SECTION 3

# Data Evaluation

This report was prepared to facilitate information sharing, communicate preliminary Phase I findings, and provide context for subsequent RI/FS scoping documents and work plans. Because this report was prepared in advance of the initial RI/FS work plans, it does not substitute for these critical steps. Given this, the objective of the data evaluation was to present the nature and extent of fish tissue contaminants seen in the Phase I sampling and to present the data relative to the secondary objectives identified in the Fish Tissue A&R Document (CH2M HILL, 2005a) and the Fish Tissue QAPP (CH2M HILL, 2005b). As noted in Section 1, the evaluation was also designed to support the planned human health and ecological risk assessments as well as consideration of an updated fish advisory for Lake Roosevelt.

The scope and limitations of the Phase I fish tissue data evaluation are summarized in Section 1. The analytical results are presented in full to allow for maximum usability of the Phase I data by all potential users. The full analytical data are supplemented by details on fish length, weight, and age as presented in the Fish Tissue Field Report (CH2M HILL, 2006a). The data evaluation did not directly address potential human health or ecological risks associated with contaminants in fish. Those evaluations will be addressed as part of the human health risk assessment being conducted by USEPA and an ecological risk assessment that will be conducted by Teck Cominco and overseen by USEPA. Updating of fish consumption advisories based on these data will done by the WDOH.

## 3.1 Data Evaluation Scope and Approach

This section describes the data evaluation scope and approach in detail. In addition, this section describes the process used to focus the evaluation on PCOIs. The sections following this scope and approach summarize the data by species and evaluate the fish tissue data consistent with the DQOs in order to characterize the nature and extent of contaminants in representative fish species from Lake Roosevelt.

### 3.1.1 Scope of Data Evaluation

For the purposes of bounding the scope of the data analysis presented in this document, a process was used that evaluated the fish tissue results against comparison values (CVs) that were adapted from published risk-based CVs. The purpose of the comparison was to identify PCOIs, which became the focus of the data evaluation. The CVs were used to illustrate broad trends and patterns in the data. It should be emphasized that the PCOI identification process did not involve an assessment of risk, site-specific or otherwise, or identification of PCOIs. Nor did the PCOI selection process entail consideration of the CVs as applicable or relevant and appropriate requirements (ARARs). These important steps will occur in subsequent stages of the RI/FS. Rather, the process constituted an initial evaluation of the large body of fish tissue analytical data generated during the Phase I Fish Tissue program in order to identify chemicals of possible interest. Site-specific PCOIs for UCR fish

tissue will be identified as part of the human health risk assessment being conducted by USEPA and an ecological risk assessment that will be conducted by Teck Cominco and overseen by USEPA.

The CVs used to identify PCOIs for further evaluation were obtained primarily from USEPA Region 3 Preliminary Remediation Goals (PRGs) (USEPA, 2003a, updated 2006). The assumed target risk was 1x10-6 for carcinogens or a hazard quotient (HQ) of 0.1 for noncarcinogens based on a fish consumption rate of 280 grams per day (every day for 30 years). The rationale, methods, formulas and citations used for selection of the CVs are sufficient to reproduce the results during subsequent analysis. For example, 280 grams (10 ounces) per day represents the 95th percentile for adult consumers of fish from a large, national survey of limited duration (USEPA, 2002). Both the ingestion rate and the exposure frequency were increased to adjust the Region 3 human health-based fish PRGs downward to derive the more protective initial CVs. The consumption rate(s) used to assess human health risk will be identified in the human health risk assessment work plan.

The adjustments for noncarcinogenic compounds were made using the following equation:

$$CV_{NC} = PRC_{NC} \times ER \times 350/365 \times 54/280 \text{ g-day}$$

Where:

$CV_{NC}$ = Comparison value for noncarcinogens
$PRC_{NC}$ = Region 3 preliminary remedial concentration (PRC) in fish for noncarcinogenic compounds
ER = Exceedance ratio of 0.1

The adjustments for carcinogenic compounds were made using the following equation:

$$CVC = PRC_{C} \times RV \times 350/365 \times 54/280 \text{ g-day}$$

Where:

$CV_{C}$ = Comparison value for carcinogens
$PRC_{C}$ = Region 3 PRC in fish for carcinogenic compounds
RV = Risk value of $1x10^{-6}$

The CVs used for dioxin/furan and PCB congeners were further adjusted as follows. For dioxin/furan and the "dioxin-like" PCB congeners (i.e., PCB 77, 81, 105, 114, 118, 123, 126, 156, 169, and 189), the Region 3 PRC for 2,3,7,8-TCDD was adjusted using the formula given above and the resulting value was then further adjusted based on the World Health Organization's updated toxicity equivalence factors (TEFs) for dioxin and dioxin-like compounds (van den Berg et al., 2006). The non-dioxin-like PCB congeners were calculated based on the reference dose (RfD) for Aroclor 1254.

The CV for iron was based on Stifelman et al. (2005). Lead was calculated using the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) lead model assuming a child (0 to 84 months) fish ingestion rate of 280 grams/day, resulting in 5.035 percent of the population with blood lead levels above 10 micrograms per deciliter (µg/dL). The ecological CVs were based on Dyer et al., 2000. These CVs were supplemented by those presented in Windward (2004).

The CVs for all of the Phase I fish tissue analytes are listed in Table 3-1. These CVs were selected to help focus the data evaluation on the objectives presented in Section 1.

The data were compared by analyte for each fish species and tissue type. The minimum and maximum detected values for each analyte were compared to both the human health and ecological CVs listed in Table 3-1. The number of samples with detected values greater than the CVs and the exceedance ratios for the minimum and maximum detected values for each species and tissue type are presented in Appendix A. Table 3-2 lists the analytes by species and tissue type for which at least one sample exceeded either the human health or ecological CVs. Table 3-3 lists the maximum exceedance ratio for each of these analytes by species and tissue type.

Seventeen metals had at least one sample with detected values that exceeded the CVs. Table 3-4 lists the metals that most frequently exceeded the CVs. The following metals most often exceeded their CVs:

- Total Mercury. Mercury exceeded both the human health and ecological CVs for all species and tissue types for all samples except for five whole body hatchery rainbow trout and 13 whole body lake whitefish samples. The maximum exceedance ratio (i.e., the maximum detected concentration for a given species/CV) of 166.8 was seen in a walleye fillet sample.
- Arsenic. Arsenic exceeded the human health CV for all species and tissue types for all samples. The maximum exceedance ratio of 246 was seen in a burbot whole body sample.
- Selenium. Selenium exceeded its CVs for all species and tissue types. The exceedances were primarily for the human health value. The maximum exceedance ratio of 9.7 was seen in a mountain whitefish whole body sample.
- Chromium. Chromium exceeded the ecological CV for all species and tissue types. The maximum exceedance ratio of 17 was seen in a largescale sucker whole body sample.
- Copper. Copper exceeded CVs for wild rainbow trout, largescale sucker , mountain whitefish, and burbot whole body samples. The maximum exceedance ratio was 12.9, seen in a largescale sucker whole body sample for the ecological CV.
- Zinc. Zinc exceeded CVs for all species and tissue types except walleye fillets. The exceedances were for both the human health and ecological CVs. The maximum exceedance ratio of 17 was seen in a largescale sucker whole body sample.
- Aluminum. Aluminum exceeded CVs for all species and tissue types except fillet samples for hatchery rainbow trout. The exceedances were all for the ecological CV. The maximum exceedance ratio of 64 was seen in a walleye fillet sample.
- Lead. Lead exceeded CVs for all species and tissue types except wild rainbow trout fillets and hatchery rainbow trout fillets and whole body samples. The exceedances were for both the human health and ecological CVs. The maximum exceedance ratio of 278 was seen in a largescale sucker whole body sample.

- Cadmium. Cadmium exceeded CVs for all species and tissue types except fillet samples for walleye, wild rainbow trout, and hatchery rainbow trout. The exceedances were all for the human health CVs. The maximum exceedance ratio of 19 was seen in a largescale sucker whole body sample.

Iron and nickel exceeded either the human health or ecological CV in about half the species and tissue types. Barium, uranium, and vanadium exceeded CVS in a small number of samples.

Three PCB aroclors exceeded CVs for at least one species and tissue type (see Table 3-2). Aroclors 1254 and 1260 exceeded the criteria for most species and tissue types (see Table 3-4). Maximum exceedance ratios of CVs for Aroclor 1254 and 1260 were 189 and 216, respectively. Both maximum ratios were for a largescale sucker whole body sample. Aroclor 1016 was detected and exceeded the CV in two of the whole body mountain whitefish samples. To allow for comparisons with historical PCB data, the PCB aroclor evaluation was based on total PCBs. Total PCBs were calculated as the sum of the aroclors. For aroclors that were reported as nondetects, one-half the reported detection limit was used.

Fourteen dioxin/furan congeners exceeded at least one CV (see Table 3-2). Only 2,3,7,8 TCDF exceeded CVs for all species and tissue types. A maximum exceedance ratio of 2287.5 times the CV was seen for a largescale sucker sample. Two additional congeners, 1,2,3,6,7,8,HxCDD and 1,2,3,7,8,PeCDF, exceeded the criteria for about half of the species and tissue types. Based on the above results the following analytes were selected as PCOIs for the purpose of this data evaluation:

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Copper
- Iron
- Lead
- Nickel
- Selenium
- Uranium
- Zinc
- Mercury
- Total PCBs
- 2,3,7,8 TCDF

Although barium generally did not exceed its CV, it did show some unique intraspecies patterns and was included as a PCOI to help to illustrate potential differences in species-specific exposure and accumulation.

PCB congener results were compared to their corresponding values (listed in Table 3-1) to help identify, based on frequency of detection and exceedance of CVs, the congeners that, at a minimum, should be considered during the planning of the human health and ecological risk assessments. In accordance with the study design, PCB congener analysis was

conducted on only a subset of the total samples in an attempt to identify a subset of PCB congeners of greatest interest for future risk analysis. Because of the limited number of samples, PCB congeners were not included in the full data evaluation presented in this report.

A total of 114 PCB congeners exceeded CVs for at least one species and tissue type (Table 3-5). Twenty-seven congeners exceeded CVs in all 13 species/tissue types, 23 congeners exceeded for 10 to 12 species/tissue types, and 13 congeners exceeded for 6 to 9 species/tissue types (Table 3-6). The largest number of PCB congeners exceeding CVs, 101, was in the walleye and largescale sucker. The second most, 107, was in mountain whitefish. The lowest number exceeding CVs, 36, was in walleye fillets. PCB congener exceedance ratios were greatest in largescale sucker whole body samples (Table 3-7). For the largescale sucker, 57 congeners had exceedance ratios greater than 10, and 10 had exceedance ratios greater than 100. The maximum exceedance ratio of 599 times the CV was seen for PCB congener 169.

PCB congeners will be further assessed as part of the human health risk assessment being conducted by USEPA, and in an ecological risk assessment that will be conducted by Teck Cominco and overseen by USEPA to determine which congeners are the most relevant for future analysis.

### 3.1.2 Data Evaluation Approach and Comparisons to DQOs

The results of the data evaluation, which was designed to support the DQOs presented in the Fish Tissue A&R Document and the Fish Tissue QAPP, are presented in Section 3.2 and summarized in Section 2.0. The full analytical results are presented in Appendix B (included as electronic version only on attached disk) to allow users of this document to perform additional types of data analysis beyond the scope of this report. The following data evaluations are provided in this report:

- Inorganic/organic arsenic speciation by species. The results of the arsenic speciation will support refinement of arsenic exposure in the human health risk assessment
- Percent metals associated with the gut/gut contents of largescale suckers. The results of the gut/gut contents evaluation will help to define the uncertainties of the tissue measurements and the future use of those data for this species.
- Comparisons of PCOI concentrations by fish collection areas for each target species. This spatial presentation of the data will support refinement of the CSM and help determine how data should be aggregated during the risk assessments.
- Sitewide comparison by species for each PCOI. A sitewide comparison by species can be used for risk assessment planning and to further prioritize pathways.
- Comparisons of PCOI concentrations between species within a fish collection area. This spatial presentation of the data will support refinement of the CSM and help determine how data should be aggregated during the risk assessments.
- Comparisons of PCOI concentrations in fillet samples by fish collection area. This spatial presentation of the data will support refinement of the CSM and help determine how data should be aggregated during the risk assessments.

- Statistical comparison of PCOI concentrations by species between site reaches. This spatial presentation of the data will support refinement of the CSM and help determine how data should be aggregated during the risk assessments. This evaluation also meets the secondary objectives of developing baseline data for the UCR.
- Comparison of PCOIs in largescale suckers to PCOIs in sediment. This evaluation will support refinement of the CSM and help determine how data should be aggregated during the risk assessments.

## 3.2 Detailed Analytical Results by Species

This section presents the full analytical results for all tissue types, including a summary of the data validation/data quality, evaluation of the arsenic speciation results, a summary of the estimated whole body concentrations from fillet and offal samples, and the contribution of metals from the gut/gut contents in largescale suckers. These groupings represent the three basic types of analytical data that will be used for the data evaluation described in Section 3.1.3.

### 3.2.1 Data Validation and Findings

#### 3.2.1.1 Data Validation Methodology

All data (100 percent) were evaluated independently of the laboratory by project chemists. All sample data were reviewed for the QC specifications identified in the Fish Tissue QAPP and USEPA CLP statements of work for each specific parameter and were flagged in accordance with the QAPP and USEPA functional validation guidelines as referenced in data validation reports that are available on request.

#### 3.2.1.2 Reporting

Sample- and parameter-specific data validation reports are based on review of the individual laboratory sample delivery groups (SDGs). The SDG-based reports are organized by analytical groups as follows:

- Mercury
- Metals
- PCB Aroclors and Lipids
- PCB Congeners
- Dioxins and Furans
- Arsenic Speciation

The cover of each report identifies individual samples included in the SDG.

Each report has subsections that correspond to the internal QC check requirements for that specific method as identified in the QAPP. If laboratory data were found to deviate from the specifications, the subsection provides quantitative details for the QC data deviation and the associated affected samples and provides flags according to defined conventions.

The individual SDG reports provide a summary table at the end of each section where flags are applied, and the report is followed by flagged data sheets. The reports list all flags and

their appropriate classifications as well as the reason for the flags. The data validation report for each analyte group can be found in Appendix F (included as electronic version only on attached disk).

#### 3.2.1.3 Data Flagging Conventions, Data Validation Findings, and Overall Summaries

USEPA data validation functional guidelines and QAPP criteria were used to determine flagging conventions. Sample- and analyte-specific data validation findings/qualifying flags for laboratory internal quality control data are provided at the end of each validation report. Data validation flags were entered into the project database.

The following QC samples were conducted on each analysis batch:

- Laboratory controls
- Instrument blanks
- Matrix spikes/matrix spike duplicates
- Laboratory duplicates
- Serial dilutions

Samples in an analysis batch were flagged if any of the concurrent QC samples did not meet the performance standards specified in the Fish Tissue QAPP and USEPA CLP statements of work.

The following subsections present a summary of the validation reports by analyte. Based on the data validation reports, the data meet and exceed project quality goals.

##### Mercury

Timeliness: Sample dates ranged from 9/6/05 thru 10/22/05. Analyses were conducted between 1/17/06 and 3/14/06. The holding time for all samples (less than 180 days) was acceptable.

Blanks: Instrument blanks were prepared and analyzed in accordance with the method requirements. All blank values were acceptable, and were either nondetect or below a concentration that could affect sample results.

Matrix Spike Analysis: Matrix spike analyses were conducted for 15 samples representing 15 analysis groups. Percent recoveries were acceptable (78 to 122 percent) and met the recovery criterion (75 to 125 percent).

Duplicate Sample Analysis: Duplicate analyses were conducted for 15 samples representing 15 analysis groups. The relative percent difference was acceptable (≤17 percent) for all samples and was within the criterion (±20 percent).

Inductively Coupled Plasma/Atomic Emission Spectroscopy (ICP/AES) Serial Dilutions: A 5-fold serial dilution was analyzed for three samples. Percent differences (≤9 percent) met the control limits (≤10 percent).

Assessment Summary: All results were reported on a wet weight basis. No data were qualified for this review.

##### TAL Metals

Timeliness: Sample dates ranged from 9/6/05 thru 10/22/05. Sample digestion and analyses were conducted between 3/27/06 and 5/1/06. The holding time for all samples (less than one year) was acceptable.

Blanks: Instrument blanks were prepared and analyzed in accordance with the method requirements. All blank values were acceptable and were either nondetect or below a concentration that could affect sample results, with the exception of cobalt. Affected samples were qualified U (not detected) for cobalt.

Matrix Spike Analysis: Matrix spike analyses were conducted for 17 samples representing 17 analysis groups. Percent recoveries were outside the acceptable recovery criterion for the following analytes in at least one sample analysis group:

- Antimony,
- Chromium
- Copper
- Iron
- Lead
- Manganese,
- Nickel
- Zinc

Samples in the corresponding analysis group were qualified J (the identification of the analyte is acceptable; the reported value is an estimate) for the relevant metals. The remaining percent recoveries were acceptable and met the recovery criterion (75 to 125 percent).

Duplicate Sample Analysis: Duplicate analyses were conducted for 17 samples representing 17 analysis groups. Duplicate results were not within the control limits for the following analytes in at least one sample analysis group:

- Barium
- Calcium
- Copper
- Lead
- Manganese
- Nickel
- Zinc

Samples in the corresponding analysis group were qualified J for the relevant metals. For all other samples, the relative percent difference was acceptable and was within the criterion (±20 percent).

ICP-AES Serial Dilutions: A five-fold serial dilution was analyzed for 17 samples representing 17 analysis groups. Percent differences met the control limits (≤10 percent).

Assessment Summary: The table on the following page summarizes TAL metals results that were qualified by sample.

### PCB Aroclors and Percent Lipids

Timeliness: Sample dates ranged from 9/10/05 thru 9/17/05. Analyses were conducted between 1/6/06 and 3/8/06. The holding time for all samples (less than 6 months) was acceptable.

Blanks: Laboratory method and homogenization proof blanks were prepared and analyzed in accordance with the method requirements. All blank values were acceptable, and none of the samples were qualified on this basis.

Matrix Spike Analysis: Matrix spike analyses were conducted for PCB aroclors in five samples. Percent recoveries were acceptable and met the recovery criterion, with the exception of samples WE4W15 and MW1W45. The amount of Aroclor 1254/1260 in sample MW1W45 was greater than four times the amount of the spike. The data associated with this sample were not qualified. Because the detected aroclor (1254/1260) in sample WE4W15 was already qualified due to peak co-elutions, no further qualification is warranted.

Duplicate Sample Analysis: Duplicate analyses were conducted for three samples. The relative percent difference was acceptable (≤21 percent) for all samples and was within the criterion (±50 percent).

Duplicate Field Samples: Field duplicates were analyzed for five samples. There were acceptable levels of variability between the lipids and aroclor duplicate values. No data were qualified on this basis.

Analytical limitations of PCB Aroclor results: The quatitation limits (QLs) or detection limits, which are based on the lowest concentration level of the Aroclors in the initial calibrations (ICALs), the amount of sample extracted and the final extract volume were about twice the project analytical concentration goals (ACGs) listed in Table 2-3 of the QAPP.

Non-detects reported for all Aroclors, except 1254 and 1260, in all species and tissue types tested. The detection limits varied by species and tissue type. The discrepancies in the reporting limits can be attributed to the varying % lipids for each species and tissue type. The ranges of detection limits by Aroclor are as follows:

- 1016 – 1.3 to 49 ug/kg WW
- 1208 – 9.7 to 49 ug/kg WW
- 1221 – 1.3 to 49 ug/kg WW
- 1232 – 2.6 to 98 ug/kg WW
- 1242 – 1.4 to 49 ug/kg WW
- 1248 – 1.3 to 49 ug/kg WW
- 1254 – 1.3 to 49 ug/kg WW
- 1262 – 9.7 to 49 ug/kg WW
- 1268 – 9.7 to 49 ug/kg WW

The laboratory reported combined results for Aroclors 1254 and 1260 as 1254/1260 because the peaks for Aroclors 1254 and 1260 overlapped. The concentrations of the Aroclors 1260 mixed with 1254 detected in most of the samples were qualified estimated, “J”, due to the co-eluting peaks used in the calculations. PCB results from samples with poor

chromatographic separations due to the interfering oily peaks were qualified estimated, "J", with a possible high bias. This result is expected because of differences between the initial Aroclor composition and the final composition in the fish tissues attributable to various processing including weathering and metabolism.

Assessment Summary: All samples were analyzed in accordance with the method specifications. No significant problems were found with these data. However, the data are limited by detection limits as discussed above. The data, as qualified, are acceptable and can be used for all purposes.

| Metal | Sample Numbers |
|---|---|
| **Samples Qualified J due to Low Matrix Spike Recovery** | |
| Antimony | LS3G40914, LS6G60734 |
| Aluminum | LS4W25, LS3W40520, LS1W45 |
| Chromium | LS1W10040, LS2W15, LS3W40486 |
| Manganese | LS1G10040, LS3G40486, LS3G40915, LS1G50769, LS1G50775, LS6G50727, LS6G50744, LS4W25, LS3W40520, LS1W45 |
| Lead | LS1W10040, LS2W15, LS3W40486, LS3W40504 |
| Copper | MW1W45, LS1W10040, LS2W15, LS3W40486, LS3W40504 |
| Iron | LS6W35, LS1W50769, MW1W45, MW1W45 |
| **Samples Qualified J due to High Matrix Spike Recovery** | |
| Zinc | MW1W45, MW1W45 |
| Aluminum | LS1W10040, LS2W15, LS3W40486, LS3W40504 |
| Nickel | LS3G40914, LS6G50734, LS6G60734 |
| **Samples Qualified J due to High Relative Percent Difference for Duplicate Sample Comparison** | |
| Barium | LS4W25, LS3W40520, LS1W45, LS6W35, LS1W50769 |
| Calcium | LS4W25, LS3W40520, LS1W45, LS6W35, LS1W50769, BB2W13, RW1F15, RW1F25, RW1F35, RW1F45, RW1F55, RW1F65, RW1O15, RW1O25, RW1)35, RW1O45, RW1O55, RW1O65, RW2W53, RW2W15 |
| Lead | LS4W25, LS3W40520, LS1W45, LS1W10040, LS2W15, 05141025-6 |
| Manganese | LS4W25, LS3W40520, LS1W45, LS6W35, LS1W50769, LS1G10040, LS1G10041, LS1G10051, LS1G10056, LS1G10089, LS3G40486, LS3G40504, LS3G40520, LS3G40915, LS1G50769, LS1G50770, LS1G 50771, LS1G50778, LS1G50775, LS1G60778, LS6G50727, LS6G50727, LS6G50744 |
| Copper | MW1W45, MW1W45, LS1W10040, LS2W15, LS3W40486, LS3W40504 |
| Zinc | LS1W10040, LS2W15, LS3W40486, LS3W40504 |
| Nickel | LS1G10040, LS1G10041, LS1G10051, LS1G10056, LS1G10089, LS3G40486, LS3G40504, LS3G40520, LS3G40915, LS1G50769, LS1G50770, LS1G 50771, LS1G50778, LS1G50775, LS1G60778, LS6G50727, LS6G50744 |
| **Samples Qualified J due to High Recovery for Laboratory Control** | |
| Magnesium | BB2W13, RW1F15, RW1F25, RW1F35, RW1F45, RW1F55, RW1F65, RW1O15, RW1O25, RW1)35, RW1O45, RW1O55, RW1O65, RW2W53, RW2W15 |
| Zinc | BB2W13 |
| **Samples Qualified J due to Low Recovery for Laboratory Control** | |
| Sodium | MW1W45, MW1W45 |
| **Samples Qualified U due To Detection In Sample Preparation Blank** | |
| Cobalt | RW1F15, RW1F25, RW1F35, RW1F45, RW1F55, RW1F65, RW1O15, RW1O25, RW1)35, RW1O45, RW1O55, RW1O65, RW2W53, RW2W15 |

### Dioxins and Furans

Timeliness: All samples were stored at -20 °C while on storage and arrived at the lab still frozen. The holding time for all samples (1 year from the date of sample collection, 10 days from validated time of sample receipt [VTSR], and 30 days from extraction) was acceptable.

Method Blanks: The required frequency of analysis of laboratory blanks was met (see Table 2-7). Trace levels of some target compounds were detected in the method blank. Samples with detection concentrations <5 times the value in their respective blanks were qualified as nondetects (U).

Assessment Summary: All samples were analyzed in accordance with the method specifications. No significant problems were found with these data. The data, as qualified, are acceptable and can be used for all purposes.

### PCB Congeners

Timeliness: All samples were stored at -20 °C while on storage and arrived at the lab still frozen. The holding time for all samples (1 year from the date of sample collection, 10 days from VTSR, and 30 days from extraction) was acceptable.

Method Blanks: The required frequency of analysis of laboratory blanks (see Table 2-7) was met. Trace levels of some target compounds were detected in the method blank. Samples with detection concentrations <5 times the value in their respective blanks were qualified as nondetects (U).

Assessment Summary: All samples were analyzed in accordance with the method specifications. The data, as qualified, are acceptable and can be used for all purposes.

### Arsenic Speciation

Timeliness: Sample dates ranged from 9/6/05 thru 10/22/05. Analyses were conducted between 3/1/06 and 4/18/06. No holding time for arsenic species in tissue samples has been established.

Blanks: The blanks did not contain detectable levels of any of the arsenic species, except for trace levels of As+3. No samples contained As+3 at reportable levels; therefore, no qualification was required.

Matrix Spikes: Matrix spike analyses were conducted for eight samples. All matrix spike recoveries were within the acceptable limits (75 to 125 percent).

Duplicates: Duplicate analyses were conducted for nine samples. The relative percent difference was acceptable for all samples and was within the criterion (±20 percent).

Assessment Summary:

- Total Arsenic—All procedures met laboratory requirements; therefore, no qualification was necessary based on the analysis of the total arsenic in the sample extracts.
- Results for $As^{+3}$ and $As^{+5}$ were summed and reported as "inorganic arsenic." This is because the sample preparation and handling processes in this method do not always preserve the individual inorganic species; As+3 and As+5 interconvert over time.

- Arsenobetanine (AsB) and other cationic species are not separated by this column, but elute together as one peak at the beginning of each chromatogram. Therefore, these results were reported together as "AsB + Cations." The "AsB + Cations" concentration was estimated based on calibration standards containing AsB. Because other cations eluting with this peak may have response factors different from those of AsB, all results reported as "AsB + Cations" were qualified J, estimated.
- The "unknown species" listed in the report are likely to be anionic arsenosugars. An estimated concentration for these species was provided using a predetermined response factor, and the results were qualified J. Further identification and quantitation of the arsenosugars is not possible because standards are not available.

#### 3.2.1.4 Data Storage and Documentation

Backup information for the data evaluation and validation findings includes the following:

- Laboratory hard copy packages, assembled in SDG units, that include all QC data. These packages are stored at USEPA offices as well as at the laboratories.
- An electronic database, which includes all sample concentration data with validation flags and a subset of laboratory QC data.
- Chain-of-custody forms and tracking records.

Laboratory bench records and sample custody logs maintained by the laboratory. Backup information is available from USEPA per request.

### 3.2.2 Analytical Results for All Tissue Types

The detailed analytical results are provided in Appendix B. The results are presented by composite in three tables for each species per FSCA, as follows:

- TAL metals, Hg, arsenic speciation, percent moisture, and percent lipids
- PCB aroclors, percent moisture, and percent lipids
- Dioxin/furan congeners, percent moisture, and percent lipids

For the purposes of this evaluation and presentation, calculation of summary statistics was done using one-half the reported detection limit for those values reported as nondetected. Total PCBs were calculated as the sum of the aroclors. For aroclors that were reported as nondetects, one-half the reported detection limit was used.

Because of the limited sample size analyzed for PCB congeners, these results are summarized by species for all FSCAs.

Table 3-8 and Figures 3-1 to 3-15 present a sitewide summary of the results for whole body samples by species for each of the PCOIs. The summaries include the estimated whole body samples for walleye, wild rainbow trout, hatchery rainbow trout, and largescale sucker. The methods for calculation are presented in Sections 3.2.2 and 3.2.3. Key results are as follows:

- Burbot contained three to five times as much total arsenic as the other target species (Figure 3-2).

- Largescale sucker and burbot had mean concentrations of barium two to four times higher than the other target species (Figure 3-3). It is unknown whether these differences are due to life history strategies, feeding habits, or unique physiologies.
- Largescale suckers had the highest mean concentrations of cadmium, chromium, copper, iron, lead, nickel, and uranium (Figures 3-4, 3-6, 3-7, 3-8, 3-9, and 3-11). There was a high degree of variability around the mean for all these metals.
- Selenium concentrations were similar across species, with slightly elevated concentrations in mountain whitefish (see Figure 3-10).
- Mean zinc concentrations in wild and hatchery rainbow trout, mountain whitefish, and largescale sucker were about twice the concentrations in the other target species (Figure 3-12). However, zinc in individual largescale sucker composites was highly variable.
- Mean mercury concentrations were elevated in walleye, largescale sucker, and burbot relative to the other target species (Figure 3-13).
- Mean total PCB concentrations were similar for walleye, wild and hatchery rainbow trout, lake whitefish and burbot. Mean total PCBs in largescale suckers were about 2.5 times higher than in the other target species, with the exception of mountain whitefish (Figure 3-14).
- Mean 2,3,7,8 TCDF concentrations were generally lower in walleye and wild and hatchery rainbow trout than in the other target species. Lake and mountain whitefish, largescale sucker, and burbot had about two times the mean 2,3,7,8 TCDF concentrations found in the other species, with the lake whitefish having the highest mean concentration (Figure 3-15).

Table 3-9 and Figures 3-16 to 3-22 present a sitewide summary of the results of the fillet analysis. Key results are as follows:

- Concentrations were similar in fillet samples across species for nine PCOIs: aluminum, barium, cadmium, chromium, copper, iron, selenium, uranium, and zinc. Figure 3-16 shows the relationship for zinc.
- Arsenic and lead concentrations in fillets from walleye and wild rainbow trout were about twice the concentrations for hatchery rainbow trout (Figures 3-17 and 3-18).
- Mean nickel concentrations in walleye fillets were about three to four times higher than in wild and hatchery rainbow trout fillets (Figure 3-19).
- Mean mercury concentrations in walleye fillets were about two times those seen in wild and hatchery rainbow trout fillets (Figure 3-20).
- Wild rainbow trout fillets had about two times the concentration of total PCBs as did walleye fillets. Hatchery rainbow trout fillets were intermediate (Figure 3-21).
- 2,3,7,8 TCDF concentrations were about five times greater in wild rainbow trout fillets than in fillets from either walleye or hatchery rainbow trout (Figure 3-22).

Total arsenic was detected in samples from all species and tissue types. Because the current understanding of the adverse health effects of arsenic is based primarily on epidemiological studies of people ingesting inorganic arsenic in drinking water, arsenic speciation was conducted on a subset of samples to determine the ratios of inorganic to organic arsenic in the target species. Table 3-10 presents the arsenic species results by species and tissue type. The arsenic speciation results did not, for most species and samples, meet the analytical concentration goals (ACGs) presented in the QAPP (CH2M HILL, 2005b). Therefore, the results should not be interpreted as quantitative. The following approach was used to present the results in an informative manner.

For illustrative purposes, the relative percent of total arsenic for each arsenic species is given. For arsenic species that were nondetects, the detection limit was used to calculate the relative percent of total arsenic. Doing this assumes that the percent is no greater than that of the detection limit, but may in fact be less or even zero. The relative percentage was calculated as follows:

1. For each sample, total arsenic ($u$g/g) was determined.
2. The sample was extracted in accordance with the methods, and total arsenic ($u$g/g) was determined in the extract.
3. The extract was then analyzed for the following As species (µg/g):
   - Dimethylarsonic acid (DMA)
   - Monomethylarsonic acid (MMA)
   - Inorganic As as $As^{+3}$ + $As^{+5}$
   - Arsenobetanine (AsB) + cation
   - Unknown species (anionic arsenosugars)

The relative percent for an arsenic species is the concentration of that species in the extract divided by the total arsenic in the extract. In cases where the value was listed as nondetect, the detection limit was used.

Inorganic arsenic (As+3 and AS+5) ranged from an average 1.4 percent in burbot whole body samples to an average of 30.4 percent in wild rainbow trout whole body samples (Figure 3-23). There was no dominant organic arsenic species seen except in burbot, where over 90 percent of the organic arsenic was in the form of DMA. The high percentage of organic arsenic measured in burbot, in general, is consistent with that reported for marine species (USEPA, 2003b, and Greene and Crecelius, 2006). This may be due to the unique taxonomy of the burbot, being the only freshwater representative of the marine cod family, and/or different exposure pathways.

As a bounding estimate on the relative percentage of inorganic arsenic present in fillets, ratios were calculated by dividing the inorganic arsenic detection limit by the mass of total elemental arsenic. The true ratio is unknown, but could be as high as shown in Figure 3-24 or as low as zero.

The percentage of inorganic to organic arsenic in fillets ranged from an average of 13.1 percent in walleye to 19.6 percent in wild rainbow trout (Figure 3-24). The inorganic arsenic was below detection limits in all of the fillet samples, and the percent inorganic is based on

the assumption that the inorganic arsenic is at the detection limit. Arsenic speciation could not be conducted on the hatchery rainbow trout fillet samples because the total arsenic determination was below detection.

The percentage of inorganic to organic arsenic in fillets ranged from an average of 13.1 percent in walleye to 19.6 percent in wild rainbow trout (Figure 3-24). The inorganic arsenic was below detection limits in these fillet samples, and the percent inorganic is based on the assumption that the inorganic arsenic is at the detection limit. Arsenic speciation could not be conducted on the hatchery rainbow trout fillet samples because the total arsenic determination was below detection.

### 3.2.3 Estimated Whole Body Results from Fillet and Offal Analysis

As specified in the Fish Tissue A&R Document and the Fish Tissue QAPP, the results from the fillet and offal samples were used to estimate a whole body concentration. The estimated whole body concentration for a given analyte was calculated using the following equation:

$$C_{EW} = ((C_f * W_f) + (C_o * W_o))/(W_f+W_o)$$

Where:

$C_{EW}$ = Estimated mean whole body composite concentration of analyte in wet weight

$C_f$ = Concentration in wet weight of analyte in fillet composite

$W_f$ = Mean wet weight of fillet tissue

$C_o$ = Concentration in wet weight of analyte in offal composite

$W_o$ = Mean wet weight of offal tissue

The estimated whole body concentrations obtained from the measured fillet and offal concentrations are presented in Appendix C for walleye and wild and hatchery rainbow trout. The results are summarized by composite in three tables per species per FSCA, as follows:

- Table series 1, which includes TAL metals, Hg, arsenic speciation, percent moisture, and percent lipids
- Table series 2, which includes PCB aroclors, PCB congeners, percent moisture, and percent lipids (because of the limited sample sized analyzed for PCB congeners, these results are summarized by species for all FSCAs)
- Table series 3, which includes dioxin/furan congeners, percent moisture, and percent lipids

### 3.2.4 Results of Largescale Sucker Gut/Gut Contents Analysis

During the sampling, the presence of sediment and slag was noted in the guts of largescale suckers collected from upstream sites. Individual largescale suckers collected from FSCAs 1, 3, and 6 were selected to assess the contribution of slag to the whole body tissue measurements. Five individual largescale suckers from the upstream portion of FSCA 1 and five from a downstream portion, termed FSCA 1A, were selected for gut/gut contents and

gutless whole body for TAL metals analysis. The upstream fish were collected between river mile 739 and 741. The downstream (FSCA 1A) fish were collected from a site just upstream from the Northport Public Boat Ramp at river mile 735.5. In addition, five largescale suckers each from FSCA3 and FSCA 6 were analyzed as gut/gut contents and gutless whole body for TAL metals. A subset was analyzed for arsenic speciation. Because of limits on sample mass, mercury analysis was not completed. The largescale sucker gut analysis was completed to estimate the relative impact of slag (which was visually apparent as a significant mass in some fish collected from the northern reach of the site) and to help understand how it might best be addressed in future data collection and analysis.

#### 3.2.4.1 Methods

A portion of the gut/gut content from each fish was used to determine ash-free dry weight (AFDW). AFDW is a measure of the amount of inorganic matter in a sample. The higher the percent AFDW of the sample, the lower the amount of inorganic matter in the sample. For the largescale sucker samples, those with lower percent AFDW have more inorganic matter in the gut/gut contents. The inorganic matter is assumed to be sediment. The results of the gutless whole body, gut/gut contents analysis and percent AFDW can be used to assess the potential contribution of slag to the analysis of whole body largescale sucker samples. Table 3-11 summarizes the potential conclusions that can be drawn from these data.

The analytical results from the gut/gut contents and gutless whole body samples were used to calculate an estimated whole body concentration for each analyte using the following equation:

$$C_{EW} = (C_{G/GC} * W_{G/GC}) + (C_{GWB} * W_{GWB})/(W_{G/GC}+W_{GWB})$$

Where:

$C_{EW}$ = Estimated whole body concentration of analyte in wet weight

$C_{G/GC}$ = Concentration in wet weight of analyte in gut/cut content sample

$W_{G/GC}$ = Total wet weight of gut/gut contents

$C_{GWB}$ = Concentration in wet weight of analyte in gutless whole body sample

$W_{GWB}$ = Total wet weight of gutless whole body

The percent of an analyte associated with the gut/gut contents was calculated using the following equation:

$$\%_{G/GC} = ((C_{G/GC} * W_{G/GC})/ (C_{G/GC} * W_{G/GC}) + (C_{GWB} * W_{GWB})) * 100$$

Where:

$\%_{G/GC}$ = Percent of estimated whole body concentration of analyte in wet weight associated with the gut/gut contents

$C_{G/GC}$ = Concentration in wet weight of analyte in gut/cut content sample

$W_{G/GC}$ = Wet weight of gut/gut contents sample

$C_{GWB}$ = Concentration in wet weight of analyte in gutless whole body sample

$W_{GWB}$ = Wet weight of gutless whole body sample

#### 3.2.4.2 Results

Tables 3-12 to 14 present the results of the analysis of the gut/gut contents and gutless whole body analysis of the individual largescale suckers from FSCAs 1, 3, and 6. Estimated whole body concentrations and percent metals associated with the gut/gut contents are also presented. Mean concentrations of metals in gut/gut contents, gutless whole body, estimated whole body, and percent associated with gut/gut contents are given by FSCA in Table 3-15.

The results presented in Table 3-15 indicate two general patterns of the potential influence of metals found in the gut/gut contents of largescale suckers on whole body metal measurements (Figures 3-25 to 3-28). The first pattern consists of a large difference in metals concentrations in the gut/gut contents compared to the gutless whole body. This pattern occurred for most of the metals. The second pattern consists of metals concentrations that are higher in the gut/gut contents than in the gutless whole body, but with a difference that is relatively small. This pattern occurred for selenium and cadmium. The gut/gut contents results also show that sediment/slag in the gut may account for higher percentages of inorganic arsenic measured in largescale suckers.

##### High Relative Concentration Difference in Gut/Gut Contents vs. Gutless Whole Body

Most of the metals can be characterized by the pattern seen in Figures 3-25, 3-26, and 3-27. These figures represent three variations of that overall pattern. This pattern is characterized by having high metals concentrations in the gut/gut contents relative to the gutless whole body at the most upstream collection area, FSCA1. The percent of the estimated whole body metals associated with the gut/gut contents tended to be high. The mean AFDW of the gut/gut contents was lower at the upstream location, indicating the presence of a greater amount of sediment in the gut/gut contents samples. Metals concentration in the gut/gut contents declined dramatically downstream. This decline is evident even at the downstream portion (i.e., FSCA 1a) of FSCA 1. The AFDW increased downstream, indicating lower amounts of sediment in the gut/gut contents samples.

Figure 3-25 shows the overall pattern for arsenic. Arsenic, chromium, nickel and uranium are characterized by having a moderate (i.e., 4- to 5-fold) difference in gut/gut contents concentrations relative to gutless whole body at FSCA 1. The relative difference declined downstream. The contribution of sediment to the gut/gut contents measurement for arsenic is illustrated in Figure 3-29 by comparing the percent AFDW to percent arsenic associated with the gut/gut contents for individual samples. The percent arsenic associated with the gut and the potential bias of whole body measurements increased as the percent AFDW of the gut/gut contents decreased, indicating the presence of sediment. For these metals the influence of sediment in the gut/gut contents on whole body measurements is possible at upstream sites, but the potential contribution to the overall concentration would be small.

Figure 3-26 shows the overall pattern for zinc. Zinc, aluminum, barium, copper, iron, and manganese all are characterized by large (i.e., 20- to 50-fold) differences in gut/gut contents concentrations relative to gutless whole body at FSCA 1. The relative difference declined downstream. The contribution of sediment to the gut/gut contents measurement for zinc is illustrated in Figure 3-30. The relationship between percent zinc associated with the gut and

percent AFDW of the gut/gut contents is more pronounced than zinc, suggesting an even greater potential influence of sediment on whole body zinc measurements. For these metals the influence of sediment in the gut/gut contents on whole body measurements is possible at upstream sites, but the potential contribution to the overall concentration would be great.

Figure 3-27 shows the pattern for lead. The lead pattern is similar to the arsenic pattern in that the relative difference in gut/gut contents concentrations relative to gutless whole body at FSCA 1 is moderate (i.e., 4- to 5-fold) and the difference declined downstream. Lead is unique in that, downstream, the gutless whole body concentrations were greater than the gut/gut contents concentrations. This pattern suggests that there is a potential for sediment in the gut to bias high any whole body lead measurements from the most upstream locations. In addition, it appears that lead has a greater potential to be taken up and stored in tissues other than the digestive tract. The contribution of sediment to the gut/gut contents measurement for lead is illustrated in Figure 3-31. The relationship between percent lead associated with the gut and percent AFDW of the gut/gut contents is poor, suggesting little influence of sediment on the lead measurements in the gut/gut contents samples and a low potential bias of lead whole body measurements.

### Small Relative Concentration Difference in Gut/Gut Contents vs. Gutless Whole Body

The second overall pattern is seen in selenium (Figure 3-28) and cadmium. This pattern is characterized by generally higher concentrations in the gut/gut contents relative to the gutless whole body; however, the relative difference is small. There is no spatial trend or trend relative to AFDW. The patterns suggest that the presence of sediment in the gut is likely not biasing whole body measurements. The low percent of the metal associated with the gut/gut contents indicates that most of the metal is stored in tissues other than the digestive tract. The contribution of sediment to the gut/gut contents measurement for selenium is illustrated in Figure 3-32. There is no apparent relationship between percent selenium associated with the gut and percent AFDW of the gut/gut contents, suggesting little influence of sediment on the selenium measurements in the gut contents samples and no potential bias of selenium whole body measurements.

### Arsenic Speciation

Arsenic speciation was conducted on gut/gut contents and gutless whole body samples from two largescale suckers from FSCA 1, and one each from FSCAs 1a, 3, and 6. The results are presented in Table 3-16. In gutless whole body samples, inorganic arsenic (As+3 and AS+5) ranged from about 13 percent at FSCA 1a to about 28 percent at FSCA 3, with an average of 19 percent inorganic arsenic (Figure 3-33). In the gut/gut contents samples, inorganic arsenic comprised about 70 percent and 60 percent at FSCA 1 and FSCA 1a, respectively. The ratio dropped to about 20 percent at FSCAs 3 and 6 (Figure 3-34). Total arsenic was four to eight times higher in the gut/gut contents samples from fish collected at FSCA 1 and FSCA 1a. The lower percent AFDW of samples from these areas (see Figure 3-25) suggests that the presence of sediment in the sample may account for the higher percentages of inorganic arsenic.

With the exception of the individuals from FSCA 1 and FSCA 1a, these results are consistent with those seen for the whole body largescale sucker composite samples presented in Tables 3-14 and 3-15. Generally, around 20 percent of the total arsenic measured in a largescale sucker is organic species; however, in upstream locations the presence of sediment in the gut may bias high the percent inorganic arsenic estimates for whole body samples.

## 3.3 Nature and Extent of Contaminants in Fish (CSM Update)

The overall results showed some differences in the concentrations of PCOIs in the target species and in the target tissue types. In order to better characterize the nature and extent of contaminants in the target species, the PCOI concentrations were compared among FSCAs within a species for both whole body and fillet samples and between species within a fish collection area. This spatial presentation of the data will support refinement of the CSM and help determine how data could be aggregated during the risk assessments.

Statistical comparison of PCOI concentrations by species between site reaches is presented to support refinement of the CSM and help determine how data should be aggregated during the risk assessments. This evaluation also meets the secondary objectives of developing baseline data for the UCR. Statistical comparisons of PCOIs in largescale sucker whole body samples to PCOIs in sediment are presented. The results from the Phase I fish tissue analysis are also compared to historical tissue sampling where species and tissue types are comparable.

### 3.3.1 Evaluation of Trends by Species and Locations

The trends in PCOI concentrations in target species were explored by comparing the mean concentrations of PCOIs in target species between FSCAs and among target species within an FSCA. The results are presented separately for the targeted tissue types, whole body and fillet. The trends discussed are general patterns and may or may not be statistically significant. Statistical comparisons consistent with the study design are presented in Section 3.3.2.

#### 3.3.1.1 Whole Body Tissue

Table 3-17 and Figures 3-35 to 3-49 present the mean whole body concentrations by target species and FSCA. For many of the target species, there were no apparent trends among FSCAs for the PCOIs. The following is a summary by species.

For walleye, mercury concentrations generally showed an increase downstream from FSCA 3. No apparent trends were noted for arsenic or other metals. Total PCBs were lower at FSCA 1 than at the other collection areas, but no other trend was noted. No trend was noted for 2,3,7,8 TCDF.

Wild rainbow trout showed no apparent trend for arsenic, mercury, or other metals. However, wild rainbow trout samples were limited at the middle and lower collection areas. Total PCBs showed a slight downstream decrease, but, as previously noted, the downstream samples are limited. 2,3,7,8 TCDF was slightly higher at FSCA 2 than at other collection areas.

For hatchery rainbow trout, aluminum, copper, and uranium were higher at FSCA 3 than at the other collection areas, but no upstream/downstream trend was noted. Mercury was higher at FSCA 6. No trends are apparent for total PCBs and 2,3,7,8 TCDF.

No trends were observed for arsenic, mercury, other metals or total PCBs in lake whitefish. For 2,3,7,8 TCDF, concentrations generally increased downstream, following a slight decline between FSCA 2 and FSCA 3.

Largescale suckers showed the most pronounced trends in PCOI concentrations. Eight metals (i.e., aluminum, barium, chromium, copper, iron, nickel, uranium, and zinc) were substantially higher at FSCA 1, declining at FSCA 2 and showing no apparent trend downstream from there. However, there was high variability in the individual composite concentrations for these metals at this FSCA. The high variability, along with the results of the largescale sucker gut/gut contents analysis, suggests that the higher concentrations observed at FSCA 1 could be from sediment and slag in the gut of some of the largescale suckers collected from this area. Lead is a notable exception. Lead was highest at FSCA 1 but showed a consistent decreasing downstream trend. The high variability seen in the individual composite lead concentrations indicates that the lead may be biased high at FSCA 1 due to the sediment and/or slag in the gut; however, when this was considered, the increasing downstream trend still was apparent. Mercury showed a slight increasing trend downstream. Total PCBs and 2,3,7,8 TCDF tended to have higher concentrations in the more downstream FSCAs.

In burbot, both arsenic and mercury showed increasing downstream trends between FSCA 4 and FSCA 6. No apparent pattern was noted for the other metals, total PCBs, or 2,3,7,8 TCDF.

The between-species patterns within an FSCA were generally similar to the trend seen in the overall species mean concentrations.

#### 3.3.1.2 Fillet Tissue

Table 3-18 and Figures 3-50 to 3-64 present the mean fillet concentrations by target species and FSCA. For many of the target species, there were no apparent trends among FSCAs for the PCOIs. The following is a summary by species.

For walleye fillets, mercury and arsenic concentrations generally showed a downstream increase. Lead showed a slight increase downstream. Conversely, nickel showed a slight decrease downstream. No apparent trends were noted for the other metals. Total PCBs in walleye fillets increased about 5-fold between FSCA 1 and FSCA 6. 2,3,7,8 TCDF also showed a slight downstream increase in concentrations.

Wild rainbow trout fillets showed no apparent trend for arsenic, mercury, or the other metals. However, wild rainbow trout samples were limited at the middle and lower collection areas. Total PCBs showed a slight downstream decrease, but, as previously noted, the downstream samples are limited. No trend in 2,3,7,8 TCDF was observed.

No trends were observed for any of the PCOIs in the fillet samples from hatchery rainbow trout.

### 3.3.2 Statistical Comparisons

The UCR Phase I fish tissue study was designed to allow for the following statistical comparisons:

- Compare fish contaminant levels among river reaches
- Characterize the variation in contaminant concentrations among individual fish of a species

- Correlate tissue concentrations with contaminant concentrations in sediment

Detailed discussion of the sampling design and statistical considerations were presented in the Fish Tissue A&R Document (CH2M HILL, 2005a) and the Fish Tissue QAPP (CH2M HILL, 2005b).

#### 3.3.2.1 Fish Tissue Comparisons

For the purposes of the statistical design, the site was stratified into the three reaches shown in Figure 3-1 of the QAPP:

- Upper Reach – FSCA 1 and FSCA 2
- Middle Reach – FSCA 3 and FSCA 4
- Lower Reach – FSCA 5 and FSCA 6

##### Methods

Within each river reach, mean fish tissue PCOI concentrations were calculated as the arithmetic average of composite sample values, $(C_i)$, as follows (Zar, 1996):

$$\hat{\bar{C}} = \frac{\sum_{i=1}^{n} C_i}{n}$$

with associated sampling variance

$$\widehat{\mathrm{Var}}\left(\hat{\bar{C}}\right) = \frac{s_{C_i}^2}{n}$$

Where:

$$s_{C_i}^2 = \frac{\sum_{i=1}^{n}\left(C_i - \hat{\bar{C}}\right)^2}{(n-1)}$$

Asymptotic $(1-\alpha)$ 100 percent confidence intervals for mean concentrations were calculated as follows:

$$\hat{\bar{C}} \pm Z_{1-\frac{\alpha}{2}} \sqrt{\widehat{\mathrm{Var}}\left(\hat{\bar{C}}\right)}$$

Where:

$Z_{0.975}$ = 1.96 for a 95 percent confidence interval

For each species, the mean whole body concentration was calculated for each PCOI by reach. For walleye, wild rainbow trout, and hatchery rainbow trout, the mean whole body calculation included the estimated whole body concentrations from the paired fillet and offal samples (see Section 3.2.2). For the largescale sucker, the estimated whole body concentrations were based on the paired gut/gut contents and gutless whole body concentrations (see Section 3.2.3). Field duplicates were averaged prior to calculating the reach mean. Nondetect values were assumed to be half the detection limit.

The variability in PCOI concentrations in individual fish was estimated using the following approach. Within a sampling area, fish were randomly assigned to the replicate composite samples. When fish are randomly selected within a locale for compositing, the expected value of the observed concentration $(C)$ is the mean $(\mu)$ of the individual fish concentrations; that is,

$$E(C) = \mu$$

If several composites are created randomly and analyzed, their observed variability $\left(s_C^2\right)$ has the expected value:

$$E\left(s_C^2\right) = \frac{\sigma^2}{k}$$

Where:

$\sigma^2$ = variance in individual fish concentrations
$k$ = number of fish forming the composite

Hence, an estimator of $\sigma^2$, the fish-to-fish variability, is:

$$\hat{\sigma}^2 = k \cdot s_C^2$$

Where:

$$s_C^2 = \frac{\sum_{i=1}^{n}\left(C_i - \bar{C}\right)^2}{(n-1)}$$

And where:

$$\bar{C} = \frac{\sum_{i=1}^{n} C_i}{n},$$

$n$ = number of composite samples formed at a locale

Hence, although individual fish tissues were not analyzed, careful compositing preserved some of the information on fish-to-fish variability in contaminant concentrations (i.e., $\sigma^2$).

Mean PCOI concentrations were compared between reaches using a one-way analysis of variance (i.e., ANOVA) and the F-test comparing among-reach and within-reach variability. The three river reaches provide 2 degrees of freedom for between-reach comparisons. One of those degrees of freedom was used to test for a linear trend in mean concentrations. Using orthogonal polynomial coefficients for a linear trend (Snedecor and Cochran, 1982), the contrast was tested using a two-tailed F-test. Thus, the analysis examined for the presence of both an upriver and downriver trend in increasing concentrations. Due to the limited sample size (i.e., five replicates from one FSCA), no comparisons were possible for the mountain whitefish. If the data were not normally distributed, the nonparametric Kruskal-Wallis test was used (Zar, 1996).

As part of the study design, power calculations based on historical fish tissue contaminant data were used, along with other criteria (i.e., availability of fish and budget), to select the targeted number of composite samples. Power calculations are used to determine the probability of rejecting the null hypothesis:

$$H_o : \mu_1 = \mu_0$$

at a significance level of αwhen it is false. For the purposes of this evaluation, a two-tailed alternative was considered:

$$H_a : \mu_1 \neq \mu_0$$

Power calculations were done based on the results of the Phase I fish tissue sampling. The power curves were expressed as a function of the coefficient of variation (CV), with:

$$CV = \frac{s}{\bar{x}}$$

among the replicate composite samples (Table 3-19). By using observed CV values taken from Table 3-19, the power $(1-\beta)$ to detect a relative difference for a specific sample size $n$ can be read directly from the charts in Figure 3-65. Sample sizes generally were n = 10 per reach.

Five of the six FSCAs (FSCAs 1, 2, 3, 4 and 6) were co-located with areas designated as sediment focus areas (Focus Areas 1, 3, 5, 7 and 11) (see Figure 2-1). Higher-density sediment sampling was conducted at sediment Focus Areas 1, 3, 5, 7 and 11. These five areas permitted examination of the correlation between concentrations of contaminants observed in fish tissues and sediment. At each FSCA, the mean sediment concentration of a PCOI was calculated from the sediment samples collected below elevation 1290 and located between the most upstream and downstream point where fish were collected at that given FSCA. For this report, sediment/tissue relationships were explored for the largescale sucker only. It was assumed that the largescale sucker has the most direct link to sediment because of its feeding habits. The mean largescale sucker tissue concentration of each PCOI was calculated for each FSCA and compared to the mean sediment concentration for the FSCA. Pearson product–moment correlations were computed from:

$$r = \frac{\mathrm{Cov}(x_i, y_i)}{\sqrt{s_{x_i}^2 \cdot s_{y_i}^2}}$$

Where:

$x_i$ = mean fish concentration at the *i*th area $(i = 1, \ldots, 5)$

$y_i$ = mean sediment concentration at the *i*th area $(i = 1, \ldots, 5)$

The test of significance of the hypothesis $\mathrm{H_o} : \rho = 0$ was based on a student's *t*-test with $n - 2$ degrees of freedom (Zar, 1996).

### Results

The results of river reach comparisons performed for each species show the following:

- Mean concentrations $(\bar{x})$ of PCOIs by river reach (upper, middle, and lower)
- Standard error of the mean $\left(S\hat{E}(\bar{x})\right)$
- Minimum and maximum composite value
- Estimate of between-fish variability $(\hat{\sigma})$

Figures showing the species relationships and between-reach comparisons are provided in Appendix E.

Table 3-20 presents the results for walleye whole body samples by reach. Table 3-21 presents the results of the statistical comparisons between reaches using the F-test and linear trend analysis. There was no significant difference (P>0.1) in the mean whole body walleye concentrations between reaches for aluminum, barium, chromium, iron, and zinc. All other PCOIs showed a significant difference (P>0.1) in mean concentrations between reaches and the highest mean concentration in the middle reach, with the exception of mercury, total PCBs, and 2,3,7,8 TCDF, which showed an increasing downstream trend.

The results by reach for wild and hatchery rainbow trout are presented in Tables 3-22 and 3-23, respectively. Because both wild and hatchery rainbow trout were not caught at all FSCAs, an alternate comparison approach was used. Wild rainbow trout were compared between the upper and middle reaches. Hatchery rainbow trout were compared between the middle and lower reaches. In the middle reach, where both wild and hatchery rainbow trout sample size was sufficient, mean PCOI concentrations were compared between the wild and hatchery fish. The results of the statistical comparisons are presented in Table 3-24.

For the comparison of whole body wild rainbow trout, the mean concentrations of lead and total PCBs were significantly different (P>0.1) between the upper and middle reaches. All other PCOIs showed no significant difference (P>0.1) in mean concentrations. For the whole body hatchery rainbow trout, aluminum, cadmium, copper, lead, nickel, selenium, and mercury showed significant differences (P>0.1) in mean concentrations between the middle and lower reaches. All other PCOIs were not significantly different (P>0.1). For the comparison of whole body wild and hatchery rainbow trout in the middle reach, the mean concentrations of arsenic and selenium were significantly different (P>0.1). All other PCOIs showed no significant difference (P>0.1) in mean concentrations.

Table 3-25 presents the results for lake whitefish whole body by reach, and Table 3-26 presents the results of the statistical comparisons. There was no significant difference (P>0.1) in the mean lake whitefish whole body concentrations between reaches for aluminum, arsenic, copper, iron, uranium, and zinc. All other PCOIs showed a significant difference (P>0.1) in mean concentrations between reaches. The observed pattern between reaches varied by PCOI. Of the PCOIs with mean differences, barium and arsenic were characterized by having the highest concentrations in the middle reach; chromium, nickel, and total PCB showed an increasing trend downstream. Mercury and 2,3,7,8 TCDF had the highest mean concentration in the lower reach. Selenium was unique in that it was characterized by a decreasing trend downstream.

The results for the mountain whitefish are presented in Table 3-27. Because mountain whitefish was collected only at FSCA 1, no statistical comparisons were possible.

The results by reach for largescale sucker are presented in Table 3-28; Table 3-29 presents the results of the statistical comparisons. There was no significant difference (P>0.1) in the mean largescale sucker whole body concentrations between reaches for aluminum, arsenic, barium, chromium, nickel, total PCBs, and 2,3,7,8 TCDF. All other PCOIs showed a significant difference (P>0.1) in mean concentrations between reaches. The observed pattern between reaches varied by PCOI. Of the PCOIs with mean differences, copper, iron, and zinc were characterized by having the highest concentrations in the upper reach and similar concentrations in the middle and lower reaches. Cadmium, lead, and uranium showed an increasing downstream trend. Mercury increased from the upper to the middle reaches and was the same in the lower reach. Selenium decreased from the middle to lower reaches.

Table 3-30 presents the results for burbot whole body by reach; Table 3-31 presents the results of the statistical comparisons. There was no significant difference (P>0.1) in the mean burbot whole body concentrations between reaches for chromium, copper, lead, nickel, uranium, zinc, total PCBs, and 2,3,7,8 TCDF. All other PCOIs showed a significant difference (P>0.1) in mean concentrations between reaches. The observed pattern between reaches varied by PCOI. Of the PCOIs with mean differences, aluminum, barium, cadmium, iron, and mercury were characterized by increasing downstream concentrations. Arsenic increased between the middle and lower reaches. Selenium decreased downstream.

The results of the walleye fillet and offal samples by reach are presented in Tables 3-32 and 3-33, respectively. The statistical comparisons by tissue type are provided in Tables 3-34 and 3-35. For walleye fillets, there was a significant difference (P>0.1) in the mean walleye fillet concentrations between reaches for arsenic, zinc, mercury, total PCBs, and 2,3,7,8 TCDF. Mercury and 2,3,7,8 TCDF increased downstream, while arsenic and total PCBs were characterized by increases between the upper and middle reaches. Zinc declined between the upper and middle reaches. All other PCOIs showed no significant difference (P>0.1) in mean concentrations between reaches.

There was a significant difference (P>0.1) in the mean walleye offal concentrations between reaches for aluminum, arsenic, copper, lead, mercury, total PCBs, and 2,3,7,8 TCDF. Aluminum, mercury, total PCBs, and 2,3,7,8 TCDF increased downstream. Arsenic was highest in the middle reach, copper increased between the middle and lower reaches, and lead declined between the middle and lower reaches. All other PCOIs showed no significant difference (P>0.1) in mean concentrations between reaches.

The results of the wild and hatchery rainbow trout fillet samples by reach are presented in Tables 3-36 and 3-37, respectively. The results of the wild and hatchery rainbow trout offal samples by reach are presented in Tables 3-38 and 3-39, respectively. Statistical comparisons by tissue type are in Table 3-40 and 3-41. The statistical comparisons were the same as those reported for the whole body comparisons with this species. For the comparison of wild rainbow trout fillets, the mean concentrations of arsenic and zinc were significantly different (P>0.1) between the upper and middle reaches. All other PCOIs showed no significant difference (P>0.1) in mean concentrations. For the hatchery rainbow trout, aluminum, cadmium, nickel, mercury, and 2,3,7,8 TCDF showed no significant difference (P>0.1) in mean concentrations. All other PCOIs were significantly different (P>0.1) between the middle and lower reaches. In the comparison of wild and hatchery rainbow trout in the middle reach, the mean concentrations of barium, chromium, iron, uranium, zinc, and total PCBs were significantly different (P>0.1). All other PCOIs showed no significant difference (P>0.1) in mean concentrations.

In the comparison of wild rainbow trout offal, the mean concentrations of chromium, zinc, mercury, total PCBs, and 2,3,7,8 TCDF showed no significant difference (P>0.1) in mean concentrations. All other PCOIs were significantly different (P>0.1) between the upper and middle reaches. For the hatchery rainbow trout, aluminum, nickel, uranium, zinc, and 2,3,7,8 TCDF showed no significant difference (P>0.1) in mean concentrations. All other PCOIs were significantly different (P>0.1) between the middle and lower reaches. In the comparison of wild and hatchery rainbow trout offal in the middle reach, the mean concentrations of cadmium, lead, selenium and total PCBs were significantly different (P>0.1). All other PCOIs showed no significant difference (P>0.1) in mean concentrations.

#### 3.3.2.2 Comparison of Fish Tissue With Sediment

Table 3-42 compares PCOI concentrations in sediment to PCOI fish tissue concentrations. Individual PCOI sediment/tissue relationships are presented in Figures 3-66 to 3-78. Copper, iron, and zinc had significant (P>0.1) correlations between sediment and largescale sucker tissue concentrations. Largescale sucker tissue concentrations for these PCOIs were lower in locations with lower sediment concentrations. There was also a downstream trend in both the sediment and tissue concentrations for these PCOIs.

### 3.3.3 Comparison to Past Studies

The Phase I fish tissue results were compared to previous data to access temporal trends in PCOI concentrations. A summary of all the historical fish tissue data from Lake Roosevelt was presented in the Fish Tissue A&R Document (CH2M HILL, 2005a). The historical studies sampled a variety of locations and tissue types. Studies that had the closest match in sample location and tissue type were chosen for this comparison. The selected studies had sampling areas that generally correspond to the three reaches (Upper River, Middle River, and Lower River) used to evaluate the current data. Results that correspond to those reaches in the historical studies and the current study were compared. The following studies were used:

- U.S. Geological Survey (USGS). 1995. *Concentrations of Mercury and Other Trace Elements in Walleye, Smallmouth Bass, and Rainbow Trout in Franklin D. Roosevelt Lake and the Upper Columbia River, Washington*. (USGS, 1995).

- EVS Consultants (EVS). 1998. *Assessment of Dioxins, Furans, and PCBs in Fish Tissue from Lake Roosevelt*. (EVS, 1998).
- Washington State Department of Ecology (Ecology). 1994. *Contaminant Trends in Lake Roosevelt*. (Ecology, 1994).

The USGS study measured a variety of trace elements and mercury in walleye, smallmouth bass, and rainbow trout fillets. Fish were collected from the following three sampling locations within the Phase I fish tissue study river reaches:

Upper Reach – Columbia River and Lake Roosevelt near Kettle Falls
Middle Reach – Lake Roosevelt and lower Spokane River
Lower Reach – Sanpoil River embayment

The EVS study reported dioxin/furan and PCB concentrations in fillets from walleye, rainbow trout, smallmouth bass, kokanee, lake whitefish, and white sturgeon. Fish were collected from the following three sampling locations within the Phase I fish tissue study river reaches:

Upper Reach– Northport area
Middle Reach– South of Kettle Falls
Lower Reach– Seven Bays area, lower Sanpoil River, or Spring Canyon area

The Ecology study measured a variety of contaminants in lake whitefish fillets and largescale sucker whole body samples. Trace elements were measured in largescale sucker samples from Northport, which corresponds to FSCA 1, and Kettle Falls, which corresponds to FSCA 3.

The mean concentrations of PCOIs were compared between these studies and the corresponding species and sample location from the Phase I fish tissue study. Table 3-43 compares the current data for selected trace elements and mercury for walleye and rainbow trout to the results from the USGS study. The comparison shows that, in the current UCR study, there were generally lower mercury concentrations in walleye and rainbow trout, both wild and hatchery. There were some differences in detection limits between the studies; overall, however, all other PCOIs appear to be comparable.

Table 3-44 compares the current UCR data for total PCBs and 2,3,7,8 TCDF for lake whitefish, walleye, and rainbow trout with data reported by EVS (1998). For rainbow trout, the comparisons in the Upper Reach are between wild rainbow trout, and in the Lower Reach, hatchery fish. The mean 2,3,7,8 TCDF concentrations in lake whitefish for the current UCR data are about half those reported in the 1998 study, whereas mean total PCB concentrations were slightly higher. The current UCR mean concentration of 2,3,7,8 TCDF measured in walleye fillets was similar to that seen in the 1998 study in the middle reach and lower in walleye from the lower reach. Total PCB concentrations in walleye fillets were lower in the upper reach, but three to four times higher in the middle and lower reaches in the current study compared to the 1998 data. Wild rainbow trout from the upper reach had about the same mean concentration of 2,3,7,8 TCDF during the current study as in 1998. The same was observed for hatchery rainbow trout collected from the lower reach. Total PCBs were similar in wild rainbow trout from the upper reach between the current and 1998

studies. The hatchery fish had a mean total PCB concentration in the current study that was about twice the concentration measured in 1998.

Comparisons of largescale sucker results from the current study to the 1994 Ecology results (Ecology, 1994) show the following (Table 3-45). Mean cadmium concentrations remain unchanged. They are similar between the Northport collection area (FSCA 1) and the Kettle Falls collection area (FSCA 3). Copper and zinc levels remain unchanged. Mean concentrations of these PCOIs are higher in the upstream station by a factor of about four to five. This was true during both studies. Mean concentrations of lead at the Northport station were lower during the current study. Mercury was lower in the current study at the Northport collection area and higher at the Kettle Falls area in the current study compared to the Ecology data.

The studies that were used for comparison were not designed to allow for detailed comparisons of trends over time with the current study. Therefore, the comparison allows only for identification of general trends. In summary, comparison of the current data to historical data from USGS, EVS Associates, and Ecology suggests the following:

- Mercury may be declining in walleye and rainbow trout (i.e., both wild and hatchery) fillets.
- 2,3,7,8 TCDF continues to decline in lake whitefish.
- Metals appear to be unchanged in walleye and rainbow trout fillets and in largescale sucker whole body, with the exception of lead in the Northport area.

### 3.3.4 Updated Conceptual Site Model

The Fish Tissue A&R Document (CH2M HILL, 2005a) presented a preliminary CSM focusing on contaminants in fish. The preliminary CSM indicates that a variety of contaminants (i.e., TAL metals and mercury, dioxins and furans, and PCBs) have been released into the UCR from various known and unknown sources. These contaminants have been transported via air, surface water, suspended particulates, or sediment, and have come to be distributed throughout the UCR. The sources, releases, and transport have been confirmed and are further refined in the Sediment Data Evaluation Report (CH2M HILL, 2006b). Fish in the UCR can be exposed to the contaminants through direct uptake (i.e., across gills, dermis, and/or gut) or through diet (i.e., feeding on suspended particulates, bed sediment, or biota that are exposed to contaminants). Fish can also act as a contaminated exposure medium for wildlife and humans.

A diverse fish community is present in the UCR. Over 25 species have been documented during recent fish population sampling. The most common species are walleye, largescale sucker, rainbow trout, lake whitefish, smallmouth bass, and burbot. Feeding studies show that the fish community is supported by both benthic and pelagic production. Pathways are present for fish to be exposed to contaminants that have been released into the UCR. They can be exposed via both surface water (i.e., surface water and suspended particulates) and sediment.

Historical data show that fish collected from the UCR have elevated concentrations of a number of slag-related metals (which include but are not limited to arsenic, cadmium,

copper and zinc), mercury, dioxins and furans, and PCBs (CH2M HILL, 2005a). Slag-related metals, especially zinc, have been detected in various fish species in the UCR, most notably the largescale sucker. Mercury has been detected in several fish species, with the highest concentrations typically found in walleye. As with mercury, dioxins and furans, especially 2,3,7,8 TCDF, have been documented in several species, with the highest concentrations generally found in lake whitefish and rainbow trout. Past studies have shown that dioxins and furans have been associated with suspended particulates (USGS, 1994). The lake whitefish and rainbow trout both feed heavily on water column species and would have a high exposure to particulate-bound contaminants. PCBs have been found in various species in the UCR. Concentrations of PCBs are similar in kokanee, rainbow trout, sturgeon, walleye, and whitefish (EVS, 1998). There is little information on whether the primary source of PCB exposure is from bed sediment or from suspended particulates.

The results of the current study are consistent with the preliminary CSM, as suggested by the following conclusions:

- The metals cadmium, copper, lead, nickel, and uranium were greatest in the largescale sucker, with concentrations being greatest in the most upstream portions of the site. The gut/gut content analysis indicates that a portion of the whole body concentration may be from slag and or sediment in the gut. Zinc was also elevated in largescale suckers and mountain whitefish, particularly in the most upstream area (i.e., FSCA 1)
- Burbot contained about three to five times more arsenic than other species, suggesting either a greater exposure or higher rates of retention. Approximately 98 percent of the arsenic found in the burbot was in organic form, compared to approximately 70 percent for other species. The total arsenic in burbot increased downstream, suggesting increased sources or different exposure dynamics in the more lake-like portion of the reservoir.
- Mercury was detected in all target species, with the highest concentrations in walleye, burbot, and largescale suckers. The elevated concentrations in walleye and burbot are consistent with their feeding habits. Both walleye and burbot are higher trophic level consumers in the UCR system, feeding on fish. The source of mercury exposure is not clear for largescale suckers. There is a significant downstream increase in mercury concentrations, but not a significant relationship to sediment mercury concentrations. It is unclear whether the exposure is from sediment contact or food, or both.
- Total PCB concentrations were similar for walleye, wild and hatchery rainbow trout, lake whitefish and burbot. Largescale suckers contained about 2.5 times as much total PCB, suggesting that PCB exposure is greater from sediment, either directly or through diet, than from the water column.
- Lake whitefish, largescale sucker, and burbot had the highest concentrations of 2,3,7,8 TCDF. Generally, 2,3,7,8 TCDF concentrations were higher in the downstream samples for these species.

The current results presented above support the preliminary CSM and the assumption that UCR fish are exposed via surface water (i.e., surface water and suspended particulates), sediment, and diet. The results indicate that the exposure varies depending on species and location within the reservoir.

**TABLE 3-1**

Phase I Fish Tissue Comparison Levels Used to Identify Preliminary Contaminants of Interest

*Upper Columbia River RI/FS*

| Analyte | Units | Region 3 PRG Fish Noncancer[a] | Region 3 PRG Fish Cancer 10E-6[a] | Ecological Risk Comparison Value |
|---|---|---|---|---|
| **TAL Metals[b]** | | | | |
| Aluminum | mg/kg WW | 25 | | 4.4[e] |
| Antimony | mg/kg WW | | | 0.03[g] |
| Arsenic | mg/kg WW | | 0.0039 | 1.6[e] |
| Barium | mg/kg WW | 5.2 | | |
| Beryllium | mg/kg WW | 0.05 | | 0.1[g] |
| Cadmium | mg/kg WW | 0.025 | | 0.042[e] |
| Calcium | mg/kg WW | | | |
| Chromium | mg/kg WW | 38 | | 0.18[e] |
| Cobalt | mg/kg WW | 0.5 | | |
| Copper | mg/kg WW | 1.0 | | 3.0[e] |
| Iron | mg/kg WW | 15.2[c] | | |
| Lead | mg/kg WW | 0.05[d] | | 0.06[e] |
| Magnesium | mg/kg WW | | | |
| Manganese | mg/kg WW | 3.5 | | |
| Nickel | mg/kg WW | 0.5 | | 0.39[e] |
| Potassium | mg/kg WW | | | |
| Selenium | mg/kg WW | 0.13 | | 0.56[e] |
| Silver | mg/kg WW | 0.13 | | 0.37[e] |
| Sodium | mg/kg WW | | | |
| Thallium | mg/kg WW | 0.002 | | 4.6[g] |
| Uranium | mg/kg WW | 0.005 | | |
| Vanadium | mg/kg WW | 0.025 | | |
| Zinc | mg/kg WW | 7.5 | | 20[e] |
| | | | | |
| Mercury | µg/kg WW | 2.5 | | 60[e] |
| **PCB Aroclors** | | | | |
| PCB-1016 | µg/kg WW | 0.8 | | 440[e] |
| PCB-1221 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1232 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1242 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1248 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1254 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1260 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1254/1260 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1262 | µg/kg WW | | 0.3 | 440[e] |
| PCB-1268 | µg/kg WW | | 0.3 | 440[e] |
| **Dioxins/Furans** | | | | |
| 2,3,7,8-TCDD | pg/g WW | | 0.004 | 6[f] |
| 1,2,3,7,8-PeCDD | pg/g WW | | 0.004 | 6[f] |
| 1,2,3,6,7,8-HxCDD | pg/g WW | | 0.04 | 6[f] |
| 1,2,3,4,7,8-HxCDD | pg/g WW | | 0.04 | 6[f] |
| 1,2,3,7,8,9-HxCDD | pg/g WW | | 0.04 | 6[f] |
| 1,2,3,4,6,7,8-HpCDD | pg/g WW | | 0.4 | 6[f] |

**TABLE 3-1**

Phase I Fish Tissue Comparison Levels Used to Identify Preliminary Contaminants of Interest

*Upper Columbia River RI/FS*

| Analyte | Units | Region 3 PRG Fish Noncancer[a] | Region 3 PRG Fish Cancer 10E-6[a] | Ecological Risk Comparison Value |
|---|---|---|---|---|
| OCDD | pg/g WW | | 13.3 | 6[f] |
| 2,3,7,8-TCDF | pg/g WW | | 0.04 | 6[f] |
| 1,2,3,7,8-PeCDF | pg/g WW | | 0.13 | 6[f] |
| 2,3,4,7,8-PeCDF | pg/g WW | | 0.013 | 6[f] |
| 1,2,3,6,7,8-HxCDF | pg/g WW | | 0.04 | 6[f] |
| 1,2,3,4,7,8-HxCDF | pg/g WW | | 0.04 | 6[f] |
| 2,3,4,6,7,8-HxCDF | pg/g WW | | 0.04 | 6[f] |
| 1,2,3,4,6,7,8-HpCDF | pg/g WW | | 0.4 | 6[f] |
| 1,2,3,4,7,8,9-HpCDF | pg/g WW | | 0.4 | 6[f] |
| OCDF | pg/g WW | | 13 | 6[f] |
| **PCB Congeners** | | | | |
| PCB 1 - 73<br>PCB 78 - 80<br>PCB 82 - 104<br>PCB 106 - 112<br>PCB 120 - 122<br>PCB 127 - 155<br>PCB 158 - 167<br>PCB 170 - 188<br>PCB 190 - 209 | pg/g WW | 522 | | 60[f] |
| PCB 77 | pg/g WW | | 40 | 60[f] |
| PCB 81 | pg/g WW | | 13.3 | 60[f] |
| PCB 126 | pg/g WW | | 0.41 | 60[f] |
| PCB169 | pg/g WW | | 0.13 | 60[f] |
| PCB 105,114,118,123,156,167,189 | pg/g WW | | 113.3 | 60[f] |

[a] For the purposes of selecting contaminats in fish tissue for evaluation and presentation, comparison values were derived from Region 3 RPC. Comparison values were derived based on an assumed target range of 1x10-6 for carcinogens or an and exceedance ration of 0.1 for noncarcinogens or ecological endpoints, unless otherwise noted. A fish consumption rate of 280 grams/day (every day for 30 years) was assumed for these estimates. However, the baseline risk assessment will evaluate a wider range of consumption rates.

[b] Potential human health comparison values for TAL metals were taken from USEPA Region 3 PRC tables modified using the assumptions listed in footnote [a] unless otherwise noted.

[c] Stifelman et al., 2005.

[d] Calculated using IEUBK lead model assuming child (0 to 84 months) fish ingestion rate of 280 grams/day, resulting in 5.035 percent of population with blood lead levels above 10 ug/dL.

[e] Dyer et al., 2000.

[f] Windward, 2004.

[g] Shepard personal communication, 2006

PCB = polychlorinated biphenyl

pg/g = picograms per gram

PRG = Preliminary Remediation Goal

TAL = Target Analyte List

µg/dL = micrograms per deciliter

WW = wet weight

**TABLE 3-2**
Summary of TAL Metals, PCB Aroclors, and Dioxins and Furans with at Least One Sample Exceeding Comparison Values
*Upper Columbia River RI/FS*

| Analyte | Walleye | | | Wild Rainbow Trout | | | Hatchery Rainbow Trout | | | Largescale Sucker | Mountain Whitefish | Lake Whitefish | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fillet | Offal | Whole Body | Fillet | Offal | Whole Body | Fillet | Offal | Whole Body | Whole Body | Whole Body | Whole Body | Whole Body |
| **TAL Metals** | | | | | | | | | | | | | |
| Aluminum | x | x | x | | x | x | | x | x | x | x | x | x |
| Antimony | | | | | | | | | | x | | | |
| Arsenic | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Barium | | | | | | | | | | x | | | x |
| Beryllium | | | | | | | | | | | | | |
| Cadmium | | x | x | | x | x | | x | x | x | x | x | x |
| Calcium | | | | | | | | | | | | | |
| Chromium | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Cobalt | | | | | | | | | | | | | |
| Copper | | | | | x | x | | x | | x | x | | x |
| Iron | | x | | | x | x | | x | x | x | x | x | x |
| Lead | x | x | x | | x | x | | x | | x | x | x | x |
| Magnesium | | | | | | | | | | | | | |
| Manganese | | | | | x | | | x | | x | x | x | |
| Nickel | | x | x | | x | | | x | | x | | | x |
| Potassium | | | | | | | | | | | | | |
| Selenium | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Silver | | | | | | | | | | | | | |
| Sodium | | | | | | | | | | | | | |
| Thallium | x | | | | | | | | | | | | |
| Uranium | | | | | x | | | x | | x | x | | x |
| Vanadium | | | | | x | | | x | | x | | x | x |
| Zinc | x | x | x | x | x | x | x | x | x | x | x | x | x |
| | | | | | | | | | | | | | |
| Mercury | x | x | x | x | x | x | x | x | x | x | x | x | x |
| **PCB Aroclors** | | | | | | | | | | | | | |
| PCB-1016 | | | | | | | | | | | x | | |
| PCB-1221 | | | | | | | | | | | | | |
| PCB-1232 | | | | | | | | | | | | | |
| PCB-1242 | | | | | | | | | | | | | |
| PCB-1248 | | | | | | | | | | | | | |
| PCB-1254 | | x | x | | | x | x | x | x | x | x | x | x |
| PCB-1260 | | x | x | | | x | x | x | x | x | | x | x |
| PCB-1254/1260 | | x | x | x | x | x | x | x | x | x | | x | x |
| PCB-1262 | | | | | | | | | | | | | |
| PCB-1268 | | | | | | | | | | | | | |
| **Dioxins/Furans** | | | | | | | | | | | | | |
| 2,3,7,8-TCDD | | | | | x | | | | | x | x | x | |
| 1,2,3,7,8-PeCDD | | x | x | x | x | | | | | x | x | x | |
| 1,2,3,6,7,8-HxCDD | | x | x | | x | x | | | | | x | x | x |
| 1,2,3,4,7,8-HxCDD | | x | | | | | | | | | | x | |
| 1,2,3,7,8,9-HxCDD | | | | x | x | | | | | | x | x | x |
| 1,2,3,4,6,7,8-HpCDD | x | x | x | | x | x | | | | x | x | | x |
| OCDD | x | | | | | | | | | | x | x | |
| 2,3,7,8-TCDF | x | x | x | x | x | x | x | x | x | x | x | x | x |
| 1,2,3,7,8-PeCDF | | | x | | x | x | | | | x | x | x | x |
| 2,3,4,7,8-PeCDF | | | x | x | | x | | | | x | | x | |
| 1,2,3,6,7,8-HxCDF | x | x | x | | | | | | | | | | |
| 1,2,3,4,7,8-HxCDF | x | x | x | | | | | | | | | | |
| 2,3,4,6,7,8-HxCDF | | x | x | | | | | | | | x | | |
| 1,2,3,4,6,7,8-HpCDF | | | | | | | | | | | x | | |
| 1,2,3,4,7,8,9-HpCDF | | | | | | | | | | | | | |
| OCDF | | | | | | | | | | | | | |

PCB = polychlorinated biphenyl
TAL = Target Analyte List

**TABLE 3-3**

Maximum Exceedance Ratios and Percent of Detects Exceeding Comparison Values for TAL Metals, PCB Aroclors, and Dioxins and Furans

*Upper Columbia River RI/FS*

| Analyte | Walleye | | | | Wild Rainbow Trout | | | | Hatchery Rainbow Trout | | | | Largescale Sucker | | Mountain Whitefish | | Lake Whitefish | | Burbot | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fillet | | Whole Body | | Fillet | | Whole Body | | Fillet | | Whole Body | | Whole Body | | Whole Body | | Whole Body | | Whole Body | |
| **TAL Metals** | | | | | | | | | | | | | | | | | | | | |
| Aluminum | 63.7 | 100% | 5.9 | 100% | -- | -- | 2.1 | 100% | -- | -- | 5.4 | 100% | 31.4 | 84% | 5.0 | 100% | 1.8 | 100% | 4.5 | 92% |
| Antimony | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 19.5 | 100% | -- | -- | -- | -- | -- | -- |
| Arsenic | 45.9 | 100% | 80.0 | 100% | 25.8 | 100% | 44.9 | 100% | 20.7 | 100% | 42.9 | 100% | 85.5 | 100% | 43.3 | 100% | 79.9 | 100% | 245.7 | 100% |
| Barium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2.2 | 4% | -- | -- | -- | -- | 1.6 | 75% |
| Beryllium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Cadmium | -- | -- | 1.7 | 35% | -- | -- | 2.6 | 100% | -- | -- | 2.4 | 92% | 19.1 | 100% | 5.4 | 100% | 1.3 | 13% | 3.5 | 83% |
| Calcium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Chromium | 5.0 | 100% | 5.4 | 100% | 4.0 | 100% | 5.0 | 100% | 2.9 | 100% | 3.5 | 100% | 17.0 | 100% | 6.6 | 100% | 5.2 | 100% | 8.3 | 100% |
| Cobalt | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Copper | -- | -- | -- | -- | -- | -- | 2.0 | 88% | -- | -- | -- | -- | 12.9 | 27% | 2.7 | 71% | -- | -- | 1.6 | 67% |
| Iron | -- | -- | -- | -- | -- | -- | 2.0 | 100% | -- | -- | 2.2 | 100% | 70.2 | 82% | 12.4 | 100% | 1.5 | 46% | 2.5 | 100% |
| Lead | 1.3 | 40% | 4.6 | 38% | -- | -- | 2.4 | 100% | -- | -- | -- | -- | 277.8 | 100% | 9.2 | 100% | 2.5 | 96% | 4.0 | 96% |
| Magnesium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Manganese | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 7.8 | 92% | 1.4 | 86% | 1.1 | 4% | -- | -- |
| Nickel | -- | -- | 1.1 | 29% | -- | -- | -- | -- | -- | -- | -- | -- | 2.4 | 45% | -- | -- | -- | -- | 1.1 | 4% |
| Potassium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Selenium | 4.5 | 100% | 6.3 | 100% | 4.8 | 100% | 5.3 | 100% | 3.3 | 100% | 4.2 | 100% | 6.0 | 100% | 9.7 | 100% | 6.9 | 100% | 6.7 | 100% |
| Silver | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Sodium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Thallium | 40.6 | 100% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Uranium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.7 | 100% | 2.5 | 71% | -- | -- | 2.6 | 46% |
| Vanadium | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 13.4 | 176% | -- | -- | 6.2 | 100% | 7.5 | 100% |
| Zinc | 1.0 | 7% | 2.1 | 100% | 1.2 | 56% | 3.0 | 100% | 1.1 | 50% | 3.5 | 100% | 16.7 | 100% | 5.3 | 100% | 1.9 | 100% | 1.9 | 100% |
| | | | | | | | | | | | | | | | | | | | | |
| Mercury | 166.8 | 100% | 85.2 | 100% | 48.0 | 189% | 27.8 | 100% | 48.9 | 100% | 30.1 | 100% | 120.0 | 100% | 33.6 | 100% | 37.8 | 100% | 96.8 | 100% |
| **PCB Aroclors** | | | | | | | | | | | | | | | | | | | | |
| PCB-1016 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 16.5 | 100% | -- | -- | -- | -- |
| PCB-1221 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB-1232 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB-1242 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB-1248 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB-1254 | -- | -- | 50.0 | 100% | 122.0 | 100% | 36.7 | 100% | 16.7 | 60% | 26.3 | 100% | 226.7 | 100% | 194.0 | 100% | 32.0 | 100% | 32.0 | 100% |
| PCB-1260 | -- | -- | 73.3 | 100% | -- | -- | 77.7 | 100% | 19.3 | 100% | 30.7 | 100% | 260.0 | 100% | -- | -- | 34.0 | 100% | 34.0 | 100% |
| PCB-1254/1260 | -- | -- | 170.0 | 100% | -- | -- | 53.3 | 100% | 33.3 | 100% | 40.0 | 100% | 1369.7 | 100% | | -- | 116.0 | 100% | 116.0 | 100% |
| PCB-1262 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB-1268 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| **Dioxins/Furans** | | | | | | | | | | | | | | | | | | | | |
| 2,3,7,8-TCDD | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 56.0 | 100% | 47.8 | 100% | 228.0 | 100% | -- | -- |
| 1,2,3,7,8-PeCDD | -- | -- | 42.3 | 100% | 67.5 | 100% | -- | -- | -- | -- | -- | -- | 367.5 | 100% | 68.5 | 100% | 585.0 | 100% | -- | -- |
| 1,2,3,6,7,8-HxCDD | -- | -- | 6.6 | 100% | -- | -- | 13.0 | 100% | -- | -- | -- | -- | -- | -- | 13.6 | 100% | 68.9 | 100% | 10.5 | 100% |
| 1,2,3,4,7,8-HxCDD | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 65.1 | 100% | -- | -- |
| 1,2,3,7,8,9-HxCDD | -- | -- | -- | -- | 1.9 | 100% | -- | -- | -- | -- | -- | -- | -- | -- | 5.7 | 100% | 39.3 | 100% | 3.9 | 100% |
| 1,2,3,4,6,7,8-HpCDD | 3.35 | 14% | 1.3 | 86% | -- | -- | 1.9 | 80% | -- | -- | -- | -- | 1.3 | 100% | 7.3 | 71% | -- | -- | 1.7 | 83% |
| OCDD | 1.5 | 22% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.1 | 100% | 3.3 | 100% | -- | -- |
| 2,3,7,8-TCDF | 19.9 | 100% | 65.5 | 100% | 60.5 | 100% | 116.8 | 100% | 29.8 | 100% | 39.5 | 100% | 287.5 | 100% | 150.0 | 100% | 1192.9 | 100% | 142.8 | 100% |
| 1,2,3,7,8-PeCDF | -- | -- | 1.5 | 100% | -- | 100% | 1.6 | 100% | -- | -- | -- | -- | 3.7 | 100% | 1.4 | 100% | 2.9 | 100% | 2.2 | 100% |
| 2,3,4,7,8-PeCDF | -- | -- | 13.1 | 100% | 11.7 | 100% | 19.7 | 100% | -- | -- | -- | -- | 36.9 | 100% | -- | -- | 82.7 | 100% | -- | -- |
| 1,2,3,6,7,8-HxCDF | 2.4 | 100% | 2.1 | 100% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 1,2,3,4,7,8-HxCDF | 2.1 | 100% | 2.2 | 100% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 2,3,4,6,7,8-HxCDF | -- | -- | 1.6 | 100% | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 9.4 | 100% | -- | -- | -- | -- |
| 1,2,3,4,6,7,8-HpCDF | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 2.2 | 25% | -- | -- | -- | -- |
| 1,2,3,4,7,8,9-HpCDF | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| OCDF | -- | | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

PCB = polychlorinated biphenyl

TAL = Target Analyte List

**TABLE 3-4**

TAL Metal, PCB Aroclor, and Dioxin and Furan Analytes Most Frequently Exceeding Comparison Values

*Upper Columbia River RI/FS*

| **Number Species/Tissue Types Exceeded:** | | |
|---|---|---|
| **13** | **10 to 12** | **5 to 9** |
| **TAL Metals** | | |
| Arsenic<br>Chromium<br>Mercury<br>Selenium | Aluminum<br>Cadmium<br>Lead | Copper<br>Iron<br>Manganese<br>Nickel<br>Uranium<br>Vanadium |
| **PCB Aroclors** | | |
| | PCB-1254<br>PCB-1260<br>PCB-1254/1260 | |
| **Dioxins/Furans** | | |
| 2,3,7,8-TCDF | | 1,2,3,7,8-PeCDD<br>1,2,3,6,7,8-HxCDD<br>1,2,3,7,8,9-HxCDD<br>1,2,3,4,6,7,8-HpCDD<br>1,2,3,7,8-PeCDF<br>1,2,3,7,8-PeCDD |

PCB = polychlorinated biphenyl

TAL = Target Analyte List

**TABLE 3-5**
Summary of PCB Congeners with at Least One Sample Exceeding Comparison Values
*Upper Columbia River RI/FS*

| | Walleye | | | Wild Rainbow Trout | | | Hatchery Rainbow Trout | | | Largescale Sucker | Mountain Whitefish | Lake Whitefish | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analyte** | **Fillet** | **Offal** | **Wholebody** | **Fillet** | **Offal** | **Whole Body** | **Fillet** | **Offal** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** |
| **PCB Congeners** | | | | | | | | | | | | | |
| PCB 1 | | | | | | | | | | | | | |
| PCB 2 | | | | | | | | | | | | | |
| PCB 3 | | | | | | | | | | | | | |
| PCB 4 | | | | | | | | | | | | | |
| PCB 5 | | | | | | | | | | | | | |
| PCB 6 | | | | | | | | | | | | | |
| PCB 7 | | | | | | | | | | | | | |
| PCB 8 | | | | | | | | | | | | | |
| PCB 9 | | | | | | | | | | | | | |
| PCB 10 | | | | | | | | | | | | | |
| PCB 11 | | x | | | | | | | | | x | x | |
| PCB 12 | | | | | | | | | | | | | |
| PCB 14 | | | | | | | | | | | | | |
| PCB 15 | | | | | | | | | | | | | |
| PCB 16 | | | | | | | | | | | | | |
| PCB 17 | | x | | | | | | | | x | | | |
| PCB 18 | | x | | | | | | | | x | x | x | |
| PCB 19 | | | | | | | | | | | | | |
| PCB 20 | | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 21 | | x | | | | | | | | x | | | |
| PCB 22 | | x | | | | | | | | x | | | |
| PCB 23 | | | | | | | | | | | | | |
| PCB 24 | | | | | | | | | | | | | |
| PCB 25 | | | | | | | | | | | | x | |
| PCB 26 | | x | | | | | | | | | | | |
| PCB 27 | | | | | | | | | | | | | |
| PCB 31 | | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 32 | | x | | | | | | | | | | | |
| PCB 34 | | | | | | | | | | | | | |
| PCB 35 | | | | | | | | | | | | | |
| PCB 36 | | | | | | | | | | | | | |
| PCB 37 | | | | | | | | | | | | | |
| PCB 38 | | | | | | | | | | | | | |
| PCB 39 | | | | | | | | | | | | | |
| PCB 40 | | x | | | | | | x | | x | x | x | |
| PCB 41 | | | | | | | | | | x | | | |
| PCB 42 | | x | x | | | | | | | x | x | x | |
| PCB 43 | | | | | | | | | | | | | |
| PCB 44 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 45 | | x | | | | | | | | | | | |
| PCB 46 | | | | | | | | | | | | | |
| PCB 48 | | x | | | x | | | x | | x | x | x | |
| PCB 49 | | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 50 | | | | | | | | | | x | | x | |
| PCB 52 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 54 | | | | | | | | | | | | | |
| PCB 55 | | x | | | | | | | | x | | | |
| PCB 56 | | x | | | | | | | | x | x | x | |
| PCB 57 | | | | | | | | | | | | | |
| PCB 58 | | | | | | | | | | | | | |
| PCB 59 | | x | | | | | | | | x | | x | |
| PCB 60 | | x | x | | x | x | | x | | x | x | x | x |
| PCB 61 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 63 | | x | | | | | | | | x | | | |
| PCB 64 | | x | x | x | x | x | x | x | x | x | x | x | x |

**TABLE 3-5**
Summary of PCB Congeners with at Least One Sample Exceeding Comparison Values
*Upper Columbia River RI/FS*

| | Walleye | | | Wild Rainbow Trout | | | Hatchery Rainbow Trout | | | Largescale Sucker | Mountain Whitefish | Lake Whitefish | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analyte** | **Fillet** | **Offal** | **Wholebody** | **Fillet** | **Offal** | **Whole Body** | **Fillet** | **Offal** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** |
| PCB 66 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 67 | | | | | | | | | | | | | |
| PCB 68 | | | | | | | | | | | | | |
| PCB 72 | | x | | | | | | | | | | | |
| PCB 73 | | x | | | | | | | | | | | |
| PCB 77 | | x | | | x | | | | | x | | x | |
| PCB 78 | | | | | | | | | | | | | |
| PCB 79 | | x | | | | | | | | x | x | x | |
| PCB 80 | | | | | | | | | | | | | |
| PCB 81 | | | | | | | | | | | | | |
| PCB 82 | | x | x | | | | | | | x | x | x | |
| PCB 83 | | x | | | x | | | x | | x | x | x | x |
| PCB 84 | | x | x | | x | x | | x | | x | x | x | |
| PCB 85 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 86 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 88 | | x | x | x | x | x | | x | | x | x | x | |
| PCB 89 | | | | | | | | | | x | | | |
| PCB 90 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 92 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 93 | x | x | x | x | x | x | | x | x | x | | | x |
| PCB 94 | | x | | | | | | | | x | x | x | |
| PCB 95 | | | | | | | x | | | | | | |
| PCB 96 | | | | | | | | | | | | | |
| PCB 98 | | | | | | | | | | x | | | |
| PCB 99 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 103 | | | | | | | | | | x | | | |
| PCB 104 | | | | | | | | | | | | | |
| PCB 105 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 106 | | | | | x | | | | | x | | | |
| PCB 107 | | x | | | x | x | | | | x | x | x | |
| PCB 109 | | x | x | x | x | x | | x | | x | x | x | x |
| PCB 110 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 111 | | | | | | | | | | | | | |
| PCB 112 | | x | x | | x | x | | x | | x | x | x | x |
| PCB 114 | | x | x | | x | x | | | | x | x | x | |
| PCB 118 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 120 | | x | | | | | | | | | | | |
| PCB 121 | | | | | | | | | | | | | |
| PCB 122 | | | | | | | | | | | | | |
| PCB 123 | | x | | | | | | | | x | | | |
| PCB 126 | x | x | x | x | x | | x | x | x | x | x | x | x |
| PCB 127 | | | | | | | | | | | | | |
| PCB 128 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 129 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 130 | | x | x | x | x | x | | x | x | x | x | x | |
| PCB 131 | | x | | | | | | | | x | | | |
| PCB 132 | x | x | x | x | x | x | x | x | x | x | x | x | |
| PCB 133 | | x | x | | x | x | | | | x | x | x | |
| PCB 134 | | x | | | x | x | | x | | x | x | x | |
| PCB 135 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 136 | | x | x | | x | x | | x | | x | x | x | |
| PCB 137 | | x | x | x | x | x | | x | | x | x | x | x |
| PCB 139 | | x | x | | x | x | | | | x | x | x | |
| PCB 141 | | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 142 | | | | | | | | | | | x | x | |
| PCB 143 | | x | x | | x | x | | x | | x | | | |

**TABLE 3-5**
Summary of PCB Congeners with at Least One Sample Exceeding Comparison Values
*Upper Columbia River RI/FS*

| | Walleye | | | Wild Rainbow Trout | | | Hatchery Rainbow Trout | | | Largescale Sucker | Mountain Whitefish | Lake Whitefish | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analyte** | **Fillet** | **Offal** | **Wholebody** | **Fillet** | **Offal** | **Whole Body** | **Fillet** | **Offal** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** |
| PCB 144 | x | x | x | x | x | x | x | x | x | x | | | x |
| PCB 145 | | | | | | | | | | | | | |
| PCB 146 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 147 | | | | | | | x | | | | x | x | x |
| PCB 148 | | x | | | | | | | | | | | |
| PCB 150 | | | | | | | | | | | | | |
| PCB 152 | | | | | | | | | | | | | |
| PCB 153 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 154 | | x | | | x | x | | | | x | x | | x |
| PCB 155 | | | | | | | | | | | | | |
| PCB 156 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 158 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 159 | | x | | | | | | | | x | x | | |
| PCB 160 | | | | | | | | | | | | | |
| PCB 161 | | | | | | | | | | | | | |
| PCB 162 | | x | | | x | x | | | | x | x | | |
| PCB 164 | | x | x | x | x | x | | x | | x | x | x | x |
| PCB 165 | | | | | | | | | | | | | |
| PCB 167 | | x | x | x | x | x | | x | | x | x | x | x |
| PCB 169 | | | x | x | | | | | x | x | x | | x |
| PCB 170 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 171 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 172 | x | x | x | x | x | x | | x | | x | x | x | x |
| PCB 174 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 175 | | x | | | | | | | | x | | | |
| PCB 176 | | x | | | | | | | | x | | | |
| PCB 177 | x | x | x | x | x | x | x | x | x | x | x | x | |
| PCB 178 | | x | x | x | x | x | | x | x | x | x | x | x |
| PCB 179 | | x | x | x | x | x | | x | x | x | x | x | |
| PCB 180 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 181 | | | | | x | | | | | x | | | |
| PCB 182 | x | x | x | x | x | x | x | x | x | x | | | |
| PCB 183 | | x | | | | | x | | | x | x | x | x |
| PCB 184 | | | | | | | | | | | | | |
| PCB 186 | | | | | | | | | | | | | |
| PCB 187 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 188 | | | | | | | | | | | | | |
| PCB 189 | | x | | | x | x | | | | x | x | | |
| PCB 190 | | x | x | x | x | x | | x | | x | x | x | x |
| PCB 191 | | x | | | | x | | | | x | x | | |
| PCB 192 | | | | | | | | | | | | | |
| PCB 194 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 195 | | x | x | x | x | x | | x | | x | x | x | x |
| PCB 196 | x | x | x | x | x | x | x | x | x | x | x | x | |
| PCB 197 | | x | | | | x | | | | x | x | | |
| PCB 198 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 201 | | x | x | | x | x | | | | x | x | x | |
| PCB 202 | | x | x | | x | x | | x | | x | x | x | x |
| PCB 203 | x | x | x | x | x | x | x | x | x | x | x | x | x |
| PCB 204 | | | | | | | | | | | | | |
| PCB 205 | | x | | | | | | | | x | | | |
| PCB 206 | x | x | x | x | x | x | x | x | | x | x | x | x |
| PCB 207 | | x | | | | | | | | x | x | | x |
| PCB 208 | | x | x | | x | x | | | | x | x | | x |
| PCB 209 | | | | | | x | | | | x | | | x |

PCB = polychlorinated biphenyl

**TABLE 3-6**

PCB Congener Analytes Most Frequently Exceeding Comparison Values

*Upper Columbia River RI/FS*

| Number of Species/Tissue Types | | |
|---|---|---|
| **13** | **10 to 12** | **5 to 9** |
| **PCB Congeners** | | |
| PCB 13 | PCB 20 | PCB 40 |
| PCB 44 | PCB 31 | PCB 42 |
| PCB 52 | PCB 93 | PCB 48 |
| PCB 61 | PCB 107 | PCB 60 |
| PCB 66 | PCB 109 | PCB 83 |
| PCB 85 | PCB 126 | PCB 84 |
| PCB 86 | PCB 130 | PCB 88 |
| PCB 90 | PCB 132 | PCB 107 |
| PCB 92 | PCB 137 | PCB 112 |
| PCB 99 | PCB 141 | PCB 114 |
| PCB 105 | PCB 144 | PCB 133 |
| PCB 110 | PCB 164 | PCB 134 |
| PCB 118 | PCB 167 | PCB 136 |
| PCB 128 | PCB 172 | PCB 139 |
| PCB 129 | PCB 178 | PCB 143 |
| PCB 135 | PCB 179 | PCB 154 |
| PCB 146 | PCB 182 | PCB 162 |
| PCB 153 | PCB 190 | PCB 169 |
| PCB 156 | PCB 170 | PCB 183 |
| PCB 158 | PCB 171 | PCB 189 |
| PCB 170 | PCB 195 | PCB 201 |
| PCB 171 | PCB 196 | PCB 202 |
| PCB 174 | PCB 206 | PCB 208 |
| PCB 180 | | |
| PCB 187 | | |
| PCB 194 | | |
| PCB 198 | | |
| PCB 203 | | |

PCB = polychlorinated biphenyl

**TABLE 3-7**

Maximum Exceedance Ratios of Comparison Values for PCB Congeners

*Upper Columbia River RI/FS*

| Analyte | Walleye | | Wild Rainbow Trout | | Hatchery Rainbow Trout | | Largescale Sucker | Mountain Whitefish | Lake Whitefish | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fillet | Wholebody | Fillet | Whole Body | Fillet | Whole Body | Whole Body | Whole Body | Whole Body | Whole Body |
| **PCB Congeners** | | | | | | | | | | |
| PCB 2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 4 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 8 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 9 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 10 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 11 | -- | -- | -- | -- | -- | -- | -- | 1.2 | 3.8 | -- |
| PCB 12 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 14 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 15 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 16 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 17 | -- | -- | -- | -- | -- | -- | 1.1 | -- | -- | -- |
| PCB 18 | -- | -- | -- | -- | -- | -- | 1.9 | 1.9 | 2.1 | -- |
| PCB 19 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 20 | -- | 2.2 | 1.8 | 3.6 | 1.4 | 1.7 | 6.4 | 6.2 | 4.8 | 2.0 |
| PCB 21 | -- | -- | -- | -- | -- | -- | 2.1 | -- | -- | -- |
| PCB 22 | -- | -- | -- | -- | -- | -- | 1.1 | -- | -- | -- |
| PCB 23 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 24 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 25 | -- | -- | -- | -- | -- | -- | -- | -- | 1.0 | -- |
| PCB 26 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 27 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 31 | -- | 1.4 | 1.5 | 2.3 | -- | 1.1 | 3.1 | 4.2 | 3.6 | 1.2 |
| PCB 32 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 34 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 35 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 36 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 37 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 38 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 39 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 40 | -- | -- | -- | -- | -- | -- | 10.1 | 1.7 | 2.8 | -- |
| PCB 41 | -- | -- | -- | -- | -- | -- | 1.4 | -- | -- | -- |
| PCB 42 | -- | 1.1 | -- | -- | -- | -- | 9.0 | 1.4 | 3.1 | -- |
| PCB 43 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 44 | 1.0 | 5.5 | 2.6 | 6.5 | 2.2 | 3.0 | 36.8 | 5.5 | 14.1 | 5.6 |
| PCB 45 | -- | -- | -- | -- | -- | -- | 1.3 | -- | -- | -- |
| PCB 46 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 48 | -- | -- | -- | -- | -- | -- | 4.5 | 1.1 | 1.8 | -- |
| PCB 49 | -- | 4.4 | 2.1 | 5.5 | 1.6 | 2.0 | 33.2 | 6.3 | 10.4 | 4.3 |
| PCB 50 | -- | -- | -- | -- | -- | -- | 1.2 | -- | 1.1 | -- |
| PCB 52 | 1.6 | 8.2 | 5.1 | 13.8 | 3.4 | 4.5 | 22.7 | 14.3 | 20.7 | 8.0 |
| PCB 54 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 55 | -- | -- | -- | -- | -- | -- | 2.1 | -- | -- | -- |
| PCB 56 | -- | -- | -- | -- | -- | -- | 6.4 | 2.1 | 4.4 | -- |
| PCB 57 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 58 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 59 | -- | -- | -- | -- | -- | -- | 3.7 | -- | 1.4 | -- |
| PCB 60 | -- | 1.7 | -- | 2.4 | -- | -- | 13.4 | 3.7 | 2.8 | 1.8 |
| PCB 61 | 2.4 | 13.1 | 8.9 | 18.7 | 4.6 | 5.6 | 62.0 | 27.2 | 25.7 | 12.5 |
| PCB 63 | -- | -- | -- | -- | -- | -- | 4.4 | -- | -- | -- |
| PCB 64 | -- | 2.6 | 1.5 | 3.7 | -- | 1.5 | 23.0 | 4.6 | 7.1 | 2.0 |
| PCB 66 | 1.7 | 9.4 | 3.9 | 10.4 | 3.0 | 3.3 | 69.7 | 18.0 | 17.2 | 10.6 |
| PCB 67 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 68 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 72 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 73 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 77 | -- | -- | -- | -- | -- | -- | 1.6 | -- | 1.5 | -- |
| PCB 78 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 79 | -- | -- | -- | -- | -- | -- | 2.5 | 1.4 | 1.1 | -- |
| PCB 80 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 81 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 82 | -- | 1.6 | -- | -- | -- | -- | 9.5 | 2.4 | 2.4 | -- |
| PCB 83 | -- | -- | -- | -- | -- | -- | 18.2 | 7.0 | 7.2 | 2.7 |
| PCB 84 | -- | 1.8 | -- | 1.6 | -- | -- | 14.1 | 5.2 | 6.2 | -- |
| PCB 85 | 1.3 | 7.7 | 2.8 | 9.6 | 1.7 | 1.7 | 35.0 | 21.0 | 12.8 | 8.3 |
| PCB 86 | 3.1 | 14.8 | 9.2 | 16.8 | 4.4 | 4.7 | 93.0 | 32.2 | 26.3 | 10.8 |
| PCB 88 | -- | 2.3 | 1.4 | 3.1 | -- | -- | 17.7 | 10.8 | 9.5 | -- |
| PCB 89 | -- | -- | -- | -- | -- | -- | 1.0 | -- | -- | -- |
| PCB 90 | 6.1 | 27.5 | 19.0 | 43.2 | 9.0 | 9.2 | 139.0 | 50.8 | 43.0 | 23.5 |
| PCB 92 | 1.4 | 6.4 | 4.3 | 9.6 | 1.8 | 1.9 | 22.0 | 11.4 | 10.2 | 6.0 |
| PCB 93 | 1.8 | 9.9 | 7.3 | 18.0 | -- | 3.7 | 48.5 | -- | -- | 2.6 |
| PCB 94 | -- | -- | -- | -- | -- | -- | 1.7 | 20.5 | 24.7 | -- |
| PCB 95 | -- | -- | -- | -- | 4.2 | -- | -- | -- | -- | -- |
| PCB 96 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 98 | -- | -- | -- | -- | -- | -- | 3.4 | -- | -- | -- |
| PCB 99 | 4.2 | 17.7 | 12.5 | 31.7 | 4.1 | 3.7 | 71.5 | 52.0 | 19.8 | 19.7 |
| PCB 103 | -- | -- | -- | -- | -- | -- | 1.0 | -- | -- | -- |
| PCB 104 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 105 | 2.8 | 10.1 | 7.3 | 16.8 | 2.5 | 3.1 | 46.0 | 33.5 | 12.5 | 15.5 |
| PCB 106 | -- | -- | -- | -- | -- | -- | 3.3 | -- | -- | -- |
| PCB 107 | -- | -- | -- | 1.2 | -- | -- | 3.4 | 2.7 | 1.3 | -- |

**TABLE 3-7**

Maximum Exceedance Ratios of Comparison Values for PCB Congeners

*Upper Columbia River RI/FS*

| | Walleye | | Wild Rainbow Trout | | Hatchery Rainbow Trout | | Largescale Sucker | Mountain Whitefish | Lake Whitefish | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|
| **Analyte** | **Fillet** | **Wholebody** | **Fillet** | **Whole Body** | **Fillet** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** | **Whole Body** |
| PCB 109 | -- | 3.5 | 2.6 | 4.8 | -- | -- | 11.9 | 7.5 | 3.6 | 2.2 |
| PCB 110 | 5.2 | 25.3 | 20.2 | 36.7 | 9.2 | 9.0 | 120.5 | 90.7 | 82.7 | 12.2 |
| PCB 111 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 112 | -- | 1.2 | -- | -- | -- | -- | 10.7 | 2.2 | 2.3 | 1.9 |
| PCB 114 | -- | 0.4 | -- | 1.1 | -- | -- | 3.5 | 16.3 | 28.1 | -- |
| PCB 118 | 8.1 | 28.7 | 20.5 | 34.8 | 7.3 | 8.6 | 127.5 | 88.8 | 144.7 | 234.5 |
| PCB 120 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 121 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 122 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 123 | -- | -- | -- | -- | -- | -- | 3.6 | -- | -- | -- |
| PCB 126 | 6.9 | 70.0 | 23.3 | -- | 11.3 | 25.9 | 185.4 | 146.8 | 45.7 | 59.0 |
| PCB 127 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 128 | 2.4 | 10.8 | 5.8 | 8.2 | 2.0 | 2.8 | 28.8 | 11.0 | 7.1 | 10.8 |
| PCB 129 | 20.8 | 88.7 | 43.0 | 99.5 | 15.4 | 18.0 | 296.7 | 149.3 | 66.5 | 66.3 |
| PCB 130 | -- | 4.2 | 2.4 | 5.9 | -- | 1.1 | 17.2 | 8.7 | 4.2 | -- |
| PCB 131 | -- | -- | -- | -- | -- | -- | 1.3 | -- | -- | -- |
| PCB 132 | 1.9 | 8.3 | 3.7 | 8.3 | 1.7 | 3.1 | 43.3 | 21.7 | 12.6 | -- |
| PCB 133 | -- | 1.7 | -- | 2.1 | -- | -- | 4.7 | 3.5 | 1.3 | 1.4 |
| PCB 134 | -- | -- | -- | 1.1 | -- | -- | 10.8 | 1.9 | 1.9 | -- |
| PCB 135 | 3.1 | 16.5 | 7.6 | 24.8 | 3.0 | 4.5 | 55.0 | 23.8 | 20.8 | 9.6 |
| PCB 136 | -- | 2.8 | -- | 2.0 | -- | -- | 12.2 | 4.8 | 4.6 | -- |
| PCB 137 | -- | 4.1 | 3.0 | 5.9 | -- | -- | 12.6 | 12.3 | 3.1 | 3.1 |
| PCB 139 | -- | 1.2 | -- | 1.6 | -- | -- | 4.1 | 3.1 | 1.2 | 1.4 |
| PCB 141 | -- | 8.3 | 4.0 | 13.3 | 1.4 | 2.0 | 35.5 | 13.8 | 6.6 | 9.0 |
| PCB 142 | -- | -- | -- | -- | -- | -- | -- | 68.5 | 35.5 | -- |
| PCB 143 | -- | 2.1 | -- | 2.7 | -- | -- | 5.1 | -- | -- | -- |
| PCB 144 | 5.0 | 24.5 | 16.4 | 41.8 | -- | 10.7 | 146.2 | -- | -- | 1.1 |
| PCB 145 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 146 | 3.2 | 12.7 | 7.4 | 18.8 | 2.4 | 3.3 | 49.0 | 19.5 | 9.7 | 8.0 |
| PCB 147 | -- | -- | -- | -- | 6.5 | -- | -- | 3.6 | 2.4 | 4.7 |
| PCB 148 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 150 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 152 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 153 | 21.5 | 85.7 | 46.5 | 136.8 | 16.5 | 21.0 | 343.3 | 221.7 | 53.3 | 70.0 |
| PCB 154 | -- | -- | -- | 1.0 | -- | -- | 2.4 | 2.0 | -- | 1.4 |
| PCB 155 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 156 | 1.8 | 6.0 | 3.9 | 10.2 | 1.3 | 1.2 | 20.0 | 20.8 | 4.3 | 7.4 |
| PCB 158 | 1.2 | 6.2 | 2.8 | 6.2 | 1.1 | 1.2 | 22.0 | 6.1 | 4.0 | 5.6 |
| PCB 159 | -- | -- | -- | -- | -- | -- | 1.1 | 1.1 | -- | -- |
| PCB 160 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 161 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 162 | -- | -- | -- | 1.4 | -- | -- | 2.2 | 1.8 | -- | -- |
| PCB 164 | -- | 2.9 | 1.6 | 4.5 | -- | -- | 10.1 | 4.9 | 2.6 | 1.0 |
| PCB 165 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 167 | -- | 1.9 | 1.5 | 1.9 | -- | -- | 8.7 | 6.8 | 1.5 | 1.3 |
| PCB 169 | -- | 73.7 | 35.7 | -- | -- | 63.9 | 599.2 | 181.5 | -- | 65.1 |
| PCB 170 | 4.7 | 16.2 | 7.4 | 35.7 | 3.6 | 3.9 | 68.3 | 53.3 | 9.0 | 12.9 |
| PCB 171 | 1.5 | 5.2 | 2.1 | 10.4 | 1.2 | 1.3 | 21.8 | 13.6 | 3.6 | 4.7 |
| PCB 172 | 1.0 | 3.3 | 1.8 | 7.1 | -- | -- | 21.7 | 9.3 | 1.9 | 2.0 |
| PCB 174 | 1.6 | 5.7 | 3.9 | 14.0 | 1.7 | 2.7 | 40.0 | 20.5 | 7.0 | 1.9 |
| PCB 175 | -- | -- | -- | -- | -- | -- | 3.4 | -- | -- | -- |
| PCB 176 | -- | -- | -- | -- | -- | -- | 6.6 | -- | -- | -- |
| PCB 177 | 2.0 | 7.9 | 3.9 | 18.5 | 2.1 | 2.8 | 43.2 | 18.7 | 7.9 | -- |
| PCB 178 | -- | 5.1 | 1.6 | 4.5 | -- | 1.1 | 17.3 | 3.4 | 3.6 | 3.7 |
| PCB 179 | -- | 5.4 | 1.1 | 4.1 | -- | 1.4 | 17.7 | 4.2 | 5.6 | -- |
| PCB 180 | 13.2 | 42.5 | 21.2 | 101.7 | 9.3 | 9.8 | 268.3 | 146.3 | 22.5 | 40.0 |
| PCB 181 | -- | -- | -- | -- | -- | -- | 20.5 | -- | -- | -- |
| PCB 182 | 4.5 | 16.4 | 7.0 | 34.2 | -- | 4.5 | 92.0 | -- | -- | -- |
| PCB 183 | -- | -- | -- | -- | 3.2 | -- | 1.4 | 43.2 | 11.6 | 13.1 |
| PCB 184 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 186 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 187 | 5.9 | 27.7 | 11.7 | 30.2 | 5.9 | 7.4 | 116.3 | 10.8 | 18.2 | 9.4 |
| PCB 188 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 189 | -- | -- | -- | 1.0 | -- | -- | 2.0 | 1.5 | -- | -- |
| PCB 190 | -- | 3.6 | 1.8 | 7.0 | -- | -- | 9.1 | 10.8 | 2.2 | 2.8 |
| PCB 191 | -- | -- | -- | 1.7 | -- | -- | 4.0 | 2.1 | -- | -- |
| PCB 192 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 194 | 1.5 | 6.0 | 3.7 | 15.8 | 1.4 | 1.0 | 35.7 | 23.0 | 2.5 | 4.4 |
| PCB 195 | -- | 3.5 | 1.4 | 6.5 | -- | -- | 16.1 | 7.7 | 1.7 | 3.3 |
| PCB 196 | 1.6 | 6.5 | 2.4 | 11.8 | 1.2 | 1.5 | 26.7 | 13.6 | 2.9 | 7.1 |
| PCB 197 | -- | -- | -- | 1.2 | -- | -- | 6.8 | 2.1 | -- | -- |
| PCB 198 | 3.0 | 12.0 | 5.1 | 21.3 | 2.7 | 3.1 | 49.0 | 25.5 | 6.0 | 8.6 |
| PCB 201 | -- | 1.3 | -- | 2.3 | -- | -- | 7.8 | 2.1 | 1.0 | -- |
| PCB 202 | -- | 2.8 | -- | 3.5 | -- | -- | 10.6 | 4.2 | 1.9 | 2.4 |
| PCB 203 | 2.7 | 7.9 | 3.8 | 14.3 | 1.8 | 1.4 | 37.7 | 19.3 | 3.8 | 8.2 |
| PCB 204 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| PCB 205 | -- | -- | -- | -- | -- | -- | 1.9 | -- | -- | -- |
| PCB 206 | 1.4 | 4.3 | 1.9 | 5.0 | 1.0 | -- | 19.5 | 8.3 | 1.4 | 7.2 |
| PCB 207 | -- | -- | -- | -- | -- | -- | 2.7 | 1.0 | -- | 1.2 |
| PCB 208 | -- | 1.2 | -- | 1.4 | -- | -- | 6.4 | 1.9 | -- | 1.6 |
| PCB 209 | -- | -- | -- | -- | -- | -- | 2.7 | -- | -- | 1.2 |

PCB = polychlorinated biphenyl

**TABLE 3-8**
Summary Statistics for Whole Body by Species for all FSCAs
*Upper Columbia River RI/FS*

| Constituent of Interest | Units | Species: | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Walleye Mean (± 1 SD) N | Wild Rainbow Trout Mean (± 1 SD) N | Hatchery Rainbow Trout Mean (± 1 SD) N | Lake Whitefish Mean (± 1 SD) N | Mountain Whitefish Mean (± 1 SD) N | Largescale Sucker Mean (± 1 SD) N | Burbot Mean (± 1 SD) N |
| Aluminum | mg/kg WW | 8.55 (-14.09-31.19) 30 | 5.25 (3.09-7.41) 14 | 11.42 (2.22-20.62) 17 | 3.74 (1.73-5.75) 22 | 11.66 (3.73-19.59) 5 | 53.66 (11.09-96.23) 29 | 7.49 (3.74-11.24) 22 |
| Arsenic | mg/kg WW | 0.15 (0.1-0.2) 30 | 0.14 (0.12-0.16) 14 | 0.11 (0.09-0.13) 17 | 0.26 (0.22-0.3) 22 | 0.19 (0.12-0.26) 5 | 0.19 (0.14-0.24) 29 | 0.77 (0.64-0.9) 22 |
| Barium | mg/kg WW | 0.87 (0.78-0.96) 30 | 0.78 (0.43-1.13) 14 | 0.61 (0.22-1) 17 | 0.56 (0.44-0.68) 22 | 0.98 (0.38-1.58) 5 | 4.06 (1.01-7.11) 29 | 5.94 (4.81-7.07) 22 |
| Cadmium | mg/kg WW | 0.02 (0.01-0.03) 30 | 0.04 (0.03-0.05) 14 | 0.05 (0.04-0.06) 17 | 0.02 (0.01-0.03) 22 | 0.1 (0.06-0.14) 5 | 0.3 (0.24-0.36) 29 | 0.04 (0.02-0.06) 22 |
| Chromium | mg/kg WW | 0.53 (0.39-0.67) 30 | 0.73 (0.6-0.86) 14 | 0.5 (0.37-0.63) 17 | 0.76 (0.63-0.89) 22 | 0.98 (0.77-1.19) 5 | 1.38 (0.48-2.28) 29 | 0.4 (0.15-0.65) 22 |
| Copper | mg/kg WW | 0.36 (0.3-0.42) 30 | 1.27 (0.82-1.72) 14 | 0.86 (0.17-1.55) 17 | 0.64 (0.53-0.75) 22 | 1.16 (0.55-1.77) 5 | 2.3 (-1.82-6.42) 29 | 1.11 (0.91-1.31) 22 |
| Iron | mg/kg WW | 9.83 (8.45-11.21) 30 | 23.5 (17.18-29.82) 14 | 21.69 (11.88-31.5) 17 | 15.14 (11.92-18.36) 22 | 84.31 (27.49-141.13) 5 | 188.8 (-152.47-530.07) 29 | 25.62 (19.99-31.25) 22 |
| Lead | mg/kg WW | 0.05 (0-0.1) 30 | 0.09 (0.04-0.14) 14 | 0.04 (-0.03-0.11) 17 | 0.06 (0.04-0.08) 22 | 0.28 (0.11-0.45) 5 | 2.55 (0.26-4.84) 29 | 0.09 (0.06-0.12) 22 |
| Nickel | mg/kg WW | 0.39 (0.34-0.44) 30 | 0.21 (0.15-0.27) 14 | 0.18 (0.09-0.27) 17 | 0.21 (0.17-0.25) 22 | 0.23 (0.18-0.28) 5 | 0.64 (0.23-1.05) 29 | 0.3 (0.25-0.35) 22 |
| Selenium | mg/kg WW | 0.52 (0.4-0.64) 30 | 0.66 (0.57-0.75) 14 | 0.41 (0.32-0.5) 17 | 0.71 (0.59-0.83) 22 | 0.95 (0.65-1.25) 5 | 0.55 (0.46-0.64) 29 | 0.55 (0.43-0.67) 22 |
| Uranium | mg/kg WW | 0.0009 (0.0006-0.0012) 30 | 0.0026 (0.0016-0.004) 14 | 0.0021 (-0.0004-0.005) 17 | 0.002 (0.001-0.003) 22 | 0.0075 (0.003-0.012) 5 | 0.0192 (0.01-0.028) 29 | 0.005 (0.003-0.0067) 22 |
| Zinc | mg/kg WW | 12.6 (11.5-13.7) 30 | 23.7 (20.9-26.5) 14 | 23.7 (22.1-25.3) 17 | 12.7 (11.7-13.7) 22 | 24.3 (16.1-32.5) 5 | 32.2 (-0.3-64.7) 29 | 12.4 (11.6-13.2) 22 |
| Mercury | ug/kg WW | 179.9 (133.6-226.2) 30 | 61.4 (43.3-79.5) 14 | 92 (35.1-148.9) 17 | 63.2 (50.1-76.3) 22 | 80.4 (69.2-91.6) 5 | 190.9 (98.8-283) 29 | 179.4 (141.2-217.6) 22 |
| Total PCBs | ug/kg WW | 68.4 (46.9-89.9) 30 | 73.6 (57.7-89.5) 14 | 52.5 (48.9-56.1) 17 | 73.2 (61.6-84.8) 22 | 104.4 (90.5-118.3) 5 | 121 (46.2-195.8) 29 | 70.5 (60.6-80.4) 22 |
| 2,3,7,8 TCDF | ug/kg WW | 0.0015 (0.0009-0.0021) 30 | 0.0019 (0.0007-0.0031) 14 | 0.0013 (0.001-0.0016) 17 | 0.0055 (0.0037-0.0073) 22 | 0.0051 (0.003-0.0072) 5 | 0.0032 (0.0007-0.0057) 29 | 0.0039 (0.0029-0.0049) 22 |

mg/kg WW = milligrams per kilogram wet weight
N = number of samples
PCB = polychlorinated biphenyl
SD = standard deviation

**TABLE 3-9**
Overall Summary Statistics for Walleye and Rainbow Trout Fillets
*Upper Columbia River RI/FS*

| Analyte | Units | Walleye Fillet Mean (± 1 SD) N | Wild Rainbow Trout Fillet Mean (± 1 SD) N | Hatchery Rainbow Trout Fillet Mean (± 1 SD) N |
|---|---|---|---|---|
| **TAL Metals** | | | | |
| Aluminum | mg/kg WW | 1.26 (1.23-1.29) 14 | 1.9 (1.743-2.057) 9 | 1.8 (1.78-1.82) 8 |
| Arsenic | mg/kg WW | 0.11 (0.08-0.14) 15 | 0.085 (0.071-0.099) 9 | 0.04 (0.022-0.058) 8 |
| Barium | mg/kg WW | 0.042 (0.041-0.043) 15 | 0.064 (0.059-0.069) 9 | 0.06 (0.0593-0.0607) 8 |
| Cadmium | mg/kg WW | 0.005 (0.0049-0.0051) 15 | 0.009 (0-0.018) 9 | 0.006 (0.00593-0.00607) 8 |
| Chromium | mg/kg WW | 0.48 (0.339-0.621) 15 | 0.54 (0.421-0.659) 9 | 0.34 (0.256-0.424) 8 |
| Copper | mg/kg WW | 0.213 (0.191-0.235) 15 | 0.328 (0.301-0.355) 9 | 0.297 (0.2478-0.3462) 8 |
| Iron | mg/kg WW | 0.51 (-0.69-1.71) 15 | 0.33 (0.303-0.357) 9 | 0.297 (0.2478-0.3462) 8 |
| Lead | mg/kg WW | 0.016 (-0.003-0.035) 15 | 0.012 (0.0064-0.0176) 9 | 0.006 (0.00593-0.00607) 8 |
| Nickel | mg/kg WW | 0.11 (0.073-0.147) 15 | 0.027 (0.015-0.039) 9 | 0.041 (0.0008-0.0812) 8 |
| Selenium | mg/kg WW | 0.39 (0.323-0.457) 15 | 0.467 (0.4-0.534) 9 | 0.28 (0.204-0.356) 8 |
| Uranium | mg/kg WW | 0.0003 (0.00029-0.00031) 15 | 0.0006 (0.00056-0.00064) 9 | 0.0006 (0.00059-0.00061) 8 |
| Zinc | mg/kg WW | 6.6 (5.934-7.266) 15 | 7.7 (6.68-8.72) 9 | 7.3 (6.577-8.023) 8 |
| Mercury | *u*g/kg WW | 267.1 (199-335.2) 15 | 88 (70.6-105.4) 9 | 86.4 (65-107.8) 8 |
| **PCB Aroclor** | | | | |
| Total PCB | *u*g/kg WW | 36.4 (14.7-58.1) 15 | 63.1 (49.6-76.6) 9 | 44 (40.8-47.2) 8 |
| **Dioxins/Furans** | | | | |
| 2,3,7,8 TCDF | *u*g/kg WW | 0.00034 (0.00011-0.00057) 15 | 0.00242 (0.00182-0.00302) 9 | 0.0004 (0.0004-0.0004) 8 |

mg/kg WW = milligrams per kilogram wet weight
N = number of samples
PCB = polychlorinated biphenyl
SD = standard deviation
TAL = Target Analyte List

**TABLE 3-10**

Percent Arsenic Species Associated with Fillet, Offal, and Whole Body Samples

*Upper Columbia River RI/FS*

| Species | Composite ID | Total Arsenic ICP/MS Arsenic (*u* g/kg WW) | | As-Species $As^{+}3$ and $As^{+}5$ (*u* g/kg WW) | | % As as $As^{+}3 + As^{+}5$ | As-Species ASB + Cation (*u* g/kg WW) | | % AS as ASB + Cation | As-Species Dimethylarsonic Acid (DMA) (*u* g/kg WW) | | % As as Dimethylarsonic Acid (DMA) | As-Species Monomethylarsonic Acid (MMA) *u* g/kg WW | | % AS as Monomethylarsonic Acid (MMA) | As-Species Unknown (*u* g/kg WW) | | % -As as Species Unknown | % Total As as Inorganic Species | % Total As as Organic Species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Walleye** | | | | | | | | | | | | | | | | | | | | |
| | WE1F15 | 111 | | 8.8 | U | 10.8% | 46 | J | 56.8% | 8.8 | U | 10.8% | 8.8 | U | 10.8% | 8.8 | UJ | 10.8% | 10.8% | 89.2% |
| | WE3F55 | 122 | | 8.7 | U | 13.9% | 23 | J | 36.3% | 8.7 | U | 13.9% | 8.7 | U | 13.9% | 14 | J | 22.0% | 13.9% | 86.1% |
| | WE6F45 | 99 | | 8.9 | U | 14.5% | 8.9 | UJ | 14.5% | 8.9 | U | 14.5% | 8.9 | U | 14.5% | 25 | J | 41.8% | 14.5% | 85.5% |
| | **Average for Fillets** | | | | | ***13.1%*** | | | ***35.9%*** | | | ***13.1%*** | | | ***13.1%*** | | | ***24.9%*** | ***13.1%*** | ***86.9%*** |
| | WE1O15 | 116 | | 12 | J | 18.9% | 18 | J | 28.6% | 9.5 | J | 14.7% | 12 | U | 18.9% | 12 | UJ | 18.9% | 18.9% | 81.1% |
| | WE3O55 | 177 | | 49 | | 48.2% | 13 | UJ | 12.2% | 14 | J | 13.7% | 13 | U | 12.2% | 14 | J | 13.7% | 48.2% | 51.8% |
| | WE6O45 | 141 | | 12 | U | 17.8% | 12 | UJ | 17.8% | 16 | J | 23.5% | 12 | U | 17.8% | 16 | J | 23.0% | 17.8% | 82.2% |
| | **Average for Offal** | | | | | ***28.3%*** | | | ***19.5%*** | | | ***17.3%*** | | | ***16.3%*** | | | ***18.5%*** | ***28.3%*** | ***71.7%*** |
| | WE2W55 | 91 | | 11 | U | 14.9% | 14 | J | 19.6% | 11 | U | 14.9% | 11 | U | 14.9% | 26 | J | 35.8% | 14.9% | 85.1% |
| | WE2W55[a] | 83 | | 11 | U | 16.1% | 9.0 | J | 13.7% | 11 | U | 16.1% | 11 | U | 16.1% | 25 | J | 38.0% | 16.1% | 83.9% |
| | WE4W35 | 230 | | 38 | | 39.8% | 11 | UJ | 11.3% | 13 | J | 13.3% | 11 | U | 11.3% | 23 | J | 24.3% | 39.8% | 60.2% |
| | WE5W35 | 189 | | 10 | U | 12.0% | 30 | J | 34.9% | 12 | J | 13.8% | 10 | U | 12.0% | 23 | J | 27.3% | 12.0% | 88.0% |
| | **Whole Body Average** | | | | | ***20.7%*** | | | ***19.9%*** | | | ***14.5%*** | | | ***13.6%*** | | | ***31.3%*** | ***20.7%*** | ***79.3%*** |
| **Wild Rainbow Trout** | | | | | | | | | | | | | | | | | | | | |
| | RW1F55 | 99 | | 11 | U | 21.4% | 7.5 | J | 14.6% | 11 | U | 21.4% | 11 | U | 21.4% | 11 | UJ | 21.4% | 21.4% | 78.6% |
| | RW1F55[a] | 101 | | 11 | U | 20.9% | 8.5 | J | 16.3% | 11 | U | 20.9% | 11 | U | 20.9% | 11 | UJ | 20.9% | 20.9% | 79.1% |
| | RW3F25 | 68 | | 10 | U | 16.4% | 10 | UJ | 16.4% | 10 | U | 16.4% | 10 | U | 16.4% | 22 | J | 34.4% | 16.4% | 83.6% |
| | **Average for Fillets** | | | | | ***19.6%*** | | | ***15.8%*** | | | ***19.6%*** | | | ***19.6%*** | | | ***25.6%*** | ***19.6%*** | ***80.4%*** |
| | RW1O35[a] | 213 | | 14 | U | 23.3% | 9.7 | J | 16.5% | 8.0 | J | 13.6% | 14 | U | 23.3% | 14 | UJ | 23.3% | 23.3% | 76.7% |
| | RW1O35[a] | 228 | | 14 | U | 18.6% | 15 | J | 19.5% | 18 | J | 24.5% | 14 | U | 18.6% | 14 | UJ | 18.6% | 18.6% | 81.4% |
| | RW3O25 | 215 | | 21 | J | 23.1% | 12 | UJ | 13.4% | 12 | J | 13.7% | 12 | U | 13.4% | 32 | J | 36.5% | 23.1% | 76.9% |
| | **Average for Offal** | | | | | ***21.7%*** | | | ***16.5%*** | | | ***17.3%*** | | | ***18.4%*** | | | ***26.1%*** | ***21.7%*** | ***78.3%*** |
| | RW2W35 | 140 | | 32 | | 35.4% | 19 | J | 21.4% | 13 | U | 14.4% | 13 | U | 14.4% | 13 | UJ | 14.4% | 35.4% | 64.6% |
| | RW2W35[a] | 148 | | 38 | | 39.6% | 18 | J | 19.1% | 13 | U | 13.8% | 13 | U | 13.8% | 13 | UJ | 13.8% | 39.6% | 60.4% |
| | RW5W15 | 175 | | 13 | U | 16.1% | 13 | UJ | 16.1% | 18 | J | 22.7% | 13 | U | 16.1% | 23 | J | 29.0% | 16.1% | 83.9% |
| | **Whole Body Average** | | | | | ***30.4%*** | | | ***18.9%*** | | | ***17.0%*** | | | ***14.7%*** | | | ***19.1%*** | ***30.4%*** | ***69.6%*** |
| **Hatchery Rainbow Trout** | | | | | | | | | | | | | | | | | | | | |
| | RH3F25 | 60 | U | NA | | NC | NA | | NC | NA | | NC | NA | | NC | - | | NC | NC | NC |
| | RH6F45 | 60 | U | NA | | NC | NA | | NC | NA | | NC | NA | | NC | - | | NC | NC | NC |
| | **Average for Fillets** | | | | | | | | | | | | | | | | | | | |
| | RH3O25 | 132 | | 28 | | 35.2% | 11 | UJ | 14.0% | 2.5 | J | 3.1% | 11 | U | 14.0% | 27 | J | 33.8% | 35.2% | 64.8% |
| | RH6O45 | 148 | | 12 | U | 16.7% | 12 | UJ | 16.7% | 13 | J | 18.4% | 12 | U | 16.7% | 23 | J | 31.4% | 16.7% | 83.3% |
| | **Average for Offal** | | | | | ***25.9%*** | | | ***15.4%*** | | | ***10.7%*** | | | ***15.4%*** | | | ***32.6%*** | ***25.9%*** | ***74.1%*** |
| | RH4W35 | 126 | | 11 | U | 19.5% | 11 | UJ | 19.5% | 3.1 | J | 5.2% | 11 | U | 19.5% | 21 | J | 36.2% | 19.5% | 80.5% |
| | RH5W25 | 106 | | 11 | U | 24.4% | 11 | UJ | 24.4% | 3.9 | J | 8.3% | 11 | U | 24.4% | 8.7 | J | 18.5% | 24.4% | 75.6% |
| | **Whole Body Average** | | | | | ***22.0%*** | | | ***22.0%*** | | | ***6.8%*** | | | ***22.0%*** | | | ***27.3%*** | ***22.0%*** | ***78.0%*** |
| **Mountain Whitefish** | | | | | | | | | | | | | | | | | | | | |
| | MW1W25 | 169 | | 14 | U | 21.2% | 8.6 | J | 13.0% | 16 | J | 23.3% | 14 | U | 21.2% | 14 | UJ | 21.2% | 21.2% | 78.8% |
| | MW1W45[a] | 147 | | 14 | U | 24.7% | 8.8 | J | 15.1% | 11 | J | 18.1% | 14 | U | 24.7% | 10 | J | 17.5% | 24.7% | 75.3% |
| | MW1W45 | 144 | | 14 | U | 22.8% | 7.7 | J | 12.2% | 15 | J | 23.9% | 14 | U | 22.8% | 12 | J | 18.3% | 22.8% | 77.2% |
| | **Whole Body Average** | | | | | ***22.9%*** | | | ***13.4%*** | | | ***21.8%*** | | | ***22.9%*** | | | ***19.0%*** | ***22.9%*** | ***77.1%*** |
| **Lake Whitefish** | | | | | | | | | | | | | | | | | | | | |
| | LW2W45 | 261 | | 14 | U | 21.9% | 5.4 | J | 8.6% | 13 | J | 20.3% | 14 | U | 21.9% | 17 | J | 27.3% | 21.9% | 78.1% |
| | LW3W25 | 283 | | 13 | U | 19.5% | 4.4 | J | 6.7% | 19 | J | 28.1% | 13 | U | 19.5% | 17 | J | 26.2% | 19.5% | 80.5% |
| | LW3W25[a] | 271 | | 13 | U | 17.1% | 8.5 | J | 10.8% | 25 | J | 32.1% | 13 | U | 17.1% | 18 | J | 22.9% | 17.1% | 82.9% |
| | LW4W45 | 251 | | 13 | UJL | 18.6% | 13 | UJL | 18.6% | 9.5 | JL | 13.2% | 13 | UJL | 18.6% | 22 | JL | 30.9% | 18.6% | 81.4% |
| | **Whole Body Average** | | | | | ***19.3%*** | | | ***11.2%*** | | | ***23.4%*** | | | ***19.3%*** | | | ***26.8%*** | ***19.3%*** | ***80.7%*** |
| **Largescale Sucker** | | | | | | | | | | | | | | | | | | | | |
| | LS1W45 | 164 | | 12 | J | 20.5% | 16 | J | 27.5% | 8.7 | J | 14.8% | 11 | U | 17.9% | 11 | J | 19.2% | 20.5% | 79.5% |
| | LS2W25[a] | 133 | | 11 | UJL | 18.1% | 15 | JL | 26.1% | 7.8 | JL | 13.3% | 11 | UJL | 18.1% | 14 | JL | 24.3% | 18.1% | 81.9% |
| | LS2W35 | 143 | | 11 | UJL | 17.2% | 8.4 | JL | 13.4% | 9.8 | JL | 15.5% | 11 | UJL | 17.2% | 23 | JL | 36.6% | 17.2% | 82.8% |
| | LS5W15 | 170 | | 11 | UJL | 12.9% | 13 | J | 16.0% | 12 | J | 14.2% | 11 | UJL | 12.9% | 36 | J | 44.0% | 12.9% | 87.1% |
| | **Whole Body Average** | | | | | ***17.2%*** | | | ***20.8%*** | | | ***14.5%*** | | | ***16.5%*** | | | ***31.0%*** | ***17.2%*** | ***82.8%*** |
| **Burbot** | | | | | | | | | | | | | | | | | | | | |
| | BB3W35 | 668 | | 8.5 | UJL | 1.6% | 15 | J | 2.8% | 487 | | 92.4% | 8.5 | UJL | 1.6% | 8.5 | UJ | 1.6% | 1.6% | 98.4% |
| | BB3W35[a] | 668 | | 8.5 | UJL | 1.6% | 15 | J | 2.9% | 480 | U | 92.2% | 8.5 | UJL | 1.6% | 8.5 | UJ | 1.6% | 1.6% | 98.4% |
| | BB4W35 | 759 | | 8.0 | UJL | 1.2% | 12 | J | 1.8% | 584 | | 87.8% | 8.0 | UJL | 1.2% | 53 | J | 7.9% | 1.2% | 98.8% |
| | BB6W45 | 958 | | 8.5 | UJL | 1.0% | 9.3 | J | 1.1% | 780 | | 92.2% | 8.5 | UJL | 1.0% | 40 | J | 4.7% | 1.0% | 99.0% |
| | **Whole Body Average** | | | | | ***1.4%*** | | | ***2.1%*** | | | ***91.2%*** | | | ***1.4%*** | | | ***4.0%*** | ***1.4%*** | ***98.6%*** |

ASB = arsenobetanine

ICP/MS = inductively coupled plasma/mass spectrometry

NA = not analyzed

NC = not calculated

µg/kg WW = micrograms per kilogram wet weight

U - The analyte was not detected at or above the reported value.

J - The identification of the analyte is acceptable; the reported value is an estimate.

UJ - The analyte was not detected at or above the reported value. The reported value is an estimate.

TABLE 3-11
Summary of Possible Conclusions from the Largescale Sucker Gut/Gut Contents Analysis
*Upper Columbia River RI/FS*

| Hypothetical Fish | Gutless Sucker Whole-Body Metals Concentration | Gut/Gut Contents Metals Concentration | % AFDW of Gut/Gut Contents | Conclusion |
|---|---|---|---|---|
| A | High | Low | High (ash weight low relative to dry weight) | Gut contents contained little sediment and would not bias the whole body metals measurements high. |
| B | High | Low | Low (ash weight high relative to dry weight) | Sediment was found in the gut contents but does not contain elevated metals and will not bias the whole body metals measurements high. |
| C | Low | High | High (ash weight low relative to dry weight) | Gut contents contained little sediment, and the elevated metals may be from the sediment and/or the gut tissue. |
| D | Low | High | Low (ash weight high relative to dry weight) | Sediment was found in the gut/gut contents. The elevated metals in the gut/gut contents may be from the sediment and/or the gut tissue. |
| E | High | High | High (ash weight low relative to dry weight) | Gut contents contained little sediment, and the elevated metals are associated with the gut tissue and other body parts |
| F | High | Low | Low (ash weight high relative to dry weight) | Sediment was found in the gut contents. Elevated metals do not appear to be associated with the gut tissue and/or contents. |
| G | Low | Low | High (ash weight low relative to dry weight) | Little sediment was found in the gut contents. Low overall metals concentrations. |
| H | Low | Low | Low (ash weight high relative to dry weight) | Sediment was found in the gut contents. Metals do not appear to be associated with the gut tissue and/or contents. |

**TABLE 3-12**

Estimated TAL Metals Results for Individual Whole Body Largescale Sucker Samples--FSCA 1

*Upper Columbia River RI/FS*

| Analyte | Units | LS1G10040[a] Primary Sample | LS1W10040[b] Primary Sample | LS1EW10040[c] Primary Sample | Associated with Gut/ Contents | LS1G10041 Primary Sample | LS1W10041 Primary Sample | LS1EW10041 Primary Sample | Associated with Gut/ Contents | LS1G10051 Primary Sample | LS1W10051 Primary Sample | LS1EW10051 Primary Sample | Associated with Gut/ Contents | LS1G10056 Primary Sample | LS1W10056 Primary Sample | LS1EW10056 Primary Sample | Associated with Gut/ Contents | LS1G10089 Primary Sample | LS1W10089 Primary Sample | LS1EW10089 Primary Sample | Associated with Gut/ Contents | LS1G50769 Primary Sample | LS1W50769 Primary Sample |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg WW | 2862.5 | 20.3 J | 232.0 | 92% | 1869.5 | 7.1 J | 150.1 | 96% | 744.1 | 112.7 J | 137.8 | 21% | 1410.5 | 6.8 J | 94.5 | 93% | 6486.0 | 8.2 J | 400.6 | 98% | 213.0 | 3.7 U |
| Antimony | mg/kg WW | 1.901 | 0.113 U | 0.246 | 57% | 1.053 | 0.107 U | 0.179 | 45% | 1.544 | 0.106 U | 0.163 | 38% | 1.281 | 0.106 U | 0.180 | 44% | 2.181 | 0.115 U | 0.240 | 55% | 0.198 | 0.097 U |
| Arsenic | mg/kg WW | 2.377 | 0.148 | 0.314 | 56% | 1.685 | 0.200 | 0.314 | 41% | 1.109 | 0.124 | 0.163 | 27% | 1.488 | 0.183 | 0.264 | 35% | 4.982 | 0.145 | 0.438 | 69% | 0.605 | 0.102 |
| Barium | mg/kg WW | 241.8 | 2.6 | 20.5 | 88% | 118.9 | 1.7 | 10.7 | 85% | 44.9 | 3.2 | 4.9 | 37% | 67.2 | 3.0 | 7.0 | 60% | 606.3 | 2.2 | 38.8 | 95% | 15.0 | 1.1 J |
| Beryllium | mg/kg WW | 0.133 | 0.006 U | 0.015 | 65% | 0.081 | 0.005 U | 0.011 | 55% | 0.039 | 0.005 U | 0.007 | 23% | 0.067 | 0.005 U | 0.009 | 46% | 0.277 | 0.006 U | 0.022 | 76% | 0.010 | 0.005 U |
| Cadmium | mg/kg WW | 1.603 | 0.273 | 0.372 | 32% | 2.138 | 0.411 | 0.544 | 30% | 2.264 | 0.343 | 0.419 | 21% | 1.624 | 0.410 | 0.485 | 21% | 2.538 | 0.382 | 0.513 | 30% | 1.384 | 0.287 |
| Calcium | mg/kg WW | 7740.2 | 9657.0 | 9514.2 | 6% | 6350.4 | 8905.0 | 8708.9 | 6% | 8985.6 | 13992.0 | 13793.3 | 3% | 5355.0 | 10592.4 | 10265.3 | 3% | 21103.0 | 8244.6 | 9023.5 | 14% | 17841.6 | 7725.6 J |
| Chromium | mg/kg WW | 54.044 J | 0.638 J | 4.616 | 87% | 99.144 J | 0.658 J | 8.218 | 93% | 53.703 J | 0.752 J | 2.854 | 75% | 37.800 J | 0.628 J | 2.949 | 80% | 101.520 J | 0.546 J | 6.663 | 92% | 3.189 J | 0.470 |
| Cobalt | mg/kg WW | 8.748 | 0.052 | 0.700 | 93% | 4.990 | 0.036 | 0.416 | 92% | 1.931 | 0.058 | 0.132 | 58% | 2.506 | 0.041 | 0.195 | 80% | 18.894 | 0.035 | 1.178 | 97% | 0.437 | 0.026 |
| Copper | mg/kg WW | 306.86 | 1.88 J | 24.60 | 93% | 163.62 | 0.92 J | 13.41 | 94% | 70.55 | 1.18 J | 3.93 | 71% | 82.60 | 0.77 J | 5.88 | 88% | 784.90 | 1.00 J | 48.49 | 98% | 24.73 U | 0.61 |
| Iron | mg/kg WW | 25006.8 | 138.9 | 1991.2 | 94% | 14061.6 | 29.6 | 1106.7 | 98% | 4984.2 | 70.0 | 265.0 | 75% | 7770.0 | 33.9 | 517.0 | 94% | 66740.0 | 61.7 | 4100.9 | 99% | 833.3 | 13.7 J |
| Lead | mg/kg WW | 34.67 | 5.02 J | 7.23 | 36% | 21.74 | 7.26 J | 8.37 | 20% | 11.58 | 13.49 J | 13.41 | 3% | 14.39 | 6.33 J | 6.84 | 13% | 116.56 | 7.78 J | 14.37 | 49% | 2.38 | 3.18 |
| Magnesium | mg/kg WW | 1200.0 | 356.7 | 419.5 | 21% | 884.5 | 331.5 | 374.0 | 18% | 498.4 | 411.8 | 415.3 | 5% | 854.0 | 368.6 | 398.9 | 13% | 2016.3 | 327.6 | 429.9 | 28% | 362.9 | 305.4 |
| Manganese | mg/kg WW | 503.8 | 8.7 | 45.6 | 82% | 284.1 | 12.1 | 32.9 | 66% | 100.4 | 15.4 | 18.8 | 21% | 166.3 | 12.4 | 22.1 | 47% | 1245.5 | 10.4 | 85.2 | 89% | 26.1 | 4.5 J |
| Nickel | mg/kg WW | 19.648 | 0.290 | 1.732 | 85% | 64.152 | 0.301 | 5.203 | 95% | 32.994 | 0.422 | 1.715 | 76% | 20.160 | 0.355 | 1.592 | 79% | 38.963 | 0.254 | 2.599 | 91% | 1.804 | 0.240 |
| Potassium | mg/kg WW | 2725.1 | 3480.0 | 3423.8 | 6% | 2527.2 | 3205.8 | 3153.7 | 6% | 2804.5 | 3352.8 | 3331.0 | 3% | 2789.5 | 3439.8 | 3399.2 | 5% | 2914.0 | 3767.4 | 3715.7 | 5% | 2120.2 | 3366.9 |
| Selenium | mg/kg WW | 1.099 | 0.551 | 0.592 | 14% | 0.807 | 0.521 | 0.543 | 11% | 1.046 | 0.681 | 0.696 | 6% | 0.840 | 0.655 | 0.667 | 8% | 1.499 | 0.519 | 0.578 | 16% | 1.179 | 0.496 |
| Silver | mg/kg WW | 0.595 | 0.073 U | 0.111 | 40% | 0.680 | 0.069 U | 0.115 | 45% | 0.291 | 0.066 U | 0.075 | 15% | 0.172 | 0.066 U | 0.072 | 15% | 1.645 | 0.071 U | 0.166 | 60% | 0.081 | 0.060 U |
| Sodium | mg/kg WW | 1309.9 | 1020.8 | 1042.3 | 9% | 1500.1 | 1120.7 | 1149.8 | 10% | 1449.6 | 1393.9 | 1396.1 | 4% | 1585.5 | 1321.3 | 1337.8 | 7% | 1856.5 | 1198.5 | 1238.3 | 9% | 1609.4 | 986.6 |
| Thallium | mg/kg WW | 0.110 | 0.073 U | 0.075 | 11% | 0.081 | 0.069 U | 0.069 | 9% | 0.084 | 0.066 U | 0.067 | 5% | 0.084 | 0.066 U | 0.067 | 8% | 0.113 | 0.071 U | 0.074 | 9% | 0.081 | 0.060 U |
| Uranium | mg/kg WW | 0.660 | 0.015 | 0.063 | 78% | 0.389 | 0.027 | 0.055 | 54% | 0.201 | 0.030 | 0.036 | 22% | 0.306 | 0.018 | 0.036 | 53% | 1.438 | 0.011 | 0.098 | 89% | 0.101 | 0.008 |
| Vanadium | mg/kg WW | 6.916 | 0.113 U | 0.620 | 83% | 5.281 | 0.107 U | 0.504 | 80% | 2.797 | 0.106 U | 0.212 | 52% | 4.515 | 0.106 U | 0.382 | 74% | 11.468 | 0.115 U | 0.802 | 87% | 0.773 | 0.097 U |
| Zinc | mg/kg WW | 1951.1 | 40.3 J | 182.6 | 80% | 1036.8 | 50.7 J | 126.4 | 63% | 331.3 | 54.6 J | 65.6 | 20% | 462.0 | 37.4 J | 63.9 | 45% | 5170.0 | 49.1 J | 359.3 | 87% | 58.1 | 22.9 |

[a] G indicates a gut/contents sample from an individual largescale sucker.

[b] W followed by a 5-digit numeric code indicates a whole body sample with the gut/contents removed from an individual largescale sucker.

[c] EW indicates estimated whole body. The estimated whole body concentration for the individual largescale sucker was calculated as a weighted average of the gut/contents and the gutless whole body concentrations.

mg/kg WW = milligrams per kilogram wet weight

U - The analyte was not detected at or above the reported value.

J - The identification of the analyte is acceptable; the reported value is an estimate.

**TABLE 3-12**

Estimated TAL Metals Results for Individual Whole Body Largescale Sucker Samples--FSCA 1

*Upper Columbia River RI/FS*

| Analyte | Units | LS1EW50769 Primary Sample | Associated with Gut/ Contents | LS1G50770 Primary Sample | LS1W50770 Primary Sample | LS1EW50770 Primary Sample | Associated with Gut/ Contents | LS1G50771 Primary Sample | LS1W50771 Primary Sample | LS1EW50771 Primary Sample | Associated with Gut/ Contents | LS1G50775 Primary Sample | LS1W50775 Primary Sample | LS1EW50775 Primary Sample | Associated with Gut/ Contents | LS1G50778 Primary Sample | LS1W50778 Primary Sample | LS1EW50778 Primary Sample | Associated with Gut/ Contents | LS1G50778 Field Duplicate | LS1W50778 Field Duplicate | LS1EW50778 Field Duplicate | Associated with Gut/ Contents |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg WW | 19.5 | 83% | 449.8 | 5.1 | 38.7 | 88% | 246.3 | 4.5 | 27.1 | 85% | 424.4 | 5.2 | 31.6 | 85% | 294.5 | 4.0 | 32.4 | 89% | 298.9 | 3.7 U | 32.5 | 90% |
| Antimony | mg/kg WW | 0.104 | 14% | 0.176 | 0.099 U | 0.105 | 13% | 0.122 | 0.110 U | 0.111 | 10% | 1.119 | 0.071 U | 0.137 | 51% | 0.124 | 0.103 U | 0.105 | 12% | 0.127 | 0.100 U | 0.102 | 12% |
| Arsenic | mg/kg WW | 0.140 | 33% | 0.727 | 0.179 | 0.220 | 25% | 0.808 | 0.180 | 0.239 | 32% | 1.017 | 0.100 | 0.158 | 41% | 0.836 U | 0.190 | 0.253 | 32% | 0.824 U | 0.189 | 0.251 | 32% |
| Barium | mg/kg WW | 2.1 | 53% | 16.9 | 2.3 J | 3.4 | 37% | 9.4 | 1.2 J | 2.0 | 44% | 24.9 | 1.8 J | 3.2 | 49% | 17.5 | 2.1 J | 3.6 | 47% | 18.6 | 1.7 J | 3.3 | 55% |
| Beryllium | mg/kg WW | 0.005 | 15% | 0.026 | 0.005 U | 0.007 | 30% | 0.013 | 0.006 U | 0.006 | 19% | 0.019 | 0.003 U | 0.004 | 27% | 0.015 | 0.005 U | 0.006 | 24% | 0.016 | 0.005 U | 0.006 | 25% |
| Cadmium | mg/kg WW | 0.370 | 28% | 1.678 | 0.255 | 0.362 | 35% | 1.026 | 0.254 | 0.326 | 29% | 2.044 | 0.346 | 0.452 | 28% | 1.345 | 0.232 | 0.341 | 39% | 1.319 | 0.252 | 0.356 | 36% |
| Calcium | mg/kg WW | 8493.0 | 16% | 8926.8 | 8109.0 J | 8170.7 | 8% | 18767.7 | 10462.2 J | 11238.4 | 16% | 27772.0 | 9408.0 J | 10563.6 | 17% | 13769.4 | 11484.0 J | 11707.4 | 11% | 14391.8 | 8305.4 J | 8900.3 | 16% |
| Chromium | mg/kg WW | 0.676 | 36% | 8.546 J | 0.676 | 1.270 | 51% | 3.476 J | 0.592 | 0.862 | 38% | 4.637 J | 0.326 | 0.598 | 49% | 3.403 J | 0.581 | 0.857 | 39% | 3.265 J | 0.634 | 0.891 | 36% |
| Cobalt | mg/kg WW | 0.057 | 58% | 0.450 | 0.033 | 0.065 | 53% | 0.364 | 0.054 | 0.083 | 41% | 0.576 | 0.040 | 0.074 | 49% | 0.350 | 0.037 | 0.068 | 51% | 0.317 | 0.037 | 0.064 | 48% |
| Copper | mg/kg WW | 2.44 | 77% | 14.22 | 0.59 | 1.62 | 66% | 13.94 U | 0.81 | 2.04 | 64% | 25.86 U | 0.74 | 2.32 | 70% | 7.41 U | 0.69 | 1.34 | 54% | 7.35 U | 0.71 | 1.36 | 53% |
| Iron | mg/kg WW | 75.9 | 83% | 1211.0 | 23.3 J | 112.9 | 81% | 728.2 | 21.8 J | 87.8 | 77% | 1391.2 | 44.0 J | 128.7 | 68% | 655.1 | 15.9 J | 78.4 | 82% | 675.2 | 14.9 J | 79.4 | 83% |
| Lead | mg/kg WW | 3.12 | 6% | 4.95 | 6.76 | 6.62 | 6% | 2.06 | 4.12 | 3.92 | 5% | 4.79 | 7.81 | 7.62 | 4% | 2.24 | 3.93 | 3.77 | 6% | 2.10 | 3.04 | 2.95 | 7% |
| Magnesium | mg/kg WW | 309.7 | 9% | 536.3 | 318.8 | 335.2 | 12% | 417.1 | 346.9 | 353.4 | 11% | 594.7 | 318.7 | 336.1 | 11% | 422.9 | 335.3 | 343.8 | 12% | 421.6 | 306.5 | 317.8 | 13% |
| Manganese | mg/kg WW | 6.1 | 32% | 28.3 | 10.9 J | 12.2 | 18% | 21.7 | 5.4 J | 6.9 | 29% | 43.5 | 9.9 J | 12.0 | 23% | 16.6 | 5.7 J | 6.8 | 24% | 16.9 | 4.5 J | 5.7 | 29% |
| Nickel | mg/kg WW | 0.359 | 38% | 4.706 | 0.306 | 0.638 | 56% | 1.963 | 0.338 | 0.490 | 37% | 2.266 | 0.288 | 0.412 | 35% | 1.797 | 0.343 | 0.485 | 36% | 1.813 | 0.314 | 0.461 | 38% |
| Potassium | mg/kg WW | 3272.3 | 5% | 2339.0 | 3595.5 | 3500.7 | 5% | 1916.5 | 2961.0 | 2863.4 | 6% | 2457.6 | 3417.6 | 3357.2 | 5% | 2117.9 | 2851.2 | 2779.5 | 7% | 2060.5 | 3013.0 | 2919.9 | 7% |
| Selenium | mg/kg WW | 0.548 | 16% | 1.453 | 0.587 | 0.652 | 17% | 1.205 | 0.677 | 0.726 | 16% | 1.048 | 0.470 | 0.507 | 13% | 1.495 | 0.681 | 0.761 | 19% | 1.458 | 0.718 | 0.790 | 18% |
| Silver | mg/kg WW | 0.062 | 10% | 0.080 | 0.064 U | 0.065 | 9% | 0.076 | 0.068 U | 0.068 | 10% | 0.131 | 0.044 U | 0.050 | 17% | 0.080 | 0.063 U | 0.065 | 12% | 0.079 | 0.060 U | 0.062 | 12% |
| Sodium | mg/kg WW | 1033.8 | 12% | 1415.1 | 1060.8 | 1087.5 | 10% | 1555.7 | 1221.1 | 1252.3 | 12% | 1747.5 | 1278.7 | 1308.2 | 8% | 1669.5 | 1248.7 | 1289.8 | 13% | 1629.4 | 1215.7 | 1256.1 | 13% |
| Thallium | mg/kg WW | 0.062 | 10% | 0.080 | 0.064 U | 0.065 | 9% | 0.076 | 0.068 U | 0.068 | 10% | 0.066 | 0.044 U | 0.046 | 9% | 0.080 | 0.063 U | 0.065 | 12% | 0.079 | 0.060 U | 0.062 | 12% |
| Uranium | mg/kg WW | 0.015 | 52% | 0.110 | 0.010 | 0.018 | 46% | 0.141 | 0.011 | 0.023 | 58% | 0.161 | 0.024 | 0.033 | 31% | 0.112 | 0.012 | 0.022 | 51% | 0.118 | 0.009 | 0.020 | 57% |
| Vanadium | mg/kg WW | 0.148 | 40% | 1.467 | 0.099 U | 0.203 | 55% | 1.066 | 0.110 U | 0.199 | 50% | 1.449 | 0.104 | 0.188 | 48% | 1.123 | 0.103 U | 0.203 | 54% | 1.163 | 0.102 | 0.206 | 55% |
| Zinc | mg/kg WW | 25.6 | 17% | 59.5 | 39.8 | 41.3 | 11% | 39.4 | 21.0 | 22.7 | 16% | 74.4 | 29.0 | 31.8 | 15% | 31.2 | 21.0 | 22.0 | 14% | 32.0 | 21.2 | 22.3 | 14% |

[a] G indicates a gut/contents sample from an individual largescale sucker.

[b] W followed by a 5-digit numeric code indicates a whole body sample with the gut/contents removed from an individual largescale sucker.

[c] EW indicates estimated whole body. The estimated whole body concentration for the individual largescale sucker was calculated as a weighted average of the gut/contents and the gutless whole body concentrations.

mg/kg WW = milligrams per kilogram wet weight

U - The analyte was not detected at or above the reported value.

J - The identification of the analyte is acceptable; the reported value is an estimate.

**TABLE 3-13**

Estimated TAL Metals Results for Individual Whole Body Largescale Sucker Samples--FSCA 3

*Upper Columbia River RI/FS*

| Analyte | Units | LS3G40486[a] Primary Sample | LS3W40486[b] Primary Sample | LS3EW40486[c] Primary Sample | Associated with Gut/ Contents | LS3G40504 Primary Sample | LS3W40504 Primary Sample | LS3EW40504 Primary Sample | Associated with Gut/ Contents | LS3G40520 Primary Sample | LS3W40520 Primary Sample | LS3EW40520 Primary Sample | Associated with Gut/ Contents | LS3G40914 Primary Sample | LS3W40914 Primary Sample | LS3EW40914 Primary Sample | Associated with Gut/ Contents | LS3G40915 Primary Sample | LS3W40915 Primary Sample | LS3EW40915 Primary Sample | Associated with Gut/ Contents |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg WW | 609.0 | 4.3 J | 38.1 | 89% | 346.0 | 3.6 J | 23.1 | 85% | 183.3 | 15.3 J | 27.3 | 48% | 323.8 | 5.8 J | 30.6 | 83% | 65.3 | 4.5 J | 8.3 | 49% |
| Antimony | mg/kg WW | 0.116 | 0.095 U | 0.097 | 7% | 0.088 | 0.089 U | 0.089 | 6% | 0.117 | 0.101 U | 0.103 | 8% | 0.197 | 0.105 U | 0.112 | 14% | 0.147 | 0.101 U | 0.104 | 9% |
| Arsenic | mg/kg WW | 0.667 | 0.193 | 0.220 | 17% | 0.394 | 0.212 | 0.222 | 10% | 0.632 U | 0.213 | 0.243 | 19% | 0.497 | 0.118 | 0.148 | 26% | 0.261 | 0.142 | 0.149 | 11% |
| Barium | mg/kg WW | 10.1 | 4.1 | 4.4 | 13% | 14.7 | 2.2 | 2.9 | 29% | 5.5 | 1.8 | 1.8 | 22% | 4.2 | 1.0 J | 1.2 | 27% | 1.3 | 2.3 J | 2.2 | 4% |
| Beryllium | mg/kg WW | 0.023 | 0.005 U | 0.006 | 22% | 0.013 | 0.005 U | 0.005 | 15% | 0.008 | 0.005 U | 0.005 | 10% | 0.012 | 0.005 U | 0.006 | 16% | 0.007 | 0.005 U | 0.005 | 9% |
| Cadmium | mg/kg WW | 1.076 | 0.201 | 0.250 | 24% | 1.218 | 0.265 | 0.319 | 22% | 0.891 | 0.114 | 0.170 | 37% | 0.207 | 0.029 | 0.043 | 38% | 0.440 | 0.104 | 0.125 | 22% |
| Calcium | mg/kg WW | 3074 | 10968.7 | 10527.043 | 2% | 8322 | 10604 | 10474.199 | 5% | 10926.3 | 12428 J | 12321.153 | 6% | 407.316 | 9520.6 J | 8809.448 | 0% | 513.8 | 10626.6 J | 9996.930 | 0% |
| Chromium | mg/kg WW | 45.53 J | 0.502 J | 3.021 | 84% | 4.7085 | 0.4338 J | 0.677 | 40% | 3.4615 J | 0.364 | 0.584 | 42% | 23.5872 J | 0.4997 | 2.301 | 80% | 1.9084 J | 0.3738 | 0.469 | 25% |
| Cobalt | mg/kg WW | 0.861 | 0.050 | 0.090 | 47% | 0.241 | 0.027 | 0.039 | 35% | 0.172 | 0.029 | 0.039 | 31% | 0.388 | 0.016 | 0.045 | 67% | 0.062 | 0.035 | 0.036 | 11% |
| Copper | mg/kg WW | 12.673 U | 0.502 J | 1.183 | 60% | 7.512 U | 0.651 J | 1.041 | 41% | 6.923 U | 0.494 | 0.951 | 52% | 5.951 U | 0.395 | 0.828 | 56% | 5.689 U | 0.454 | 0.780 | 45% |
| Iron | mg/kg WW | 1081.7 | 11.3 | 71.2 | 85% | 676.7 | 25.5 | 62.6 | 62% | 304.0 | 11.2 | 32.0 | 68% | 617.0 | 9.7 | 57.1 | 84% | 146.4 | 15.6 | 23.8 | 38% |
| Lead | mg/kg WW | 0.795 | 0.713 J | 0.717 | 6% | 1.940 | 4.338 J | 4.202 | 3% | 1.364 | 2.005 J | 1.959 | 5% | 0.655 | 0.118 J | 0.160 | 32% | 0.286 | 1.744 J | 1.653 | 1% |
| Magnesium | mg/kg WW | 504.6 | 333.8 | 343.4 | 8% | 348.2 | 361.5 | 360.7 | 5% | 295.3 | 384.8 | 378.4 | 6% | 262.1 | 389.2 | 379.3 | 5% | 145.7 | 373.8 | 359.6 | 3% |
| Manganese | mg/kg WW | 46.7 | 4.5 | 6.9 | 38% | 22.3 | 5.8 | 6.7 | 19% | 19.0 | 6.8 J | 7.6 | 18% | 13.4 | 2.0 J | 2.9 | 36% | 3.1 | 5.9 J | 5.7 | 3% |
| Nickel | mg/kg WW | 30.160 | 0.377 | 2.043 | 83% | 2.650 | 0.362 | 0.492 | 31% | 2.062 | 0.338 | 0.461 | 32% | 17.472 | 0.342 | 1.679 | 81% | 0.697 | 0.320 | 0.344 | 13% |
| Potassium | mg/kg WW | 2665.1 | 3388.5 | 3348.0 | 4% | 2628.0 | 3735.5 | 3672.5 | 4% | 2221.4 | 3458.0 | 3370.0 | 5% | 1577.9 | 3550.5 | 3396.6 | 4% | 2286.4 | 3497.7 | 3422.3 | 4% |
| Selenium | mg/kg WW | 1.061 | 0.577 | 0.604 | 10% | 0.944 | 0.769 | 0.779 | 7% | 0.828 | 0.494 | 0.518 | 11% | 0.819 | 0.421 | 0.452 | 14% | 0.936 | 0.561 | 0.584 | 10% |
| Silver | mg/kg WW | 0.073 | 0.060 U | 0.061 | 7% | 0.055 | 0.055 U | 0.055 | 6% | 0.075 | 0.062 U | 0.063 | 8% | 0.126 | 0.066 U | 0.070 | 14% | 0.092 | 0.061 U | 0.063 | 9% |
| Sodium | mg/kg WW | 1374.6 | 1229.9 | 1238.0 | 6% | 1752.0 | 1368.9 | 1390.7 | 7% | 1387.6 | 1084.2 | 1105.8 | 9% | 961.0 | 836.3 | 846.1 | 9% | 1247.8 | 1038.6 | 1051.7 | 7% |
| Thallium | mg/kg WW | 0.073 | 0.060 U | 0.061 | 7% | 0.055 | 0.055 U | 0.055 | 6% | 0.075 | 0.062 U | 0.063 | 8% | 0.126 | 0.066 U | 0.070 | 14% | 0.092 | 0.061 U | 0.063 | 9% |
| Uranium | mg/kg WW | 0.058 | 0.019 | 0.021 | 15% | 0.123 | 0.019 | 0.025 | 28% | 0.050 | 0.024 | 0.026 | 14% | 0.024 | 0.003 | 0.004 | 42% | 0.010 | 0.022 | 0.022 | 3% |
| Vanadium | mg/kg WW | 2.059 | 0.120 | 0.229 | 50% | 1.097 | 0.118 | 0.174 | 36% | 0.512 | 0.101 U | 0.131 | 28% | 1.201 | 0.105 U | 0.191 | 49% | 0.250 | 0.101 U | 0.111 | 14% |
| Zinc | mg/kg WW | 27.8 | 21.8 J | 22.1 | 7% | 25.8 | 24.1 J | 24.2 | 6% | 25.9 | 23.2 | 23.4 | 8% | 15.7 | 13.3 | 13.4 | 9% | 17.2 | 23.9 | 23.5 | 5% |

[a] G indicates a gut/contents sample from an individual largescale sucker.

[b] W followed by a 5-digit numeric code indicates a whole body sample with the gut/contents removed from an individual largescale sucker.

[c] EW indicates estimated whole body. The estimated whole body concentration for the individual largescale sucker was calculated as a weighted average of the gut/contents and the gutless whole body concentrations.

mg/kg WW = milligrams per kilogram wet weight

U - The analyte was not detected at or above the reported value.

J - The identification of the analyte is acceptable; the reported value is an estimate.

**TABLE 3-14**

Estimated TAL Metals Results for Individual Whole Body Largescale Sucker Samples--FSCA 6

*Upper Columbia River RI/FS*

| Analyte | Units | LS6G50727[a] Primary Sample | LS6W50727[b] Primary Sample | LS6EW50727[c] Primary Sample | Associated with Gut/ Contents | LS6G50732 Primary Sample | LS6W50732 Primary Sample | LS6EW50732 Primary Sample | Associated with Gut/ Contents | LS6G50734 Primary Sample | LS6W50734 Primary Sample | LS6EW50734 Primary Sample | Associated with Gut/ Contents | LS6G50744 Primary Sample | LS6W50744 Primary Sample | LS6EW50744 Primary Sample | Associated with Gut/ Contents | LS6G50747 Primary Sample | LS6W50747 Primary Sample | LS6EW50747 Primary Sample | Associated with Gut/ Contents | LS6G5073 Field Duplicate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | mg/kg WW | 56.1 | 4.8 U | 8.0 | 44% | 29.4 | 3.7 U | 5.0 | 29% | 1253.2 | 13.6 | 112.6 | 89% | 117.1 | 3.9 U | 13.3 | 73% | 149.9 | 4.0 U | 11.1 | 66% | 1102.1 |
| Antimony | mg/kg WW | 0.102 | 0.125 U | 0.123 | 5% | 0.118 | 0.101 U | 0.102 | 6% | 0.212 | 0.120 U | 0.127 | 13% | 0.106 | 0.103 U | 0.104 | 8% | 0.120 | 0.106 U | 0.107 | 5% | 0.214 |
| Arsenic | mg/kg WW | 0.470 | 0.214 | 0.230 | 13% | 0.248 | 0.199 | 0.201 | 6% | 1.609 | 0.081 | 0.203 | 63% | 0.379 | 0.139 | 0.159 | 20% | 0.349 | 0.150 | 0.159 | 11% | 1.659 |
| Barium | mg/kg WW | 2.8 | 2.0 J | 2.0 | 9% | 0.4 | 1.7 J | 1.6 | 1% | 17.3 | 2.6 J | 3.7 | 37% | 3.6 | 3.3 J | 3.3 | 9% | 3.6 | 2.6 J | 2.7 | 7% | 16.3 |
| Beryllium | mg/kg WW | 0.005 | 0.006 U | 0.006 | 5% | 0.006 | 0.005 U | 0.005 | 6% | 0.046 | 0.006 U | 0.009 | 39% | 0.007 | 0.005 U | 0.005 | 10% | 0.006 | 0.005 U | 0.005 | 6% | 0.046 |
| Cadmium | mg/kg WW | 1.984 | 0.301 | 0.405 | 30% | 0.967 | 0.146 | 0.186 | 26% | 0.690 | 0.240 | 0.276 | 20% | 0.780 | 0.166 | 0.217 | 30% | 1.018 | 0.150 | 0.192 | 26% | 0.696 |
| Calcium | mg/kg WW | 2563.0 | 7840.0 J | 7512.3 | 2% | 167.3 | 11660.0 J | 11089.9 | 0% | 2209.0 | 7938.0 J | 7480.8 | 2% | 1704.6 | 12566.4 J | 11662.0 | 1% | 735.4 | 10308.8 J | 9844.5 | 0% | 2295.2 |
| Chromium | mg/kg WW | 1.255 | 0.813 | 0.840 | 9% | 2.000 | 0.761 | 0.822 | 12% | 22.302 | 0.551 | 2.287 | 78% | 6.748 | 0.462 | 0.986 | 57% | 5.579 | 0.952 | 1.176 | 23% | 19.100 |
| Cobalt | mg/kg WW | 0.102 | 0.035 | 0.039 | 16% | 0.064 | 0.023 | 0.025 | 13% | 0.797 | 0.045 | 0.105 | 60% | 0.146 | 0.046 | 0.055 | 22% | 0.159 | 0.027 | 0.033 | 23% | 0.803 |
| Copper | mg/kg WW | 3.863 U | 0.608 | 0.810 | 30% | 7.378 U | 0.371 | 0.719 | 51% | 4.179 | 0.551 | 0.840 | 40% | 2.656 | 0.544 | 0.720 | 31% | 5.896 | 0.354 | 0.622 | 46% | 4.205 |
| Iron | mg/kg WW | 95.5 | 10.9 J | 16.1 | 37% | 102.1 | 10.1 J | 14.6 | 35% | 2086.8 | 28.2 J | 192.5 | 87% | 258.5 | 11.4 J | 32.0 | 67% | 351.9 | 11.7 J | 28.2 | 61% | 1979.5 |
| Lead | mg/kg WW | 0.136 | 0.352 | 0.339 | 2% | 0.070 | 0.292 | 0.281 | 1% | 1.062 | 0.454 | 0.502 | 17% | 0.165 | 0.517 | 0.488 | 3% | 0.197 | 0.272 | 0.268 | 4% | 1.017 |
| Magnesium | mg/kg WW | 173.3 | 289.3 | 282.1 | 4% | 129.4 | 307.4 | 298.6 | 2% | 908.0 | 293.2 | 342.3 | 21% | 174.0 | 318.2 | 306.2 | 5% | 214.0 | 340.0 | 333.9 | 3% | 866.7 |
| Manganese | mg/kg WW | 10.6 | 2.4 J | 2.9 | 23% | 1.7 | 2.6 J | 2.6 | 3% | 47.6 | 6.2 J | 9.5 | 40% | 11.7 | 4.6 J | 5.2 | 19% | 8.8 | 2.4 J | 2.8 | 16% | 46.2 |
| Nickel | mg/kg WW | 0.470 | 0.211 | 0.227 | 13% | 0.700 | 0.249 | 0.271 | 13% | 11.204 | 0.421 | 1.282 | 70% | 3.848 | 0.299 | 0.595 | 54% | 3.056 | 0.218 | 0.355 | 42% | 9.363 |
| Potassium | mg/kg WW | 2056.7 | 2921.6 | 2867.9 | 4% | 2318.2 | 3206.5 | 3162.4 | 4% | 1784.2 | 3074.8 | 2971.8 | 5% | 1861.8 | 2711.8 | 2641.1 | 6% | 2149.3 | 3400.0 | 3339.3 | 3% | 1728.1 |
| Selenium | mg/kg WW | 0.932 | 0.608 | 0.628 | 9% | 0.948 | 0.477 | 0.500 | 9% | 0.903 | 0.389 | 0.430 | 17% | 0.867 | 0.544 | 0.571 | 13% | 1.176 | 0.299 | 0.342 | 17% | 0.963 |
| Silver | mg/kg WW | 0.063 | 0.077 U | 0.076 | 5% | 0.073 | 0.064 U | 0.064 | 6% | 0.133 | 0.075 U | 0.079 | 13% | 0.065 | 0.065 U | 0.065 | 8% | 0.076 | 0.065 U | 0.066 | 6% | 0.134 |
| Sodium | mg/kg WW | 1652.1 | 1072.0 | 1108.0 | 9% | 1682.2 | 1179.3 | 1204.2 | 7% | 945.2 | 1014.1 | 1008.6 | 7% | 1674.8 | 1487.8 | 1503.4 | 9% | 1451.9 | 1292.0 | 1299.8 | 5% | 941.6 |
| Thallium | mg/kg WW | 0.063 | 0.077 U | 0.076 | 5% | 0.073 | 0.064 U | 0.064 | 6% | 0.133 | 0.075 U | 0.079 | 13% | 0.065 | 0.065 U | 0.065 | 8% | 0.076 | 0.065 U | 0.066 | 6% | 0.134 |
| Uranium | mg/kg WW | 0.010 | 0.011 | 0.011 | 6% | 0.006 | 0.007 | 0.007 | 4% | 0.098 | 0.014 | 0.021 | 37% | 0.016 | 0.010 | 0.011 | 13% | 0.019 | 0.007 | 0.007 | 13% | 0.095 |
| Vanadium | mg/kg WW | 0.149 | 0.125 U | 0.126 | 7% | 0.130 | 0.101 U | 0.102 | 6% | 3.064 | 0.120 U | 0.355 | 69% | 0.352 | 0.103 U | 0.124 | 24% | 0.444 | 0.106 U | 0.122 | 18% | 2.841 |
| Zinc | mg/kg WW | 15.5 | 17.9 | 17.7 | 5% | 16.8 | 18.8 | 18.7 | 4% | 20.5 | 17.2 | 17.5 | 9% | 12.6 | 18.0 | 17.6 | 6% | 17.0 | 18.2 | 18.1 | 5% | 21.3 |

[a] G indicates a gut/contents sample from an individual largescale sucker.

[b] W followed by a 5-digit numeric code indicates a whole body sample with the gut/contents removed from an individual largescale sucker.

[c] EW indicates estimated whole body. The estimated whole body concentration for the individual largescale sucker was calculated as a weighted average of the gut/contents and the gutless whole body concentrations.

mg/kg WW = milligrams per kilogram wet weight

U - The analyte was not detected at or above the reported value.

J - The identification of the analyte is acceptable; the reported value is an estimate.

**TABLE 3-15**
Mean Concentration Gut/Gut Content Analysis for Largescale Sucker
*Upper Columbia River RI/FS*

| Analyte | Units | FSCA 1 | | | FSCA 1A | | | FSCA 3 | | | FSCA 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean Concentration | SD | N | Mean Concentration | SD | N | Mean Concentration | SD | N | Mean Concentration | SD | N |
| **Gut/Gut Contents** | | | | | | | | | | | | | |
| Aluminum | mg/kg WW | 2674 | 2265 | 5 | 325 | 106 | 5 | 305 | 204 | 5 | 321 | 523 | 5 |
| Arsenic | mg/kg WW | 2.33 | 1.55 | 5 | 0.80 | 0.15 | 5 | 0.49 | 0.17 | 5 | 0.61 | 0.56 | 5 |
| Barium | mg/kg WW | 150 | 255 | 5 | 15.3 | 6.3 | 5 | 2.85 | 2.06 | 5 | 4.94 | 7.13 | 5 |
| Cadmium | mg/kg WW | 2.03 | 0.41 | 5 | 1.49 | 0.38 | 5 | 0.766 | 0.428 | 5 | 1.09 | 0.518 | 5 |
| Chromium | mg/kg WW | 69.2 | 29.1 | 5 | 4.65 | 2.25 | 5 | 15.8 | 18.7 | 5 | 7.6 | 8.6 | 5 |
| Copper | mg/kg WW | 281 | 296 | 5 | 17.23 | 7.86 | 5 | 7.75 | 2.85 | 5 | 4.8 | 1.9 | 5 |
| Iron | mg/kg WW | 23712 | 25254 | 5 | 963 | 320 | 5 | 565 | 362 | 5 | 579 | 850 | 5 |
| Lead | mg/kg WW | 39.7 | 43.8 | 5 | 3.28 | 1.45 | 5 | 1.1 | 0.65 | 5 | 0.326 | 0.414 | 5 |
| Manganese | mg/kg WW | 460 | 465 | 5 | 27.2 | 10.1 | 5 | 20.9 | 16.2 | 5 | 16.1 | 18 | 5 |
| Nickel | mg/kg WW | 35.1 | 18.2 | 5 | 2.5 | 1.2 | 5 | 10.6 | 12.9 | 5 | 3.86 | 4.36 | 5 |
| Selenium | mg/kg WW | 1.06 | 0.28 | 5 | 1.28 | 0.2 | 5 | 0.918 | 0.01 | 5 | 0.965 | 0.122 | 5 |
| Uranium | mg/kg WW | 0.6 | 0.5 | 5 | 0.125 | 0.03 | 5 | 0.053 | 0.04 | 5 | 0.030 | 0.04 | 5 |
| Zinc | mg/kg WW | 1790 | 1994 | 5 | 52.5 | 17.2 | 5 | 22.4 | 5.58 | 5 | 16.5 | 2.9 | 5 |
| **Gutless Whole Body** | | | | | | | | | | | | | |
| Aluminum | mg/kg WW | 31 | 46 | 5 | 4.48 | 0.68 | 5 | 6.71 | 4.89 | 5 | 6.00 | 4.29 | 5 |
| Arsenic | mg/kg WW | 0.16 | 0.03 | 5 | 0.15 | 0.05 | 5 | 0.18 | 0.04 | 5 | 0.16 | 0.05 | 5 |
| Barium | mg/kg WW | 2.36 | 0.838 | 5 | 2.28 | 1.1 | 5 | 1.9 | 0.5 | 5 | 1.7 | 1.6 | 5 |
| Cadmium | mg/kg WW | 0.364 | 0.058 | 5 | 0.275 | 0.044 | 5 | 0.143 | 0.092 | 5 | 0.200 | 0.068 | 5 |
| Chromium | mg/kg WW | 0.64 | 0.07 | 5 | 0.53 | 0.13 | 5 | 0.43 | 0.07 | 5 | 0.71 | 0.20 | 5 |
| Copper | mg/kg WW | 1.15 | 0.43 | 5 | 0.69 | 0.09 | 5 | 0.5 | 0.1 | 5 | 0.49 | 0.12 | 5 |
| Iron | mg/kg WW | 66.8 | 43.9 | 5 | 23.7 | 12 | 5 | 14.7 | 6.5 | 5 | 14.5 | 7.7 | 5 |
| Lead | mg/kg WW | 7.98 | 3.26 | 5 | 5.16 | 2.01 | 5 | 1.78 | 1.62 | 5 | 0.377 | 0.105 | 5 |
| Manganese | mg/kg WW | 11.8 | 2.5 | 5 | 7.27 | 2.89 | 5 | 4.5 | 1.9 | 5 | 3.64 | 1.68 | 5 |
| Nickel | mg/kg WW | 0.325 | 0.066 | 5 | 0.303 | 0.042 | 5 | 0.348 | 0.022 | 5 | 0.280 | 0.086 | 5 |
| Selenium | mg/kg WW | 0.585 | 0.077 | 5 | 0.582 | 0.098 | 5 | 0.564 | 0.130 | 5 | 0.463 | 0.123 | 5 |
| Uranium | mg/kg WW | 0.02 | 0.008 | 5 | 0.013 | 0.006 | 5 | 0.017 | 0.008 | 5 | 0.010 | 0.003 | 5 |
| Zinc | mg/kg WW | 46.4 | 7.2 | 5 | 26.7 | 8.0 | 5 | 21.2 | 4.6 | 5 | 18.0 | 0.59 | 5 |
| **Estimated Whole Body** | | | | | | | | | | | | | |
| Aluminum | mg/kg WW | 202 | 121 | 5 | 29.8 | 7.1 | 5 | 25.5 | 11.1 | 5 | 30.0 | 46.3 | 5 |
| Arsenic | mg/kg WW | 0.30 | 0.10 | 5 | 0.20 | 0.05 | 5 | 0.20 | 0.04 | 5 | 0.19 | 0.03 | 5 |
| Barium | mg/kg WW | 11.2 | 15.5 | 5 | 3.23 | 0.892 | 5 | 1.78 | 0.390 | 5 | 1.95 | 1.8 | 5 |
| Cadmium | mg/kg WW | 0.467 | 0.070 | 5 | 0.37 | 0.05 | 5 | 0.18 | 0.11 | 5 | 0.26 | 0.09 | 5 |

**TABLE 3-15**
Mean Concentration Gut/Gut Content Analysis for Largescale Sucker
*Upper Columbia River RI/FS*

| Analyte | Units | FSCA 1 | | | FSCA 1A | | | FSCA 3 | | | FSCA 6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean Concentration | SD | N | Mean Concentration | SD | N | Mean Concentration | SD | N | Mean Concentration | SD | N |
| Chromium | mg/kg WW | 5.06 | 2.35 | 5 | 0.85 | 0.26 | 5 | 1.41 | 1.17 | 5 | 1.22 | 0.61 | 5 |
| Copper | mg/kg WW | 19.2 | 18.2 | 5 | 1.95 | 0.46 | 5 | 0.96 | 0.16 | 5 | 0.74 | 0.09 | 5 |
| Iron | mg/kg WW | 1596 | 1549 | 5 | 96.8 | 23.1 | 5 | 49.3 | 20.4 | 5 | 56.7 | 76.3 | 5 |
| Lead | mg/kg WW | 10 | 3.57 | 5 | 5.01 | 1.98 | 5 | 1.74 | 1.55 | 5 | 0.375 | 0.112 | 5 |
| Manganese | mg/kg WW | 40.9 | 26.9 | 5 | 8.8 | 3.0 | 5 | 5.98 | 1.86 | 5 | 4.57 | 2.93 | 5 |
| Nickel | mg/kg WW | 2.57 | 1.53 | 5 | 0.477 | 0.105 | 5 | 1.004 | 0.795 | 5 | 0.546 | 0.435 | 5 |
| Selenium | mg/kg WW | 0.615 | 0.064 | 5 | 0.639 | 0.110 | 5 | 0.587 | 0.123 | 5 | 0.494 | 0.113 | 5 |
| Uranium | mg/kg WW | 0.056 | 0.025 | 5 | 0.022 | 0.007 | 5 | 0.020 | 0.009 | 5 | 0.011 | 0.006 | 5 |
| Zinc | mg/kg WW | 159 | 121 | 5 | 28.6 | 8.0 | 5 | 21.3 | 4.5 | 5 | 17.9 | 0.52 | 5 |
| **% Associated with Gut** | | | | | | | | | | | | | |
| Aluminum | | 80% | 33% | 5 | 86% | 3% | 5 | 71% | 21% | 5 | 60% | 24% | 5 |
| Arsenic | | 46% | 17% | 5 | 32% | 6% | 5 | 17% | 7% | 5 | 23% | 23% | 5 |
| Barium | | 56% | 24% | 5 | 36% | 15% | 5 | 13% | 11% | 5 | 35% | 26% | 5 |
| Cadmium | | 27% | 5% | 5 | 32% | 5% | 5 | 29% | 8% | 5 | 26% | 4% | 5 |
| Chromium | | 85% | 8% | 5 | 42% | 7% | 5 | 54% | 26% | 5 | 36% | 30% | 5 |
| Copper | | 89% | 10% | 5 | 66% | 8% | 5 | 51% | 8% | 5 | 39% | 9% | 5 |
| Iron | | 92% | 10% | 5 | 78% | 6% | 5 | 67% | 19% | 5 | 57% | 22% | 5 |
| Lead | | 24% | 18% | 5 | 5% | 1% | 5 | 9% | 13% | 5 | 5% | 6% | 5 |
| Manganese | | 61% | 27% | 5 | 25% | 6% | 5 | 23% | 14% | 5 | 20% | 13% | 5 |
| Nickel | | 85% | 8% | 5 | 40% | 9% | 5 | 48% | 32% | 5 | 38% | 25% | 5 |
| Selenium | | 11% | 4% | 5 | 16% | 2% | 5 | 10% | 3% | 5 | 13% | 4% | 5 |
| Uranium | | 59% | 26% | 5 | 48% | 10% | 5 | 20% | 15% | 5 | 15% | 13% | 5 |
| Zinc | | 59% | 27% | 5 | 15% | 2% | 5 | 7% | 2% | 5 | 6% | 2% | 5 |
| **% AFDW** | | 53% | 11% | 5 | 73% | 12% | 5 | 84% | 11% | 5 | 90% | 6% | 5 |

AFDW = ash-free dry weight
mg/kg WW = milligrams per kilogram wet weight
N = number of samples
SD = standard deviation

**TABLE 3-16**
Arsenic Speciation Gut/Gut Contents Analysis for Largescale Suckers
*Upper Columbia River RI/FS*

| Species | Composite ID | Total Arsenic ICP/MS Arsenic (*u* g/kg WW) | | As-Species $As^{+}3 + As^{+}5$ (*u* g/kg WW) | | % As as $As^{+}3 + As^{+}5$ | As-Species ASB + Cation (*u* g/kg WW) | | % AS as ASB + Cation | As-Species Dimethylarsonic acid (DMA) (*u* g/kg WW) | | % As as Dimethylarsonic acid (DMA) | As-Species Monomethylarsonic acid (MMA) (*u* g/kg WW) | | % AS as Monomethylarsonic acid (MMA) | As-Species Unknown (*u* g/kg WW) | | % -As as Species Unknown | % Total As as Inorganic Species | % Total As as Organic Species |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Largescale Sucker Gut/Gut Contents** | | | | | | | | | | | | | | | | | | | | |
| | LS1G10041 | 1,685 | | 187 | | 70.0% | 13 | UJ | 5.0% | 26 | J | 9.8% | 13 | U | 5.0% | 28 | J | 10.3% | 70.0% | 30.0% |
| | LS1G10051 | 1,109 | | 118 | | 65.6% | 14 | UJ | 8.0% | 18 | J | 9.9% | 14 | U | 8.0% | 15 | J | 8.6% | 65.6% | 34.4% |
| | LS1G50778 | 836 | | 216 | | 56.9% | 22 | J | 5.8% | 23 | J | 6.0% | 30 | J | 7.9% | 89 | J | 23.5% | 56.9% | 43.1% |
| | LS1G60778[a] | 824 | | 241 | | 56.4% | 13 | UJ | 3.0% | 24 | J | 5.6% | 29 | J | 6.8% | 120 | J | 28.2% | 56.4% | 43.6% |
| | LS3G40915 | 261 | | 15 | J | 21.0% | 11 | J | 15.9% | 17 | J | 23.6% | 15 | U | 21.0% | 13 | J | 18.5% | 21.0% | 79.0% |
| | LS6G50732 | 248 | | 13 | U | 18.6% | 3.5 | J | 5.0% | 15 | J | 21.7% | 13 | U | 18.6% | 25 | J | 36.2% | 18.6% | 81.4% |
| | **Average** | | | | | 48.1% | | | 7.1% | | | 12.8% | | | 11.2% | | | 20.9% | 48.1% | 51.9% |
| **Largescale Sucker Gutless Whole Body** | | | | | | | | | | | | | | | | | | | | |
| | LS1W10041 | 200 | | 11 | UJL | 17.5% | 17 | JL | 26.1% | 14 | JL | 21.4% | 11 | UJL | 17.5% | 11 | JL | 17.5% | 17.5% | 82.5% |
| | LS1W10051 | 124 | | 11 | UJL | 21.2% | 7.7 | JL | 15.0% | 11 | UJL | 21.2% | 11 | UJL | 21.2% | 11 | UJL | 21.2% | 21.2% | 78.8% |
| | LS1W50778 | 190 | | 11 | U | 13.4% | 39 | J | 48.2% | 7.1 | J | 8.8% | 11 | U | 13.4% | 13 | J | 16.3% | 13.4% | 86.6% |
| | LS1W60778[a] | 189 | | 11 | U | 13.4% | 37 | J | 46.9% | 7.6 | J | 9.5% | 11 | U | 13.4% | 13 | J | 16.7% | 13.4% | 86.6% |
| | LS3W40915 | 142 | | 11 | U | 27.7% | 2.1 | J | 5.4% | 4.8 | J | 12.2% | 11 | U | 27.7% | 11 | J | 27.0% | 27.7% | 72.3% |
| | LS6W50732 | 199 | | 11 | UJL | 18.7% | 3.7 | J | 6.4% | 8.0 | J | 13.7% | 11 | UJL | 18.7% | 25 | J | 42.5% | 18.7% | 81.3% |
| | **Average** | | | | | 18.7% | | | 24.7% | | | 14.5% | | | 18.7% | | | 23.5% | 18.7% | |

[a] Field duplicate.

ASB = arsenobetanine
µg/kg WW = micrograms per kilogram wet weight

J = The identification of the analyte is acceptable; the reported value is an estimate.
U = The analyte was not detected at or above the reported value.
UJL = The analyte was not detected at or above the reported value. The identification of the analyte is acceptable; the reported value is an estimate and may be biased low. The actual value is expected to be greater than the reported value.

**TABLE 3-17**
Summary Statistics for Composites of Each Target Species by FSCA
*Upper Columbia River RI/FS*

| Target Species | FSCA 1 Mean (± 1 SD) N | FSCA 2 Mean (± 1 SD) N | FSCA 3 Mean (± 1 SD) N | FSCA 4 Mean (± 1 SD) N | FSCA 5 Mean (± 1 SD) N | FSCA 6 Mean (± 1 SD) N |
|---|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | | |
| Walleye | 27.6 (-27.4 - 82.7) 5 | 3.1 (1.0 - 5.2) 5 | 3.7 (3.1 - 4.4) 5 | 5.0 (3 - 7.1) 5 | 9.7 (-4.4 - 23.7) 3 | 4.3 (2.4 - 6.2) 7 |
| Wild Rainbow Trout | 5.3 (4.2 - 6.4) 5 | 4.2 (1.2 - 7.2) 5 | 7.7 (6.1 - 9.3) 2 | NA | 5.1 (5.1 - 5.1) 1 | 5.7 (5.7 - 5.7) 1 |
| Hatchery Rainbow Trout | NA | NA | 25.2 (13.9 - 36.5) 3 | 9.0 (3.7 - 14.3) 5 | 10.1 (2.2 - 18.0) 5 | 5.8 (5.3 - 6.3) 4 |
| Lake Whitefish | NA | 2.5 (1.3 - 3.8) 5 | 3.1 (1.3 - 4.9) 5 | 6.2 (4.9 - 7.4) 5 | 3.9 (2.1 - 5.8) 5 | 2.0 (1.93 - 2.03) 2 |
| Mountain Whitefish | 14.6 (8.7 - 20.5) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 103.2 (35.0 - 171.4) 5 | 24.2 (11.5 - 36.7) 4 | 31.4 (14.3 - 48.4) 5 | 77.2 (59.3 - 95.1) 5 | 29.1 (0.7 - 57.6) 5 | 50.3 (28.2 - 72.4) 5 |
| Burbot | NA | 4.7 (3.8 - 5.6) 3 | 7.1 (3.2 - 11.1) 5 | 5.4 (4.8 - 6.0) 4 | 10.4 (4.8 - 16.1) 5 | 8.3 (6.2 - 10.3) 5 |
| **Arsenic (mg/kg WW)** | | | | | | |
| Walleye | 0.09 (0.07 - 0.11) 5 | 0.12 (0.09 - 0.14) 5 | 0.15 (0.12 - 0.17) 5 | 0.24(0.20 - 0.28) 5 | 0.16 (0.12 - 0.19) 3 | 0.16 (0.13 - 0.18) 7 |
| Wild Rainbow Trout | 0.14 (0.12 - 0.16) 5 | 0.12 (0.1 - 0.15) 5 | 0.15 (0.15 - 0.16) 2 | NA | 0.18 (0.18 - 0.18) 1 | 0.14 (0.14 - 0.14) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.1 (0.095 - 0.109) 3 | 0.10 (0.08 - 0.13) 5 | 0.14 (0.12 - 0.16) 5 | 0.1 (0.09 - 0.11) 4 |
| Lake Whitefish | NA | 0.23 (0.2 - 0.27) 5 | 0.26 (0.24 - 0.28) 5 | 0.25 (0.22 - 0.28) 5 | 0.28 (0.25 - 0.32) 5 | 0.25 (0.16 - 0.34) 2 |
| Mountain Whitefish | 0.15 (0.13 - 0.17) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 0.26 (0.19 - 0.33) 5 | 0.16 (0.14 - 0.19) 4 | 0.17 (0.14 - 0.2.0) 5 | 0.19 (0.18 - 0.21) 5 | 0.18 (0.15 - 0.22) 5 | 0.2 (0.18 - 0.21) 5 |
| Burbot | NA | 0.73 (0.67 - 0.78) 3 | 0.62 (0.52 - 0.73) 5 | 0.8 (0.67 - 0.94) 4 | 0.83 (0.73 - 0.93) 5 | 0.84 (0.72 - 0.96) 5 |
| **Barium (mg/kg WW)** | | | | | | |
| Walleye | 0.83 (0.77 - 0.9) 5 | 0.86 (0.8 - 0.93) 5 | 0.83 (0.76 - 0.89) 5 | 0.98 (0.9 - 1.05) 5 | 0.88 (0.75 - 1.0) 3 | 0.86 (0.78 - 0.94) 7 |
| Wild Rainbow Trout | 0.81 (0.64 - 0.98) 5 | 0.95 (0.43 - 1.5) 5 | 0.52 (0.45 - 0.59) 2 | NA | 0.38 (0.38 - 0.38) 1 | 0.77 (0.77 - 0.77) 1 |
| Hatchery Rainbow Trout | NA | NA | 1.26 (0.7 - 1.81) 3 | 0.41 (0.28 - 0.54) 5 | 0.55 (0.32 - 0.77) 5 | 0.47 (0.4 - 0.54) 4 |
| Lake Whitefish | NA | 0.5 (0.43 - 0.55) 5 | 0.55 (0.51 - 0.6) 5 | 0.68 (0.57 - 0.80) 5 | 0.6 (0.55 - 0.65) 5 | 0.33 (0.31 - 0.35) 2 |
| Mountain Whitefish | 1.5 (0.6 - 2.4) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 8.7 (3.4 - 14.1) 5 | 2.7 (2.06 - 3.34) 4 | 2.34 (1.76 - 2.92) 5 | 3.7 (3.0 - 4.4) 5 | 3.34 (2.67 - 4.01) 5 | 3.29 (2.75 - 3.84) 5 |
| Burbot | NA | 4.96 (4.1 - 5.84) 3 | 5.26 (4.32 - 6.21) 5 | 5.92 (5.22 - 6.62) 4 | 6.64 (5.1 - 8.17) 5 | 6.51 (5.88 - 7.15) 5 |
| **Chromium (mg/kg WW)** | | | | | | |
| Walleye | 0.5 (0.49 - 0.57) 5 | 0.5 (0.3 - 0.8) 5 | 0.5 (0.4 - 0.7) 5 | 0.56 (0.49 - 0.63) 5 | 0.47 (0.45 - 0.48) 3 | 0.55 (0.39 - 0.71) 7 |
| Wild Rainbow Trout | 0.8 (0.72 - 0.93) 5 | 0.8 (0.6 - 0.9) 5 | 0.65 (0.61 - 0.69) 2 | NA | 0.7 (0.7 - 0.7) 1 | 0.49 (0.49 - 0.49) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.64 (0.45 - 0.83) 3 | 0.5 (0.44 - 0.54) 5 | 0.53 (0.45 - 0.62) 5 | 0.35 (0.32 - 0.37) 4 |
| Lake Whitefish | NA | 0.6 (0.5 - 0.7) 5 | 0.73 (0.61 - 0.85) 5 | 0.83 (0.78 - 0.88) 5 | 0.87 (0.81 - 0.93) 5 | 0.78 (0.58 - 0.97) 2 |
| Mountain Whitefish | 1.1 (1.0 - 1.2) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 2.4 (0.7 - 4.1) 5 | 1.1 (0.7- 1.5) 4 | 0.9 (0.6 - 1.2) 5 | 1.4 (0.9 - 1.9) 5 | 0.89 (0.48 - 1.29) 5 | 1.6 (1.3 - 1.9) 5 |
| Burbot | NA | 0.4 (0.37 - 0.49) 3 | 0.4 (0.3 - 0.4) 5 | 0.33 (0.25 - 0.41) 4 | 0.56 (0.04 - 1.08) 5 | 0.36 (0.26 - 0.46) 5 |
| **Copper (mg/kg WW)** | | | | | | |
| Walleye | 0.33 (0.31 - 0.34) 5 | 0.33 (0.29 - 0.38) 5 | 0.35 (0.29 - 0.40) 5 | 0.46 (0.38 - 0.54) 5 | 0.35 (0.3 - 0.39) 3 | 0.36 (0.33 - 0.39) 7 |
| Wild Rainbow Trout | 1.4 (0.9 - 1.7) 5 | 1.6 (1.3 - 1.9) 5 | 1.2 (1.0 - 1.3) 2 | NA | 0.56 (0.56 - 0.56) 1 | 0.43 (0.43 - 0.43) 1 |
| Hatchery Rainbow Trout | NA | NA | 2.2 (1.7 - 2.8) 3 | 0.66 (0.52 - 0.81) 5 | 0.6 (0.45 - 0.75) 5 | 0.4 (0.37 - 0.44) 4 |
| Lake Whitefish | NA | 0.68 (0.57 - 0.79) 5 | 0.60 (0.44 - 0.76) 5 | 0.68 (0.65 - 0.72) 5 | 0.63 (0.56 - 0.71) 5 | 0.5 (0.43 - 0.59) 2 |
| Mountain Whitefish | 1.3 (0.8 - 1.8) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 9.0 (1.9 - 16.1) 5 | 1.3 (1.0 - 1.5) 4 | 0.87 (0.76 - 0.97) 5 | 0.81 (0.75 - 0.87) 5 | 0.72 (0.63 - 0.8) 5 | 0.94 (0.76 - 1.12) 5 |
| Burbot | NA | 1.1 (1.0 - 1.2) 3 | 1.2 (0.94 - 1.5) 5 | 1.1 (0.94 - 1.3) 4 | 1.0 (0.81 - 1.21) 5 | 1.1 (0.87 - 1.34) 5 |
| **Iron (mg/kg WW)** | | | | | | |
| Walleye | 10.2 (9.4 - 11.1) 5 | 9.4 (8.2 - 10.7) 5 | 9.8 (8.0 - 11.7) 5 | 10.5 (9.0 - 12.0) 5 | 8.1 (7.2 - 9.0) 3 | 10.1 (8.9 - 11.2) 7 |
| Wild Rainbow Trout | 26.9 (18.6 - 35.3) 5 | 22.0 (16.8 - 27.3) 5 | 22.4 (18.3 - 26.6) 2 | NA | 17.2 (17.2 - 17.2) 1 | 22.0 (22.0 - 22.0) 1 |
| Hatchery Rainbow Trout | NA | NA | 36.6 (23.4 - 49.8) 3 | 18.4 (13.1 - 23.6) 5 | 20.1 (12.4 - 27.9) 5 | 16.6 (15.3 - 17.9) 4 |
| Lake Whitefish | NA | 14.1 (11.6 - 16.5) 5 | 14.5 (9.9 - 19.2) 5 | 17.0 (15.5 - 18.5) 5 | 15.1 (11.7 - 18.6) 5 | 14.6 (9.6 - 19.6) 2 |
| Mountain Whitefish | 102.6 (59.3 - 145.9) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 728.8 (122.9 - 1334.7) 5 | 65.3 (44.9 - 85.7) 4 | 61.3 (33.0 - 89.5) 5 | 108.5 (80.9 - 136.1) 5 | 49.5 (8.7 - 90.3) 5 | 94.8 (60.4 - 129.2) 5 |
| Burbot | NA | 19.2 (16.7 - 21.8) 3 | 26.3 (17.6 - 35.0) 5 | 22.6 (21.1 - 24.1) 4 | 29.9 (26.4 - 33.3) 5 | 26.9 (24.0 - 29.9) 5 |

**TABLE 3-17**
Summary Statistics for Composites of Each Target Species by FSCA
*Upper Columbia River RI/FS*

| Target Species | FSCA 1 Mean (± 1 SD) N | FSCA 2 Mean (± 1 SD) N | FSCA 3 Mean (± 1 SD) N | FSCA 4 Mean (± 1 SD) N | FSCA 5 Mean (± 1 SD) N | FSCA 6 Mean (± 1 SD) N |
|---|---|---|---|---|---|---|
| **Lead (mg/kg WW)** | | | | | | |
| Walleye | 0.035 (0.030 - 0.041) 5 | 0.039 (0.027 - 0.051) 5 | 0.044 (0.035 - 0.054) 5 | 0.122 (0.062 - 0.181) 5 | 0.072 (-0.008 - 0.153) 3 | 0.025 (0.012 - 0.039) 7 |
| Wild Rainbow Trout | 0.138 (0.101 - 0.175) 5 | 0.097 (0.073 - 0.121) 5 | 0.033 (0.032 - 0.034) 2 | NA | 0.008 (0.008 - 0.008) 1 | 0.025 (0.025 - 0.025) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.162 (0.078 - 0.246) 3 | 0.012 (0.007 - 0.017) 5 | 0.01 (0.003 - 0.017) 5 | 0.017 (0.014 - 0.02) 4 |
| Lake Whitefish | NA | 0.067 (0.057 - 0.077) 5 | 0.077 (0.047 - 0.107) 5 | 0.067 (0.039 - 0.095) 5 | 0.048 (0.042 - 0.054) 5 | 0.056 (0.034 - 0.078) 2 |
| Mountain Whitefish | 0.335 (0.23 - 0.44) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 6.223 (3.713 - 8.733) 5 | 3.911 (3.598 - 4.224) 4 | 2.722 (1.929 - 3.515) 5 | 1.461 (1.055 - 1.867) 5 | 0.653 (0.534 - 0.772) 5 | 0.623 (0.375 - 0.871) 5 |
| Burbot | NA | 0.067 (0.062 - 0.072) 3 | 0.101 (0.053 - 0.149) 5 | 0.095 (0.082 - 0.108) 4 | 0.088 (0.059 - 0.117) 5 | 0.085 (0.08 - 0.09) 5 |
| **Nickel (mg/kg WW)** | | | | | | |
| Walleye | 0.43 (0.39 - 0.47) 5 | 0.38 (0.33 - 0.42) 5 | 0.38 (0.33 - 0.44) 5 | 0.40 (0.37 - 0.43) 5 | 0.35 (0.34 - 0.37) 3 | 0.40 (0.34 - 0.46) 7 |
| Wild Rainbow Trout | 0.22 (0.18 - 0.27) 5 | 0.22 (0.14 - 0.30) 5 | 0.2 (0.19 - 0.21) 2 | NA | 0.14 (0.14 - 0.14) 1 | 0.24 (0.24 - 0.24) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.32 (0.24 - 0.42) 3 | 0.16 (0.13 - 0.19) 5 | 0.19 (0.15 - 0.23) 5 | 0.08 (0.07 - 0.1) 4 |
| Lake Whitefish | NA | 0.17 (0.16 - 0.18) 5 | 0.22 (0.16 - 0.27) 5 | 0.20 (0.17 - 0.24) 5 | 0.23 (0.19 - 0.27) 5 | 0.2.3 (0.21 - 0.25) 2 |
| Mountain Whitefish | 0.24 (0.19 - 0.29) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 0.99 (0.085 - 1.89) 5 | 0.59 (0.38 - 0.79) 4 | 0.57 (0.32 - 0.83) 5 | 0.62 (0.46 - 0.77) 5 | 0.50 (0.34 - 0.66) 5 | 0.58 (0.56 - 0.60) 5 |
| Burbot | NA | 0.31 (0.30 - 0.32) 3 | 0.28 (0.24 - 0.33) 5 | 0.30 (0.24 - 0.35) 4 | 0.34 (0.27 - 0.40) 5 | 0.30 (0.26 - 0.34) 5 |
| **Selenium (mg/kg WW)** | | | | | | |
| Walleye | 0.41 (0.40 - 0.43) 5 | 0.48 (0.45 - 0.52) 5 | 0.52 (0.41 - 0.62) 5 | 0.72 (0.61 - 0.83) 5 | 0.50 (0.39 - 0.61) 3 | 0.48 (0.39 - 0.57) 7 |
| Wild Rainbow Trout | 0.76 (0.7 - 0.8) 5 | 0.61 (0.59 - 0.64) 5 | 0.69 (0.67 - 0.72) 2 | NA | 0.53 (0.53 - 0.53) 1 | 0.54 (0.54 - 0.54) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.51 (0.46 - 0.55) 3 | 0.46 (0.41 - 0.52) 5 | 0.38 (0.33 - 0.43) 5 | 0.29 (0.27 - 0.31) 4 |
| Lake Whitefish | NA | 0.73 (0.64 - 0.81) 5 | 0.73 (0.62 - 0.85) 5 | 0.81 (0.76 - 0.86) 5 | 0.69 (0.59 - 0.78) 5 | 0.46 (0.43 - 0.50) 2 |
| Mountain Whitefish | 1.0 (0.9 - 1.2) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 0.56 (0.45 - 0.67) 5 | 0.60 (0.58 - 0.63) 4 | 0.66 (0.59 - 0.73) 5 | 0.53 (0.46 - 0.61) 5 | 0.45 (0.39 - 0.50) 5 | 0.53 (0.48 - 0.59) 5 |
| Burbot | | 0.68 (0.59 - 0.78) 3 | 0.65 (0.52 - 0.77) 5 | 0.59 (0.56 - 0.62) 4 | 0.48 (0.43 - 0.53) 5 | 0.43 (0.40 - 0.47) 5 |
| **Uranium (mg/kg WW)** | | | | | | |
| Walleye | 0.0009 (0.0007 - 0.0011) 5 | 0.0005 (0.0003 - 0.0007) 5 | 0.0011 (0.0008 - 0.0014) 5 | 0.001 (0.0008 - 0.0012) 5 | 0.0009 (0.0006 - 0.0012) 3 | 0.0011 (0.0007 - 0.0015) 7 |
| Wild Rainbow Trout | 0.003 (0.002 - 0.004) 5 | 0.003 (0.002 - 0.004) 5 | 0.002 (0.002 - 0.002) 2 | NA | 0.001 (0.001 - 0.001) 1 | 0.002 (0.002 - 0.002) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.007 (0.004 - 0.01) 3 | 0.001 (0.001 - 0.001) 5 | 0.001 (0 - 0.002) 5 | 0.002 (0.002 - 0.002) 4 |
| Lake Whitefish | NA | 0.002 (0.002 - 0.002) 5 | 0.003 (0.001 - 0.005) 5 | 0.001 (0 - 0.002) 5 | 0.002 (0.001 - 0.003) 5 | 0.001 (0.001 - 0.001) 2 |
| Mountain Whitefish | 0.009 (0.006 - 0.012) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 0.033 (0.019 - 0.047) 5 | 0.017 (0.015 - 0.019) 4 | 0.019 (0.015 - 0.023) 5 | 0.017 (0.014 - 0.02) 5 | 0.015 (0.012 - 0.018) 5 | 0.014 (0.011 - 0.017) 5 |
| Burbot | NA | 0.004 (0.003 - 0.005) 3 | 0.006 (0.003 - 0.009) 5 | 0.004 (0.003 - 0.005) 4 | 0.005 (0.004 - 0.006) 5 | 0.005 (0.004 - 0.006) 5 |
| **Zinc (mg/kg WW)** | | | | | | |
| Walleye | 12.9 (12.6 - 13.2) 5 | 12.9 (12.0 - 13.8) 5 | 11.7 (11.0 - 12.4) 5 | 13.8 (12.2 - 15.4) 5 | 12.5 (11.4 - 13.6) 3 | 12.0 (11.5 - 12.5) 7 |
| Wild Rainbow Trout | 25.9 (23.4 - 28.3) 5 | 21.5 (20.4 - 22.5) 5 | 22.6 (22.3 - 22.9) 2 | NA | 21.8 (21.8 - 21.8) 1 | 28.3 (28.3 - 28.3) 1 |
| Hatchery Rainbow Trout | NA | NA | 22.8 (20.6 - 24.8) 3 | 23.1 (21.6 - 24.5) 5 | 23.8 (22.2 - 25.5) 5 | 25.0 (23.8 - 26.1) 4 |
| Lake Whitefish | NA | 12.6 (11.8 - 13.4) 5 | 13.5 (13.1 - 13.8) 5 | 11.9 (10.7 - 13.1) 5 | 13.2 (12.3 - 14.0) 5 | 12.3 (12.0 - 12.6) 2 |
| Mountain Whitefish | 29.9 (22.6 - 37.2) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 85.5 (30.1 - 140.8) 5 | 25.6 (23.5 - 27.7) 4 | 20.6 (19.1 - 22.1) 5 | 22.3 (20.7 - 23.8) 5 | 19.3 (17.3 - 21.4) 5 | 18.6 (17.6 - 19.6) 5 |
| Burbot | NA | 12.1 (11.9 - 12.3) 3 | 12.5 (11.7 - 13.3) 5 | 12.3 (11.6 - 13.0) 4 | 12.7 (11.8 - 13.5) 5 | 12.4 (11.5 - 13.3) 5 |
| **Mercury (ug/kg WW)** | | | | | | |
| Walleye | 158.3 (128.5 - 188.1) 5 | 134.9 (119.1 - 150.6) 5 | 172.5 (151.0 - 194.0) 5 | 164.2 (122.0 - 206.4) 5 | 204.7 (161.6 - 247.7) 3 | 233.4 (194.3 - 272.5) 7 |
| Wild Rainbow Trout | 70.6 (60.3 - 80.9) 5 | 42.7 (36.2 - 49.2) 5 | 62.7 (52.9 - 72.5) 2 | NA | 69.5 (69.5 - 69.5) 1 | 97.5 (97.5 - 97.5) 1 |
| Hatchery Rainbow Trout | NA | NA | 56.1 (51.9 - 60.2) 3 | 65.1 (56.9 - 73.4) 5 | 63.8 (58.7 - 68.9) 5 | 188.0 (155.4 - 220.5) 4 |
| Lake Whitefish | NA | 59.8 (52.9 - 66.7) 5 | 52.1 (49.5 - 54.7) 5 | 59.1 (49.4 - 68.7) 5 | 69.3 (63.4 - 75.1) 5 | 94.1 (93.5 - 94.7) 2 |
| Mountain Whitefish | 76.5 (68.5 - 84.5) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 72.8 (-7.4 - 153.0) 5 | 191.7 (163.3 - 220.1) 4 | 215.8 (93.0 - 338.6) 5 | 256.8 (226.7 - 287.0) 5 | 227.2 (205.5 - 248.9) 5 | 181.4 (78.7 - 284.1) 5 |
| Burbot | NA | 138.0 (100.5 - 175.5) 3 | 163.3 (131.7 - 194.8) 5 | 189.5 (161.6 - 217.4) 4 | 189.2 (149.0 - 229.5) 5 | 202.4 (167.0 - 237.9) 5 |

**TABLE 3-17**
Summary Statistics for Composites of Each Target Species by FSCA
*Upper Columbia River RI/FS*

| Target Species | FSCA 1 Mean (± 1 SD) N | FSCA 2 Mean (± 1 SD) N | FSCA 3 Mean (± 1 SD) N | FSCA 4 Mean (± 1 SD) N | FSCA 5 Mean (± 1 SD) N | FSCA 6 Mean (± 1 SD) N |
|---|---|---|---|---|---|---|
| **Total PCBs (ug/kg WW)** | | | | | | |
| Walleye | 28.9 (21.6 - 36.3) 5 | 86.3 (75.8 - 96.9) 5 | 62.8 (60.5 - 65.1) 5 | 74.6 (72.4 - 76.8) 5 | 68.6 (62.5 - 74.8) 3 | 83.5 (68.9 - 98.0) 7 |
| Wild Rainbow Trout | 88.7 (74.3 - 103.1) 5 | 72.4 (68.5 - 76.4) 5 | 57.8 (55.5 - 60.2) 2 | NA | 56.2 (56.2 - 56.2) 1 | 53.1 (53.1 - 53.1) 1 |
| Hatchery Rainbow Trout | NA | NA | 50.5 (47.0 - 54.0) 3 | 51.5 (50.9 - 52.2) 5 | 53.1 (48.0 - 58.3) 5 | 54.4 (50.9 - 57.9) 4 |
| Lake Whitefish | NA | 58.1 (48.5 - 67.6) 5 | 70.6 (66.3 - 74.9) 5 | 74.7 (68.6 - 80.8) 5 | 84.8 (79.7 - 90.0) 5 | 84.5 (81.1 - 87.4) 2 |
| Mountain Whitefish | 110.8 (104.5 - 117.2) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 65.9 (4.2 - 127.6) 5 | 80.6 (24.3 - 137.3) 4 | 77.0 (32.1 - 121.9) 5 | 182.1 (121.2 - 243.1) 5 | 195.2 (142.1 - 248.3) 5 | 117.1 (46.6 - 187.5) 5 |
| Burbot | NA | 74.0 (62.2 - 85.8) 3 | 70.9 (63.6 - 78.2) 5 | 67.3 (57.7 - 76.8) 4 | 74.4 (58.6 - 90.2) 5 | 66.6 (63.0 - 70.2) 5 |
| **2,3,7,8 TCDF (ug/kg WW)** | | | | | | |
| Walleye | 0.001 (0.0008 - 0.0012) 5 | 0.0012 (0.001 - 0.0014) 5 | 0.0012 (0.0011 - 0.0013) 5 | 0.002 (0.0014 - 0.0026) 5 | 0.0017 (0.0015 - 0.0019) 3 | 0.002 (0.0015 - 0.0025) 7 |
| Wild Rainbow Trout | 0.002 (0.001 - 0.003) 5 | 0.003 (0.002 - 0.004) 5 | 0.002 (0.002 - 0.002) 2 | NA | 0.001 (0.001 - 0.001) 1 | 0.001 (0.001 - 0.001) 1 |
| Hatchery Rainbow Trout | NA | NA | 0.001 (0.001 - 0.001) 3 | 0.001 (0.001 - 0.001) 5 | 0.001 (0.001 - 0.001) 5 | 0.001 (0.001 - 0.001) 4 |
| Lake Whitefish | NA | 0.005 (0.004 - 0.006) 5 | 0.003 (0.002 - 0.004) 5 | 0.006 (0.005 - 0.007) 5 | 0.007 (0.006 - 0.008) 5 | 0.008 (0.007 - 0.009) 2 |
| Mountain Whitefish | 0.004 (0.003 - 0.005) 5 | NA | NA | NA | NA | NA |
| Largescale Sucker | 0.001 (0 - 0.002) 5 | 0.005 (0 - 0.01) 4 | 0.002 (0.001 - 0.003) 5 | 0.004 (0.003 - 0.005) 5 | 0.004 (0.003 - 0.005) 5 | 0.004 (0.001 - 0.007) 5 |
| Burbot | NA | 0.005 (0.004 - 0.006) 3 | 0.003 (0.002 - 0.004) 5 | 0.004 (0.003 - 0.005) 4 | 0.003 (0.002 - 0.004) 5 | 0.004 (0.003 - 0.005) 5 |

Note: Mean and standard deviation are reported in mg/kg WW for all chemicals except mercury, total PCBs, and 2,3,7,8-TCDF, which are reported in ug/kg WW.

mg/kg = milligrams per kilogram
N = number of samples
NA = not analyzed
PCB = polychlorinated biphenyl
SD = standard deviation
ug/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-18**

Summary Statistics for Fillet and Offal Samples from Walleye and Rainbow Trout by FSCA

*Upper Columbia River RI/FS*

| Target Species | FSCA 1<br>Mean (± 1 SD) N | FSCA 3<br>Mean (± 1 SD) N | FSCA 6<br>Mean (± 1 SD) N |
|---|---|---|---|
| **Aluminum** | | | |
| Walleye Fillet | 1.25 (1.2-1.3) 4 | 1.26 (1.23-1.28) 5 | 1.26 (1.25-1.28) 5 |
| Walleye Offal | 1.74 (1.65-1.83) 5 | 4.0 (1.9-6.1) 5 | 5.5 (3.8-7.4) 5 |
| Wild Rainbow Trout Fillet | 2.0 (1.9-2.1) 5 | 1.85 (1.8-1.9) 2 | 1.6 (1.6-1.6) 1 |
| Wild Rainbow Trout Offal | 4.8 (1.5-8.1) 5 | 11.2 (7.9-14.6) 2 | 8.2 (8.2-8.2) 1 |
| Hatchery Rainbow Trout Fillet | NA | 1.85 (1.8-1.9) 3 | 1.827 (1.82-1.834) 4 |
| Hatchery Rainbow Trout Offal | NA | 45.9 (25.4-66.4) 3 | 8.4 (7.4-9.3) 4 |
| **Arsenic** | | | |
| Walleye Fillet | 0.09 (0.07-0.11) 5 | 0.11 (0.1-0.12) 5 | 0.13 (0.1-0.16) 5 |
| Walleye Offal | 0.09 (0.05-0.13) 5 | 0.12 (0.07-0.17) 5 | 0.16 (0.13-0.19) 5 |
| Wild Rainbow Trout Fillet | 0.09 (0.07-0.11) 5 | 0.07 (0.06-0.08) 2 | 0.08 (0.08-0.08) 1 |
| Wild Rainbow Trout Offal | 0.2 (0.17-0.23) 5 | 0.22 (0.21-0.23) 2 | 0.2 (0.2-0.2) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.03 (0.029-0.031) 3 | 0.04 (0.01-0.07) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.15 (0.135-0.165) 3 | 0.13 (0.107-0.153) 4 |
| **Barium** | | | |
| Walleye Fillet | 0.04 (0.039-0.041) 5 | 0.04 (0.039-0.041) 5 | 0.04 (0.039-0.041) 5 |
| Walleye Offal | 1.45 (1.35-1.55) 5 | 1.44 (1.31-1.57) 5 | 1.51 (1.37-1.65) 5 |
| Wild Rainbow Trout Fillet | 0.07 (0.068-0.072) 5 | 0.06 (0.058-0.062) 2 | 0.05 (0.05-0.05) 1 |
| Wild Rainbow Trout Offal | 1.5 (1.16-1.84) 5 | 0.87 (0.71-1.03) 2 | 1.42 (1.42-1.42) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.06 (0.059-0.061) 3 | 0.06 (0.06-0.06) 4 |
| Hatchery Rainbow Trout Offal | NA | 1.65 (0.6-2.7) 3 | 0.86 (0.72-1) 4 |
| **Cadmium** | | | |
| Walleye Fillet | 0.005 (0.0048-0.0052) 5 | 0.005 (0.0049-0.0051) 5 | 0.005 (0.0049-0.0051) 5 |
| Walleye Offal | 0.034 (0.028-0.04) 5 | 0.036 (0.024-0.048) 5 | 0.033 (0.03-0.036) 5 |
| Wild Rainbow Trout Fillet | 0.012 (0.001-0.023) 5 | 0.006 (0.006-0.006) 2 | 0.005 (0.005-0.005) 1 |
| Wild Rainbow Trout Offal | 0.035 (0.028-0.042) 5 | 0.082 (0.069-0.095) 2 | 0.086 (0.086-0.086) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.006 (0.0059-0.0061) 3 | 0.006 (0.0059-0.0061) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.109 (0.099-0.119) 3 | 0.091 (0.074-0.108) 4 |
| **Chromium** | | | |
| Walleye Fillet | 0.45 (0.34-0.56) 5 | 0.53 (0.31-0.75) 5 | 0.45 (0.39-0.51) 5 |
| Walleye Offal | 0.59 (0.46-0.72) 5 | 0.56 (0.42-0.7) 5 | 0.71 (0.41-1.01) 5 |
| Wild Rainbow Trout Fillet | 0.57 (0.48-0.66) 5 | 0.41 (0.4-0.42) 2 | 0.44 (0.44-0.44) 1 |
| Wild Rainbow Trout Offal | 1.08 (0.94-1.22) 5 | 0.86 (0.78-0.94) 2 | 0.52 (0.52-0.52) 1 |

**TABLE 3-18**
Summary Statistics for Fillet and Offal Samples from Walleye and Rainbow Trout by FSCA
*Upper Columbia River RI/FS*

| Target Species | FSCA 1 Mean (± 1 SD) N | FSCA 3 Mean (± 1 SD) N | FSCA 6 Mean (± 1 SD) N |
|---|---|---|---|
| Hatchery Rainbow Trout Fillet | NA | 0.35 (0.2-0.5) 3 | 0.35 (0.32-0.38) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.7 (0.33-1.07) 3 | 0.36 (0.34-0.38) 4 |
| **Copper** | | | |
| Walleye Fillet | 0.23 (0.21-0.25) 5 | 0.2 (0.17-0.23) 5 | 0.21 (0.2-0.22) 5 |
| Walleye Offal | 0.41 (0.39-0.43) 5 | 0.46 (0.38-0.54) 5 | 0.5 (0.47-0.53) 5 |
| Wild Rainbow Trout Fillet | 0.34 (0.32-0.36) 5 | 0.33 (0.32-0.34) 2 | 0.27 (0.27-0.27) 1 |
| Wild Rainbow Trout Offal | 2.38 (1.68-3.08) 5 | 1.9 (1.52-2.28) 2 | 0.58 (0.58-0.58) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.35 (0.3-0.4) 3 | 0.27 (0.25-0.29) 4 |
| Hatchery Rainbow Trout Offal | NA | 2.7 (0.7-4.7) 3 | 0.55 (0.5-0.6) 4 |
| **Iron** | | | |
| Walleye Fillet | 3.5 (2.7 - 4.4) 5 | 3.3 (2.0 - 4.6) 5 | 2.7 (2.3 - 3.1) 5 |
| Walleye Offal | 15.9 (14.7 - 17.1) 5 | 15.2 (12.4 - 18.1) 5 | 16.1 (13.6 - 18.6) 5 |
| Wild Rainbow Trout Fillet | 5.2 (4.4 - 6.0) 5 | 3.9 (3.7 - 4.1) 2 | 5.2 (5.2 - 5.2) 1 |
| Wild Rainbow Trout Offal | 49.6 (32.3 - 66.9) 5 | 39 (29.8 - 48.3) 2 | 38.4 (38.4 - 38.4) 1 |
| Hatchery Rainbow Trout Fillet | NA | 4.1 (3.3 - 4.9) 3 | 3.9 (3.4 - 4.4) 4 |
| Hatchery Rainbow Trout Offal | NA | 50.9 (23.8 - 78.0) 3 | 30.7 (29.7 - 31.7) 4 |
| **Lead** | | | |
| Walleye Fillet | 0.005 (0.0048 - 0.0052) 5 | 0.019 (-0.0009 - 0.0389) 5 | 0.024 (-0.002 - 0.05) 5 |
| Walleye Offal | 0.056 (0.046 - 0.066) 5 | 0.062 (0.038 - 0.086) 5 | 0.032 (0.024 - 0.04) 5 |
| Wild Rainbow Trout Fillet | 0.015 (0.01 - 0.02) 5 | 0.006 (0.006 - 0.006) 2 | 0.005 (0.005 - 0.005) 1 |
| Wild Rainbow Trout Offal | 0.265 (0.188 - 0.342) 5 | 0.052 (0.051 - 0.053) 2 | 0.039 (0.039 - 0.039) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.006 (0.006 - 0.006) 3 | 0.006 (0.006 - 0.006) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.175 (-0.014 - 0.364) 3 | 0.021 (0.014 - 0.028) 4 |
| **Nickel** | | | |
| Walleye Fillet | 0.14 (0.1086 - 0.1714) 5 | 0.11 (0.0699 - 0.1501) 5 | 0.1 (0.0652 - 0.1348) 5 |
| Walleye Offal | 0.68 (0.612 - 0.748) 5 | 0.61 (0.526 - 0.694) 5 | 0.69 (0.632 - 0.748) 5 |
| Wild Rainbow Trout Fillet | 0.03 (0.015 - 0.045) 5 | 0.03 (0.016 - 0.044) 2 | 0.03 (0.03 - 0.03) 1 |
| Wild Rainbow Trout Offal | 0.41 (0.333 - 0.487) 5 | 0.34 (0.334 - 0.346) 2 | 0.44 (0.44 - 0.44) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.07 (0.012 - 0.128) 3 | 0.02 (0.013 - 0.027) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.48 (0.287 - 0.673) 3 | 0.35 (0.282 - 0.418) 4 |
| **Selenium** | | | |
| Walleye Fillet | 0.4 (0.37 - 0.43) 5 | 0.4 (0.37 - 0.43) 5 | 0.4 (0.29 - 0.51) 5 |
| Walleye Offal | 0.5 (0.49 - 0.51) 5 | 0.6 (0.44 - 0.76) 5 | 0.5 (0.4 - 0.61) 5 |

**TABLE 3-18**

Summary Statistics for Fillet and Offal Samples from Walleye and Rainbow Trout by FSCA

*Upper Columbia River RI/FS*

| Target Species | FSCA 1<br>Mean (± 1 SD) N | FSCA 3<br>Mean (± 1 SD) N | FSCA 6<br>Mean (± 1 SD) N |
|---|---|---|---|
| Wild Rainbow Trout Fillet | 0.5 (0.43 - 0.57) 5 | 0.4 (0.36 - 0.44) 2 | 0.4 (0.4 - 0.4) 1 |
| Wild Rainbow Trout Offal | 1 (0.93 - 1.07) 5 | 0.9 (0.87 - 0.93) 2 | 0.7 (0.7 - 0.7) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.4 (0.34 - 0.46) 3 | 0.2 (0.16 - 0.24) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.5 (0.34 - 0.66) 3 | 0.4 (0.39 - 0.41) 4 |
| **Uranium** | | | |
| Walleye Fillet | 0.0003 (0.00029 - 0.00031) 5 | 0.0003 (0.00029 - 0.00031) 5 | 0.0003 (0.0003 - 0.0003) 5 |
| Walleye Offal | 0.0012 (0.00091 - 0.0015) 5 | 0.0015 (0.001 - 0.002) 5 | 0.0013 (0.001 - 0.0017) 5 |
| Wild Rainbow Trout Fillet | 0.0007 (0.00068 - 0.00072) 5 | 0.0006 (0.00058 - 0.00062) 2 | 0.0006 (0.0006 - 0.0006) 1 |
| Wild Rainbow Trout Offal | 0.0046 (0.0034 - 0.0058) 5 | 0.003 (0.0025 - 0.0035) 2 | 0.003 (0.003 - 0.003) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.0006 (0.00059 - 0.00061) 3 | 0.0006 (0.0006 - 0.0006) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.0073 (0.0003 - 0.01) 3 | 0.0018 (0.00092 - 0.0027) 4 |
| **Zinc** | | | |
| Walleye Fillet | 7.3 (6.9 - 7.7) 5 | 6.1 (5.5 - 6.7) 5 | 6.4 (6.3 - 6.5) 5 |
| Walleye Offal | 17.6 (17.1 - 18.1) 5 | 16.4 (15.1 - 17.7) 5 | 16.9 (15.9 - 17.9) 5 |
| Wild Rainbow Trout Fillet | 8.3 (8.0 - 8.6) 5 | 6.4 (6.3 - 6.5) 2 | 6.3 (6.3 - 6.3) 1 |
| Wild Rainbow Trout Offal | 44.1 (39.8 - 48.4) 5 | 37.1 (36.7 - 37.5) 2 | 49.7 (49.7 - 49.7) 1 |
| Hatchery Rainbow Trout Fillet | NA | 7.4 (6.6 - 8.2) 3 | 7.1 (6.6 - 7.6) 4 |
| Hatchery Rainbow Trout Offal | NA | 38.2 (35.2 - 41.2) 3 | 44 (42.5 - 45.8) 4 |
| **Mercury** | | | |
| Walleye Fillet | 227.2 (183.8-270.6) 5 | 240.6 (211.5-269.7) 5 | 333.6 (262.1-405.1) 5 |
| Walleye Offal | 100.8 (81.7-119.9) 5 | 115.8 (96.9-134.7) 5 | 161.8 (136.3-187.3) 5 |
| Wild Rainbow Trout Fillet | 86.1 (70.6-101.6) 5 | 76.1 (65.2-87) 2 | 120 (120-120) 1 |
| Wild Rainbow Trout Offal | 54.7 (48.4-61) 5 | 50.8 (41-60.6) 2 | 75.7 (75.7-75.7) 1 |
| Hatchery Rainbow Trout Fillet | NA | 66.8 (60.4-73.2) 3 | 99.9 (81.4-118.4) 4 |
| Hatchery Rainbow Trout Offal | NA | 48 (43.2-52.8) 3 | 65.2 (52.9-77.5) 4 |
| **Total PCBs** | | | |
| Walleye Fillet | 7 (5.9-8.1) 5 | 50.2 (46.3-54.1) 5 | 52.2 (51.1-53.3) 5 |
| Walleye Offal | 45.1 (31.6-58.6) 5 | 60.9 (55.7-66.1) 5 | 107 (81.6-132.4) 5 |
| Wild Rainbow Trout Fillet | 72.1 (66.5-77.7) 5 | 47 (46.6-47.4) 2 | 43.7 (43.7-43.7) 1 |
| Wild Rainbow Trout Offal | 92.9 (69.3-116.5) 5 | 54 (53.3-54.7) 2 | 51.4 (51.4-51.4) 1 |
| Hatchery Rainbow Trout Fillet | NA | 43.2 (38.6-47.8) 3 | 45.1 (42.6-47.6) 4 |
| Hatchery Rainbow Trout Offal | NA | 46.8 (44.9-48.7) 3 | 54.3 (49.3-59.3) 4 |

**TABLE 3-18**

Summary Statistics for Fillet and Offal Samples from Walleye and Rainbow Trout by FSCA

*Upper Columbia River RI/FS*

| Target Species | FSCA 1<br>Mean (± 1 SD) N | FSCA 3<br>Mean (± 1 SD) N | FSCA 6<br>Mean (± 1 SD) N |
|---|---|---|---|
| **2,3,7,8 TCDF** | | | |
| Walleye Fillet | 0.0002 (0.00017-0.00023) 5 | 0.0003 (0.0002-0.0004) 5 | 0.0006 (0.0004-0.0008) 5 |
| Walleye Offal | 0.002 (0.0016-0.0024) 5 | 0.002 (0.0018-0.0022) 5 | 0.003 (0.002-0.004) 5 |
| Wild Rainbow Trout Fillet | 0.001 (0.0002-0.0018) 5 | 0.0008 (0.0007-0.0009) 2 | 0.0006 (0.0006-0.0006) 1 |
| Wild Rainbow Trout Offal | 0.0021 (0.0008-0.0034) 5 | 0.0014 (0.00134-0.00146) 2 | 0.0014 (0.0014-0.0014) 1 |
| Hatchery Rainbow Trout Fillet | NA | 0.0007 (0.0003-0.0011) 3 | 0.0007 (0.0004-0.001) 4 |
| Hatchery Rainbow Trout Offal | NA | 0.0016 (0.001-0.0022) 3 | 0.0022 (0.002-0.0024) 4 |

Note: Mean and standard deviation are reported in mg/kg WW for all chemicals except mercury, total PCBs, and 2,3,7,8-TCDF, which are reported in ug/kg WW.

mg/kg = milligrams per kilogram
N = number of samples
NA = not analyzed
PCB = polychlorinated biphenyl
SD = standard deviation
ug/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-19**
Average Values of the Coefficient of Variation Among Composite Samples
*Upper Columbia River RI/FS*

| Analyte | Walleye | | | Wild Rainbow Trout | | | Hatchery Rainbow Trout | | | Lake Whitefish | Largescale Sucker | Burbot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Whole | Fillet | Offal | Whole | Fillet | Offal | Whole | Fillet | Offal | | | |
| Aluminum | 0.633 | 0.443 | 0.792 | 0.479 | 0.088 | 0.577 | 0.484 | 0.554 | 0.750 | 0.366 | 0.551 | 0.328 |
| Arsenic | 0.223 | 0.370 | 0.362 | 0.120 | 0.355 | 0.704 | 0.131 | 1.273 | 0.592 | 0.158 | 0.161 | 0.134 |
| Barium | 0.091 | 0.393 | 0.160 | 0.315 | 0.162 | 0.156 | 0.337 | 0.556 | 0.596 | 0.184 | 0.276 | 0.161 |
| Cadmium | 0.245 | 0.400 | 0.620 | 0.302 | 1.348 | 0.127 | 0.188 | 0.556 | 0.523 | 0.266 | 0.172 | 0.286 |
| Chromium | 0.223 | 0.556 | 0.363 | 0.113 | 1.168 | 0.208 | 0.173 | 0.942 | 0.752 | 0.126 | 0.403 | 0.355 |
| Copper | 0.127 | 0.539 | 0.708 | 0.257 | 0.466 | 0.260 | 0.205 | 0.570 | 0.579 | 0.194 | 0.247 | 0.174 |
| Iron | 0.131 | 0.439 | 0.417 | 0.246 | 0.810 | 0.270 | 0.282 | 0.581 | 0.912 | 0.262 | 0.497 | 0.151 |
| Lead | 0.461 | 0.827 | 0.398 | 0.284 | 1.228 | 1.251 | 0.433 | 0.556 | 0.473 | 0.300 | 0.255 | 0.215 |
| Nickel | 0.101 | 0.240 | 0.254 | 0.218 | 0.090 | 1.176 | 0.213 | 0.636 | 0.195 | 0.156 | 0.408 | 0.146 |
| Selenium | 0.162 | 0.826 | 0.779 | 0.044 | 0.297 | 0.504 | 0.114 | 0.364 | 0.093 | 0.116 | 0.119 | 0.116 |
| Uranium | 0.313 | NA | 0.142 | 0.274 | 1.414 | 0.401 | 0.414 | NA | 0.148 | 0.312 | 0.230 | 0.268 |
| Zinc | 0.069 | 0.647 | 0.420 | 0.059 | 0.468 | 1.149 | 0.072 | 0.231 | 0.437 | 0.087 | 0.172 | 0.058 |
| Mercury | 0.187 | 0.277 | 0.099 | 0.223 | 0.159 | 0.353 | 0.113 | 0.439 | 1.226 | 0.087 | 0.176 | 0.200 |
| Total PCB | 0.106 | 0.084 | 0.207 | 0.101 | 0.043 | 0.140 | 0.076 | 0.083 | 0.062 | 0.077 | 0.358 | 0.134 |
| 2,3,7,8-TCDF | 0.204 | 0.334 | 0.216 | 0.411 | 0.501 | 0.331 | 0.284 | 0.581 | 0.209 | 0.186 | 0.348 | 0.215 |

**TABLE 3-20**
Summary Statistics for COIs in Whole Body Walleye by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 3.06 | 0.50 | 1.55 | 5.70 | 1.12 |
| Middle | 4.38 | 0.50 | 1.66 | 6.82 | 1.13 |
| Lower | 5.90 | 2.30 | 1.51 | 25.91 | 5.15 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.10 | 0.008 | 0.07 | 0.15 | 0.018 |
| Middle | 0.19 | 0.019 | 0.116 | 0.312 | 0.042 |
| Lower | 0.16 | 0.008 | 0.118 | 0.197 | 0.019 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 0.846 | 0.020 | 0.732 | 0.955 | 0.0449 |
| Middle | 0.899 | 0.033 | 0.744 | 1.055 | 0.0737 |
| Lower | 0.864 | 0.0280 | 0.782 | 1.025 | 0.0627 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.0234 | 0.00203 | 0.0166 | 0.0384 | 0.00453 |
| Middle | 0.0271 | 0.00236 | 0.0177 | 0.0416 | 0.00527 |
| Lower | 0.0204 | 0.00118 | 0.0141 | 0.0250 | 0.00264 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.53 | 0.05 | 0.38 | 0.97 | 0.12 |
| Middle | 0.55 | 0.04 | 0.38 | 0.80 | 0.08 |
| Lower | 0.52 | 0.04 | 0.40 | 0.84 | 0.10 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 0.33 | 0.010 | 0.28 | 0.38 | 0.022 |
| Middle | 0.40 | 0.028 | 0.26 | 0.57 | 0.063 |
| Lower | 0.36 | 0.010 | 0.30 | 0.40 | 0.023 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 9.8 | 0.35 | 8.2 | 11.6 | 0.78 |
| Middle | 10.2 | 0.52 | 7.1 | 13.1 | 1.16 |
| Lower | 9.5 | 0.44 | 7.1 | 11.7 | 0.98 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.037 | 0.003 | 0.0231 | 0.055 | 0.0064 |
| Middle | 0.0828 | 0.0182 | 0.0317 | 0.2228 | 0.0406 |
| Lower | 0.0394 | 0.01438 | 0.0066 | 0.1618 | 0.0322 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.037 | 0.003 | 0.0231 | 0.055 | 0.0064 |
| Middle | 0.0828 | 0.0182 | 0.0317 | 0.2228 | 0.0406 |

**TABLE 3-20**
Summary Statistics for COIs in Whole Body Walleye by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 0.0394 | 0.01438 | 0.0066 | 0.1618 | 0.0322 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.45 | 0.014 | 0.39 | 0.52 | 0.03 |
| Middle | 0.62 | 0.046 | 0.41 | 0.80 | 0.10 |
| Lower | 0.49 | 0.029 | 0.33 | 0.62 | 0.07 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0007 | 0.0001 | 0.0003 | 0.001 | 0.0002 |
| Middle | 0.0010 | 0.0001 | 0.0007 | 0.001 | 0.0002 |
| Lower | 0.0010 | 0.0001 | 0.0007 | 0.002 | 0.0003 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 12.9 | 0.19 | 11.5 | 13.6 | 0.44 |
| Middle | 12.7 | 0.51 | 11.0 | 15.9 | 1.13 |
| Lower | 12.2 | 0.22 | 11.4 | 13.7 | 0.49 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 146.585 | 8.1129 | 114.00 | 192.34 | 18.1409 |
| Middle | 168.351 | 10.0787 | 114.00 | 214.00 | 22.5367 |
| Lower | 224.793 | 12.7472 | 155.00 | 291.99 | 28.5037 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 57.6100 | 9.94048 | 22.3 | 103.5 | 22.2276 |
| Middle | 68.6700 | 2.08210 | 60.0 | 76.9 | 4.6557 |
| Lower | 79.0100 | 4.47840 | 61.5 | 110.8 | 10.0140 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.00108 | 0.000068 | 0.0007 | 0.0014 | 0.000152 |
| Middle | 0.00164 | 0.0001881 | 0.0011 | 0.0026 | 0.0004206 |
| Lower | 0.00196 | 0.0001392 | 0.0014 | 0.0028 | 0.0003113 |

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-21**
Results of Tests of Equal Concentration of COIs in Whole Body Walleye
*Upper Columbia River RI/FS*

| Analyte | Equality of Means | | Linear Trend | | $\bar{\bar{x}}$ | $S\hat{E}(\bar{\bar{x}})$ |
|---|---|---|---|---|---|---|
| | F-test | p-value | F-test | p-value | | |
| Aluminum | 0.96 | 0.39 | 1.92 | 0.18 | 6.6 | 0.843 |
| Arsenic | ***12.63*** | ***0.0001*** | ***8.33*** | ***0.008*** | NA | NA |
| Barium | 0.94 | 0.40 | 0.20 | 0.66 | 0.778 | 0.037 |
| Cadmium | ***3.05*** | ***0.06*** | 1.21 | 0.28 | NA | NA |
| Chromium | 0.12 | 0.89 | 0.00 | 0.96 | 0.568 | 0.020 |
| Copper | ***4.24*** | ***0.03*** | 1.16 | 0.29 | NA | NA |
| Iron | 0.62 | 0.54 | 0.35 | 0.56 | 16.3 | 1.12 |
| Lead | ***3.67*** | ***0.040*** | 0.02 | 0.90 | NA | NA |
| Nickel | 0.38 | 0.69 | 0.74 | 0.40 | 0.292 | 0.015 |
| Selenium | ***7.51*** | ***0.002*** | 0.67 | 0.42 | NA | NA |
| Uranium | ***3.88*** | ***0.03*** | ***6.35*** | ***0.02*** | NA | NA |
| Zinc | 1.34 | 0.28 | 2.44 | 0.13 | 18.2 | 0.750 |
| Mercury | ***14.82*** | ***< .0001*** | ***27.81*** | ***< .0001*** | NA | NA |
| Total PCB | ***2.79*** | ***0.08*** | ***5.58*** | ***0.03*** | NA | NA |
| 2,3,7,8 TCDF | ***10.02*** | ***0.0006*** | ***19.56*** | ***0.0001*** | NA | NA |

Notes:

Tests between river reach (upper, middle and lower) (F-test) and single degree of freedom contrast for a linear trend (F-test) in concentration. In the case of equality of means (p > .10), the grand mean $(\bar{\bar{x}})$ and associated standard $(S\hat{E}(\bar{\bar{x}}))$ error are reported.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-22**
Summary Statistics for COIs in Whole Body Wild Rainbow Trout by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\bar{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 4.77 | 0.63 | 2.21 | 9.26 | 1.41 |
| Middle | 7.65 | 1.11 | 6.54 | 8.76 | 2.48 |
| Lower | 5.69 | 0.00 | 5.69 | 5.69 | 0.00 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.135 | 0.007 | 0.10 | 0.18 | 0.016 |
| Middle | 0.152 | 0.005 | 0.148 | 0.157 | 0.010 |
| Lower | 0.143 | 0.000 | 0.143 | 0.143 | 0.000 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 0.831 | 0.115 | 0.382 | 1.738 | 0.2573 |
| Middle | 0.519 | 0.047 | 0.472 | 0.566 | 0.1061 |
| Lower | 0.771 | 0.0000 | 0.771 | 0.771 | 0.0000 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.0364 | 0.00440 | 0.0204 | 0.0657 | 0.00985 |
| Middle | 0.0488 | 0.00373 | 0.0451 | 0.0526 | 0.00833 |
| Lower | 0.0486 | 0.00000 | 0.0486 | 0.0486 | 0.00000 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.77 | 0.04 | 0.58 | 1.00 | 0.08 |
| Middle | 0.65 | 0.03 | 0.62 | 0.68 | 0.06 |
| Lower | 0.48 | 0.00 | 0.48 | 0.48 | 0.00 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 1.37 | 0.125 | 0.56 | 1.94 | 0.278 |
| Middle | 1.16 | 0.125 | 1.04 | 1.29 | 0.280 |
| Lower | 0.43 | 0.000 | 0.43 | 0.43 | 0.000 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 23.8 | 2.13 | 17.2 | 40.4 | 4.75 |
| Middle | 22.4 | 2.93 | 19.5 | 25.3 | 6.56 |
| Lower | 22.0 | 0.00 | 22.0 | 22.0 | 0.00 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.107 | 0.014 | 0.0077 | 0.194 | 0.0323 |
| Middle | 0.0331 | 0.0010 | 0.0321 | 0.0341 | 0.0022 |
| Lower | 0.0249 | 0.00000 | 0.0249 | 0.0249 | 0.0000 |

**TABLE 3-22**
Summary Statistics for COIs in Whole Body Wild Rainbow Trout by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.214 | 0.020 | 0.138 | 0.369 | 0.044 |
| Middle | 0.200 | 0.006 | 0.194 | 0.206 | 0.014 |
| Lower | 0.240 | 0.000 | 0.240 | 0.240 | 0.000 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.67 | 0.027 | 0.53 | 0.82 | 0.06 |
| Middle | 0.69 | 0.017 | 0.68 | 0.71 | 0.04 |
| Lower | 0.54 | 0.000 | 0.54 | 0.54 | 0.00 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0027 | 0.0003 | 0.0008 | 0.004 | 0.0007 |
| Middle | 0.0022 | 0.0001 | 0.0020 | 0.002 | 0.0003 |
| Lower | 0.0019 | 0.0000 | 0.0019 | 0.002 | 0.0000 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 23.5 | 0.86 | 20.1 | 30.0 | 1.91 |
| Middle | 22.6 | 0.24 | 22.4 | 22.9 | 0.53 |
| Lower | 28.3 | 0.00 | 28.3 | 28.3 | 0.00 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 78.3 | 4.37412 | 56.2 | 113.2 | 9.78084 |
| Middle | 57.9 | 1.65000 | 56.2 | 59.5 | 3.68951 |
| Lower | 53.1 | 0.00000 | 53.1 | 53.1 | 0.00000 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 78.2636 | 4.37 | 56.2 | 113.2 | 9.8 |
| Middle | 57.8500 | 1.65 | 56.2 | 59.5 | 3.7 |
| Lower | 53.1000 | 0.0 | 53.1 | 53.1 | 0.0 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.00221 | 0.0004226 | 0.0009 | 0.0047 | 0.0009451 |
| Middle | 0.0015 | 0.0003 | 0.0012 | 0.0018 | 0.0006708 |
| Lower | 0.001 | 0.0 | 0.0010 | 0.0010 | 0.0 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-23**
Summary Statistics for COIs in Whole Body Hatchery Rainbow Trout
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 15.06 | 3.92 | 4.51 | 33.95 | 8.76 |
| Lower | 8.18 | 2.02 | 4.70 | 23.54 | 4.52 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.103 | 0.006 | 0.085 | 0.127 | 0.013 |
| Lower | 0.119 | 0.009 | 0.083 | 0.162 | 0.020 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.727 | 0.190 | 0.283 | 1.578 | 0.4257 |
| Lower | 0.512 | 0.0568 | 0.355 | 0.877 | 0.1270 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0552 | 0.00382 | 0.0381 | 0.0677 | 0.00854 |
| Lower | 0.0430 | 0.00355 | 0.0216 | 0.0567 | 0.00793 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.55 | 0.05 | 0.41 | 0.77 | 0.10 |
| Lower | 0.45 | 0.04 | 0.31 | 0.63 | 0.09 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 1.24 | 0.306 | 0.54 | 2.57 | 0.683 |
| Lower | 0.51 | 0.050 | 0.36 | 0.86 | 0.112 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 25.2 | 4.39 | 14.9 | 45.2 | 9.81 |
| Lower | 18.6 | 1.95 | 14.7 | 33.8 | 4.37 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0681 | 0.0318 | 0.0069 | 0.2111 | 0.0710 |
| Lower | 0.0130 | 0.00200 | 0.0068 | 0.0217 | 0.0045 |

**TABLE 3-23**
Summary Statistics for COIs in Whole Body Hatchery Rainbow Trout
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\bar{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Nickel (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.220 | 0.036 | 0.122 | 0.388 | 0.081 |
| Lower | 0.141 | 0.021 | 0.068 | 0.242 | 0.046 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.48 | 0.019 | 0.41 | 0.55 | 0.04 |
| Lower | 0.34 | 0.020 | 0.27 | 0.44 | 0.04 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0029 | 0.0013 | 0.0007 | 0.009 | 0.0028 |
| Lower | 0.0013 | 0.0002 | 0.0007 | 0.002 | 0.0004 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 22.9 | 0.55 | 20.4 | 24.5 | 1.23 |
| Lower | 24.3 | 0.50 | 22.0 | 26.2 | 1.11 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 61.745 | 2.8655 | 53.25 | 75.20 | 6.4074 |
| Lower | 118.956 | 22.8377 | 58.50 | 234.10 | 51.0668 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 51.1625 | 0.70405 | 48.0 | 54.5 | 1.57431 |
| Lower | 53.6889 | 1.42959 | 46.8 | 61.1 | 3.19667 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.00125 | 0.000087 | 0.0009 | 0.0017 | 0.000194 |
| Lower | 0.00141 | 0.000087 | 0.0010 | 0.0018 | 0.000195 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight
-- No samples collected at this location.

**TABLE 3-24**
One-Way Analysis of Variance Results for Rainbow Trout
*Upper Columbia River RI/FS*

| | Upper vs Middle Wild | | Middle vs Lower Hatchery | | Middle Wild vs Hatchery | |
|---|---|---|---|---|---|---|
| | **F-test** | **p-value** | **F-test** | **p-value** | **F-test** | **p-value** |
| Aluminum | 0.3 | 0.59 | 4.34 | 0.05 | 1.9 | 0.18 |
| Arsenic | 0.94 | 0.34 | 1.99 | 0.17 | ***7.6*** | ***0.01*** |
| Barium | 1.15 | 0.29 | 1.38 | 0.35 | 0.48 | 0.49 |
| Cadmium | 1.76 | 0.19 | ***4.19*** | ***0.05*** | 0.43 | 0.51 |
| Chromium | 1.69 | 0.20 | 2.71 | 0.11 | 1.12 | 0.30 |
| Copper | 0.27 | 0.61 | ***8.29*** | ***0.008*** | 0.04 | 0.84 |
| Iron | 0.05 | 0.83 | 2.61 | 0.12 | 0.17 | 0.68 |
| Lead | ***3.05*** | ***0.09*** | ***4.19*** | ***0.05*** | 0.64 | 0.43 |
| Nickel | 0.06 | 0.81 | ***4.69*** | ***0.04*** | 0.11 | 0.74 |
| Selenium | 0.17 | 0.69 | ***16.63*** | ***0.0004*** | ***14.53*** | ***.0008*** |
| Uranium | 0.13 | 0.73 | 2.77 | 0.11 | 0.24 | 0.63 |
| Zinc | 0.28 | 0.60 | 1.86 | 0.18 | 0.03 | 0.87 |
| Mercury | 0.03 | 0.87 | ***8.83*** | ***0.006*** | 0.00 | 0.98 |
| Total PCB | ***8.02*** | ***0.009*** | 0.31 | 0.58 | 0.81 | 0.37 |
| 2,3,7,8 TCDF | 1.06 | 0.31 | 0.14 | 0.71 | 0.13 | 0.73 |

Notes:

Results show F-tests and p-values for tests of equal concentrations of COIs in rainbow trout between river reach and between hatchery and wild rainbow trout.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-25**
Summary Statistics for COIs in Whole Body Lake Whitefish by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 2.5 | 0.57 | 1.9 | 4.8 | 1.27 |
| Middle | 4.6 | 0.69 | 1.7 | 7.8 | 1.55 |
| Lower | 3.6 | 0.69 | 1.9 | 6.0 | 1.54 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.23 | 0.017 | 0.18 | 0.27 | 0.039 |
| Middle | 0.26 | 0.007 | 0.22 | 0.29 | 0.017 |
| Lower | 0.28 | 0.016 | 0.18 | 0.31 | 0.036 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 0.49 | 0.03 | 0.4 | 0.6 | 0.06 |
| Middle | 0.62 | 0.03 | 0.5 | 0.9 | 0.08 |
| Lower | 0.55 | 0.05 | 0.3 | 0.7 | 0.10 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.016 | 0.0033 | 0.008 | 0.024 | 0.007 |
| Middle | 0.021 | 0.0018 | 0.015 | 0.032 | 0.004 |
| Lower | 0.012 | 0.0022 | 0.008 | 0.023 | 0.005 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.62 | 0.04 | 0.52 | 0.72 | 0.08 |
| Middle | 0.78 | 0.03 | 0.65 | 0.94 | 0.07 |
| Lower | 0.85 | 0.03 | 0.64 | 0.92 | 0.08 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 0.68 | 0.05 | 0.5 | 0.8 | 0.11 |
| Middle | 0.64 | 0.04 | 0.4 | 0.9 | 0.08 |
| Lower | 0.61 | 0.03 | 0.5 | 0.7 | 0.08 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 14.1 | 1.09 | 11.1 | 17.3 | 2.45 |
| Middle | 15.8 | 1.11 | 10.6 | 22.4 | 2.49 |
| Lower | 15.0 | 1.29 | 10.6 | 19.4 | 2.88 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.067 | 0.005 | 0.058 | 0.08 | 0.01 |
| Middle | 0.072 | 0.009 | 0.041 | 0.12 | 0.02 |
| Lower | 0.050 | 0.004 | 0.038 | 0.07 | 0.01 |

**TABLE 3-25**
Summary Statistics for COIs in Whole Body Lake Whitefish by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.17 | 0.003 | 0.16 | 0.18 | 0.01 |
| Middle | 0.21 | 0.014 | 0.16 | 0.30 | 0.03 |
| Lower | 0.23 | 0.013 | 0.18 | 0.27 | 0.03 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.72 | 0.039 | 0.62 | 0.86 | 0.09 |
| Middle | 0.77 | 0.030 | 0.59 | 0.87 | 0.07 |
| Lower | 0.64 | 0.048 | 0.44 | 0.84 | 0.11 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0022 | 0.0001 | 0.0018 | 0.003 | 0.0003 |
| Middle | 0.0021 | 0.0004 | 0.0007 | 0.005 | 0.0009 |
| Lower | 0.0019 | 0.0003 | 0.0008 | 0.003 | 0.0008 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 12.6 | 0.35 | 11.9 | 13.8 | 0.78 |
| Middle | 12.7 | 0.37 | 10.7 | 13.9 | 0.83 |
| Lower | 13.0 | 0.31 | 11.7 | 13.8 | 0.70 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 59.8 | 3.1 | 52.1 | 68.8 | 6.9 |
| Middle | 55.6 | 2.4 | 44.7 | 69.8 | 5.4 |
| Lower | 74.1 | 4.4 | 65.4 | 94.5 | 9.9 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 58.1 | 4.26 | 49.5 | 74.5 | 9.54 |
| Middle | 72.6 | 1.71 | 65.5 | 80.6 | 3.83 |
| Lower | 84.7 | 1.73 | 77.8 | 91.5 | 3.88 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.0045 | 0.0003 | 0.0036 | 0.0049 | 0.0006 |
| Middle | 0.0047 | 0.0006 | 0.0021 | 0.0075 | 0.0013 |
| Lower | 0.0072 | 0.0004 | 0.0053 | 0.0084 | 0.0009 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-26**
Results of Tests of Equal Concentration of COIs in Whole Body Lake Whitefish
*Upper Columbia River RI/FS*

| Analyte | Equality of Means | | Linear Trend | | $\bar{\bar{x}}$ | $S\hat{E}(\bar{\bar{x}})$ |
|---|---|---|---|---|---|---|
| | F-test | p-value | F-test | p-value | | |
| Aluminum | 2.19 | 0.14 | 0.58 | 0.46 | 3.7 | 0.428 |
| Arsenic | 1.75 | 0.20 | ***3.48*** | ***0.08*** | 0.256 | 0.008 |
| Barium | ***2.71*** | ***0.09*** | 0.20 | 0.66 | NA | NA |
| Cadmium | ***4.04*** | ***0.035*** | 0.50 | 0.49 | NA | NA |
| Chromium | ***7.79*** | ***0.003*** | ***15.12*** | ***0.001*** | NA | NA |
| Copper | 0.79 | 0.47 | 1.56 | 0.23 | 0.636 | 0.023 |
| Iron | 0.47 | 0.63 | 0.23 | 0.64 | 15.14 | 0.687 |
| Lead | 2.3 | 0.13 | 1.98 | 0.18 | 0.064 | 0.005 |
| Nickel | ***4.45*** | ***0.03*** | ***8.05*** | ***0.01*** | NA | NA |
| Selenium | ***4.04*** | ***0.03*** | 2.62 | 0.12 | NA | NA |
| Uranium | 0.23 | 0.80 | 0.41 | 0.53 | 0.002 | 0.0002 |
| Zinc | 0.18 | 0.84 | 0.32 | 0.58 | 12.73 | 0.203 |
| Mercury | ***10.15*** | ***0.001*** | ***8.8*** | ***0.008*** | NA | NA |
| Total PCB | ***26.4*** | ***< .0001*** | ***52.7*** | ***< .0001*** | NA | NA |
| 2,3,7,8 TCDF | ***8.23*** | ***0.003*** | ***11.18*** | ***0.003*** | NA | NA |

Notes:

Tests between river reach (upper, middle and lower) (F-test) and single degree of freedom contrast for a linear trend (F-test) in concentration. In the case of equality of means (p > .10), the grand mean $(\bar{\bar{x}})$ and associated standard $(S\hat{E}(\bar{\bar{x}}))$ error are reported.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-27**
Summary Statistics for COIs in Whole Body Mountain Whitefish by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 14.6 | 2.65 | 4.9 | 19.6 | 5.92 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.15 | 0.008 | 0.12 | 0.17 | 0.018 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 1.48 | 0.39 | 0.5 | 2.8 | 0.87 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.111 | 0.0084 | 0.092 | 0.130 | 0.019 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 1.07 | 0.04 | 0.95 | 1.16 | 0.08 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 1.31 | 0.23 | 0.6 | 2.0 | 0.52 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 102.6 | 19.37 | 30.2 | 147.3 | 43.30 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.335 | 0.047 | 0.176 | 0.45 | 0.10 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |

**TABLE 3-27**
Summary Statistics for COIs in Whole Body Mountain Whitefish by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.24 | 0.023 | 0.17 | 0.29 | 0.05 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 1.03 | 0.062 | 0.84 | 1.22 | 0.14 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0089 | 0.0013 | 0.0046 | 0.012 | 0.0029 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 29.9 | 3.25 | 20.1 | 40.1 | 7.27 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 76.4 | 3.57 | 63.3 | 82.7 | 7.99 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 110.82 | 2.8 | 105 | 120.3 | 6.3 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.0039 | 0.0006 | 0.0026 | 0.0060 | 0.0013 |
| Middle | -- | -- | -- | -- | -- |
| Lower | -- | -- | -- | -- | -- |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight
-- No samples collected at this location.

**TABLE 3-28**
Summary Statistics for COIs in Whole Body Largescale Sucker by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 68.1 | 21.39 | 12.2 | 203.0 | 47.83 |
| Middle | 54.3 | 9.25 | 12.8 | 88.9 | 20.68 |
| Lower | 41.2 | 8.32 | 8.5 | 88.0 | 18.60 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.21 | 0.024 | 0.14 | 0.33 | 0.053 |
| Middle | 0.18 | 0.008 | 0.13 | 0.22 | 0.017 |
| Lower | 0.19 | 0.009 | 0.13 | 0.23 | 0.020 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 6.0 | 1.66 | 2.0 | 16.4 | 3.70 |
| Middle | 3.0 | 0.30 | 1.6 | 4.3 | 0.66 |
| Lower | 3.4 | 0.19 | 2.3 | 4.3 | 0.42 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.341 | 0.0282 | 0.203 | 0.467 | 0.063 |
| Middle | 0.301 | 0.0185 | 0.181 | 0.391 | 0.041 |
| Lower | 0.280 | 0.0060 | 0.244 | 0.301 | 0.013 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 1.81 | 0.47 | 0.67 | 5.06 | 1.05 |
| Middle | 1.14 | 0.15 | 0.60 | 2.11 | 0.34 |
| Lower | 1.26 | 0.16 | 0.47 | 1.83 | 0.36 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 5.5 | 2.16 | 0.9 | 19.3 | 4.84 |
| Middle | 0.8 | 0.03 | 0.7 | 1.0 | 0.06 |
| Lower | 0.8 | 0.06 | 0.6 | 1.2 | 0.13 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 433.9 | 184.39 | 44.0 | 1596.1 | 412.30 |
| Middle | 84.9 | 11.46 | 29.4 | 130.6 | 25.62 |
| Lower | 74.1 | 13.41 | 19.3 | 151.0 | 29.99 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 5.20 | 0.720 | 3.214 | 10.04 | 1.61 |
| Middle | 2.09 | 0.282 | 1.089 | 3.47 | 0.63 |
| Lower | 0.66 | 0.048 | 0.432 | 0.95 | 0.11 |

**TABLE 3-28**
Summary Statistics for COIs in Whole Body Largescale Sucker by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.81 | 0.228 | 0.34 | 2.57 | 0.51 |
| Middle | 0.59 | 0.064 | 0.37 | 1.00 | 0.14 |
| Lower | 0.55 | 0.044 | 0.30 | 0.76 | 0.10 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.58 | 0.028 | 0.36 | 0.64 | 0.06 |
| Middle | 0.60 | 0.031 | 0.45 | 0.73 | 0.07 |
| Lower | 0.49 | 0.022 | 0.36 | 0.62 | 0.05 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0257 | 0.0045 | 0.0142 | 0.058 | 0.010 |
| Middle | 0.0181 | 0.0011 | 0.0142 | 0.025 | 0.002 |
| Lower | 0.0150 | 0.0010 | 0.0092 | 0.019 | 0.002 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 58.8 | 16.76 | 23.2 | 159.6 | 37.47 |
| Middle | 21.4 | 0.53 | 17.9 | 24.2 | 1.19 |
| Lower | 18.9 | 0.50 | 17.3 | 22.3 | 1.12 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 161.51 | 21.24 | 77.10 | 222.00 | 47.50 |
| Middle | 262.56 | 9.19 | 216.00 | 300.00 | 20.55 |
| Lower | 227.60 | 5.76 | 203.00 | 258.00 | 12.87 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 181.07 | 72.59 | 83.50 | 615.00 | 162.33 |
| Middle | 143.94 | 21.04 | 75.00 | 241.50 | 47.05 |
| Lower | 173.48 | 16.38 | 121.83 | 247.50 | 36.63 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.00364 | 0.00149 | 0.00092 | 0.01150 | 0.00333 |
| Middle | 0.00293 | 0.00033 | 0.00157 | 0.00428 | 0.00073 |
| Lower | 0.00450 | 0.00037 | 0.00345 | 0.00652 | 0.00083 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-29**
Results of Tests of Equal Concentration of COIs in Whole Body Largescale Sucker
*Upper Columbia River RI/FS*

| Analyte | Equality of Means | | Linear Trend | | $\bar{\bar{x}}$ | $S\hat{E}(\bar{\bar{x}})$ |
|---|---|---|---|---|---|---|
| | F-test | p-value | F-test | p-value | | |
| Aluminum | 0.95 | 0.4 | 1.9 | 0.18 | 54.0 | 7.9 |
| Arsenic | 1.37 | 0.27 | 1.32 | 0.26 | 0.194 | 0.009 |
| Barium | NA* | 0.37* | 4.05 | 0.055 | 4.1 | 0.564 |
| Cadmium | ***NA**** | ***0.1**** | ***5.12*** | ***0.03*** | NA | NA |
| Chromium | 1.51 | 0.24 | 1.82 | 0.19 | 1.4 | 0.167 |
| Copper | ***NA**** | ***<.0001**** | ***8.09*** | ***0.009*** | NA | NA |
| Iron | ***4.1*** | ***0.03*** | ***6.44*** | ***0.02*** | NA | NA |
| Lead | ***29.34*** | ***< .0001*** | ***56.73*** | ***< .0001*** | NA | NA |
| Nickel | 1.08 | 0.35 | 1.92 | 0.18 | 0.646 | 0.076 |
| Selenium | ***4.13*** | ***0.03*** | ***4.59*** | ***0.04*** | NA | NA |
| Uranium | ***4.51*** | ***0.02*** | ***8.62*** | ***0.007*** | NA | NA |
| Zinc | ***NA**** | ***<.0001**** | ***9.67*** | ***0.004*** | NA | NA |
| Mercury | ***NA**** | ***<.0001**** | ***14.76*** | ***0.0008*** | NA | NA |
| Total PCB | 0.26 | 0.77 | 0.02 | 0.89 | 164.973 | 21.5632 |
| 2,3,7,8 TCDF | 1.11 | 0.35 | 0.58 | 0.45 | 0.00370 | 0.000451 |

* Nonparametric Kruskal-Wallis test used.

Notes:

Tests between river reach (upper, middle and lower) (F-test) and single degree of freedom contrast for a linear trend (F-test) in concentration. In the case of equality of means (P > .10), the grand mean $(\bar{\bar{x}})$ and associated standard $(S\hat{E}(\bar{\bar{x}}))$ error are reported.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-30**
Summary Statistics for COIs in Whole Body Burbot by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability ( $\hat{\sigma}$ ) |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 4.7 | 0.53 | 3.7 | 5.5 | 1.2 |
| Middle | 6.4 | 0.98 | 3.8 | 13.5 | 2.2 |
| Lower | 9.3 | 1.31 | 5.3 | 19.8 | 2.9 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.725 | 0.032 | 0.668 | 0.780 | 0.073 |
| Middle | 0.704 | 0.048 | 0.452 | 0.941 | 0.108 |
| Lower | 0.835 | 0.033 | 0.676 | 0.958 | 0.074 |
| **Barium** | | | | | |
| Upper | 5.0 | 0.51 | 3.9 | 5.6 | 1.14 |
| Middle | 5.6 | 0.29 | 3.8 | 6.6 | 0.64 |
| Lower | 6.6 | 0.35 | 5.1 | 8.5 | 0.79 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.025 | 0.0029 | 0.020 | 0.030 | 0.006 |
| Middle | 0.037 | 0.0032 | 0.021 | 0.048 | 0.007 |
| Lower | 0.048 | 0.0056 | 0.023 | 0.088 | 0.013 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.43 | 0.03 | 0.39 | 0.50 | 0.08 |
| Middle | 0.33 | 0.02 | 0.26 | 0.44 | 0.05 |
| Lower | 0.46 | 0.12 | 0.26 | 1.49 | 0.26 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 1.1 | 0.05 | 1.0 | 1.2 | 0.10 |
| Middle | 1.2 | 0.07 | 0.9 | 1.4 | 0.16 |
| Lower | 1.1 | 0.07 | 0.8 | 1.5 | 0.15 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 19.2 | 1.48 | 17.3 | 22.1 | 3.31 |
| Middle | 24.7 | 2.18 | 17.9 | 37.2 | 4.87 |
| Lower | 28.4 | 1.08 | 23.8 | 35.6 | 2.41 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.07 | 0.003 | 0.064 | 0.07 | 0.01 |
| Middle | 0.10 | 0.012 | 0.054 | 0.17 | 0.03 |
| Lower | 0.09 | 0.006 | 0.056 | 0.12 | 0.01 |

**TABLE 3-30**
Summary Statistics for COIs in Whole Body Burbot by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability ($\hat{\sigma}$) |
|---|---|---|---|---|---|
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.31 | 0.006 | 0.30 | 0.32 | 0.01 |
| Middle | 0.29 | 0.017 | 0.22 | 0.38 | 0.04 |
| Lower | 0.32 | 0.018 | 0.25 | 0.42 | 0.04 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.68 | 0.055 | 0.58 | 0.77 | 0.12 |
| Middle | 0.62 | 0.031 | 0.52 | 0.83 | 0.07 |
| Lower | 0.46 | 0.016 | 0.39 | 0.52 | 0.03 |
| **Uranium** | | | | | |
| Upper | 0.0041 | 0.0005 | 0.0031 | 0.005 | 0.001 |
| Middle | 0.0052 | 0.0008 | 0.0033 | 0.011 | 0.002 |
| Lower | 0.0051 | 0.0003 | 0.0037 | 0.007 | 0.001 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 12.1 | 0.13 | 11.8 | 12.3 | 0.30 |
| Middle | 12.4 | 0.25 | 11.3 | 13.5 | 0.56 |
| Lower | 12.5 | 0.27 | 11.2 | 13.6 | 0.60 |
| **Mercury (µg/kg)** | | | | | |
| Upper | 138.00 | 21.66 | 112.00 | 181.00 | 48.43 |
| Middle | 174.93 | 10.43 | 123.00 | 230.00 | 23.33 |
| Lower | 195.80 | 11.52 | 134.00 | 242.00 | 25.76 |
| **Total PCB (µg/kg)** | | | | | |
| Upper | 74.00 | 6.81 | 64.00 | 87.00 | 15.22 |
| Middle | 69.26 | 2.67 | 55.00 | 79.33 | 5.98 |
| Lower | 70.50 | 3.66 | 63.00 | 102.00 | 8.19 |
| **2,3,7,8 TCDF (µg/kg)** | | | | | |
| Upper | 0.0048533 | 0.0004544 | 0.0039700 | 0.0054800 | 0.00102 |
| Middle | 0.0038711 | 0.0003112 | 0.0027100 | 0.0057100 | 0.00070 |
| Lower | 0.0035720 | 0.0003248 | 0.0015900 | 0.0049300 | 0.00073 |

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-31**
Results of Tests of Equal Concentration of COIs in Whole Body Burbot
*Upper Columbia River RI/FS*

| Analyte | Equality of Means | | Linear Trend | | $\bar{\bar{x}}$ | $S\hat{E}(\bar{\bar{x}})$ |
|---|---|---|---|---|---|---|
| | F-test | p-value | F-test | p-value | | |
| Aluminum | ***2.91*** | ***0.08*** | ***4.18*** | ***0.06*** | NA | NA |
| Arsenic | ***3.06*** | ***0.07*** | 1.95 | 0.18 | NA | NA |
| Barium | ***4.21*** | ***0.03*** | ***6.15*** | ***0.02*** | NA | NA |
| Cadmium | ***3.51*** | ***0.05*** | ***6.11*** | ***0.02*** | NA | NA |
| Chromium | 0.58 | 0.57 | 0.02 | 0.89 | 0.403 | 0.054 |
| Copper | 0.71 | 0.5 | 0.14 | 0.71 | 1.11 | 0.432 |
| Iron | ***4.29*** | ***0.03*** | ***8.01*** | ***0.01*** | NA | NA |
| Lead | 1.58 | 0.23 | 1.21 | 0.29 | 0.089 | 0.006 |
| Nickel | 0.74 | 0.49 | 0.07 | 0.79 | 0.304 | 0.01 |
| Selenium | ***16.09*** | ***< .0001*** | ***20.55*** | ***0.0002*** | NA | NA |
| Uranium | 0.49 | 0.62 | 0.8 | 0.38 | 0.005 | 0.0004 |
| Zinc | 0.32 | 0.73 | 0.63 | 0.44 | 12.4 | 0.158 |
| Mercury | ***3.37*** | ***0.06*** | ***6.48*** | ***0.02*** | NA | NA |
| Total PCB | 0.24 | 0.79 | 0.27 | 0.61 | 70.4697 | 2.10686 |
| 2,3,7,8 TCDF | 2.03 | 0.16 | 4.07 | 0.06 | 0.003869 | 0.000216 |

Notes:

River reach (upper, middle and lower) (F-test) and single degree of freedom contrast for a linear trend (F-test) in concentration. In the case of equality of means (p > .10), the grand mean $(\bar{\bar{x}})$ and associated standard $(S\hat{E}(\bar{\bar{x}}))$ error are reported.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-32**
Summary Statistics for COIs in Walleye Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variabiilty $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 1.25 | 0.02 | 1.21 | 1.30 | 0.05 |
| Middle | 1.26 | 0.01 | 1.22 | 1.29 | 0.03 |
| Lower | 1.27 | 0.01 | 1.25 | 1.30 | 0.02 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.09 | 0.009 | 0.06 | 0.11 | 0.021 |
| Middle | 0.11 | 0.006 | 0.10 | 0.13 | 0.012 |
| Lower | 0.13 | 0.013 | 0.10 | 0.18 | 0.029 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 0.0420 | 0.0006 | 0.0402 | 0.0434 | 0.0014 |
| Middle | 0.0418 | 0.0004 | 0.0406 | 0.0430 | 0.0009 |
| Lower | 0.0422 | 0.0003 | 0.0416 | 0.0432 | 0.0006 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.0052 | 0.00008 | 0.0050 | 0.0054 | 0.00018 |
| Middle | 0.0053 | 0.00005 | 0.0051 | 0.0054 | 0.00011 |
| Lower | 0.0053 | 0.00004 | 0.0052 | 0.0054 | 0.00008 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.45 | 0.05 | 0.26 | 0.52 | 0.11 |
| Middle | 0.53 | 0.10 | 0.39 | 0.90 | 0.22 |
| Lower | 0.45 | 0.02 | 0.39 | 0.54 | 0.06 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 0.23 | 0.008 | 0.20 | 0.24 | 0.018 |
| Middle | 0.20 | 0.013 | 0.18 | 0.25 | 0.028 |
| Lower | 0.21 | 0.004 | 0.20 | 0.23 | 0.010 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 15.9 | 0.53 | 14.6 | 17.8 | 1.18 |
| Middle | 15.2 | 1.27 | 11.5 | 18.5 | 2.85 |

**TABLE 3-32**
Summary Statistics for COIs in Walleye Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\bar{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variabiilty $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 16.1 | 1.13 | 12.9 | 19.7 | 2.54 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.005 | 0.381 | 0.0050 | 0.005 | 0.0002 |
| Middle | 0.019 | 0.585 | 0.0052 | 0.053 | 0.020 |
| Lower | 0.024 | 0.191 | 0.0053 | 0.062 | 0.026 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.14 | 0.014 | 0.10 | 0.17 | 0.03 |
| Middle | 0.11 | 0.018 | 0.07 | 0.16 | 0.04 |
| Lower | 0.10 | 0.016 | 0.06 | 0.13 | 0.03 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.36 | 0.012 | 0.32 | 0.39 | 0.03 |
| Middle | 0.41 | 0.015 | 0.37 | 0.44 | 0.03 |
| Lower | 0.39 | 0.050 | 0.30 | 0.57 | 0.11 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0003 | 0.0000 | 0.0003 | 0.000 | 0.0000 |
| Middle | 0.0003 | 0.0000 | 0.0003 | 0.000 | 0.0000 |
| Lower | 0.0003 | 0.0000 | 0.0003 | 0.000 | 0.0000 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 7.3 | 0.19 | 6.7 | 7.7 | 0.43 |
| Middle | 6.1 | 0.27 | 5.2 | 6.7 | 0.61 |
| Lower | 6.4 | 0.06 | 6.2 | 6.6 | 0.14 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 227.20 | 19.39 | 181.00 | 273.00 | 43.35 |
| Middle | 240.60 | 13.02 | 201.00 | 281.00 | 29.11 |
| Lower | 333.60 | 31.99 | 256.00 | 417.00 | 71.52 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 6.96 | 0.47 | 5.15 | 7.85 | 1.05 |
| Middle | 50.20 | 1.76 | 47.50 | 56.70 | 3.94 |

**TABLE 3-32**
Summary Statistics for COIs in Walleye Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variabiilty $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 52.15 | 0.50 | 50.20 | 53.00 | 1.12 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.000150 | 0.000014 | 0.000102 | 0.000178 | 0.00003 |
| Middle | 0.000295 | 0.000055 | 0.000149 | 0.000404 | 0.00012 |
| Lower | 0.000571 | 0.000096 | 0.000234 | 0.000796 | 0.00021 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-33**
Summary Statistics for of COIs in Walleye Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 1.74 | 0.04 | 1.64 | 1.83 | 0.09 |
| Middle | 4.00 | 0.94 | 1.72 | 6.04 | 2.09 |
| Lower | 5.58 | 0.80 | 3.50 | 8.25 | 1.79 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.09 | 0.016 | 0.03 | 0.12 | 0.035 |
| Middle | 0.18 | 0.022 | 0.12 | 0.25 | 0.049 |
| Lower | 0.16 | 0.013 | 0.13 | 0.19 | 0.029 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 1.45 | 0.04 | 1.30 | 1.56 | 0.10 |
| Middle | 1.44 | 0.06 | 1.26 | 1.59 | 0.13 |
| Lower | 1.51 | 0.06 | 1.41 | 1.75 | 0.14 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.034 | 0.0027 | 0.026 | 0.040 | 0.006 |
| Middle | 0.036 | 0.0056 | 0.024 | 0.054 | 0.012 |
| Lower | 0.034 | 0.0015 | 0.029 | 0.036 | 0.003 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.59 | 0.06 | 0.46 | 0.81 | 0.13 |
| Middle | 0.56 | 0.06 | 0.37 | 0.72 | 0.14 |
| Lower | 0.71 | 0.13 | 0.39 | 1.17 | 0.30 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 0.41 | 0.011 | 0.38 | 0.45 | 0.024 |
| Middle | 0.46 | 0.037 | 0.34 | 0.54 | 0.083 |
| Lower | 0.50 | 0.013 | 0.47 | 0.54 | 0.028 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 5.2 | 0.36 | 4.1 | 6.3 | 0.80 |
| Middle | 4.0 | 0.26 | 3.4 | 5.0 | 0.58 |

**TABLE 3-33**
Summary Statistics for of COIs in Walleye Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 4.2 | 0.27 | 3.6 | 5.2 | 0.60 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.056 | 0.530 | 0.0446 | 0.066 | 0.0102 |
| Middle | 0.062 | 1.273 | 0.0372 | 0.089 | 0.024 |
| Lower | 0.032 | 1.135 | 0.0212 | 0.041 | 0.008 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.68 | 0.030 | 0.61 | 0.78 | 0.07 |
| Middle | 0.61 | 0.037 | 0.53 | 0.73 | 0.08 |
| Lower | 0.69 | 0.026 | 0.61 | 0.75 | 0.06 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.46 | 0.004 | 0.45 | 0.47 | 0.01 |
| Middle | 0.60 | 0.072 | 0.43 | 0.82 | 0.16 |
| Lower | 0.49 | 0.047 | 0.36 | 0.63 | 0.11 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0012 | 0.0001 | 0.0010 | 0.002 | 0.0003 |
| Middle | 0.0015 | 0.0002 | 0.0010 | 0.002 | 0.0005 |
| Lower | 0.0013 | 0.0002 | 0.0009 | 0.002 | 0.0004 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 17.6 | 0.24 | 16.7 | 18.0 | 0.54 |
| Middle | 16.4 | 0.56 | 14.5 | 17.6 | 1.26 |
| Lower | 16.9 | 0.44 | 15.5 | 18.2 | 0.99 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 100.80 | 8.52 | 78.00 | 127.00 | 19.04 |
| Middle | 115.80 | 8.44 | 86.00 | 135.00 | 18.87 |
| Lower | 161.80 | 11.39 | 132.00 | 191.00 | 25.47 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 45.13 | 6.01 | 33.25 | 65.70 | 13.45 |
| Middle | 60.94 | 2.34 | 54.10 | 68.00 | 5.23 |

**TABLE 3-33**
Summary Statistics for of COIs in Walleye Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 106.98 | 11.36 | 84.90 | 150.00 | 25.41 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.001602 | 0.000177 | 0.001050 | 0.002100 | 0.00039 |
| Middle | 0.001926 | 0.000072 | 0.001750 | 0.002100 | 0.00016 |
| Lower | 0.003188 | 0.000453 | 0.002140 | 0.004600 | 0.00101 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-34**
Results of Tests of Equal Concentration of COIs in Walleye Fillets
*Upper Columbia River RI/FS*

| Analyte | Equality of Means | | Linear Trend | | $\bar{\bar{x}}$ | $S\hat{E}(\bar{\bar{x}})$ |
|---|---|---|---|---|---|---|
| | F-test | p-value | F-test | p-value | | |
| Aluminum | 0.25 | 0.7849 | 0.42 | 0.53 | 1.29 | 0.008 |
| Arsenic | ***5.16*** | ***0.024*** | ***10.2989*** | ***0.0075*** | NA | NA |
| Barium | 0.16 | 0.86 | 0.14 | 0.72 | 0.042 | 0.0003 |
| Cadmium | 0.11 | 0.89 | 0.23 | 0.64 | 0.005 | 0.00003 |
| Chromium | 0.48 | 0.63 | 0.0 | 0.98 | 0.479 | 0.036 |
| Copper | 2.04 | 0.17 | 0.83 | .38 | 0.213 | 0.006 |
| Iron | 1.12 | 0.36 | 1.95 | 0.19 | 3.163 | 0.243 |
| Lead | 1.28 | 0.31 | 2.33 | 0.15 | 0.016 | 0.005 |
| Nickel | 1.63 | 0.24 | 0.69 | 0.52 | 0.114 | 0.01 |
| Selenium | 0.55 | 0.59 | 0.43 | 0.52 | 0.389 | 0.017 |
| Uranium | NA | NA | NA | NA | 0.0003 | 0 |
| Zinc | ***10.18*** | ***0.003*** | ***9.4*** | ***0.01*** | NA | NA |
| Mercury | ***6.42*** | ***.013*** | ***10.83*** | ***.0065*** | NA | NA |
| Total PCB | ***547.01*** | ***< .0001*** | ***855.86*** | ***< .0001*** | NA | NA |
| 2,3,7,8 TCDF | ***11.02*** | ***0.002*** | ***21.33*** | ***.0006*** | NA | NA |

Notes:

River reach (upper, middle and lower) (F-test) and single degree of freedom contrast for a linear trend (F-test) in concentration. In the case of equality of means (p > .10), the grand mean $(\bar{\bar{x}})$ and associated standard $(S\hat{E}(\bar{\bar{x}}))$ error are reported.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-35**
Results of Tests of Equal Concentration of COIs in Walleye Offal
*Upper Columbia River RI/FS*

| Analyte | Equality of Means | | Linear Trend | | $\bar{\bar{x}}$ | $S\hat{E}(\bar{\bar{x}})$ |
|---|---|---|---|---|---|---|
| | F-test | p-value | F-test | p-value | | |
| Aluminum | ***7.35*** | ***0.008*** | ***14.56*** | ***0.003*** | NA | NA |
| Arsenic | ***7.15*** | ***0.009*** | ***8.1239*** | ***0.015*** | NA | NA |
| Barium | 0.53 | 0.60 | 0.56 | 0.47 | 1.47 | 0.031 |
| Cadmium | 0.10 | 0.90 | 0.01 | 0.94 | 0.034 | 0.002 |
| Chromium | 0.73 | 0.50 | 0.81 | 0.39 | 0.621 | 0.052 |
| Copper | ***3.47*** | ***0.06*** | ***6.82*** | ***0.02*** | NA | NA |
| Iron | 0.2 | 0.82 | 0.03 | 0.86 | 15.8 | 0.56 |
| Lead | ***5.07*** | ***0.02*** | ***5.71*** | ***0.03*** | NA | NA |
| Nickel | 1.81 | 0.21 | 0.08 | 0.79 | 0.66 | 0.019 |
| Selenium | 2.36 | 0.14 | 0.27 | 0.61 | 0.517 | 0.031 |
| Uranium | 0.96 | 0.41 | 0.03 | 0.88 | 0.001 | 0.0001 |
| Zinc | 2.0 | 0.18 | 1.21 | 0.29 | 17 | 0.270 |
| Mercury | ***11.08*** | ***.002*** | ***20.41*** | ***0.0007*** | NA | NA |
| Total PCB | ***18.14*** | ***0.0002*** | ***33.61*** | ***< .0001*** | NA | NA |
| 2,3,7,8 TCDF | ***8.73*** | ***.005*** | ***15.64*** | ***0.002*** | NA | NA |

Notes:

River reach (upper, middle and lower) (F-test) and single degree of freedom contrast for a linear trend (F-test) in concentration. In the case of equality of means (p > .10), the grand mean $(\bar{\bar{x}})$ and associated standard $(S\hat{E}(\bar{\bar{x}}))$ error are reported.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-36**
Summary of Statistics for COIs in Wild Rainbow Trout Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 1.99 | 0.03 | 1.91 | 2.08 | 0.06 |
| Middle | 1.85 | 0.04 | 1.82 | 1.89 | 0.08 |
| Lower | 1.55 | 0.00 | 1.55 | 1.55 | 0.00 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.09 | 0.007 | 0.07 | 0.10 | 0.016 |
| Middle | 0.07 | 0.006 | 0.068 | 0.080 | 0.013 |
| Lower | 0.08 | 0.000 | 0.080 | 0.080 | 0.000 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 0.066 | 0.001 | 0.064 | 0.069 | 0.0024 |
| Middle | 0.062 | 0.001 | 0.061 | 0.063 | 0.0028 |
| Lower | 0.053 | 0.0000 | 0.053 | 0.053 | 0.0000 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.0117 | 0.00502 | 0.0064 | 0.0318 | 0.01123 |
| Middle | 0.0062 | 0.00010 | 0.0061 | 0.0063 | 0.00022 |
| Lower | 0.0053 | 0.00000 | 0.0053 | 0.0053 | 0.00000 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 0.57 | 0.04 | 0.51 | 0.72 | 0.09 |
| Middle | 0.41 | 0.00 | 0.40 | 0.41 | 0.01 |
| Lower | 0.44 | 0.00 | 0.44 | 0.44 | 0.00 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 0.34 | 0.007 | 0.32 | 0.36 | 0.016 |
| Middle | 0.33 | 0.006 | 0.33 | 0.34 | 0.013 |
| Lower | 0.27 | 0.000 | 0.27 | 0.27 | 0.000 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 5.2 | 0.36 | 4.1 | 6.3 | 0.80 |
| Middle | 3.9 | 0.12 | 3.8 | 4.1 | 0.26 |

**TABLE 3-36**
Summary of Statistics for COIs in Wild Rainbow Trout Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 5.2 | 0.00 | 5.2 | 5.2 | 0.00 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.015 | 0.002 | 0.0064 | 0.018 | 0.0047 |
| Middle | 0.0062 | 0.0001 | 0.0061 | 0.0063 | 0.0002 |
| Lower | 0.0053 | 0.00000 | 0.0053 | 0.0053 | 0.0000 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.027 | 0.007 | 0.020 | 0.053 | 0.015 |
| Middle | 0.029 | 0.010 | 0.019 | 0.039 | 0.022 |
| Lower | 0.033 | 0.000 | 0.033 | 0.033 | 0.000 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 0.49 | 0.031 | 0.43 | 0.61 | 0.07 |
| Middle | 0.43 | 0.028 | 0.40 | 0.46 | 0.06 |
| Lower | 0.38 | 0.000 | 0.38 | 0.38 | 0.00 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0007 | 0.0000 | 0.0006 | 0.001 | 0.0000 |
| Middle | 0.0006 | 0.0000 | 0.0006 | 0.001 | 0.0000 |
| Lower | 0.0006 | 0.0000 | 0.0006 | 0.001 | 0.0000 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 8.3 | 0.13 | 7.9 | 8.6 | 0.29 |
| Middle | 6.4 | 0.08 | 6.3 | 6.5 | 0.18 |
| Lower | 6.3 | 0.00 | 6.3 | 6.3 | 0.00 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | 86.06 | 6.90 | 65.40 | 108.00 | 15.43 |
| Middle | 76.10 | 7.70 | 68.40 | 83.80 | 17.22 |
| Lower | 120.00 | 0.00 | 120.00 | 120.00 | 0.00 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | 72 | 2.6 | 68.725 | 82.1 | 5.6989 |
| Middle | 47 | 0.3 | 46.700 | 47.3 | 0.6708 |

**TABLE 3-36**
Summary of Statistics for COIs in Wild Rainbow Trout Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 44 | 0.0 | 43.700 | 43.7 | 0.0 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | 0.000958 | 0.000366 | 0.000534 | 0.00242 | 0.000819 |
| Middle | 0.000763 | 0.000079 | 0.000684 | 0.000843 | 0.000178 |
| Lower | 0.000559 | 0.0 | 0.000559 | 0.000559 | 0.00 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight

TABLE 3-37
Summary of Statistics for COIs in Hatchery Rainbow Trout Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 1.85 | 0.02 | 1.82 | 1.88 | 0.04 |
| Lower | 1.83 | 0.01 | 1.82 | 1.85 | 0.02 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.03 | 0.0003 | 0.030 | 0.031 | 0.001 |
| Lower | 0.04 | 0.006 | 0.030 | 0.056 | 0.014 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.062 | 0.001 | 0.061 | 0.063 | 0.0014 |
| Lower | 0.061 | 0.0002 | 0.061 | 0.062 | 0.0005 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0062 | 0.00007 | 0.0061 | 0.0063 | 0.00015 |
| Lower | 0.0061 | 0.00003 | 0.0061 | 0.0062 | 0.00006 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.35 | 0.09 | 0.27 | 0.53 | 0.19 |
| Lower | 0.34 | 0.01 | 0.30 | 0.36 | 0.03 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.34 | 0.028 | 0.32 | 0.40 | 0.063 |
| Lower | 0.27 | 0.008 | 0.24 | 0.28 | 0.018 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 4.1 | 0.47 | 3.4 | 5.0 | 1.04 |

TABLE 3-37
Summary of Statistics for COIs in Hatchery Rainbow Trout Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\bar{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 4.0 | 0.16 | 3.6 | 4.4 | 0.36 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0062 | 0.00007 | 0.0061 | 0.0063 | 0.0002 |
| Lower | 0.0061 | 0.00003 | 0.0061 | 0.0062 | 0.0001 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.07 | 0.034 | 0.02 | 0.13 | 0.08 |
| Lower | 0.02 | 0.004 | 0.02 | 0.03 | 0.01 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.36 | 0.033 | 0.32 | 0.43 | 0.07 |
| Lower | 0.23 | 0.011 | 0.21 | 0.26 | 0.02 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0006 | 0.0000 | 0.0006 | 0.001 | 0.0000 |
| Lower | 0.0006 | 0.0000 | 0.0006 | 0.001 | 0.0000 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 7.4 | 0.45 | 6.5 | 8.0 | 1.01 |
| Lower | 7.1 | 0.27 | 6.4 | 7.7 | 0.60 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 66.77 | 3.67 | 63.10 | 74.10 | 8.20 |
| Lower | 100.13 | 9.05 | 81.10 | 122.00 | 20.23 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 43.2000 | 2.6690 | 40.000 | 48.50 | 5.9680 |

TABLE 3-37
Summary of Statistics for COIs in Hatchery Rainbow Trout Fillets by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 44.8563 | 1.3332 | 42.100 | 47.90 | 2.9810 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.000725 | 0.000232 | 0.000363 | 0.00116 | 0.000520 |
| Lower | 0.000678 | 0.000205 | 0.000186 | 0.00119 | 0.000459 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight
-- No samples collected at this location.

**TABLE 3-38**
Summary Statistics for COIs in Wild Rainbow Trout Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | 5.09 | 1.61 | 2.39 | 9.33 | 3.59 |
| Middle | 11.23 | 2.36 | 8.87 | 13.58 | 5.27 |
| Lower | 8.20 | 0.00 | 8.20 | 8.20 | 0.00 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | 0.197 | 0.012 | 0.16 | 0.22 | 0.027 |
| Middle | 0.222 | 0.007 | 0.215 | 0.229 | 0.016 |
| Lower | 0.204 | 0.000 | 0.204 | 0.204 | 0.000 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | 1.504 | 0.151 | 1.072 | 1.907 | 0.3372 |
| Middle | 0.874 | 0.111 | 0.763 | 0.985 | 0.2483 |
| Lower | 1.416 | 0.0000 | 1.416 | 1.416 | 0.0000 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | 0.0348 | 0.00293 | 0.0278 | 0.0455 | 0.00654 |
| Middle | 0.0816 | 0.00905 | 0.0725 | 0.0906 | 0.02024 |
| Lower | 0.0856 | 0.00000 | 0.0856 | 0.0856 | 0.00000 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | 1.08 | 0.06 | 0.93 | 1.30 | 0.14 |
| Middle | 0.86 | 0.06 | 0.80 | 0.92 | 0.13 |
| Lower | 0.52 | 0.00 | 0.52 | 0.52 | 0.00 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | 2.38 | 0.311 | 1.83 | 3.48 | 0.696 |
| Middle | 1.91 | 0.272 | 1.64 | 2.18 | 0.608 |
| Lower | 0.58 | 0.000 | 0.58 | 0.58 | 0.000 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | 49.6 | 7.75 | 36.7 | 78.8 | 17.32 |

**TABLE 3-38**
Summary Statistics for COIs in Wild Rainbow Trout Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Middle | 39.0 | 6.54 | 32.5 | 45.6 | 14.63 |
| Lower | 38.4 | 0.00 | 38.4 | 38.4 | 0.00 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | 0.265 | 0.034 | 0.2010 | 0.387 | 0.0771 |
| Middle | 0.0516 | 0.0007 | 0.0509 | 0.0522 | 0.0015 |
| Lower | 0.0386 | 0.00000 | 0.0386 | 0.0386 | 0.0000 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | 0.407 | 0.034 | 0.313 | 0.488 | 0.077 |
| Middle | 0.344 | 0.004 | 0.340 | 0.348 | 0.009 |
| Lower | 0.442 | 0.000 | 0.442 | 0.442 | 0.000 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | 1.03 | 0.030 | 0.91 | 1.07 | 0.07 |
| Middle | 0.93 | 0.020 | 0.90 | 0.95 | 0.05 |
| Lower | 0.70 | 0.000 | 0.70 | 0.70 | 0.00 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | 0.0046 | 0.0005 | 0.0032 | 0.006 | 0.0012 |
| Middle | 0.0030 | 0.0003 | 0.0027 | 0.003 | 0.0007 |
| Lower | 0.0027 | 0.0000 | 0.0027 | 0.003 | 0.0000 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | 44.1 | 1.92 | 40.1 | 51.0 | 4.28 |
| Middle | 37.1 | 0.26 | 36.8 | 37.4 | 0.59 |
| Lower | 49.7 | 0.00 | 49.7 | 49.7 | 0.00 |
| **Mercury (ug/kg WW)** | | | | | |
| Upper | 54.74 | 2.83 | 47.80 | 64.00 | 6.32 |
| Middle | 50.80 | 6.90 | 43.90 | 57.70 | 15.43 |
| Lower | 75.70 | 0.00 | 75.70 | 75.70 | 0.00 |
| **Total PCB (ug/kg WW)** | | | | | |
| Upper | 91.86 | 10.99 | 72.20 | 132.40 | 24.57 |

**TABLE 3-38**
Summary Statistics for COIs in Wild Rainbow Trout Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\bar{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Middle | 54.00 | 0.50 | 53.50 | 54.50 | 1.12 |
| Lower | 51.40 | 0.0 | 51.40 | 51.40 | 0.0 |
| **2,3,7,8 TCDF (ug/kg WW)** | | | | | |
| Upper | 0.00211 | 0.000581 | 0.001390 | 0.004420 | 0.00130 |
| Middle | 0.00141 | 0.000045 | 0.0013600 | 0.001450 | 0.000101 |
| Lower | 0.00137 | 0.0 | 0.0013700 | 0.001370 | 0.0 |

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
WW = wet weight

**TABLE 3-39**
Summary Statistics for COIs in Hatchery Rainbow Trout Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| **Aluminum (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 45.88 | 11.82 | 22.50 | 60.55 | 26.43 |
| Lower | 8.10 | 0.56 | 7.49 | 9.77 | 1.24 |
| **Arsenic (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.14 | 0.005 | 0.132 | 0.148 | 0.011 |
| Lower | 0.13 | 0.010 | 0.106 | 0.148 | 0.022 |
| **Barium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 2.355 | 0.588 | 1.184 | 3.030 | 1.3142 |
| Lower | 0.844 | 0.0742 | 0.701 | 1.037 | 0.1659 |
| **Cadmium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.1150 | 0.00682 | 0.1014 | 0.1229 | 0.01524 |
| Lower | 0.0871 | 0.00972 | 0.0656 | 0.1082 | 0.02174 |
| **Chromium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.91 | 0.16 | 0.60 | 1.11 | 0.35 |
| Lower | 0.36 | 0.02 | 0.32 | 0.40 | 0.04 |
| **Copper (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 4.05 | 0.532 | 2.99 | 4.61 | 1.189 |
| Lower | 0.55 | 0.026 | 0.48 | 0.59 | 0.059 |
| **Iron (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 68.2 | 13.15 | 41.9 | 81.4 | 29.40 |

**TABLE 3-39**
Summary Statistics for COIs in Hatchery Rainbow Trout Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\bar{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 30.4 | 1.10 | 27.3 | 32.1 | 2.45 |
| **Lead (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.3064 | 0.0905 | 0.1260 | 0.4095 | 0.2024 |
| Lower | 0.0215 | 0.00275 | 0.0148 | 0.0282 | 0.0061 |
| **Nickel (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.569 | 0.084 | 0.411 | 0.696 | 0.187 |
| Lower | 0.353 | 0.034 | 0.285 | 0.446 | 0.076 |
| **Selenium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.65 | 0.024 | 0.60 | 0.68 | 0.05 |
| Lower | 0.35 | 0.010 | 0.32 | 0.37 | 0.02 |
| **Uranium (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.0117 | 0.0037 | 0.0044 | 0.016 | 0.0082 |
| Lower | 0.0016 | 0.0005 | 0.0007 | 0.003 | 0.0012 |
| **Zinc (mg/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 38.0 | 1.60 | 36.2 | 41.2 | 3.58 |
| Lower | 44.5 | 0.86 | 42.1 | 45.7 | 1.92 |
| **Mercury (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 45.20 | 0.35 | 44.60 | 45.80 | 0.77 |
| Lower | 65.28 | 6.09 | 54.10 | 82.50 | 13.62 |
| **Total PCB (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 47.43 | 1.465 | 44.60 | 49.50 | 3.28 |

**TABLE 3-39**
Summary Statistics for COIs in Hatchery Rainbow Trout Offal by River Reach
*Upper Columbia River RI/FS*

| Reach | Mean Concentration $\overline{X}$ | Standard Error of the Mean $S\hat{E}(\overline{x})$ | Minimum Composite Value | Maximum Composite Value | Between-Fish Variability $\hat{\sigma}$ |
|---|---|---|---|---|---|
| Lower | 55.15 | 1.932 | 50.20 | 59.55 | 4.32 |
| **2,3,7,8 TCDF (*u*g/kg WW)** | | | | | |
| Upper | -- | -- | -- | -- | -- |
| Middle | 0.00108 | 0.000158 | 0.000795 | 0.001340 | 0.000353 |
| Lower | 0.00211 | 0.000174 | 0.001650 | 0.002460 | 0.000389 |

mg/kg = milligrams per kilogram
μg/kg = micrograms per kilogram
WW = wet weight
-- No samples collected at this location.

**TABLE 3-40**
One-Way Analysis of Variance Results for Rainbow Trout Fillets
*Upper Columbia River RI/FS*

| | Upper vs Middle Wild | | Middle vs Lower Hatchery | | Middle Wild vs Hatchery | |
|---|---|---|---|---|---|---|
| | **F-test** | **p-value** | **F-test** | **p-value** | **F-test** | **p-value** |
| Aluminum | 2.15 | 0.15 | 0.09 | 0.77 | 0.33 | 0.57 |
| Arsenic | ***13.85*** | ***0.004*** | ***33.49*** | ***0.0002*** | 1.32 | 0.28 |
| Barium | 0.02 | 0.89 | ***20.1*** | ***0.0012*** | ***9.85*** | ***0.01*** |
| Cadmium | 0 | 0.99 | 1.38 | 0.27 | 0.86 | 0.37 |
| Chromium | 0.44 | 0.52 | **16.51** | **0.002** | ***5.2*** | ***0.04*** |
| Copper | 0.25 | 0.63 | **18.53** | **0.001** | 0.11 | 0.75 |
| Iron | 0.07 | 0.79 | **7,21** | **0.02** | ***5.45*** | ***0.04*** |
| Lead | 0 | 0.99 | **17.95** | **0.002** | ***11.35*** | ***0.007*** |
| Nickel | 2.41 | 0.15 | 0.07 | 0.8 | 0.01 | 0.93 |
| Selenium | 2.01 | 0.19 | ***51.92*** | ***< .0001*** | 1.85 | 0.2 |
| Uranium | 0 | 1 | ***17.78*** | ***0.002*** | ***11.43*** | ***0.007*** |
| Zinc | ***5.11*** | ***0.047*** | ***12.13*** | ***0.006*** | ***20.3*** | ***0.001*** |
| Mercury | 0.49 | 0.5 | 2.06 | 0.18 | 0.66 | 0.43 |
| Total PCB | 0.91 | 0.36 | ***86.55*** | ***< .0001*** | ***47.23*** | ***< .0001*** |
| 2,3,7,8 TCDF | 0 | 0.95 | 0.49 | 0.5 | 0.15 | 0.70 |

Notes:

Results show F-tests and p-values for tests of equal concentrations of COIs in rainbow trout fillets between river reach and between hatchery and wild rainbow trout fillets.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-41**
One-Way Analysis of Variance Results for Rainbow Trout Offal
*Upper Columbia River RI/FS*

| | Upper vs Middle Wild | | Middle vs Lower Hatchery | | Middle Wild vs Hatchery | |
|---|---|---|---|---|---|---|
| | **F-test** | **p-value** | **F-test** | **p-value** | **F-test** | **p-value** |
| Aluminum | ***15.93*** | ***0.003*** | 0.22 | 0.65 | 0.6 | 0.46 |
| Arsenic | ***17.59*** | ***0.002*** | ***21.11*** | ***0.001*** | 2.05 | 0.18 |
| Barium | ***10.05*** | ***0.01*** | ***3.7*** | ***0.08*** | 2.17 | 0.17 |
| Cadmium | ***7.67*** | ***0.02*** | ***34.78*** | ***0.0002*** | ***17.84*** | ***0.0018*** |
| Chromium | 0.12 | 0.74 | ***49.28*** | ***< .0001*** | 2.89 | 0.12 |
| Copper | ***14.53*** | ***0.003*** | ***19.61*** | ***0.001*** | 0.85 | 0.38 |
| Iron | ***4.38*** | ***0.06*** | ***3.51*** | ***0.09*** | 0.69 | 0.43 |
| Lead | ***10.67*** | ***0.009*** | ***18.03*** | ***0.0017*** | ***8.91*** | ***0.01*** |
| Nickel | ***7.67*** | ***0.02*** | 0.83 | 0.38 | 0.72 | 0.42 |
| Selenium | ***39.88*** | ***< .0001*** | ***437.1*** | ***< .0001*** | ***6.36*** | ***0.03*** |
| Uranium | ***10.22*** | ***0.01*** | 2.29 | 0.16 | 0.41 | 0.53 |
| Zinc | 0.11 | 0.75 | 0.03 | 0.86 | ***7.23*** | ***0.02*** |
| Mercury | 0.54 | 0.48 | ***3.52*** | ***0.09*** | 0.32 | 0.59 |
| Total PCB | 0.21 | 0.66 | ***12.11*** | ***0.006*** | ***8.28*** | ***0.02*** |
| 2,3,7,8 TCDF | 0.18 | 0.68 | 0 | 0.99 | 0.97 | 0.35 |

Notes:

Results show F-tests and p-values for tests of equal concentrations of COIs in rainbow trout offal between river reach and between hatchery and wild rainbow trout offal.

Bold and italics indicate test was significantly different at p>0.1.

**TABLE 3-42**
Correlations Between Mean Analyte Concentration in Whole Body Largescale Sucker and Mean Analyte Concentration in Sediment Across all FSCAs
*Upper Columbia River RI/FS*

| Analyte | Correlation Coefficient | p-value |
|---|---|---|
| Aluminum | 0.386 | 0.521 |
| Arsenic | 0.682 | 0.204 |
| Barium | 0.776 | 0.123 |
| Cadmium | -0.361 | 0.551 |
| Chromium | 0.709 | 0.18 |
| Copper | ***0.909*** | ***0.033*** |
| Iron | ***0.868*** | ***0.056*** |
| Lead | 0.617 | 0.268 |
| Mercury | 0.555 | 0.331 |
| Nickel | -0.506 | 0.385 |
| Selenium | 0.003 | 0.996 |
| Uranium | -0.525 | 0.363 |
| Zinc | ***0.864*** | ***0.059*** |

Bold and italics indicate test was significantly different at p>0.1.

TABLE 3-43
Comparisons of the Current UCR Mean Trace Metals Concentrations in Select Target Species to Data from the 1995 USGS Study
*Upper Columbia River RI/FS*

| River Reach | Walleye | | Wild Rainbow Trout | | Hatchery Rainbow Trout | |
|---|---|---|---|---|---|---|
| | USGS (1995) | Current | USGS (1995) | Current | USGS (1995) | Current |
| **Arsenic (mg/kg WW)** | | | | | | |
| Upper | <0.1 | 0.09 | <0.1 | 0.09 | | |
| Middle | <0.1 | 0.11 | | | | |
| Lower | 0.12 | 0.13 | <0.1 | 0.08 | <0.1 | 0.04 |
| **Cadmium (mg/kg WW)** | | | | | | |
| Upper | <0.03 | 0.0052 | <0.03 | 0.0117 | | |
| Middle | <0.03 | 0.0053 | | | | |
| Lower | <0.03 | 0.0053 | <0.03 | 0.0053 | <0.03 | 0.0061 |
| **Copper (mg/kg WW)** | | | | | | |
| Upper | 0.38 | 0.23 | 0.46 | 0.34 | | |
| Middle | 0.32 | 0.2 | | | | |
| Lower | 0.27 | 0.21 | 0.68 | 0.27 | 0.48 | 0.27 |
| **Lead (mg/kg WW)** | | | | | | |
| Upper | 0.07 | 0.005 | 0.05 | 0.015 | | |
| Middle | <0.05 | 0.019 | | | | |
| Lower | <0.05 | 0.024 | 0.1 | 0.0053 | 0.07 | 0.0061 |
| **Selenium (mg/kg WW)** | | | | | | |
| Upper | 0.37 | 0.36 | <0.2 | 0.49 | | |
| Middle | 0.23 | 0.41 | | | | |
| Lower | 0.32 | 0.39 | 0.37 | 0.38 | 4.6 | 0.27 |
| **Mercury (ug/kg WW)** | | | | | | |
| Upper | 310 | 273 | 200 | 108 | | |
| Middle | 380 | 281 | | | | |
| Lower | 390 | 417 | 202 | 83 | 135 | 122 |

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
WW = wet weight

TABLE 3-44
Comparisons of the Current UCR TCDF and Total PCB Concentrations in Select Target Species to Data from the 1998 EVS Study
*Upper Columbia River RI/FS*

| River Reach | Lake Whitefish | | Walleye | | Rainbow Trout | |
|---|---|---|---|---|---|---|
| | EVS (1998) | Current | EVS (1998) | Current | EVS (1998) | Current |
| **2,3,7,8 TCDF (ug/kg WW)** | | | | | | |
| Upper | | | | | 0.0017 | 0.00096 |
| Middle | 0.0102 | 0.0047 | 0.0003 | 0.0003 | | |
| Lower | | | 0.001 | 0.0006 | 0.001 | 0.00068 |
| **Total PCBs (ug/kg WW)** | | | | | | |
| Upper | | | 15.5 | 6.96 | 87.6 | 75 |
| Middle | 60 | 72.6 | 15.3 | 50.2 | | |
| Lower | | | 12.9 | 52.12 | 23.6 | 44.85 |

ug/kg = micrograms per kilogram
WW = wet weight

TABLE 3-45
Comparisons of the Current UCR Mean Trace Metals Concentrations in Largescale Sucker to Data from the 1994 Ecology Study
*Upper Columbia River RI/FS*

| Contaminant of Interest | Largescale Sucker | | | |
|---|---|---|---|---|
| | Ecology (1994) | | Current | |
| | Northport | Kettle Falls | FSCA 1 | FSCA 3 |
| Cadmium (mg/kg WW) | 0.48 | 0.35 | 0.32 | 0.29 |
| Copper (mg/kg WW) | 10.4 | 1.23 | 8.9 | 0.87 |
| Lead (mg/kg WW) | 12 | 3 | 6.2 | 2.7 |
| Zinc (mg/kg WW) | 84.5 | 23.1 | 85.4 | 20.6 |
| Mercury (*u*g/kg WW) | 120 | 180 | 72.8 | 215.8 |

mg/kg = milligrams per kilogram
ug/kg = micrograms per kilogram
WW = wet weight

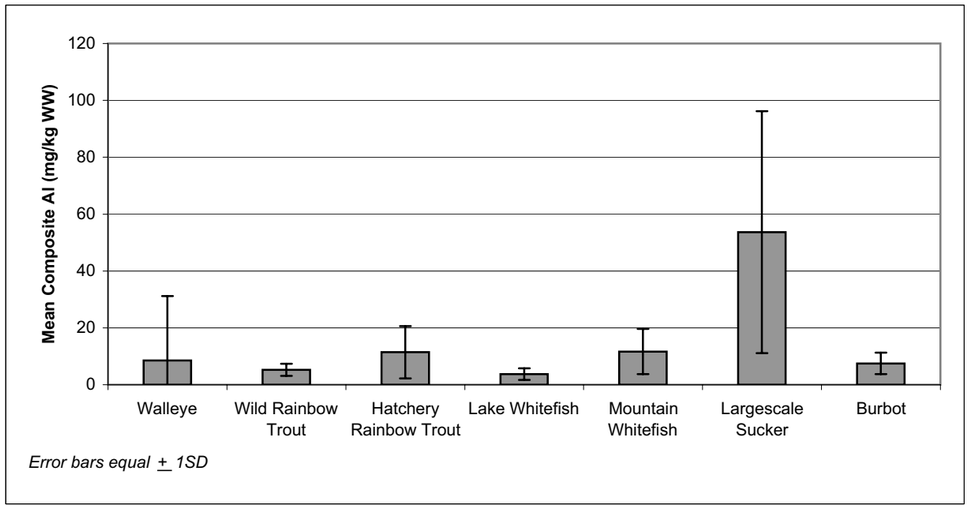



**Figure 3-1 Comparison of Mean Aluminum Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

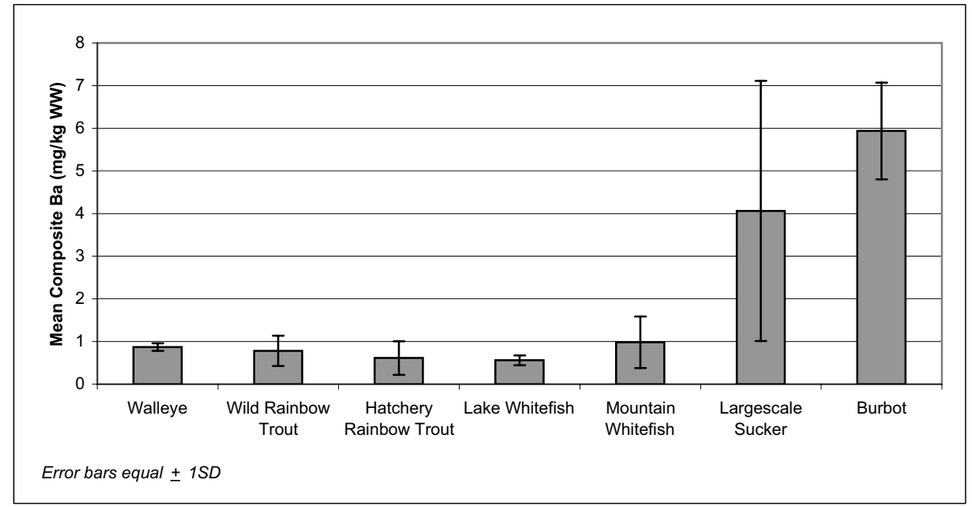



**Figure 3-3 Comparison of Mean Barium Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

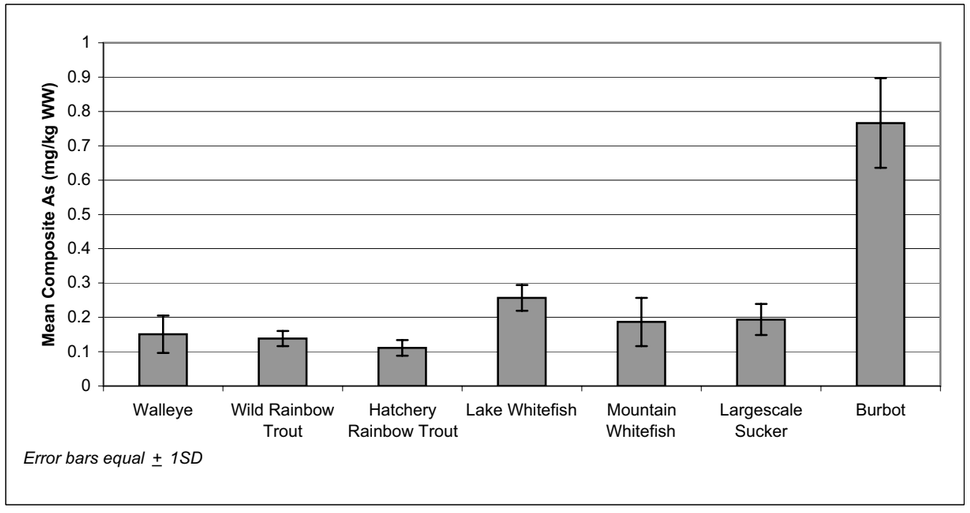



**Figure 3-2 Comparison of Mean Arsenic Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

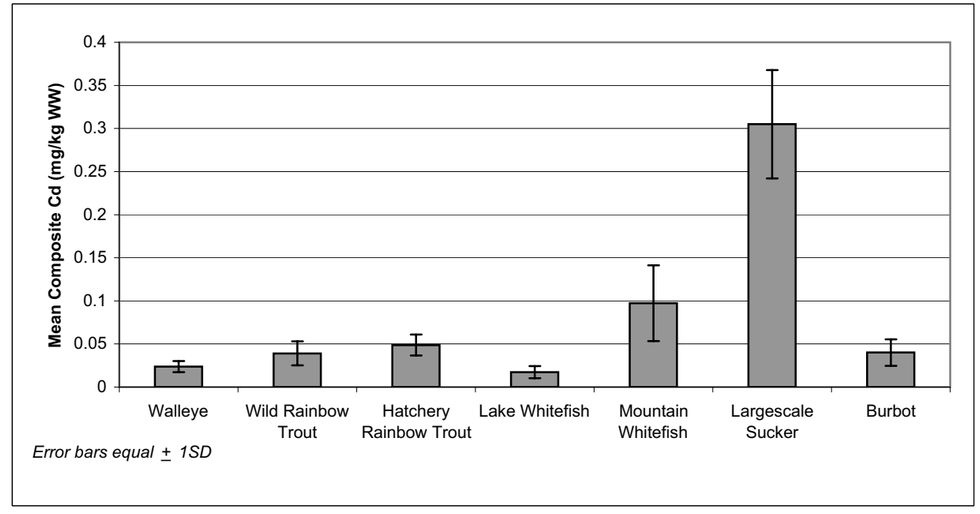



**Figure 3-4 Comparison of Mean Cadmium Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

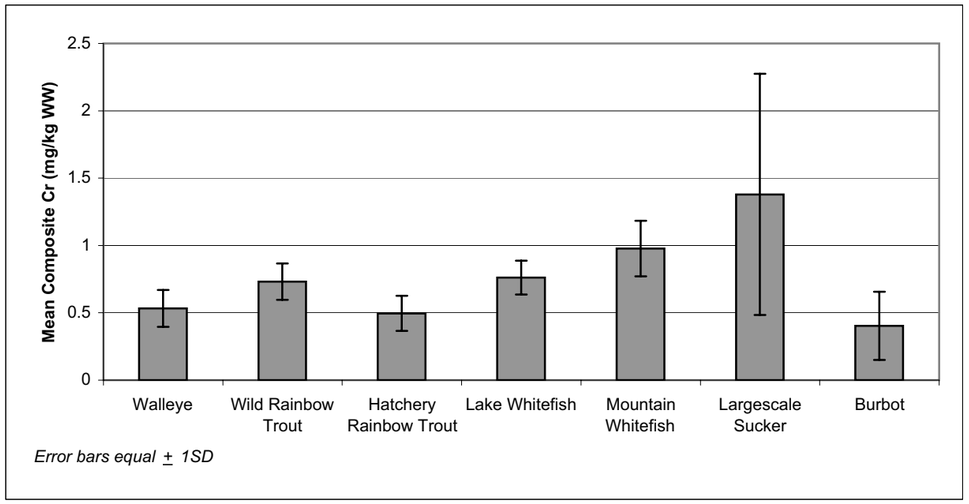



**Figure 3-5 Comparison of Mean Chromium Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

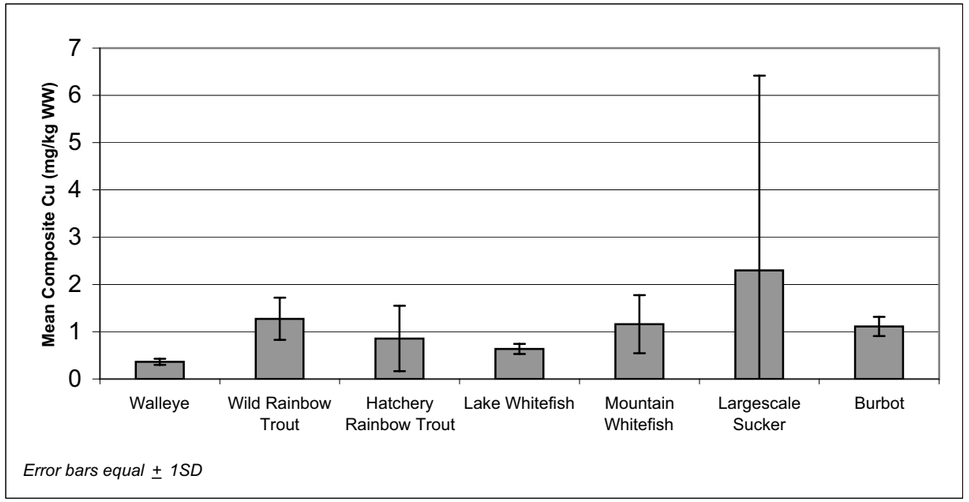



**Figure 3-6 Comparison of Mean Copper Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

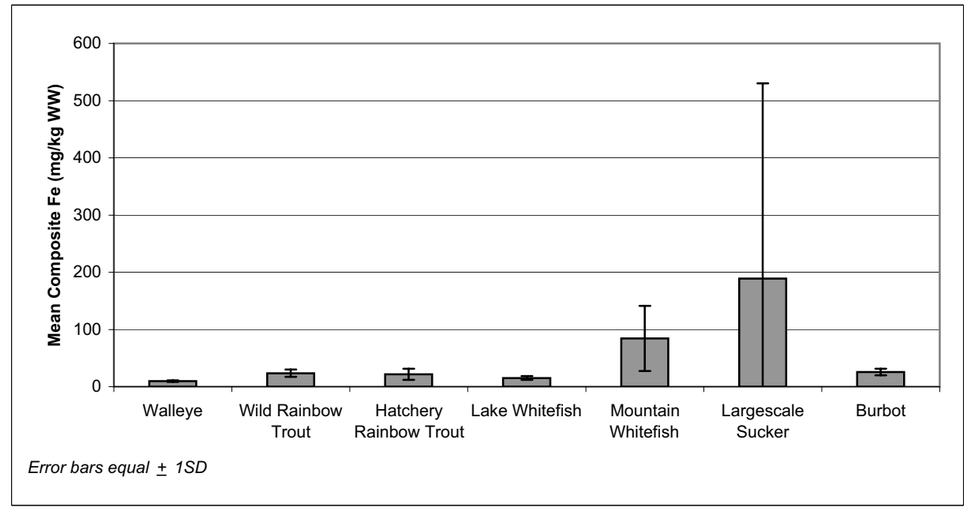



**Figure 3-7 Comparison of Mean Iron Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

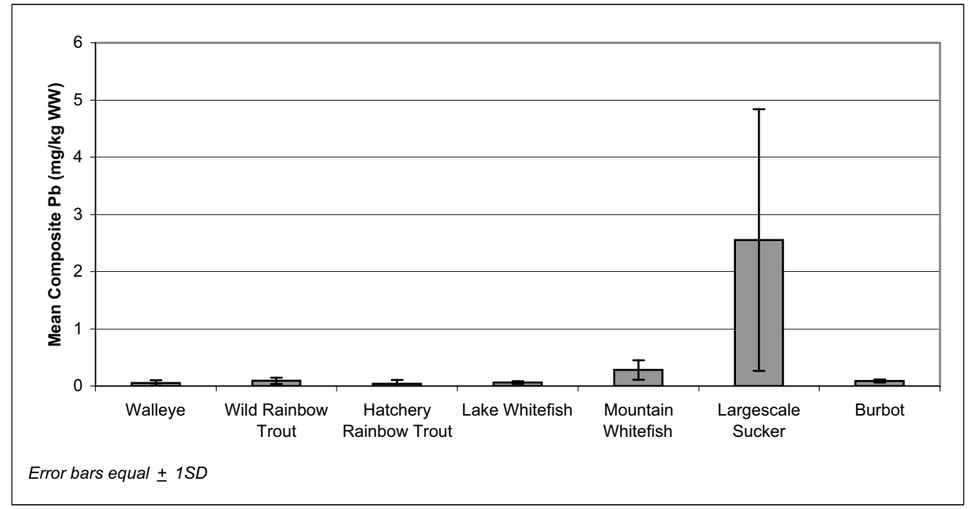



**Figure 3-8 Comparison of Mean Lead Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

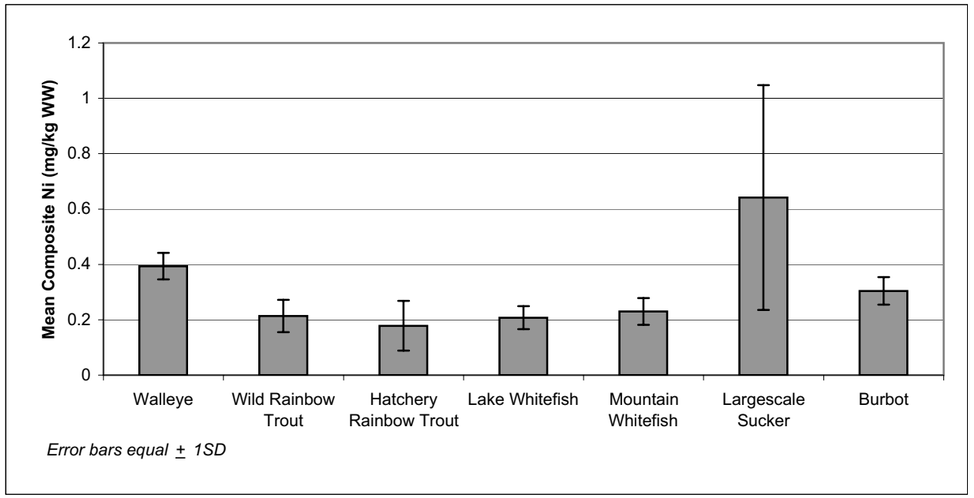



**Figure 3-9 Comparison of Mean Nickel Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

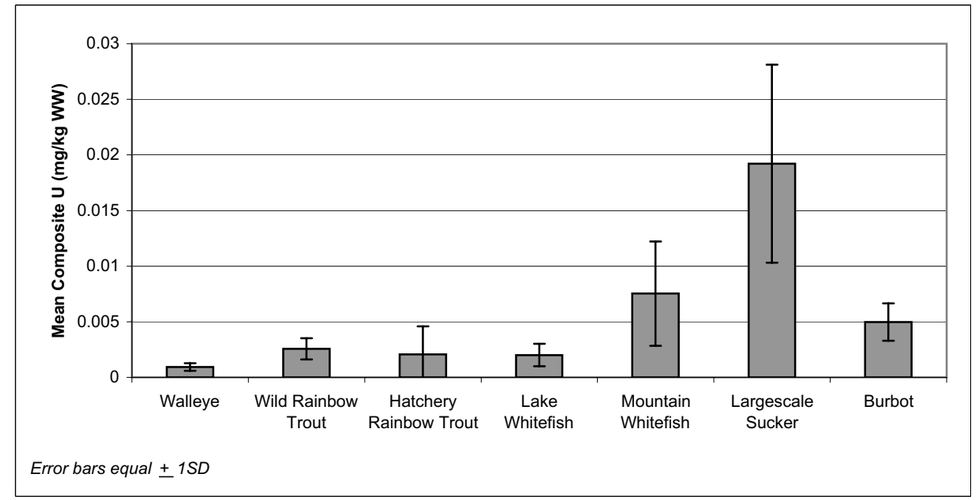



**Figure 3-11 Comparison of Mean Uranium Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

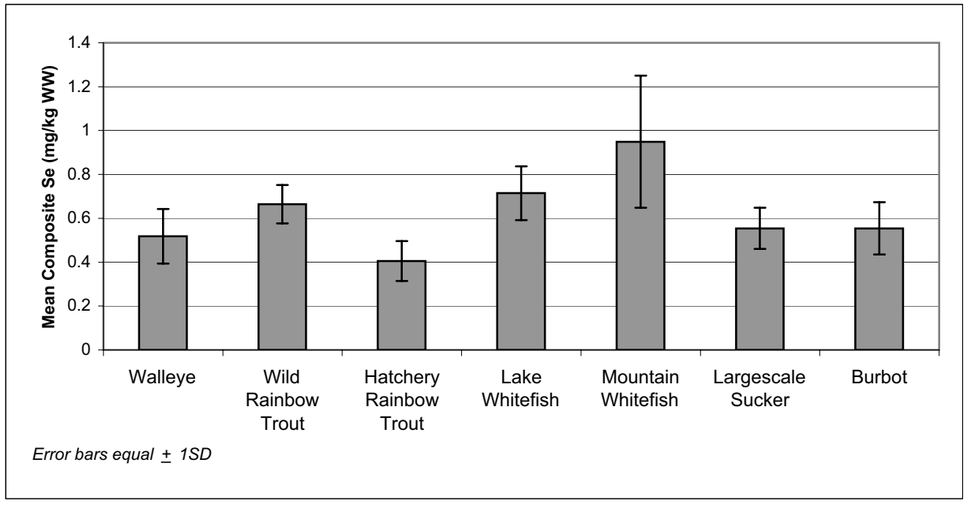



**Figure 3-10 Comparison of Mean Selenium Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

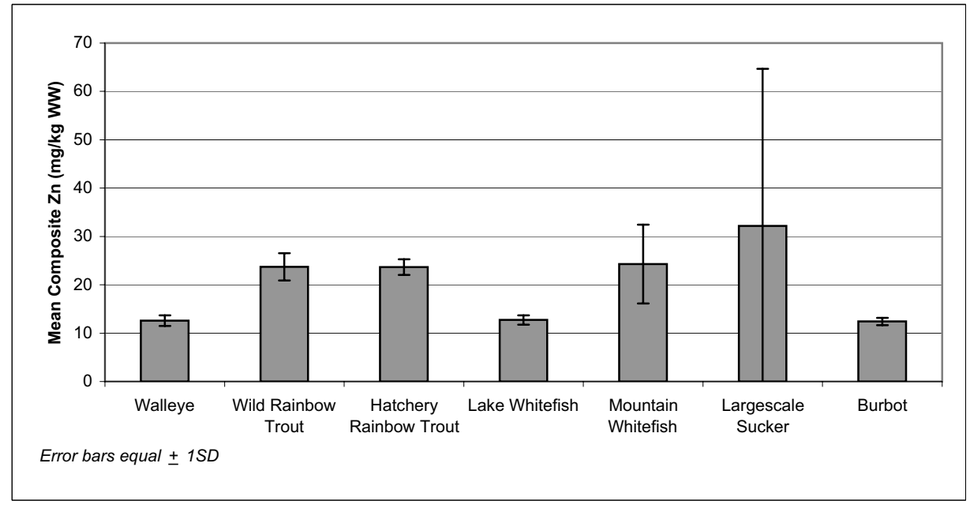



**Figure 3-12 Comparison of Mean Zinc Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

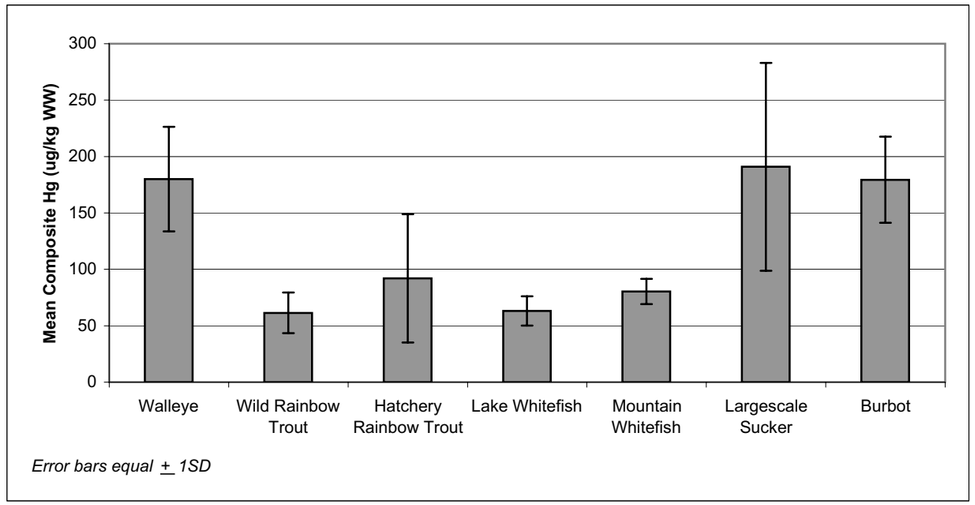



**Figure 3-13 Comparison of Mean Mercury Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

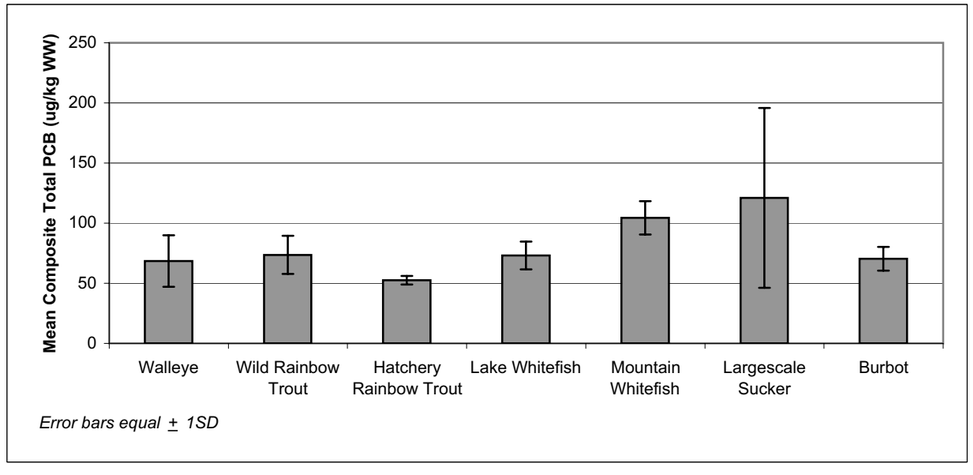



**Figure 3-14 Comparison of Mean Total PCBs as Aroclor Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

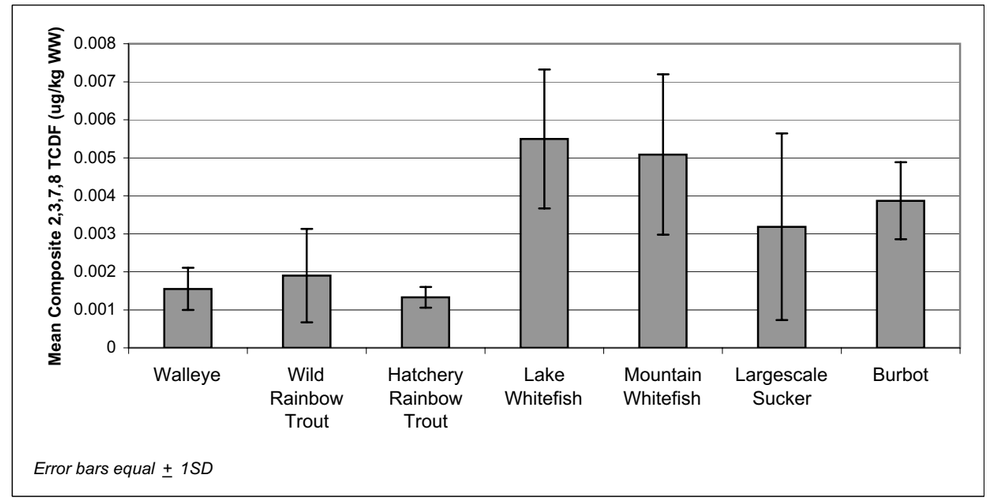



**Figure 3-15 Comparison of Mean 2,3,7,8 TCDF Concentrations in Whole Body Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

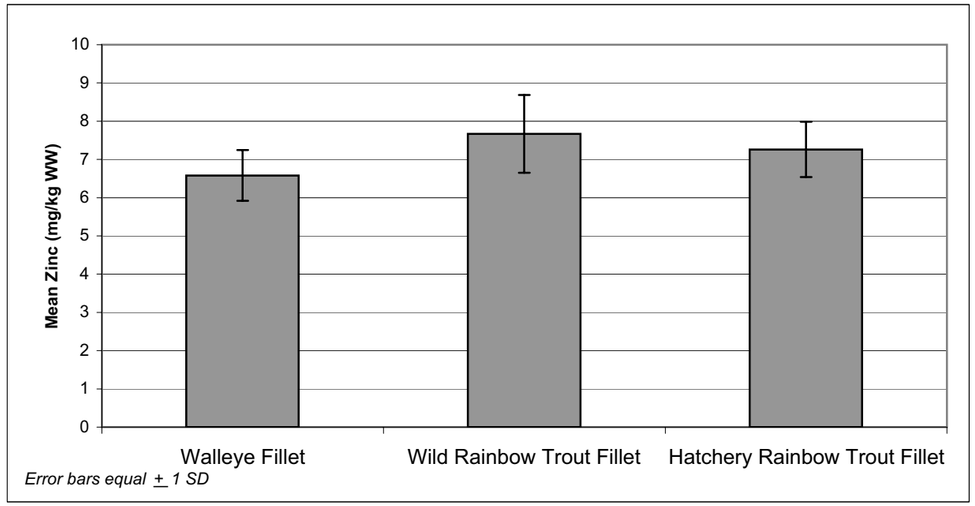



**Figure 3-16 Comparison of Mean Zinc Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

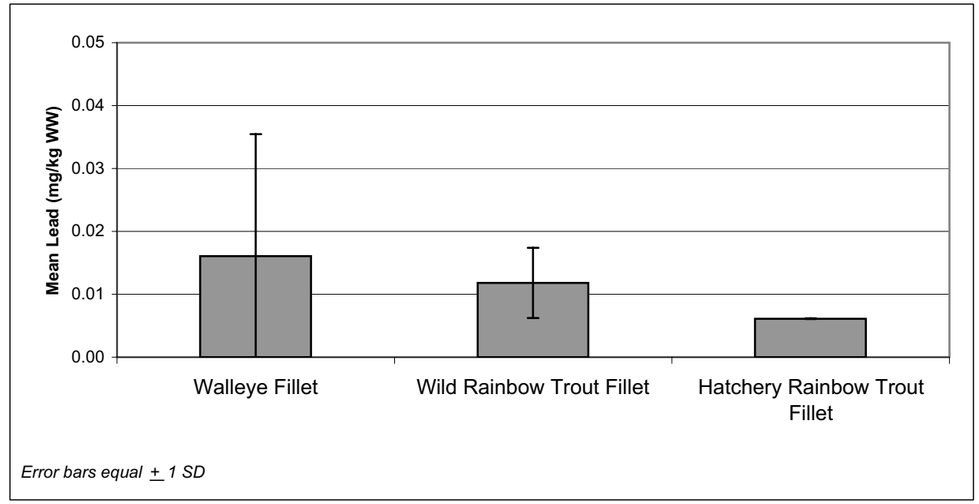



**Figure 3-18 Comparison of Mean Lead Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

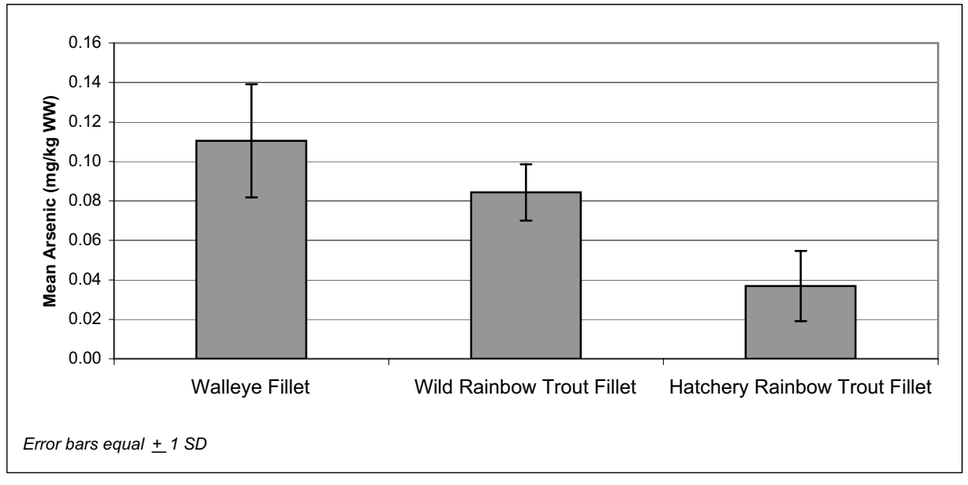



**Figure 3-17 Comparison of Mean Arsenic Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

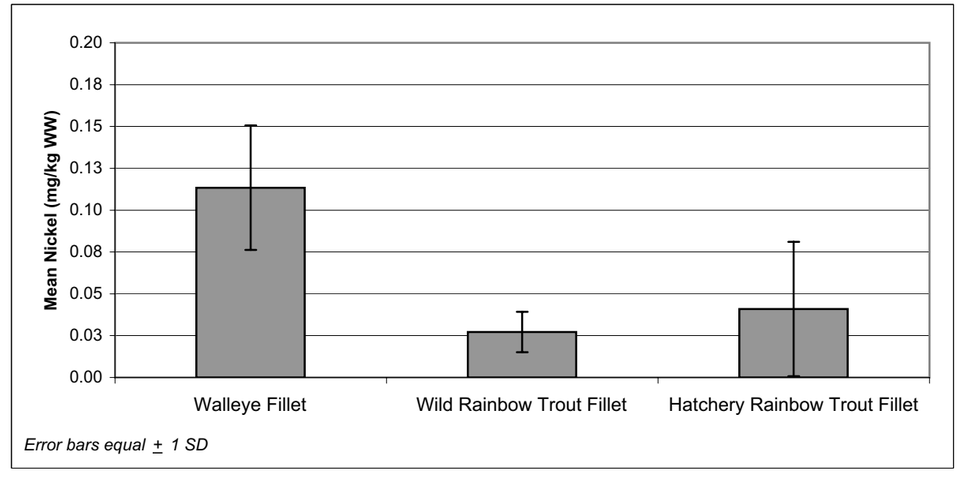



**Figure 3-19 Comparison of Mean Nickel Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

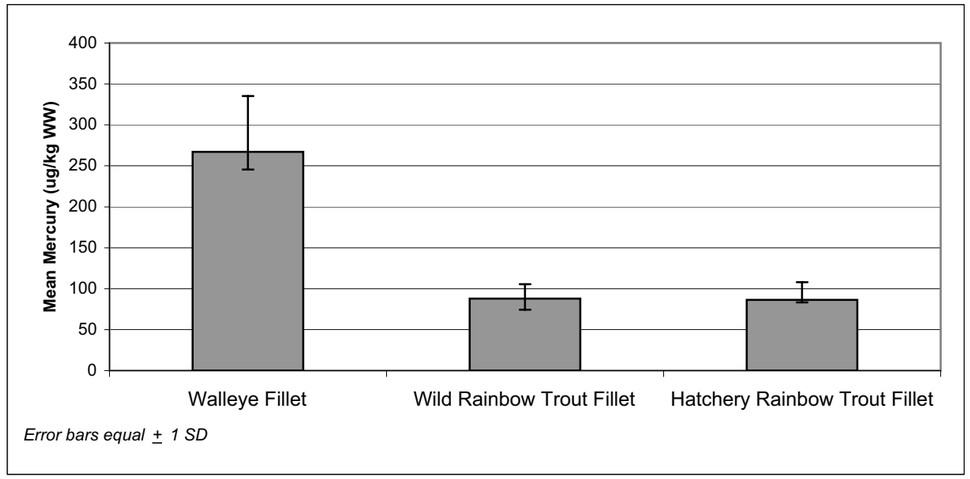



**Figure 3-20 Comparison of Mean Mercury Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

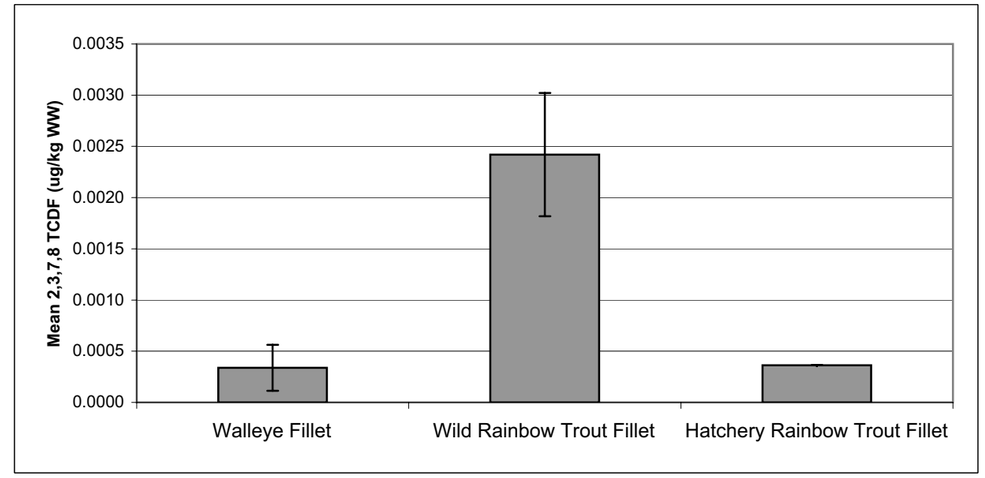



**Figure 3-22 Comparison of Mean 2,3,7,8 TCDF Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

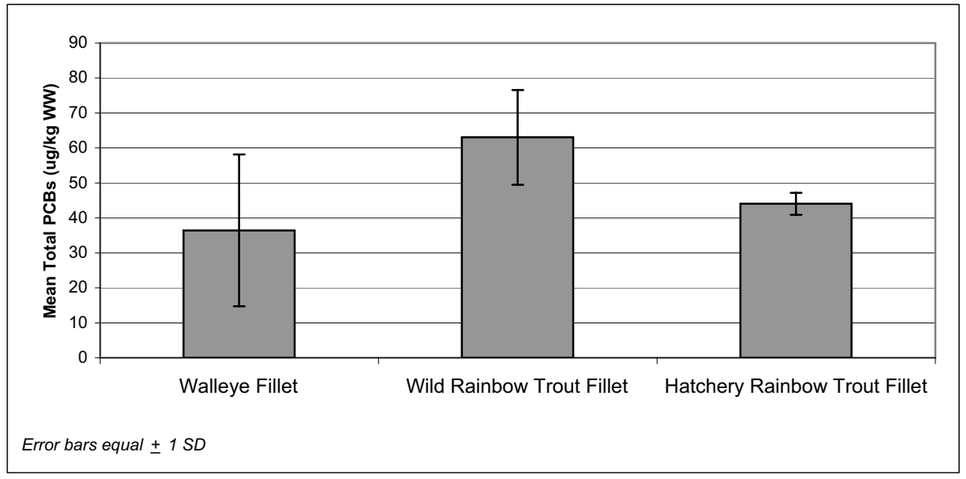



**Figure 3-21 Comparison of Mean Total PCBs as Aroclor Concentrations in Fillet Samples from Target Species Across all FSCAs**
*Upper Columbia River RI/FS*

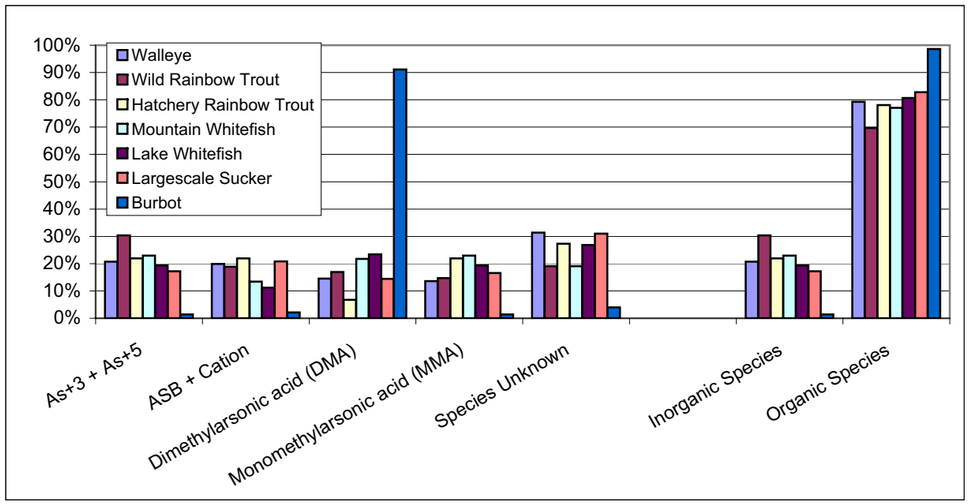



**Figure 3-23 Comparison of Inorganic and Organic Arsenic Species in Whole Body Samples by Species**
*Upper Columbia River RI/FS*

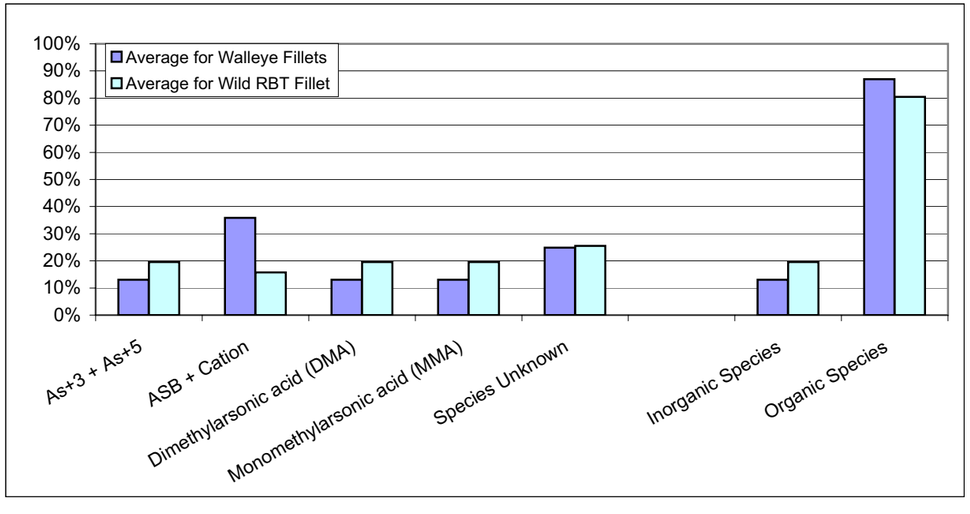



**Figure 3-24 Comparison of Inorganic and Organic Arsenic Species in Fillets of Walleye and Rainbow Trout**
*Upper Columbia River RI/FS*

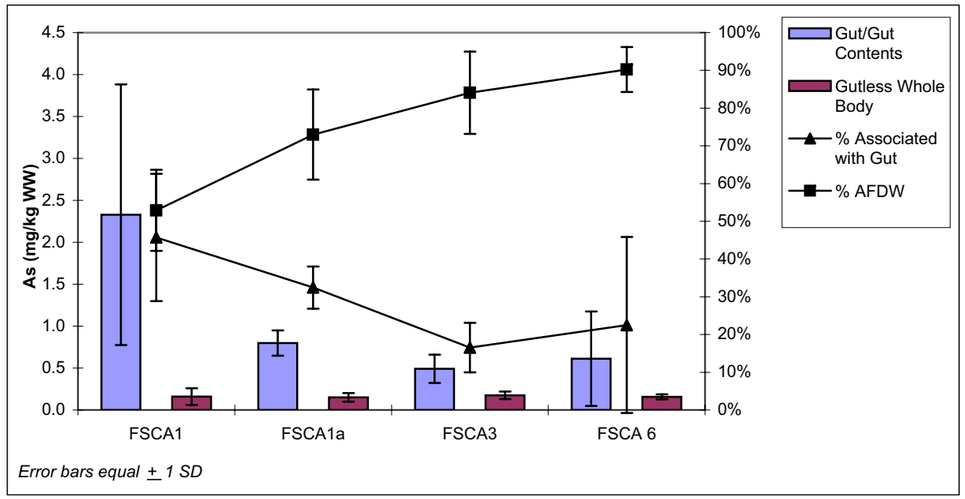



**Figure 3-25 Comparison of As in Gut/Gut Contents to Gutless Whole Body Concentration in Largescale Suckers**
*Upper Columbia River RI/FS*

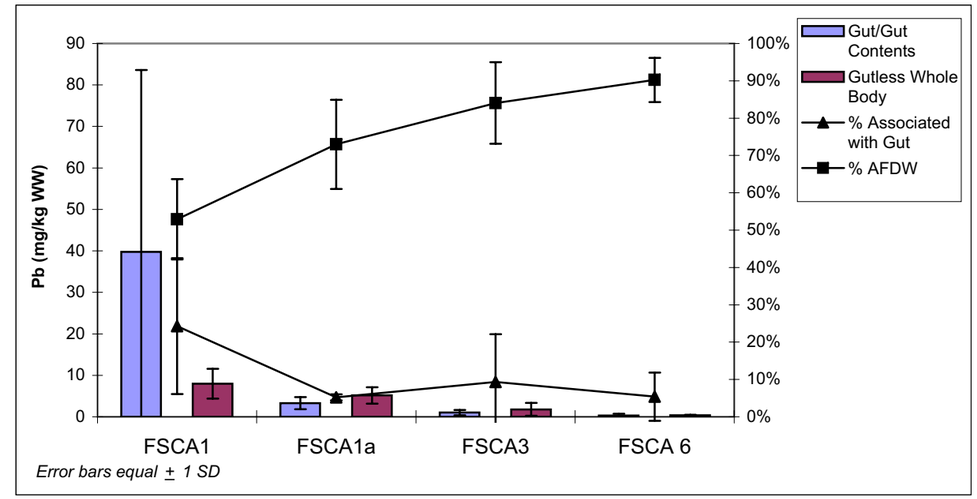



**Figure 3-27 Comparison of Pb in Gut/Gut Contents to Gutless Whole Body Concentration in Largescale Suckers**
*Upper Columbia River RI/FS*

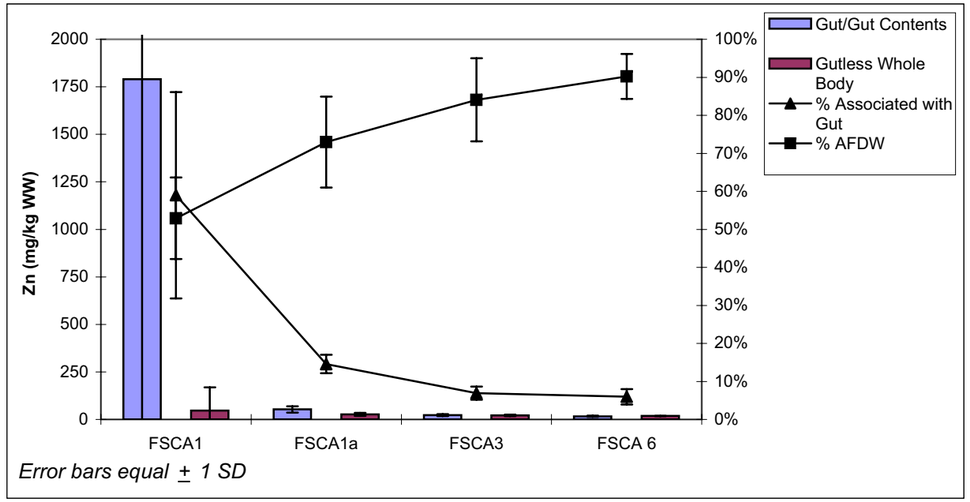



**Figure 3-26 Comparison of Zn in Gut/Gut Contents to Gutless Whole Body Concentration in Largescale Suckers**
*Upper Columbia River RI/FS*

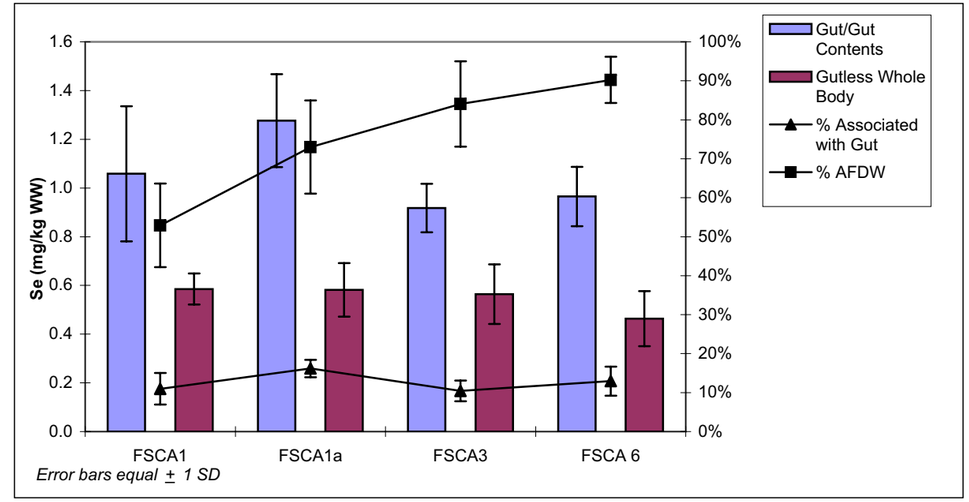



**Figure 3-28 Comparison of Se in Gut/Gut Contents to Gutless Whole Body Concentration in Largescale Suckers**
*Upper Columbia River RI/FS*

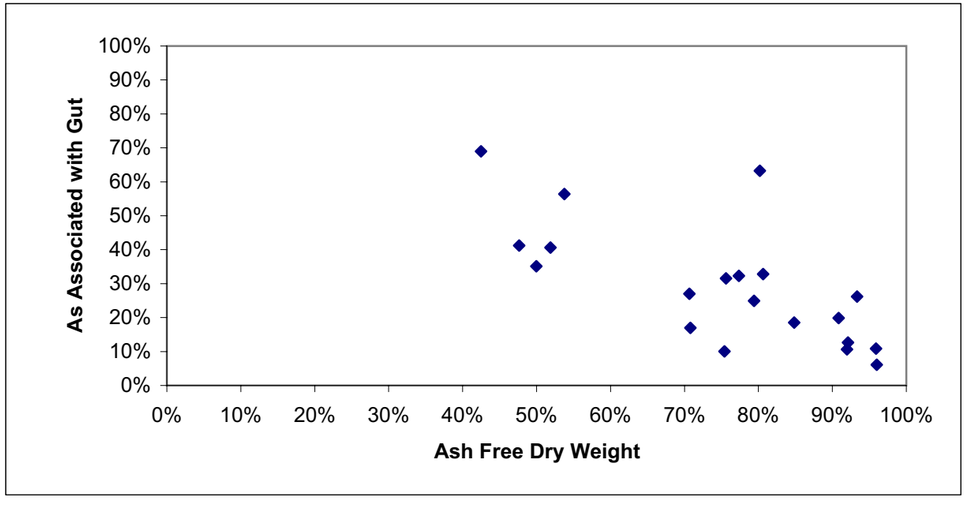



**Figure 3-29 Comparison of Percent As Associated with Gut/Contents and % Inorganic Matter as Ash Free Dry Weight for Largescale Sucker**

*Upper Columbia River RI/FS*

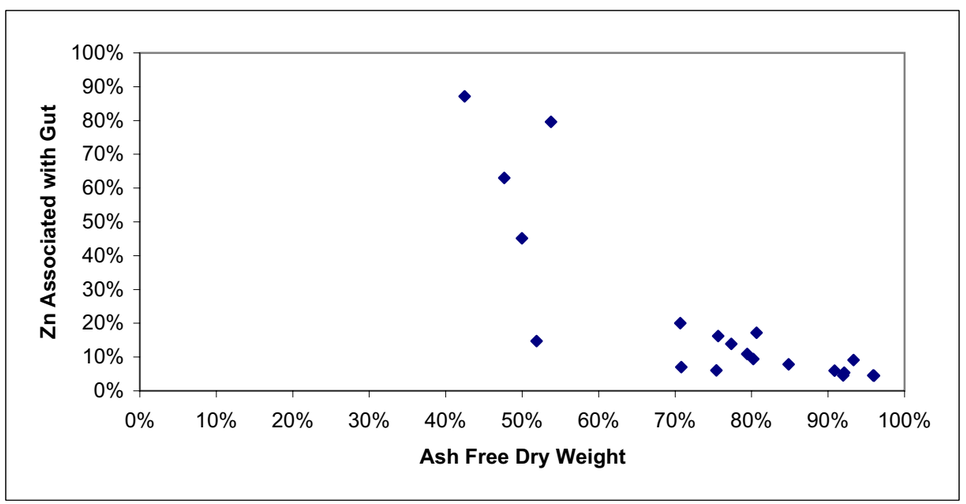



**Figure 3-30 Comparison of Percent Zn Associated with Gut/Contents and % Inorganic Matter as Ash Free Dry Weight for Largescale Sucker**

*Upper Columbia River RI/FS*

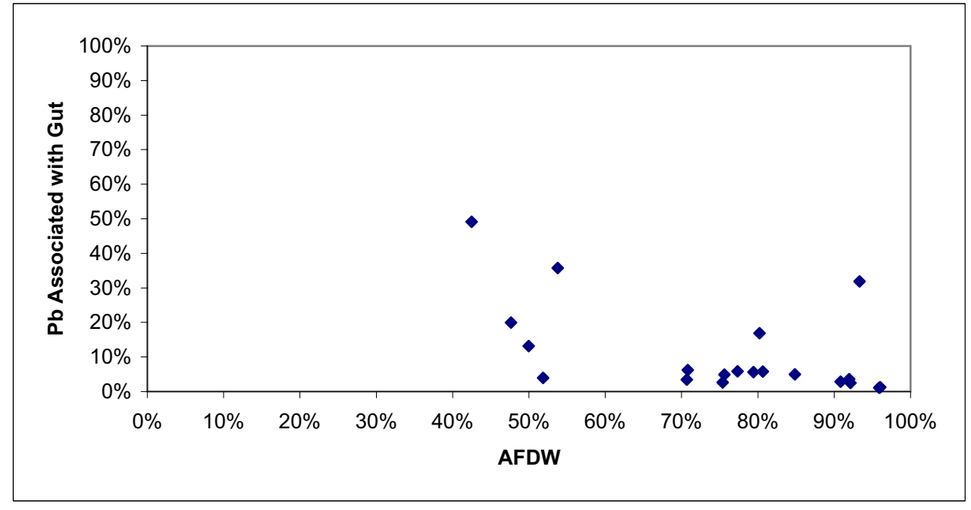



**Figure 3-31 Comparison of Percent Pb Associated with Gut/Contents and % Inorganic Matter as Ash Free Dry Weight for Largescale Sucker**

*Upper Columbia River RI/FS*

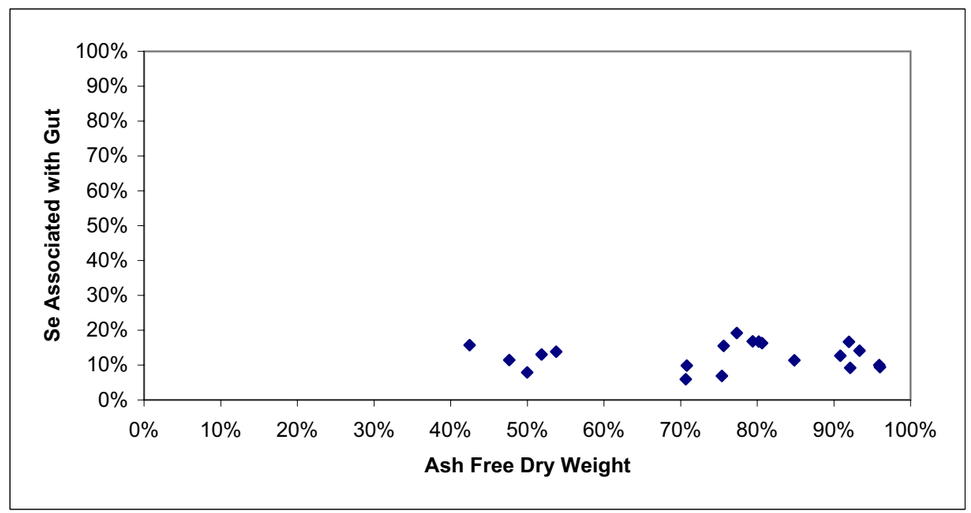



**Figure 3-32 Comparison of Percent Se Associated with Gut/Contents and % Inorganic Matter as Ash Free Dry Weight for Largescale Sucker**

*Upper Columbia River RI/FS*

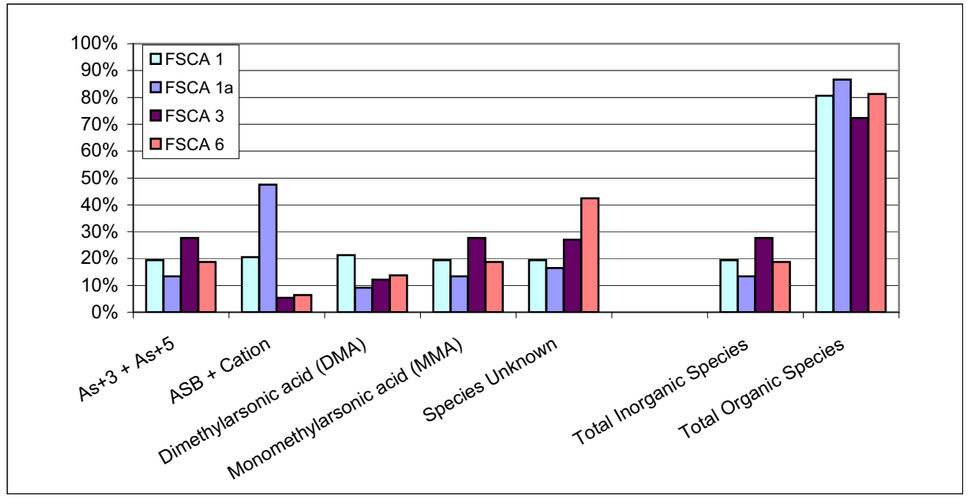



**Figure 3-33 Comparison of Inorganic and Organic Arsenic Species in Gutless Whole Body Largescale Sucker Samples by FSCA**
*Upper Columbia River RI/FS*

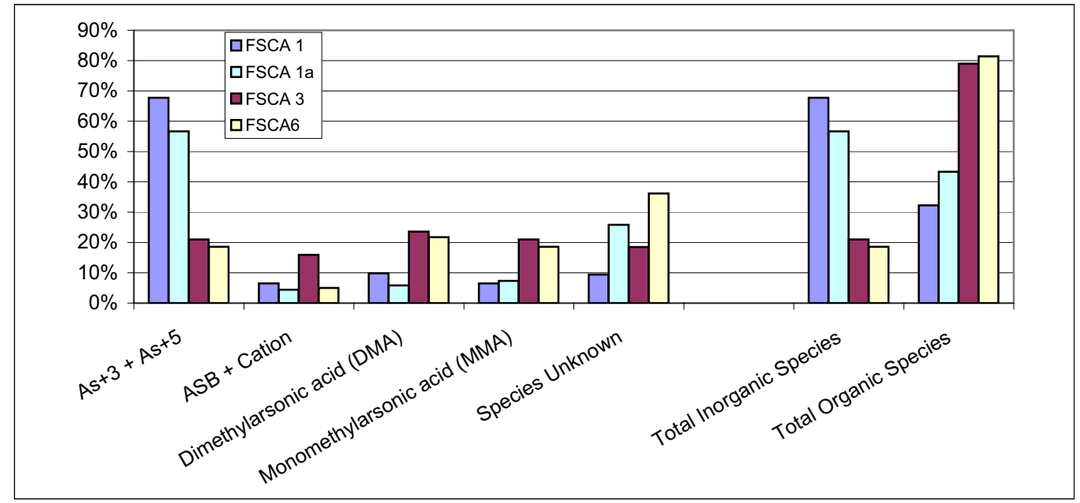



**Figure 3-34 Comparison of Inorganic and Organic Arsenic Species in Largescale Sucker Gut/Contents Samples by FSCA**
*Upper Columbia River RI/FS*

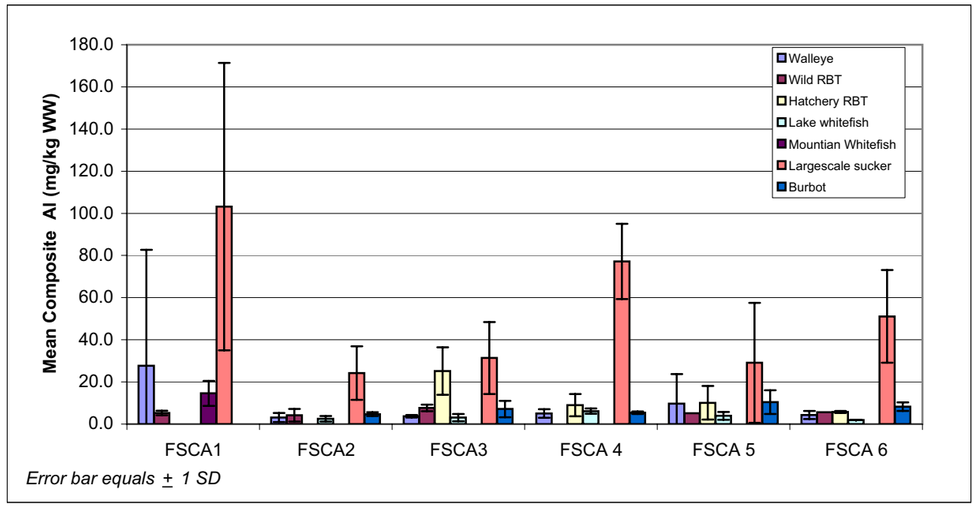



**Figure 3-35 Comparison of Aluminum Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

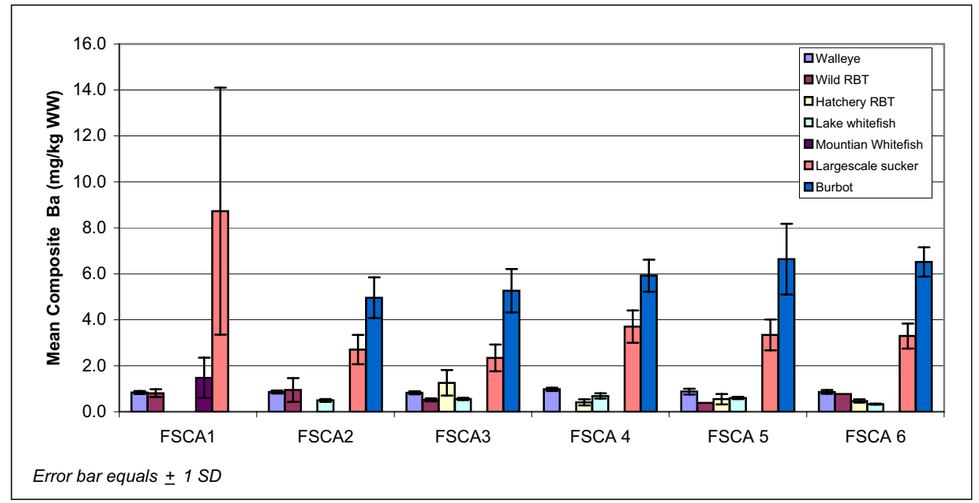



**Figure 3-37 Comparison of Barium Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

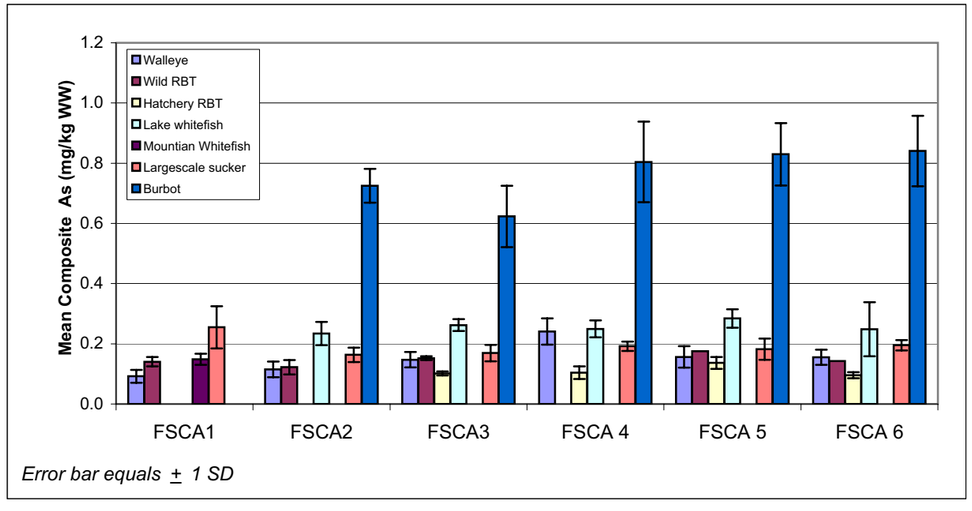



**Figure 3-36 Comparison of Arsenic Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

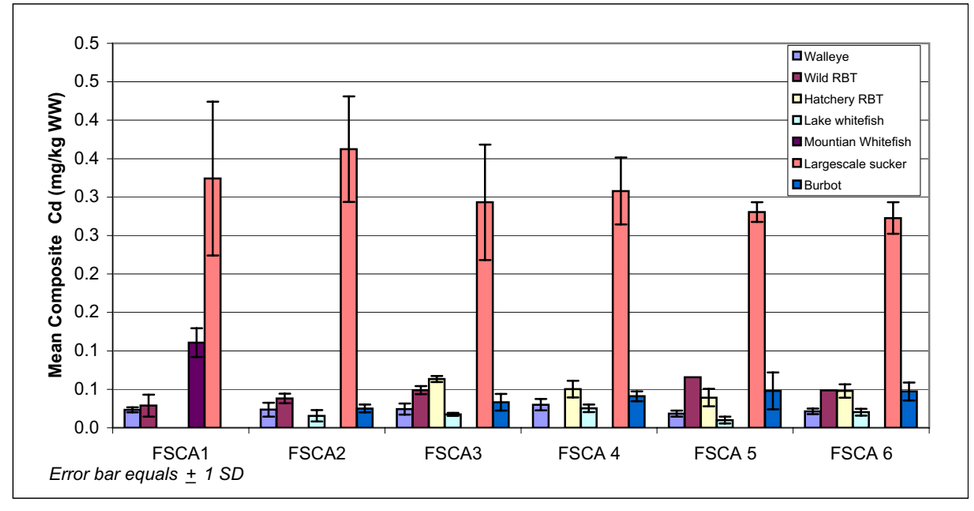



**Figure 3-38 Comparison of Cadmium Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

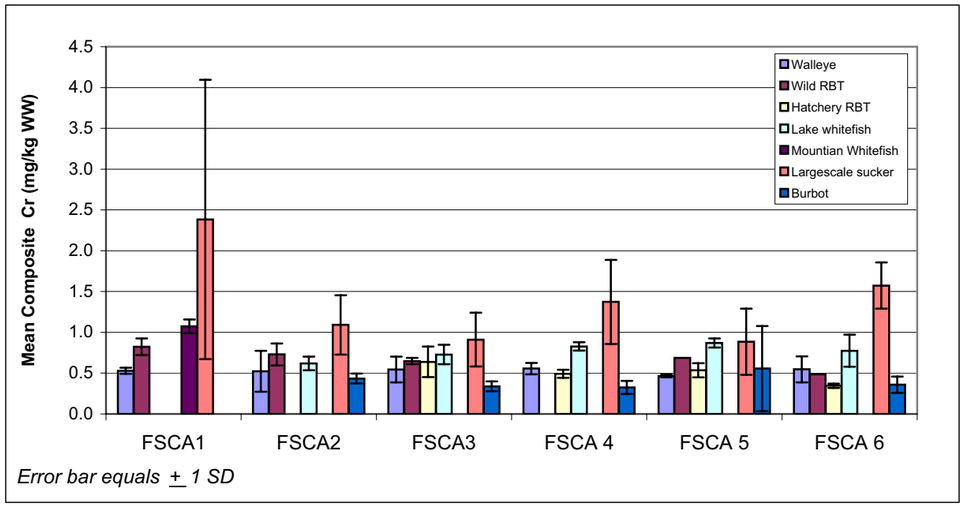



**Figure 3-39 Comparison of Chromium Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

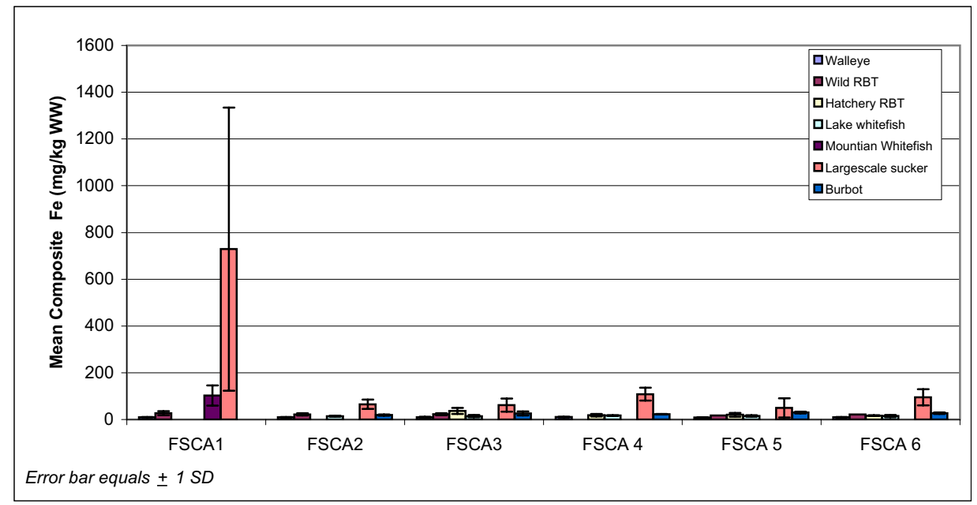



**Figure 3-41 Comparison of Iron Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

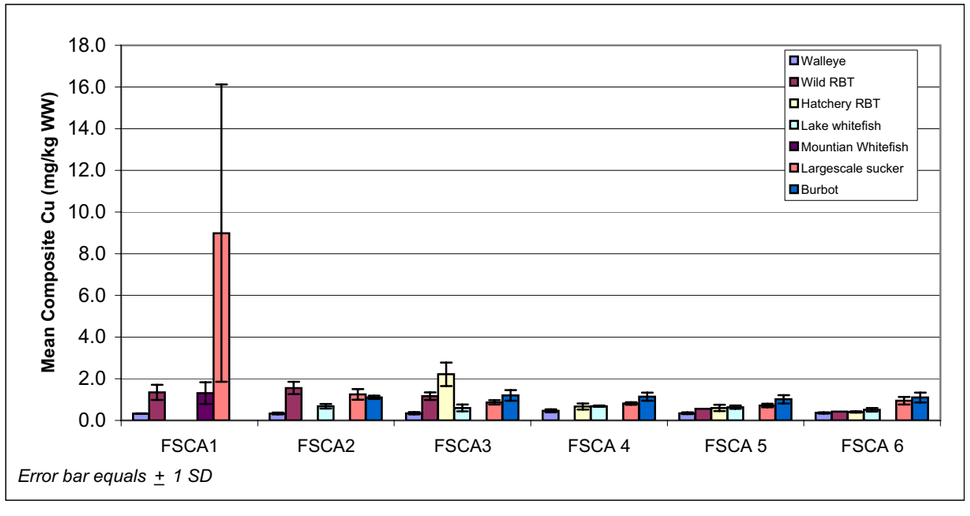



**Figure 3-40 Comparison of Copper Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

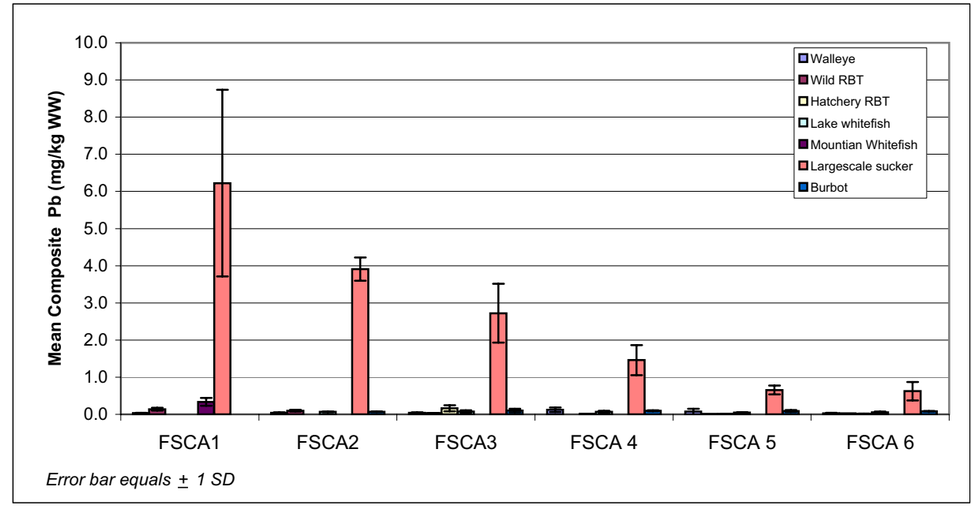



**Figure 3-42 Comparison of Lead Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

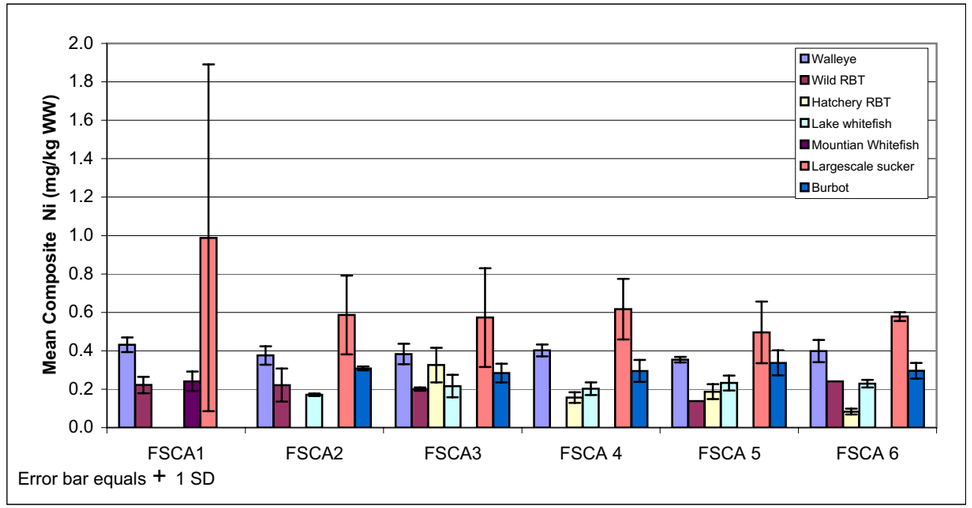



**Figure 3-43 Comparison of Nickel Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

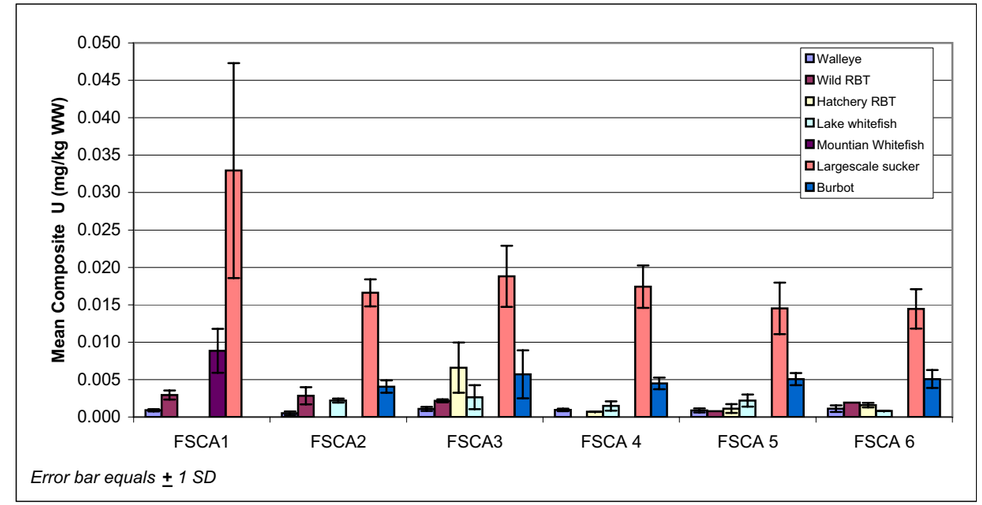



**Figure 3-45 Comparison of Uranium Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

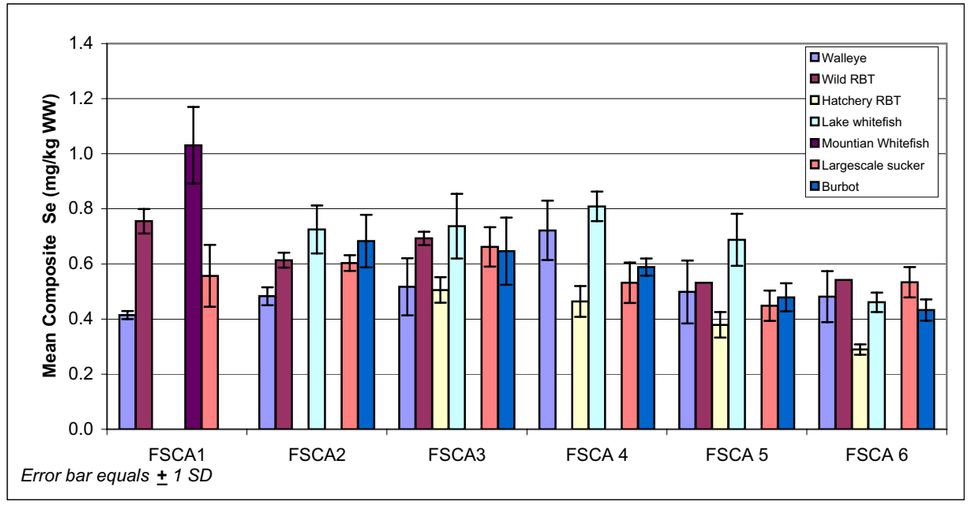



**Figure 3-44 Comparison of Selenium Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

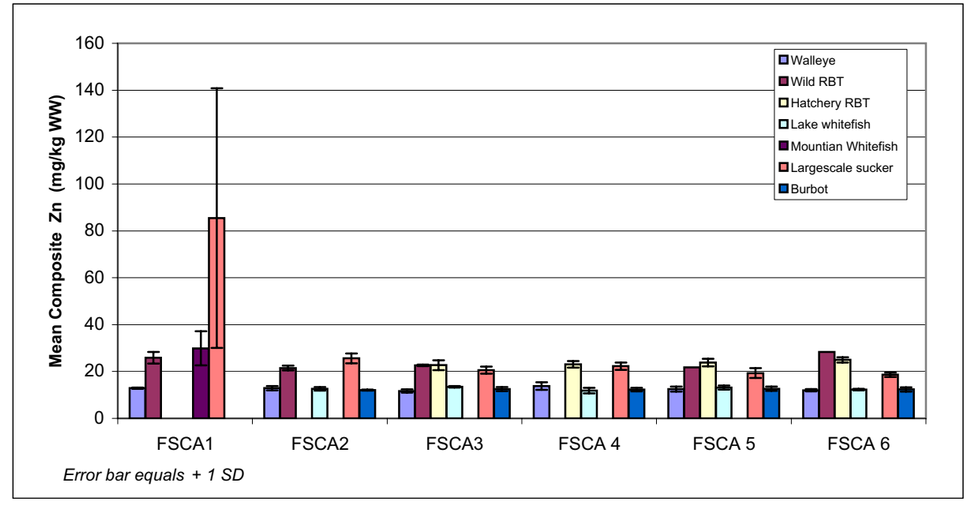



**Figure 3-46 Comparison of Zinc Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

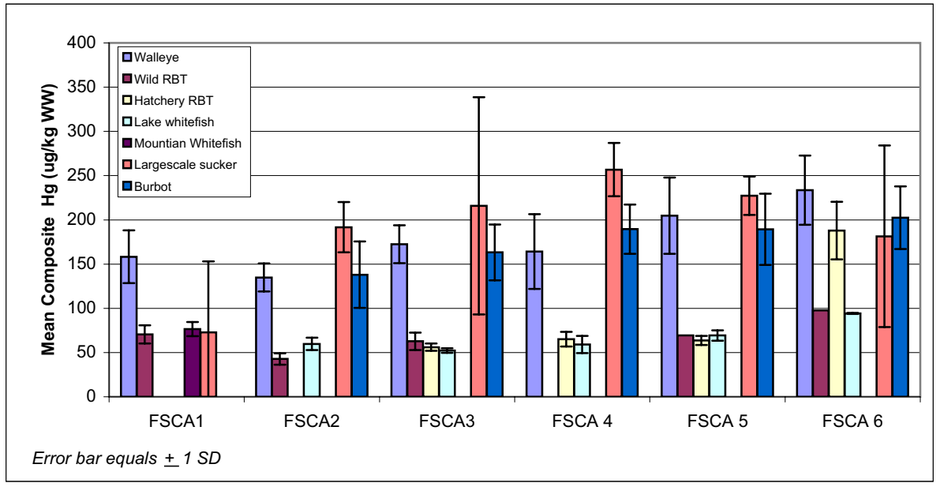



**Figure 3-47 Comparison of Mercury Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

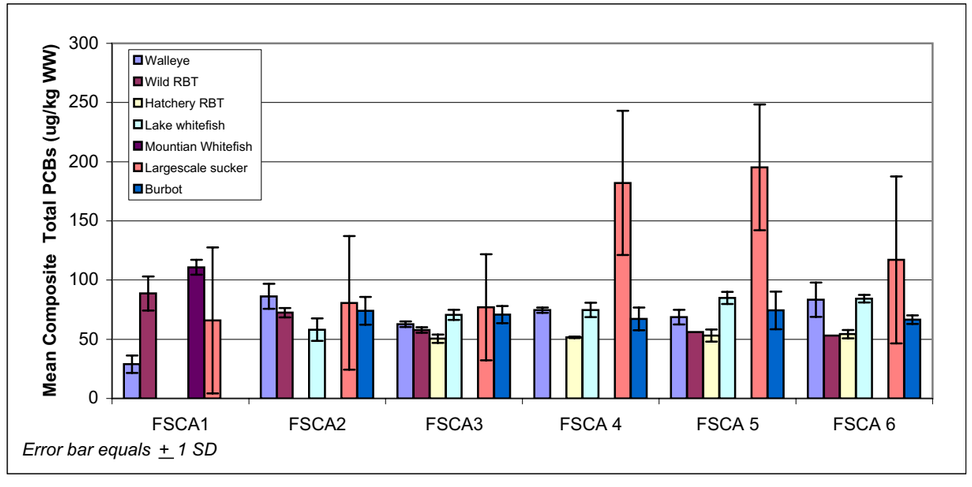



**Figure 3-48 Comparison of Total PCB as Aroclor Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

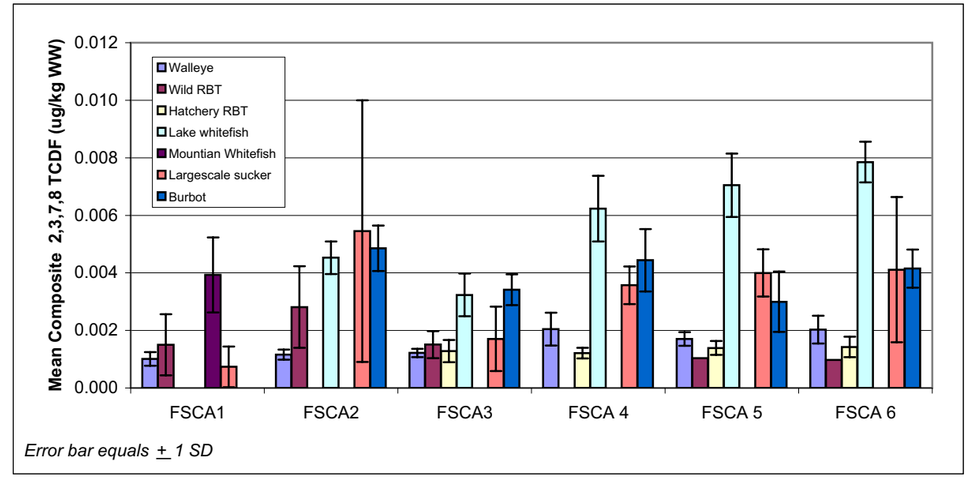



**Figure 3-49 Comparison of 2,3,7,8 TCDF Concentrations in Whole Body Samples from Target Species by FSCA**
*Upper Columbia River RI/FS*

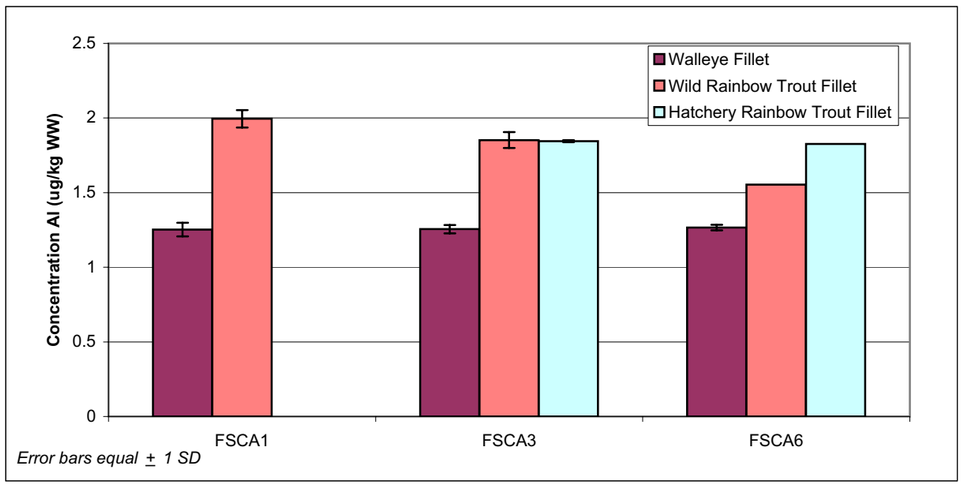



**Figure 3-50 Comparison of Aluminum Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

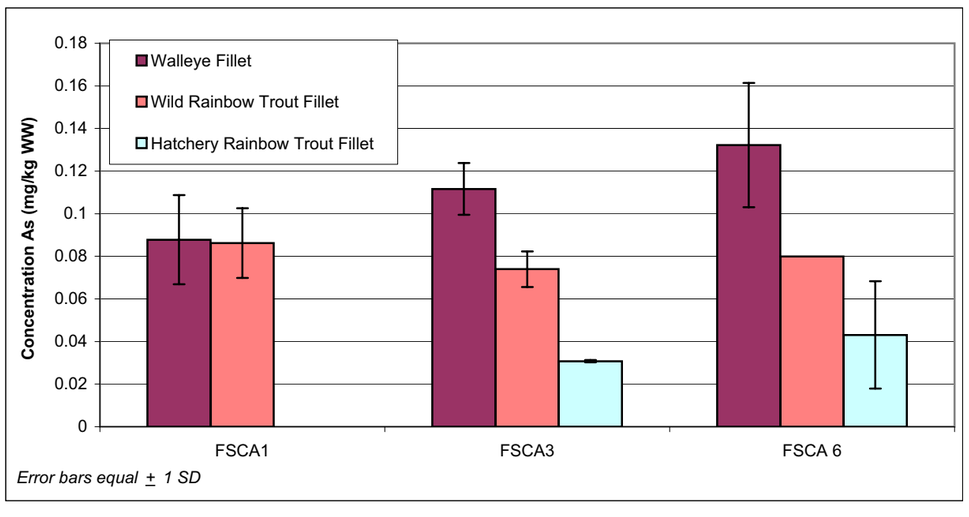



**Figure 3-51 Comparison of Arsenic Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

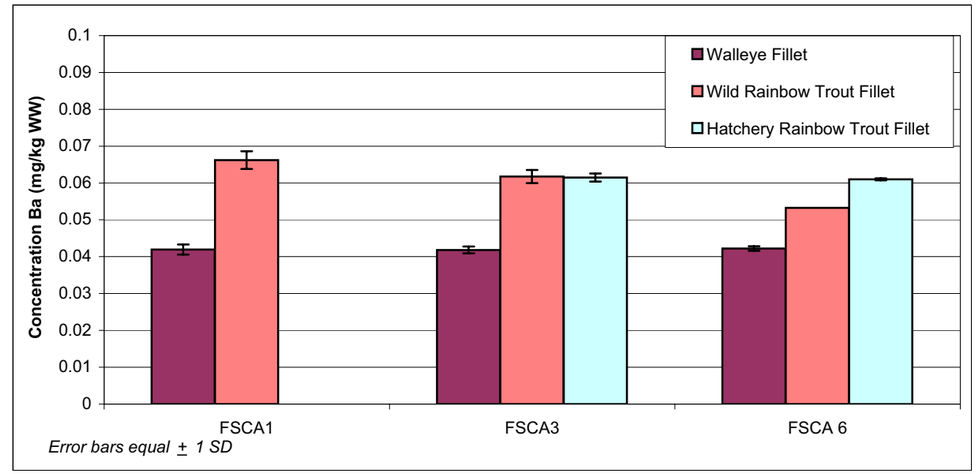



**Figure 3-52 Comparison of Barium Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

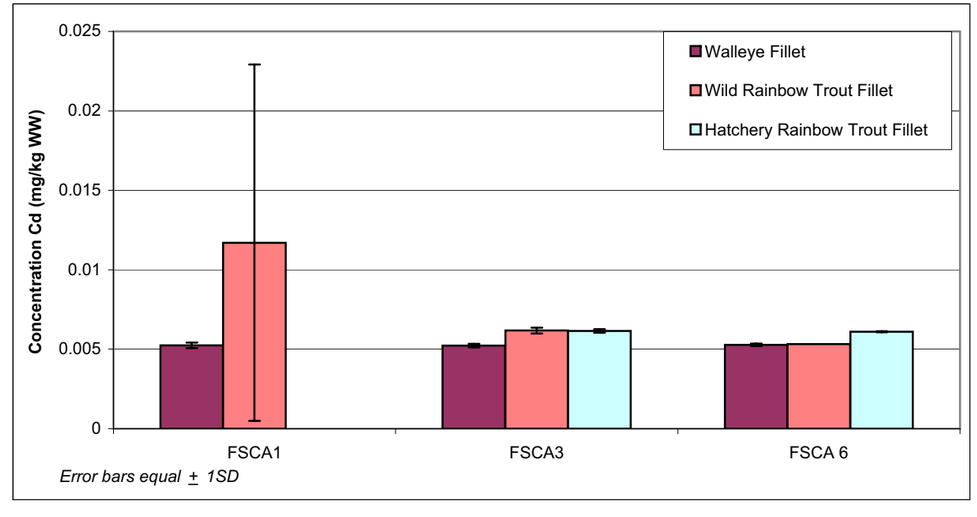



**Figure 3-53 Comparison of Cadmium Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

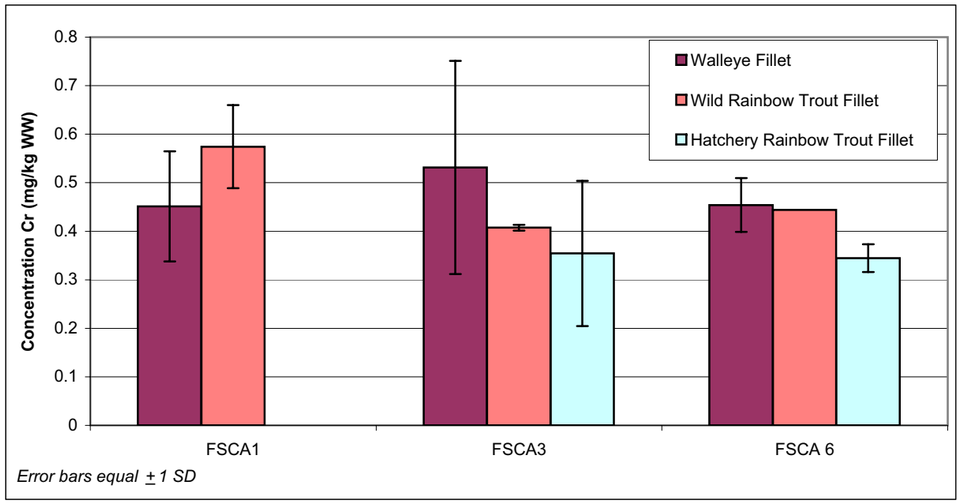



**Figure 3-54 Comparison of Chromium Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

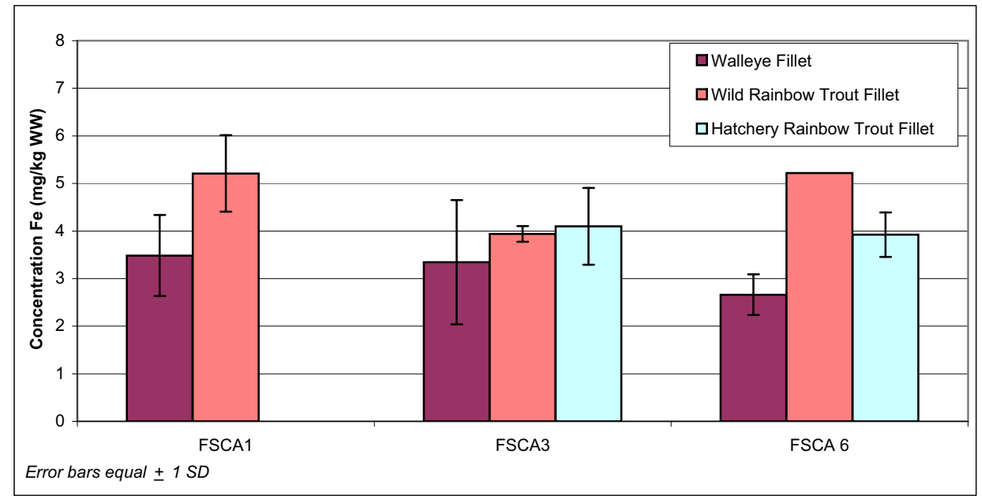



**Figure 3-56 Comparison of Iron Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

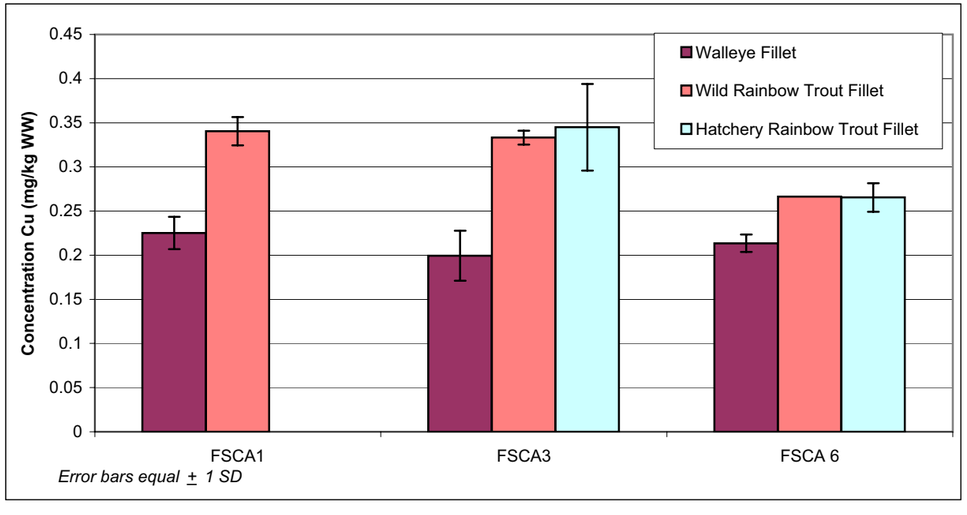



**Figure 3-55 Comparison of Copper Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

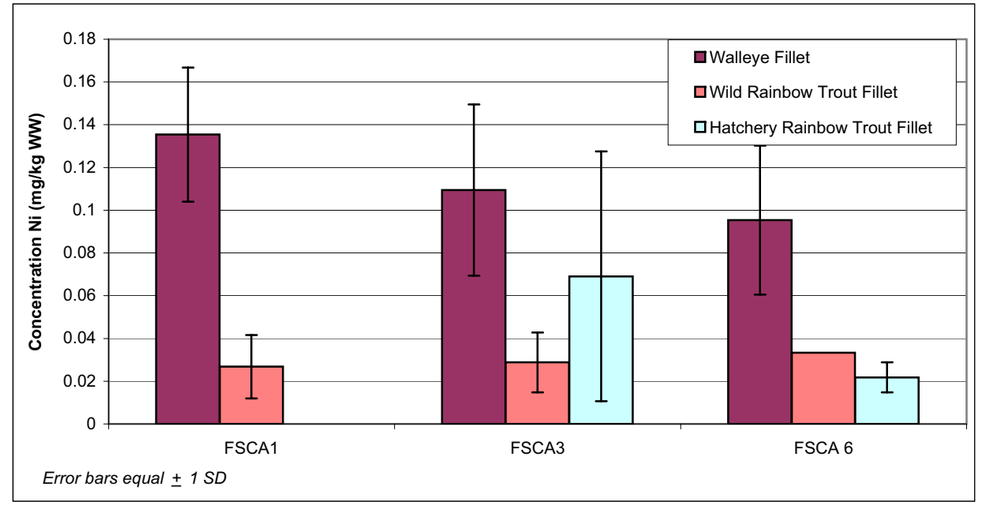



**Figure 3-57 Comparison of Nickel Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

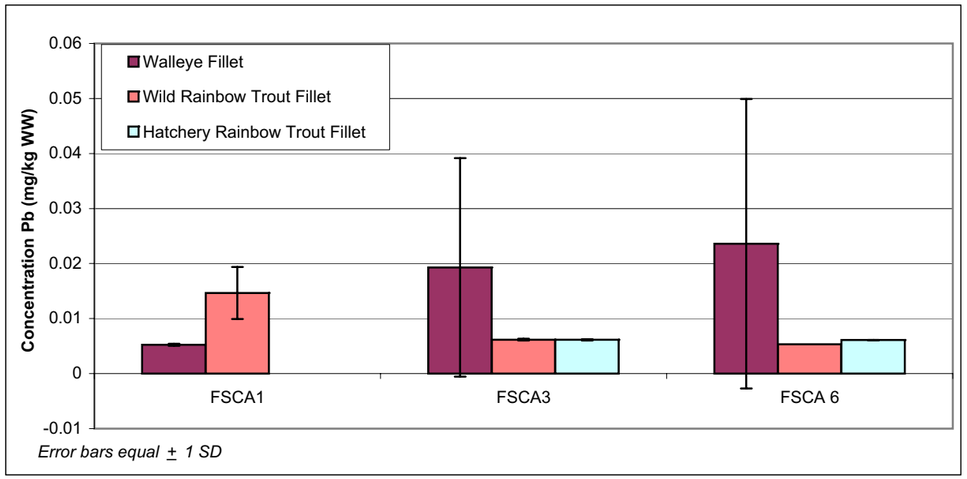



**Figure 3-58 Comparison of Lead Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

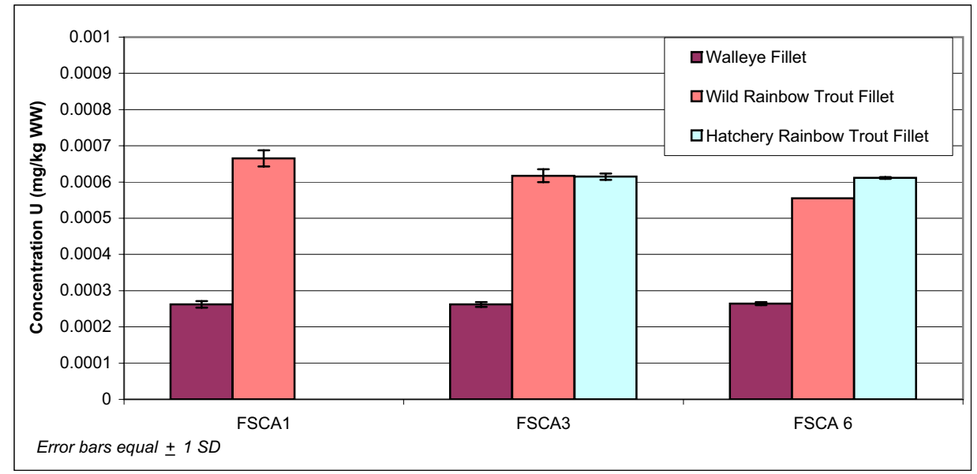



**Figure 3-60 Comparison of Uranium Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

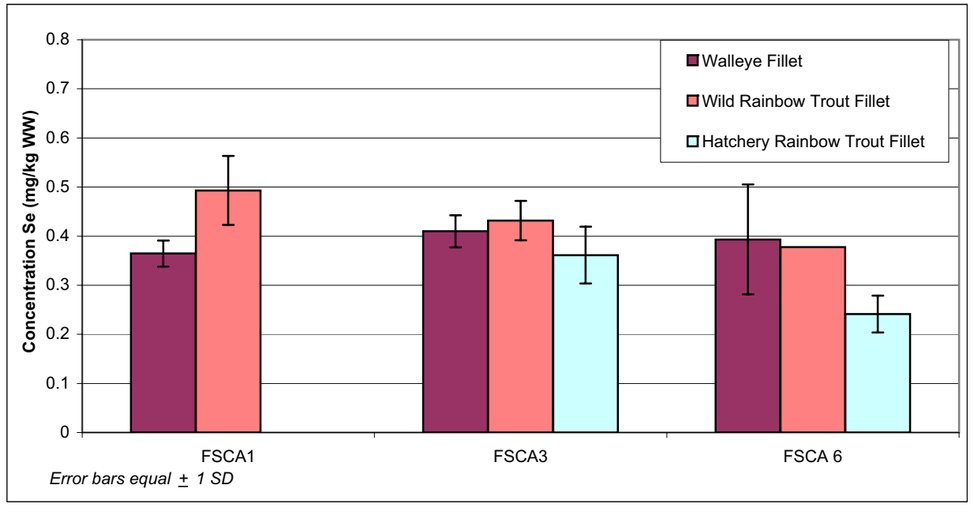



**Figure 3-59 Comparison of Selenium Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

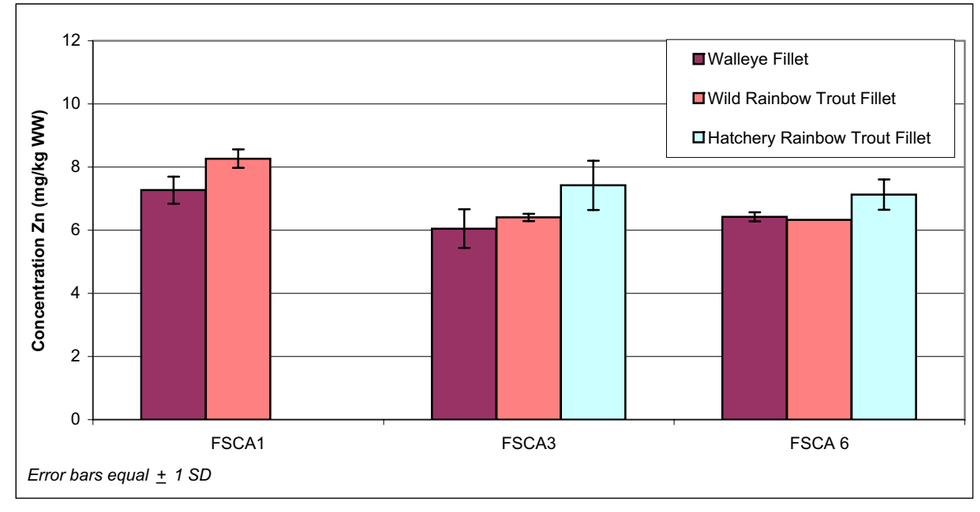



**Figure 3-61 Comparison of Zinc Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

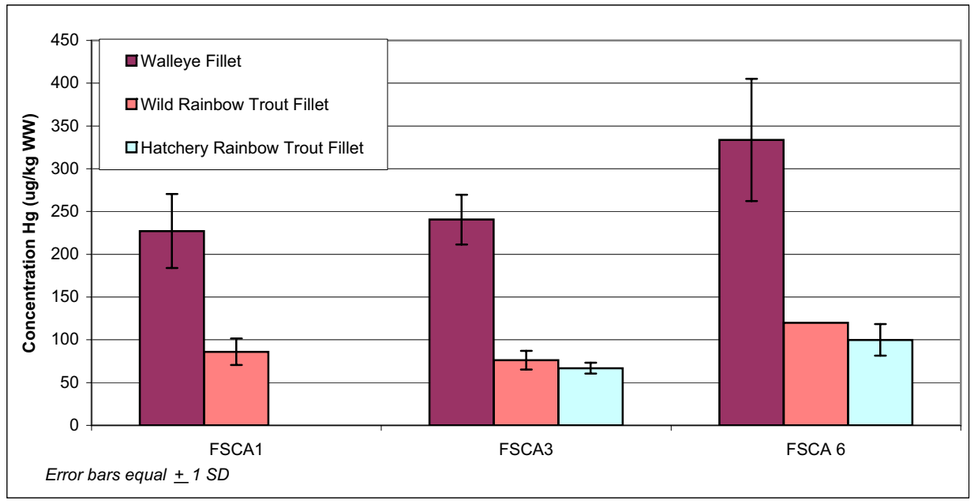



**Figure 3-62 Comparison of Mercury Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

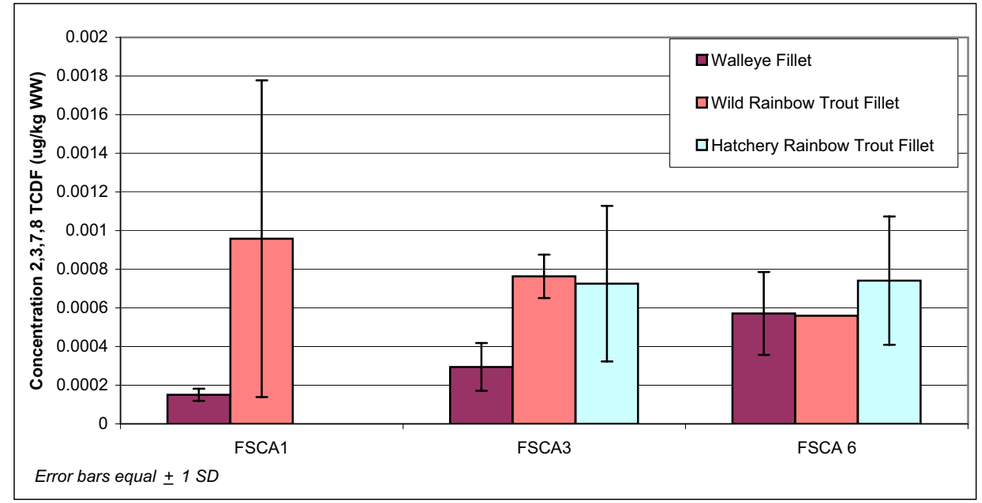



**Figure 3-64 Comparison of 2,3,7,8 TCDF Concentrations in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

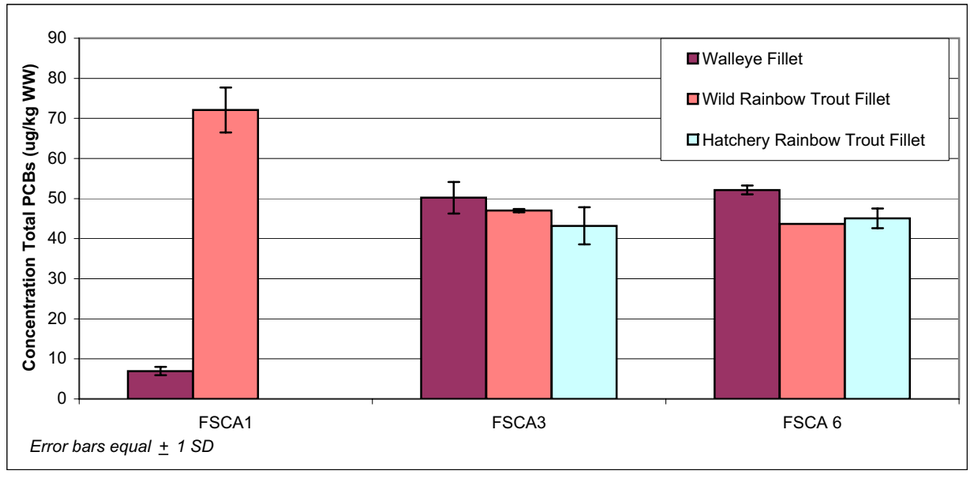
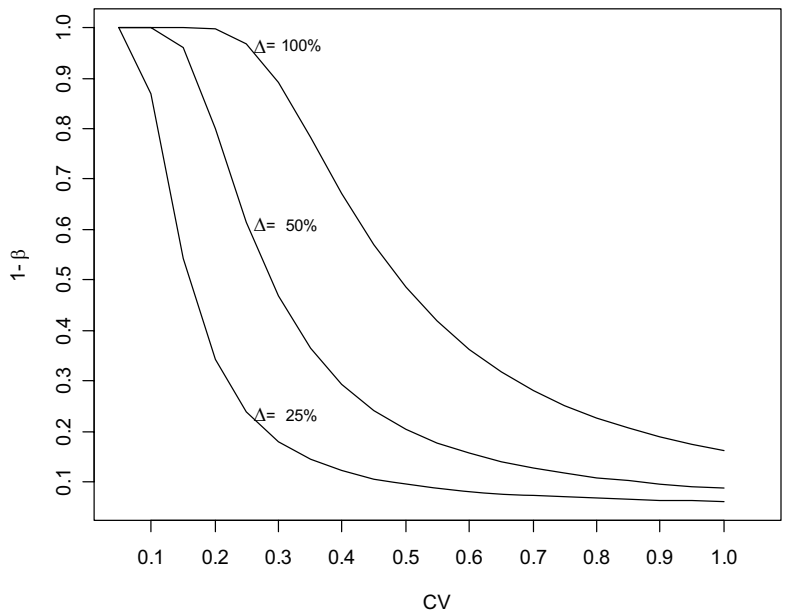


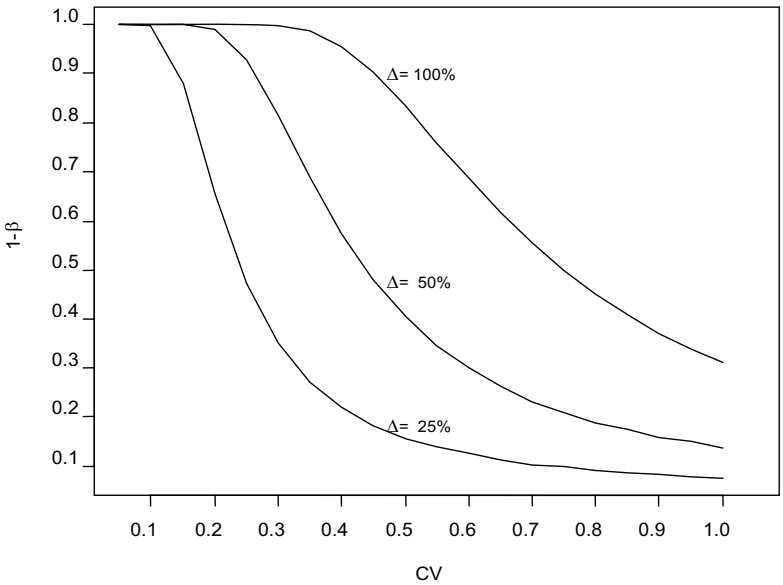

**Figure 3-63 Comparison of Total PCBs Concentrations as Aroclors in Fillet Samples from Walleye and Rainbow Trout by FSCA**
*Upper Columbia River RI/FS*

**FIGURE 3-65**
Statistical Power to Detect Increase or Decrease in Mean Concentration Between Composite Samples
*Upper Columbia River RI/FS*

a. $n$ = 5




b. $n$ = 10




Note: Graphs show statistical power $(1-\beta)$ to detect a relative increase of 25%, 50%, or 100% (or, equivalently a decrease of 20%, 33%, or 50%) in mean concentration at $\alpha$ = 0.05, two-tailed, as a function of the coefficient of variation (CV) between composite samples when sample sizes are (a) $n$ = 5, (b) $n$ = 10.

**FIGURE 3-66A**
Mean Aluminum Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*

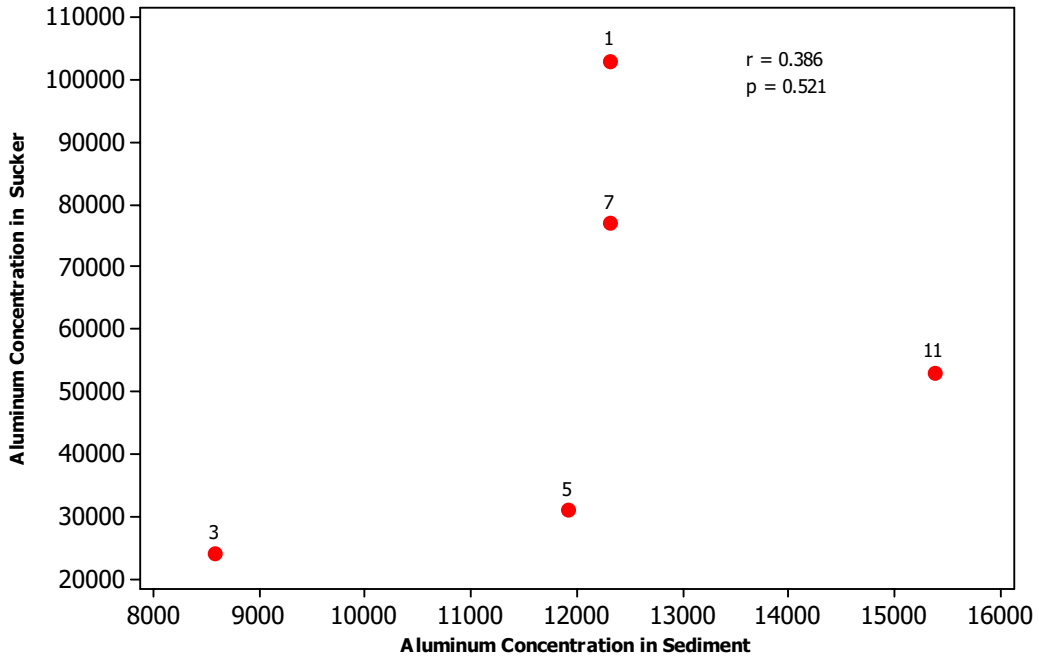



**FIGURE 3-66B**
Mean Aluminum Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*

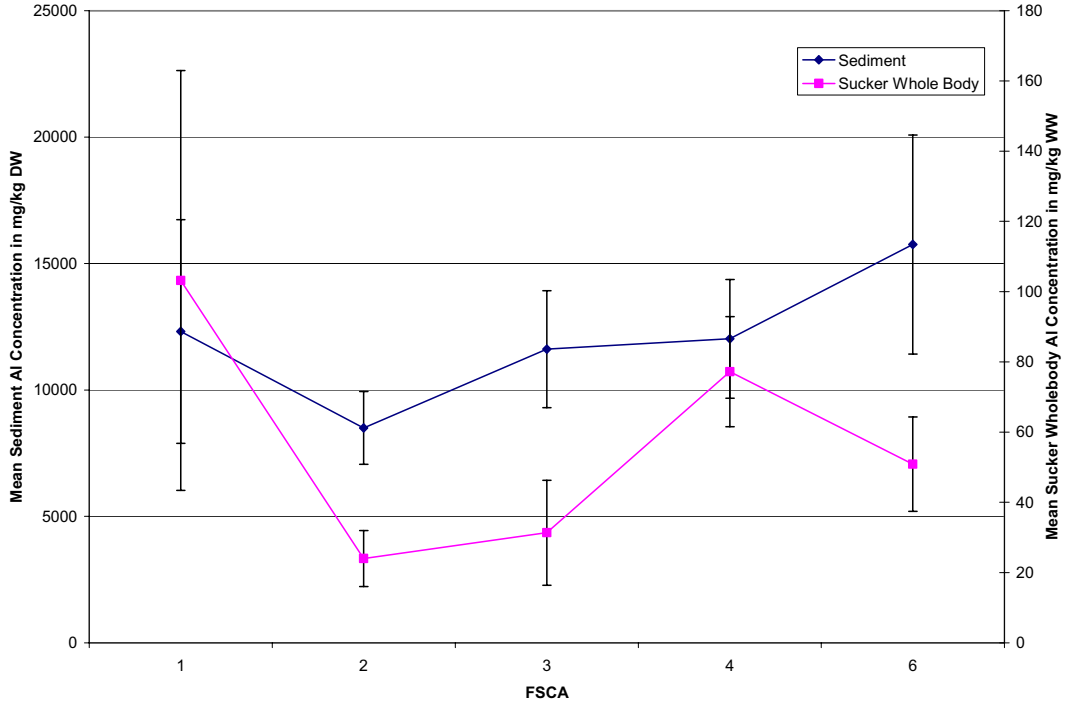


**FIGURE 3-67A**
Mean Arsenic Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in μg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*

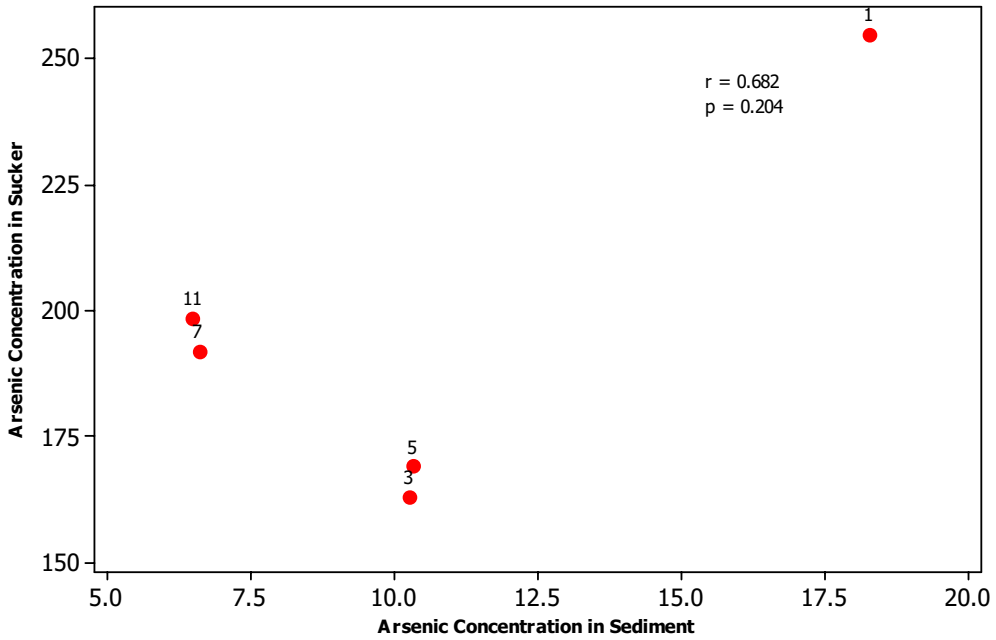



**FIGURE 3-67B**
Mean Arsenic Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*

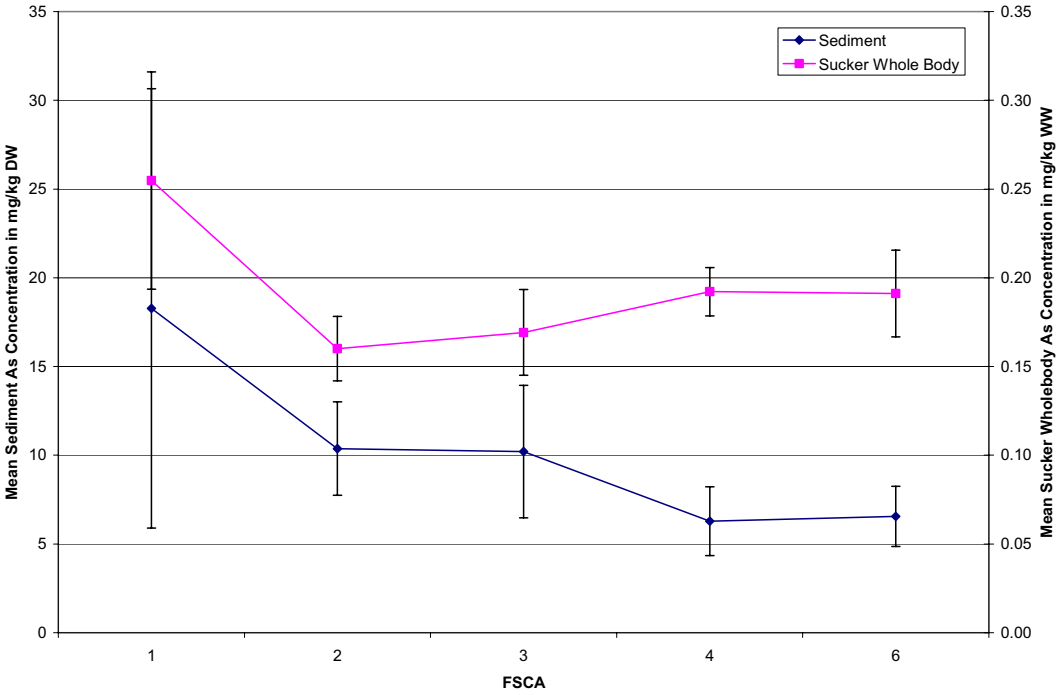


**FIGURE 3-68A**
Mean Barium Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*

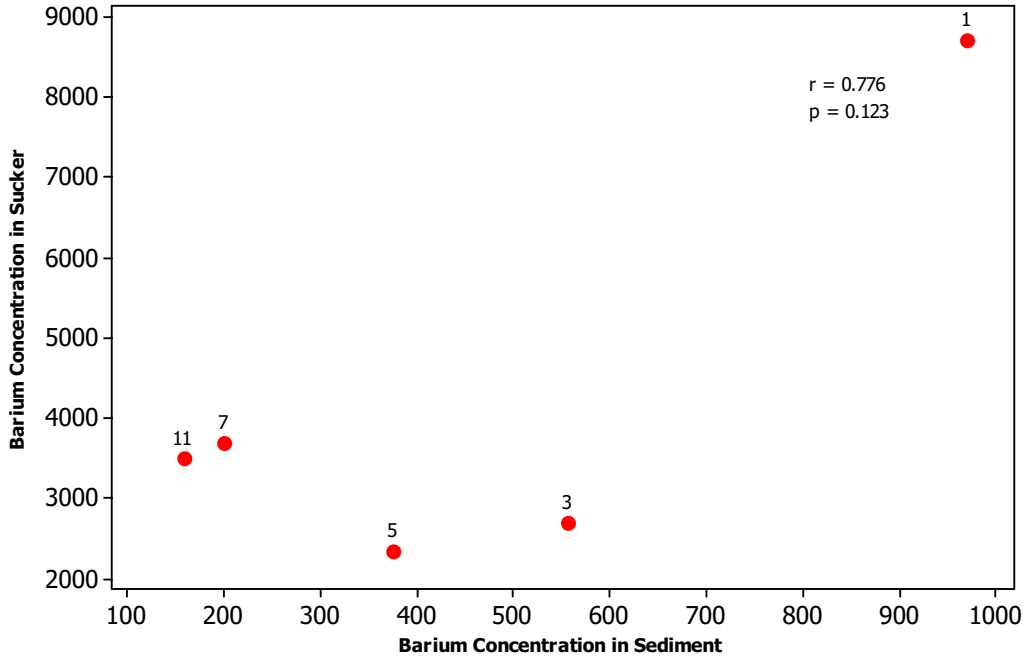



**FIGURE 3-68B**
Mean Barium Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*

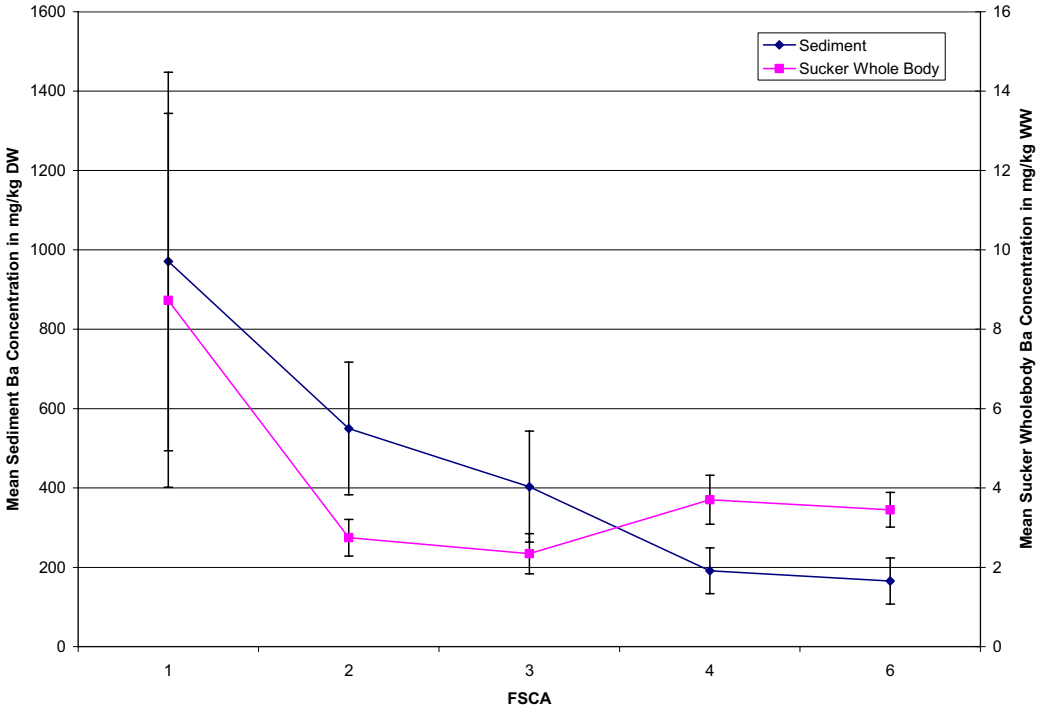


**FIGURE 3-69A**
Mean Cadmium Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*

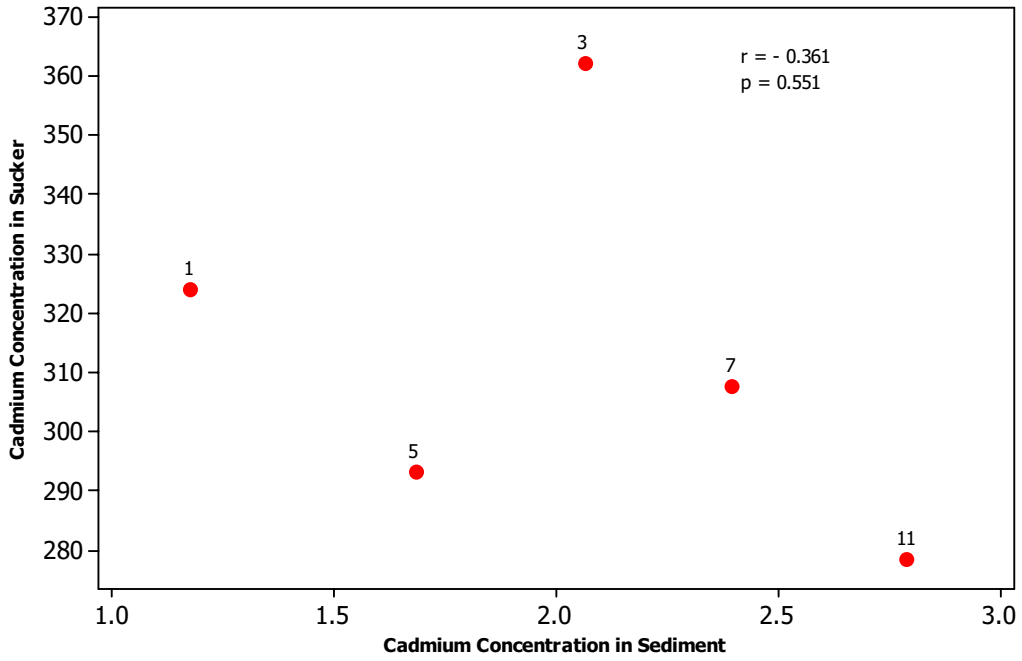



**FIGURE 3-69B**
Mean Cadmium Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*

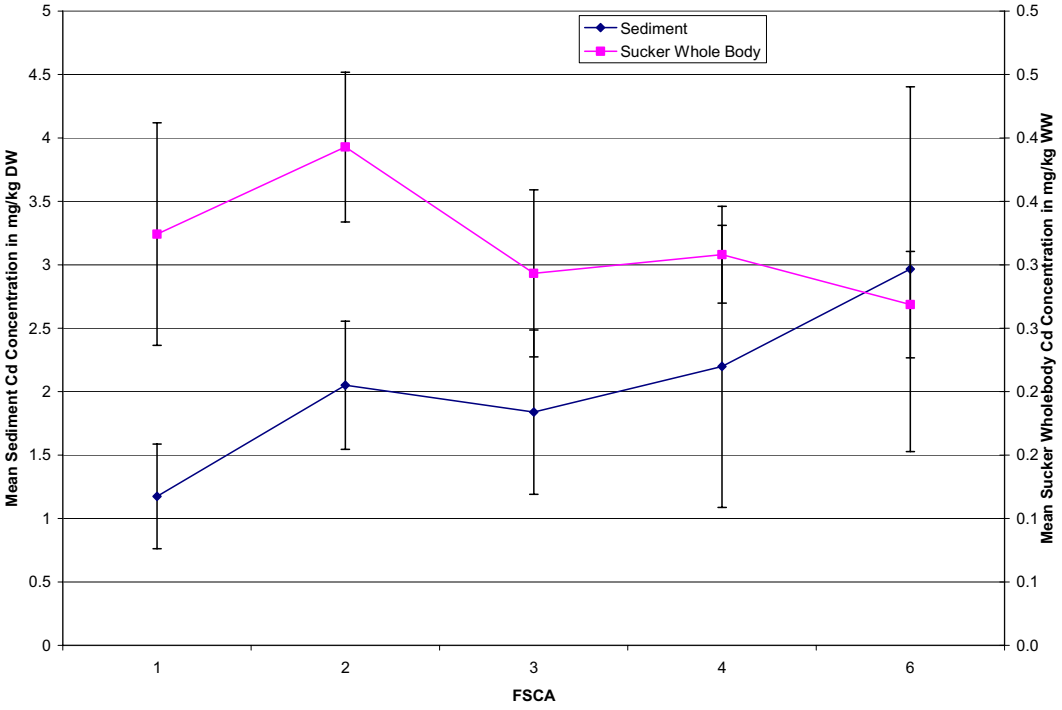


**FIGURE 3-70A**

Mean Chromium Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in μg/kg Wet Weight vs. Sediment in mg/kg Dry Weight

*Upper Columbia River RI/FS*

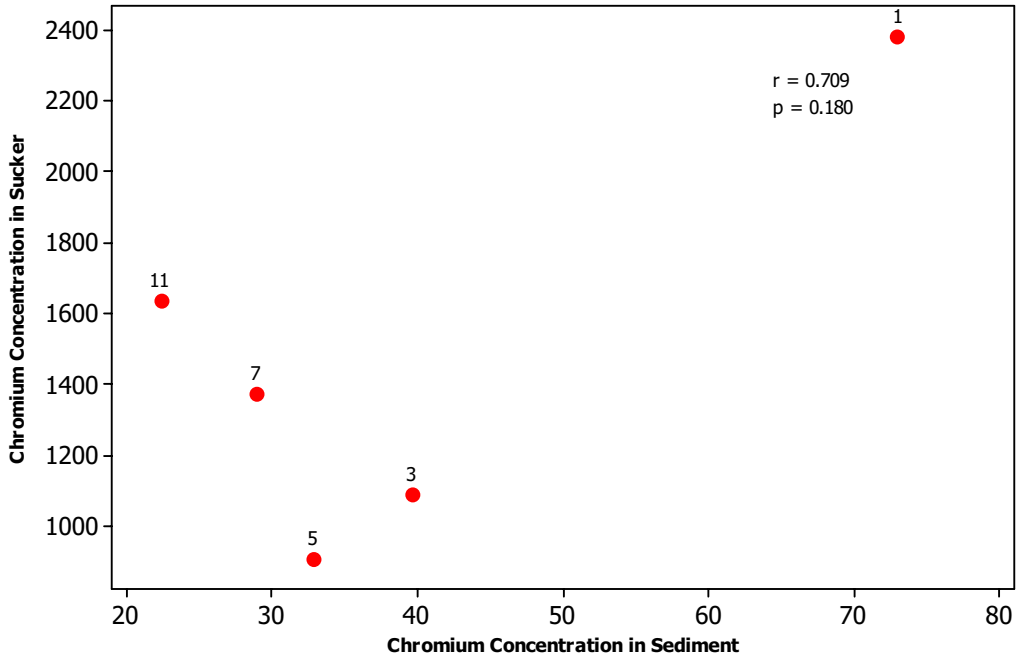



**FIGURE 70B**

Mean Chromium Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment

*Upper Columbia River RI/FS*

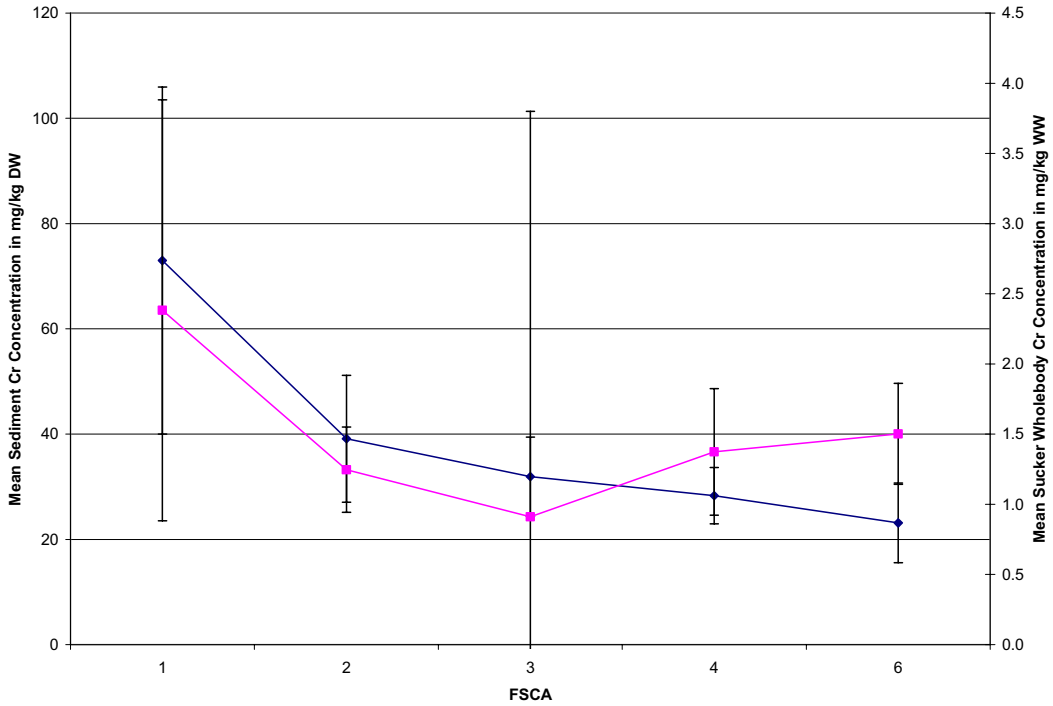


**FIGURE 3-71A**
Mean Copper Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*

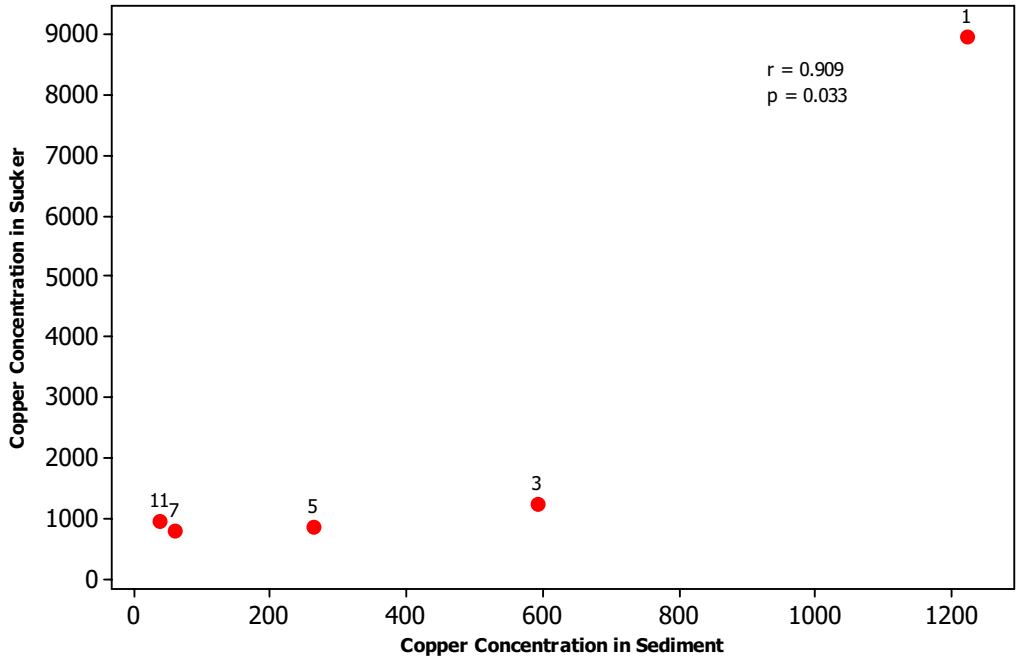



**FIGURE 3-71B**
Mean Copper Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*

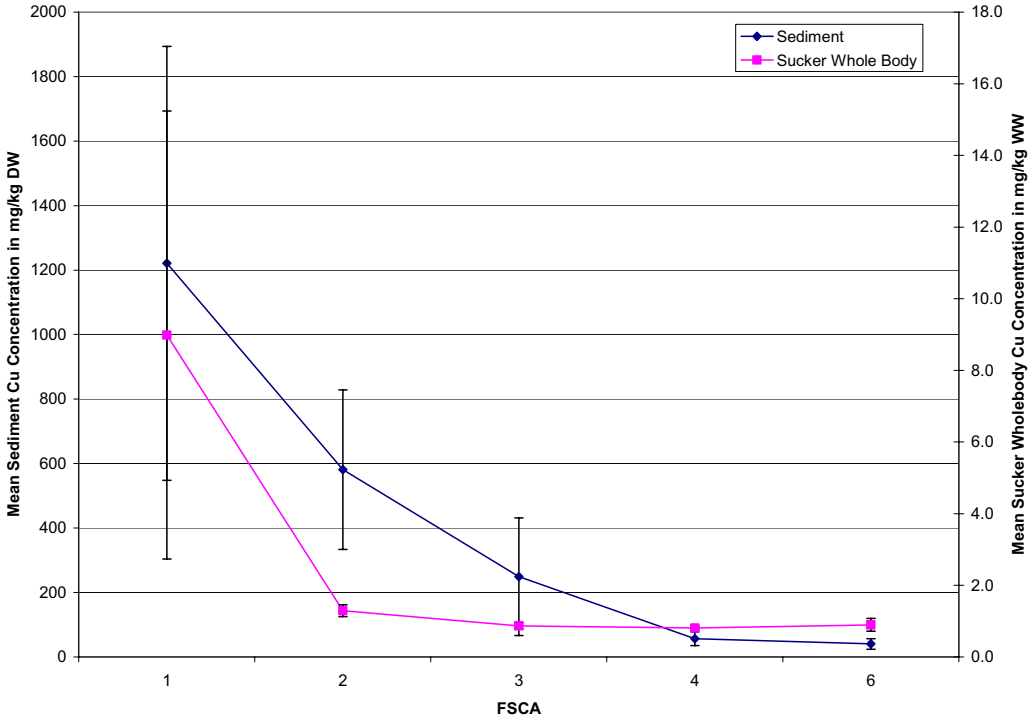


**FIGURE 3-72A**

Mean Iron Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight

*Upper Columbia River RI/FS*

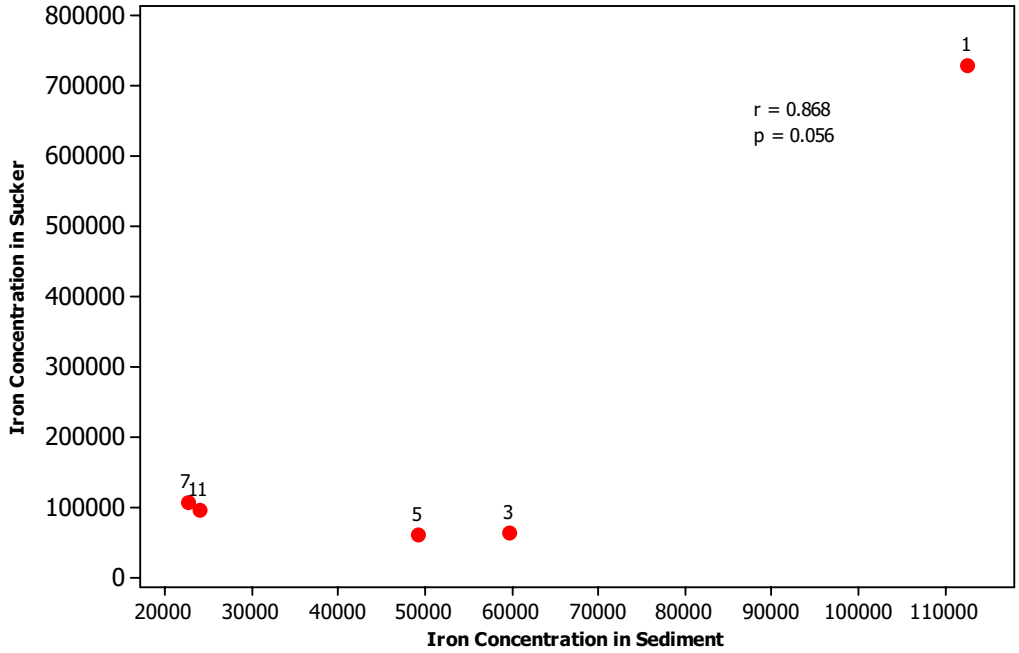



**FIGURE 3-72B**

Mean Iron Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment

*Upper Columbia River RI/FS*

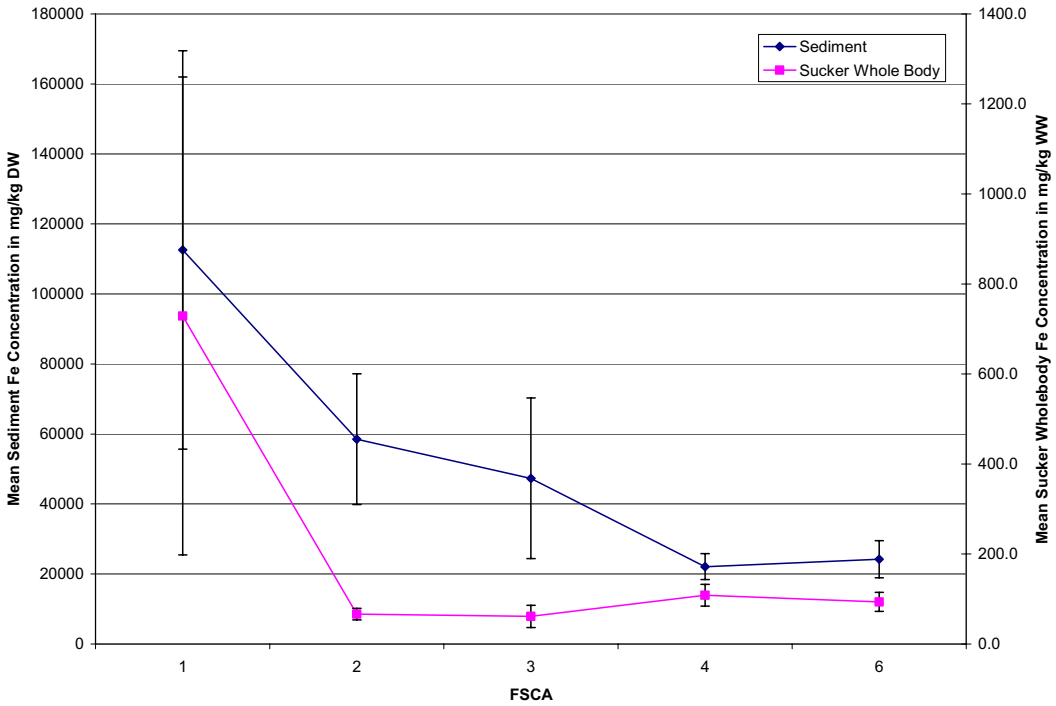


**FIGURE 3-73A**

Mean Mercury Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in μg/kg Wet Weight vs. Sediment in mg/kg Dry Weight

*Upper Columbia River RI/FS*

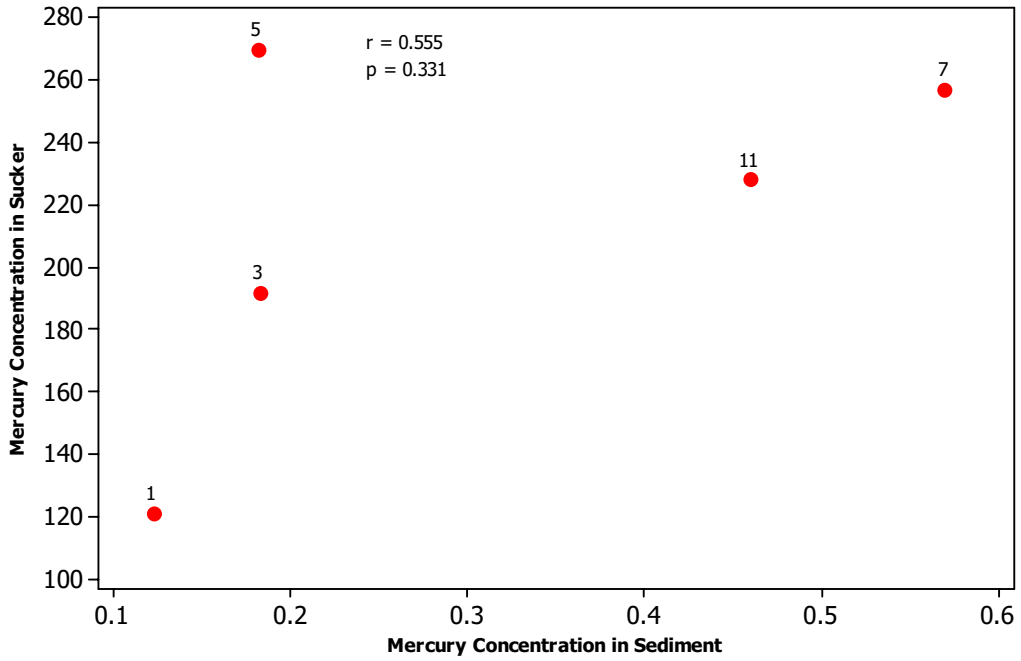



**FIGURE 3-73B**

Mean Mercury Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment

*Upper Columbia River RI/FS*

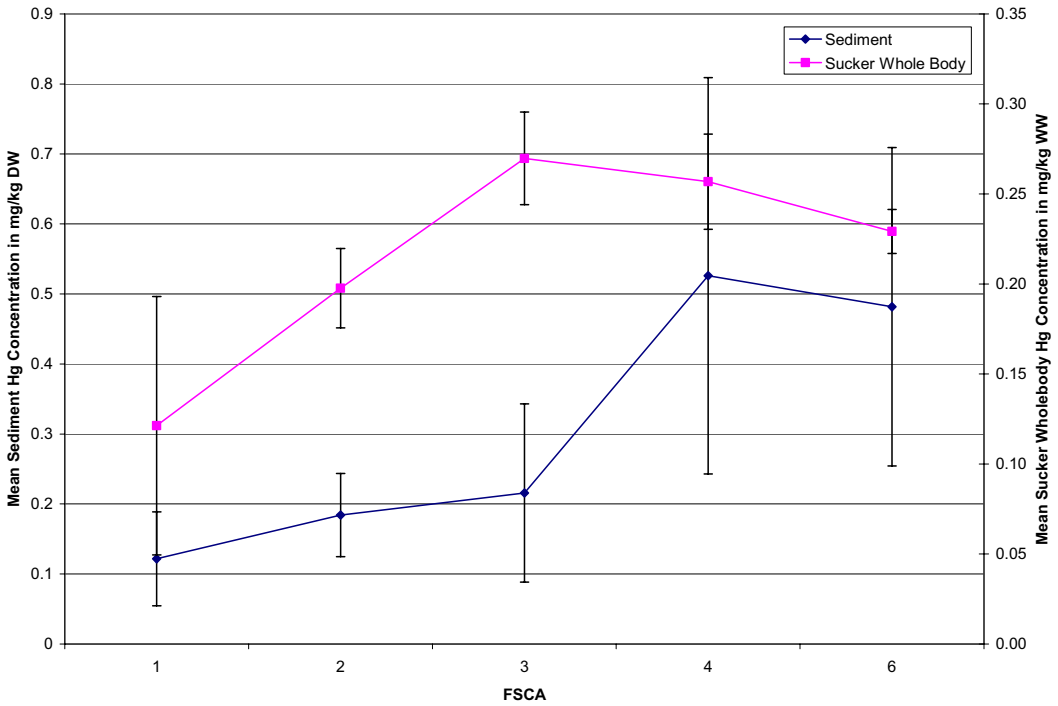


**FIGURE 3-74A**

Mean Nickel Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight

*Upper Columbia River RI/FS*

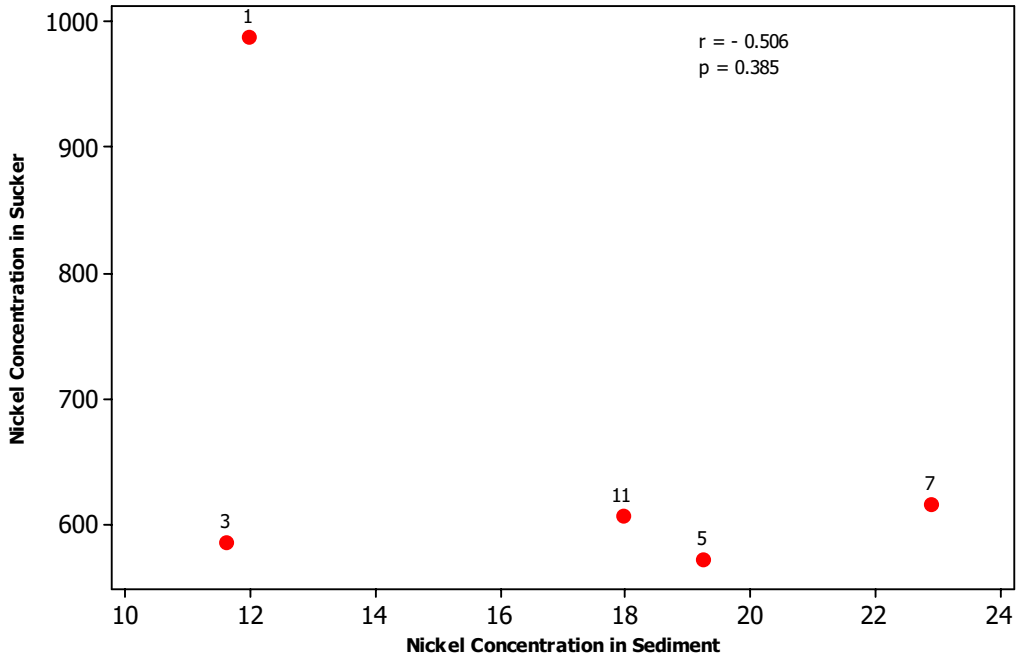



**FIGURE 3-74B**

Mean Nickel Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment

*Upper Columbia River RI/FS*

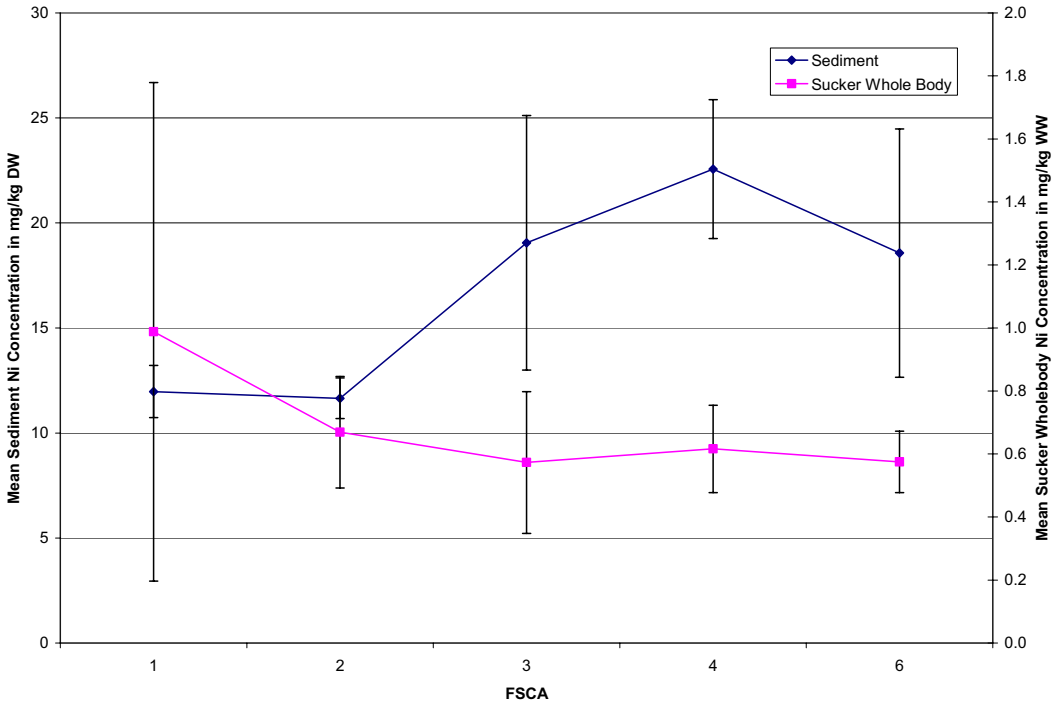


**FIGURE 3-75A**

Mean Lead Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight

*Upper Columbia River RI/FS*

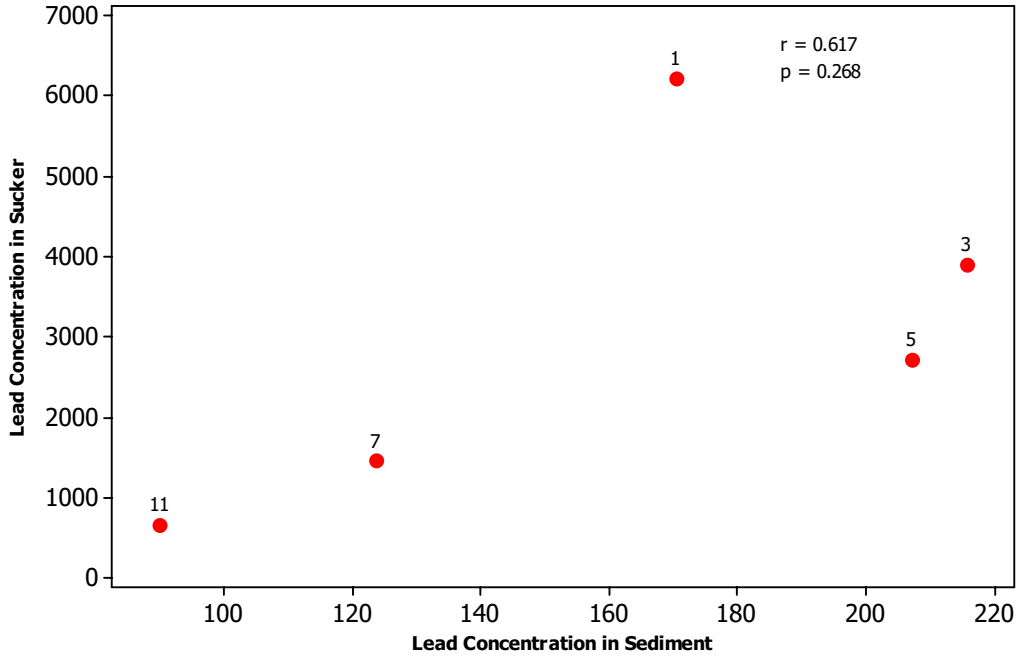



**FIGURE 3-75B**

Mean Lead Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment

*Upper Columbia River RI/FS*

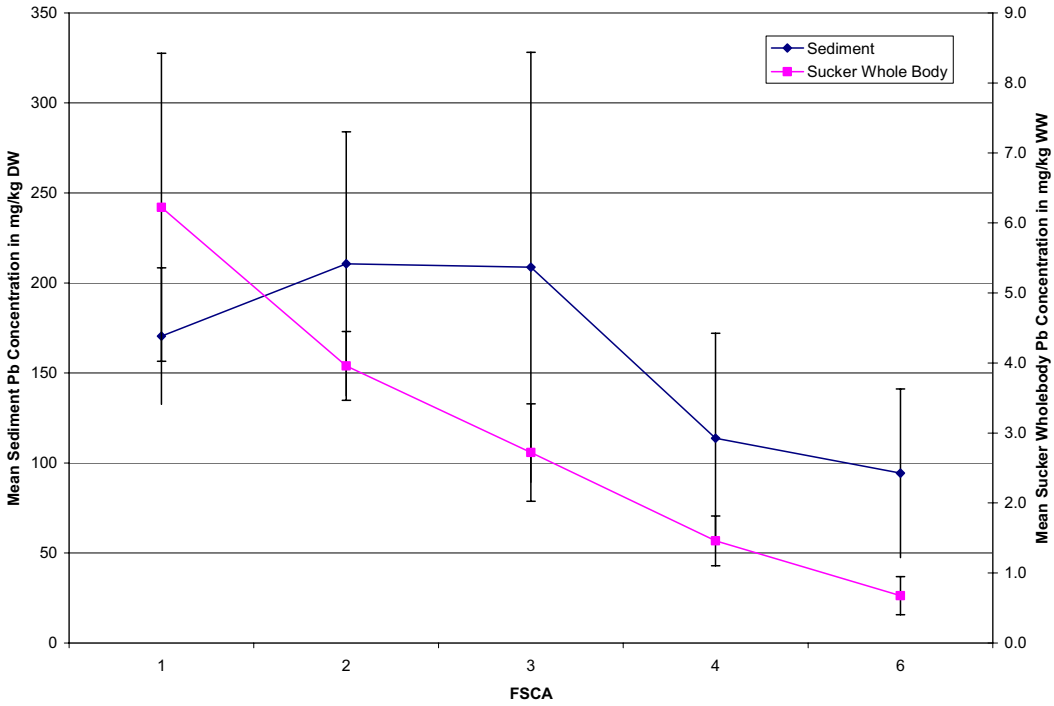


**FIGURE 3-76A**
Mean Selenium Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*

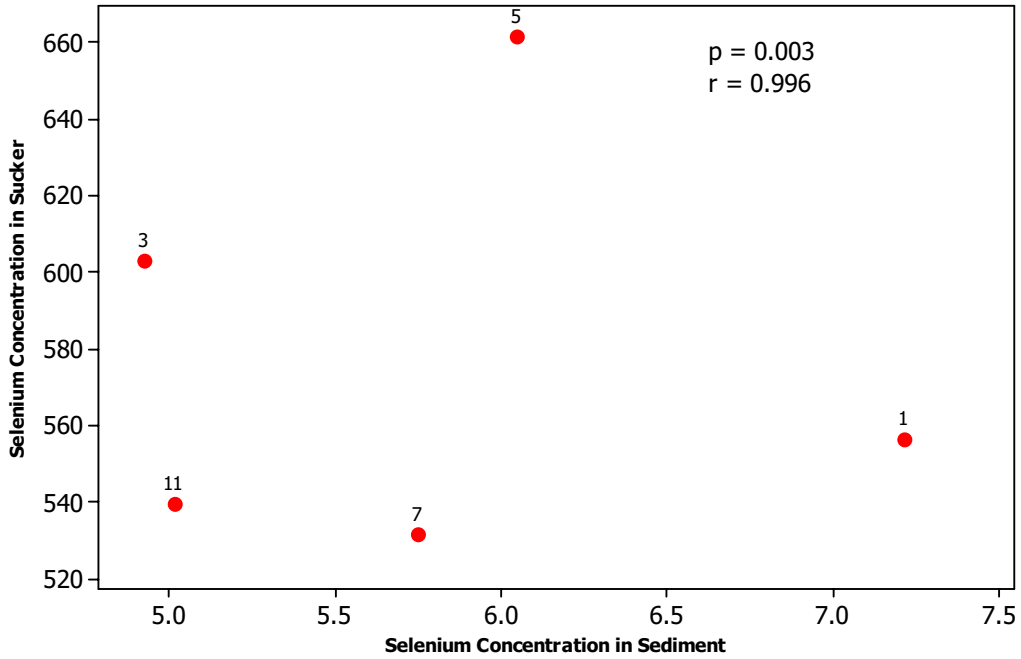



**FIGURE 3-76B**
Mean Selenium Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*

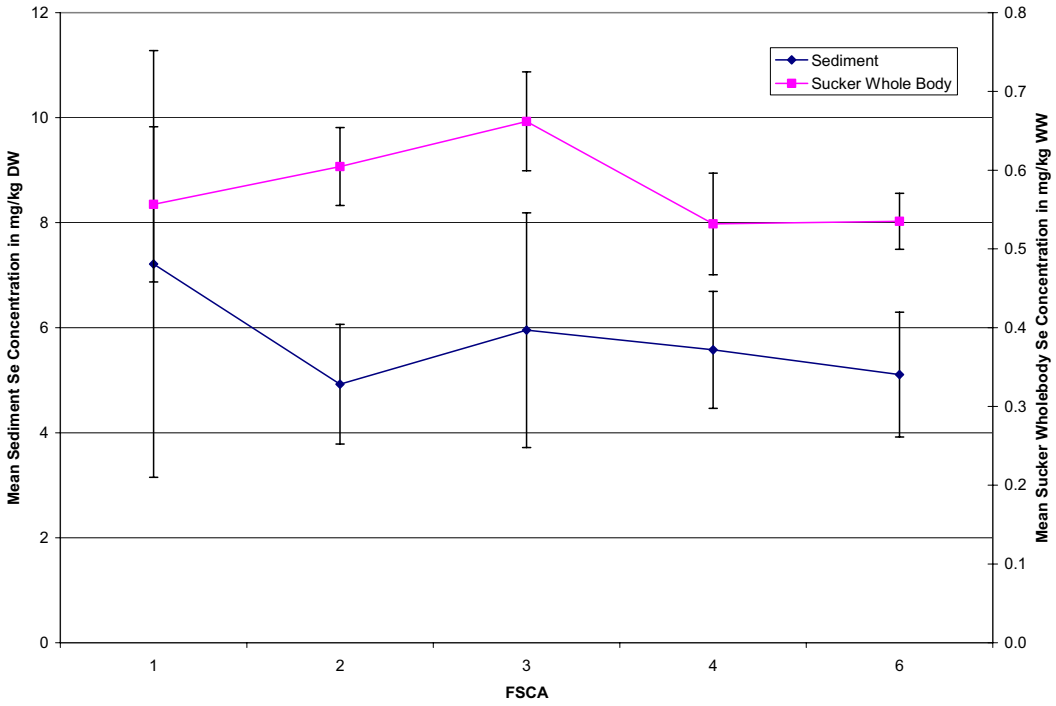


**FIGURE 3-77A**

Mean Uranium Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight

*Upper Columbia River RI/FS*

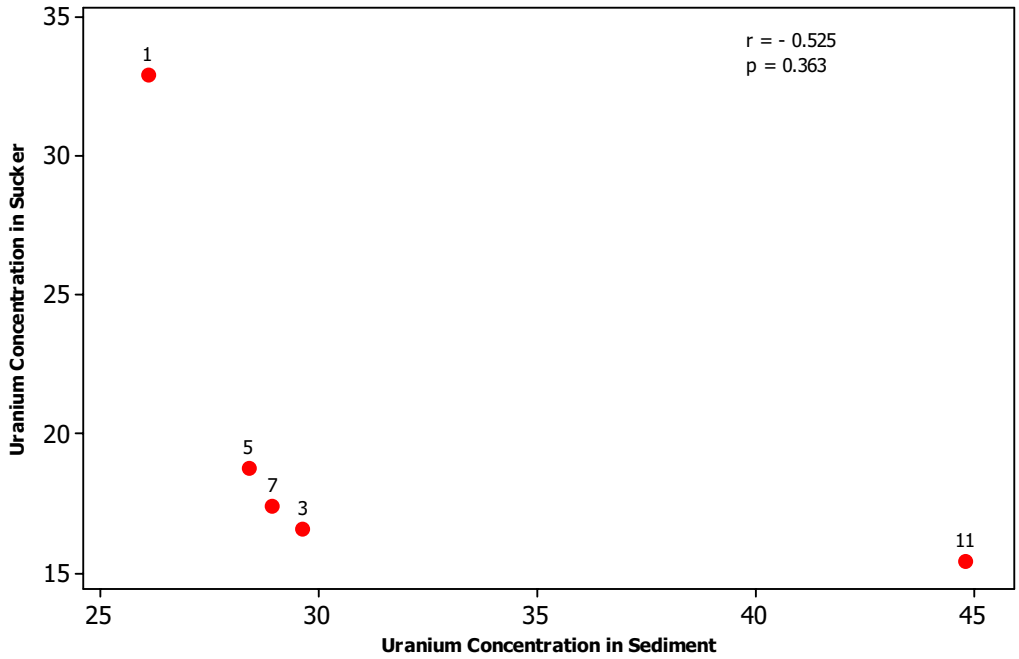



**FIGURE 3-77B**

Mean Uranium Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment

*Upper Columbia River RI/FS*

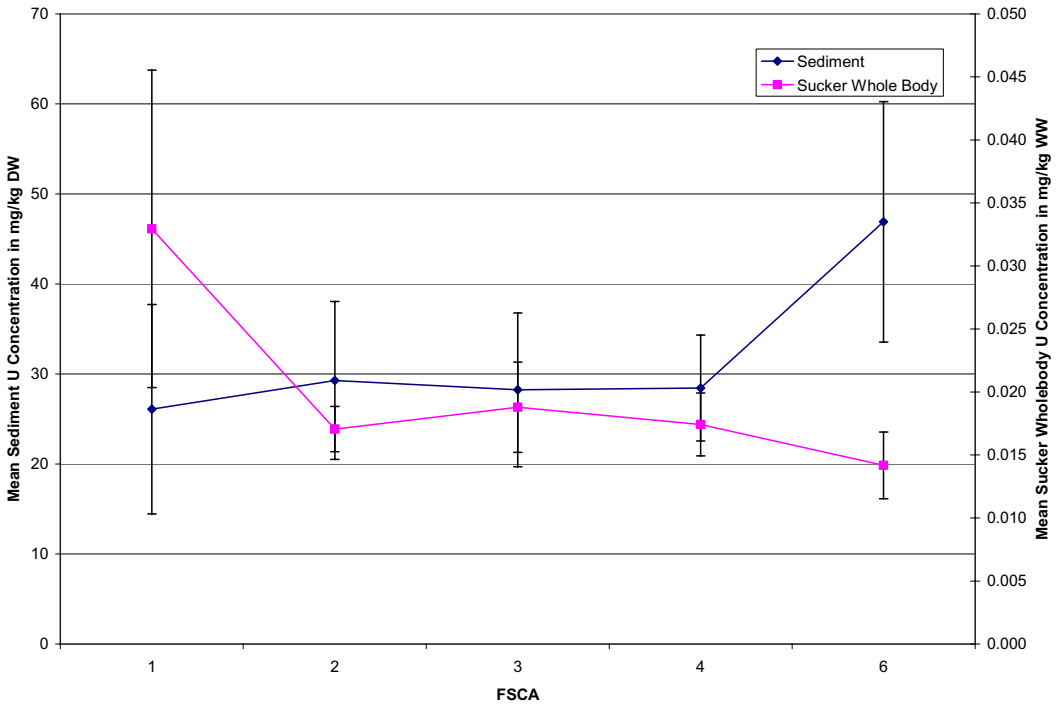
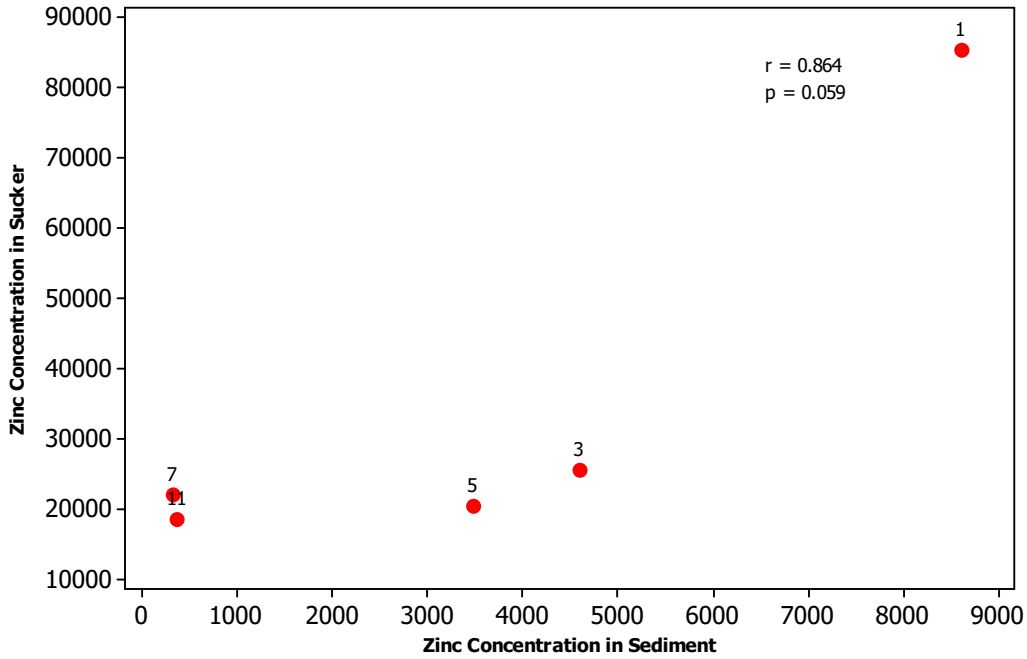


**FIGURE 3-78A**
Mean Zinc Concentration Comparison by Sediment Focus Area (1, 3, 5, 7, 11) — Largescale Sucker in µg/kg Wet Weight vs. Sediment in mg/kg Dry Weight
*Upper Columbia River RI/FS*



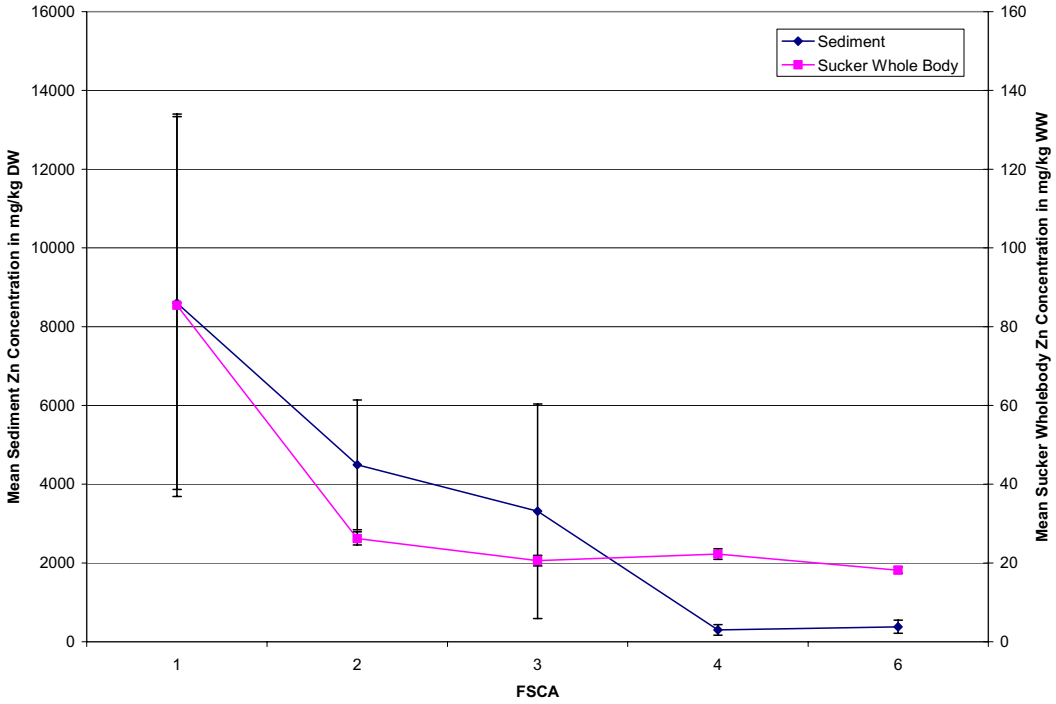


**FIGURE 3-78B**
Mean Zinc Concentration with Associated Asymptotic 95% Confidence Intervals — Largescale Sucker and Sediment
*Upper Columbia River RI/FS*