a dredged channel, 3 m deep and 20 m wide. Three bridges cross the canal within the study area, and these bridges provide access to natural gas and oil wells in the marshes adjacent to the canal.

Bayou d'Inde is a lowland channel that meanders through a tidally-influenced brackish/freshwater marsh. Water from Bayou d'Inde flows in a southeasterly direction into the Calcasieu River ship canal, and Bayou d'Inde is used for commercial navigation. Commercial navigation in the bayou consists primarily of petroleum carrying barges and barge tows. Water levels in Bayou d'Inde and the surrounding marsh fluctuate with the daily tidal cycle, and with seiches generated by northerly and southerly winds on the lower Calcasieu River system. The water level of the effluent canal is influenced by the fluctuating water levels in Bayou d'Inde. Typical tidal fluctuations are about 15 cm in the bayou [2].

Bayou d'Inde is a highly industrialized estuary and the bayou receives discharges from at least five different manufacturing facilities. The bayou is highly contaminated with metals and chlorinated nonpolar organics [3,4]. In general, the water quality of the bayou is highly degraded, and numerous EPA criteria and state water quality standards are exceeded.

15

Figure 2-1. Location of sampling sites during a toxicity-characterization study of the lower Calcasieu River and Bayou d'Inde, Louisiana, June 1988, from Demcheck et al. 1990 [5].
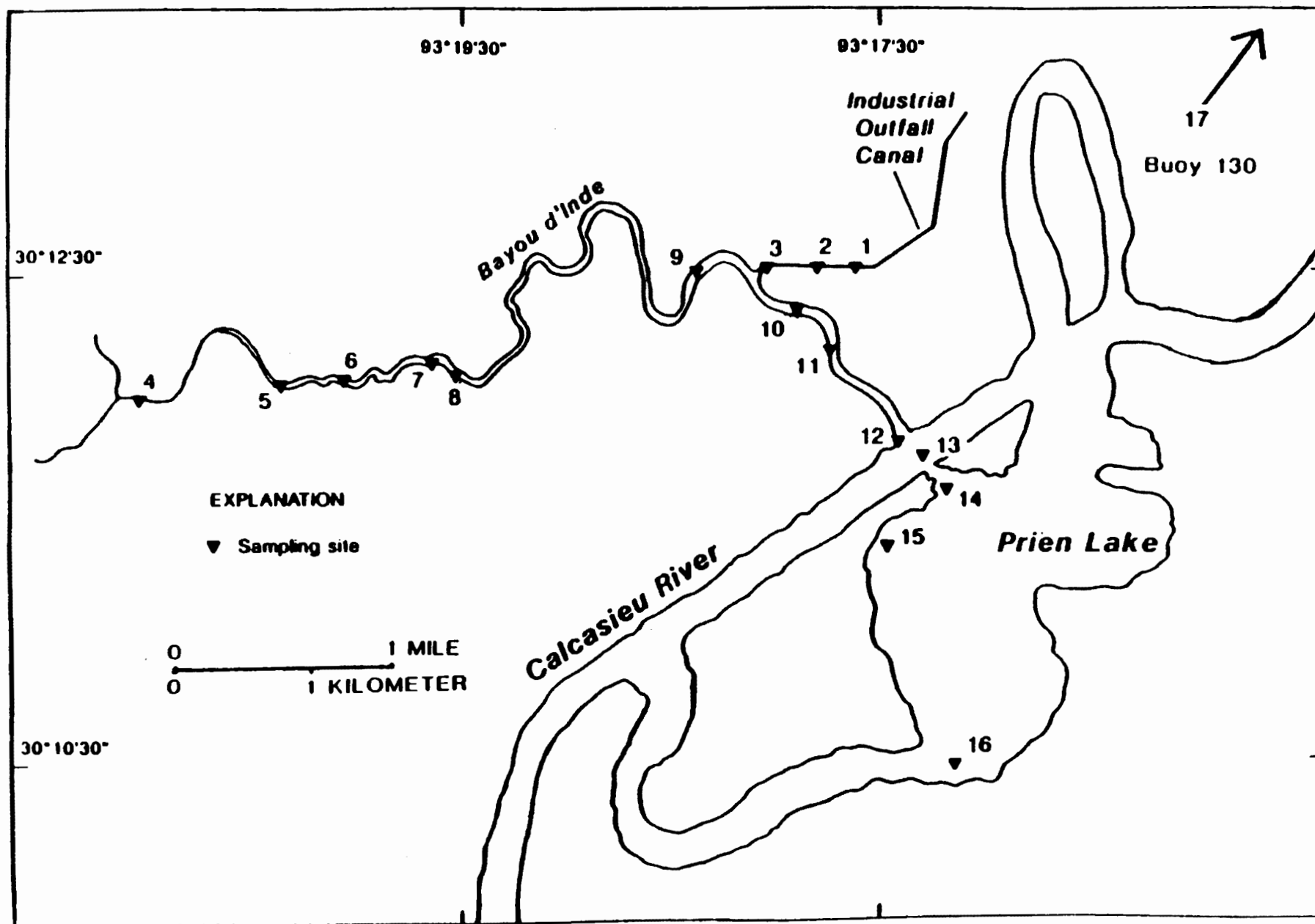
After discovery of the contaminant problem in 1986 and 1987, advisories were issued by the Louisiana Department of Environmental Quality and the Louisiana Department of Health and Hospitals against the consumption of fish and shellfish and against swimming, wading, and water sports in Bayou d'Inde. In 1989, advisories against the sale and consumption of speckled trout and white trout from the lower Calcasieu estuary were issued in light of the high fish and shellfish tissue residue levels of hexachlorobenzene and hexachlorobutadiene.

Seven sample collection sites were used for this study (Figure 2-1). This figure was taken from a previous study [5], and therefore, the sample locations 1, 2, 3, 9, 10, and 11 correspond with stations A, 1, B, C, D, E, respectively, in this study. For the effluent/cooling water canal, three stations, Stations A, 1, and B, were located at the three bridges crossing the canal. Station A was furthest upstream and Station 1 was 400 m downstream of Station A. Station B was 400 m downstream of Station 1, and approximately 400 m upstream of the confluence of the effluent/cooling water canal and Bayou d'Inde.

Three stations, Stations C, D and E, were located in a navigable stretch of Bayou d'Inde. Station C was located 400 m upstream of the confluence of the effluent/cooling water canal and Bayou d'Inde. Stations D and E were located 400 and 800 m, respectively, downstream of the confluence of the effluent/cooling water canal and Bayou d'Inde.

The seventh sampling station was the outfall from the chemical plant prior to dilution with cooling water. The outfall after dilution with cooling water enters the upstream end of the canal. The canal is composed of 100% effluent, i.e., outfall after dilution with cooling water, and Station 1 corresponds to the NPDES permitted sample location for the chemical manufacturing facility.

2.2 Screening of the Effluents

Prior to the site study, the effluent analytical method was performed on grab effluent samples from Station 1 and the outfall. This method detected and identified a number of chlorinated organics, i.e., chloro-benzenes and chloro-butadienes, and a few polycyclic aromatic hydrocarbons (PAHs). Data for these analyses are reported in Appendix A (Tables A-1 through A-6) for the samples from Station 1 and the outfall.

2.3 Selection of Target Chemicals

For this study, thirteen chemicals were chosen for evaluation. In Table 2-1, a listing of the thirteen site study chemicals, their abbreviations, and BCFs are reported. Six of the thirteen chemicals were identified by using the effluent analytical procedure on the outfall and Station 1 grab samples prior to the study (Table 2-1). Of the remaining seven chemicals, two were isomers and five were structural analogs of the chemicals identified using the effluent analytical procedure.

Table 2.1   Site Study Chemicals

Full Chemical Name	Abbreviation	Calculated BCF	Identified in the Effluent Analysis?
Hexachloroethane	(HCE)	742	yes
Tetrachlorobutadiene #1	(TeCBD#1)	140	no
Tetrachlorobutadiene #2	(TeCBD#2)	140	no
Pentachlorobutadiene #1	(PeCBD#1)	340	yes
Pentachlorobutadiene #2	(PeCBD#2)	340	no
Hexachlorobuta-1,3-diene	(HCBD)	2380	yes
1,2,3-Trichlorobenzene	(1,2,3-TrCB)	630	no
1,2,4-Trichlorobenzene	(1,2,4-TrCB)	597	yes
1,2,4,5- and 1,2,3,5- Tetrachlorobenzene	(TeCB Mix)	2800	no
1,2,3,4-Tetrachlorobenzene	(1,2,3,4-TeCB)	1840	no
Pentachlorobenzene	(PeCB)	4850	yes
Hexachlorobenzene	(HCB)	6240	yes

All thirteen site study chemicals were present in the outfall and/or Station 1 grab samples even though they were not all identified with the effluent analytical procedure. The inclusion of the seven remaining chemicals allowed a more complete and comprehensive evaluation of the chlorinated butadiene and benzene classes of compounds.

Two of the selected chemicals, 1,2,4,5- and 1,2,3,5-TeCBs, could not be consistently resolved in the instrumental analysis and therefore, these two chemicals were treated as one in this site study. For the TeCBDs and PeCBDs, the lack of reference materials, i.e., neat material, prevented direct confirmation of each chemical. Therefore, the TeCBDs and PeCBDs were referred to as TeCBD#1, TeCBD#2, PeCBD#1, and PeCBD#2 in this study.

The chemicals selected for the site study were typical of the chemicals from the discharge. Their calculated BCFs ranged from 140 to 6,420 (Table 2-1). Some of the chemicals were available in stable isotope form; with stable isotopes, recoveries for the chemicals through the analytical procedure can be determined for each sample.

METHODS

3.1 Site Study Plan

Measured residue levels in indigenous organisms for the Bayou d'Inde site were compared to residue concentrations predicted for these organisms.

Residue levels in the organisms were predicted by determining the ambient chemical concentrations and using these data in the residue prediction procedure. Ambient water concentrations were determined by collecting and analyzing one grab¯water sample every seven days for four weeks at six sampling stations. Three of the sampling stations were located in the canal, and the remaining three stations were located in the bayou. One of the bayou stations was above the confluence of the canal and the bayou. In conjunction with the collection of the grab samples, a series of four, seven-day 24-hour composite ambient water samples were collected and analyzed from one of the sampling stations located on the canal.

Indigenous organisms were collected at the end of the 28 day period at the six stations used for the collection of the ambient water samples. Residue analyses and lipid content determinations were performed on the indigenous organisms.

Replicate chemical analyses were performed on the ambient water samples and indigenous organisms by two analytical laboratories. These analyses included both inter- and intra-laboratory replication of the ambient water samples. For the tissue samples, replicate analyses were performed on selected samples when enough tissue mass was available.

3.2 - Estimation of Residues in Aquatic Organisms

Only a brief description of the residue prediction technique is presented here. The reader is referred to EPA 1991 [1] for further details.

3.2.1 Prediction of Bioconcentration Factors for Aquatic Organisms

Bioconcentration factors for aquatic organisms were estimated using the multi-species log BCF-log P correlation developed by Veith and Kosian [6]:

$$\log \text{BCF} = 0.79 \log P - 0.40 \qquad n = 112 \qquad r^2 = 0.86$$

This correlation, derived from a data set consisting of 122 BCF values for 13 freshwater and marine species, was typical of all log BCF-log P correlations [7]. The above equation has 95% prediction intervals (note, 95% confidence intervals for the mean BCF are much smaller) of approximately one order of magnitude, and the predicted BCF values were for organisms with 7.6% lipid content.

The predicted BCF values must be corrected to the appropriate lipid content before prediction of the tissue residues since numerous fishes and shellfishes have lipid contents differing from 7.6%. The BCF is directly proportional to lipid content, and corrections for lipid content were done using a simple proportionality.

3.2.2 Prediction of Bioaccumulation Factors for Aquatic Organisms

Bioaccumulation factors are derived by "adjusting" the BCF using a food chain multiplier (FM) for the organism of concern [1]:

$$BAF = FM * BCF$$

The FM is dependent upon the log P of the chemical and the structure of the organism's food chain [8-10].

In this site study, the FMs for the chemicals under investigation were equal to 1.0 for eleven of the thirteen chemicals due to their relatively low log P values and consequently, the BAF and BCF were equal for these chemicals. For two other chemicals, PeCB and HCB, their FMs were 3.0 and 3.7, respectively. For different chemicals, readers should consult EPA 1991 [1] to obtain the appropriate FM value.

3.2.3 Prediction of Residues in Aquatic Organisms

The tissue residues for a chemical were calculated by multiplying the BAF, the product of the BCF and FM terms, after correction for lipid content, by the concentration of the chemical in the water:

$$[Fish] = BAF * [Water] = BCF * FM * [Water]$$

The [Fish] and [Water] terms are the concentration of the chemical in the aquatic organism and in the receiving water, respectively. Residue concentrations predicted using the BCF or BAF were for steady-state conditions which implies that the concentration of a chemical in the receiving water was at steady-state also.

3.2.4 Metabolism and Prediction of Residues in Aquatic Organisms

The tissue residues predicted using the procedure outlined in Sections 3.2.1 through 3.2.3 assumes that *in vivo* metabolism of the contaminants does not occur. When metabolism occurs, the predicted residues will be larger than those measured in the organisms, because metabolism enhances excretion of zenobiotic chemicals.

The effects of metabolism on the actual versus predicted tissue residue concentrations is dependent upon the rate of metabolism for each chemical. For chemicals with slow rates of metabolism, the differences between the predicted and measured tissue residues will be small, while for chemicals with rapid rates of metabolism, differences between the predicted and measured tissue residues will be large.

21

3.3   Sampling Procedures

3.3.1   Field Sampling Procedures for the Composite Ambient Water Samples

A series of four, seven-day, 24-hour composite ambient water samples were collected from Station 1. Sample collection was initiated on September 12, 1990, and was completed on October 10, 1990. The individual composites were taken during the time periods of September 12-19, September 19-26, September 26 to October 3, and October 3-10.

The samples were collected in an iced ISCO° water sampler equipped with a glass collection vessel. The ISCO° sampler was inspected daily, at which time the ice was replenished and the water samples were removed and placed in refrigerated storage. Because of the heat and humidity at Station 1 during the course of the study, the ISCO° sampler occasionally failed. On the days when a 24-hour composite sample was not available, or when the volume of sample was insufficient, a grab sample from the canal was collected to supplement the daily composite sample. At the end of each seven-day period, the individual 24-hour samples were composited and mixed in a 60 liter carboy container. Replicate four liter samples were drawn from the seven-day composite samples, placed into new brown glass 1 gallon solvent bottles with teflon lined caps, packed on ice, and shipped using overnight delivery to two analytical laboratories, Battelle-Columbus and Environmental Research Laboratory-Duluth (ERL-D).

3.3.2   Field Sampling Procedures for the Grab Ambient Water Samples

On the seventh day of the collection of the seven-day composite ambient water samples at Station 1, replicate four liter ambient canal and Bayou d'Inde water samples were collected from stations A, 1, B, C, D and E. These samples were collected on September 19, September 26, October 3, and October 10. The only exception was the collection of the Station 1 grab sample which was taken on the 20th instead of the 19th of September.

The ambient grab samples were collected at mid-channel/mid-water column at each station using a battery operated electric pump. Upon collection, these samples were placed into new brown glass 1 gallon solvent bottles with teflon lined caps, packed on ice, and shipped using overnight delivery to Battelle and EPA-Duluth.

3.3.3 Field Sampling Procedure for the Grab Water Samples From the Outfall.

- Replicate four liter grab samples were collected from the outfall from the chemical plant prior to dilution with cooling water on September 20, September 26 October 3, and October 10, 1990. These samples were placed into new brown glass 1 gallon solvent bottles with teflon lined caps, packed on ice, and shipped using overnight delivery to ERL-D.

22

3.3.4 Field Procedures for Sampling Sediments

Concurrently with the collection of the last ambient water grab samples (10 and 11 October 1990), sediment samples were collected from all six ambient stations using an Eckman dredge sampler. Three samples were collected per station, the quarter, mid-, and 3/4 quarters channel locations. Samples were transferred to glass containers, capped with teflon lined lids, packed on ice, and shipped to Battelle-Columbus and EPA-Duluth.

3.3.5 Field Sampling Procedures for Indigenous Organisms

Resident organisms were collected on October 8-11, 1990, using a combination of variable mesh gill nets, cast nets, minnow traps and crab pots. The common and scientific names of the organisms collected are listed in Table 3-1. Of the ten species collected, two species, _Fundulus heteroclitus_ and _Callinectes sapidus_, were collected at all six stations. The third most common species, _Brevoortia patronus_, was collected at five of the six stations. The fourth most abundant species, _Micropogan undulus_, was collected at four of the six stations. The six remaining species collected were present only at low numbers (one or two) at few of the stations.

Immediately after collection, the organisms were placed in coolers containing

wet ice until they were labeled and frozen (< 24 h). Special care was taken to insure that separate coolers were used for holding the organisms at each station. The collected organisms were frozen whole in solvent rinsed aluminum foil packages containing 3 to 10 organisms. Individual organisms that weighed more than 100 grams were packaged separately. When the collection of resident organisms was completed, the frozen packages of organisms were inventoried, shipped on dry ice to Battelle-Great Lakes, and then shipped on dry ice to Battelle-Columbus and ERL-D for compositing and analysis.

3.4 Analytical Procedures

3.4.1 Effluent Analysis Procedure

Only a brief account of the procedure for detecting and identifying bioconcentratable chemicals in effluents will be presented here. Readers are referred to Appendix B of EPA's guidance [1] for further details.

A 10 L effluent sample was spiked with three surrogate compounds, d_{10}-biphenyl, $^{13}C_6$-1,2,4,5-TeCB, and $^{13}C_6$-HCB, and extracted with hexane. The hexane extract was subsequently cleaned up using sulfuric acid, and concentrated to a volume of 0.50 mL. The extract was chromatographed using reverse phase high pressure liquid chromatography (HPLC), and three fractions were collected. The fractions were extracted, concentrated to 0.10 mL, and spiked with the internal standard, d_{12}-chrysene. The fraction extracts were analyzed using capillary gas chromatography with full scan electron impact ionization mass spectrometry (GC/MS).

Table 3-1. Common and Scientific Names of Organisms Collected at Six
Sample Stations Near Lake Charles, Louisiana.

Common Name	Scientific Name[a]
Cockahoo (mummy chog)[b]	Fundulus heteroclitus
Striped Mullet	Mugil cephalus
Blue Crab[c]	Callinectes sapidus
Gulf Menhaden[d]	Brevoortia patronus
Butterfish (spot)	Leiostomus xanthurus
Atlantic Croaker[e]	Micropogan undulus
Sea Catfish (hardhead)	Arius filus
Marsh Killifish	Fundulus confluentus
Banana Fish (Lady Fish)	Elopes saurus
Fiddler Crab	Uca pugilator

[a] Scientific names of fishes taken from: Common and Scientific Names of North American Fishes. American Fisheries Society. 1970.
[b] Most common fish.
[c] Most common invertebrate.
[d] Third most common organism collected.
[e] Fourth most common organisms collected.

24

Each chromatographic peak in the GC/MS chromatograms was quantified using the response factor calculated from its appropriate surrogate. For fractions one, two, and three, the quantification surrogates were d_{10}-biphenyl, $^{13}C_6$-1,2,4,5-TeCB, and $^{13}C_6$-HCB, respectively.

For each fraction, all chromatographic peaks were reverse-searched against (compared with) the Chemicals of Highest Concern (CHC) mass spectral library [1]. Those chemicals not identified with the CHC search with effluent concentrations above 100 ng/L, were then reversed-searched against the EPA/NIH/NBS mass spectral library. Peaks with fits of greater than 70% were considered tentatively identified. For each tentatively identified component, a list of the best mass spectral library identifications (up to a total of ten identifications) was reported along with the percent fit values.

3.4.2 Weekly Ambient Water (Grab and Composite) and Outfall (Grab) Samples Analysis Procedure

The weekly ambient composite and ambient grab samples were analyzed at two different laboratories, Battelle-Columbus and ERL-D. The outfall water sample from the chemical plant was analyzed at ERL-D. The ambient grab samples for Station 1 were analyzed for dissolved and particulate chemical concentrations at Battelle-Columbus.

The analytical methods used at both laboratories were similar, and the concentrations reported for the target chemicals were comparable between the two laboratories. Similar data between the two laboratories were obtained by the use of an internal standard quantification method, ^{13}C- labelled surrogates for determining compound recoveries, and reporting of the data after recovery correction.

The analytical procedures consisted of spiking a known sample volume of water, Battelle, 5.0 L, and ERL-D, 3.6 L, with $^{13}C_1$-HCE, $^{13}C_4$-HCBD, $^{13}C_6$-TeCB, and $^{13}C_6$-HCB at concentrations similar to the target chemical concentrations, Battelle, 600 ng/L, and ERL-D, 200 ng/L. The spiked water samples were extracted three times using hexane at 60 mL per liter. The hexane was dried using sodium sulfate, concentrated using a Kuderna-Danish concentrator (K-D) to ca. 10 mL and reduced to 1.0 or 0.10 mL using a gentle stream of nitrogen. These extracts were spiked with the internal standard, d_{12}-chrysene, Battelle, 2 mg/L and ERL-D, 10 mg/L.

Dissolved chemical concentrations in this study were defined as the chemical which passes through a Whatman glass fiber filter. (Note, the exact filter type was not recorded in laboratory record book.) Particulate chemical concentrations were defined as the chemical which was retained by the Whatman

glass fiber filter. For the filtered samples from Station 1, ten liter samples were filtered through Whatman glass fiber filters, (pore size was not recorded) using vacuum filtration. The filtered ambient samples were analyzed as described above. The particulates retained on the filters were analyzed by crumbling the filters, then spiking the filters with the surrogate solution, and finally extracting with two 100 mL aliquots of hexane followed by one 100 mL aliquot of acetone using a tumbling extractor device. The hexane and acetone were combined, concentrated to approximately 0.5 mL using a K-D concentrator, and reduced to 100 μL using natural evaporation. These extracts were spiked with the internal standard, d_{12}-chrysene, at a 2 mg/L concentration.

GC/MS analysis using selected ion monitoring (SIM) was performed, and quantifications were performed using an internal standard method with 5 or 6 standard concentrations. An average response factor (Battelle) or a piece-wise calibration curve (ERL-D) were used in the quantification of each chemical. The responses of the surrogate chemicals were corrected for isotopic inferences from the native chemical responses prior to calculation of their response factors. The most predominant ion was used to quantify each compound.

Quantification standards contained the internal standard (d_{12}-chrysene), the four carbon-13 labelled surrogates ($^{13}C_1$-HCE, $^{13}C_4$-HCBD, $^{13}C_6$-TeCB, and $^{13}C_6$-HCB), and the native forms of the target chemicals except for the TeCBD and PeCBD compounds, which were not available commercially. For the TeCBD#1, TeCBD#2, PeCBD#1, and PeCBD#2 compounds, the response factor for HCBD was used for quantification. The 1,2,4,5- and 1,2,3,5-TeCBs could not be consistently resolved on the gas chromatograph and therefore, these two chemicals were quantified and reported as a mixture.

All quantification results for the site study chemicals were recovery corrected. For HCE, recovery corrections were made using the recoveries of $^{13}C_1$-HCE. For PeCB and HCB, recovery corrections were made using the recoveries of $^{13}C_6$-HCB. For 1,2,4-TrCB, 1,2,3-TrCB, 1,2,4,5-and 1,2,3,5-TeCB mixture (TeCB Mix), 1,2,3,4-TeCB, TeCBD#1, TeCBD#2, PeCBD#1, PeCBD#2, and HCBD, recovery corrections were made using the recoveries of $^{13}C_6$-1,2,4,5-TeCB. The recovery of the $^{13}C_4$-HCBD surrogate was not used to recovery correct the TeCBD#1, TeCBD#2, PeCBD#1, PeCBD#2, and HCBD compounds due to the extremely high concentrations of natural HCBD which masked the responses of the labelled HCBD on the GC/MS.

Since some of the site study chemicals were recovery corrected using the recoveries for different compounds, recovery confirmation experiments were performed using the analysis procedure with reagent water spiked with these chemicals. Differences in recoveries between PeCB and HCB were 1%, and

between TeCB Mix and 1,2,4-TrCB, 1,2,3-TrCB, 1,2,3,4-TeCB, and HCBD were small, 23, 17, 14, and 1%, respectively.

Before finalizing the data, surrogate recoveries, inter- and intra-laboratory consistency, and procedure blank values were evaluated for each sample. An acceptable range of recoveries for the surrogates was set at 20% to 120% for water analyses. Site chemicals with surrogate recoveries outside of this range were rejected as being unreliable. For chemicals failing this evaluation, their determinations were not reported but were labeled as not passing this quality control evaluation.

Inter- and intra-laboratory precision of the recovery corrected chemical concentrations reported was evaluated by comparing replicate determinations. For replicate samples with chemical concentrations differing by a factor of 4 or more, sample extracts were reanalyzed on the GC/MS, and when available, an additional aliquot of sample was prepared and analyzed. Samples with data not consistent with their reanalysis on the GC/MS were rejected as unreliable. Samples not consistent with the newly prepared sample extracts were also rejected as unreliable. The chemical concentrations determined by the reanalysis of the sample extracts and by the extraction of a new aliquot sample were not reported.

Procedural blanks for each sample set were evaluated for each site study chemical. Blank concentrations were compared with previous analyses. When blank concentrations changed by a factor of 4 or more, the procedural blank extract was reanalyzed on the GC/MS. Blanks with data not consistent with their reanalysis on the GC/MS were rejected as unreliable. If all of the analytes in the blank were greater than a factor of 4 from past analyses, the entire sample set was rejected as unreliable.

For each sampling station, average concentrations were determined for each chemical after correction for the procedural blank. Correction for the procedural blank was performed by averaging blank concentrations from all procedural blank analyses and then subtracting their average blank value from their reported concentrations. If a blank corrected concentration of less than zero was obtained, a value of zero was used for that replicate when the average station concentration was calculated.

3.4.3 Tissue Analysis Procedure

3.4.3.1   Compositing and Homogenization
Procedures

Enough organisms and tissue mass existed for four of the ten species for making tissue composites. These species were the F. heteroclitus, C. sapidus,

27

between PeCB and $^{13}C_6$-HCB, 0%, and between $^{13}C_6$-1,2,4,5-TeCB and 1,2,4-TrCB, 1,2,3-TrCB, 1,2,3,4-TeCB, and HCBD, 14%, 1%, 9%, and 4%, respectively.

3.4.4 Sediment Analysis Procedure

The sediment analysis was performed at ERL-D. Although sediment was collected from three locations at each station, only one sample (usually the mid-channel location) was analyzed per station.

Samples were removed from the refrigerator and allowed to warm to room temperature. Two grams of sediment were weighed out and mixed with enough anhydrous sodium sulfate to dry the sample. The dried samples were spiked with the ^{13}C-labelled surrogates, i.e., $^{13}C_1$-HCE, $^{13}C_4$-HCBD, $^{13}C_6$-TeCBD and $^{13}C_6$-HCB, at a concentration of approximately 4.0 $\mu g/g$ per compound and were Soxhlet extracted using 1:1 mixture of methylene chloride and hexane. After extraction, the extracts were passed through columns containing sodium sulfate and activated copper, and were concentrated using a K-D concentrator to approximately 10 mL. These extracts were concentrated further to 1.5 mL using a stream of nitrogen gas. Portions of the 1.5 mL extract were spiked with the internal standard, d_{12}-chrysene, at concentrations ranging from 0.5 mg/L to 10 mg/L. The spiked extracts were analyzed using the GC/MS and data review procedures used for the ambient water samples.

Concurrently with the sediment residue analyses, percent moisture determinations for sediment samples were performed by drying a 4 to 5 g aliquot of the sediment in an oven at 105°C for 12 hours.

Concurrently with the sediment residue analyses, total organic carbon analysis was performed by weighing a 4 or 5 g aliquot of each sample and drying them at 105°C for 12 hours. The samples were allowed to cool in a desiccator and then were ground with a mortar and pestle into a fine powder. Approximately 0.3 to 0.5 g of each sample was transferred into a preweighed vial. The samples were acidified dropwise with 10% HCl until the foaming ceased and returned to the oven for 12 hours (overnight). The following day, total organic carbon was measured for each sample by using a Dohrmann TOC Analyzer DC80 with a DC183 furnace.

3.4.5 Dissolved and Particulate Organic Carbon Analysis Procedures

Dissolved, particulate, and total organic carbon (DOC, POC, and TOC, respectively) were determined for the ambient water samples. Prior to filtration, all glassware and glass fiber filters were "ashed" in a muffle furnace. A 100 mL aliquot of a water sample was vacuum-filtered through a pre-moistened 47 mm (filter diameter) Gelman A/E glass fiber filter (1 μm pore size). The filtrates were poured into a glass bottle, adjusted to less than a pH of 2 with HCl, capped with a teflon lined lid, and placed in a refrigerator at 4°C. Between each filtration, the filtering apparatus was rinsed with Millipore* water. The filter pads were dried in a covered aluminum pan at 110°C for more than 2 hours. Filter and filtrate blanks were collected after the processing of every 2 to 3 samples by filtering 100 mL of Millipore* water through the system. Concurrently with the filtration of the water samples, whole water samples were poured into a glass bottle, adjusted to less than a pH of 2 with HCl, capped with a teflon lined lid, and placed into a refrigerator at 4°C.

The ambient water samples collected on September 19 and 26 were not acidified (preserved) until the 9th of October, 17 and 11 days after filtration, respectively.

The filtrates, filters, and whole water samples were analyzed by the National Spectrographic Laboratories (Cleveland, Ohio) for organic carbon. Dissolved organic carbon and total organic carbon were measured using the EPA method 415.1. Particulate organic carbon was measured using a LECO* carbon analyzer and the ASTM method E350.

3.4.6 Procedures for Particle Sizing the Sediments

A composite sediment sample was prepared for each station by mixing equal portions of the mid-channel and quarter points. An aliquot of the composite was treated with H_2O_2 to remove organic carbon and the sample was dispersed in water using a sodium metaphosphate and sodium carbonate solution. The <20 μm, <5 μm, and <0.2 μm fractions were determined by pipetting after sedimentation and <0.2 μm fraction was determined by pipetting after centrifugation. The pipetted solutions were dried at 105°C for at least 12 hours and then weighed. The sand fraction was separated from the silt and clay fractions by washing a sample through a 300 mesh sieve and the various sand fractions were determined by sieving and weighing a dried portion (at 105°C) of the washed sand. The particle sizing procedure was performed by the Ohio State University, Department of Agronomy, Soil Characterization Laboratory in Columbus Ohio.

31

RESULTS AND DISCUSSION

4.1   Expected Tissue Residue Trends

The guidance procedure for predicting residues in aquatic organisms does not account for metabolism. For this site study, it is believed that the chemicals under investigation, i.e., chlorinated benzenes, butadienes, and ethanes, are very slowly metabolized by invertebrate and vertebrate aquatic organisms.

Studies by Nichols et al. [11] and Gargas and Andersen [12] have shown that hexachloroethane is poorly metabolized in rainbow trout and rats, respectively. In the review by Matthews [13], pentachlorobenzene and hexachlorobenzene were reported to be slightly metabolized in rabbits and rats. Bauer et al. [14] and Sanborn et al. [15] have shown that hexachlorobenzene metabolites can be found at trace levels in blue mussel and green sunfish when they are exposed to hexachlorobenzene. Matthews [13] has also reported that for the chlorinated benzene family, the rate of metabolism by mammalian species was inversely proportional to the degree of chlorination, i.e., the higher the degree of chlorination, the less metabolism occurs.

In view of the slow rate of metabolism for these chemicals, the following general statements about the comparison of the measured and predicted tissue residues can be made prior to examining the site study data.

a)   Agreement between the measured and predicted tissue residues should be fairly similar for invertebrate and vertebrate organisms.

b)   Similar agreement between the measured and predicted tissue residues should be observed all for chemicals for a given organism.

c)   If any metabolism did occur in the site study organisms, the lower chlorinated benzenes and butadienes would have poorer agreement between the measured and predicted tissue residues than the higher chlorinated congeners .

4.2   Ambient Water Concentrations: Results

Replicate analyses were performed on each ambient water sample for the thirteen site study chemicals. The individual determinations as well as the procedural blanks performed with these analyses are reported in Tables A-7 through A-18. In Table 4-1, the weekly and four week average chemical concentrations are reported for the ambient grab samples taken at each sampling station, for the ambient composite samples taken at Station 1, and for the grab samples taken from the outfall of the chemical plant prior to dilution with cooling water.

32

Table 4-1. Concentration of Target Chemicals in Weekly Ambient Water Samples from the Canal and Bayou d'Inde.

	Concentration in Effluent ng/L*						
	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %
Hexachloroethane							
Outfall	350	87.2	23.1	34.0	124	153	124
A	222	188	134	848	348	335	96.4
1 Composite	46.9	144	153	229	143	74.8	52.2
1 Grab	99.0	237	138	1283	439	566	129
B	932	264	144	681	505	366	72.4
C	47.2	136	8.67	21.6	53.3	57.2	107
D	81.5	198	16.4	874	292	395	135
E	51.5	152	8.23	425	159	187	118
Tetrachlorobutadiene #1							
Outfall	0.665	0.00	0.00	0.00	0.166	0.333	200
A	13.6	18.9	26.2	94.5	38.3	37.8	98.8
1 Composite	7.56	8.07	9.15	16.6	10.3	4.22	40.8
1 Grab	12.5	30.4	8.26	194	61.3	89.0	145
B	18.9	44.5	33.0	61.0	39.3	17.8	45.4
C	9.77	24.3	1.31	3.89	9.81	10.3	105
D	11.4	32.0	2.36	137	45.7	62.1	136
E	7.29	30.3	1.05	32.5	17.8	16.0	89.7
Tetrachlorobutadiene #2							
Outfall	1.04	2.95	1.69	2.79	2.12	0.912	43.1
A	33.1	45.3	49.1	302	107	130	121
1 Composite	17.7	24.6	17.5	37.8	24.4	9.53	39.1
1 Grab	26.6	73.4	18.5	484	151	224	148
B	38.5	90.3	67.9	204	100	72.7	72.1
C	23.7	62.2	5.33	13.0	26.1	25.3	97.0
D	31.9	71.1	7.63	466	144	216	150
E	16.9	45.6	7.64	102	43.0	42.5	98.8
Pentachlorobutadiene #1							
Outfall	7.08	8.44	5.38	8.50	7.35	1.47	20.0
A	199	280	356	1503	584	615	105
1 Composite	70.9	92.6	64.2	179	102	53.0	52.1
1 Grab	102	340	90.2	2240	692	1040	150
B	275	303	324	799	425	250	58.8
C	113	123	0.00	16.9	63.2	63.7	101
D	171	246	0.302	899	329	393	120
E	96.0	231	0.393	369	174	161	92.3

Table 4-1.   Continued

	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %

Concentration in Effluent ng/L*

Pentachlorobutadiene #2

	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %
Outfall	3.39	6.35	2.99	2.72	3.86	1.68	43.5
A	58.2	73.6	102	530	191	227	119
1 Composite	22.8	29.6	23.3	41.5	29.3	87.0	29.7
1 Grab	37.0	110	24.0	821	248	384	155
B	75.3	93.4	118	249	134	78.7	58.7
C	28.8	79.1	0.475	3.89	28.0	36.3	129
D	37.5	109	1.44	1610	439	780	178
E	20.5	114	1.75	85.8	55.4	52.9	95.5

Hexachlorobutadiene

	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %
Outfall	51.5	253	83.8	173	141	91.3	64.9
A	389	616	598	4280	1470	1880	128
1 Composite	128	397	407	1540	618	628	102
1 Grab	235	681	498	5040	1610	2290	142
B	745	890	530	4780	1740	2030	117
C	235	385	0.359	180	200	159	79.3
D	364	562	0.894	4630	1390	2170	156
E	224	456	1.72	2740	855	1270	148

Trichlorobenzene, 1,2,3-

	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %
Outfall	2.02	1.39	3.35	2.60	2.34	0.835	35.7
A	15.7	20.1	27.4	156	54.8	67.7	123
1 Composite	16.1	28.0	28.8	42.9	28.9	10.9	37.8
1 Grab	12.4	28.1	25.7	202	67.1	90.3	135
B	32.7	33.7	22.0	194	70.7	82.6	171
C	26.4	28.4	5.96	13.3	18.5	10.7	58.0
D	14.8	23.6	2.01	182	55.6	84.8	152
E	23.8	22.2	7.0	90.3	35.8	37.1	103

Trichlorobenzene, 1,2,4-

	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Coefficient of Variation, %
Outfall	9.95	16.1	14.6	12.8	13.3	2.63	19.7
A	103	149	148	801	300	334	111
1 Composite	49.8	115	121	222	127	70.9	55.9
1 Grab	80.8	216	104	1130	382	500	131
B	164	242	157	685	312	251	80.6
C	77.4	169	23.8	57.8	81.9	61.9	75.5
D	106	180	18.4	1140	360	523	145
E	67.9	172	14.5	458	178	198	111

34

Table 4-1.   Continued

| | Concentration in Effluent ng/L* | | | | | | Coefficient of |
	Week 1	Week 2	Week 3	Week 4	Avg.	Std. Dev.	Variation, %
Tetrachlorobenzene Mix							
Outfall	7.63	15.2	15.6	12.3	12.7	3.68	29.0
A	26.1	21.8	42.1	435	131	203	154
1 Composite	13.9	27.9	74.9	129	61.3	51.9	84.7
1 Grab	26.5	65.2	65.4	524	170	236	139
B	44.3	63.0	34.4	830	243	392	161
C	24.1	53.8	25.0	41.0	36.0	14.2	39.5
D	30.3	53.9	13.5	467	141	218	154
E	25.3	34.4	9.87	361	108	169	157
Tetrachlorobenzene, 1,2,3,4-							
Outfall	3.95	5.94	10.8	6.55	6.81	2.88	42.4
A	27.6	10.9	49.2	347	109	159	147
1 Composite	7.83	23.9	41.9	83.1	39.2	32.4	82.7
1 Grab	26.0	28.3	41.9	471	142	220	155
B	40.2	63.6	46.7	448	150	199	133
C	20.4	48.2	16.4	22.2	26.8	14.5	54.0
D	26.6	56.4	11.6	408	126	189	150
E	21.2	45.2	10.1	197	68.4	87.0	127
Pentachlorobenzene							
Outfall	15.7	54.7	32.1	27.7	32.5	16.3	50.1
A	40.1	52.0	46.9	855	249	404	163
1 Composite	17.9	52.0	97.4	148	78.8	56.5	71.6
1 Grab	35.1	78.2	48.9	1160	331	554	167
B	72.9	76.8	56.7	1190	349	561	161
C	25.2	61.1	23.0	23.3	33.2	18.7	56.3
D	33.4	69.7	16.1	544	166	253	153
E	31.5	56.0	13.7	287	97.1	128	132
Hexachlorobenzene							
Outfall	44.6	189	88.0	189	128	72.9	57.2
A	41.8	31.8	41.9	739	214	350	164
1 Composite	16.6	30.1	77.1	138	65.4	54.8	83.8
1 Grab	28.9	34.1	56.5	1340	364	649	178
B	127	35.9	43.4	1460	418	699	167
C	17.9	25.9	17.3	8.26	17.4	7.22	41.6
D	24.9	32.9	14.2	265	84.2	121	143
E	28.0	26.0	13.6	122	47.4	50.1	106

* Recovery and blank corrected

35

The inter- and intra-laboratory agreement was good for all of the site study chemicals, e.g., for HCBD at Station B, coefficients of variation were 0.5, 4.4, 12.4, and 25.4% for intra- and 2.8 and 11.7% for inter-laboratory variability. The average recoveries (coefficients of variation) of the surrogates, $^{13}C_1$-HCE, $^{13}C_6$-TeCB, and $^{13}C_6$-HCB, were 45.7 (36.6), 45.5 (39.1), and 49.7 (35.0)%, respectively. The procedural blanks performed with these analyses were consistently very low at both laboratories for all chemicals. The only exception was one procedural blank which had an unusually high HCE concentration and very low concentrations for all of the other chemicals. We believe that this high determination is an outlier since 10 other procedural blanks performed by this laboratory were consistent and substantially lower in concentration. Consequently, this value was not used in the blank correction procedure for determining the average concentrations reported in Table 4-1.

In Tables A-19 and A-20, the dissolved and particulate chemical concentrations for the ambient composite samples taken from Station 1 are reported, respectively. In Tables A-21 and A-22, particulate and dissolved organic carbon results are reported for the ambient water samples, respectively.

4.3   Ambient Water Concentrations: Discussion

To predict residues in the indigenous organisms, the ambient water concentration of each chemical must be known and these concentrations must be relatively constant for a 20 to 40 day period. The best way to estimate the ambient water concentrations would have been to collect four, seven day 24-hour composite samples at each of the field sampling stations. However, field conditions, especially in the bayou, as well as the costs associated with such field work precluded this type of sampling for this study.

For this study, ambient seven day 24-hour composite samples were collected at Station 1 only. For the other field stations as well as Station 1, weekly ambient grab samples were collected. By comparing the composite and grab samples at Station 1, the representativeness of the grab samples for establishing the overall ambient water concentrations for the site study could be evaluated.

Examination of the composite and grab sample data taken at Station 1 (Table 4-1) indicates that for the first three weeks of the site study that the grab samples provided estimates similar to those obtained by the composite sampling technique. Differences between the grab and composite chemical concentrations were less than a factor of 1.8 on average and the individual differences ranged from 0.5 to 3.8. These composite samples, weeks 1, 2, and 3, were not completely based upon continuous intermittent sampling. Due to problems with the ISCO* sampler, some of the composite sample collected each day were brought

to volume using a grab sample taken that same day. In Table A-23, the percentages of composite versus grab samples in the seven day composites are reported. This equipment problem introduces some bias into the ambient water concentrations reported for the composite samples.

In contrast to weeks 1, 2, and 3, the grab and composite samples for the fourth week were markedly different. The ambient concentrations reported for the grab sample were always higher than the composite sample concentrations, sometimes by an order of magnitude. In addition, the water concentrations for the grab and composite samples were higher than the concentrations observed for the previous three weeks. Differences in reported ambient concentrations between weeks 3 and 4 ranged from a factor of 7.8 to 34 for the grab samples, and 1.5 to 3.8 for the composite samples.

In comparing the grab samples from the canal and bayou sampling stations for weeks 3 and 4, elevated chemical concentrations observed at these field stations suggest that the grab sample from Station 1 wasn't an outlier. The whole field site appears to have elevated ambient concentrations during the fourth week of the study, Table 4-1. The only site where an elevated grab sample doesn't exist was the outfall for the chemical plant prior to dilution with cooling water.

The establishment of the 28 day "steady-state" exposure concentrations for the six field stations presents some difficulty due to the unusually high grab sample concentrations in the fourth week. In this investigation, we decided to determine the 28 day "steady-state" exposure concentration by averaging the four weekly concentrations for each station since none of the data could be dismissed as being not representative. Furthermore, by including on an equal basis all four weeks of data, naturally occurring variability for this site is included. The bayou is influenced by storm and wind surges off the Gulf of Mexico, by the tides, runoff passing through Bayou d'Inde, and changes in discharge flow and its composition.

- By using the four week arithmetic average for the 28 day exposure concentration, some error exists in the derived average exposure concentrations. The dynamics of this tidally influenced receiving water are complex, and should not be overlooked.

4.4 Sediment Results

For each field station, the concentrations of the site study chemicals in the sediments were measured. In general, the canal sediments were highly contaminated and bayou sediments were less contaminated, Table 4-2. The organic carbon content and particle size data for the sediments are reported in Tables A-24 and A-25.

37

Table 4-2. Concentration of Target Chemicals in Sediment Samples from the Canal and Bayou d'Inde.

Station	TOC[a] Percent	Percent Moisture	Surrogate % Recovery	Target Chemical Recovery Corrected [ng/g]	
Hexachloroethane[b]					
Blank	0.00	0.00	78.2	206	
Blank	0.00	0.00	83.0	218	
A	7.19	75.8	100	1090	(1.09 μg/g)
1	3.69	72.9	43.5	199	
B	9.12	80.6	41.7	266	
C	2.99	60.3	82.3	157	
D	4.14	69.5	92.1	210	
E	5.31	69.9	81.6	183	
Tetrachlorobutadiene #1[c]					
Blank	0.00	0.00	86.2	0.00	
Blank	0.00	0.00	91.1	0.00	
A	7.19	75.8	97.3	233	
1	3.69	72.9	91.4	70.6	
B	9.12	80.6	86.9	124	
C	2.99	60.3	91.6	0.00	
D	4.14	69.5	87.2	3.71	
E	5.31	69.9	95.2	0.00	
Tetrachlorobutadiene #2[c]					
Blank	0.00	0.00	86.2	0.00	
Blank	0.00	0.00	91.1	0.00	
A	7.19	75.8	97.3	3150	(3.15 μg/g)
1	3.69	72.9	91.4	955	
B	9.12	80.6	86.9	2070	(2.07 μg/g)
C	2.99	60.3	91.6	4.50	
D	4.14	69.5	87.2	29.3	
E	5.31	69.9	95.2	15.1	

Table 4-2.   Continued.

Station	TOC[a] Percent	Percent Moisture	Surrogate % Recovery	Target Chemical Recovery Corrected [ng/g]
Pentachlorobutadiene #1[c]				
Blank	0.00	0.00	86.2	0.00
Blank	0.00	0.00	91.1	0.00
A	7.19	75.8	97.3	17300 (17.3 μg/g)
1	3.69	72.9	91.4	3920 (3.92 μg/g)
B	9.12	80.6	86.9	2920 (2.92 μg/g)
C	2.99	60.3	91.6	6.50
D	4.14	69.5	87.2	44.8
E	5.31	69.9	95.2	23.7
Pentachlorobutadiene #2[c]				
Blank	0.00	0.00	86.2	0.00
Blank	0.00	0.00	91.1	0.00
A	7.19	75.8	97.3	2380 (2.38 μg/g)
1	3.69	72.9	91.4	354
B	9.12	80.6	86.9	365
C	2.99	60.3	91.6	0.00
D	4.14	69.5	87.2	4.87
E	5.31	69.9	95.2	2.52
Hexachlorobutadiene[d]				
Blank	0.00	0.00	86.2	12.9
Blank	0.00	0.00	91.1	18.7
A	7.19	75.8	97.3	591000(591 μg/g)
1	3.69	72.9	91.4	301000(301 μg/g)
B	9.12	80.6	86.9	245000(245 μg/g)
C	2.99	60.3	91.6	62.1
D	4.14	69.5	87.2	1110 (1.11 μg/g)
E	5.31	69.9	95.2	249

Table 4-2.   Continued.

Station	TOC[a] Percent	Percent Moisture	Surrogate % Recovery	Target Chemical Recovery Corrected [ng/g]	
Trichlorobenzene, 1,2,3-[c]					
Blank	0.00	0.00	86.2	8.88	
Blank	0.00	0.00	91.1	0.523	
A -	7.19	75.8	97.3	2080	(2.08 μg/g)
1	3.69	72.9	91.4	368	
B	9.12	80.6	86.9	747	
C	2.99	60.3	91.6	8.01	
D	4.14	69.5	87.2	28.4	
E	5.31	69.9	95.2	9.67	
Trichlorobenzene, 1,2,4-[c]					
Blank	0.00	0.00	86.2	0.00	
Blank	0.00	0.00	91.1	0.00	
A	7.19	75.8	97.3	21500	(21.5 μg/g)
1	3.69	72.9	91.4	5310	(5.31 μg/g)
B	9.12	80.6	86.9	12100	(12.1 μg/g)
C	2.99	60.3	91.6	59.9	
D	4.14	69.5	87.2	529	
E	5.31	69.9	95.2	232	
Tetrachlorobenzene Mix[c] -					
Blank	0.00	0.00	86.2	12.7	
Blank	0.00	0.00	91.1	12.5	
A	7.19	75.8	97.3	24800	(24.8 μg/g)
1	3.69	72.9	91.4	8330	(8.33 μg/g)
B	9.12	80.6	86.9	10600	(10.6 μg/g)
C	2.99	60.3	91.6	22.6	
D	4.14	69.5	87.2	145	
E	5.31	69.9	95.2	88.9	

Table 4-2.   Continued.

Station	TOC[a] Percent	Percent Moisture	Surrogate % Recovery	Target Chemical Recovery Corrected [ng/g]
Tetrachlorobenzene, 1,2,3,4-[c]				
Blank	0.00	0.00	86.2	0.00
Blank	0.00	0.00	91.1	0.00
A	7.19	75.8	97.3	17400 (17.4 μg/g)
1	3.69	72.9	91.4	5520 (5.52 μg/g)
B	9.12	80.6	86.9	2940 (2.94 μg/g)
C	2.99	60.3	91.6	9.27
D	4.14	69.5	87.2	100
E	5.31	69.9	95.2	43.9
Pentachlorobenzene[d]				
Blank	0.00	0.00	93.8	0.00
Blank	0.00	0.00	95.9	0.00
A	7.19	75.8	67.9	152000(152 μg/g)
1	3.69	72.9	32.8	167000(167 μg/g)
B	9.12	80.6	59.6	48200 (48.2 μg/g)
C	2.99	60.3	97.9	0.00
D	4.14	69.5	85.2	1100 (1.10 μg/g)
E	5.31	69.9	93.8	272
Hexachlorobenzene[d]				
Blank	0.00	0.00	93.8	4.18
Blank	0.00	0.00	95.9	5.53
A	7.19	75.8	67.9	156000(156 μg/g)
1	3.69	72.9	32.8	656000(656 μg/g)
B	9.12	80.6	59.6	246000(246 μg/g)
C	2.99	60.3	97.9	56.2
D	4.14	69.5	85.2	7690 (7.69 μg/g)
E	5.31	69.9	93.8	1810 (1.81 μg/g)

[a] TOC = total organic carbon.
[b] $^{13}C_1$ HCE surrogate.
[c] $^{13}C_6$ TeCB surrogate.
[d] $^{13}C_6$ HCB surrogate.

4.5   Tissue Data: Results

Replicate analyses were performed on each tissue composite for the thirteen site study chemicals. The individual determinations as well as the procedural blanks performed these analyses are reported in Tables A-27 through A-62 for the F. heteroclitus, C. sapidus, B. patronus, and M. undulus species. In Tables 4-3, 4-4, 4-5, and 4-6, the average residue concentrations after correction for procedural blanks and normalization to 7.6% lipid content for each species are reported for each station.

The inter- and intra-laboratory agreement was good for all of the site study data, e.g., for C. sapidus, the coefficients of variation for HCBD were 52.8, 11.0, 14.1, 12.8, and 56.8% for intra- and 9.8, 7.21, 25.4, and 4.4% for inter-laboratory variability. The average recoveries (coefficients of variation) of the surrogates, $^{13}C_1$-HCE, $^{13}C_6$-TeCB, and $^{13}C_6$-HCB, were 38.6 (36.0), 33.0 (37.3), and 36.1 (35.9)%, respectively. The procedural blanks performed with these analyses were consistently low at both laboratories for all chemicals and species.

4.6   Prediction of the Tissue Residues

To evaluate the residue prediction procedure, residues were predicted and then compared to the measured residues for the indigenous organisms. By using the residue prediction procedures, values for the log P, BCF, FM, and BAF were derived for each chemical, Table 4-7. For HCE, 1,2,4-TrCB, 1,2,3-TrCB, 1,2,3,4-TeCB, PeCB, HCB, and HCBD, measured log P values were used [16, 16, 17, 18, 17, 17, 19, respectively]. For the TeCB Mix, a mixture of 1,2,4,5- and 1,2,3,5-TeCBs, the average of the measured log P value for each compound was used [18]. For the PeCBD#1, PeCBD#2, TeCBD#1, and TeCBD#2 compounds, log P values were derived by using the CLogP program [20] with the buta-1,3-diene structure. For the TeCBDs and PeCBDs, the average of the CLogP log P values for the 5 and 2 possible isomers were used, respectively.

Residues were predicted for the Louisiana site by using the derived BAFs (Table 4-7) and the average ambient water chemical concentrations. The predicted tissue residues are reported in Tables 4-8, 4-9, 4-10, and 4-11.

Table 4-3. Concentration of Target Chemicals in Fundulus heteroclitus from Cooling Water/Effluent Canal and Bayou d'Inde.

Concentration in Tissue, μg/kg[a]

ss[b]	avg[b]	sd[b]	cv,%[b]	n[b]	ss	avg	sd	cv,%	n	ss	avg	sd	cv,%	n
Hexachloroethane					**Tetrachlorobutadiene #1**					**Tetrachlorobutadiene #2**				
A	471	97.0	20.6	4	A	30.4	16.5	54.2	4	A	137	36.8	26.9	4
1	925	-	-	1	1	31.0	-	-	1	1	206	-	-	1
B	688	245	35.7	5	B	54.0	36.4	67.3	5	B	183	61.3	33.5	5
C	788	-	-	1	C	23.7	-	-	1	C	133	-	-	1
D	176	143	80.9	3	D	13.3	21.4	161	3	D	38.5	29.6	76.9	3
E	533	-	-	1	E	13.3	-	-	1	E	87.6	-	-	1
Pentachlorobutadiene #1					**Pentachlorobutadiene #2**					**Hexachlorobutadiene**				
A	1270	1130	88.7	4	A	221	361	163	4	A	28900	15400	53.4	4
1	1660	-	-	1	1	360	-	-	1		169800	-	-	1
B	2720	2040	74.8	5	B	663	506	76.2	5	B	38000	21600	55.6	5
C	902	-	-	1	C	205	-	-	1	C	68100	-	-	1
D	594	885	149	3	D	144	240	166	3	D	8580	5480	63.9	3
E	430	-	-	1	E	100	-	-	1	E	34100			
Trichlorobenzene, 1,2,3-					**Trichlorobenzene, 1,2,4-**					**Tetrachlorobenzene Mix**				
A	122	25.4	20.8	4	A	807	199	24.6	4	A	1290	846	65.5	4
1	266	-	-	1	1	1350	-	-	1	1	2770	-	-	1
B	226	70.6	31.3	5	B	1240	303	24.4	5	B	1750	1170	66.6	5
C	182	-	-	1	C	2670	-	-	1	C	9.45	-	-	1
D	47.5	31.6	66.5	3	D	280	155	55.4	3	D	499	215	43.1	3
E	142	-	-	1	E	872	-	-	1	E	1790	-	-	1
Tetrachlorobenzene, 1,2,3,4-					**Pentachlorobenzene**					**Hexachlorobenzene**				
A	717	151	21.1	4	A	4720	1010	21.4	4	A	5400	2930	54.3	4
1	1160	-	-	1	1	8210	-	-	1	1	6430	-	-	1
B	1240	361	29.2	5	B	7880	4820	61.2	5	B	4650	2880	62.0	5
C	1050	-	-	1	C	7980	-	-	1	C	5960	-	-	1
D	371	219	59.0	3	D	1740	897	51.5	3	D	1220	317	26.1	3
E	734	-	-	1	E	3990	-	-	1	E	1370	-	-	1

[a] Recovery, blank and lipid corrected. 7.6% lipid content.
[b] ss = sampling station, avg = average, sd = standard deviation, cv,% = coefficient of variation in percent, n = number of tissue samples analyzed.

Table 4-4.   Concentration of Target Chemicals in _Callinectes sapidus_ from Cooling Water/Effluent Canal and Bayou d'Inde.

Concentration in Tissue, μg/kg[a]

Hexachloroethane					Tetrachlorobutadiene #1					Tetrachlorobutadiene #2				
ss[b]	avg[b]	sd[b]	cv,%[b]	n[b]	ss	avg	sd	cv,%	n	ss	avg	sd	cv,%	n
A	16.8	6.77	40.2	3	A	6.20	7.10	115	3	A	21.9	5.22	23.8	3
1	11.0	3.07	27.8	4	1	16.5	16.4	99.0	4	1	64.3	30.3	47.1	4
B	18.6	4.52	24.2	2	B	33.5	8.19	24.5	2	B	170	82.8	48.8	2
C	19.8	14.5	73.2	2	C	29.8	42.1	141	2	C	103	132	128	2
D	10.0	1.68	16.9	2	D	7.85	1.04	13.3	2	D	52.2	15.2	29.2	2
E	15.3	8.21	53.6	3	E	24.4	15.2	62.3	3	E	80.4	36.2	45.0	3

Pentachlorobutadiene #1					Pentachlorobutadiene #2					Hexachlorobutadiene				
A	106	74.3	69.8	3	A	1.81	3.13	173	3	A	274	160	58.6	3
1	219	78.8	36.0	4	1	7.24	3.46	47.8	4	1	340	270	79.6	4
B	459	219	47.7	2	B	10.3	9.51	92.0	2	B	728	259	35.6	2
C	328	464	141	2	C	10.7	15.2	141	2	C	482	682	141	2
D	80	28.4	35.6	2	D	3.04	1.03	33.9	2	D	261	175	67.1	2
E	309	216	69.8	3	E	4.86	4.80	98.7	3	E	363	200	55.2	3

Trichlorobenzene, 1,2,3-					Trichlorobenzene, 1,2,4-					Tetrachlorobenzene Mix				
A	81.5	45.7	56.1	3	A	308	209	67.8	3	A	476	85.1	17.9	3
1	166	78.0	47.0	4	1	713	315	44.3	4	1	849	524	61.7	4
B	267	154	57.7	2	B	1455	652	44.8	2	B	1450	1210	83.2	2
C	172	189	110	2	C	967	1220	126	2	C	1049	933	89.0	2
D	91.1	29.5	32.4	2	D	416	84.2	20.2	2	D	571	332	58.1	2
E	138	83.7	60.6	3	E	706	349	49.4	3	E	682	468	68.6	3

Tetrachlorobenzene, 1,2,3,4-					Pentachlorobenzene					Hexachlorobenzene				
A	368	122	33.1	3	A	1467	278	19.0	3	A	1772	131	7.37	3
1	706	294	41.6	4	1	2473	845	34.2	4	1	2093	624	29.8	4
B	928	625	67.4	2	B	2348	1500	63.9	2	B	1486	943	63.5	2
C	692	654	94.5	2	C	1630	1380	84.7	2	C	868	594	68.5	2
D	368	188	51.2	2	D	987	717	72.7	2	D	781	713	91.3	2
E	497	292	58.8	3	E	1239	787	63.5	3	E	1052	734	69.7	3

[a] Recovery, blank and lipid corrected. 7.6% lipid content.
[b] ss = sampling station, avg = average, sd = standard deviation, cv,% = coefficient of variation in percent, n = number of tissue samples analyzed.

Table 4-5. Concentration of Target Chemicals in <u>Brevoortia patronus</u> from Cooling Water/Effluent Canal and Bayou d'Inde.

					Concentration in Tissue, μg/kg[a]									
ss[b]	avg[b]	sd[b]	cv,%[b]	n[b]	ss	avg	sd	cv,%	n	ss	avg	sd	cv,%	n
Hexachloroethane					Tetrachlorobutadiene #1					Tetrachlorobutadiene #2				
C	222	108	48.7	7	C	46.0	19.7	42.9	7	C	132	60.1	45.5	7
D	391	225	57.5	2	D	79.7	53.0	66.5	2	D	235	136	57.6	2
E	374	149	39.7	4	E	91.3	30.1	33.0	5	E	237	75.6	31.9	4
Pentachlorobutadiene #1					Pentachlorobutadiene #2					Hexachlorobutadiene				
C	2440	1210	49.5	7	C	530	246	46.4	7	C	8510	3460	40.7	7
D	5320	2950	55.5	2	D	1090	640	58.8	2	D	15900	6100	38.5	2
E	5370	1970	36.8	4	E	1020	354	34.6	4	E	16600	5850	35.2	4
Trichlorobenzene, 1,2,3-					Trichlorobenzene, 1,2,4-					Tetrachlorobenzene Mix				
C	113	34.2	30.3	7	C	669	262	39.2	7	C	497	162	32.6	7
D	165	91.4	55.4	2	D	1150	684	59.6	2	D	862	382	44.4	2
E	201	46.0	22.9	4	E	1200	315	26.1	4	E	887	331	37.3	4
Tetrachlorobenzene, 1,2,3,4-					Pentachlorobenzene					Hexachlorobenzene				
C	646	249	38.5	7	C	3040	1130	37.1	7	C	1950	530	27.1	7
D	1070	574	53.6	2	D	5140	1500	29.2	2	D	3510	670	19.1	2
E	1170	442	37.6	4	E	5320	2670	50.2	4	E	4920	4520	91.9	4

[a] Recovery, blank and lipid corrected. 7.6% lipid content.
[b] ss = sampling station, avg = average, sd = standard deviation, cv,% = coefficient of variation in percent, n = number of tissue samples analyzed.

Table 4-6. Concentration of Target Chemicals in Micropogan undulus from Cooling Water/Effluent Canal and Bayou d'Inde.

Concentration in Tissue, μg/kg[a]

ss[b]	avg[b]	sd[b]	cv,%[b]	n[b]	ss	avg	sd	cv,%	n	ss	avg	sd	cv,%	n
Hexachloroethane					**Tetrachlorobutadiene #1**					**Tetrachlorobutadiene #2**				
B	85.2			1	B	19.2			1	B	65.6			1
C	48.7			1	C	6.35			1	C	20.2			1
D	241	53.1	22.1	2	D	81.5	0.965	1.18	3	D	203	1.50	0.737	3
E	326			1	E	102			1	E	276			1
Pentachlorobutadiene #1					**Pentachlorobutadiene #2**					**Hexachlorobutadiene**				
B	858			1	B	92.2			1	B	5600			1
C	401			1	C	35.5			1	C	4180			1
D	4040	400	9.90	3	D	426	118	27.7	3	D	20600	7820	37.9	3
E	5000			1	E	443			1	E	17300			1
Trichlorobenzene, 1,2,3-					**Trichlorobenzene, 1,2,4-**					**Tetrachlorobenzene Mix**				
B	81.4			1	A	356			1	B	309			1
C	27.0			1	B	142			1	C	248			1
D	210	94.8	45.1	3	C	1160	241	20.9	3	D	810	242	29.9	3
E	218			1	D	1290			1	E	788			1
Tetrachlorobenzene, 1,2,3,4-					**Pentachlorobenzene**					**Hexachlorobenzene**				
B	339			1	B	1972			1	B	2200			1
C	303			1	C	1820			1	C	2100			1
D	1020	322	31.6	3	D	3860	910	23.6	3	D	2890	800	27.7	3
E	948			1	E	3360			1	E	2500			1

[a] Recovery, blank and lipid corrected. 7.6% lipid content.
[b] ss = sampling station, avg = average, sd = standard deviation, cv,% = coefficient of variation in percent, n = number of tissue samples analyzed.

46

Table 4-7.   Residue Prediction Parameters.

Compound	log P	BCF	FM	BAF
Hexachloroethane	4.14	742	1	742
Tetrachlorobutadiene #1	3.22	140	1	140
Tetrachlorobutadiene #2	3.22	140	1	140
Pentachlorobutadiene #1	3.71	340	1	340
Pentachlorobutadiene #2	3.71	340	1	340
Hexachlorobutadiene	4.78	2380	1	2380
1,2,3- Trichlorobenzene	4.05	630	1	630
1,2,4- Trichlorobenzene	4.02	597	1	597
Tetrachlorobenzene Mix	4.87	2800	1	2800
1,2,3,4- Tetrachlorobenzene	4.64	1840	1	1840
Pentachlorobenzene	5.17	4830	3	14500
Hexachlorobenzene	5.31	6240	3.7	23100

Table 4-8.   Predicted and Measured Fundulus heteroclitus Tissue Concentrations
for the Louisiana Study.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (µg/kg)	Observed[b] Conc. in Tissue (µg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Hexachloroethane				
A	348	258	471	1.82
1 Composite	143	106	925	
1 Grab	439	326		2.84
B	505	375	688	1.84
C	53.3	39.5	788	19.9
D	292	217	176	0.812
E	159	118	533	4.52
Tetrachlorobutadiene #1				
A	38.3	5.36	30.4	5.67
1 Composite	10.3	1.44	31.0	
1 Grab	61.3	8.58		3.61
B	39.3	5.50	54.0	9.81
C	9.81	1.37	23.7	17.3
D	45.7	6.40	13.3	2.08
E	17.8	2.46	13.3	5.34
Tetrachlorobutadiene #2				
A	107	15.0	137	9.15
1 Composite	24.4	3.42	206	
1 Grab	151	21.1		9.74
B	100	14.0	183	13.1
C	26.1	3.65	133	36.4
D	144	20.2	38.5	1.93
E	43.0	6.02	87.6	14.6

Table 4-8. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Pentachlorobutadiene #1				
A	584	199	1270	6.40
1 Composite	102	34.7	1660	
1 Grab	692	235		7.06
B	425	145	2720	18.8
C	63.2	21.5	902	42.0
D	329	112	594	5.31
E	174	59.2	430	7.27
Pentachlorobutadiene #2				
A	191	64.9	221	3.40
1 Composite	29.3	10.0	360	
1 Grab	248	84.3		4.27
B	134	45.6	663	14.6
C	28.0	9.52	205	21.5
D	439	149	144	0.965
E	55.4	18.8	100	5.31
Hexachlorobutadiene				
A	1470	3499	28900	8.26
1 Composite	618	1471	69800	
1 Grab	1610	3832		18.2
B	1740	4141	38000	9.18
C	200	476	68100	143
D	1390	3308	8580	2.59
E	855	2035	34100	16.8

49

Table 4-8.   Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (µg/kg)	Observed[b] Conc. in Tissue (µg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Trichlorobenzene, 1,2,3-				
A	54.8	34.5	122	3.53
1 Composite	28.9	18.2	266	
1 Grab	67.1	42.3		6.29
B	70.7	44.5	226	5.07
C -	18.5	11.7	182	15.6
D	55.6	35.0	47.5	1.36
E	35.8	22.6	142	6.30
Trichlorobenzene, 1,2,4-				
A	300	179	807	4.51
1 Composite	127	75.8	1350	
1 Grab	382	228		5.92
B	312	186	1240	6.66
C	81.9	48.9	9.45	0.193
D	360	215	280	1.30
E	178	106	872	8.21
Tetrachlorobenzene Mix				
A	131	367	1290	3.52
1 Composite	61.3	172	2770	
1 Grab	170	476		5.82
B -	243	681	1750	2.57
C	36.0	101	2670	26.5
D	141	395	499	1.26
E	108	303	1790	5.92

Table 4-8. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (µg/kg)	Observed[b] Conc. in Tissue (µg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Tetrachlorobenzene, 1,2,3,4-				
A	109	201	717	3.57
1 Composite	39.2	72.1	1160	
1 Grab	142	261		4.44
B	150	276	1240	4.49
C	26.8	49.3	1050	21.3
D	126	232	371	1.60
E	68.4	126	734	5.83
Pentachlorobenzene				
A	249	3610	4720	1.31
1 Composite	78.8	1140	8210	
1 Grab	331	4800		1.71
B	349	5060	7880	1.56
C	33.2	481	7980	16.6
D	166	2400	1740	0.723
E	97.1	1410	3990	2.84
Hexachlorobenzene				
A	214	4940	5400	1.09
1 Composite	65.4	1510	6430	
1 Grab	364	8400		0.765
B	418	9650	4650	0.482
C	17.4	402	5960	14.8
D	84.2	1940	1220	0.628
E	47.4	1090	1370	1.25

[a] 7.6% lipid content.
[b] 7.6% lipid content and corrected for recovery and procedural blank.

51

Table 4-9. Predicted and Measured _Callinectes sapidus_ Tissue Concentrations for the Louisiana Study.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Hexachloroethane				
A	348	258	16.8	0.0651
1 Composite	143	106	11.0	
1 Grab	439	326		0.0338
B	505	375	18.6	0.0496
C	53.3	39.5	19.8	0.501
D	292	217	10.0	0.0462
E	159	118	15.3	0.130
Tetrachlorobutadiene #1				
A	38.3	5.36	6.20	1.16
1 Composite	10.3	1.44	16.5	
1 Grab	61.3	8.58		1.92
B	39.3	5.50	33.5	6.09
C	9.81	1.37	29.8	21.7
D	45.7	6.40	7.85	1.23
E	17.8	2.49	24.4	9.79
Tetrachlorobutadiene #2				
A	107	15.0	21.9	1.46
1 Composite	24.4	3.42	64.3	
1 Grab	151	21.1		3.04
B	100	14.0	170	12.1
C	26.1	3.65	103	28.2
D	144	20.2	52.2	2.59
E	43.0	6.02	80.4	13.4

52

Table 4-9. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Pentachlorobutadiene #1				
A	584	199	106	0.534
1 Composite	102	34.7	219	
1 Grab	692	235		0.931
B	425	145	459	3.18
C	63.2	21.5	328	15.3
D	329	112	80	0.715
E	174	59.2	309	5.22
Pentachlorobutadiene #2				
A	191	64.9	1.81	0.0279
1 Composite	29.3	10.0	7.24	
1 Grab	248	84.3		0.0859
B	134	45.6	10.3	0.226
C	28.0	9.52	10.7	1.12
D	439	149	3.04	0.0204
E	55.4	18.8	4.86	0.258
Hexachlorobutadiene				
A	1470	3499	274	0.0783
1 Composite	618	1471	340	
1 Grab	1610	3832		0.0887
B	1740	4141	728	0.176
C	200	476	482	1.01
D	1390	3308	261	0.0789
E	855	2035	363	0.178

Table 4-9. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Trichlorobenzene, 1,2,3-				
A	54.8	34.5	81.5	2.36
1 Composite	28.9	18.2	166	
1 Grab	67.1	42.3		3.93
B	70.7	44.5	267	5.99
C	18.5	11.7	172	14.8
D	55.6	35.0	91.1	2.60
E	35.8	22.6	138	6.12
Trichlorobenzene, 1,2,4-				
A	300	179	308	1.72
1 Composite	127	75.8	713	
1 Grab	382	228		3.13
B	312	186	1460	7.84
C	81.9	48.9	967	19.8
D	360	215	416	1.94
E	178	106	706	6.66
Tetrachlorobenzene Mix				
A	131	367	476	1.30
1 Composite	61.3	172	849	
1 Grab	170	476		1.78
B	243	681	1450	2.13
C	36.0	101	1050	10.4
D	141	395	571	1.45
E	108	303	682	2.25

Table 4-9. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Tetrachlorobenzene, 1,2,3,4-				
A	109	201	368	1.83
1 Composite	39.2	72.1	706	
1 Grab	142	261		2.70
B	150	276	928	3.36
C	26.8	49.3	692	14.0
D	126	232	368	1.59
E	68.4	126	497	3.95
Pentachlorobenzene				
A	249	3610	1470	0.407
1 Composite	78.8	1140	2470	
1 Grab	331	4800		0.515
B	349	5060	2350	0.465
C	33.2	481	1630	3.39
D	166	2400	987	0.410
E	97.1	1410	1240	0.881
Hexachlorobenzene				
A	214	4940	1770	0.358
1 Composite	65.4	1510	2090	
1 Grab	364	8400		0.249
B	418	9650	1490	0.154
C	17.4	402	868	2.16
D	84.2	1940	781	0.402
E	47.4	1090	1050	0.959

[a] 7.6% lipid content.
[b] 7.6% lipid content and corrected for recovery and procedural blank.

Table 4-10. Predicted and Measured Brevoortia patronus Tissue Concentrations for the Louisiana Study.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (µg/kg)	Observed[b] Conc. in Tissue (µg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Hexachloroethane				
C	53.3	39.5	222	5.61
D	292	217	391	1.80
E	159	118	374	3.17
Tetrachlorobutadiene #1				
C	9.81	1.37	46.0	33.5
D	45.7	6.40	79.7	12.5
E	17.8	2.49	91.3	36.6
Tetrachlorobutadiene #2				
C	26.1	3.65	132	36.1
D	144	20.2	235	11.7
E	43.0	6.02	237	39.4
Pentachlorobutadiene #1				
C	63.2	21.5	2440	114
D	329	112	5320	47.6
E	174	59.2	5370	90.8
Pentachlorobutadiene #2				
C	28.0	9.52	530	55.7
D	439	149	1090	7.30
E	55.4	18.8	1020	54.2
Hexachlorobutadiene				
C	200	476	8510	17.9
D	1390	3308	15900	4.81
E	855	2035	16600	8.16

56

Table 4-10. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Trichlorobenzene, 1,2,3-				
C	18.5	11.7	113	9.70
D	55.6	35.0	165	4.71
E	35.8	22.6	201	8.91
Trichlorobenzene, 1,2,4-				
C	81.9	48.9	669	13.7
D	360	215	1150	5.35
E	178	106	1200	11.3
Tetrachlorobenzene Mix				
C	36.0	101	497	4.93
D	141	395	862	2.18
E	108	303	887	2.93
Tetrachlorobenzene, 1,2,3,4-				
C	26.8	49.3	646	13.1
D	126	232	1070	4.62
E	68.4	126	1170	9.30
Pentachlorobenzene				
C	33.2	481	3040	6.32
D	166	2400	5140	2.14
E	97.1	1410	5320	3.78
Hexachlorobenzene				
C	17.4	402	1950	4.85
D	84.2	1940	3510	1.81
E	47.4	1090	4920	4.50

[a] 7.6% lipid content.
[b] 7.6% lipid content and corrected for recovery and procedural blank.

57

Table 4-11. Predicted and Measured <u>Micropogan undulus</u> Tissue Concentrations for the Louisiana Study.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Hexachloroethane				
B	505	375	85.2	0.227
C	53.3	39.5	48.7	1.23
D	292	217	241	1.11
E	159	118	326	2.76
Tetrachlorobutadiene #1				
B	39.3	5.50	19.2	3.49
C	9.81	1.37	6.35	4.62
D	45.7	6.40	81.5	12.7
E	17.8	2.49	102.0	40.9
Tetrachlorobutadiene #2				
B	100	14.0	65.6	4.69
C	26.1	3.65	20.2	5.53
D	144	20.2	203.0	10.1
E	43	6.02	276.0	45.8
Pentachlorobutadiene #1				
B	425	145	858	5.94
C	63.2	21.5	401	18.7
D	329	112	4040	36.1
E	174	59.2	5000	84.5
Pentachlorobutadiene #2				
B	134	45.6	92.2	2.02
C	28.0	9.5	35.5	3.73
D	439	149	426	2.85
E	55.4	18.8	443	23.5

Table 4-11. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Hexachlorobutadiene				
B	1740	4141	5600	1.35
C	200	.476	4180	8.78
D	1390	3308	20600	6.23
E	855	2035	17300	8.50
Trichlorobenzene, 1,2,3-				
B	70.7	44.5	81.4	1.83
C	18.5	11.7	27.0	2.32
D	55.6	35.0	210	6.00
E	35.8	22.6	218	9.67
Trichlorobenzene, 1,2,4-				
B	312	186	356	1.91
C	81.9	48.9	142	2.90
D	360	215	1160	5.40
E	178	106	1290	12.1
Tetrachlorobenzene Mix				
B	243	681	309	0.454
C	36.0	101	248	2.46
D	141	395	810	2.05
E	108	303	788	2.60
Tetrachlorobenzene, 1,2,3,4-				
B	150	276	339	1.23
C	26.8	49	303	6.14
D	126	232	1020	4.40
E	68.4	126	948	7.53

59

Table 4-11. Continued.

Station	Average Conc. in Ambient Water (ng/L)	Predicted[a] Conc. in Tissue (μg/kg)	Observed[b] Conc. in Tissue (μg/kg)	Ratio of Observed to Predicted Conc. in Tissue
Pentachlorobenzene				
B	349	5060	1970	0.390
C	33.2	481	1820	3.78
D	166	2400	3860	1.60
E	97.1	1410	3360	2.39
Hexachlorobenzene				
B	418	9650	2200	0.228
C	17.4	402	2100	5.23
D	84.2	1940	2890	1.49
E	47.4	1090	2500	2.28

[a] 7.6% lipid content.
[b] 7.6% lipid content and corrected for recovery and procedural blank.

4.7 Comparison of the Predicted and Observed Tissue Residues: Results

In Table 4-12, all of the tissue predictions based upon the ambient grab water samples were tabulated according to the ratio of the observed to predicted tissue residues.

For the C. sapidus, 32, 42, and 53 of the 72 predicted residues for all chemicals were within a factor of 3, 5, and 10, respectively, of the observed residues. For predicted residues differing by a factor of 5 or more, approximately half were smaller than the measured residues. In general, better predictability was observed for the tetra- through hexa-chlorobenzenes, i.e., 17 of the 24 predicted residues were within a factor of 3, and 21 of the 24 predicted residues were within a factor of 5 of the measured residues. The poorest predictability was observed for HCE and HCBD where only of 2 of the 12 predicted residues were within a factor of 5 of the measured tissue residues. The field stations where the best predictability was observed were A and D, i.e., 10 of the 12 predicted residues for each station were within a factor of 3. Stations C and E tended to predict tissue residues which were much smaller than the observed residues.

For the F. heteroclitus, 23, 33, and 55 of the 72 predicted residues for all chemicals were within a factor of 3, 5, and 10 of the observed residues, respectively. All of the remaining predicted residues, except for one, were smaller than the measured residues. The best predictability was observed for HCE, PeCB and HCB where 4, 5, and 5 of the 6 predicted residues, respectively, were within a factor of 3 of the measured tissues. The poorest predictability was observed for the chlorinated butadienes where 1 or less of the 6 predicted residues were within a factor of 3 at each station. The field stations where the best predictability was observed were A, 1, and D. The poorest predictability was observed at stations B and C and predictions were smaller than the measured residues by factors ranging up to 42.

For the M. undulus, 20, 28, and 35 of the 48 predicted residues were within a factor of 3, 5, and 10 of the observed residues, respectively. The remaining predicted residues were all too small by factors ranging up to 84.5. Predicted residues for HCE, TeCB mix, PeCB and HCB were all within a factor of 5 (16 of 16 predictions) and the predicted residues for HCBD, 1,2,3-TrCB, and 1,2,3,4-TeCB were all within a factor of 10. Stations B, C, D, and E had 7, 6, 5, and 4 of the 12 predicted residues within a factor of 3, respectively, and had 11, 8, 6, and 4 of the 12 residues with a factor of 5, respectively.

For the B. patronus, 5, 13, and 21 of the 36 predicted residues were within a factor of 3, 5, and 10 of the observed residues, respectively. The best predictability was observed with the HCE, TeCB Mix, 1,2,3,4-TeCB, PeCB and HCB compounds. For the rest of the chemicals, 14 of the 36 predicted residues

Table 4-12 Distribution of the Ratios of the Observed to Predicted Tissue Concentrations for All Field Stations.

	Factor[a] of 3			Factor[b] of 5			Factor[c] of 10			Total Number of Tissue Predictions
	lt	eq	gt	lt	eq	gt	lt	eq	gt	
Hexachloroethane										
C. sapidus	5	1	0	5	1	0	4	2	0	6
F.-heteroclitus	0	4	2	0	5	1	0	5	1	6
M. undulus	1	3	0	0	4	0	0	4	0	4
B. patronus	0	1	2	0	2	1	0	3	0	3
All fishes	1	8	4	0	11	2	0	12	1	13
Chlorinated Butadienes										
C. sapidus	10	10	10	8	14	8	6	19	5	30
F. heteroclitus	0	4	26	0	7	23	0	19	11	30
M. undulus	0	3	17	0	7	13	0	8	12	20
B. patronus	0	0	15	0	1	14	0	3	12	15
All fishes	0	7	58	0	15	50	0	30	35	65
Chlorinated Benzenes										
C. sapidus	2	21	13	1	27	8	0	32	4	36
F. heteroclitus	1	15	20	1	21	14	0	31	5	36
M. undulus	1	14	9	0	17	7	0	23	1	24
B. patronus	0	4	14	0	10	8	0	15	3	18
All fishes	2	33	43	1	48	29	0	69	9	78
All Chemicals										
C. sapidus	17	32	23	14	42	16	10	53	9	72
F. heteroclitus	1	23	48	1	33	38	0	55	17	72
M. undulus	2	20	26	0	28	20	0	35	13	48
B. patronus	0	5	31	0	13	23	0	21	15	36
All fishes	3	48	105	1	74	81	0	111	45	156

[a] lt = Number of ratios < 1/3; eq = Number of ratios ≥ 1/3 and ≤ 3; gt = Number of tissue residue ratios > 3.

[b] lt = Number of ratios < 1/5; eq = Number of ratios ≥ 1/5 and ≤ 5; gt = Number of tissue residue ratios > 5.

[c] lt = Number of ratios < 1/10; eq = Number of ratios ≥ 1/10 and ≤ 10; gt = Number of tissue residue ratios > 10.

were too small by a factor of 10 or more and the poorest predictability was observed at Stations C and E.

Overall, the guidance residue prediction procedure had slightly better predictability for the invertebrate, C. sapidus than for the fishes, F. heteroclitus, B. patronus, and M. undulus. The guidance procedure tended to have a skewed predictability for the fishes, i.e., substantially more of the predicted residues were smaller than the measured residues. The residues predicted using the guidance procedure were in better agreement for Stations A and D, and in poorest agreement at Stations C and E. The predicted and measured residues for the highly chlorinated benzenes, TeCB Mix, 1,2,3,4-TeCB, PeCB, and HCB, were in good agreement for all species at nearly of all stations. The predicted and measured residues for HCE were in good agreement for the fishes but in poor agreement for the invertebrate, C. sapidus, at nearly all stations.

4.8 Comparison of the Predicted and Observed Tissue Residues: Discussion

The predicted tissue residues derived using the guidance procedure tended to be, on average, smaller than the concentrations measured in the site study organisms. Prediction of tissue residues which were smaller than the observed residues might be caused by the elevated ambient water concentrations in the fourth week of the study and/or the use of inaccurate log P values with the guidance procedure.

As previously discussed, the ambient water concentrations for the site study chemicals were not constant during the 28 day study. During the fourth week of the study, chemical concentrations in the ambient water samples were up to an order of magnitude larger than the concentrations observed in the previous three weeks of the study.

In this study, the indigenous organisms were collected in the fourth week, the time of the highest ambient water concentrations. For some of the site study chemicals, aquatic organisms reach or approach steady-state conditions with their exposure water in relatively short time periods. For example, Könemann and van Leeuwen [21] have shown with Poecilia reticulata (guppy) that di- and tri-chlorobenzenes reach steady-state conditions within 2 days, and TeCBs, PeCB and HCB reach steady-state conditions in approximately 7 days. It can be estimated by using the third and fourth week concentrations in the ambient grab samples and assuming that an abrupt change in the ambient water concentrations occurred at Station 1, e.g., HCB concentrations went from 56.5 to 1340 ng/L, that a time period of approximately 0.5 to 1.5 days of higher exposure concentrations, e.g., 1340 ng/L, could have existed (based upon HCBD, PeCB, and HCB data). This short period of higher exposure concentration just before collection of the

63

organisms would cause the observed residues to be slightly larger than predicted residues. The ratios of the observed to predicted tissue concentrations for the chlorinated benzenes are consistent with this hypothesis since their ratios tend to decrease with decreasing chemical uptake rate in all four species, e.g., 1,2,3-TrCB should and does have, on average, larger ratios than HCB.

The tendency of the predicted tissue residues to be smaller than the observed residues may also be, in part, caused by the use of inaccurate log P values with the guidance technique. The guidance procedure uses a log P - log BCF relationship to estimate the BCF for each chemical and then uses this value to predict the tissue residue. Therefore, any uncertainty/inaccuracy in the log P values are directly reflected in the predicted tissue residues.

For the chlorinated benzenes, numerous high quality log P measurements exist. For the chlorinated butadienes, a few log P measurements exist only for HCBD. In this study, we used estimated log P values for the TeCBDs and PeCBDs, and the uncertainties associated with these values could be large. For the HCBD, the estimated and measured log P values are 4.3 [20] and 4.78 [19], respectively. This difference suggests that estimated log P values for the chlorinated butadienes in all likelihood are too small. In addition, a field measured BAF for HCBD of 3580 [22] is also slightly larger than the predicted BAF of 2380 for HCBD which suggests that the log P values are, possibly, too low for the chlorinated butadienes. The ratios of the observed to predicted residues (Table 4-12) shows that the tendency to predict residues which are too small are greater for the chlorinated butadienes than for the chlorinated benzenes and this trend is consistent with the quality of the log P values used in the residue predictions.

The tendency to predict residues which were smaller than the observed residues can not be solely attributed to the quality of the log P values used with the guidance technique. Overall, the log P values for the chlorinated benzenes were of high quality and approximately 12% of the predicted residues for this chemical class were too small by a factor of 10 or more.

Variability associated with the ambient exposure concentrations used in the prediction of the tissues might also be, in part, a cause of the tendency to predict residues which were too small for the site study chemicals. Based upon the hydrodynamics of the field site, greater changes/fluctuations in ambient concentrationswould be expected at the bayou sampling stations due to tides and run-off. In Table 4-13, the distribution of the ratios of the observed to predicted tissue residues for the canal sampling stations are reported. As expected, substantially better predictability was obtained for the canal sampling stations, e.g., all of the residues predicted for the chlorinated benzenes were within a factor of 10 or less.

The residue prediction procedure provided particularly poor estimates for Station C. Station C was located above the confluence of the bayou and the canal and had the lowest ambient water chemical concentrations of all of the stations. This station should have had the lowest observed tissue residues in the study. However, tissue residues measured at station C were very similar to those at stations D and E in the bayou. The mobility of the aquatic organisms at this site is unknown. However, the tissue data suggests that the organisms were fairly mobile in the bayou during the time of the site study since fairly similar tissue concentrations were observed for all three bayou sampling stations. If station C is not included in the tabulation of the ratios of the observed to predicted tissue residues (Table 4-14), the number of predicted residues which were too small decreases substantially, e.g., 24% to 13%. Even with C station not included in the tabulation, the poorest predictability was still observed for the chlorinated butadienes.

The chemicals predicted to be larger than their measured tissue concentrations for the *C. sapidus*, in general, were HCE, PeCBDs, and HCBD. In contrast, no chemicals were predicted to be larger for the fishes, e.g., none of 156 predicted tissue concentrations were greater than their measured residues by a factor of 10 or more (Table 4-12).

The measured ambient water concentrations were expected to be more representative of the exposure conditions for the fishes since these samples were taken from the middle of the water column at each sampling station. The *C. sapidus* live on the sediments and their exposure via the water could be different from that observed at the middle of the water column. Groundwater intrusion from the marshes surrounding the canal and bayou, salinity gradients due to the tides, thermal gradients caused by the discharge, and/or runoff could cause differences in ambient water concentrations between the middle of the water column and the sediment/water interface. These differences might account for the tissue predictions which were much larger than the measured concentrations. For example, the sediments contain nondetectable amounts of HCE and therefore, the *C. sapidus* might have lower tissue concentrations for HCE due to lower ambient water concentrations at the sediment/water interface.

The measured and predicted tissue concentrations were in agreement with the expected trends for metabolic behavior of the site study chemicals. In Section 4.1, similar agreement between the measured and predicted tissue residues a) for all chemicals for a given organism and b) for both invertebrate and vertebrate organisms were forecasted. Similar levels of agreement did occur for these chemicals for each organism as well as among the fishes and *C. sapidus*. The only chemicals with divergent behavior were HCE, PeCDBs, and HCBD for the *C. sapidus*. Exposure conditions, specific metabolic abilities and/or special

Table 4-13 Distribution of the Ratios of the Observed to Predicted Tissue Concentrations for Field Stations A, 1-G, and B

	Factor[a] of 3			Factor[b] of 5			Factor[c] of 10			Total Number of Tissue Predictions
	lt	eq	gt	lt	eq	gt	lt	eq	gt	
Hexachloroethane										
C. sapidus	3	0	0	3	0	0	3	0	0	3
F. heteroclitus	0	3	0	0	3	0	0	3	0	3
M. undulus	1	0	0	0	1	0	0	1	0	1
B. patronus	0	0	0	0	0	0	0	0	0	0
All fishes	1	3	0	0	4	0	0	4	0	4
Chlorinated Butadienes										
C. sapidus	6	5	4	5	8	2	4	10	1	15
F. heteroclitus	0	0	15	0	3	12	0	11	4	15
M. undulus	0	2	3	0	4	1	0	5	0	5
B. patronus	0	0	0	0	0	0	0	0	0	0
All fishes	0	2	18	0	7	13	0	16	4	20
Chlorinated Benzenes										
C. sapidus	2	11	5	1	15	2	0	18	0	18
F. heteroclitus	0	7	11	0	13	5	0	18	0	18
M. undulus	1	5	0	0	6	0	0	6	0	6
B. patronus	0	0	0	0	0	0	0	0	0	0
All fishes	1	12	11	0	19	5	0	24	0	24
All Chemicals										
C. sapidus	11	16	9	10	23	4	7	28	1	36
F. heteroclitus	0	10	26	0	19	17	0	32	4	36
M. undulus	2	7	3	0	11	1	0	12	0	12
B. patronus	0	0	0	0	0	0	0	0	0	0
All fishes	2	17	29	0	30	18	0	44	4	48

[a] lt = Number of ratios $< 1/3$; eq = Number of ratios $\geq 1/3$ and ≤ 3; gt = Number of tissue residue ratios > 3.

[b] lt = Number of ratios $< 1/5$; eq = Number of ratios $\geq 1/5$ and ≤ 5; gt = Number of tissue residue ratios > 5.

[c] lt = Number of ratios $< 1/10$; eq = Number of ratios $\geq 1/10$ and ≤ 10; gt = Number of tissue residue ratios > 10.

Table 4-14 Distribution of the Ratios of the Observed to Predicted Tissue Concentrations for Field Stations A, 1-G, B, D, and E.

	Factor[a] of 3			Factor[b] of 5			Factor[c] of 10			Total Number of Tissue Predictions
	lt	eq	gt	lt	eq	gt	lt	eq	gt	
Hexachloroethane										
C. sapidus	5	0	0	5	0	0	4	1	0	5
F. heteroclitus	0	4	1	0	5	0	0	5	0	5
M. undulus	1	2	0	0	3	0	0	3	0	3
B. patronus	0	1	1	0	2	0	0	2	0	2
All fishes	1	7	2	0	10	0	0	10	0	10
Chlorinated Butadienes										
C. sapidus	10	8	7	8	12	5	6	17	2	25
F. heteroclitus	0	4	21	0	7	18	0	19	6	25
M. undulus	0	3	12	0	5	10	0	8	7	15
B. patronus	0	0	10	0	1	9	0	3	7	10
All fishes	0	7	43	0	13	37	0	30	20	50
Chlorinated Benzenes										
C. sapidus	2	20	8	1	25	4	0	30	0	30
F. heteroclitus	0	15	15	0	21	9	0	30	0	30
M. undulus	1	11	6	0	13	5	0	17	1	18
B. patronus	0	4	8	0	8	4	0	11	1	12
All fishes	1	30	29	0	42	18	0	58	2	60
All Chemicals										
C. sapidus	17	28	15	14	37	9	10	38	2	60
F. heteroclitus	0	23	37	0	33	27	0	54	6	60
M. undulus	2	16	18	0	21	15	0	28	8	36
B. patronus	0	5	19	0	11	13	0	16	8	24
All fishes	2	44	74	0	65	55	0	98	22	120

[a] lt = Number of ratios < 1/3; eq = Number of ratios ≥ 1/3 and ≤ 3; gt = Number of tissue residue ratios > 3.

[b] lt = Number of ratios < 1/5; eq = Number of ratios ≥ 1/5 and ≤ 5; gt = Number of tissue residue ratios > 5.

[c] lt = Number of ratios < 1/10; eq = Number of ratios ≥ 1/10 and ≤ 10; gt = Number of tissue residue ratios > 10.

physiological abilities, i.e., *C. sapidus* have anaerobic metabolism pathways, might be responsible for the observed differences for these four chemicals.

4.9 Summary

Six chemicals identified in the grab samples from Station 1 and the outfall using the effluent analytical method produced chemical residues in the receiving water fishes and *C. sapidus*. Seven additional chemicals, found in the sample extracts prepared by using the effluent analytical method and which were similar to those identified by the effluent method, also produced chemical residues in the receiving fishes and *C. sapidus*.

The guidance technique predicted tissue concentrations which were smaller than the measured concentrations by a factor of 1.1 and 5.3 on average (geometric average) for the *C. sapidus* and fishes, respectively. For the *C. sapidus*, 32, 42, and 53 of 72 predicted tissue residues were within a factor of 3, 5, and 10 of the measured tissue concentrations, respectively (Table 4-12). For the fishes, 48, 74, and 111 of 156 predicted tissue residues were within a factor of 3, 5, and 10, respectively (Table 4-12).

The guidance technique provided more accurate tissue concentrations for chemicals with the highest quality log P values and with the least variable exposure concentrations. The best predictability was observed for the chlorinated benzenes (chemicals with the highest quality log P values) at the canal sampling stations, the field stations with the smallest variability in exposure concentrations. The poorest predictability was observed for the chlorinated butadienes (chemicals with the lowest quality log P values) at Station C, the field station upstream of the confluence of the bayou and canal.

The measured and predicted tissue concentrations were in agreement with the expected trends for metabolic behavior for the site study chemicals for the fishes. For the *C. sapidus*, the measured and predicted tissue concentrations except for HCE, PeCBDs, and HCBD were in agreement with their expected metabolic behavior. The HCE, PeCBDs, and HCBD were divergent from their expected metabolic behavior in that their measured concentrations were substantially lower than the predicted tissue concentrations suggesting that special metabolic, exposure, and/or physiological conditions might be controlling bioaccumulation of these chemicals in *C. sapidus*.

Field studies, by their inherent nature, include the dynamics and variabilities associated with natural aquatic systems. The predictability demonstrated at this tidal site includes the variabilities associated with the natural system, e.g. tides, highly contaminated sediments, non-sessile organisms, and run off events, and uncertainties associated with the predictive technique, e.g., uncertainties associated with the log P values, the log P - BCF relationship, and the food chain multipliers.

68

REFERENCES

[1]   United States Environmental Protection Agency, Office of Water Enforcement and Permits. Assessment and control of bioconcentratable contaminants in surface waters. Public Comment Draft (Fed. Regist. 1991, 56, 13150-13151), March 1991.

[2]   Racca, L. 1991. Louisiana Department of Environmental Quality, Personal Communication.

[3]   United States Environmental Protection Agency, Water Quality Management Branch, Region 6. 1990. Toxics Study of the Lower Calcasieu River.

[4]   Pereira, W.E., C.E. Rostad, C.T. Chiou, T.I. Brinton and L.B. Barber II. 1988. Contamination of estuaries, water, biota, and sediment by halogenated organic compounds: A field study. Environmental Science and Technology, 22: 772-778.

[5]   Demcheck, D.K., C.R. Demas and C.R. Garrison. 1990. Chemical, tissue, and physical data from water and bottom material in the lower Calcasieu River, Louisiana, 1985-88. United States Geological Survey, Open-File Report 89-420.

[6]   Veith, G.D. and P. Kosian. 1982. Estimating bioconcentration potential from octanol/water partition coefficients, in Physical Behavior of PCBs in the Great Lakes, MacKay, Paterson, Eisenreich, and Simmons, Eds., Chapter 15, Ann Arbor Science, Ann Arbor, MI.

[7]   Schuurmann, G. and W. Klein. 1988. Advances in bioconcentration prediction. Chemosphere, 17(8): 1551-1574.

[8]   Thomann, R.V. 1989. Bioaccumulation model of organic chemical distribution in aquatic food chains. Environmental Science and Technology, 23: 699-707.

[9]   Thomann, R.V. 1987. A statistical model of environmental contaminants using variance spectrum analysis. Report to National Science Foundation. August 1987. NTIS #: PB88-235130/A09.

[10]   Rasmussen, J.B., D.J. Rowan, D.R.S. Lean, and J.H. Carey. 1990. Food chain structure in ontario lakes determines PCB levels in lake trout (*Salvelinus namaycush*) and other pelagic fish. Canadian Journal of Fisheries Science, 47: 2030-2038.

[11]   Nichols, J.W., J.M. McKim, G.J. Lien, A.D. Hoffman and S.L. Bertelsen. 1991. Physiologically based toxicokinetic modeling of three waterborne

chloroethanes in rainbow trout Oncorhynchus mykiss. Toxicology and
Applied Pharmacology, 110: 374-389.

[12] Gargas, M.L. and Andersen, M.E. 1989. Determining kinetic constants of
chlorinated ethane metabolism in the rat from rates of exhalation.
Toxicology and Applied Pharmacology, 99: 344-353.

[13] Matthews, H.B. 1982. Aryl halides. In Metabolic basis of detoxification:
Metabolism of functional groups. Jakoby, Bend and Caldwell, Editors.
Chapter 3. Academic Press, New York, NY.

[14] Bauer, I., S. Weigelt and W. Ernst. 1989. Biotransformation of
hexachlorobenzene in the blue mussel Mytilus edulis. Chemosphere,
19(10/11): 1701-1707.

[15] Sanborn, J.R., W.F. Childers and L.G. Hansen. 1977. Uptake and
elimination of [14C]hexachlorobenzene (HCB) by the green sunfish, Lepomis
cyanellus Raf., after feeding contaminated food. Journal Agricultural Food
and Chemistry, 25(3): 551-553.

[16] Chiou, C.T. 1985. Partition coefficients of organic compounds in lipid water
systems and correlation with fish bioconcentration factors. Environmental
Science and Technology, 19(1): 57-62.

[17] Watarai, H., M. Tanaka, and N. Suzuki. 1982. Determination of partition
coefficients of halobenzenes in heptane/water and 1-octanol/water systems
and comparison with the scaled particle calculation. Analytical Chemistry,
54(4): 702-705.

[18] Könemann, H., R. Zelle, F. Busser and W.E. Hammers. 1979. Determination
of log P_{oct} values of chloro-substituted benzenes, toluenes and anilines by
high-performance liquid chromatography on ODS-silica. Journal of
Chromatography, 178: 559-565.

[19] Banarjee, S., S.H. Yalkowsky and S.C. Valvani. 1980. Water solubility and
octanol/water partition coefficients of organics. Limitations of the solubility-
partition coefficient correlation. Environmental Science and Technology,
14(10): 1227.

[20] Leo, A. and D. Weininger. 1984. CLog P version 3.2 User Reference
Manual. Pomona Medicinal Chemistry Project, Pomona College, Claremont,
CA 91711.

[21] Könemann, H. and K. van Leeuwen. 1980. Toxicokinetics in fish:
      Accumulation and elimination of six chlorobenzenes by guppies.
      Chemosphere, 9: 3-19.

[22] Oliver, B.G. and A.J. Niimi. 1983. Bioconcentration of chlorobenzenes from
      water by brook trout. Correlations with partition coefficients and
      environmental residues. Environmental Science and Technology, 17(5): 287-
      291.

APPENDIX   A

Table A-1. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Outfall, Fraction 1.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS /chem/msd/90c911601016.d

Peak RT	(Fit)	Height (Name)	Amount (ng/L)
8.756		73916	182.07
	97	Benzene, 1,2-dichloro- (9CI)	
	96	Benzene, 1,4-dichloro- (9CI)	
	95	Benzene, 1,3-dichloro- (9CI)	
9.514		138398	325.87
	91	Ethane, hexachloro- (8CI9CI)	
10.213		48924	126.33
	74	Benzene, (2-chloroethyl)- (8CI9CI)	
11.186		28443	82.24
	93	1,3-Butadiene, pentachloro- (9CI)	
11.476		101974	244.64
	95	Naphthalene (ACN) (DOT) (8CI9CI)	
	94	1H-Indene, 1-methylene- (9CI)	
	94	Azulene (8CI9CI)	
14.508		3881660	10766.62
	93	Naphthalene, 2-ethenyl- (9CI)	
	76	1,1'-Biphenyl (9CI)	
15.859		43474	114.18
	76	Acenaphthene (8CI)	
16.258		77577	190.23
	86	Dibenzofuran (8CI9CI)	
16.990		100639	241.66
	81	Benzene, 1-chloro-2-phenoxy- (9CI)	
17.221		212867	491.94
	95	Benzene, 1-chloro-4-phenoxy- (9CI)	
	89	Benzene, 1-chloro-3-phenoxy- (9CI)	
18.550		306136	699.93
	86	Benzene, bromophenoxy- (9CI)	
19.848		71340	176.32
	90	Phenanthrene (8CI9CI)	
	87	Benzene, 1,1'-(1,2-ethynediyl)bis- (9CI)	
	83	Anthracene (8CI9CI)	
	81	9H-Fluorene, 9-methylene- (9CI)	
	78	2-Cyclopropen-1-one, 2,3-diphenyl- (9CI)	
22.568		153846	360.32
	90	1,2-Benzenedicarboxylicacid, bis(2-methoxyethyl) ester (9CI)	
	90	1,2-Benzenedicarboxylicacid, butyl cyclohexylester (9CI)	
	86	1,2-Benzenedicarboxylicacid, butyl 2-methylpropyl ester (9CI)	
	78	1,2-Benzenedicarboxylicacid, butyl 8-methylnonyl ester (9CI)	
24.226		48495	125.38
	87	Fluoranthene (8CI9CI)	

A-1

Table A-2. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Outfall, Fraction 2.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90c911601017.d

Peak RT	(Fit)	Height (Name)	Amount (ng/L)
11.233		394254	362.25
	99	1,3-Butadiene, pentachloro- (9CI)	
12.098		1090000	1012.20
	99	1,3-Butadiene, 1,1,2,3,4,4,-hexachloro- (8CI9CI)	
15.651		272065	252.21
	99	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)- (9CI)	
16.352		94122	91.95
	94	Benzene, pentachloro- (8CI9CI)	
20.052		99228	96.55
	95	Benzene, 1-1'-oxybis (4-chloro- (9CI)	
24.232		93216	91.14
	90	Fluoranthene (8CI9CI)	
	72	Benzene, 1,1'-(1,3-butadiyne-1,4-diyl)bis- (9CI)	
25.080		129281	123.62
	96	Pyrene (8CI9CI)	
	87	Fluoranthene (8CI9CI)	

Table A-3.   Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Outfall, Fraction 3.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90c911601018.d

Peak RT	(Fit)	Height (Name)	Amount (ng/L)
12.070		460690	203.13
	99	1,3-Butadiene, 1,1,2,3,4,4,-hexachloro- (8CI9CI)	
18.907		652558	285.62
	98	Benzene, hexachloro- (8CI9CI)	
	89	1,3-Cyclopentadiene, 1,2,3,4-tetrachloro-5-(dichloromethylene)-(8CI9CI)	
23.987		1539990	1052.43
	93	Sulfur, mol. (S8) (8CI9CI)	
24.779		271343	121.72
	72	Mirex	
31.999		156969	72.55
	72	1,2-Benzenedicarboxylic acid, 3-nitro- (9CI)	

Table A-4   Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Station 1, Fraction 1

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90c911601022.d

Peak RT	(Fit)	Height (Name)	Amount (ng/L)
8.048		227053	151.17
	72	Pyridine, 2,3,4,5-tetrahydro- (8CI9CI)	
8.320		301839	199.07
	97	Benzene, 1,4-dichloro- (9CI)	
	97	Benzene, 1,3-dichloro- (9CI)	
	96	Benzene, 1,2-dichloro- (9CI)	
11.400		116305	80.23
	94	Benzene, 1,2,4-trichloro- (8CI9CI)	
	87	Benzene, 1,2,3-trichloro- (8CI9CI)	
	87	Benzene, 1,3,5-trichloro- (8CI9CI)	
11.501		102574	71.44
	91	Azulene (8CI9CI)	
	91	1H-Indene, 1-methylene- (9CI)	
	90	Naphthalene (ACN) (DOT) (8CI9CI)	
14.463		1541280	1169.58
	90	Naphthalene, 2-ethenyl- (9CI)	
	81	1,1'-Biphenyl (9CI)	

Table A-5 Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Station 1, Fraction 2.

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90c911601023.d

Peak RT	(Fit)	Height (Name)	Amount (ng/L)
11.208		391250	184.59
	98	1,3-Butadiene, pentachloro- (9CI)	
12.071		292527	139.43
	99	1,3-Butadiene, 1,1,2,3,4,4,-hexachloro- (8CI9CI)	
15.646		640694	298.69
	99	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)- (9CI)	

Table A-6. Bioconcentratable Chemicals Tentatively Identified Using the Effluent Analytical Procedure: Station 1, Fraction 3

NBS/EPA/NIH TENTATIVE IDENTIFICATIONS   /chem/msd/90c911601024.d

Peak RT	(Fit)	Height (Name)	Amount (ng/L)
8.107		307900	113.68
	72	Cyclopropane, 1,1,2,2-tetramethyl- (8CI9CI)	
12.040		539792	195.64
	99	1,3-Butadiene, 1,1,2,3,4,4,-hexachloro- (8CI9CI)	
23.889		9532070	400.37
	93	Sulfur, mol. (S8) (8CI9CI)	
	91	Maneb (ACN)	

Table A-7. Concentrations of Hexachloroethane in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battělle	A	R-L	
	B	71.5	3.95
	C	34.7	3.53
	D	R-L	
	E	23.8	4.91
	F	58.5	1.17
	G	57.9	4.46
	H	28.0	2.21
	I	25.5	2.26
	J	R-L	
	K	61.3	1.66
	L	74.4	3.28
	M	48.6	5.27
	N	26.2	84.1
ERL-D	a	72.9	3.80
	b	87.0	4.00
	c	66.8	3.82
	d	86.8	5.06
Outfall			
ERL-D	1-a	33.4	330
	1-a	33.7	378
	2-b	36.0	91.3
	3-c	38.4	27.3
	4-d	51.0	38.2
Station A			
Battelle	1-A	34.7	203
	1-G	R-L	
	1-B	21.6	206
	2-D	22.4	167
	2-M	39.2	246
	3-E	R-L	
	3-N	35.0	137
	4-K	R-L	
	4-K	24.1	865

A-7

Table A-7. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	37.9	267
	2-b	47.3	161
	3-c	42.7	138
	4-d	78.8	838
Station 1 - Composite			
Battelle	1-A	38.7	48.8
	2-C	21.0	131
	3-E	R-L	
ERL-D	1-a	40.7	52.5
	2-b	45.7	164
	3-c	54.1	158
	4-d	59.9	233
Station 1 - Grab			
Battelle	1-B	38.7	104
	1-B	R-L	
	2-E	R-L	
	2-N	26.8	245
	3-F	R-L	
	3-L	R-I	
	4-J	32.6	1320
	4-J	39.7	1200
ERL-D	1-a	37.5	102
	2-b	41.4	237
	3-c	44.9	142
	4-d	58.7	1340
Station B			
Battelle	1-C	46.4	774
	1-H	45.7	1080
	2-D	30.3	283
	2-M	45.4	243
	3-E	54.2	137
	3-N	42.4	158
	4-J	R-I	
	4-J	R-I	

Table A-7. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	39.1	954
	2-b	47.4	276
	3-c	R-H	
	4-d	61.2	789
	4-d	63.4	582
Station C			
Battelle	1-C	97.6	52.3
	1-H	43.0	47.5
	2-D	40.7	176
	2-N	48.7	101
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	34.2	52.5
	2-b	47.9	141
	3-c	53.5	13.9
	3-c	34.4	11.8
	4-d	70.4	25.8
Station D			
Battelle	1-A	R-L	
	1-H	77.1	76.3
	1-B	51.6	85.8
	2-D	31.5	233
	2-M	67.2	162
	3-F	28.7	23.4
	3-L	R-I	
	4-K	29.1	1210
	4-K	34.4	1350
ERL-D	1-a	43.9	93.0
	2-b	46.4	208
	2-b	R-H	
	3-c	40.5	16.7
	4-d	67.5	73.2

A-9

Table A-7. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	35.8	62.3
	2-C	47.7	122
	2-M	26.6	188
	3-F	29.6	7.69
	3-L	22.3	18.2
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.7	48.2
	2-b	R-P	
	3-c	41.7	9.52
	4-d	59.3	429

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: $1,2,4,5-^{13}C_1$ HCE, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-8. Concentrations of Tetrachlorobutadiene #1 in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	0.00
	C	33.6	0.00
	D	29.8	0.00
	E	39.4	0.00
	F	51.9	0.00
	G	45.7	0.00
	H	34.2	0.00
	J	R-L	
	I	29.1	0.00
	K	55.4	0.00
	L	53.9	0.00
	M	40.6	0.00
	N	37.6	0.00
ERL-D	a	88.2	0.00
	b	106	0.00
	c	84.3	0.00
	d	93.0	0.00
Outfall			
ERL-D	1-a	39.9	1.33
	1-a	39.7	0.00
	2-b	40.5	0.00
	3-c	52.3	0.00
	4-d	53.7	0.00
Station A			
Battelle	1-A	33.6	20.2
	1-G	29.3	4.60
	1-B	20.9	21.7
	2-D	28.7	17.3
	2-M	29.1	30.6
	3-E	21.1	46.7
	3-N	31.7	25.1
	4-K	R-L	
	4-K	22.7	142

Table A-8. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.9	7.70
	2-b	55.2	8.85
	3-c	54.6	6.81
	4-d	80.0	46.9
Station 1 - Composite			
Battelle	1-A	29.5	11.4
	2-C	20.7	6.64
	3-E	R-L	
ERL-D	1-a	44.5	3.72
	2-b	54.8	9.50
	3-c	72.6	9.15
	4-d	59.8	16.6
Station 1 - Grab			
Battelle	1-B	29.9	24.4
	1-B	25.3	5.31
	2-E	R-L	
	2-N	29.7	42.8
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	292
	4-J	26.4	217
ERL-D	1-a	41.9	7.92
	2-b	46.6	18.0
	3-c	66.9	8.26
	4-d	57.7	73.1
Station B			
Battelle	1-C	39.6	5.10
	1-H	29.0	39.9
	2-D	27.2	67.0
	2-M	30.9	46.0
	3-E	40.5	27.4
	3-N	41.4	38.5
	4-J	R-I	
	4-J	R-I	

Table A-8. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.5	11.6
	2-b	53.4	20.4
	3-c	R-H	
	4-d	67.1	60.1
	4-d	62.7	61.8
Station - C			
Battelle	1-C	55.6	11.1
	1-H	37.3	13.7
	2-D	39.6	33.4
	2-N	45.6	28.3
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	4.52
	2-b	57.6	11.1
	3-c	76.5	1.33
	3-c	53.7	1.28
	4-d	80.3	3.89
Station - D			
Battelle	1-A	R-L	
	1-H	40.5	4.27
	1-B	42.3	21.0
	2-D	30.1	51.4
	2-M	48.5	30.2
	3-F	29.8	3.82
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	230
ERL-D	1-a	46.7	8.79
	2-b	55.7	14.5
	2-b	R-H	
	3-c	55.5	0.896
	4-d	66.5	43.9

Table A-8. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	39.1	10.1
	2-C	35.9	30.8
	2-M	27.5	29.8
	3-F	33.9	1.12
	3-L	25.5	1.49
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	4.48
	2-b	R-P	
	3-c	59.2	0.526
	4-d	63.3	32.5

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: 1,2,4,5-$^{13}C_6$ TeCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-9. Concentrations of Tetrachlorobutadiene #2 in Ambient Water
Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	46.4	0.00
	C	33.6	0.00
	D	29.7	0.00
	E	39.4	0.00
	F	51.9	0.00
	G	45.7	0.00
	H	34.2	0.00
	I	29.1	0.00
	J	R-L	
	K	55.4	0.00
	L	53.9	0.00
	M	40.6	0.00
	N	37.6	0.00
ERL-D	a	88.2	0.00
	b	106	0.00
	c	84.3	0.00
	d	93.0	0.00
Outfall			
ERL-D	1-a	39.9	0.814
	1-a	39.7	1.26
	2-b	40.5	2.95
	3-c	52.3	1.69
	4-d	53.7	2.79
Station A			
Battelle	1-A	33.6	46.2
	1-G	29.3	25.6
	1-B	20.9	43.9
	2-D	28.7	34.3
	2-M	29.1	77.3
	3-E	21.1	75.2
	3-N	31.7	57.3
	4-K	R-L	
	4-K	22.7	422

Table A-9. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.9	16.6
	2-b	55.2	24.4
	3-c	54.6	14.7
	4-d	80.0	181
Station 1 - Composite			
Battelle	1-A	29.5	28.5
	2-C	20.7	27.3
	3-E	R-L	
ERL-D	1-a	44.5	6.85
	2-b	54.8	21.8
	3-c	72.6	17.5
	4-d	59.8	37.8
Station 1 - Grab			
Battelle	1-B	29.9	53.9
	1-B	25.3	10.1
	2-E	R-L	
	2-N	29.7	105
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	628
	4-J	20.1	570
ERL-D	1-a	41.9	15.9
	2-b	46.6	41.8
	3-c	66.9	18.5
	4-d	57.7	254
Station B			
Battelle	1-C	39.6	13.2
	1-H	29.0	78.1
	2-D	27.2	113
	2-M	30.9	113
	3-E	40.4	61.3
	3-N	41.3	74.5
	4-J	R-I	
	4-J	R-I	

Table A-9. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.5	24.2
	2-b	53.4	44.9
	3-c	R-H	
	4-d	67.1	202
	4-d	62.7	205
Station C			
Battelle	1-C	55.5	30.8
	1-H	37.3	28.3
	2-D	39.6	80.7
	2-N	45.5	72.5
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	11.90
	2-b	57.6	33.50
	3-c	76.5	5.15
	3-c	53.7	5.50
	4-d	80.3	13.0
Station D			
Battelle	1-A	R-L	
	1-H	40.5	31.2
	1-B	42.3	45.8
	2-D	30.1	117
	2-M	48.5	62.3
	3-F	29.8	10.9
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	708
ERL-D	1-a	46.7	18.7
	2-b	55.7	34.0
	2-b	R-H	
	3-c	55.5	4.36
	4-d	66.5	224

Table A-9. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	39.1	22.6
	2-C	35.9	83.1
	2-M	27.5	8.13
	3-F	33.9	4.84
	3-L	25.5	15.1
	4-I	R-I	
	4-I	n-i	
ERL-D	1-a	45.0	11.1
	2-b	R-P	
	3-c	59.2	2.97
	4-d	63.3	102

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: $1,2,4,5$-$^{13}C_6$ TeCB, R-L: rejected, recovery $<20\%$, R-H: rejected, recovery $>120\%$, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-10. Concentrations of Pentachlorobutadiene #1 in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	0.00
	C	33.6	0.00
	D	29.8	0.00
	E	39.4	0.00
	F	51.9	0.00
	G	45.7	0.00
	H	34.2	0.00
	I	29.1	0.00
	J	R-L	
	K	55.4	0.00
	L	53.9	0.00
	M	40.6	0.00
	N	37.6	0.00
ERL-D	1-a	88.2	0.00
	2-b	106	0.00
	3-c	84.3	0.00
	4-d	93.0	0.00
Outfall			
ERL-D	1-a	39.9	8.23
	1-a	39.7	5.92
	2-b	40.5	8.44
	3-c	52.3	5.38
	4-d	53.7	8.50
Station A			
Battelle	1-A	33.6	247
	1-G	29.3	202
	1-B	20.9	277
	2-D	28.7	204
	2-M	29.1	515
	3-E	21.1	605
	3-N	31.7	381
	4-K	R-L	

Table A-10. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-K	22.7	2200
ERL-D	1-a	44.9	71.3
	2-b	55.2	121
	3-c	54.6	82.5
	4-d	80.0	805
Station 1 - Composite			
Battelle	1-A	29.5	114
	2-C	20.7	88.4
	3-E	R-L	
ERL-D	1-a	44.5	27.8
	2-b	54.8	96.7
	3-c	72.6	64.2
	4-d	59.8	179
Station 1 - Grab			
Battelle	1-B	29.9	195
	1-B	25.3	62.2
	2-E	R-L	
	2-N	29.7	525
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	2770
	4-J	26.4	3000
ERL-D	1-a	41.9	49.4
	2-b	46.6	154
	3-c	66.9	90.2
	4-d	57.7	938
Station B			
Battelle	1-C	39.6	324
	1-H	29.0	423
	2-D	27.2	652
	2-M	30.9	58.6
	3-E	40.5	311
	3-N	41.4	337

Table A-10. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-J	R-I	
	4-J	R-I	
ERL-D	1-a	44.5	77.5
	2-b	53.4	199
	3-c	R-H	
	4-d	67.1	739
	4-d	62.7	859
Station C			
Battelle	1-C	55.6	149
	1-H	37.3	156
	2-D	39.6	181
	2-N	45.6	144
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	32.7
	2-b	57.6	45.0
	3-c	76.5	0.00
	3-c	53.7	0.00
	4-d	80.3	16.9
Station D			
Battelle	1-A	R-L	
	1-H	40.5	211
	1-B	42.3	245
	2-D	30.1	364
	2-M	48.5	285
	3-F	29.8	0.603
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	1150
ERL-D	1-a	46.7	56.6
	2-b	55.7	88.6
	2-b	R-H	
	3-c	55.5	0.00

Table A-10. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-d	66.5	647
Station E			
Battelle	1-A	R-L	
	1-H	39.1	165
	2-C	35.9	222
	2-M	27.5	240
	3-F	33.9	0.00
	3-L	25.5	1.18
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	26.9
	2-b	R-P	
	3-c	59.2	0.00
	4-d	63.3	369

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: 1,2,4,5-$^{13}C_6$ TeCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-11. Concentrations of Pentachlorobutadiene #2 in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	0.00
	C	33.6	0.00
	D	29.8	0.00
	E	39.4	0.00
	F	51.9	0.00
	G	45.7	0.00
	H	34.2	0.00
	I	29.1	0.00
	J	R-L	
	K	55.4	0.00
	L	53.9	0.00
	M	40.6	0.00
	N	37.6	0.00
ERL-D	a	88.2	0.00
	b	106	0.00
	c	84.3	0.00
	d	93.0	0.00
Outfall			
ERL-D	1-a	39.9	3.57
	1-a	39.7	3.20
	2-b	40.5	6.35
	3-c	52.3	2.99
	4-d	53.7	2.72
Station A			
Battelle	1-A	33.6	72.5
	1-G	29.3	58.6
	1-B	20.9	81.1
	2-D	28.7	59.6
	2-M	29.1	132
	3-E	21.1	175
	3-N	31.7	109
	4-K	R-L	
	4-K	22.7	837

Table A-11. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.9	20.5
	2-b	55.2	29.3
	3-c	54.6	20.6
	4-d	80.0	223
Station 1 - Composite			
Battelle	1-A	29.5	37.7
	2-C	20.7	31.0
	3-E	R-L	
ERL-D	1-a	44.5	7.88
	2-b	54.8	28.2
	3-c	72.6	23.3
	4-d	59.8	41.5
Station 1 - Grab			
Battelle	1-B	29.9	72.6
	1-B	25.3	21.3
	2-E	R-L	
	2-N	29.7	177
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	1080
	4-J	26.4	1100
ERL-D	1-a	41.9	17.0
	2-b	46.6	43.2
	3-c	66.9	24.0
	4-d	57.7	282
Station B			
Battelle	1-C	39.6	90.0
	1-H	29.0	115
	2-D	27.2	207
	2-M	30.9	21.3
	3-E	40.5	109
	3-N	41.4	127
	4-J	R-I	
	4-J	R-I	

A-24

Table A-11. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.5	21.0
	2-b	53.4	52.0
	3-c	R-H	
	4-d	67.1	241
	4-d	62.7	257
Station C			
Battelle	1-C	55.6	42.0
	1-H	37.3	34.9
	2-D	39.6	117
	2-N	45.6	93.9
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	9.35
	2-b	57.6	26.3
	3-c	76.5	0.530
	3-c	53.7	0.420
	4-d	80.3	3.89
Station D			
Battelle	1-A	R-L	
	1-H	40.5	38.0
	1-B	42.3	58.7
	2-D	30.1	169
	2-M	48.5	121
	3-F	29.8	2.88
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	3170
ERL-D	1-a	46.7	15.8
	2-b	55.7	36.0
	2-b	R-H	
	3-c	55.5	0.00
	4-d	66.5	43.9

Table A-11. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	39.1	32.1
	2-C	35.9	112
	2-M	27.5	115
	3-F	33.9	1.47
	3-L	25.5	3.77
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	8.85
	2-b	R-P	
	3-c	59.2	0.00
	4-d	63.3	85.8

[a] The letter following the week is the procedural blank done with the analysis of the sample.

[b] Surrogate: 1,2,4,5-$^{13}C_6$ TeCB, R-L: rejected, recovery < 20%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-12. Concentrations of Hexachlorobutadiene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	0.501
	C	33.6	0.787
	D	29.8	0.202
	E	39.4	0.00
	F	51.9	0.362
	G	45.7	0.455
	H	34.2	0.00
	I	29.1	0.282
	J	R-L	
	K	55.4	1.34
	L	53.9	0.520
	M	40.6	0.542
	N	37.6	0.402
ERL-D	a	88.2	0.00
	b	106	0.410
	c	84.3	0.00
	d	93.0	1.72
Outfall			
ERL-D	1-a	39.9	59.2
	1-a	39.7	44.9
	2-b	40.5	254
	3-c	52.3	84.3
	4-d	53.7	174
Station A			
Battelle	1-A	33.6	333
	1-G	29.3	342
	1-B	20.9	360
	2-D	28.7	586
	2-M	29.1	770
	3-E	21.1	860
	3-N	31.7	501
	4-K	R-L	
	4-K	22.7	3740

Table A-12. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.9	521
	2-b	55.2	494
	3-c	54.6	433
	4-d	80.0	4820
Station 1 - Composite			
Battelle	1-A	29.5	141
	2-C	20.7	385
	3-E	R-L	
ERL-D	1-a	44.5	116
	2-b	54.8	409
	3-c	72.6	408
	4-d	59.8	1540
Station 1 - Grab			
Battelle	1-B	29.9	304
	1-B	25.3	100
	2-E	R-L	
	2-N	29.7	688
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	4700
	4-J	26.4	5550
ERL-D	1-a	41.9	302
	2-b	46.6	674
	3-c	66.9	499
	4-d	57.7	4880
Station B			
Battelle	1-C	39.6	577
	1-H	29.0	829
	2-D	27.2	906
	2-M	30.9	899
	3-E	40.5	547
	3-N	41.4	514
	4-J	R-I	
	4-J	R-I	

Table A-12. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.5	830
	2-b	53.4	867
	3-c	R-H	
	4-d	67.1	4360
	4-d	62.7	5200
Station C			
Battelle	1-C	55.6	270
	1-H	37.3	239
	2-D	39.6	475
	2-N	45.6	321
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	197
	2-b	57.6	359
	3-c	76.5	0.908
	3-c	53.7	0.874
	4-d	80.3	181
Station D			
Battelle	1-A	R-L	
	1-H	40.5	359
	1-B	42.3	357
	2-D	30.1	636
	2-M	48.5	526
	3-F	29.8	1.67
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	5520
ERL-D	1-a	46.7	377
	2-b	55.7	525
	2-b	R-H	
	3-c	55.5	1.10
	4-d	66.5	3740

Table A-12. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	39.1	266
	2-C	35.9	423
	2-M	27.5	490
	3-F	33.9	1.06
	3-L	25.5	4.63
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	182
	2-b	R-P	
	3-c	59.2	0.916
	4-d	63.3	2740

[a] The letter following the week is the procedural blank done with the analysis of the sample.

[b] Surrogate: $1,2,4,5\text{-}^{13}C_6$ TeCB, R-L: rejected, recovery $<20\%$, R-H: rejected, recovery $>120\%$, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-13. Concentrations of 1,2,3-Trichlorobenzene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	2.41
	C	33.6	21.9
	D	29.8	3.56
	E	39.4	1.21
	F	51.9	1.47
	G	45.7	31.8
	H	34.2	7.19
	I	29.1	25.6
	J	R-L	
	K	55.4	29.4
	L	53.9	9.14
	M	40.6	8.50
	N	37.6	9.04
ERL-D	a	88.2	0.00
	b	106	0.174
	c	84.3	0.386
	d	93.0	0.400
Outfall			
ERL-D	1-a	39.9	2.39
	1-a	39.7	2.13
	2-b	40.5	1.63
	3-c	52.3	3.59
	4-d	53.7	2.84
Station A			
Battelle	1-A	33.6	29.3
	1-G	29.3	21.5
	1-B	20.9	27.7
	2-D	28.7	32.3
	2-M	29.1	40.9
	3-E	21.1	55.2
	3-N	31.7	29.1
	4-K	R-L	
	4-K	22.7	168

Table A-13. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.9	22.5
	2-b	55.2	12.5
	3-c	54.6	23.4
	4-d	80.0	157
Station 1 - Composite			
Battelle	1-A	29.5	33.1
	2-C	20.7	57.3
	3-E	R-L	
ERL-D	1-a	44.5	12.0
	2-b	54.8	11.6
	3-c	72.6	29.0
	4-d	59.8	43.1
Station 1 - Grab			
Battelle	1-B	29.9	26.1
	1-B	25.3	13.5
	2-E	R-L	
	2-N	29.7	48.4
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	193
	4-J	26.4	210
ERL-D	1-a	41.9	22.9
	2-b	46.6	20.7
	3-c	66.9	25.9
	4-d	57.7	229
Station B			
Battelle	1-C	39.6	51.2
	1-H	29.0	45.0
	2-D	27.2	48.1
	2-M	30.9	51.9
	3-E	40.5	30.1
	3-N	41.4	39.2
	4-J	R-I	
	4-J	R-I	

A-32

Table A-13. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.5	27.3
	2-b	53.4	26.5
	3-c	R-H	
	4-d	67.1	192
	4-d	62.7	197
Station C			
Battelle	1-C	55.6	68.4
	1-H	37.3	21.3
	2-D	39.6	57.6
	2-N	45.6	37.1
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	14.8
	2-b	57.6	16.0
	3-c	76.5	5.99
	3-c	53.7	6.40
	4-d	80.3	13.5
Station D			
Battelle	1-A	R-L	
	1-H	40.5	27.1
	1-B	42.3	21.1
	2-D	30.1	41.0
	2-M	48.5	38.6
	3-F	29.8	7.76
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	225
ERL-D	1-a	46.7	21.5
	2-b	55.7	16.5
	2-b	R-H	
	3-c	55.5	4.27
	4-d	66.5	152

Table A-13. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	39.1	47.7
	2-C	35.9	32.1
	2-M	27.5	37.6
	3-F	33.9	3.89
	3-L	25.5	31.3
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	12.7
	2-b	R-P	
	3-c	59.2	2.64
	4-d	63.3	90.5

[a] The letter following the week is the procedural blank done with the analysis of the sample.

[b] Surrogate: 1,2,4,5-$^{13}C_6$ TeCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-14. Concentrations of 1,2,4-Trichlorobenzene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	4.26
	C	33.6	3.66
	D	29.8	1.55
	E	39.4	1.76
	F	51.9	1.55
	G	45.7	7.17
	H	34.2	2.92
	I	29.1	6.08
	J	R-L	
	K	55.4	7.69
	L	53.9	3.40
	M	40.6	4.00
	N	37.6	4.24
ERL-D	a	88.2	1.30
	b	106	0.415
	c	84.3	0.00
	d	93.0	0.00
Outfall			
ERL-D	1-a	39.9	11.0
	1-a	39.7	9.75
	2-b	40.5	16.5
	3-c	52.3	15.0
	4-d	53.7	13.2
Station A			
Battelle	1-A	33.6	116
	1-G	29.3	87.3
	1-B	20.9	117
	2-D	28.7	139
	2-M	29.1	191
	3-E	21.1	218
	3-N	31.7	138
	4-K	R-L	
	4-K	22.7	872

Table A-14. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	44.9	105
	2-b	55.2	125
	3-c	54.6	95.6
	4-d	80.0	734
Station 1 - Composite			
Battelle	1-A	29.5	57.4
	2-C	20.7	120
	3-E	R-L	
ERL-D	1-a	44.5	46.7
	2-b	54.8	115
	3-c	72.6	121
	4-d	59.8	222
Station 1 - Grab			
Battelle	1-B	29.9	111
	1-B	25.3	44.1
	2-E	R-L	
	2-N	29.7	233
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	1050
	4-J	26.4	1260
ERL-D	1-a	41.9	95.8
	2-b	46.6	203
	3-c	66.9	104
	4-d	57.7	1080
Station B			
Battelle	1-C	39.6	152
	1-H	29.0	210
	2-D	27.2	259
	2-M	30.9	258
	3-E	40.5	153

Table A-14. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	3-N	41.4	170
	4-J	R-I	
	4-J	R-I	
ERL-D	1-a	44.5	139
	2-b	53.4	216
	3-c	R-H	
	4-d	67.1	330
	4-d	62.7	1040
Station C			
Battelle	1-C	55.6	90.6
	1-H	37.3	81.6
	2-D	39.6	212
	2-N	45.6	162
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	68.5
	2-b	57.6	140
	3-c	76.5	22.0
	3-c	53.7	26.5
	4-d	80.3	58.2
Station D			
Battelle	1-A	R-L	
	1-H	40.5	106
	1-B	42.3	114
	2-D	30.1	206
	2-M	48.5	183
	3-F	29.8	26.0
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	1460

Table A-14. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	46.7	105
	2-b	55.7	158
	2-b	R-H	
	3-c	55.5	15.3
	4-d	66.5	821
Station E			
Battelle	1-A	R-L	
	1-H	39.1	81.6
	2-C	35.9	172
	2-M	27.5	180
	3-F	33.9	13.0
	3-L	25.5	31.7
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	58.6
	2-b	R-P	
	3-c	59.2	7.41
	4-4	63.3	458

[a] The letter following the week is the procedural blank done with the analysis of the sample.

[b] Surrogate: 1,2,4,5-$^{13}C_6$ TeCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-15. Concentrations of 1,2,4,5- and 1,2,3,5-Tetrachlorobenzene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	1.11
	C	33.6	0.00
	D	29.8	2.02
	E	39.4	0.507
	F	51.9	0.617
	G	45.7	0.00
	H	34.2	0.00
	I	29.1	0.00
	J	R-L	
	K	55.4	0.397
	L	53.9	0.00
	M	40.6	0.00
	N	37.6	0.00
ERL-D	a	88.2	1.24
	b	106	1.05
	c	84.3	1.23
	d	93.0	1.65
Outfall			
ERL-D	1-a	39.9	9.36
	1-a	39.7	8.49
	2-b	40.5	16.5
	3-c	52.3	16.9
	4-d	53.7	13.6
Station A			
Battelle	1-A	33.6	19.4
	1-G	29.3	22.9
	1-B	20.9	19.4
	2-D	28.7	14.2
	2-M	29.1	2.3
	3-E	21.1	44.9
	3-N	31.7	26.8
	4-K	R-L	

Table A-15. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-K	22.7	256
ERL-D	1-a	44.9	45.3
	2-b	55.2	50.9
	3-c	54.6	56.6
	4-d	80.0	616
Station 1 - Composite			
Battelle	1-A	29.5	8.81
	2-C	20.7	7.62
	3-E	R-L	
ERL-D	1-a	44.5	20.7
	2-b	54.8	49.8
	3-c	72.6	76.2
	4-d	59.8	130
Station 1 - Grab			
Battelle	1-B	29.9	19.6
	1-B	25.3	18.3
	2-E	R-L	
	2-N	29.7	45.1
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	330
	4-J	26.4	348
ERL-D	1-a	41.9	43.6
	2-b	46.6	87.0
	3-c	66.9	66.7
	4-d	57.7	895
Station B			
Battelle	1-C	39.6	29.6
	1-H	29.0	39.3
	2-D	27.2	48.3
	2-M	30.9	43.7
	3-E	40.5	31.8
	3-N	41.4	37.7

Table A-15. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-J	R-I	
	4-J	R-I	
ERL-D	1-a	44.5	66.2
	2-b	53.4	99.0
	3-c	R-H	
	4-d	67.1	858
	4-d	62.7	805
Station C			
Battelle	1-C	55.6	17.7
	1-H	37.3	17.7
	2-D	39.6	44.7
	2-N	45.6	36.1
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	38.9
	2-b	57.6	82.7
	3-c	76.5	25.0
	3-c	53.7	27.5
	4-d	80.3	42.3
Station D			
Battelle	1-A	R-L	
	1-H	40.5	20.8
	1-B	42.3	23.5
	2-D	30.1	44.2
	2-M	48.5	34.9
	3-F	29.8	9.72
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	349
ERL-D	1-a	46.7	48.7
	2-b	55.7	84.8
	2-b	R-H	
	3-c	55.5	19.0

Table A-15. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-d	66.5	587
Station E			
Battelle	1-A	R-L	
	1-H	39.1	18.9
	2-C	35.9	32.5
	2-M	27.5	37.0
	3-F	33.9	7.02
	3-L	25.5	11.3
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	33.3
	2-b	R-P	
	3-c	59.2	13.4
	4-d	63.3	362

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: 1,2,4,5-$^{13}C_6$ TeCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-16. Concentrations of 1,2,3,4-Tetrachlorobenzene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	45.0	0.00
	C	33.6	0.00
	D	29.8	0.00
	E	39.4	0.00
	F	51.9	0.347
	G	45.7	2.37
	H	34.2	0.00
	I	29.1	2.27
	J	R-L	
	K	55.4	2.46
	L	53.9	0.928
	M	40.6	0.00
	N	37.6	1.33
ERL-D	a	88.2	0.00
	b	106	0.00
	c	84.3	0.00
	d	93.0	0.00
Outfall			
ERL-D	1-a	39.9	4.74
	1-a	39.7	3.15
	2-b	40.5	5.94
	3-c	52.3	10.8
	4-d	53.7	6.55
Station A			
Battelle	1-A	33.6	25.9
	1-G	29.3	33.5
	1-B	20.9	26.9
	2-D	28.7	15.2
	2-M	29.1	3.16
	3-E	21.1	69.6
	3-N	31.7	40.4
	4-K	R-L	

Table A-16. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-K	22.7	349
ERL-D	1-a	44.9	26.6
	2-b	55.2	16.0
	3-c	54.6	39.1
	4-d	80.0	345
Station 1 - Composite			
Battelle	1-A	29.5	5.76
	2-C	20.7	12.7
	3-E	R-L	
ERL-D	1-a	44.5	10.7
	2-b	54.8	35.9
	3-c	72.6	41.9
	4-d	59.8	83.1
Station 1 - Grab			
Battelle	1-B	29.9	27.7
	1-B	25.3	28.1
	2-E	R-L	
	2-N	29.7	1.14
	3-F	R-L	
	3-L	R-I	
	4-J	28.0	458
	4-J	26.4	496
ERL-D	1-a	41.9	23.9
	2-b	46.6	56.2
	3-c	66.9	41.9
	4-d	57.7	462
Station B			
Battelle	1-C	39.6	35.0
	1-H	29.0	46.0
	2-D	27.2	67.2
	2-M	30.9	61.0
	3-E	40.5	44.1
	3-N	41.4	50.9

Table A-16. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-J	R-I	
	4-J	R-I	
ERL-D	1-a	44.5	41.3
	2-b	53.4	64.3
	3-c	R-H	
	4-d	67.1	424
	4-d	62.7	471
Station C			
Battelle	1-C	55.6	20.6
	1-H	37.3	21.0
	2-D	39.6	44.9
	2-N	45.5	45.0
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	39.5	21.3
	2-b	57.6	56.2
	3-c	76.5	15.8
	3-c	53.7	16.9
	4-d	80.3	22.2
Station D			
Battelle	1-A	R-L	
	1-H	40.5	24.8
	1-B	42.3	29.3
	2-D	30.1	64.1
	2-M	48.5	49.3
	3-F	29.8	11.8
	3-L	R-I	
	4-K	R-L	
	4-K	20.1	486
ERL-D	1-a	46.7	27.4
	2-b	55.7	57.5
	2-b	R-H	
	3-c	55.5	12.2

Table A-16. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
	4-d	66.5	330
Station E			
Battelle	1-A	R-L	
	1-H	39.1	25.8
	2-C	35.9	41.7
	2-M	27.5	50.3
	3-F	33.9	8.79
	3-L	25.5	14.6
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	45.0	17.5
	2-b	R-P	
	3-c	59.2	8.45
	4-d	63.3	197

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: $1,2,4,5\text{-}^{13}C_6$ TeCB, R-L: rejected, recovery < 20%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-17. Concentrations of Pentachlorobenzene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	49.5	0.866
	C	39.8	1.01
	D	32.1	0.00
	E	44.3	0.00
	F	52.7	1.11
	G	49.2	1.48
	H	40.3	0.466
	I	31.8	1.42
	J	R-L	
	K	60.1	1.59
	L	56.8	0.794
	M	42.2	0.756
	N	44.1	0.714
ERL-D	a	94.2	0.00
	b	104	0.00
	c	79.4	0.00
	d	120	0.00
Outfall			
ERL-D	1-a	48.3	17.8
	1-a	56.3	13.6
	2-b	44.2	54.7
	3-c	48.9	32.1
	4-d	74.6	27.7
Station A			
Battelle	1-A	36.0	41.2
	1-G	37.8	46.1
	1-B	R-L	
	2-D	37.6	49.6
	2-M	48.8	46.0
	3-E	35.8	54.0
	3-N	39.9	40.8
	4-K	27.1	916
	4-K	R-L	

A-47

Table A-17. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	53.9	34.7
	2-b	44.5	62.1
	3-c	53.4	47.7
	4-d	87.7	795
Station 1 - Composite			
Battelle	1-A	33.0	19.5
	2-C	26.1	48.7
	3-E	22.7	118
ERL-D	1-a	54.9	17.1
	2-b	53.4	56.2
	3-c	62.1	76.9
	4-d	72.9	148
Station 1 - Grab			
Battelle	1-B	33.5	37.7
	1-B	50.0	35.0
	2-E	R-L	
	2-N	35.4	75.4
	3-F	32.2	37.6
	3-L	R-I	
	4-J	34.3	938
	4-J	31.2	1060
ERL-D	1-a	43.6	34.2
	2-b	45.5	81.9
	3-c	58.2	60.3
	4-d	43.8	1490
Station B			
Battelle	1-C	41.9	72.0
	1-H	43.2	69.4
	2-D	36.4	75.4
	2-M	38.3	72.0
	3-E	42.8	57.7
	3-N	50.1	57.4
	4-J	R-I	
	4-J	R-I	

Table A-17. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	56.1	78.9
	2-b	52.9	84.8
	3-c	R-H	
	4-d	60.7	1180
	4-d	61.5	1200
Station C			
Battelle	1-C	60.4	29.3
	1-H	43.2	24.8
	2-D	52.9	65.6
	2-N	51.0	54.4
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	47.0	23.2
	2-b	57.1	65.1
	3-c	70.1	21.7
	3-c	50.8	24.4
	4-d	94.6	23.3
Station D			
Battelle	1-A	21.8	52.8
	1-H	47.0	33.0
	1-B	50.2	39.0
	2-D	38.9	70.8
	2-M	51.2	67.7
	3-F	36.3	15.3
	3-L	R-I	
	4-K	30.9	552
	4-K	34.7	542
ERL-D	1-a	58.3	29.9
	2-b	54.2	72.3
	2-b	R-H	
	3-c	54.3	17.8
	4-d	68.2	540

Table A-17. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	37.8	41.0
	2-C	39.3	59.8
	2-M	37.4	54.0
	3-F	39.0	12.7
	3-L	29.6	17.2
	4-I	R-I	
	4-I	R-I	
ERL-D	1	52.7	22.9
	2	R-P	
	3	56.4	12.9
	4	75.7	287

[a] The letter following the week is the procedural blank done with the analysis of the sample.

[b] Surrogate: 1,2,4,5-$^{13}C_6$ HCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-18. Concentrations of Hexachlorobenzene in Ambient Water Samples.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Procedure Blanks			
Battelle	A	R-L	
	B	49.5	1.08
	C	39.8	1.18
	D	32.1	0.125
	E	44.3	0.00
	F	52.7	1.25
	G	49.2	1.23
	H	40.3	0.492
	I	31.8	1.21
	J	R-L	
	K	60.1	1.32
	L	56.8	1.55
	M	42.2	0.887
	N	44.1	0.695
ERL-D	a	94.2	0.00
	b	104	0.204
	c	79.4	0.252
	d	120	0.00
Outfall			
ERL-D	1-a	48.3	49.0
	1-a	56.3	40.5
	2-b	44.2	189
	3-c	48.9	88.1
	4-d	74.6	189
Station A			
Battelle	1-A	36.0	39.6
	1-G	37.8	58.9
	2-D	37.6	42.1
	2-M	48.8	30.0
	3-E	35.8	49.1
	3-N	39.9	39.0
	4-K	27.1	618
	4-K	R-L	

Table A-18. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	53.9	29.0
	2-b	44.5	25.3
	3-c	53.4	39.7
	4-d	87.7	861
Station 1 - Composite			
Battelle	1-A	33.0	19.9
	2-C	26.1	32.9
	3-E	22.7	86.7
ERL-D	1-a	54.9	14.3
	2-b	53.4	28.3
	3-c	62.1	67.6
	4-d	72.9	138
Station 1 - Grab			
Battelle	1-B	33.5	30.8
	1-B	50.0	33.1
	2-E	R-L	
	2-N	35.4	34.3
	3-F	32.2	57.8
	3-L	R-I	
	4-J	34.3	805
	4-J	31.2	970
ERL-D	1-a	43.6	24.8
	2-b	45.5	34.9
	3-c	58.2	55.4
	4-d	43.8	2240
Station B			
Battelle	1-C	41.9	145
	1-H	43.2	110
	2-D	36.4	36.8
	2-M	38.3	33.0
	3-E	42.8	44.6
	3-N	50.1	44.0
	4-J	R-I	
	4-J	R-I	

A-52

Table A-18. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
ERL-D	1-a	56.1	129
	2-b	52.9	39.9
	3-c	R-H	
	4-d	60.7	1210
	4-d	61.5	1720
Station C			
Battelle	1-C	60.4	24.9
	1-H	43.2	16.0
	2-D	52.9	27.3
	2-N	51.0	25.6
	3-L	R-I	
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	47.0	14.9
	2-b	57.1	26.8
	3-c	70.1	17.5
	3-c	50.8	17.3
	4-d	94.6	8.37
Station D			
Battelle	1-A	21.8	37.8
	1-H	47.0	26.4
	1-B	50.2	25.6
	2-D	38.9	33.5
	2-M	51.2	31.8
	3-F	36.3	13.8
	3-L	R-I	
	4-K	30.9	269
	4-K	34.7	284
ERL-D	1-a	58.3	24.6
	2-b	54.2	35.5
	2-b	R-H	
	3-c	54.3	15.6
	4-d	68.2	242

Table A-18. Continued.

	Week of[a] Sample Collection	Surrogate Recovery[b] %	Concentration (Recovery Corrected) [ng/L]
Station E			
Battelle	1-A	R-L	
	1-H	37.8	34.5
	2-C	39.3	27.1
	2-M	37.4	26.8
	3-F	39.0	11.4
	3-L	29.6	20.1
	4-I	R-I	
	4-I	R-I	
ERL-D	1-a	52.7	22.5
	2-b	R-P	
	3-c	56.4	11.4
	4-d	75.7	122

[a]   The letter following the week is the procedural blank done with the analysis of the sample.

[b]   Surrogate: $1,2,4,5\text{-}^{13}C_6$ HCB, R-L: rejected, recovery <20%, R-H: rejected, recovery >120%, R-I: rejected, incorrect data, R-P: rejected, procedural error in sample preparation.

Table A-19. Dissolved Chemical Concentrations for Ambient Composite Water Samples from Station 1.

Hexachloroethane	$^{13}C_1$-HCE Recovery (%)	HCE (ng/L)
Week 1	18.0	55.5
Week 2	26.5	159
Week 3	18.9	125
Blank	57.9	4.46

Tetrachlorobutadiene #1	$^{13}C_6$-TeCB Recovery (%)	TeCBD #1 (ng/L)
Week 1	18.7	7.51
Week 2	26.7	20.2
Week 3	20.3	25.6
Blank	45.7	0

Tetrachlorobutadiene #2	$^{13}C_6$-TeCB Recovery (%)	TeCBD #2 (ng/L)
Week 1	18.7	30.9
Week 2	26.7	55.7
Week 3	20.3	81.1
Blank	45.7	0

Pentachlorobutadiene #1	$^{13}C_6$-TeCB Recovery (%)	PeCBD #1 (ng/L)
Week 1	18.7	99.9
Week 2	26.7	286
Week 3	20.3	246
Blank	45.7	0

Pentachlorobutadiene #2	$^{13}C_6$-TeCB Recovery (%)	PeCBD #2 (ng/L)
Week 1	18.7	35.0
Week 2	26.7	94.7
Week 3	20.3	101
- Blank	45.7	0

Hexachlorobutadiene	$^{13}C_6$-TeCB Recovery (%)	HCBD (ng/L)
Week 1	18.7	110
Week 2	26.7	352
Week 3	20.3	336
Blank	45.7	0.455

Table A-19. Continued.

Trichlorobenzene, 1,2,3-	$^{13}C_6$-TeCB Recovery (%)	TrCB, 1,2,3- (ng/L)
Week 1	18.7	12.9
Week 2	26.7	26.8
Week 3	20.3	73.7
Blank	45.7	31.8
Trichlorobenzene, 1,2,4-	$^{13}C_6$-TeCB Recovery (%)	TrCB, 1,2,4- (ng/L)
Week 1	18.7	54.8
Week 2	26.7	136
Week 3	20.3	150
Blank	45.7	7.17
Tetrachlorobenzene Mix	$^{13}C_6$-TeCB Recovery (%)	TeCB Mix (ng/L)
Week 1	18.7	8.61
Week 2	26.7	27.0
Week 3	20.3	31.6
Blank	45.7	0
Tetrachlorobenzene, 1,2,3,4-	$^{13}C_6$-TeCB Recovery (%)	TeCB, 1,2,3,4- (ng/L)
Week 1	18.7	14.4
Week 2	26.7	41.3
Week 3	20.3	48.1
Blank	45.7	2.37
Pentachlorobenzene	$^{13}C_6$-HCB Recovery (%)	PeCB (ng/L)
Week 1	25.6	14.0
Week 2	37.0	45.1
Week 3	20.6	54.5
Blank	49.2	1.48
Hexachlorobenzene	$^{13}C_6$-HCB Recovery (%)	HCB (ng/L)
Week 1	25.6	10.6
Week 2	37.0	19.4
Week 3	20.6	34.1
Blank	49.2	1.23

Table A-20. Particulate Chemical Concentrations for Ambient Composite Water Samples from Station 1.

Hexachloroethane	$^{13}C_1$-HCE Recovery (%)	HCE (ng/L)
Week 1	30.4	3.10
Week 2	10.3	1.90
Week 3	41.4	2.48
Week 4	9.80	2.68
Blank	48.0	1.91

Tetrachlorobutadiene #1	$^{13}C_6$-TeCB Recovery (%)	TeCBD #1 (ng/L)
Week 1	51.8	0
Week 2	12.0	0
Week 3	52.9	0
Week 4	40.6	0
Blank	49.5	0

Tetrachlorobutadiene #2	$^{13}C_6$-TeCB Recovery (%)	TeCBD #2 (ng/L)
Week 1	51.8	0
Week 2	12.0	0
Week 3	52.9	0
Week 4	40.6	0
Blank	49.5	0

Pentachlorobutadiene #1	$^{13}C_6$-TeCB Recovery (%)	PeCBD #1 (ng/L)
Week 1	51.8	0
Week 2	12.0	0
Week 3	52.9	1.65
Week 4	40.6	0.580
Blank	49.5	0

Pentachlorobutadiene #2	$^{13}C_6$-TeCB Recovery (%)	PeCBD #2 (ng/L)
Week 1	51.8	0
Week 2	12.0	0
Week 3	52.9	0.507
Week 4	40.6	0
Blank	49.5	0

Table A-20. Continued.

Hexachlorobutadiene	$^{13}C_6$-TeCB Recovery (%)	HCBD (ng/L)
Week 1	51.8	7.33
Week 2	12.0	7.08
Week 3	52.9	16.2
Week 4	40.6	60.1
Blank	49.5	0.275

Trichlorobenzene, 1,2,3-	$^{13}C_6$-TeCB Recovery (%)	TrCB, 1,2,3- (ng/L)
Week 1	51.8	6.25
Week 2	12.0	3.60
Week 3	52.9	5.85
Week 4	40.6	4.24
Blank	49.5	7.14

Trichlorobenzene, 1,2,4-	$^{13}C_6$-TeCB Recovery (%)	TrCB, 1,2,4- (ng/L)
Week 1	51.8	1.87
Week 2	12.0	1.24
Week 3	52.9	2.31
Week 4	40.6	3.72
Blank	49.5	1.70

Tetrachlorobenzene Mix	$^{13}C_6$-TeCB Recovery (%)	TeCB Mix (ng/L)
Week 1	51.8	0.541
Week 2	12.0	0
Week 3	52.9	0.454
Week 4	40.6	0.837
Blank	49.5	0

Tetrachlorobenzene, 1,2,3,4-	$^{13}C_6$-TeCB Recovery (%)	TeCB, 1,2,3,4- (ng/L)
Week 1	51.8	0.386
Week 2	12.0	0
Week 3	52.9	1.04
Week 4	40.6	1.21
Blank	49.5	0

Table A-20. Continued.

Pentachlorobenzene	$^{13}C_6$-HCB Recovery (%)	PeCB (ng/L)
Week 1	62.1	2.38
Week 2	17.1	2.48
Week 3	64.3	6.13
Week 4	53.7	24.9
Blank	60.0	0.632
Hexachlorobenzene	$^{13}C_6$-HCB Recovery (%)	HCB (ng/L)
Week 1	62.1	7.45
Week 2	17.1	6.70
Week 3	64.3	14.0
Week 4	53.7	60.7
Blank	60.0	5.05

Table A-21. POC and DOC for Ambient Water Samples.

POC:

Station	POC, μg/filter[1]			
	Week 1	Week 2	Week 3	Week 4
A	580	400	400	360
B	440	370	270	410
C	510	350	330	460
D	360	340	390	380
E	610	400	380	400
1 Grab	620	330	300	420
1 Composite	710	330		400

mean of 9 blank samples = 184 μg/filter (std. dev. = 31 μg/filter)

sample size = 100 mL

DOC:

Station	DOC, mg/L			
	Week 1	Week 2	Week 3	Week 4[2]
A	8.6	81	78	
B	7.2	94	84	
C	11.0	50	77	
D	7.8	81	76	
E	7.7	73	78	
1 Grab	60	82	33	
1 Composite	363	39	67	

mean of 9 blank samples = 1.4 mg/L (std. dev. = 0.5 mg/L)

[2] Samples were not analyzed because holding time of samples were exceeded.

Table A-22. DOC, POC, and TOC Values for Ambient Water Samples.

Week	Station	DOC[1]	POC[2]	TOC[1]
1	A	7.2	4.0	7.1
	B	5.8	2.6	11.6
	C	9.6	3.3	7.5
	D	6.4	1.8	6.2
	E	6.3	4.3	12.6
	1 Grab	59	4.4	68
	1 Composite	362	5.3	408
2	A	80	2.2	81
	B	93	1.9	101
	C	49	1.7	61
	D	80	1.6	82
	E	72	2.2	84
	1 Grab	81	1.5	89
	1 Composite	38	1.5	68
3	A	77	2.2	
	B	83	0.9	
	C	76	1.5	
	D	75	2.1	
	E	77	2.0	
	1 Grab	32	1.2	
	1 Composite	66		
4	A		1.8	
	B		2.3	
	C		2.8	
	D		2.0	
	E		2.2	
	1 Grab		2.4	
	1 Composite		2.2	

[1] Corrected for background (1.4 mg/L)
[2] Corrected for background (184 μg/filter)

Table A-23. Percentages of Daily Composite Versus Daily Grab Samples in the Seven Day Composite Water Samples from Station 1.

Sampling Date	% Composite	% Grab
Week 1		
Sept. 12/13	100	0
Sept. 13/14	33	66
Sept. 14/15	33	66
Sept. 15/16	33	66
Sept. 16/17	50	50
Sept. 17/18	0	100
Sept. 18/19	100	0
Week 2		
Sept. 19/20	33	66
Sept. 20/21	100	0
Sept. 21/22	100	0
Sept. 22/23	0	100
Sept. 23/24	33	66
Sept. 24/25	0	100
Sept. 25/26	0	100
Week 3		
Sept. 26/27	100	0
Sept. 27/28	0	100
Sept. 28/29	100	0
Sept. 29/30	12	88
Sept. 30/Oct. 1	0	100
Oct. 1/2	100	0
Oct. 2/3	100	0
Week 4		
Oct. 3/4	100	0
Oct. 4/5	100	0
Oct. 5/6	100	0
Oct. 6/7	100	0
Oct. 7/8	100	0
Oct. 8/9	100	0

Table A-24. Organic Carbon Content for Sediment Samples.

Station	Percent Organic Carbon[1]
A	7.19
1	3.69
B	9.12
C	2.99
D	4.14
E	5.31

[1] Percent organic carbon = total carbon - carbonate carbon

Table A-25.   Particle Size Distribution for Sediments.

| | Particle Size Distribution (% <2 mm) | | | | | | | | | | | | | |
| | Sand (mm) | | | | | | Silt (μm) | | | | Clay (μm) | | | |
Station	VCS 2-1	CS 1-0.5	MS 0.5-0.25	FS 0.25-0.1	VFS 0.1-0.05	TS 2-0.05	CSI 50-20	MSI 20-5	FSI 5-2	TSI 50-2	CC 2-0.2	FC <0.2	TC <2	Text. Class
A	0.8	1.1	2.2	16.9	32.5	53.5	14.7	8.5	2.9	26.1	12.0	8.4	20.4	SCL
1	5.0	3.3	2.6	21.6	1.6	34.1	44.5	5.0	1.9	51.4	9.9	4.6	14.5	SIL
B	0.7	1.1	1.6	23.8	17.7	44.9	18.0	8.0	3.8	29.8	11.7	13.6	25.3	L
C	0.4	0.4	0.3	10.1	17.4	28.6	16.8	11.3	6.9	35.0	20.8	15.6	36.4	CL
D	0.2	0.9	1.2	23.2	18.2	43.7	11.6	8.5	4.6	24.7	14.3	17.3	31.6	CL
E	0.4	0.3	0.6	15.3	17.4	34.0	19.0	9.8	6.0	34.8	14.5	16.7	31.2	CL

V = Very
C = Coarse
S = Sand
M = Medium
F = Fine
SI = Silt
C = Clay
T = Total

Table A-26. Tissue Compositing Information.

For each composite sample, the wet weight (g) of the organism and the field sample package from which that organism was randomly chosen are listed.

Fundulus heteroclitus

Station A

Composite 1		Composite 2		Composite 3		Composite 4	
-0009	2.7	-0009	4.1	-0010	1.9	-0012	14.0
-0011	2.4	-0009	7.9	-0011	1.4	-0009	6.7
-0009	2.1	-0011	2.2	-0009	2.1	-0011	2.2
-0011	3.4	-0012	5.0	-0011	2.5	-0009	8.4
-0012	14.2	-0012	9.3	-0010	5.3	-0010	8.7
-0011	1.8	-0012	4.7	-0011	2.5	-0010	4.0
-0012	5.4	-0009	2.5	-0011	4.7	-0010	3.7
-0012	8.9	-0012	5.8	-0010	6.0	-0009	5.7
-0009	10.8	-0011	2.0	-0010	3.4	-0012	14.6
-0010	4.5	-0012	2.9	-0012	6.1	-0011	5.0
-0010	9.0	-0010	5.4	-0011	4.7	-0012	2.5
-0012	5.8	-0009	1.7	-0011	2.3	-0010	2.6

	Composite 1	Composite 2	Composite 3	Composite 4
Tissue mass g	71.0	53.5	42.9	78.1
n=	12	12	12	12
Average mass	5.9	4.5	3.6	6.5
Std Dev.	6.0	2.4	1.7	4.2
Coef.Var.	67.2	53.9	47.3	65.0

Station 1   Composite 1

-011	7.1
-011	4.6
-011	1.5
-009	9.3
-009	2.1
-009	6.5
-009	1.7
-009	1.9
-009	3.3
-009	2.0
-009	2.4
-009	2.1

	Composite 1
Tissue mass g	44.5
n=	12
Average mass	3.7
Std Dev.	2.6
Coef.Var.	69.7

Station 8

Composite 1		Composite 2		Composite 3		Composite 4		Composite 5		Composite 6	
-0017	2.6	-0017	8.4	-0013	5.1	-0017	4.7	-0013	4.4	-0018	6.6
-014	4.7	-0020	2.2	-0019	9.3	-0014	1.9	-0017	4.0	-0018	4.5
-014	3.0	-0013	3.6	-0014	4.4	-0014	10.4	-0013	5.4	-0018	0.7
-0020	3.6	-0013	1.9	-0017	4.2	-0017	7.0	-0018	6.4	-0018	1.3
-013	2.6	-0020	3.4	-0019	5.6	-0014	11.5	-0014	14.1	-0013	0.6
-0018	8.2	-0017	3.8	-0020	10.6	-0013	1.8	-0018	14.2	-0014	3.6
-0018	8.2	-0020	5.8	-0020	4.8	-0013	2.4	-0014	3.3	-0014	3.1
-0020	7.0	-0013	2.4	-0017	6.2	-0014	3.5	-0014	8.4	-0014	2.0
-0020	9.2	-0018	4.7	-0014	5.7	-0013	2.6	-0014	1.5	-0014	1.2
-0018	2.1	-0018	4.8	-0019	10.3	-0013	2.4	-0018	12.4	-0014	1.3
-0020	3.4	-0017	3.5	-0017	3.0	-0018	6.8	-0018	13.1	-0014	1.1
-0017	4.1	-0020	4.3	-0017	7.4	-0013	3.4	-0014	3.4	-0014	1.6

Tissue mass g	58.5	48.8	76.6	58.4	90.6	27.6
n=	12	12	12	12	12	12
Average mass	4.9	4.1	6.4	4.9	7.6	2.3
Std Dev.	2.6	1.8	2.5	3.3	4.7	1.8
Coef.Var.	52.6	43.7	39.0	68.6	62.2	79.0

Station C   Composite 1

```
2.2
3.3
6.0
4.7
5.1
5.1
9.9
8.3
8.7
10.4
11.8
12.3
```

Tissue mass g	87.8
n=	12
Average mass	7.3
Std Dev.	3.4
Coef.Var.	46.0

Station D   Composite 1   Composite 2   Composite 3

-0001	13.7	-0002	4.6	-0002	3.8
-0022	5.3	-0024	1.6	-0002	5.4
-0021	4.7	-0024	4.4	-0001	12.7
-0026	4.2	-0024	2.1	-0001	4.3
-0022	12.3	-0001	12.7	-0002	2.1
-0022	3.2	-0026	8.9	-0001	6.6
-0022	13.3	-0001	6.0	-0001	5.0
-0022	14.0	-0002	4.6	-0001	11.8
-0021	6.6	-0002	13.9	-0002	2.1
-0022	7.5	-0024	1.6	-0002	7.0
-0001	10.3	-0001	13.4	-0002	4.8
-0002	2.7	-0001	6.4	-0002	5.7

Tissue mass g	97.8		79.8		71.1
n=	12		12		12
Average mass	8.2		6.7		5.9
Std Dev.	4.3		4.6		3.3
Coef.Var.	53.1		68.5		55.9

Station D   Composite 1

```
2.2
2.8
3.1
2.0
2.9
4.9
2.8
2.1
3.7
3.1
3.4
3.4
```

Tissue mass g	36.4

```
n=                      12
Average mass            3.0
Std Dev.                0.8
Coef.Var.              26.2
```

Callinectes sapidus   Whole mass (g) includes shell and soft body without legs.

Station A   Composite 1

		Whole	Soft	Composite 2	Whole	Soft	Composite 3	Whole	Soft
	-0001	94.6	22.4	-0001	125.7	34.3	-0002	138.0	50.6
	-0002	123.7	33.5	-0007	101.6	62.7	-0002	110.6	38.9
	-0003	110.3	36.0	-0003	202.0	40.8	-0001	103.6	27.7
Tissue mass g		328.6	91.9		429.3	137.8		352.2	117.2
n=		3	3		3	3		3	3
Average mass		109.5	30.6		143.1	45.9		117.4	39.1
Std Dev.		14.6	7.2		52.4	14.9		18.2	11.5
Coef.Ver.		13.3	23.6		36.6	32.4		15.5	29.3

Station 1   Composite 1

		Whole	Soft	Composite 2	Whole	Soft	Composite 3	Whole	Soft	Composite 4	Whole	Soft
	-0006	184.5	91.8	-0003	130.5	44.6	-0004	71.3	36.2	-0006	86.0	28.5
	-0002	146.0	65.2	-0005	91.2	39.1	-0003	82.2	28.5	-0006	67.8	24.5
	-0005	240.8	96.4	-0003	96.7	50.8	-0002	68.6	28.1	-0006	56.4	18.7
Tissue mass g		571.3	253.4		316.4	134.3		222.1	92.8		210.2	71.7
n=		3	3		3	3		3	3		3	3
Average mass		190.4	84.5		105.5	44.8		74.0	30.9		70.1	23.9
Std Dev.		47.7	16.8		21.8	5.9		7.2	4.6		14.9	6.9
Coef.Var.		25.0	19.9		20.6	13.1		9.7	14.8		21.3	20.6

Station B   Composite 1

		Whole	Soft	Composite 2	Whole	Soft
	-012	179.0	92.5	-012	171.6	70.4
	-0009	147.8	56.6	-011	181.1	76.6
	-0010	114.2	42.6	-011	208.6	74.1
Tissue mass g		441.0	191.7		561.3	221.1
n=		3	3		3	3
Average mass		147.0	63.9		187.1	73.7
Std Dev.		32.4	25.7		19.2	3.1
Coef.Var.		22.0	40.3		10.3	4.2

Station C   Composite 1

		Whole	Soft	Composite 2	Whole	Soft
	-0008	249.6	97.5	-0001	56.6	20.9
	-0009	244.1	93.3	-0007	64.8	26.6
	-0009	208.8	84.6	-0007	48.2	20.1
Tissue mass g		702.5	275.4		169.6	67.6
n=		3	3		3	3
Average mass		234.2	91.8		56.5	22.5
Std Dev.		22.1	6.6		8.3	3.5
Coef.Var.		9.5	7.2		14.7	15.7

Station D   Composite 1

		Whole	Soft	Composite 2	Whole	Soft
	-0016	229.8	89.8	-0005	118.3	54.5
	-0004	171.2	76.2	-0015	99.8	39.6

	-0018	145.7	83.1	-0015	91.8	36.9
Tissue mass g		546.7	249.1		309.9	131.0
n=		3	3		3	3
Average mass		182.2	83.0		103.3	43.7
Std Dev.		43.1	6.8		13.6	9.5
Coef.Var.		23.7	8.2		13.2	21.7

Station E	Composite 1			Composite 2			Composite 3		
		Whole	Soft		Whole	Soft		Whole	Soft
	-0003	228.6	98.9	-0002	193.0	74.1	-0004	154.5	64.7
	-0002	232.8	90.6	-0005	216.9	90.6	-0001	169.6	54.8
	-0004	244.6	108.6	-0001	195.7	65.3	-0003	164.7	59.6
Tissue mass g		705.8	297.9		605.6	229.8		488.8	178.9
n=		3	3		3	3		3	3
Average mass		235.3	99.3		201.9	76.6		162.9	59.6
Std Dev.		8.4	9.1		13.1	12.7		7.7	5.0
Coef.Var.		3.6	9.2		6.5	16.6		4.7	8.3

Micropogon undulus

Station B   Composite 1

	-0006	28.6
	-0006	28.3
	-0006	21.7
Tissue mass g		78.6
n=		3
Average mass		26.2
Std Dev.		3.9
Coef.Var.		16.9

Station C   Composite 1

	-0006	21.0
	-0006	20.8
	-0006	18.2
Tissue mass g		59.9
n=		3
Average mass		20.0
Std Dev.		1.6
Coef.Var.		7.8

Station D	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)	
	-0010	26.8	-0009	20.7	-0009	24.7
	-0010	20.9	-0009	27.7	-0009	20.6
	-0010	25.2	-0019	27.9	-0019	19.3
Tissue mass g		70.9		76.3		64.6
n=		3		3		3
Average mass		23.6		25.4		21.5
Std Dev.		2.4		4.1		2.9
Coef.Var.		10.2		16.1		13.3

Station E   Composite 1

	-0011	20.7
	-0011	19.3
	-0011	22.5

Tissue mass g	62.6
n=	3
Average mass	20.9
Std Dev.	1.6
Coef.Var.	7.6

Brevoortia patronus

Station C	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)		Composite 4 (D)		Composite 5 (E)		Composite 6 (F)	
	-0011	8.6	-0005	14.8	-0004	13.8	-0005	15.1	-0014	13.2	-0014	11.5
	-0004	12.3	-0014	10.6	-0005	10.3	-0002	11.7	-0014	9.7	-0011	8.5
	-0011	11.1	-0005	13.6	-0004	15.6	-0016	17.8	-0014	12.7	-0004	11.1
	-0005	12.2	-0011	10.3	-0005	13.3	-0014	17.4	-0005	12.7	-0011	14.1
	-0002	14.1	-0004	15.1	-0014	11.8	-0014	14.8	-0004	11.2	-0004	11.1
Tissue mass g	58.3		64.4		64.8		76.7		59.5		56.3	
n=	5		5		5		5		5		5	
Average mass	11.7		12.9		13.0		15.3		11.9		11.3	
Std Dev.	2.0		2.3		2.0		2.5		1.4		2.0	
Coef.Var.	17.4		17.6		15.7		16.0		12.0		17.6	

Composite 6 (G)	
-0004	12.2
-0005	12.8
-0002	13.9
-0014	12.6
-0014	13.5

Tissue mass g	64.9
n=	5
Average mass	13.0
Std Dev.	0.7
Coef.Var.	5.4

Station D	Composite 1 (A)		Composite 2 (B)	
	-0020	11.2	-0011	9.0
	-0020	10.6	-0011	11.9
	-0020	6.5	-0011	8.2
	-0011	10.2	-0011	8.2
	-0011	8.5	-0011	8.3
Tissue mass g	47.0		45.5	
n=	5		5	
Average mass	9.4		9.1	
Std Dev.	1.9		1.6	
Coef.Var.	20.4		17.3	

Station E	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)		Composite 4 (D)	
	-0010	10.8	-0009	13.5	-0009	9.1	-0007	13.4
	-0010	12.4	-0009	13.8	-0010	10.5	-0009	10.6
	-0007	10.7	-0009	13.1	-0010	8.7	-0010	9.0
	-0010	9.2	-0010	12.0	-0009	11.7	-0007	10.4
	-0010	14.4	-0007	11.0	-0009	12.3	-0009	11.3
Tissue mass g	57.5		63.4		52.2		54.7	
n=	5		5		5		5	
Average mass	11.5		12.7		10.4		10.9	
Std Dev.	2.0		1.2		1.6		1.6	
Coef.Var.	17.1		9.1		15.2		14.8	

Table A-27. Hexachloroethane Tissue Concentrations for **Fundulus heteroclitus**.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	42.6	78.0	523
Comp #2	ERL-D 5/17	1.01	16.3[c]	55.6	396
Comp #3	Bat E	1.42	55.1	82.6	384
Comp #4	ERL-D 5/15	0.612	16.7	69.6	827
Comp #4	ERL-D 5/15	1.42	17.1	65.8	336
1					
Comp #1	ERL-D 5/15	1.24	18.7	154	925
B .					
Comp #1	ERL-D 5/17	0.794	20.8	107	995
Comp #1	ERL-D 5/17	1.37	20.4	91.1	489
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	39.0	128	563
Comp #3	Bat E		36.7	119	520
Comp #4	Bat E	1.54	23.8	202	943
Comp #5	ERL-D 5/15	0.954	20.1	112	868
Comp #6	Bat E	2.04	45.8	103	343
C					
Comp #1	ERL-D 5/17	0.825	18.0	102	912
Comp #1	ERL-D 5/17	0.994	20.3	90.0	665
D					
Comp #1	Bat E	2.18	24.8	104	325
Comp #2	ERL-D 5/15	0.930	39.2	20.8	145
Comp #2	ERL-D 5/15	1.03	38.0	22.3	142
Comp #2	ERL-D 4/23	0.988	20.1	29.4	203
Comp #3	ERL-D 5/15	1.30	19.1	9.97	40.6
E					
Comp #1	ERL-D 5/15	1.31	20.4	94.9	533

		-0018	145.7	83.1	-0015	91.8	36.9
Tissue mass g			546.7	249.1		309.9	131.0
n=			3	3		3	3
Average mass			182.2	83.0		103.3	43.7
Std Dev.			43.1	6.8		13.6	9.5
Coef.Var.			23.7	8.2		13.2	21.7

Station E	Composite 1			Composite 2			Composite 3		
		Whole	Soft		Whole	Soft		Whole	Soft
	-0003	228.4	98.9	-0002	193.0	74.1	-0004	154.5	64.7
	-0002	232.8	90.4	-0005	216.9	90.4	-0001	169.6	54.8
	-0004	244.6	108.6	-0001	195.7	65.3	-0003	166.7	59.4
Tissue mass g		705.8	297.9		605.6	229.8		488.8	178.9
n=		3	3		3	3		3	3
Average mass		235.3	99.3		201.9	76.6		162.9	59.6
Std Dev.		8.4	9.1		13.1	12.7		7.7	5.0
Coef.Var.		3.6	9.2		6.5	16.6		4.7	8.3

Micropogon undulus

Station B   Composite 1

	-0006	28.6
	-0006	28.3
	-0006	21.7

Tissue mass g	78.6
n=	3
Average mass	26.2
Std Dev.	3.9
Coef.Var.	14.9

Station C   Composite 1

	-0006	21.0
	-0006	20.8
	-0006	18.2

Tissue mass g	59.9
n=	3
Average mass	20.0
Std Dev.	1.6
Coef.Var.	7.8

Station D   Composite 1 (A)   Composite 2 (B)   Composite 3 (C)

	-0010	24.8	-0009	20.7	-0009	24.7
	-0010	20.9	-0009	27.7	-0009	20.6
	-0010	25.2	-0019	27.9	-0019	19.3
Tissue mass g		70.9		76.3		64.6
n=		3		3		3
Average mass		23.6		25.4		21.5
Std Dev.		2.4		4.1		2.9
Coef.Var.		10.2		16.1		13.3

Station E   Composite 1

	-0011	20.7
	-0011	19.3
	-0011	22.5

n=		12
Average mass		3.0
Std Dev.		0.8
Coef.Var.		26.2

Callinectes sapidus   Whole mass (g) includes shell and soft body without legs.

Station A

Composite 1			Composite 2			Composite 3		
	Whole	Soft		Whole	Soft		Whole	Soft
-0001	94.6	22.4	-0001	125.7	34.3	-0002	138.0	50.6
-0002	123.7	33.5	-0007	101.6	62.7	-0002	110.6	38.9
-0003	110.3	36.0	-0003	202.0	60.8	-0001	103.6	27.7
Tissue mass g	328.6	91.9		429.3	137.8		352.2	117.2
n=	3	3		3	3		3	3
Average mass	109.5	30.6		143.1	45.9		117.4	39.1
Std Dev.	16.6	7.2		52.4	16.9		18.2	11.5
Coef.Var.	13.3	23.6		36.6	32.4		15.5	29.3

Station 1

Composite 1			Composite 2			Composite 3			Composite 4		
	Whole	Soft		Whole	Soft		Whole	Soft		Whole	Soft
-0004	184.5	91.8	-0003	130.5	44.6	-0004	71.3	36.2	-0006	86.0	28.5
-0002	146.0	65.2	-0005	91.2	39.1	-0003	82.2	28.5	-0006	67.8	24.5
-0005	240.8	96.4	-0003	94.7	50.8	-0002	68.6	28.1	-0006	56.4	18.7
Tissue mass g	571.3	253.4		316.4	134.3		222.1	92.8		210.2	71.7
n=	3	3		3	3		3	3		3	3
Average mass	190.4	84.5		105.5	44.8		74.0	30.9		70.1	23.9
Std Dev.	47.7	16.8		21.8	5.9		7.2	4.6		14.9	4.9
Coef.Var.	25.0	19.9		20.6	13.1		9.7	14.8		21.3	20.6

Station B

Composite 1			Composite 2		
	Whole	Soft		Whole	Soft
-012	179.0	92.5	-012	171.6	70.4
-0009	147.8	56.6	-011	181.1	76.6
-0010	114.2	42.6	-011	208.6	74.1
Tissue mass g	441.0	191.7		561.3	221.1
n=	3	3		3	3
Average mass	147.0	63.9		187.1	73.7
Std Dev.	32.4	25.7		19.2	3.1
Coef.Var.	22.0	40.3		10.3	4.2

Station C

Composite 1			Composite 2		
	Whole	Soft		Whole	Soft
-0008	249.6	97.5	-0001	56.6	20.9
-0009	244.1	93.3	-0007	64.8	26.6
-0009	208.8	84.6	-0007	48.2	20.1
Tissue mass g	702.5	275.4		169.6	67.6
n=	3	3		3	3
Average mass	234.2	91.8		56.5	22.5
Std Dev.	22.1	6.6		8.3	3.5
Coef.Var.	9.5	7.2		14.7	15.7

Station D

Composite 1			Composite 2		
	Whole	Soft		Whole	Soft
-0014	229.8	89.8	-0005	118.3	54.5
-0004	171.2	76.2	-0015	99.8	39.6

Table A-27. Hexachloroethane Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	42.6	78.0	523
Comp #2	ERL-D 5/17	1.01	16.3[c]	55.6	396
Comp #3	Bat E	1.42	55.1	82.6	384
Comp #4	ERL-D 5/15	0.612	16.7	69.6	827
Comp #4	ERL-D 5/15	1.42	17.1	65.8	336
1					
Comp #1	ERL-D 5/15	1.24	18.7	154	925
B -					
Comp #1	ERL-D 5/17	0.794	20.8	107	995
Comp #1	ERL-D 5/17	1.37	20.4	91.1	489
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	39.0	128	563
Comp #3	Bat E		36.7	119	520
Comp #4	Bat E	1.54	23.8	202	943
Comp #5	ERL-D 5/15	0.954	20.1	112	868
Comp #6	Bat E	2.04	45.8	103	343
C					
Comp #1	ERL-D 5/17	0.825	18.0	102	912
Comp #1	ERL-D 5/17	0.994	20.3	90.0	665
D					
Comp #1	Bat E	2.18	24.8	104	325
Comp #2	ERL-D 5/15	0.930	39.2	20.8	145
Comp #2	ERL-D 5/15	1.03	38.0	22.3	142
Comp #2	ERL-D 4/23	0.988	20.1	29.4	203
Comp #3	ERL-D 5/15	1.30	19.1	9.97	40.6
E					
Comp #1	ERL-D 5/15	1.31	20.4	94.9	533

Tissue mass g	62.6
n=	3
Average mass	20.9
Std Dev.	1.6
Coef.Var.	7.6

Brevoortia patronus

Station C	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)		Composite 4 (D)		Composite 5 (E)		Composite 6 (F)	
	-0011	8.6	-0005	14.8	-0004	13.8	-0005	15.1	-0014	13.2	-0014	11.5
	-0004	12.3	-0014	10.6	-0009	10.3	-0002	11.7	-0014	9.7	-0011	8.5
	-0011	11.1	-0005	13.6	-0004	15.6	-0014	17.8	-0014	12.7	-0004	11.1
	-0005	12.2	-0011	10.3	-0009	13.3	-0014	17.4	-0005	12.7	-0011	14.1
	-0002	14.1	-0004	15.1	-0014	11.8	-0014	14.8	-0004	11.2	-0004	11.1
Tissue mass g	58.3		64.4		64.8		76.7		59.5		56.3	
n=	5		5		5		5		5		5	
Average mass	11.7		12.9		13.0		15.3		11.9		11.3	
Std Dev.	2.0		2.3		2.0		2.5		1.4		2.0	
Coef.Var.	17.4		17.6		15.7		16.0		12.0		17.6	

	Composite 6 (G)	
	-0004	12.2
	-0005	12.8
	-0002	13.9
	-0014	12.6
	-0014	13.5
Tissue mass g	66.9	
n=	5	
Average mass	13.0	
Std Dev.	0.7	
Coef.Var.	5.4	

Station D	Composite 1 (A)		Composite 2 (B)	
	-0020	11.2	-0011	9.0
	-0020	10.6	-0011	11.9
	-0020	6.5	-0011	8.2
	-0011	10.2	-0011	8.2
	-0011	8.5	-0011	8.3
Tissue mass g	47.0		45.5	
n=	5		5	
Average mass	9.4		9.1	
Std Dev.	1.9		1.6	
Coef.Var.	20.4		17.3	

Station E	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)		Composite 4 (D)	
	-0010	10.8	-0009	13.5	-0009	9.1	-0007	13.6
	-0010	12.4	-0009	13.8	-0010	10.5	-0009	10.6
	-0007	10.7	-0009	13.1	-0010	8.7	-0010	9.0
	-0010	9.2	-0010	12.0	-0009	11.7	-0007	10.4
	-0010	14.4	-0007	11.0	-0009	12.3	-0009	11.3
Tissue mass g	57.5		63.4		52.2		54.7	
n=	5		5		5		5	
Average mass	11.5		12.7		10.4		10.9	
Std Dev.	2.0		1.2		1.6		1.6	
Coef.Var.	17.1		9.1		15.2		14.8	

n= 12
Average mass 3.0
Std Dev. 0.8
Coef.Var. 26.2

Callinectes sapidus   Whole mass (g) includes shell and soft body without legs.

Station A   Composite 1

	Whole	Soft	Composite 2	Whole	Soft	Composite 3	Whole	Soft
-0001	94.6	22.4	-0001	123.7	34.3	-0002	138.0	50.6
-0002	123.7	33.5	-0007	101.6	62.7	-0002	110.6	38.9
-0003	110.3	36.0	-0003	202.0	40.8	-0001	103.6	27.7
Tissue mass g	328.6	91.9		429.3	137.8		352.2	117.2
n=	3	3		3	3		3	3
Average mass	109.5	30.6		143.1	45.9		117.4	39.1
Std Dev.	14.6	7.2		52.4	14.9		18.2	11.5
Coef.Var.	13.3	23.6		36.6	32.4		15.5	29.3

Station 1   Composite 1

	Whole	Soft	Composite 2	Whole	Soft	Composite 3	Whole	Soft	Composite 4	Whole	Soft
-0004	184.5	91.8	-0003	130.5	44.4	-0004	71.3	36.2	-0004	86.0	28.5
-0002	146.0	65.2	-0005	91.2	39.1	-0003	82.2	28.5	-0006	67.8	24.5
-0005	240.8	96.4	-0003	94.7	50.8	-0002	68.6	28.1	-0006	56.4	18.7
Tissue mass g	571.3	253.4		316.4	134.3		222.1	92.8		210.2	71.7
n=	3	3		3	3		3	3		3	3
Average mass	190.4	84.5		105.5	44.8		74.0	30.9		70.1	23.9
Std Dev.	47.7	16.8		21.8	5.9		7.2	4.6		14.9	4.9
Coef.Var.	25.0	19.9		20.6	13.1		9.7	14.8		21.3	20.6

Station B   Composite 1

	Whole	Soft	Composite 2	Whole	Soft
-012	179.0	92.5	-012	171.6	70.4
-0009	147.8	56.6	-011	181.1	76.6
-0010	116.2	42.6	-011	208.6	74.1
Tissue mass g	441.0	191.7		561.3	221.1
n=	3	3		3	3
Average mass	147.0	63.9		187.1	73.7
Std Dev.	32.4	25.7		19.2	3.1
Coef.Var.	22.0	40.3		10.3	4.2

Station C   Composite 1

	Whole	Soft	Composite 2	Whole	Soft
-0008	249.6	97.5	-0001	56.6	20.9
-0009	244.1	93.3	-0007	64.8	26.6
-0009	208.8	84.6	-0007	48.2	20.1
Tissue mass g	702.5	275.4		169.6	67.6
n=	3	3		3	3
Average mass	234.2	91.8		56.5	22.5
Std Dev.	22.1	6.6		8.3	3.5
Coef.Var.	9.5	7.2		14.7	15.7

Station D   Composite 1

	Whole	Soft	Composite 2	Whole	Soft
-0014	229.8	89.8	-0005	118.3	54.5
-0004	171.2	76.2	-0015	99.8	39.6

Table A-28. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-29. Tetrachlorobutadiene #2 Tissue Concentrations for Fundulus heteroclitus.

Station[*]	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	22.4	175
Comp #2	ERL-D 5/17	1.01	18.1[c]	11.9	89.5
Comp #3	Bat E	1.42	30.8	24.1	129
Comp #4	ERL-D 5/15	0.612	16.6	16.3	202
Comp #4	ERL-D 5/15	1.42	18.4	20.3	109
1					
Comp #1	ERL-D 5/15	1.24	17.7	33.6	206
B					
Comp #1	ERL-D 5/17	0.794	24.1	15.8	151
Comp #1	ERL-D 5/17	1.37	21.2	18.2	101
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	40.5	195
Comp #3	Bat E		30.4	28.7	138
Comp #4	Bat E	1.54	15.4	58.0	286
Comp #5	ERL-D 5/15	0.954	19.3	23.1	184
Comp #6	Bat E	2.04	9.5	41.2	153
C					
Comp #1	ERL-D 5/17	0.825	18.5	17.3	159
Comp #1	ERL-D 5/17	0.994	21.1	13.9	106
D					
Comp #1	Bat E	2.18	22.7	20.6	71.8
Comp #2	ERL-D 5/15	0.930	45.5	2.94	24.0
Comp #2	ERL-D 5/15	1.03	40.9	3.07	22.7
Comp #2	ERL-D 4/23	0.988	19.8	5.18	39.8
Comp #3	ERL-D 5/15	1.30	20.2	2.56	15.0
E					
Comp #1	ERL-D 5/15	1.31	20.1	15.1	87.6

Table A-27. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.3	4.01	
Blank	ERL-D 1/3		42.4	3.63	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		58.8	4.12	
Blank	ERL-D 4/23		23.3	0.00	
Blank	ERL-D 5/15		62.7	3.21	
Blank	ERL-D 5/15		64.1	2.91	
Blank	ERL-D 5/17		51.1	3.38	
Blank	ERL-D 5/17		59.1	3.01	
Blank	Bat A		41.2	11.9	
Blank	Bat B		R-L		
Blank	Bat C		37.5	8.41	
Blank	Bat D		31.4	9.50	
Blank	Bat E		45.5	12.7	
Blank	Bat F		46.9	11.1	
Blank	Bat G		52.8	11.5	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-28. Tetrachlorobutadiene #1 Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	5.71	44.5
Comp #2	ERL-D 5/17	1.01	18.1[c]	1.44	10.8
Comp #3	Bat E	1.42	30.8	8.12	43.5
Comp #4	ERL-D 5/15	0.612	16.6	2.60	32.3
Comp #4	ERL-D 5/15	1.42	18.4	2.43	13.0
1					
Comp #1	ERL-D 5/15	1.24	17.7	5.05	31.0
B					
Comp #1	ERL-D 5/17	0.794	24.1	2.90	27.8
Comp #1	ERL-D 5/17	1.37	21.2	3.28	18.2
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	16.4	78.9
Comp #3	Bat E		30.4	8.58	41.3
Comp #4	Bat E	1.54	15.4	22.5	111
Comp #5	ERL-D 5/15	0.954	19.3	2.73	21.7
Comp #6	Bat E	2.04	29.5	14.6	54.4
C					
Comp #1	ERL-D 5/17	0.825	18.5	3.03	27.9
Comp #1	ERL-D 5/17	0.994	21.1	2.56	19.6
D					
Comp #1	Bat E	2.18	22.7	10.9	38.0
Comp #2	ERL-D 5/15	0.930	45.5	0.00	0.00
Comp #2	ERL-D 5/15	1.03	40.9	0.00	0.00
Comp #2	ERL-D 4/23	0.988	19.8	0.709	5.45
Comp #3	ERL-D 5/15	1.30	20.2	0.00	0.00
E					
Comp #1	ERL-D 5/15	1.31	20.1	2.29	13.3

A-72

Tissue mass g	62.6	
n=	3	
Average mass	20.9	
Std Dev.	1.6	
Coef.Var.	7.6	

Brevoortia patronus

Station C	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)		Composite 4 (D)		Composite 5 (E)		Composite 6 (F)	
	-0011	8.6	-0005	14.8	-0004	13.8	-0005	15.1	-0014	13.2	-0014	11.5
	-0004	12.3	-0014	10.6	-0005	10.3	-0002	11.7	-0014	9.7	-0011	8.5
	-0011	11.1	-0005	13.6	-0004	15.6	-0014	17.8	-0014	12.7	-0004	11.1
	-0005	12.2	-0011	10.3	-0005	13.3	-0014	17.4	-0005	12.7	-0011	14.1
	-0002	14.1	-0004	15.1	-0014	11.8	-0014	14.8	-0004	11.2	-0004	11.1
Tissue mass g	58.3		64.4		64.8		76.7		59.5		56.3	
n=	5		5		5		5		5		5	
Average mass	11.7		12.9		13.0		15.3		11.9		11.3	
Std Dev.	2.0		2.3		2.0		2.5		1.4		2.0	
Coef.Var.	17.4		17.6		15.7		16.0		12.0		17.6	

Composite 6 (G)	
-0004	12.2
-0005	12.8
-0002	13.9
-0014	12.6
-0014	13.5

Tissue mass g	64.9	
n=	5	
Average mass	13.0	
Std Dev.	0.7	
Coef.Var.	5.4	

Station D	Composite 1 (A)		Composite 2 (B)	
	-0020	11.2	-0011	9.0
	-0020	10.6	-0011	11.9
	-0020	6.5	-0011	8.2
	-0011	10.2	-0011	8.2
	-0011	8.5	-0011	8.3
Tissue mass g	47.0		45.5	
n=	5		5	
Average mass	9.4		9.1	
Std Dev.	1.9		1.6	
Coef.Var.	20.6		17.3	

Station E	Composite 1 (A)		Composite 2 (B)		Composite 3 (C)		Composite 4 (D)	
	-0010	10.8	-0009	13.5	-0009	9.1	-0007	13.4
	-0010	12.4	-0009	13.8	-0010	10.5	-0009	10.6
	-0007	10.7	-0009	13.1	-0010	8.7	-0010	9.0
	-0010	9.2	-0010	12.0	-0009	11.7	-0007	10.4
	-0010	14.4	-0007	11.0	-0009	12.3	-0009	11.3
Tissue mass g	57.5		63.4		52.2		54.7	
n=	5		5		5		5	
Average mass	11.5		12.7		10.4		10.9	
Std Dev.	2.0		1.2		1.6		1.6	
Coef.Var.	17.1		9.1		15.2		14.8	

Table A-27. Hexachloroethane Tissue Concentrations for <u>Fundulus heteroclitus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	42.6	78.0	523
Comp #2	ERL-D 5/17	1.01	16.3[c]	55.6	396
Comp #3	Bat E	1.42	55.1	82.6	384
Comp #4	ERL-D 5/15	0.612	16.7	69.6	827
Comp #4	ERL-D 5/15	1.42	17.1	65.8	336
1					
Comp #1	ERL-D 5/15	1.24	18.7	154	925
B -					
Comp #1	ERL-D 5/17	0.794	20.8	107	995
Comp #1	ERL-D 5/17	1.37	20.4	91.1	489
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	39.0	128	563
Comp #3	Bat E		36.7	119	520
Comp #4	Bat E	1.54	23.8	202	943
Comp #5	ERL-D 5/15	0.954	20.1	112	868
Comp #6	Bat E	2.04	45.8	103	343
C					
Comp #1	ERL-D 5/17	0.825	18.0	102	912
Comp #1	ERL-D 5/17	0.994	20.3	90.0	665
D					
Comp #1	Bat E	2.18	24.8	104	325
Comp #2	ERL-D 5/15	0.930	39.2	20.8	145
Comp #2	ERL-D 5/15	1.03	38.0	22.3	142
Comp #2	ERL-D 4/23	0.988	20.1	29.4	203
Comp #3	ERL-D 5/15	1.30	19.1	9.97	40.6
E					
Comp #1	ERL-D 5/15	1.31	20.4	94.9	533

Table A-27. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.3	4.01	
Blank	ERL-D 1/3		42.4	3.63	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		58.8	4.12	
Blank	ERL-D 4/23		23.3	0.00	
Blank	ERL-D 5/15		62.7	3.21	
Blank	ERL-D 5/15		64.1	2.91	
Blank	ERL-D 5/17		51.1	3.38	
Blank	ERL-D 5/17		59.1	3.01	
Blank	Bat A		41.2	11.9	
Blank	Bat B		R-L		
Blank	Bat C		37.5	8.41	
Blank	Bat D		31.4	9.50	
Blank	Bat E		45.5	12.7	
Blank	Bat F		46.9	11.1	
Blank	Bat G		52.8	11.5	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth.   The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-28. Tetrachlorobutadiene #1 Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	5.71	44.5
Comp #2	ERL-D 5/17	1.01	18.1[c]	1.44	10.8
Comp #3	Bat E	1.42	30.8	8.12	43.5
Comp #4	ERL-D 5/15	0.612	16.6	2.60	32.3
Comp #4	ERL-D 5/15	1.42	18.4	2.43	13.0
1					
Comp #1	ERL-D 5/15	1.24	17.7	5.05	31.0
B					
Comp #1	ERL-D 5/17	0.794	24.1	2.90	27.8
Comp #1	ERL-D 5/17	1.37	21.2	3.28	18.2
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	16.4	78.9
Comp #3	Bat E		30.4	8.58	41.3
Comp #4	Bat E	1.54	15.4	22.5	111
Comp #5	ERL-D 5/15	0.954	19.3	2.73	21.7
Comp #6	Bat E	2.04	29.5	14.6	54.4
C					
Comp #1	ERL-D 5/17	0.825	18.5	3.03	27.9
Comp #1	ERL-D 5/17	0.994	21.1	2.56	19.6
D					
Comp #1	Bat E	2.18	22.7	10.9	38.0
Comp #2	ERL-D 5/15	0.930	45.5	0.00	0.00
Comp #2	ERL-D 5/15	1.03	40.9	0.00	0.00
Comp #2	ERL-D 4/23	0.988	19.8	0.709	5.45
Comp #3	ERL-D 5/15	1.30	20.2	0.00	0.00
E					
Comp #1	ERL-D 5/15	1.31	20.1	2.29	13.3

Table A-28. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-29. Tetrachlorobutadiene #2 Tissue Concentrations for _Fundulus heteroclitus._

Station[*]	Laboratory[*]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	22.4	175
Comp #2	ERL-D 5/17	1.01	18.1[c]	11.9	89.5
Comp #3	Bat E	1.42	30.8	24.1	129
Comp #4	ERL-D 5/15	0.612	16.6	16.3	202
Comp #4	ERL-D 5/15	1.42	18.4	20.3	109
1					
Comp #1	ERL-D 5/15	1.24	17.7	33.6	206
B					
Comp #1	ERL-D 5/17	0.794	24.1	15.8	151
Comp #1	ERL-D 5/17	1.37	21.2	18.2	101
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	40.5	195
Comp #3	Bat E		30.4	28.7	138
Comp #4	Bat E	1.54	15.4	58.0	286
Comp #5	ERL-D 5/15	0.954	19.3	23.1	184
Comp #6	Bat E	2.04	9.5	41.2	153
C					
Comp #1	ERL-D 5/17	0.825	18.5	17.3	159
Comp #1	ERL-D 5/17	0.994	21.1	13.9	106
D					
Comp #1	Bat E	2.18	22.7	20.6	71.8
Comp #2	ERL-D 5/15	0.930	45.5	2.94	24.0
Comp #2	ERL-D 5/15	1.03	40.9	3.07	22.7
Comp #2	ERL-D 4/23	0.988	19.8	5.18	39.8
Comp #3	ERL-D 5/15	1.30	20.2	2.56	15.0
E					
Comp #1	ERL-D 5/15	1.31	20.1	15.1	87.6

Table A-29. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-30. Pentachlorobutadiene #1 Tissue Concentrations for _Fundulus heteroclitus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	380	2960
Comp #2	ERL-D 5/17	1.01	18.1[c]	92.5	696
Comp #3	Bat E	1.42	30.8	110	587
Comp #4	ERL-D 5/15	0.612	16.6	100	1242
Comp #4	ERL-D 5/15	1.42	18.4	86.3	462
1					
Comp #1	ERL-D 5/15	1.24	17.7	270	1655
B					
Comp #1	ERL-D 5/17	0.794	24.1	136	1302
Comp #1	ERL-D 5/17	1.37	21.2	146	810
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	656	3154
Comp #3	Bat E		30.4	460	2211
Comp #4	Bat E	1.54	15.4	1230	6069
Comp #5	ERL-D 5/15	0.954	19.3	138	1099
Comp #6	Bat E	2.04	29.5	730	2718
C					
Comp #1	ERL-D 5/17	0.825	18.5	112	1032
Comp #1	ERL-D 5/17	0.994	21.1	101	772
D					
Comp #1	Bat E	2.18	22.7	463	1613
Comp #2	ERL-D 5/15	0.930	45.5	17.8	145
Comp #2	ERL-D 5/15	1.03	40.9	16.3	120
Comp #2	ERL-D 4/23	0.988	19.8	21.5	165
Comp #3	ERL-D 5/15	1.30	20.2	4.24	24.8
E					
Comp #1	ERL-D 5/15	1.31	20.1	74.2	430

Table A-30. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	2.19	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-31. Pentachlorobutadiene #2 Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	97.0	755
Comp #2	ERL-D 5/17	1.01	18.1[c]	17.1	129
Comp #3	Bat E	1.42	30.8	0.00	0.00
Comp #4	ERL-D 5/15	0.612	16.6	21.2	263
Comp #4	ERL-D 5/15	1.42	18.4	18.5	99.0
1					
Comp #1	ERL-D 5/15	1.24	17.7	58.7	360
B					
Comp #1	ERL-D 5/17	0.794	24.1	25.7	246
Comp #1	ERL-D 5/17	1.37	21.2	31.3	174
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	184	884
Comp #3	Bat E		30.4	139	668
Comp #4	Bat E	1.54	15.4	294	1450
Comp #5	ERL-D 5/15	0.954	19.3	29.3	233
Comp #6	Bat E	2.04	29.5	174	648
C					
Comp #1	ERL-D 5/17	0.825	18.5	24.3	224
Comp #1	ERL-D 5/17	0.994	21.1	24.3	186
D					
Comp #1	Bat E	2.18	22.7	121	421
Comp #2	ERL-D 5/15	0.930	45.5	4.42	36.1
Comp #2	ERL-D 5/15	1.03	40.9	5.00	36.9
Comp #2	ERL-D 4/23	0.988	19.8	5.32	40.9
Comp #3	ERL-D 5/15	1.30	20.2	2.05	12.0
CT5-E					
Comp #1	ERL-D 5/15	1.31	20.1	17.2	100

Table A-31. Continued.

Station-	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.948	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank -	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-32. Hexachlorobutadiene Tissue Concentrations for _Fundulus heteroclitus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	2510	19538
Comp #2	ERL-D 5/17	1.01	18.1[c]	3960	29742
Comp #3	Bat E	1.42	30.8	2990	15984
Comp #4	ERL-D 5/15	0.612	16.6	5990	74293
Comp #4	ERL-D 5/15	1.42	18.4	4920	26292
1					
Comp #1	ERL-D 5/15	1.24	17.7	11400	69825
B					
Comp #1	ERL-D 5/17	0.794	24.1	7130	68175
Comp #1	ERL-D 5/17	1.37	21.2	8320	46113
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	5840	28074
Comp #3	Bat E		30.4	4270	20522
Comp #4	Bat E	1.54	15.4	6290	31024
Comp #5	ERL-D 5/15	0.954	19.3	7940	63194
Comp #6	Bat E	2.04	29.5	3890	14479
C					
Comp #1	ERL-D 5/17	0.825	18.5	8540	78603
Comp #1	ERL-D 5/17	0.994	21.1	7530	57516
D					
Comp #1	Bat E	2.18	22.7	3270	11388
Comp #2	ERL-D 5/15	0.930	45.5	1410	11461
Comp #2	ERL-D 5/15	1.03	40.9	1540	11308
Comp #2	ERL-D 4/23	0.988	19.8	1760	13481
Comp #3	ERL-D 5/15	1.30	20.2	395	2266
E					
Comp #1	ERL-D 5/15	1.31	20.1	5890	34128

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	5.04	
Blank	ERL-D 1/3		44.0	2.81	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	4.93	
Blank	ERL-D 4/23		21.5	9.90	
Blank	ERL-D 5/15		61.9	7.46	
Blank	ERL-D 5/15		59.1	7.28	
Blank	ERL-D 5/17		48.5	11.2	
Blank	ERL-D 5/17		54.9	11.2	
Blank	Bat A		31.4	11.5	
Blank	Bat B		23.6	1.50	
Blank	Bat C		27.8	2.11	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	6.30	
Blank	Bat F		29.1	2.23	
Blank	Bat G		28.9	0.840	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-33. 1,2,3-Trichlorobenzene Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	22.1	152
Comp #2	ERL-D 5/17	1.01	18.1[c]	13.8	101
Comp #3	Bat E	1.42	30.8	21.5	101
Comp #4	ERL-D 5/15	0.612	16.6	15.3	185
Comp #4	ERL-D 5/15	1.42	18.4	16.0	83.7
1					
Comp #1	ERL-D 5/15	1.24	17.7	43.8	266
B					
Comp #1	ERL-D 5/17	0.794	24.1	41.6	395
Comp #1	ERL-D 5/17	1.37	21.2	27.2	149
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	39.8	179
Comp #3	Bat E		30.4	33.0	146
Comp #4	Bat E	1.54	15.4	57.2	269
Comp #5	ERL-D 5/15	0.954	19.3	36.5	288
Comp #6	Bat E	2.04	29.5	39.1	136
C					
Comp #1	ERL-D 5/17	0.825	18.5	22.1	200
Comp #1	ERL-D 5/17	0.994	21.1	21.9	165
D					
Comp #1	Bat E	2.18	22.7	25.6	80.2
Comp #2	ERL-D 5/15	0.930	45.5	6.08	46.7
Comp #2	ERL-D 5/15	1.03	40.9	5.82	40.2
Comp #2	ERL-D 4/23	0.988	19.8	6.70	48.7
Comp #3	ERL-D 5/15	1.30	20.2	3.30	17.1
E					
Comp #1	ERL-D 5/15	1.31	20.1	24.9	142

Table A-33. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.473	
Blank	ERL-D 5/15		59.1	0.856	
Blank	ERL-D 5/17		48.5	0.902	
Blank	ERL-D 5/17		54.9	0.717	
Blank	Bat A		31.4	4.58	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	3.42	
Blank	Bat E		27.8	4.57	
Blank	Bat F		29.1	2.21	
Blank	Bat G		28.9	3.44	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-34. 1,2,4-Trichlorobenzene Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	110	846
Comp #2	ERL-D 5/17	1.01	18.1[c]	102	642
Comp #3	Bat E	1.42	30.8	126	667
Comp #4	ERL-D 5/15	0.612	16.6	137	1494
Comp #4	ERL-D 5/15	1.42	18.4	138	649
1					
Comp #1	ERL-D 5/15	1.24	17.7	237	1350
B					
Comp #1	ERL-D 5/17	0.794	24.1	167	1439
Comp #1	ERL-D 5/17	1.37	21.2	169	845
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	230	1099
Comp #3	Bat E		30.4	174	830
Comp #4	Bat E	1.54	15.4	333	1636
Comp #5	ERL-D 5/15	0.954	19.3	203	1484
Comp #6	Bat E	2.04	29.5	266	986
C					
Comp #1	ERL-D 5/17	0.825	18.5	141	1145
Comp #1	ERL-D 5/17	0.994	21.1	114	744
D					
Comp #1	Bat E	2.18	22.7	126	434
Comp #2	ERL-D 5/15	0.930	45.5	38.0	174
Comp #2	ERL-D 5/15	1.03	40.9	55.4	286
Comp #2	ERL-D 4/23	0.988	19.8	66.1	380
Comp #3	ERL-D 5/15	1.30	20.2	38.0	125
E					
Comp #1	ERL-D 5/15	1.31	20.1	167	872

Table A-34. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	12.7	
Blank -	ERL-D 1/3		44.0	10.5	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	14.7	
Blank	ERL-D 4/23		21.5	35.6	
Blank	ERL-D 5/15		61.9	12.8	
Blank	ERL-D 5/15		59.1	12.6	
Blank	ELD-D 5/17		48.5	17.6	
Blank	ELD-D 5/17		54.9	17.0	
Blank	Bat A		31.4	1.90	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	1.02	
Blank	Bat E		27.8	1.05	
Blank	Bat F		29.1	3.11	
Blank	Bat G		28.9	3.12	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-35. 1,2,4,5- and 1,2,3,5- Tetrachlorobenzene Tissue Concentrations for <u>Fundulus</u>
-    <u>heteroclitus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	100	769
Comp #2	ERL-D 5/17	1.01	18.1[c]	189	1410
Comp #3	Bat E	1.42	30.8	104	549
Comp #4	ERL-D 5/15	0.612	16.6	276	3408
Comp #4	ERL-D 5/15	1.42	18.4	275	1464
1					
Comp #1	ERL-D 5/15	1.24	17.7	453	2767
B					
Comp #1	ERL-D 5/17	0.794	24.1	356	3393
Comp #1	ERL-D 5/17	1.37	21.2	387	2138
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	190	907
Comp #3	Bat E		30.4	177	845
Comp #4	Bat E	1.54	15.4	263	1291
Comp #5	ERL-D 5/15	0.954	19.3	404	3206
Comp #6	Bat E	2.04	29.5	164	606
C					
Comp #1	ERL-D 5/17	0.825	18.5	331	3035
Comp #1	ERL-D 5/17	0.994	21.1	303	2305
D					
Comp #1	Bat E	2.18	22.7	131	452
Comp #2	ERL-D 5/15	0.930	45.5	86.9	697
Comp #2	ERL-D 5/15	1.03	40.9	99.9	726
Comp #2	ERL-D 4/23	0.988	19.8	103	780
Comp #3	ERL-D 5/15	1.30	20.2	54.9	312
E					
Comp #1	ERL-D 5/15	1.31	20.1	310	1789

Table A-35. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	1.38	
Blank	ERL-D 1/3		44.0	0.799	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	1.14	
Blank	ERL-D 4/23		21.5	1.81	
Blank	ERL-D 5/15		61.9	1.92	
Blank	ERL-D 5/15		59.1	1.60	
Blank	ERL-D 5/17		48.5	1.85	
Blank	ERL-D 5/17		54.9	1.92	
Blank	Bat A		31.4	1.86	
Blank	Bat B		23.6	3.36	
Blank	Bat C		27.8	1.03	
Blank	Bat D		23.5	0.958	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	1.39	
Blank	Bat G		28.9	0.778	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-36. 1,2,3,4- Tetrachlorobenzene Tissue Concentrations for _Fundulus heteroclitus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	30.7	116	897
Comp #2	ERL-D 5/17	1.01	18.1[c]	72.7	543
Comp #3	Bat E	1.42	30.8	124	659
Comp #4	ERL-D 5/15	0.612	16.6	90.8	1121
Comp #4	ERL-D 5/15	1.42	18.4	78.5	417
1					
Comp #1	ERL-D 5/15	1.24	17.7	189	1155
B					
Comp #1	ERL-D 5/17	0.794	24.1	133	1268
Comp #1	ERL-D 5/17	1.37	21.2	151	835
Comp #2	ERL-D 5/17	0.615	R-L		
Comp #3	Bat E	1.58	19.2	243	1165
Comp #3	Bat E		30.4	227	1088
Comp #4	Bat E	1.54	15.4	343	1688
Comp #5	ERL-D 5/15	0.954	19.3	191	1517
Comp #6	Bat E	2.04	29.5	215	798
C					
Comp #1	ERL-D 5/17	0.825	18.5	131	1202
Comp #1	ERL-D 5/17	0.994	21.1	119	906
D					
Comp #1	Bat E	2.18	22.7	172	597
Comp #2	ERL-D 5/15	0.930	45.5	35.8	288
Comp #2	ERL-D 5/15	1.03	40.9	47.6	347
Comp #2	ERL-D 4/23	0.988	19.8	56.5	431
Comp #3	ERL-D 5/15	1.30	20.2	27.9	160
E					
Comp #1	ERL-D 5/15	1.31	20.1	127	734

Table A-36. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.361	
Blank	ERL-D 4/23		21.5	0.981	
Blank	ERL-D 5/15		61.9	0.888	
Blank	ERL-D 5/15		59.1	0.647	
Blank	ERL-D 5/17		48.5	0.640	
Blank	ERL-D 5/17		54.9	0.686	
Blank	Bat A		31.4	0.954	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	1.57	
Blank	Bat D		23.5	1.73	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	1.49	
Blank	Bat G		28.9	0.467	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-37. Pentachlorobenzene Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	26.7	705	5479
Comp #2	ERL-D 5/17	1.01	19.9[c]	483	3631
Comp #3	Bat E	1.42	28.3	769	4105
Comp #4	ERL-D 5/15	0.612	17.7	620	7693
Comp #4	ERL-D 5/15	1.42	17.6	685	3664
1					
Comp #1	ERL-D 5/15	1.24	18.2	1340	8210
B					
Comp #1	ERL-D 5/17	0.794	27.2	806	7710
Comp #1	ERL-D 5/17	1.37	22.7	1060	5878
Comp #2	ERL-D 5/17	0.615	16.3	1400	17295
Comp #3	Bat E	1.58	18.8	1390	6676
Comp #3	Bat E		29.7	1320	6340
Comp #4	Bat E	1.54	15.6	1280	6307
Comp #5	ERL-D 5/15	0.954	20.3	899	7158
Comp #6	Bat E	2.04	30.2	871	3237
C					
Comp #1	ERL-D 5/17	0.825	19.5	962	8857
Comp #1	ERL-D 5/17	0.994	25.1	929	7099
D					
Comp #1	Bat E	2.18	25.2	715	2486
Comp #2	ERL-D 5/15	0.930	49.9	251	2047
Comp #2	ERL-D 5/15	1.03	46.4	257	1893
Comp #2	ERL-D 4/23	0.988	21.7	265	2035
Comp #3	ERL-D 5/15	1.30	23.2	128	745
E					
Comp #1	ERL-D 5/15	1.31	21.9	688	3989

Table A-37. Continued.

Station	Laboratory[a]	Lipid %	¹³C₆-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		31.5	0.456	
Blank	ERL-D 1/3		46.2	0.425	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		· 55.6	0.507	
Blank	ERL-D 4/23		22.8	0.480	
Blank	ERL-D 5/15		63.8	0.481	
Blank	ERL-D 5/15		62.9	0.241	
Blank	ERL-D 5/17		50.8	0.838	
Blank	ERL-D 5/17		57.2	0.588	
Blank	Bat A		36.9	2.47	
Blank	Bat B		32.2	3.74	
Blank	Bat C		29.5	0.967	
Blank	Bat D		24.6	1.38	
Blank	Bat E		37.6	1.35	
Blank	Bat F		35.1	3.63	
Blank	Bat G		34.0	0.779	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-38. Hexachlorobenzene Tissue Concentrations for Fundulus heteroclitus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	Bat E	0.975	26.7	644	4996
Comp #2	ERL-D 5/17	1.01	19.9[c]	528	3970
Comp #3	Bat E	1.42	28.3	564	3002
Comp #4	ERL-D 5/15	0.612	17.7	844	10475
Comp #4	ERL-D 5/15	1.42	17.6	1640	8775
1					
Comp #1	ERL-D 5/15	1.24	18.2	1050	6433
B					
Comp #1	ERL-D 5/17	0.794	27.2	732	7002
Comp #1	ERL-D 5/17	1.37	22.7	753	4175
Comp #2	ERL-D 5/17	0.615	16.3	805	9942
Comp #3	Bat E	1.58	18.8	719	3443
Comp #3	Bat E		29.7	633	3030
Comp #4	Bat E	1.54	15.6	648	3183
Comp #5	ERL-D 5/15	0.954	20.3	528	4203
Comp #6	Bat E	2.04	30.2	475	1758
C					
Comp #1	ERL-D 5/17	0.825	19.5	703	6472
Comp #1	ERL-D 5/17	0.994	25.1	714	5456
D					
Comp #1	Bat E	2.18	25.2	361	1248
Comp #2	ERL-D 5/15	0.930	49.9	201	1639
Comp #2	ERL-D 5/15	1.03	46.4	200	1472
Comp #2	ERL-D 4/23	0.988	21.7	188	1443
Comp #3	ERL-D 5/15	1.30	23.2	152	886
E					
Comp #1	ERL-D 5/15	1.31	21.9	237	1372

Table A-38. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		31.5	0.458	
Blank	ERL-D 1/3		46.2	0.347	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		55.6	0.446	
Blank	ERL-D 4/23		22.8	0.552	
Blank	ERL-D 5/15		63.8	0.393	
Blank	ERL-D 5/15		62.9	0.318	
Blank	ERL-D 5/17		50.8	0.594	
Blank	ERL-D 5/17		57.2	0.570	
Blank	Bat A		36.9	3.78	
Blank	Bat B		32.2	1.33	
Blank	Bat C		29.5	6.06	
Blank	Bat D		24.6	3.27	
Blank	Bat E		37.6	2.74	
Blank	Bat F		35.1	2.43	
Blank	Bat G		34.0	2.25	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-39. Hexachloroethane Tissue Concentrations for <u>Callinectes</u> <u>sapidus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	28.9	4.83	23.7
Comp #2	Bat FG	2.49	37.2	14.2	10.2
Comp #3	ERL-D 1/30	0.916	24.5	5.03	16.6
1					
Comp #1	Bat FG	0.902	42.2	13.7	24.0
Comp #1	ERL-D 5/15	0.416	8.61[c]	0.00	0.00
Comp #2	Bat FG	1.22	49.0	12.5	10.3
Comp #3	ERL-D 1/30	1.49	29.9	5.90	14.6
Comp #4	Bat E	1.09	46.1	11.9	7.31
B					
Comp #1	Bat FG	2.59	27.1	15.6	13.9
Comp #1	Bat FG		62.3	10.8	0.00
Comp #1	ERL-D 5/15	1.93	22.2	4.36	5.22
Comp #2	ERL-D 1/30	1.02	29.7	7.18	30.9
Comp #2	ERL-D 4/23	0.953	R-L		
C					
Comp #1	Bat FG	1.95	44.4	21.1	39.9
Comp #1	ERL-D 1/3	1.56	48.2	9.25	30.3
Comp #1	ERL-D 1/24	1.83	18.7	7.82	19.9
Comp #2	ERL-D 1/30	0.960	23.6	4.24	9.55
D					
Comp #1	Bat FG	2.22	16.2	14.9	13.9
Comp #1	ERL-D 1/3	1.25	33.2	4.43	8.49
Comp #2	ERL-D 1/30	1.57	26.8	4.85	8.79
E					
Comp #1	Bat FG	1.10	48.8	16.6	39.7
Comp #1	ERL-D 1/3	0.953	36.8	5.14	16.8
Comp #1	ERL-D 1/3	1.06	47.5	5.52	17.8
Comp #2	Bat E	3.36	41.2	15.8	11.2
Comp #3	ERL-D 1/30	1.85	27.8	5.47	10.0

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.3	4.01	
Blank	ERL-D 1/3		42.4	3.63	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		58.8	4.12	
Blank	ERL-D 4/23		23.3	0.00	
Blank	ERL-D 5/15		62.7	3.21	
Blank	ERL-D 5/15		64.1	2.91	
Blank	ERL-D 5/17		51.1	3.38	
Blank	ERL-D 5/17		59.1	3.01	
Blank	Bat A		41.2	11.9	
Blank	Bat B		R-L		
Blank	Bat C		37.5	8.41	
Blank	Bat D		31.4	9.50	
Blank	Bat E		45.5	12.7	
Blank	Bat F		46.9	11.1	
Blank	Bat G		52.8	11.5	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-40. Tetrachlorobutadiene #1 Tissue Concentrations for <u>Callinectes</u> <u>sapidus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	0.00	0.00
Comp #2	Bat FG	2.49	27.8	4.57	13.9
Comp #3	ERL-D 1/30	0.916	30.4	0.559	4.64
1					
Comp #1	Bat FG	0.902	27.4	8.79	74.1
Comp #1	ERL-D 5/15	0.416	9.07[c]	0.00	0.00
Comp #2	Bat FG	1.22	32.2	3.48	21.7
Comp #3	ERL-D 1/30	1.49	33.8	1.45	7.40
Comp #4	Bat E	1.09	28.8	0.00	0.00
B					
Comp #1	Bat FG	2.59	18.7	17.7	51.9
Comp #1	Bat FG		42.4	17.4	51.1
Comp #1	ERL-D 5/15	1.93	24.7	3.75	14.8
Comp #2	ERL-D 1/30	1.02	31.7	4.09	30.5
Comp #2	ERL-D 4/23	0.953	16.4	3.12	24.9
C					
Comp #1	Bat FG	1.95	24.0	29.0	113
Comp #1	ERL-D 1/3	1.56	55.3	7.86	38.3
Comp #1	ERL-D 1/24	1.83	22.0	6.61	27.5
Comp #2	ERL-D 1/30	0.960	28.3	0.00	0.00
D					
Comp #1	Bat FG	2.22	17.2	2.87	9.83
Comp #1	ERL-D 1/3	1.25	37.7	1.21	7.36
Comp #2	ERL-D 1/30	1.57	32.1	1.47	7.12
E					
Comp #1	Bat FG	1.10	27.4	13.8	95.3
Comp #1	ERL-D 1/3	0.953	43.0	1.85	14.8
Comp #1	ERL-D 1/3	1.06	50.1	1.72	12.3
Comp #2	Bat E	3.36	27.6	9.57	21.6
Comp #3	ERL-D 1/30	1.85	32.9	2.62	10.8

Table A-40. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-41. Tetrachlorobutadiene #2 Tissue Concentrations for <u>Callinectes</u> <u>sapidus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_8$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	1.21	16.0
Comp #2	Bat FG	2.49	27.8	7.81	23.8
Comp #3	ERL-D 1/30	0.916	30.4	3.12	25.9
1					
Comp #1	Bat FG	0.902	27.4	13.9	117
Comp #1	ERL-D 5/15	0.416	9.07[c]	5.19	94.8
Comp #2	Bat FG	1.22	32.2	6.70	41.7
Comp #3	ERL-D 1/30	1.49	33.8	13.2	67.3
Comp #4	Bat E	1.09	28.8	6.03	42.0
B					
Comp #1	Bat FG	2.59	18.7	38.4	113
Comp #1	Bat FG		42.4	38.6	113
Comp #1	ERL-D 5/15	1.93	24.7	27.2	107
Comp #2	ERL-D 1/30	1.02	31.7	33.2	247
Comp #2	ERL-D 4/23	0.953	16.4	26.2	209
C					
Comp #1	Bat FG	1.95	24.0	47.9	187
Comp #1	ERL-D 1/3	1.56	55.3	46.4	226
Comp #1	ERL-D 1/24	1.83	22.0	42.3	176
Comp #2	ERL-D 1/30	0.960	28.3	1.19	9.42
D					
Comp #1	Bat FG	2.22	17.2	7.39	25.3
Comp #1	ERL-D 1/3	1.25	37.7	9.45	57.5
Comp #2	ERL-D 1/30	1.57	32.1	13.0	62.9
E					
Comp #1	Bat FG	1.10	27.4	18.7	129
Comp #1	ERL-D 1/3	0.953	43.0	13.4	107
Comp #1	ERL-D 1/3	1.06	50.1	13.1	93.9
Comp #2	Bat E	3.36	27.6	17.7	40.0
Comp #3	ERL-D 1/30	1.85	32.9	22.2	91.2

Table A-41. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-42. Pentachlorobutadiene #1 Tissue Concentrations for <u>Callinectes</u> <u>sapidus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	6.31	83.4
Comp #2	Bat FG	2.49	27.8	62.4	190
Comp #3	ERL-D 1/30	0.916	30.4	5.59	46.4
1					
Comp #1	Bat FG	0.902	27.4	43.7	366
Comp #1	ERL-D 5/15	0.416	9.07[c]	9.30	170
Comp #2	Bat FG	1.22	32.2	45.3	280
Comp #3	ERL-D 1/30	1.49	33.8	21.0	107
Comp #4	Bat E	1.09	28.8	32.0	221
B					
Comp #1	Bat FG	2.59	18.7	272	797
Comp #1	Bat FG		42.4	282	827
Comp #1	ERL-D 5/15	1.93	24.7	55.4	218
Comp #2	ERL-D 1/30	1.02	31.7	43.3	323
Comp #2	ERL-D 4/23	0.953	16.4	35.8	285
C					
Comp #1	Bat FG	1.95	24.0	347	1351
Comp #1	ERL-D 1/3	1.56	55.3	72.0	351
Comp #1	ERL-D 1/24	1.83	22.0	64.1	266
Comp #2	ERL-D 1/30	0.960	28.3	0.00	0.00
D					
Comp #1	Bat FG	2.22	17.2	41.4	141
Comp #1	ERL-D 1/3	1.25	37.7	9.64	58.6
Comp #2	ERL-D 1/30	1.57	32.1	12.3	59.5
E					
Comp #1	Bat FG	1.10	27.4	172	1186
Comp #1	ERL-D 1/3	0.953	43.0	22.0	175
Comp #1	ERL-D 1/3	1.06	50.1	22.0	158
Comp #2	Bat E	3.36	27.6	152	343
Comp #3	ERL-D 1/30	1.85	32.9	19.1	78.5

Table A-42. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	2.19	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-43. Pentachlorobutadiene #2 Tissue Concentrations for _Callinectes sapidus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	0.00	0.00
Comp #2	Bat FG	2.49	27.8	1.91	5.42
Comp #3	ERL-D 1/30	0.916	30.4	0.00	0.00
1					
Comp #1	Bat FG	0.902	27.4	2.20	17.40
Comp #1	ERL-D 5/15	0.416	9.07[c]	0.00	0.00
Comp #2	Bat FG	1.22	32.2	1.01	5.45
Comp #3	ERL-D 1/30	1.49	33.8	0.687	3.50
Comp #4	Bat E	1.09	28.8	1.76	11.33
B					
Comp #1	Bat FG	2.59	18.7	7.97	22.99
Comp #1	Bat FG		42.4	8.26	23.84
Comp #1	ERL-D 5/15	1.93	24.7	1.10	4.33
Comp #2	ERL-D 1/30	1.02	31.7	0.969	7.22
Comp #2	ERL-D 4/23	0.953	16.4	0.00	0.00
C					
Comp #1	Bat FG	1.95	24.0	11.9	45.85
Comp #1	ERL-D 1/3	1.56	55.3	2.07	10.08
Comp #1	ERL-D 1/24	1.83	22.0	2.04	8.47
Comp #2	ERL-D 1/30	0.960	28.3	0.00	0.00
D					
Comp #1	Bat FG	2.22	17.2	2.34	7.55
Comp #1	ERL-D 1/3	1.25	37.7	0.00	0.00
Comp #2	ERL-D 1/30	1.57	32.1	0.478	2.31
E					
Comp #1	Bat FG	1.10	27.4	3.78	25.18
Comp #1	ERL-D 1/3	0.953	43.0	0.454	3.62
Comp #1	ERL-D 1/3	1.06	50.1	0.00	0.00
Comp #2	Bat E	3.36	27.6	2.34	4.99
Comp #3	ERL-D 1/30	1.85	32.9	0.00	0.00

Table A-43. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.00	
Blank	ERL-D 5/15		59.1	0.00	
Blank	ERL-D 5/17		48.5	0.00	
Blank	ERL-D 5/17		54.9	0.00	
Blank	Bat A		31.4	0.948	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-44. Hexachlorobutadiene Tissue Concentrations for _Callinectes_ _sapidus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	41.6	451
Comp #2	Bat FG	2.49	27.8	79.3	231
Comp #3	ERL-D 1/30	0.916	30.4	24.2	139
1					
Comp #1	Bat FG	0.902	27.4	52.2	410
Comp #1	ERL-D 5/15	0.416	9.07[c]	56.7	899
Comp #2	Bat FG	1.22	32.2	0.947	0.00
Comp #3	ERL-D 1/30	1.49	33.8	85.4	397
Comp #4	Bat E	1.09	28.8	47.4	306
B					
Comp #1	Bat FG	2.59	18.7	185	533
Comp #1	Bat FG		42.4	212	612
Comp #1	ERL-D 5/15	1.93	24.7	132	490
Comp #2	ERL-D 1/30	1.02	31.7	136	958
Comp #2	ERL-D 4/23	0.953	16.4	116	865
C					
Comp #1	Bat FG	1.95	24.0	285	1097
Comp #1	ERL-D 1/3	1.56	55.3	225	1060
Comp #1	ERL-D 1/24	1.83	22.0	185	737
Comp #2	ERL-D 1/30	0.960	28.3	3.64	0.00
D					
Comp #1	Bat FG	2.22	17.2	39.9	125
Comp #1	ERL-D 1/3	1.25	37.7	32.2	150
Comp #2	ERL-D 1/30	1.57	32.1	87.1	385
E					
Comp #1	Bat FG	1.10	27.4	141	950
Comp #1	ERL-D 1/3	0.953	43.0	59.9	418
Comp #1	ERL-D 1/3	1.06	50.1	62.3	393
Comp #2	Bat E	3.36	27.6	136	300
Comp #3	ERL-D 1/30	1.85	32.9	56.6	202

Table A-44. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	5.04	
Blank	ERL-D 1/3		44.0	2.81	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	4.93	
Blank	ERL-D 4/23		21.5	9.90	
Blank	ERL-D 5/15		61.9	7.46	
Blank	ERL-D 5/15		59.1	7.28	
Blank	ERL-D 5/17		48.5	11.2	
Blank	ERL-D 5/17		54.9	11.2	
Blank	Bat A		31.4	11.5	
Blank	Bat B		23.6	1.50	
Blank	Bat C		27.8	2.11	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	6.30	
Blank	Bat F		29.1	2.23	
Blank	Bat G		28.9	0.840	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-45. 1,2,3-Trichlorobenzene Tissue Concentrations for <u>Callinectes</u> <u>sapidus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	3.24	38.0
Comp #2	Bat FG	2.49	27.8	44.9	129
Comp #3	ERL-D 1/30	0.916	30.4	9.71	77.5
1					
Comp #1	Bat FG	0.902	27.4	24.5	184
Comp #1	ERL-D 5/15	0.416	9.07[c]	18.8	337
Comp #2	Bat FG	1.22	32.2	30.0	171
Comp #3	ERL-D 1/30	1.49	33.8	32.4	163
Comp #4	Bat E	1.09	28.8	12.6	69.7
B					
Comp #1	Bat FG	2.59	18.7	53.2	148
Comp #1	Bat FG		42.4	58.3	163
Comp #1	ERL-D 5/15	1.93	24.7	41.8	163
Comp #2	ERL-D 1/30	1.02	31.7	52.8	391
Comp #2	ERL-D 4/23	0.953	16.4	45.8	362
C					
Comp #1	Bat FG	1.95	24.0	87.2	330
Comp #1	ERL-D 1/3	1.56	55.3	69.0	334
Comp #1	ERL-D 1/24	1.83	22.0	61.7	255
Comp #2	ERL-D 1/30	0.960	28.3	5.23	38.5
D					
Comp #1	Bat FG	2.22	17.2	18.2	53.4
Comp #1	ERL-D 1/3	1.25	37.7	14.7	87.1
Comp #2	ERL-D 1/30	1.57	32.1	23.5	112
E					
Comp #1	Bat FG	1.10	27.4	50.8	333
Comp #1	ERL-D 1/3	0.953	43.0	22.5	176
Comp #1	ERL-D 1/3	1.06	50.1	24.0	169
Comp #2	Bat E	3.36	27.6	29.1	59.9
Comp #3	ERL-D 1/30	1.85	32.9	31.5	128

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.00	
Blank	ERL-D 4/23		21.5	0.00	
Blank	ERL-D 5/15		61.9	0.473	
Blank	ERL-D 5/15		59.1	0.856	
Blank	ERL-D 5/17		48.5	0.902	
Blank	ERL-D 5/17		54.9	0.717	
Blank	Bat A		31.4	4.58	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	3.42	
Blank	Bat E		27.8	4.57	
Blank	Bat F		29.1	2.21	
Blank	Bat G		28.9	3.44	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-46. 1,2,4-Trichlorobenzene Tissue Concentrations for Callinectes sapidus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	26.7	132
Comp #2	Bat FG	2.49	27.8	178	539
Comp #3	ERL-D 1/30	0.916	30.4	47.1	252
1					
Comp #1	Bat FG	0.902	27.4	89.6	743
Comp #1	ERL-D 5/15	0.416	9.07[c]	93.6	1405
Comp #2	Bat FG	1.22	32.2	136	838
Comp #3	ERL-D 1/30	1.49	33.8	134	598
Comp #4	Bat E	1.09	28.8	50.2	340
B					
Comp #1	Bat FG	2.59	18.7	337	985
Comp #1	Bat FG		42.4	354	1034
Comp #1	ERL-D 5/15	1.93	24.7	261	962
Comp #2	ERL-D 1/30	1.02	31.7	294	2066
Comp #2	ERL-D 4/23	0.953	16.4	238	1765
C					
Comp #1	Bat FG	1.95	24.0	534	2076
Comp #1	ERL-D 1/3	1.56	55.3	432	2023
Comp #1	ERL-D 1/24	1.83	22.0	352	1393
Comp #2	ERL-D 1/30	0.960	28.3	29.7	103
D					
Comp #1	Bat FG	2.22	17.2	97.1	327
Comp #1	ERL-D 1/3	1.25	37.7	80.2	386
Comp #2	ERL-D 1/30	1.57	32.1	115	476
E					
Comp #1	Bat FG	1.10	27.4	260	1786
Comp #1	ERL-D 1/3	0.953	43.0	111	752
Comp #1	ERL-D 1/3	1.06	50.1	113	691
Comp #2	Bat E	3.36	27.6	171	383
Comp #3	ERL-D 1/30	1.85	32.9	177	659

Table A-46. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	12.7	
Blank	ERL-D 1/3		44.0	10.5	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	14.7	
Blank	ERL-D 4/23		21.5	35.6	
Blank	ERL-D 5/15		61.9	12.8	
Blank	ERL-D 5/15		59.1	12.6	
Blank	ELD-D 5/17		48.5	17.6	
Blank	ELD-D 5/17		54.9	17.0	
Blank	Bat A		31.4	1.90	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	1.02	
Blank	Bat E		27.8	1.05	
Blank	Bat F		29.1	3.11	
Blank	Bat G		28.9	3.12	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-47. 1,2,4,5- and 1,2,3,5-Tetrachlorobenzene Tissue Concentrations for
Callinectes sapidus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	38.8	492
Comp #2	Bat FG	2.49	27.8	127	384
Comp #3	ERL-D 1/30	0.916	30.4	68.0	551
1					
Comp #1	Bat FG	0.902	27.4	59.1	487
Comp #1	ERL-D 5/15	0.416	9.07[c]	124	2237
Comp #2	Bat FG	1.22	32.2	98.1	603
Comp #3	ERL-D 1/30	1.49	33.8	236	1196
Comp #4	Bat E	1.09	28.8	34.9	234
B					
Comp #1	Bat FG	2.59	18.7	126	366
Comp #1	Bat FG		42.4	123	357
Comp #1	ERL-D 5/15	1.93	24.7	273	1069
Comp #2	ERL-D 1/30	1.02	31.7	310	2298
Comp #2	ERL-D 4/23	0.953	16.4	291	2308
C					
Comp #1	Bat FG	1.95	24.0	197	763
Comp #1	ERL-D 1/3	1.56	55.3	510	2477
Comp #1	ERL-D 1/24	1.83	22.0	456	1887
Comp #2	ERL-D 1/30	0.960	28.3	50.7	389
D					
Comp #1	Bat FG	2.22	17.2	39.1	129
Comp #1	ERL-D 1/3	1.25	37.7	90.9	543
Comp #2	ERL-D 1/30	1.57	32.1	168	806
E					
Comp #1	Bat FG	1.10	27.4	110	751
Comp #1	ERL-D 1/3	0.953	43.0	155	1224
Comp #1	ERL-D 1/3	1.06	50.1	156	1107
Comp #2	Bat E	3.36	27.6	67.5	150
Comp #3	ERL-D 1/30	1.85	32.9	213	869

Table A-47. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	1.38	
Blank	ERL-D 1/3		44.0	0.799	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	1.14	
Blank	ERL-D 4/23		21.5	1.81	
Blank	ERL-D 5/15		61.9	1.92	
Blank	ERL-D 5/15		59.1	1.60	
Blank	ERL-D 5/17		48.5	1.85	
Blank	ERL-D 5/17		54.9	1.92	
Blank	Bat A		31.4	1.86	
Blank	Bat B		23.6	3.36	
Blank	Bat C		27.8	1.03	
Blank	Bat D		23.5	0.958	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	1.39	
Blank	Bat G		28.9	0.778	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery < 15%, R-H: rejected, recovery > 120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-48. 1,2,3,4-Tetrachlorobenzene Tissue Concentrations for Callinectes sapidus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	33.8	21.7	280
Comp #2	Bat FG	2.49	27.8	167	507
Comp #3	ERL-D 1/30	0.916	30.4	38.8	318
1					
Comp #1	Bat FG	0.902	27.4	86.5	721
Comp #1	ERL-D 5/15	0.416	9.07[c]	73.9	1340
Comp #2	Bat FG	1.22	32.2	137	848
Comp #3	ERL-D 1/30	1.49	33.8	115	584
Comp #4	Bat E	1.09	28.8	52.9	363
B					
Comp #1	Bat FG	2.59	18.7	176	514
Comp #1	Bat FG		42.4	169	493
Comp #1	ERL-D 5/15	1.93	24.7	115	451
Comp #2	ERL-D 1/30	1.02	31.7	189	1404
Comp #2	ERL-D 4/23	0.953	16.4	168	1336
C					
Comp #1	Bat FG	1.95	24.0	264	1025
Comp #1	ERL-D 1/3	1.56	55.3	284	1381
Comp #1	ERL-D 1/24	1.83	22.0	255	1057
Comp #2	ERL-D 1/30	0.960	28.3	29.5	229
D					
Comp #1	Bat FG	2.22	17.2	48.7	164
Comp #1	ERL-D 1/3	1.25	37.7	50.8	306
Comp #2	ERL-D 1/30	1.57	32.1	104	501
E					
Comp #1	Bat FG	1.10	27.4	145	996
Comp #1	ERL-D 1/3	0.953	43.0	90.1	714
Comp #1	ERL-D 1/3	1.06	50.1	89.3	636
Comp #2	Bat E	3.36	27.6	88.5	198
Comp #3	ERL-D 1/30	1.85	32.9	125	511

Table A-48. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		29.6	0.00	
Blank	ERL-D 1/3		44.0	0.00	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		52.9	0.361	
Blank	ERL-D 4/23		21.5	0.981	
Blank	ERL-D 5/15		61.9	0.888	
Blank	ERL-D 5/15		59.1	0.647	
Blank	ERL-D 5/17		48.5	0.640	
Blank	ERL-D 5/17		54.9	0.686	
Blank	Bat A		31.4	0.954	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	1.57	
Blank	Bat D		23.5	1.73	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	1.49	
Blank	Bat G		28.9	0.467	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b]   R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c]   Recovery was low because not all of the extract was subjected to GPC cleanup.

[d]   No surrogate added to these procedural blanks.

Table A-49. Pentachlorobenzene Tissue Concentrations for _Callinectes sapidus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	38.1	102	1342
Comp #2	Bat FG	2.49	28.1	587	1785
Comp #3	ERL-D 1/30	0.916	33.4	154	1274
1					
Comp #1	Bat FG	0.902	30.8	241	2013
Comp #1	ERL-D 5/15	0.416	9.83[c]	212	3864
Comp #2	Bat FG	1.22	33.7	507	3146
Comp #3	ERL-D 1/30	1.49	36.8	500	2548
Comp #4	Bat E	1.09	33.2	183	1262
B					
Comp #1	Bat FG	2.59	21.9	406	1185
Comp #1	Bat FG		48.2	408	1191
Comp #1	ERL-D 5/15	1.93	27.4	377	1483
Comp #2	ERL-D 1/30	1.02	32.0	503	3744
Comp #2	ERL-D 4/23	0.953	17.0	386	3074
C					
Comp #1	Bat FG	1.95	25.9	586	2276
Comp #1	ERL-D 1/3	1.56	60.1	617	3003
Comp #1	ERL-D 1/24	1.83	24.5	612	2540
Comp #2	ERL-D 1/30	0.960	31.4	83.0	653
D					
Comp #1	Bat FG	2.22	15.3	115	387
Comp #1	ERL-D 1/3	1.25	41.8	94.7	573
Comp #2	ERL-D 1/30	1.57	34.5	309	1493
E					
Comp #1	Bat FG	1.10	27.9	380	2611
Comp #1	ERL-D 1/3	0.953	50.5	219	1742
Comp #1	ERL-D 1/3	1.06	53.1	233	1667
Comp #2	Bat E	3.36	29.9	194	434
Comp #3	ERL-D 1/30	1.85	36.3	311	1276

Table A-49. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		31.5	0.456	
Blank	ERL-D 1/3		46.2	0.425	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		55.6	0.507	
Blank	ERL-D 4/23		22.8	0.480	
Blank	ERL-D 5/15		63.8	0.481	
Blank	ERL-D 5/15		62.9	0.241	
Blank	ERL-D 5/17		50.8	0.838	
Blank	ERL-D 5/17		57.2	0.588	
Blank	Bat A		36.9	2.47	
Blank	Bat B		32.2	3.74	
Blank	Bat C		29.5	0.967	
Blank	Bat D		24.6	1.38	
Blank	Bat E		37.6	1.35	
Blank	Bat F		35.1	3.63	
Blank	Bat G		34.0	0.779	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-50. Hexachlorobenzene Tissue Concentrations for Callinectes sapidus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
A					
Comp #1	ERL-D 1/30	0.575	38.1	145	1910
Comp #2	Bat FG	2.49	28.1	544	1651
Comp #3	ERL-D 1/30	0.916	33.4	212	1755
1					
Comp #1	Bat FG	0.902	30.8	196	1625
Comp #1	ERL-D 5/15	0.416	9.83[c]	178	3244
Comp #2	Bat FG	1.22	33.7	400	2472
Comp #3	ERL-D 1/30	1.49	36.8	452	2303
Comp #4	Bat E	1.09	33.2	170	1164
1164					
B					
Comp #1	Bat FG	2.59	21.9	256	742
Comp #1	Bat FG		48.2	253	733
Comp #1	ERL-D 5/15	1.93	27.4	250	983
Comp #2	ERL-D 1/30	1.02	32.0	320	2381
Comp #2	ERL-D 4/23	0.953	17.0	242	1926
C					
Comp #1	Bat FG	1.95	25.9	274	1056
Comp #1	ERL-D 1/3	1.56	60.1	328	1596
Comp #1	ERL-D 1/24	1.83	24.5	292	1211
Comp #2	ERL-D 1/30	0.960	31.4	57.0	448
D					
Comp #1	Bat FG	2.22	15.3	60.7	197
Comp #1	ERL-D 1/3	1.25	41.8	59.1	357
Comp #2	ERL-D 1/30	1.57	34.5	266	1285
E					
Comp #1	Bat FG	1.10	27.9	287	1961
Comp #1	ERL-D 1/3	0.953	50.5	203	1615
Comp #1	ERL-D 1/3	1.06	53.1	199	1423
Comp #2	Bat E	3.36	29.9	109	239
Comp #3	ERL-D 1/30	1.85	36.3	305	1251

Table A-50. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Blank	ERL-D 1/3		31.5	0.458	
Blank	ERL-D 1/3		46.2	0.347	
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/24		0.00[d]		
Blank	ERL-D 1/30		55.6	0.446	
Blank	ERL-D 4/23		22.8	0.552	
Blank	ERL-D 5/15		63.8	0.393	
Blank	ERL-D 5/15		62.9	0.318	
Blank	ERL-D 5/17		50.8	0.594	
Blank	ERL-D 5/17		57.2	0.570	
Blank	Bat A		36.9	3.78	
Blank	Bat B		32.2	1.33	
Blank	Bat C		29.5	6.06	
Blank	Bat D		24.6	3.27	
Blank	Bat E		37.6	2.74	
Blank	Bat F		35.1	2.43	
Blank	Bat G		34.0	2.25	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

[c] Recovery was low because not all of the extract was subjected to GPC cleanup.

[d] No surrogate added to these procedural blanks.

Table A-51. Hexachloroethane Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	45.5	36.0	69.0
Comp B	Bat A	2.56	32.7	105	280
Comp C	Bat A	3.46	21.9	45.2	75.4
Comp D	Bat A	6.15	48.2	231	272
Comp E	Bat BCD	3.28	51.8	164	355
Comp F	Bat BCD	3.22	48.9	116	248
Comp G	Bat BCD	3.14	31.2	129	286
Comp G⁻	Bat BCD		65.9	102	221
D					
Comp A	Bat A	2.34	33.2	180	549
Comp B	Bat A	3.22	27.7	109	232
E					
Comp A	Bat BCD	2.06	31.0	168	580
Comp B	Bat BCD	3.05	30.8	123	279
Comp B	Bat BCD		25.4	127	289
Comp C	Bat BCD	2.37	30.7	130	382
Comp D	Bat BCD	1.54	26.0	61.2	248
Micropogan undulus					
B					
Comp A	Bat A	1.53	31.2	28.0	85.2
C					
Comp A⁻	Bat BCD	1.24	57.6	18.8	48.7
Comp A	Bat BCD		R-L		
D					
Comp A	Bat A	1.51	R-L		
Comp B	Bat A	3.01	52.1	108	245
Comp B	Bat A		37.9	134	311
Comp C	Bat BCD	0.964	35.5	36.6	203

Table A-51. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_1$-HCE Recovery[b] %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	51.4	64.9	326
Blank	Bat A		41.2	11.9	
Blank	Bat B		R-L		
Blank	Bat C		37.5	8.41	
Blank	Bat D		31.4	9.50	
Blank	Bat E		45.5	12.7	
Blank	Bat F		46.9	11.1	
Blank	Bat G		52.8	11.5	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

[b] R-L: rejected, recovery <15%, R-H: rejected, recovery >120%, R-I: rejected, incorrect sample, R-P: rejected, procedural error during sample preparation.

Table A-52. Tetrachlorobutadiene #1 Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	8.90	24.4
Comp B	Bat A	2.56	28.0	23.7	70.4
Comp C	Bat A	3.46	25.3	7.20	15.8
Comp D	Bat A	6.15	48.2	37.0	45.7
Comp E	Bat BCD	3.28	39.0	27.4	63.5
Comp F[*]	Bat BCD	3.22	39.1	22.1	52.2
Comp G	Bat BCD	3.14	21.2	21.4	51.8
Comp G	Bat BCD		46.5	19.7	47.7
D					
Comp A	Bat A	2.34	27.8	36.1	117
Comp B	Bat A	3.22	30.0	17.9	42.2
E					
Comp A	Bat BCD	2.06	22.0	31.1	115
Comp B	Bat BCD	3.05	25.4	30.4	75.8
Comp B	Bat BCD		23.6	23.4	58.3
Comp C	Bat BCD	2.37	21.8	37.4	120
Comp D	Bat BCD	1.54	24.4	12.9	63.7
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	3.87	19.2
C					
Comp A	Bat BCD	1.24	41.7	2.08	12.7
Comp A	Bat BCD		17.4	0.00	0.00
D					
Comp A	Bat A	1.51	28.6	16.4	82.5
Comp B	Bat A	3.01	40.6	25.1	63.4
Comp B	Bat A		23.6	38.8	98.0
Comp C	Bat BCD	0.964	25.9	10.3	81.2

Table A-52. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	16.9	102
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-53. Tetrachlorobutadiene #2 Tissue Concentrations for _Brevoortia patronus_ and _Micropogan undulus_.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	21.8	59.8
Comp B	Bat A	2.56	28.0	66.1	196
Comp C	Bat A	3.46	25.3	20.9	45.9
Comp D	Bat A	6.15	48.2	119	147
Comp E	Bat BCD	3.28	39.0	84.7	196
Comp F	Bat BCD	3.22	39.1	65.3	154
Comp G	Bat BCD	3.14	21.2	55.8	135
Comp G	Bat BCD		46.5	47.8	116
D					
Comp A	Bat A	2.34	27.8	102	331
Comp B	Bat A	3.22	30.0	59.1	139
E					
Comp A	Bat BCD	2.06	22.0	76.2	281
Comp B	Bat BCD	3.05	25.4	77.0	192
Comp B-	Bat BCD		23.6	63.9	159
Comp C	Bat BCD	2.37	21.8	99.8	320
Comp D	Bat BCD	1.54	24.4	34.4	170
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	13.2	65.6
C					
Comp A	Bat BCD	1.24	41.7	6.60	40.5
Comp A	Bat BCD		17.4	0.00	0.00
D					
Comp A	Bat A	1.51	28.6	40.3	203
Comp B	Bat A	3.01	40.6	60.2	152
Comp B	Bat A		23.6	102	258
Comp C	Bat BCD	0.964	25.9	25.6	202

Table A-53. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	45.7	276
Blank	Bat A		31.4	0.00	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-54. Pentachlorobutadiene #1 Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[*]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	334	916
Comp B	Bat A	2.56	28.0	1340	3977
Comp C	Bat A	3.46	25.3	366	803
Comp D	Bat A	6.15	48.2	2020	2496
Comp E	Bat BCD	3.28	39.0	1460	3382
Comp F	Bat BCD	3.22	39.1	1340	3162
Comp G	Bat BCD	3.14	21.2	1060	2565
Comp G	Bat BCD		46.5	890	2153
D					
Comp A	Bat A	2.34	27.8	2280	7404
Comp B	Bat A	3.22	30.0	1370	3233
E					
Comp A	Bat BCD	2.06	22.0	1870	6898
Comp B	Bat BCD	3.05	25.4	1480	3687
Comp B	Bat BCD		23.6	1370	3413
Comp C	Bat BCD	2.37	21.8	2260	7246
Comp D	Bat BCD	1.54	24.4	767	3784
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	173	858
C					
Comp A	Bat BCD	1.24	41.7	120	734
Comp A	Bat BCD		17.4	11.6	69
D					
Comp A	Bat A	1.51	28.6	826	4156
Comp B	Bat A	3.01	40.6	1250	3155
Comp B	Bat A		23.6	1600	4039
Comp C	Bat BCD	0.964	25.9	555	4373

Table A-54. Continued.

Station	Laboratory[*]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	830	5004
Blank	Bat A		. 31.4	2.19	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[*] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-55. Pentachlorobutadiene #2 Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[*]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	79.7	218
Comp B	Bat A	2.56	28.0	268	795
Comp C	Bat A	3.46	25.3	81.0	178
Comp D	Bat A	6.15	48.2	491	607
Comp E	Bat BCD	3.28	39.0	331	767
Comp F	Bat BCD	3.22	39.1	266	628
Comp G	Bat BCD	3.14	21.2	227	549
Comp G	Bat BCD		46.5	200	484
D					
Comp A	Bat A	2.34	27.8	475	1542
Comp B	Bat A	3.22	30.0	270	637
E					
Comp A	Bat BCD	2.06	22.0	333	1228
Comp B	Bat BCD	3.05	25.4	300	747
Comp B	Bat BCD		23.6	279	695
Comp C	Bat BCD	2.37	21.8	443	1420
Comp D	Bat BCD	1.54	24.4	148	730
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	18.7	92.2
C					
Comp A	Bat BCD	1.24	41.7	9.39	56.7
Comp A	Bat BCD		17.4	2.48	14.4
D					
Comp A	Bat A	1.51	28.6	111	558
Comp B	Bat A	3.01	40.6	111	280
Comp B	Bat A		23.6	151	381
Comp C	Bat BCD	0.964	25.9	49.6	390

Table A-55. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	73.6	443
Blank	Bat A		31.4	0.948	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	0.00	
Blank	Bat G		28.9	0.00	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-56. Hexachlorobutadiene Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	1960	5368
Comp B	Bat A	2.56	28.0	4610	13676
Comp C	Bat A	3.46	25.3	1960	4298
Comp D	Bat A	6.15	48.2	4730	5841
Comp E	Bat BCD	3.28	39.0	4470	10349
Comp F	Bat BCD	3.22	39.1	4730	11156
Comp G	Bat BCD	3.14	21.2	3980	9625
Comp G	Bat BCD		46.5	3360	8124
D					
Comp A	Bat A	2.34	27.8	6220	20190
Comp B	Bat A	3.22	30.0	4900	11557
E					
Comp A	Bat BCD	2.06	22.0	5890	21717
Comp B	Bat BCD	3.05	25.4	4110	10233
Comp B	Bat BCD		23.6	4140	10307
Comp C	Bat BCD	2.37	21.8	6700	21474
Comp D	Bat BCD	1.54	24.4	2650	13061
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	1130	5596
C					
Comp A	Bat BCD	1.24	41.7	1110	6782
Comp A	Bat BCD		17.4	262	1584
D					
Comp A	Bat A	1.51	28.6	5470	27514
Comp B	Bat A	3.01	40.6	4290	10823
Comp B	Bat A		23.6	5330	13449
Comp C	Bat BCD	0.964	25.9	2830	22284

Table A-56. Continued.

Station	Laboratory	Lipid Percent	$^{13}C_6$-TeCB % Recovery	Targeted Chemical Rec. Corrected [ng/g]	Lipid Corrected
E					
Comp A	Bat A	1.26	39.5	2870	17290
Blank	Bat A		31.4	11.5	
Blank	Bat B		23.6	1.50	
Blank	Bat C		27.8	2.11	
Blank	Bat D		23.5	0.00	
Blank	Bat E		27.8	6.30	
Blank	Bat F		29.1	2.23	
Blank	Bat G		28.9	0.840	

• Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-57. 1,2,3-Trichlorobenzene Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	31.1	78.2
Comp B	Bat A	2.56	28.0	59.7	170
Comp C	Bat A	3.46	25.3	33.2	67.2
Comp D	Bat A	6.15	48.2	87.0	104
Comp E	Bat BCD	3.28	39.0	59.2	131
Comp F	Bat BCD	3.22	39.1	52.6	118
Comp G	Bat BCD	3.14	21.2	58.3	135
Comp G	Bat BCD		46.5	48.4	111
D					
Comp A	Bat A	2.34	27.8	73.3	230
Comp B	Bat A	3.22	30.0	45.1	100
E					
Comp A	Bat BCD	2.06	22.0	60.1	212
Comp B	Bat BCD	3.05	25.4	65.6	157
Comp B	Bat BCD		23.6	63.7	152
Comp C	Bat BCD	2.37	21.8	83.6	260
Comp D	Bat BCD	1.54	24.4	38.3	176
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	19.0	81.4
C					
Comp A	Bat BCD	1.24	41.7	10.8	50.2
Comp A	Bat BCD		17.4	3.21	3.72
D					
Comp A	Bat A	1.51	28.6	66.1	320
Comp B	Bat A	3.01	40.6	54.6	131
Comp B	Bat A		23.6	68.8	167
Comp C	Bat BCD	0.964	25.9	23.2	162

Table A-57. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	38.7	218
Blank	Bat A		31.4	4.58	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	3.42	
Blank	Bat E		27.8	4.57	
Blank	Bat F		29.1	2.21	
Blank	Bat G		28.9	3.44	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-58. 1,2,4-Trichlorobenzene Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	37.1	130	353
Comp B	Bat A	2.56	28.0	339	1002
Comp C	Bat A	3.46	25.3	133	289
Comp D	Bat A	6.15	48.2	565	696
Comp E	Bat BCD	3.28	39.0	383	884
Comp F	Bat BCD	3.22	39.1	327	768
Comp G	Bat BCD	3.14	21.2	297	715
Comp G	Bat BCD		46.5	275	662
D					
Comp A	Bat A	2.34	27.8	504	1632
Comp B	Bat A	3.22	30.0	283	665
E					
Comp A	Bat BCD	2.06	22.0	374	1374
Comp B	Bat BCD	3.05	25.4	393	976
Comp B	Bat BCD		23.6	365	906
Comp C	Bat BCD	2.37	21.8	489	1563
Comp D.	Bat BCD	1.54	24.4	192	940
Micropogan undulus					
B					
Comp A	Bat A	1.53	37.1	73.1	356
C					
Comp A	Bat BCD	1.24	41.7	39.3	232
Comp A	Bat BCD		17.4	9.85	51.4
D					
Comp A	Bat A	1.51	28.6	286	1432
Comp B	Bat A	3.01	40.6	336	845
Comp B	Bat A		23.6	455	1145
Comp C	Bat BCD	0.964	25.9	133	1037

Table A-58. Continued

Station	Laboratory[*]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	215	1288
Blank	Bat A		31.4	1.90	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	0.00	
Blank	Bat D		23.5	1.02	
Blank	Bat E		27.8	1.05	
Blank	Bat F		29.1	3.11	
Blank	Bat G		28.9	3.12	

[*] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-59. 1,2,4,5- and 1,2,3-5 Tetrachlorobenzene Tissue Concentrations for <u>Brevoortia</u> <u>patronus</u> and <u>Micropogan</u> <u>undulus</u>.

Station	Laboratory*	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
<u>Brevoortia</u> <u>patronus</u>					
C					
Comp A	Bat A	2.77	37.1	117	317
Comp B	Bat A	2.56	28.0	227	670
Comp C	Bat A	3.46	25.3	129	280
Comp D	Bat A	6.15	48.2	343	422
Comp E	Bat BCD	3.28	39.0	274	632
Comp F	Bat BCD	3.22	39.1	278	653
Comp G	Bat BCD	3.14	21.2	221	532
Comp G	Bat BCD		46.5	200	481
D					
Comp A	Bat A	2.34	27.8	350	1132
Comp B	Bat A	3.22	30.0	252	592
E					
Comp A	Bat BCD	2.06	22.0	295	1083
Comp B	Bat BCD	3.05	25.4	261	647
Comp B	Bat BCD		23.6	234	580
Comp C	Bat BCD	2.37	21.8	392	1253
Comp D	Bat BCD	1.54	24.4	123	600
<u>Micropogan</u> <u>undulus</u>					
B					
Comp A	Bat A	1.53	37.1	63.5	309
C					
Comp A	Bat BCD	1.24	41.7	36.5	216
Comp A	Bat BCD	17.4	47.1	280	
D					
Comp A	Bat A	1.51	28.6	216	1080
Comp B	Bat A	3.01	40.6	222	557
Comp B	Bat A		23.6	268	673
Comp C	Bat BCD	0.964	25.9	94.4	734

Table A-59. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	132	788
Blank	Bat A		31.4	1.86	
Blank	Bat B		23.6	3.36	
Blank	Bat C		27.8	1.03	
Blank	Bat D		23.5	0.958	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	1.39	
Blank	Bat G		28.9	0.778	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-60. 1,2,3,4-Tetrachlorobenzene Tissue Concentrations for <u>Brevoortia patronus</u> and <u>Micropogan undulus</u>.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
<u>Brevoortia patronus</u>					
C					
Comp A	Bat A	2.77	37.1	143	390
Comp B	Bat A	2.56	28.0	343	1016
Comp C	Bat A	3.46	25.3	155	339
Comp D	Bat A	6.15	48.2	423	522
Comp E	Bat BCD	3.28	39.0	352	814
Comp F	Bat BCD	3.22	39.1	348	819
Comp G	Bat BCD	3.14	21.2	276	666
Comp G	Bat BCD		46.5	243	586
D					
Comp A	Bat A	2.34	27.8	456	1478
Comp B	Bat A	3.22	30.0	283	666
E					
Comp A	Bat BCD	2.06	22.0	391	1439
Comp B	Bat BCD	3.05	25.4	345	857
Comp B	Bat BCD		23.6	300	745
Comp C	Bat BCD	2.37	21.8	514	1645
Comp D-	Bat BCD	1.54	24.4	159	780
<u>Micropogan undulus</u>					
B					
Comp A	Bat A	1.53	37.1	69.1	339
C					
Comp A	Bat BCD	1.24	41.7	41.2	247
Comp A	Bat BCD		17.4	59.6	360
D					
Comp A	Bat A	1.51	28.6	275	1380
Comp B	Bat A	3.01	40.6	266	669
Comp B	Bat A		23.6	333	839
Comp C	Bat BCD	0.964	25.9	119	931

Table A-60. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-TeCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	39.5	158	948
Blank	Bat A		31.4	0.954	
Blank	Bat B		23.6	0.00	
Blank	Bat C		27.8	1.57	
Blank	Bat D		23.5	1.73	
Blank	Bat E		27.8	0.00	
Blank	Bat F		29.1	1.49	
Blank	Bat G		28.9	0.467	

[a] Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-61. Pentachlorobenzene Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	32.2	778	2129
Comp B	Bat A	2.56	23.1	1570	4655
Comp C	Bat A	3.46	24.6	753	1649
Comp D	Bat A	6.15	36.7	1740	2148
Comp E	Bat BCD	3.28	33.0	1510	3494
Comp F-	Bat BCD	3.22	31.6	1763	4156
Comp G	Bat BCD	3.14	19.4	1260	3045
Comp G	Bat BCD		39.4	1250	3021
D					
Comp A	Bat A	2.34	25.6	1910	6197
Comp B	Bat A	3.22	27.7	1730	4078
E					
Comp A	Bat BCD	2.06	18.2	2240	8257
Comp B	Bat BCD	3.05	21.9	1330	3309
Comp B	Bat BCD		21.3	1240	3085
Comp C	Bat BCD	2.37	20.3	2160	6920
Comp D	Bat BCD	1.54	23.7	594	2921
Micropogan undulus					
B					
Comp A	Bat A	1.53	31.8	399	1972
C					
Comp A	Bat BCD	1.24	45.8	268	1630
Comp A	Bat BCD		29.8	331	2016
D					
Comp A	Bat A	1.51	39.3	910	4570
Comp B	Bat A	3.01	31.9	1110	2797
Comp B	Bat A		27.0	1140	2873
Comp C	Bat BCD	0.964	29.5	532	4178

Table A-61. Continued.

Station	Laboratory[*]	Lipid %	$^{13}C_6$-HCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	35.1	560	3365
Blank	Bat A		36.9	2.47	
Blank	Bat B		32.2	3.74	
Blank	Bat C		29.5	0.967	
Blank	Bat D		24.6	1.38	
Blank	Bat E		37.6	1.35	
Blank	Bat F		35.1	3.63	
Blank	Bat G		34.0	0.779	

[*]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

Table A-62. Hexachlorobenzene Tissue Concentrations for Brevoortia patronus and Micropogan undulus.

Station	Laboratory*	Lipid %	$^{13}C_6$-HCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
Brevoortia patronus					
C					
Comp A	Bat A	2.77	32.2	615	1679
Comp B	Bat A	2.56	23.1	912	2698
Comp C	Bat A	3.46	24.6	632	1381
Comp D	Bat A	6.15	36.7	1030	1269
Comp E	Bat BCD	3.28	33.0	894	2064
Comp F	Bat BCD	3.22	31.6	1020	2400
Comp G	Bat BCD	3.14	19.4	920	2219
Comp G	Bat BCD		39.4	877	2115
D					
Comp A	Bat A	2.34	25.6	1230	3985
Comp B	Bat A	3.22	27.7	1290	3037
E					
Comp A	Bat BCD	2.06	18.2	3140	11573
Comp B	Bat BCD	3.05	21.9	860	2135
Comp B	Bat BCD		21.3	863	2143
Comp C	Bat BCD	2.37	20.3	1240	3966
Comp D-	Bat BCD	1.54	23.7	410	2008
Micropogan undulus					
B					
Comp A	Bat A	1.53	31.8	447	2205
C					
Comp A	Bat BCD	1.24	45.8	282	1709
Comp A	Bat BCD		29.8	410	2494
D					
Comp A	Bat A	1.51	39.3	729	3653
Comp B	Bat A	3.01	31.9	724	1820
Comp B	Bat A		27.0	912	2295
Comp C	Bat BCD	0.964	29.5	377	2948

Table A-62. Continued.

Station	Laboratory[a]	Lipid %	$^{13}C_6$-HCB Recovery %	Concentration (Recovery Corrected) [ng/g]	Concentration (Blank Corrected, 7.6% Lipid Content) [ng/g]
E					
Comp A	Bat A	1.26	35.1	418	2502
Blank	Bat A		36.9	3.78	
Blank	Bat B		32.2	1.33	
Blank	Bat C		29.5	6.06	
Blank	Bat D		24.6	3.27	
Blank	Bat E		37.6	2.74	
Blank	Bat F		35.1	2.43	
Blank	Bat G		34.0	2.25	

[a]   Bat: Battelle-Columbus, ERL-D: Environmental Research Laboratory-Duluth. The letters or date following the laboratory abbreviation are the procedural blanks done with the analysis of the sample.

&EPA

United States
Environmental Protection
Agency
EN-336
Washington, DC 20460

Official Business
Penalty for Private Use
$300