USGS
science for a changing world

Prepared in cooperation with the Missouri Department of Conservation

Concentration of Elements in Hellbender Blood and Fish Fillets from the 2006 Missouri Department of Conservation Monitoring Programs

Open-File Report 07–1229

U.S. Department of the Interior
U.S. Geological Survey

Concentration of Elements in Hellbender Blood and Fish Fillets from the 2006 Missouri Department of Conservation Monitoring Programs

By Thomas W. May, Michael J. Walther, William G. Brumbaugh, Jeffrey T. Briggler[1], Yue-wern Huang[2], and Michael J. McKee[1]

[1]Missouri Department of Conservatiom
[2]University of Missouri–Rolla

Prepared in cooperation with the Missouri Department of Conservation

Open-File Report 2007-1229

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director

U.S. Geological Survey, Reston, Virginia: 2007

For product and ordering information:
World Wide Web: http://www.usgs.gov/pubprod
Telephone: 1-888-ASK-USGS

For more information on the USGS--the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:
World Wide Web: http://www.usgs.gov
Telephone: 1-888-ASK-USGS

Suggested citation:
May, T.W., Walther, M.J., Brumbaugh, W.G., Briggler, J.T., Huang, Yue-wern, and McKee, M.J., 2007, Concentrations of elements in hellbender blood and fish fillets from the 2006 Missouri Department of Conservation monitoring programs: U.S. Geological Survey Open-File Report 2007–1229, 18 p.

Contents

Tables

Conversion Factors and Datum

Multiply	By	To obtain
	Length	
millimeter)	0.03937	inch (in.)
micrometer (μm)	0.0000393	inch (in.)
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
milliliter (mL)	0.034	ounce, fluid (fl. oz)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)
milligram (mg)	0.000035	ounce (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\ °C)+32$$

Concentrations of chemical constituents in water are given in milligrams per liter (mg/L).

Concentrations of chemical constituents in solid materials are given in micrograms per gram (μg/g).

Concentrations of Elements in Hellbender Blood and Fish Fillets from the Missouri Department of Conservation Monitoring Programs

By Thomas W. May, Michael J. Walther, and William G. Brumbaugh, Jeffrey T. Briggler[1], Yue-wern Huang[2], and Michael J. McKee[1]

Abstract

This report presents the results of contaminant monitoring surveys conducted annually by the Missouri Department of Conservation to examine the levels of selected elemental contaminants in hellbender (*Cryptobranchus alleganiensis*) blood and fish. Catfish (*Ictalurus furcatus, Ictalurus punctatus, Pylodictis olivaris*), redhorse (*Moxostoma anisorum, Moxostoma erythrurum*), bass (*Micropterus salmoides, Micropterus punctulatus, Micropterus lacepède, Ambloplites rupestris*), walleye (*Sander vitreus*), and sunfish (*Lepomis megalotis*) were collected from 17 sites as part of the Department's General Contaminant Monitoring Program. Bluegill (*Lepomis macrochirus*) and other sunfish (*Lepomis megalotis, Lepomis cyanellus*) were collected from 18 sites as part of the Department's Resource Assessment and Monitoring Program. Blood from hellbenders was collected from seven sites as part of the Department's Hellbender Monitoring Program.

Introduction

The Missouri Department of Conservation (MDC) initiated long-term statewide fish monitoring programs in 1984. The programs' designs are to annually select predator and bottom dwelling species from each of 20–30 lakes and streams across Missouri to characterize concentrations of targeted metal and other chemical contaminants. Actual sites monitored each year vary based on data needs, budgets, and personnel resources. Emphasis is on human health and, therefore, incorporates fish fillets, composite samples, and sample replication at each site. In 2006, 17 sites were selected for sampling as part of the MDC General Contaminant Monitoring (GCM) Program. Predator and bottom dwelling species were selected based on the need for specific mercury information (walleye, *Sander vitreus*; flathead catfish, *Pylodictis olivaris*; various bass species, *Micropterus salmoides, Micropterus punctulatus, Micropterus lacepède, Ambloplites rupestris*), having a propensity to accumulate lead (Pb), or the potentially greater risk for consumption (large river catfish, *Ictalurus Furcatus, Ictalurus Punctatus, Pylodictis Olivaris*). In addition to the GCM samples, blood samples were collected from hellbenders (*Cryptobranchus alleganiensis*) from seven sites in the Missouri Ozarks as part of the MDC Resource Science Division's Hellbender Monitoring Program (HMP). Finally, bluegill (*Lepomis macrochirus*) and other sunfish (*Lepomis megalotis, Lepomis cyanellus*) were collected from 18 small wadeable stream sites as part of the MDC Resource Assessment and Monitoring Program (RAM), which consisted of fillets from three fish collected at each site. MDC has requested the assistance of the USGS Columbia Environmental Research Center (CERC) for this monitoring program because of CERC's past experience with aquatic biota monitoring projects and expertise in the preparation and analysis of fish for elemental contaminants. For more detailed information on the overall study design or specific sample information, please contact Jeff T. Briggler (Hellbenders) or Mike McKee (other MDC samples) at the Missouri Department of Conservation.

Sampling History

A shipment of 90 fish fillet composites was received by CERC's Inorganic Section on November 17, 2006. The samples included skin-on and skinless fillets, depending upon species. Upon receipt, the shipment was assigned CERC batch #1316 and sample identifications (IDs) 38400–38489. A second shipment of 52 skinless fish fillets, 3 fillets per site, was received on November 17, 2006, and assigned CERC batch #1317 and sample IDs 38490–38541. A third shipment consisting of 56 samples of hellbender blood was received on November 17, 2006. These samples were assigned CERC batch #1318 and sample IDs 38542–38597. All samples had been stored since collection at the MDC's Resource Science Center in Columbia, Mo. and were delivered by MDC personnel. Requested analyses included cadmium (Cd), mercury

[1]Missouri Department of Conservation.

[2]University of Missouri–Rolla.

(Hg), and lead (Pb) for the GCM samples (shipment 1), zinc (Zn), Cd, and Pb for the RAM samples (shipment 2), and cobalt (Co), chromium (Cr), Cd, Hg, and Pb for the HMP samples (shipment 3). Because fish fillet samples were highly variable in the way they were extracted and, thus, may have varying amounts of calcium-rich bone fragments that can be comparatively high in Pb, calcium (Ca) was added to the list of requested elements as a potential means to help explain Pb variability (Schmitt and Finger, 1987).

Methods

Homogenization and Lyophilization

GCM fillet samples were chopped with a titanium meat cleaver on a cleaned polypropylene cutting board. Larger fillets were ground with a Hobart© meat grinder, whereas, smaller fillets were ground in a modified KitchenAid© meat grinder. The smallest mass samples were simply minced with a ceramic knife. All chopped and ground samples then were lyophilized followed by either hand kneading in a plastic (polyethylene) bag or crushing with a rolling pin in a plastic bag. All dried and ground products were stored at room temperature in a 40-milliliter (mL) glass vial in a desiccator.

RAM samples were received in the form of single fillets per sample. Each sample was minced with a ceramic knife. An aliquot of the minced material less than (<) 30 grams (g) was lyophilized to a constant dry weight using a Genesis© 35EL lyophilizer; percent moisture was determined in conjunction with the lyophilization process. After drying, fillet samples were reduced to a coarse powder by crushing with a glass rod. All dried and ground products were stored at room temperature in a 40-mL glass vial in a desiccator.

Chemical Preparation

To prepare fish samples for Ca, Zn, Cd, and Pb analysis, a dried sample (about or approximately 0.25 g) was heated with 6-mL nitric acid in a sealed low-pressure Teflon® vessel in a laboratory microwave oven. The cooled digestate liquid was transferred into a 125-mL polyethylene bottle with ultrapure water [greater than (>) 10 megOhms per centimeter (megOhm/cm)] and diluted to a final weight of 101.5 g. Final acid matrix was 6 percent nitric acid. For the determination of Hg in fish samples, there was no chemical preparation (digestion) because the dried sample was decomposed thermally during instrumental analysis (see below). The lyophilized hellbender blood samples were digested for analysis by quantitative inductively coupled plasma-mass spectrometry (ICP-MS). A 20- to 50-milligram (mg) subsample of each hellbender blood sample was weighed into a 10-mL Teflon®-lined, screw-cap borosilicate test tube and 0.5 mL sub-boiled nitric acid was added. After a 1-hour pre-digestion at room temperature, the tube was sealed and placed in a hot-block heater at 110 degrees Celsius for 30 minutes. The tube was cooled for 10 minutes, 0.2 mL high-purity hydrogen peroxide was added, and the tube was returned to the hot-block heater for 30 minutes. After cooling, the sample was diluted to a final volume of 5 mL. Final acid matrix was 10 percent nitric acid.

Instrumental Analysis

Calcium, Cr, Co, Zn, Cd, and Pb analyses were conducted using a PE/SCIEX Elan 6000© ICP-MS, which was set up in "Standard Mode" and optimized according to the manufacturer's specifications. Samples were automatically delivered to the ICP-MS by means of a software-controlled CETAC ASD-500 autosampler/autodiluter system. All sample digestates were analyzed with a ten-fold (10X) predilution by autodiluter.

The ICP-MS quantitative method was designed to determine the following masses: ^{44}Ca and ^{48}Ca, ^{52}Cr and ^{53}Cr, ^{59}Co, ^{66}Zn and ^{68}Zn, ^{111}Cd and ^{114}Cd, and Pb as the sum of three masses (^{206}Pb+^{207}Pb+^{208}Pb). The internal standards were Sc at 10 nanograms per milliliter (ng/mL), Rh (10 ng/mL), and Bi (10 ng/mL), which were metered into the sample line via peristaltic pump. Calibration standards for analyses were as follows: Ca—2,500, 5,000, and 10,000 ng/mL; Co, Cr, and Pb—5, 10, 20, 40 ng/mL; Cd—1.5, 3.0, 6.0, 12 ng/mL; Zn—75, 150, 300 ng/mL. During the actual analysis, any digestate concentration greater than the upper calibration standard for any element was automatically diluted 10 times in a serial fashion until its concentration was below this level. Where multiple masses for an element were measured, the concentration reported was based on the mass exhibiting least interferences, which were as follows: ^{44}Ca, ^{53}Cr, ^{66}Zn, ^{114}Cd (five instances) and ^{111}Cd (one instance), and Pb as the sum of three masses ^{206}Pb+^{207}Pb+^{208}Pb).

Mercury was determined with a Milestone DMA-80 analyzer equipped with an automated sample carousel. With this method, a dried fish sample (40–60 mg) was combusted in a stream of oxygen. All Hg in the sample was volatilized and trapped by amalgamation on a gold substrate and was thermally desorbed and quantitated by atomic absorption spectrophotometry (United States Environmental Protection Agency, 1998).

Quality Control

The samples were digested and analyzed in seven groups or batches for Ca, Cd, and Pb, and eight batches for Hg. The quality control incorporated in the digestion stage of the samples (for subsequent ICP-MS analysis) included digestion blanks, reference materials, replicates, and spikes. For the determination of Ca, Co, Cr, Zn, Cd, and Pb by ICP-MS, instrumental quality control included calibration checks, laboratory control solutions, duplicate digestate analysis,

analysis spikes, and interference checks (dilution percent difference and a synthetic interference solution). Quality control for Hg included blanks, independent calibration verification checks, replicates, pre-combustion spikes, and tissue reference materials. All quality control results were tabulated to provide an overview of quality assurance and to facilitate interpretation.

Results

Percent moisture, concentrations in micrograms per gram (µg/g) dry weight of Ca, Cd, Hg, and Pb, and molar ratios of [Pb/Ca] (1×10^{-6}) for the GCM samples are presented in table 1. To facilitate comparison with any regulatory guidelines, concentrations of Ca, Cd, Hg and Pb are presented in µg/g wet weight in table 2. Similarly, percent moisture, concentrations (µg/g dry weight) of Ca, Zn, Cd, Hg, and Pb, and molar ratios of [Pb/Ca] (1×10^{-6}) for the RAM samples are presented in table 3, and wet weight concentrations are presented in table 4. Percent moisture and concentrations (µg/g dry weight) of Cr, Co, Cd, Hg, and Pb in hellbender blood from the HMP are presented in table 5. For this report all sample and quality control data are discussed in terms of the dry weight results only.

GCM: Calcium concentrations were variable among fillet samples, but within each species differences were generally within a factor of 2 (table 1). Such variation was presumably because of differing bone content in the fillets and was undoubtedly influenced by significant variations in fillet preparation techniques as well as by the fish species (such as catostomids, or sucker fish, possess numerous tiny intermuscular bones). Fillets from some species contained noticeably higher Ca concentrations than other, for example, longear sunfish compared to walleye. Although Ca is normally not a target analyte, fillet Ca concentrations are useful when target analytes include those that markedly accumulate in bone, for example, Pb. Thus, measurements of Ca can serve to help explain variability of Pb concentrations for individual samples caused by the inclusion of variable amounts of Ca-rich tissue in the sample [1]. Cadmium concentrations (µg/g dry weight) were less than 0.050 in most samples, with many samples having concentrations less than method quantitation and method detection limits. Two of the highest Cd concentrations were from a flathead catfish sample (#38439; 0.092 µg/g dry weight) and a longear sunfish sample (#38463; 0.28 µg/g dry weight). On an individual fish basis, the highest mercury concentrations were measured in six largemouth bass, nine walleye, and six catfish; these ranged from 1.59 to 5.57 µg/g dry weight. All walleye and largemouth bass samples, and six catfish samples equaled or exceeded the current United States Environmental Protection Agency (USEPA) fish consumption advisory for Hg of 0.30 µg/g wet weight (United States Environmental Protection Agency, 2001). All catfish fillet samples except one exhibited Pb concentrations less than or equal to (≤) 0.10 µg/g dry weight. The one exception was sample 38407 (site 297), which had a Pb concentration of 0.51 µg/g dry weight. This sample did not contain an unusually high concentration of Ca, indicating that the fillet Pb concentration was not influenced by inclusion of bone fragments (table 1). Numerous fillets from redhorse and golden redhorse species exceeded 0.10 µg/g dry weight, ranging from 0.11 to 0.42 µg/g dry weight. The highest Pb concentrations were observed in fillets of longear sunfish, which ranged from 0.30 to 1.23 µg/g dry weight. Notably, these fish also had the highest Ca concentrations, suggesting that bone fragments may have been present in the fillets, which in addition to probable Pb exposure, might explain these comparably higher Pb concentrations.

RAM: Calcium concentrations in sunfish were highly variable, ranging from 357 to 4,490 µg/g dry weight (table 3). Within the green sunfish species, Ca concentrations varied as much as eightfold, whereas longear sunfish exhibited Ca variations as much as sevenfold. Zinc concentrations were fairly uniform across the sample set, with variation of less than threefold among fillet samples. Zinc concentrations ranged from 20.9 to 54.3 µg/g dry weight. Cadmium concentrations ranged from less than 0.008 to 0.43 µg/g dry weight. All Cd concentrations were below 0.10 µg/g dry weight except for three samples (38539, 0.41 µg/g dry weight; 38490, 0.43 µg/g dry weight; 38528, 0.17 µg/g dry weight). Mercury concentrations in bluegill and other sunfish ranged from 0.050 to 0.90 µg/g dry weight. All Hg concentrations were less than the current USEPA fish consumption advisory for Hg of 0.30 µg/g wet weight (USEPA, 2001). Pb concentrations in bluegill and sunfish fillets ranged from < 0.003 to 0.21 µg/g dry weight. All samples had Pb concentrations < 0.10 µg/g dry weight except for two samples (38499, 0.21 µg/g dry weight; 38501, 0.10 µg/g dry weight).

HMP: Chromium concentrations in hellbender blood ranged from < 0.13 to 6.87 µg/g dry weight (table 5). Some of the highest Cr concentrations were from the following samples: 38573, 6.87 µg/g dry weight; 38575, 2.17 µg/g dry weight; 38582, 2.52 µg/g dry weight. Cobalt concentrations in hellbender blood ranged from 0.12 to 1.41 µg/g dry weight. Some of the higher Co concentrations were from samples 38546 (1.41 µg/g dry weight) and 38550 (1.37 µg/g dry weight). Cadmium concentrations in hellbender blood ranged from < 0.002 to 0.11 µg/g dry weight. All except one Cd concentration (38573, 0.11 µg/g dry weight) were < 0.06 µg/g dry weight. Mercury concentrations ranged from 0.080 to 0.65 µg/g dry weight, and Pb concentrations ranged from 0.013 to 0.23 µg/g dry weight.

Quality Control Results

Calibration Verification: A calibration blank and an independent calibration verification standard (ICVS) were analyzed every 10 samples to confirm the calibration status of the ICP-MS during instrumental analyses of the fish fillet and

diet digestates for Ca, Cr, Co, Zn, Cd, and Pb; blanks were within plus and minus (±) three times the instrument detection limits for each element and ICVS recoveries were within the target of 90 to 110 percent of the ICVS standard concentration for each element. Three reference solutions (Spex Claritas Instrument Check Standard ICS-1;National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) 1640: Trace Elements in Natural Water; High Purity Standards Certified Reference Solution Trace Metals in Fish: HP CRM-TF) used as laboratory control samples exhibited elemental recoveries ranging from 93 to 104 percent. Calibration verification reference tissues (National Research Council Canada (NRCC) SRM DOLT-2; International Atomic Energy Agency (IAEA) SRM 407-Trace Elements and Methylmercury in Fish Tissue; NRCC SRM DOLT-3: Dogfish Liver) for total Hg were analyzed at the beginning and end of the instrumental runs to confirm the calibration status of the DMA-80 system; percent errors were within the target of ±10 percent except for three cases where percent errors were 12.0, 10.3, and 10.5.

Reference Materials: Recoveries of Ca, Zn, Cd and Pb in three tissue reference materials (NIST SRM 1566b: Oyster Tissue, n=5; IAEA SRM 407, n=5; NRCC SRM DORM-2: Dogfish Muscle, n=5) ranged from 83 to 108 percent, with one higher recovery for Pb (164 percent), and averaged 99 percent. Recoveries of Cr, Co, Cd, and Pb in two blood reference materials (SeroNorm 201705: Trace Elements in Whole Blood, n=1; ClinChek 8841 Whole Blood, Control Level II, n=1) ranged from 100 to 141 percent and averaged 119 percent. Recoveries of Hg from eight different tissue reference materials (NIST SRM 966: Bovine Blood, n=2; SeroNorm 201705, n=2; ClinChek 8841, n=2; IAEA 407, n=8; NIST RM50: Albacore Tuna, n=5; NRCC DOLT-3, n=8; NRCC DORM-2, n=6; NIST SRM 2976: Mussel Tissue, n=6) ranged from 98 to 107 percent and averaged 101 percent.

Method and Instrumental Precision: Method precision from the triplicate digestion and analysis of fish fillet (n=8) and blood (SeroNorm 201705, n=1) had percent relative standard deviations (%RSDs) for Cr, Co, Zn, Cd, and Pb that were < 37, except for Pb, which had one higher RSD of 42 percent. This degree of variability for Pb is not unusual for tissues containing low Pb concentrations. The RSDs for Ca were highly variable, apparently because of variability in bone content in the fillets; these ranged from 0.8 to 131 percent. The RSDs for Hg (n=8) were all ≤ 4 percent. Method precision from the duplicate analysis of blood (ClinCheck 8841, n=1) and fish fillets (n=1), measured as relative percent difference (RPD), ranged from 5.4 to 36 percent, with higher RPDs for Cd (64 percent, blood) and Pb (47 percent, fish). Instrumental precision measured as RPD from the analysis of fish fillet (n= 13) and blood (n=4) duplicate digestates was < 10 percent.

Spikes: Spike recoveries of Cr, Co, Cd, and Pb from reference blood materials (n=4) ranged from 96 to 122 percent and averaged 103 percent. Recoveries of Ca, Zn, Cd, and Pb spiked into fish tissue (n=16) ranged from 79 to 112 percent and averaged 99 percent. Recoveries of methylmercury hydroxide spiked into fillet tissue (n=16) ranged from 84 to 117 percent. Post-digestion or analysis spikes for Cr, Co, Cd, and Pb in hellbender blood (n=6) had recoveries ranging from 96 to 113 percent. Recoveries of analysis spikes of Ca, Zn, Cd, and Pb from fish fillet digestates (n=13) ranged from 97 to 109 percent.

Interference Checks: As a check for potential interferences, dilution percent differences (DPDs) based on fivefold dilutions of the blood (n=4) and fish fillet (n=14) digestates were determined. DPDs were ≤ 10 percent for all elements except Ca. Calcium had DPDs ranging from 12 to 23 percent, indicating the potential of a small interferent for this element. A synthetic solution containing high concentrations of aluminum, Ca, iron, magnesium, sodium, phosphorus, potassium, sulfur, carbon, molybdenum, and titanium was analyzed to observe the effects of these potential interfering elements on the determination of Cd and Pb concentrations in this matrix. Recoveries were within the ± 20 percent target except for one instance for Cr (138 percent) and three instances for Cd (134 percent, 138 percent, and 129 percent). Cadmium exceeded this target because of an interference from molybdenum (Mo) oxide ($^{98}Mo^{16}O$) on ^{114}Cd caused by the high Mo concentration in this synthetic matrix. Such a high Mo concentration is not a probable concern for the hellbender blood or fish fillet matrix.

Blank Equivalent Concentrations (BEC): BECs (Ca, Cr, Co, Zn, Cd, Pb) for digestion blanks prepared with each batch were determined; all BECs were less than the corresponding method detection limits (MDLs) except for one instance of Zn (0.68 BEC vs 0.27 µg/g MDL) and three instances of Pb (0.012 BEC vs 0.011 µg/g MDL; 0.010 BEC vs 0.007 µg/g MDL; 0.007 BEC vs 0.003). All BECs for Hg were less than the corresponding Hg MDLs.

Instrument Detection, Method Detection, and Method Quantitation Limits: Instrument detection limit (IDL) for Hg was 0.003 nanograms (ng); the IDLs for other target analytes in nanograms per milliliter were as follows: Cr, 0.020; Co, 0.001; Ca, 2.49; Zn, 1.78; Cd, 0.002; Pb, 0.002. Method detection limits (MDL) were computed in micrograms per gram dry weight for each batch of samples as:

$$3 \text{ X } (SD_b^{\ 2} + SD_s^{\ 2})^{1/2}$$

where

SD_b = standard deviation of a blank (n=3);

and

SD_s = standard deviation of a low level sample or spiked sample (n=3); and were as follows: Cr, 0.13; Co, 0.005; Ca, 3.40 to 11.4; Zn, 0.27 and 0.54; Cd, 0.002 to 0.014; Hg, 0.002 to 0.017; Pb, 0.003 to 0.018. Method quantitation limits (MQLs) were calculated in micrograms per gram dry weight as 3.3 x MDLs and were as follows: Cr, 0.43; Co, 0.017; Ca, 11.2 to 37.6; Zn, 0.89 and 1.78; Cd, 0.007 to 0.046; Hg, 0.008 to 0.056; Pb, 0.010 to 0.059. All quality control results for the study were within acceptable limits as specified by USGS-CERC.

References Cited

Schmitt, C.J., and Finger, S.E., 1987, The effects of sample preparation on measured concentrations of eight elements in edible tissues of fish from streams contaminated by lead mining: Archives of Environmental Contamination and Toxicology, v. 16, p.185–207.

United States Environmental Protection Agency, 1998, Mercury in solids and solutions by thermal decomposition, amalgamation, and atomic absorption spectrophotometry: accessed August 28, 2007, at *http://www.epa.gov/epaoswer/hazwaste/test/up4a.htm#7_series*.

United States Environmental Protection Agency, 2001, Water quality criterion for protection of human health: methylmercury: United States Environmental Protection Agency, EPA–823–R–01–001, January 2001, Office of Water, Washington, D.C., 16 p.

Tables

Table 1. Dry weight concentrations of calcium, cadmium, mercury, and lead and lead/calcium molar ratios in Missouri Department of Conservation 2006 General Contaminant Monitoring fish fillets

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Moisture (percent)	Calcium (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)	Lead/calcium molar ratio ($1X10^{-6}$)
38400	2006-297-232-1	blue catfish	76.9	334	**0.015**	0.41	0.050	29.0
38401	2006-297-232-2	blue catfish	67.8	183	< 0.007	0.25	**0.022**	23.3
38402	2006-297-232-3	blue catfish	70.2	257	< 0.007	0.16	**0.026**	19.6
38403	2006-297-232-4	blue catfish	79.8	342	< 0.007	0.96	**0.028**	15.8
38404	2006-297-232-5	blue catfish	76.9	280	< 0.007	1.13	**0.028**	19.3
38405	2006-297-232-6	blue catfish	80.6	470	< 0.007	1.00	0.067	27.6
38406	2006-297-232-7	blue catfish	77.6	398	**0.012**	1.16	0.081	39.4
38407	2006-297-232-8	blue catfish	66.3	200	**0.021**	1.03	0.51	493
38411	2006-331-232-1	blue catfish	84.2	393	0.041	2.49	**0.033**	16.2
38412	2006-331-232-2	blue catfish	70.3	234	**0.010**	0.23	**0.025**	20.7
38413	2006-331-232-3	blue catfish	79.8	344	**0.015**	2.76	**0.023**	12.9
38414	2006-331-232-4	blue catfish	78.1	284	< 0.007	0.47	0.036	24.5
38415	2006-331-232-5	blue catfish	74.6	217	< 0.007	0.60	0.041	36.5
38416	2006-331-232-6	blue catfish	80.7	309	0.036	5.57	0.036	22.5
38417	2006-331-232-7	blue catfish	70.3	175	**0.013**	0.92	< 0.011	12.2
38418	2006-331-232-8	blue catfish	71.7	207	< 0.007	0.71	< 0.011	10.3
38408	2006-312-230-1	channel catfish	80.6	395	< 0.007	0.32	0.048	23.5
38409	2006-312-230-2	channel catfish	79.9	339	**0.008**	0.54	**0.012**	6.8
38410	2006-312-230-3	channel catfish	80.2	334	< 0.007	0.49	**0.028**	16.2
38419	2006-618-230-1	channel catfish	84.4	399	**0.013**	1.65	0.065	31.5
38420	2006-618-230-2	channel catfish	83.9	609	< 0.007	0.40	0.10	31.8
38421	2006-618-230-3	channel catfish	82.4	390	**0.013**	0.99	**0.032**	15.9
38428	2006-705-245-1	flathead catfish	81.6	403	< 0.007	1.45	**0.017**	8.16
38429	2006-705-245-2	flathead catfish	81.6	479	< 0.007	1.19	0.047	19.0
38430	2006-705-245-3	flathead catfish	80.4	388	0.087	2.57	0.10	49.9
38431	2006-705-245-4	flathead catfish	82.7	475	0.025	1.82	0.062	25.2
38432	2006-705-245-5	flathead catfish	83.4	485	**0.017**	0.88	**0.029**	11.6
38433	2006-705-245-6	flathead catfish	81.3	454	**0.010**	1.40	**0.034**	14.5
38434	2006-705-245-7	flathead catfish	80.5	430	**0.012**	1.05	0.056	25.2
38435	2006-705-245-8	flathead catfish	80.0	381	0.032	1.34	0.063	32.0
38436	2006-705-245-9	flathead catfish	81.9	445	0.023	1.28	**0.027**	11.7

Table 1. Dry weight concentrations of calcium, cadmium, mercury, and lead and lead/calcium molar ratios in Missouri Department of Conservation 2006 General Contaminant Monitoring fish fillets.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Moisture (percent)	Calcium (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)	Lead/calcium molar ratio ($1X10^{-6}$)
38437	2006-705-245-10	flathead catfish	83.3	446	< 0.007	0.87	0.047	20.4
38438	2006-705-245-11	flathead catfish	81.2	472	**0.014**	1.07	0.066	27.0
38439	2006-705-245-12	flathead catfish	81.0	425	0.092	0.83	**0.025**	11.4
38440	2006-706-245-1	flathead catfish	82.2	685	0.028	0.87	**0.017**	4.80
38441	2006-120-068-1	redhorse	78.3	1,930	0.026	0.090	0.23	23.1
38442	2006-120-068-2	redhorse	79.0	2,670	0.029	0.14	0.35	25.4
38443	2006-120-068-3	redhorse	79.4	2,610	0.029	0.11	0.34	25.2
38449	2006-411-068-1	redhorse	80.4	2,530	0.023	0.35	0.064	4.89
38450	2006-411-068-2	redhorse	80.3	1,160	0.033	0.35	0.092	15.3
38451	2006-411-068-3	redhorse	79.7	2,020	**0.013**	0.26	0.059	5.65
38484	2006-712-060-1	redhorse	81.4	1,370	0.035	0.12	0.16	22.6
38485	2006-712-060-2	redhorse	80.7	1,180	0.020	0.14	0.11	18.0
38486	2006-712-060-3	redhorse	80.7	3,210	**0.011**	0.11	0.11	6.63
38454	2006-654-062-1	golden redhorse	79.4	987	**0.009**	0.23	0.055	10.8
38455	2006-654-062-2	golden redhorse	79.2	1,960	**0.007**	0.24	0.14	13.8
38456	2006-654-062-3	golden redhorse	79.8	1,100	< 0.006	0.26	0.090	15.8
38460	2006-707-062-1	golden redhorse	79.9	2,270	**0.016**	0.35	0.19	16.2
38461	2006-707-062-2	golden redhorse	79.3	1,040	**0.014**	0.27	0.079	14.7
38462	2006-707-062-3	golden redhorse	78.5	1,290	**0.011**	0.28	0.082	12.3
38466	2006-708-062-1	golden redhorse	81.0	1,950	**0.009**	0.45	0.14	13.9
38467	2006-708-062-2	golden redhorse	80.8	1,810	**0.016**	0.49	0.14	15.0
38468	2006-708-062-3	golden redhorse	80.0	1,380	0.028	0.49	0.090	12.6
38472	2006-709-062-1	golden redhorse	80.0	1,220	< 0.006	0.32	0.30	47.6
38473	2006-709-062-2	golden redhorse	80.5	1,700	< 0.006	0.16	0.42	47.8
38474	2006-709-062-3	golden redhorse	80.5	1,310	**0.008**	0.23	0.40	59.1
38422	2006-703-406-1	largemouth bass	80.1	705	< 0.014	1.87	**0.021**	5.76
38423	2006-703-406-2	largemouth bass	80.0	421	< 0.014	1.52	< 0.018	8.27
38424	2006-703-406-3	largemouth bass	80.7	391	< 0.014	2.41	**0.038**	18.8
38425	2006-704-406-1	largemouth bass	80.5	434	< 0.014	2.30	< 0.018	8.02
38426	2006-704-406-2	largemouth bass	79.6	354	< 0.014	2.09	**0.018**	9.84
38427	2006-704-406-3	largemouth bass	80.5	363	< 0.014	1.56	< 0.018	9.59

Table 1. Dry weight concentrations of calcium, cadmium, mercury, and lead and lead/calcium molar ratios in Missouri Department of Conservation 2006 General Contaminant Monitoring fish fillets.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Moisture (percent)	Calcium (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)	Lead/calcium molar ratio ($1X10^{-6}$)
38444	2006-120-400-1	spotted bass	79.3	370	**0.032**	0.31	0.076	39.7
38445	2006-120-400-2	spotted bass	79.3	397	**0.028**	0.13	0.081	39.5
38452	2006-411-406-1	black bass	80.0	403	< 0.014	0.50	**0.027**	13.0
38453	2006-411-406-2	black bass	79.9	1,160	< 0.014	0.45	**0.033**	5.50
38487	2006-712-426-1	rock bass	80.5	1,410	< 0.014	0.11	**0.035**	4.80
38488	2006-712-426-2	rock bass	80.8	1,720	< 0.014	0.15	**0.020**	2.25
38489	2006-712-426-3	rock bass	81.0	1,130	< 0.014	0.13	**0.043**	7.36
38446	2006-172-318-1	walleye	78.2	615	< 0.014	2.46	< 0.018	5.66
38447	2006-172-318-2	walleye	78.1	560	< 0.014	2.16	< 0.018	6.22
38448	2006-172-318-3	walleye	78.0	403	< 0.014	2.34	< 0.018	8.64
38478	2006-710-318-1	walleye	79.0	394	< 0.014	1.59	< 0.018	8.84
38479	2006-710-318-2	walleye	79.4	576	< 0.014	2.65	< 0.018	6.05
38480	2006-710-318-3	walleye	78.0	429	< 0.014	2.61	< 0.018	8.12
38481	2006-711-318-1	walleye	80.4	863	< 0.014	2.30	< 0.018	4.03
38482	2006-711-318-2	walleye	79.8	315	< 0.014	3.72	< 0.018	11.1
38483	2006-711-318-3	walleye	79.9	309	< 0.014	2.51	< 0.018	11.3
38457	2006-654-420-1	longear sunfish	77.8	8,640	< 0.014	0.25	0.67	15.0
38458	2006-654-420-2	longear sunfish	77.1	4,950	< 0.014	0.22	0.46	18.0
38459	2006-654-420-3	longear sunfish	77.7	2,860	< 0.014	0.27	0.35	23.7
38463	2006-707-420-1	longear sunfish	77.5	6,130	0.28	0.24	0.55	17.4
38464	2006-707-420-2	longear sunfish	77.9	7,820	**0.044**	0.23	0.69	17.1
38465	2006-707-420-3	longear sunfish	78.1	5,240	**0.040**	0.30	0.58	21.4
38469	2006-708-420-1	longear sunfish	78.7	6,610	**0.027**	0.36	0.67	19.6
38470	2006-708-420-2	longear sunfish	79.0	3,400	**0.016**	0.40	0.30	17.1
38471	2006-708-420-3	longear sunfish	80.5	10,770	**0.019**	0.40	0.58	10.4
38475	2006-709-420-1	longear sunfish	80.1	3,860	**0.014**	0.17	1.23	61.6
38476	2006-709-420-2	longear sunfish	79.5	2,970	**0.025**	0.12	0.63	41.0
38477	2006-709-420-3	longear sunfish	80.5	2,490	< 0.014	0.15	0.60	46.6

Table 2. Wet weight concentrations of calcium, cadmium, mercury, and lead in Missouri Department of Conservation 2006 General Contaminant Monitoring fish fillets

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Calcium (µg/g wet weight)	Cadmium (µg/g wet weight)	Mercury (µg/g wet weight)	Lead (µg/g wet weight)
38400	2006-297-232-1	blue catfish	77	**0.003**	0.095	0.012
38401	2006-297-232-2	blue catfish	59	< 0.002	0.082	**0.007**
38402	2006-297-232-3	blue catfish	76	< 0.002	0.049	**0.008**
38403	2006-297-232-4	blue catfish	69	< 0.001	0.19	**0.006**
38404	2006-297-232-5	blue catfish	65	< 0.002	0.26	**0.006**
38405	2006-297-232-6	blue catfish	91	< 0.001	0.19	0.013
38406	2006-297-232-7	blue catfish	89	**0.003**	0.26	0.018
38407	2006-297-232-8	blue catfish	67	**0.007**	0.35	0.17
38411	2006-331-232-1	blue catfish	62	0.006	0.39	**0.005**
38412	2006-331-232-2	blue catfish	69	**0.003**	0.070	**0.007**
38413	2006-331-232-3	blue catfish	69	**0.003**	0.56	**0.005**
38414	2006-331-232-4	blue catfish	62	< 0.002	0.10	0.008
38415	2006-331-232-5	blue catfish	55	< 0.002	0.15	0.010
38416	2006-331-232-6	blue catfish	59	0.007	1.07	0.007
38417	2006-331-232-7	blue catfish	52	**0.004**	0.27	< 0.003
38418	2006-331-232-8	blue catfish	59	< 0.002	0.20	< 0.003
38408	2006-312-230-1	channel catfish	77	< 0.001	0.062	0.009
38409	2006-312-230-2	channel catfish	68	**0.002**	0.11	**0.002**
38410	2006-312-230-3	channel catfish	66	< 0.001	0.096	**0.006**
38419	2006-618-230-1	channel catfish	62	**0.002**	0.26	0.010
38420	2006-618-230-2	channel catfish	98	< 0.001	0.065	0.02
38421	2006-618-230-3	channel catfish	69	**0.002**	0.17	**0.006**
38428	2006-705-245-1	flathead catfish	74	< 0.001	0.27	**0.003**
38429	2006-705-245-2	flathead catfish	88	< 0.001	0.22	0.009
38430	2006-705-245-3	flathead catfish	76	0.017	0.50	0.02
38431	2006-705-245-4	flathead catfish	82	0.004	0.32	0.011
38432	2006-705-245-5	flathead catfish	80	**0.003**	0.15	**0.005**
38433	2006-705-245-6	flathead catfish	85	**0.002**	0.26	**0.006**
38434	2006-705-245-7	flathead catfish	84	**0.002**	0.20	0.011
38435	2006-705-245-8	flathead catfish	76	0.006	0.27	0.013
38436	2006-705-245-9	flathead catfish	81	0.004	0.23	**0.005**
38437	2006-705-245-10	flathead catfish	74	< 0.001	0.15	0.008
38438	2006-705-245-11	flathead catfish	89	**0.003**	0.20	0.012
38439	2006-705-245-12	flathead catfish	81	0.017	0.16	**0.005**
38440	2006-706-245-1	flathead catfish	122	0.005	0.15	**0.003**
38441	2006-120-068-1	redhorse	419	0.006	0.019	0.050
38442	2006-120-068-2	redhorse	560	0.006	0.029	0.073
38443	2006-120-068-3	redhorse	537	0.006	0.023	0.070
38449	2006-411-068-1	redhorse	497	0.005	0.070	0.013
38450	2006-411-068-2	redhorse	228	0.006	0.068	0.018
38451	2006-411-068-3	redhorse	411	**0.003**	0.052	0.012
38484	2006-712-060-1	redhorse	255	0.007	0.022	0.030
38485	2006-712-060-2	redhorse	228	0.004	0.027	0.021
38486	2006-712-060-3	redhorse	618	**0.002**	0.020	0.021
38454	2006-654-062-1	golden redhorse	203	**0.002**	0.047	0.011

Table 2. Wet weight concentrations of calcium, cadmium, mercury, and lead in Missouri Department of Conservation 2006 General Contaminant Monitoring fish fillets.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Calcium (µg/g wet weight)	Cadmium (µg/g wet weight)	Mercury (µg/g wet weight)	Lead (µg/g wet weight)
38455	2006-654-062-2	golden redhorse	408	**0.001**	0.049	0.029
38456	2006-654-062-3	golden redhorse	222	< 0.001	0.053	0.018
38460	2006-707-062-1	golden redhorse	456	**0.003**	0.070	0.038
38461	2006-707-062-2	golden redhorse	215	**0.003**	0.056	0.016
38462	2006-707-062-3	golden redhorse	277	**0.002**	0.061	0.018
38466	2006-708-062-1	golden redhorse	370	**0.002**	0.085	0.027
38467	2006-708-062-2	golden redhorse	348	**0.003**	0.095	0.027
38468	2006-708-062-3	golden redhorse	276	0.006	0.099	0.018
38472	2006-709-062-1	golden redhorse	244	< 0.001	0.065	0.060
38473	2006-709-062-2	golden redhorse	332	< 0.001	0.032	0.082
38474	2006-709-062-3	golden redhorse	255	**0.002**	0.045	0.078
38422	2006-703-406-1	largemouth bass	141	< 0.003	0.37	**0.004**
38423	2006-703-406-2	largemouth bass	84.2	< 0.003	0.30	< 0.004
38424	2006-703-406-3	largemouth bass	75.6	< 0.003	0.47	**0.007**
38425	2006-704-406-1	largemouth bass	84.5	< 0.003	0.45	< 0.004
38426	2006-704-406-2	largemouth bass	72.4	< 0.003	0.43	**0.004**
38427	2006-704-406-3	largemouth bass	70.7	< 0.003	0.30	< 0.004
38444	2006-120-400-1	spotted bass	76.5	**0.007**	0.063	0.016
38445	2006-120-400-2	spotted bass	82.0	**0.006**	0.028	0.017
38452	2006-411-406-1	black bass	80.5	< 0.003	0.099	**0.005**
38453	2006-411-406-2	black bass	233	< 0.003	0.090	**0.007**
38487	2006-712-426-1	rock bass	276	< 0.003	0.021	**0.007**
38488	2006-712-426-2	rock bass	330	< 0.003	0.028	**0.004**
38489	2006-712-426-3	rock bass	215	< 0.003	0.025	**0.008**
38446	2006-172-318-1	walleye	134	< 0.003	0.54	< 0.004
38447	2006-172-318-2	walleye	122	< 0.003	0.47	< 0.004
38448	2006-172-318-3	walleye	88	< 0.003	0.51	< 0.004
38478	2006-710-318-1	walleye	83	< 0.003	0.34	< 0.004
38479	2006-710-318-2	walleye	118	< 0.003	0.54	< 0.004
38480	2006-710-318-3	walleye	95	< 0.003	0.58	< 0.004
38481	2006-711-318-1	walleye	169	< 0.003	0.45	< 0.004
38482	2006-711-318-2	walleye	64	< 0.003	0.75	< 0.004
38483	2006-711-318-3	walleye	62	< 0.003	0.50	< 0.004
38457	2006-654-420-1	longear sunfish	1,920	< 0.003	0.055	0.15
38458	2006-654-420-2	longear sunfish	1,130	< 0.003	0.050	0.11
38459	2006-654-420-3	longear sunfish	639	< 0.003	0.061	0.08
38463	2006-707-420-1	longear sunfish	1,380	0.063	0.054	0.12
38464	2006-707-420-2	longear sunfish	1,730	**0.010**	0.050	0.15
38465	2006-707-420-3	longear sunfish	1,150	**0.009**	0.065	0.13
38469	2006-708-420-1	longear sunfish	1,410	**0.006**	0.076	0.14
38470	2006-708-420-2	longear sunfish	714	**0.003**	0.083	0.06
38471	2006-708-420-3	longear sunfish	2,110	**0.004**	0.078	0.11
38475	2006-709-420-1	longear sunfish	769	**0.003**	0.033	0.25
38476	2006-709-420-2	longear sunfish	608	**0.005**	0.024	0.13
38477	2006-709-420-3	longear sunfish	487	< 0.003	0.030	0.12

Table 3. Dry weight concentrations of calcium, zinc, cadmium, mercury, and lead and lead/calcium molar ratios in Missouri Department of Conservation 2006 Resource Assessment and Monitoring fish fillets.

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Moisture (percent)	Calcium (µg/g dry weight)	Zinc (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)	Lead/calcium molar ratio ($1X10^{-6}$)
38493	2006-807-420-1	longear sunfish	81.4	995	26.8	0.028	0.072	0.056	10.9
38494	2006-807-420-2	longear sunfish	82.3	1,280	28.3	***0.008***	0.053	0.050	7.56
38495	2006-807-420-3	longear sunfish	82.6	2,280	31.5	0.017	0.16	0.092	7.81
38516	2006-862-420-1	longear sunfish	82.8	4,490	54.3	0.084	0.44	0.032	1.38
38517	2006-862-420-2	longear sunfish	82.1	3,850	33.7	0.013	0.21	0.030	1.51
38518	2006-862-420-3	longear sunfish	82.0	668	28.8	0.033	0.47	0.025	7.24
38531	2006-867-420-1	longear sunfish	80.5	2,080	23.3	0.043	0.18	***0.009***	0.84
38532	2006-867-420-2	longear sunfish	81.3	677	26.5	0.030	0.27	< 0.007	2.00
38533	2006-867-420-3	longear sunfish	82.3	2,660	29.1	0.023	0.30	< 0.007	0.51
38522	2006-864-424-1	bluegill	80.8	487	35.1	0.013	0.20	0.075	29.8
38523	2006-864-424-2	bluegill	80.5	397	33.1	0.018	0.27	0.082	40.0
38524	2006-864-424-3	bluegill	80.2	396	25.4	0.015	0.13	0.032	15.6
38529	2006-866-412-2	green sunfish	83.1	2,140	26.3	0.093	0.66	0.033	2.98
38530	2006-866-412-3	green sunfish	81.3	484	26.5	0.071	0.53	***0.010***	4.00
38534	2006-868-412-1	green sunfish	78.9	787	30.5	0.048	0.74	< 0.007	1.72
38535	2006-868-412-2	green sunfish	80.1	731	25.8	0.018	0.59	< 0.007	1.85
38536	2006-869-412-1	green sunfish	81.0	1,020	27.9	0.043	0.26	0.024	4.55
38537	2006-869-412-2	green sunfish	80.9	494	25.0	0.019	0.18	0.023	9.01
38538	2006-869-412-3	green sunfish	80.9	432	25.6	0.015	0.18	0.028	12.5
38539	2006-870-412-1	green sunfish	80.3	361	21.4	0.41	0.27	0.037	19.8
38540	2006-870-412-2	green sunfish	79.7	477	23.2	0.074	0.19	***0.013***	5.27
38541	2006-870-412-3	green sunfish	80.9	638	23.4	0.056	0.26	< 0.007	2.12
38490	2006-803-412-1	green sunfish	79.8	369	24.0	0.43	0.24	0.030	15.7
38491	2006-803-412-2	green sunfish	79.4	362	22.1	0.085	0.18	0.011	5.88
38492	2006-803-412-3	green sunfish	79.7	550	25.7	0.075	0.48	0.014	4.92
38496	2006-855-412-1	green sunfish	81.4	670	34.6	***0.014***	0.21	0.018	5.20
38497	2006-855-412-2	green sunfish	81.6	679	28.2	< 0.008	0.31	< 0.003	0.85

Table 3. Dry weight concentrations of calcium, zinc, cadmium, mercury, and lead and lead/calcium molar ratios in Missouri Department of Conservation 2006 Resource Assessment and Monitoring fish fillets.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Moisture (percent)	Calcium (µg/g dry weight)	Zinc (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)	Lead/calcium molar ratio ($1X10^{-6}$)
38498	2006-855-412-3	green sunfish	80.5	824	30.7	**0.010**	0.39	**0.007**	1.64
38499	2006-856-412-1	green sunfish	81.6	1,590	27.9	0.059	0.64	0.21	25.5
38500	2006-856-412-2	green sunfish	82.7	360	27.8	0.029	0.36	0.064	34.4
38501	2006-856-412-3	green sunfish	82.0	682	29.2	**0.017**	0.44	0.10	28.4
38502	2006-857-412-1	green sunfish	80.2	1,810	37.1	0.087	0.74	0.016	1.71
38503	2006-857-412-2	green sunfish	80.9	713	42.3	**0.014**	0.90	**0.008**	2.17
38504	2006-858-412-1	green sunfish	81.0	436	21.2	0.028	0.050	0.021	9.32
38505	2006-858-412-2	green sunfish	81.5	359	24.4	**0.012**	0.088	0.011	5.93
38506	2006-858-412-3	green sunfish	81.1	1,870	25.3	**0.017**	0.068	0.019	1.97
38507	2006-859-412-1	green sunfish	81.6	1,560	45.0	0.029	0.49	0.044	5.46
38508	2006-859-412-2	green sunfish	80.5	1,410	27.7	**0.009**	0.26	0.026	3.57
38509	2006-859-412-3	green sunfish	80.0	2,920	23.8	< 0.008	0.31	**0.008**	0.53
38510	2006-860-412-1	green sunfish	81.2	817	28.5	0.057	0.44	0.038	9.00
38511	2006-860-412-2	green sunfish	82.0	627	26.6	**0.015**	0.53	0.010	3.09
38512	2006-860-412-3	green sunfish	81.5	948	25.8	**0.017**	0.42	0.015	3.06
38513	2006-861-412-1	green sunfish	79.0	514	26.2	**0.021**	0.78	0.024	9.03
38514	2006-861-412-2	green sunfish	81.6	357	24.7	**0.012**	0.45	0.014	7.59
38515	2006-861-412-3	green sunfish	80.4	378	24.1	< 0.008	0.53	0.011	5.63
38519	2006-863-412-1	green sunfish	79.7	376	23.8	0.027	0.15	0.096	49.4
38520	2006-863-412-2	green sunfish	79.2	401	20.9	**0.024**	0.14	0.011	5.31
38521	2006-863-412-3	green sunfish	80.6	369	29.9	0.038	0.24	0.011	5.77
38525	2006-865-412-1	green sunfish	80.3	439	24.8	**0.023**	0.38	0.031	13.7
38526	2006-865-412-2	green sunfish	81.0	558	23.3	**0.009**	0.32	0.019	6.59
38527	2006-865-412-3	green sunfish	79.0	875	23.2	**0.024**	0.27	0.025	5.53
38528	2006-866-412-1	green sunfish	81.6	1,320	28.2	0.17	0.52	0.014	2.05

Table 4. Wet weight concentrations of calcium, zinc, cadmium, mercury, and lead in Missouri Department of Conservation 2006 Resource Assessment and Monitoring fish fillets.

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Calcium (µg/g wet weight)	Zinc (µg/g wet weight)	Cadmium (µg/g wet weight)	Mercury (µg/g wet weight)	Lead (µg/g wet weight)
38493	2006-807-420-1	longear sunfish	185	4.98	0.005	0.013	0.010
38494	2006-807-420-2	longear sunfish	227	5.01	**0.001**	0.009	0.009
38495	2006-807-420-3	longear sunfish	396	5.47	0.003	0.027	0.016
38516	2006-862-420-1	longear sunfish	770	9.32	0.014	0.076	0.005
38517	2006-862-420-2	longear sunfish	689	6.03	0.002	0.037	0.005
38518	2006-862-420-3	longear sunfish	120	5.19	0.006	0.084	0.005
38531	2006-867-420-1	longear sunfish	406	4.55	0.008	0.035	**0.002**
38532	2006-867-420-2	longear sunfish	126	4.95	0.006	0.051	< 0.001
38533	2006-867-420-3	longear sunfish	470	5.14	0.004	0.054	< 0.001
38522	2006-864-424-1	bluegill	93.4	6.73	0.002	0.038	0.014
38523	2006-864-424-2	bluegill	77.5	6.47	0.004	0.052	0.016
38524	2006-864-424-3	bluegill	78.6	5.04	0.003	0.025	0.006
38529	2006-866-412-2	green sunfish	361	4.43	0.016	0.11	0.006
38530	2006-866-412-3	green sunfish	90.3	4.95	0.013	0.099	**0.002**
38534	2006-868-412-1	green sunfish	166	6.43	0.010	0.16	< 0.001
38535	2006-868-412-2	green sunfish	146	5.14	0.004	0.12	< 0.001
38536	2006-869-412-1	green sunfish	194	5.29	0.008	0.049	0.005
38537	2006-869-412-2	green sunfish	94.4	4.78	0.004	0.034	0.004
38538	2006-869-412-3	green sunfish	82.4	4.88	0.003	0.034	0.005
38539	2006-870-412-1	green sunfish	70.9	4.21	0.081	0.053	0.007
38540	2006-870-412-2	green sunfish	96.6	4.70	0.015	0.039	**0.003**
38541	2006-870-412-3	green sunfish	122	4.47	0.011	0.049	< 0.001
38490	2006-803-412-1	green sunfish	75	4.85	0.087	0.049	0.006
38491	2006-803-412-2	green sunfish	75	4.56	0.018	0.037	0.002
38492	2006-803-412-3	green sunfish	112	5.22	0.015	0.097	0.003
38496	2006-855-412-1	green sunfish	125	6.45	**0.003**	0.039	0.003
38497	2006-855-412-2	green sunfish	125	5.18	< 0.001	0.057	< 0.001
38498	2006-855-412-3	green sunfish	160	5.98	**0.002**	0.077	**0.001**

Table 4. Wet weight concentrations of calcium, zinc, cadmium, mercury, and lead in Missouri Department of Conservation 2006 Resource Assessment and Monitoring fish fillets.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Field ID	Fish common name	Calcium (µg/g wet weight)	Zinc (µg/g wet weight)	Cadmium (µg/g wet weight)	Mercury (µg/g wet weight)	Lead (µg/g wet weight)
38499	2006-856-412-1	green sunfish	293	5.15	0.011	0.118	0.039
38500	2006-856-412-2	green sunfish	62	4.82	0.005	0.063	0.011
38501	2006-856-412-3	green sunfish	123	5.25	**0.003**	0.080	0.018
38502	2006-857-412-1	green sunfish	358	7.35	0.017	0.147	0.003
38503	2006-857-412-2	green sunfish	136	8.08	**0.003**	0.172	**0.002**
38504	2006-858-412-1	green sunfish	83	4.02	0.005	0.009	0.004
38505	2006-858-412-2	green sunfish	67	4.52	**0.002**	0.016	0.002
38506	2006-858-412-3	green sunfish	354	4.79	**0.003**	0.013	0.004
38507	2006-859-412-1	green sunfish	288	8.30	0.005	0.091	0.008
38508	2006-859-412-2	green sunfish	274	5.39	**0.002**	0.050	0.005
38509	2006-859-412-3	green sunfish	583	4.76	< 0.002	0.063	**0.002**
38510	2006-860-412-1	green sunfish	153	5.35	0.011	0.082	0.007
38511	2006-860-412-2	green sunfish	113	4.79	**0.003**	0.096	0.002
38512	2006-860-412-3	green sunfish	176	4.78	**0.003**	0.078	0.003
38513	2006-861-412-1	green sunfish	108	5.50	**0.004**	0.163	0.005
38514	2006-861-412-2	green sunfish	66	4.56	**0.002**	0.083	0.003
38515	2006-861-412-3	green sunfish	74	4.72	< 0.002	0.105	0.002
38519	2006-863-412-1	green sunfish	77	4.84	0.005	0.031	0.020
38520	2006-863-412-2	green sunfish	83	4.34	**0.005**	0.029	0.002
38521	2006-863-412-3	green sunfish	71	5.79	0.007	0.047	0.002
38525	2006-865-412-1	green sunfish	87	4.89	**0.005**	0.075	0.006
38526	2006-865-412-2	green sunfish	106	4.42	**0.002**	0.061	0.004
38527	2006-865-412-3	green sunfish	184	4.88	**0.005**	0.056	0.005
38528	2006-866-412-1	green sunfish	242	5.18	0.031	0.096	0.003

Table 5. Concentrations of chromium, cobalt, cadmium, mercury, and lead in Missouri Department of Conservation 2006 Hellbender Monitoring Program hellbender blood

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Moisture (percent)	Chromium (µg/g dry weight)	Cobalt (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)
38542	88.9	***0.39***	0.43	0.023	0.13	0.030
38543	85.4	0.76	0.76	0.022	0.11	0.043
38544	82.9	1.69	0.75	0.019	0.089	0.038
38545	86.6	0.59	0.96	0.026	0.11	0.039
38546	86.6	0.72	1.41	0.032	0.11	0.040
38547	86.9	0.67	0.84	0.011	0.081	0.038
38548	85.4	0.69	1.12	0.017	0.080	0.066
38549	88.8	0.58	0.89	0.018	0.16	0.039
38550	89.3	1.63	1.37	0.030	0.12	0.066
38551	88.1	0.47	0.27	< 0.002	0.51	0.070
38552	86.3	0.97	0.24	0.010	0.23	0.042
38553	86.2	0.58	0.27	0.010	0.64	0.099
38554	85.9	0.54	0.31	***0.003***	0.40	0.11
38555	88.1	***0.34***	0.42	***0.004***	0.59	0.047
38556	88.4	1.11	0.27	***0.003***	0.57	0.11
38557	81.5	***0.29***	0.25	< 0.002	0.42	0.063
38558	86.5	***0.21***	0.63	***0.003***	0.36	0.061
38559	87.4	0.52	0.39	***0.003***	0.42	0.060
38560	88.8	0.48	0.30	***0.003***	0.55	0.048
38561	88.9	0.78	0.16	< 0.002	0.27	0.045
38562	89.8	1.17	0.85	< 0.002	0.32	0.18
38563	88.2	0.63	0.25	***0.003***	0.21	0.16
38564	88.9	1.00	0.74	< 0.002	0.55	0.16
38565	84.5	0.55	0.12	< 0.002	0.54	0.029
38566	86.5	0.59	0.23	< 0.002	0.35	0.061
38567	87.2	2.16	0.24	***0.003***	0.38	0.073
38568	85.9	1.03	0.38	***0.003***	0.31	0.069
38569	87.9	0.45	0.38	***0.004***	0.22	0.096

Table 5. Concentrations of chromium, cobalt, cadmium, mercury, and lead in Missouri Department of Conservation 2006 Hellbender Monitoring Program hellbender blood.—Continued

[USGS, U.S. Geological Survey; ID, identification; µg/g, microgram per gram; <, less than; MDL, Method Detection Limit; MQL, Method Quantitation Limit; bold and italicized values are greater than MDL but less than MQL; these values have high uncertainty and are presented for information purposes only]

USGS ID number	Moisture (percent)	Chromium (µg/g dry weight)	Cobalt (µg/g dry weight)	Cadmium (µg/g dry weight)	Mercury (µg/g dry weight)	Lead (µg/g dry weight)
38570	86.5	< 0.13	0.068	**0.003**	0.65	0.033
38571	89.0	**0.34**	0.27	< 0.002	0.38	0.084
38572	83.6	**0.38**	0.34	< 0.002	0.36	0.091
38573	94.7	6.87	0.96	0.11	0.10	0.15
38574	86.6	0.52	0.84	**0.004**	0.23	0.027
38575	86.7	2.17	0.48	0.008	0.15	0.052
38576	89.7	1.71	0.19	0.012	0.17	0.23
38577	87.1	1.09	0.28	< 0.002	0.13	0.073
38578	87.1	1.15	0.36	< 0.002	0.15	0.12
38579	88.0	1.76	0.25	**0.003**	0.20	0.098
38580	85.4	0.57	0.44	< 0.002	0.15	0.037
38581	85.9	1.87	0.45	< 0.002	0.23	0.045
38582	86.4	2.52	0.55	< 0.002	0.17	0.046
38583	85.2	0.99	1.11	0.022	0.35	0.028
38584	87.5	1.17	1.32	0.027	0.30	0.056
38585	83.3	1.53	0.75	0.057	0.39	0.044
38586	85.2	0.79	0.62	0.015	0.37	0.013
38587	86.8	1.51	0.56	0.022	0.24	0.039
38588	86.1	0.34	1.21	0.007	0.44	0.18
38589	85.1	0.47	0.53	0.008	0.48	0.038
38590	87.6	1.91	0.82	0.012	0.48	0.050
38591	85.8	1.88	0.69	0.007	0.38	0.044
38592	84.0	0.49	0.54	0.013	0.37	0.045
38593	84.9	**0.30**	0.68	0.014	0.20	0.026
38594	86.1	**0.19**	0.76	0.008	0.61	0.056
38595	88.2	0.62	1.15	0.016	0.20	0.041
38596	85.8	0.47	0.53	0.028	0.24	0.054
38597	89.5	1.04	0.77	0.014	0.46	0.053

Publishing support provided by:
Rolla Publishing Service Center

For more information concerning this publication, contact:
Director, USGS Columbia Environmental Research Center
4200 New Haven Road
Columbia, MO 65201
(573) 875–5399

Or visit the Columbia Environmental Research Center Web site at:
http://www.cerc.usgs.gov