OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

P.O. Box 2008
Oak Ridge, TN 37831-6351
Phone: (865) 576-4163
Fax: (865) 576-9938
E-mail:smithjg@ornl.gov

May 4, 2012

Dr. Neil Carriker
Program Manager, Special Projects
Tennessee Valley Authority Kingston Ash Recovery Project
Kingston, Tennessee

Dr. Carriker,

Subject: Preliminary Evaluation of 2011 ORNL Results: *Aquatic Invertebrate Bioaccumulation*

I am pleased to submit to you a preliminary evaluation of 2011 *Aquatic Invertebrate Bioaccumulation* Task results.

The enclosed report covers collections of snails, mayfly nymph and mayfly adult samples collected in 2011.

We hope this preliminary update is useful to you. If you have any questions or require additional information, please call me at (865) 576-4163.

Sincerely,

John G. Smith
Principal Investigator, Aquatic Invertebrate Bioaccumulation Task
Environmental Sciences Division
Oak Ridge National Laboratory

c: M. J. Peterson, ORNL
D. Jones, ARCADIS

Preliminary Evaluation of 2011 ORNL Results: *Invertebrate Bioaccumulation*
May 4, 2012

Introduction

This report summarizes the results of samples collected between May and August 2011, for the aquatic invertebrate bioaccumulation task for the Kingston Fossil Plant (KIF) Coal Ash Spill Project. As in 2009 and 2010, the target invertebrate species for this task included the silty hornsnail, *Pleurocera canaliculatum*, and the nymphs and adults of the burrowing mayfly, *Hexagenia bilineata*. All sites sampled in 2010 were included in the 2011 effort for snails and nymphs, while as in the past, adult mayflies were collected opportunistically as close to core sites as possible. The same strategy followed in 2010 for the collection and analysis of depurated and non-depurated snails and nymphs and segregated adult mayflies by sex and adult developmental stage (i.e., subimagos and imagos) also was followed in 2011.

In this summary, the primary focus is on those elements considered constituents of potential ecological concern (COPECs; arsenic, chromium, copper, lead, mercury, nickel, selenium, and zinc) and aluminum. Based on the analysis in the preliminary Baseline Ecological Risk Assessment for KIF that included results from 2009 and 2010, As and Se, and potentially Al, were identified as constituents potentially posing moderate risks to invertebrates via direct exposure and wildlife via consumption of invertebrates, and thus, are covered in greater detail. Consideration of the other COPECs provides clarification and further insight on temporal trending of these potential ecologically important elements. Furthermore, the general trends exhibited by these COPECs are representative of those exhibited by the other 17 elements that were analyzed in the samples.

Preliminary Results

Plots of mean concentrations for As, Se, and Al in snails, mayfly nymphs and adult mayflies are presented in Figs. 1 through 3, respectively, and mean concentrations, standard deviations, and percent concentration differences between 2010 and 2011 for Al and all eight COPECs between 2010 and 2011 are provided in Tables 1 through 3 for snails, mayfly nymphs, and adult mayflies respectively. Although there were some exceptions, concentrations of the COPECs were generally somewhat lower in 2011 at most sites. Higher concentrations of As were found in 2011 in depurated snails from CRM 1.5 and TRM 566.3, but the concentration of As in depurated snails at TRM 571.9 was also somewhat higher in 2011. Concentrations of As in snails were lower or remained relatively unchanged at all Emory River sites in 2011. While concentrations of As were generally lower in adult mayflies collected at most sites in 2011, there were notably higher concentrations in female subimagos at ERM 1.0 and CRM 3.5.

With few exceptions, concentrations of Se were lower or relatively unchanged in snails and nymphs in 2011 compared with 2010, but the concentration of Se in depurated nymphs from ERM 1.0 was higher (Fig. 2, Tables 1 and 2). In previous years, the only adult mayflies collected that had concentration that exceeded EPA's proposed whole body fish criterion were female imagos from ERM 2 in 2010 (Fig 2). In 2011, however, average concentrations equal to or exceeding the proposed criterion were found in several adult mayfly subgroups and sites (Fig. 2, Table 3). Highest concentrations in male subgroups and female subimagos were found at ERM 1.0 (no female imagos were collected at this site in 2011), and based on the concentrations in adults from CRM 3.5 and CRM 1.5, there appeared to be a distinct decreasing concentration gradient with distance from the spill site.

Some of the largest changes in element concentrations in 2011 were exhibited by Al. Concentrations of Al in non-depurated snails were much lower at Emory River sites in 2011 (Table 1, Fig. 3). The only site downstream of the ash spill where concentrations of Al were notably higher in snails was CRM 1.5 (non-depurated only), but the concentration of Al also increased by a similar magnitude in non-depurated snails at CRM 6.0 (Table 1, Fig. 3). Except for much lower concentrations of Al in non-depurated nymphs from the Tennessee River sites, differences between 2010 and 2011 in nymphs were generally not as great as those in snails (Table 2, Fig. 3). Aluminum concentrations in non-

depurated nymphs were still higher in the Emory River downstream of the spill site, but concentrations of Al in depurated nymphs from these sites were similar to those at ERM 6.0.

General Conclusions from 2011 Results

- Little or none of the Al, Cr, Pb, or Ni accumulated in mayfly nymphs appears to be retained in the adults.
- Results for Se continue to show its enrichment in mayfly nymphs and adults downstream of the spill site. Higher concentrations of Se in depurated than non-depurated nymphs, and higher concentrations in adults in 2011 suggest much of the Se in mayflies is associated with tissues. Lower concentrations of Se in non-depurated nymphs in 2011 compared with 2010 suggest that concentrations of Se in the food of the nymphs (including incidentally consumed inorganic particles) may be lower now.
- It appears that concentrations of As may be declining, but results for the nymphs and adults of the mayflies may indicate that some isolated pockets of As may still be present (e.g., ERM 1.0, CRM 1.5, and the shallow inlet on the right descending side of Emory River immediately upstream of the ash disposal ponds and referred to as ERM 3).
- There still appears to potentially be some enrichment of Al in the lower Emory River as suggested from results for non-depurated mayfly nymphs. Concentrations of Al in non-depurated nymphs from the Clinch River sites remain similar to those from the lower Emory River sites, including CRM 6.0. Although the fly ash could be a source of additional Al to the ecosystem, the facts that Al is one of the most abundant elements on earth and it is generally associated with clays are probably important factors contributing the high concentrations and annual variation in non-depurated snails and nymphs. Other than natural physiological differences, differences in habitat and feeding strategies are probably two of the most important factors that can explain the higher concentrations of nymphs relative to snails. Nymphs live in burrows dug in clay where they consume organic matter and inorganic particles including particles with high clay content (that latter is likely incidental). Snails generally live on solid surfaces (e.g., bounders, rocks) in shallow water where they feed on periphyton, which probably presents less opportunity for consumption of clay particles.
- Concentrations of most other COPECs (and many other elements) were generally lower in 2011 compared with 2010. One exception was Hg in adult mayflies where slightly higher concentrations were found in several subgroups/sites downstream or near the spill site. However, concentrations of Hg were still highest at CRM 6.0 in all invertebrate groups, and concentrations of Hg in adult subgroups were similar to, and in most cases, higher at LERM 1.0 than at Emory River sites.
- While concentrations of most COPECs and other elements appeared to be generally lower in 2011, the highest concentrations of several elements were present in the lower Emory and Clinch Rivers.

Uncertainties

- While results from 2011 suggest that concentrations of most contaminants potentially associated with the coal ash may be declining, enough variation exists in the results since 2009 to warrant caution in drawing any conclusions about concentration trends at this time.

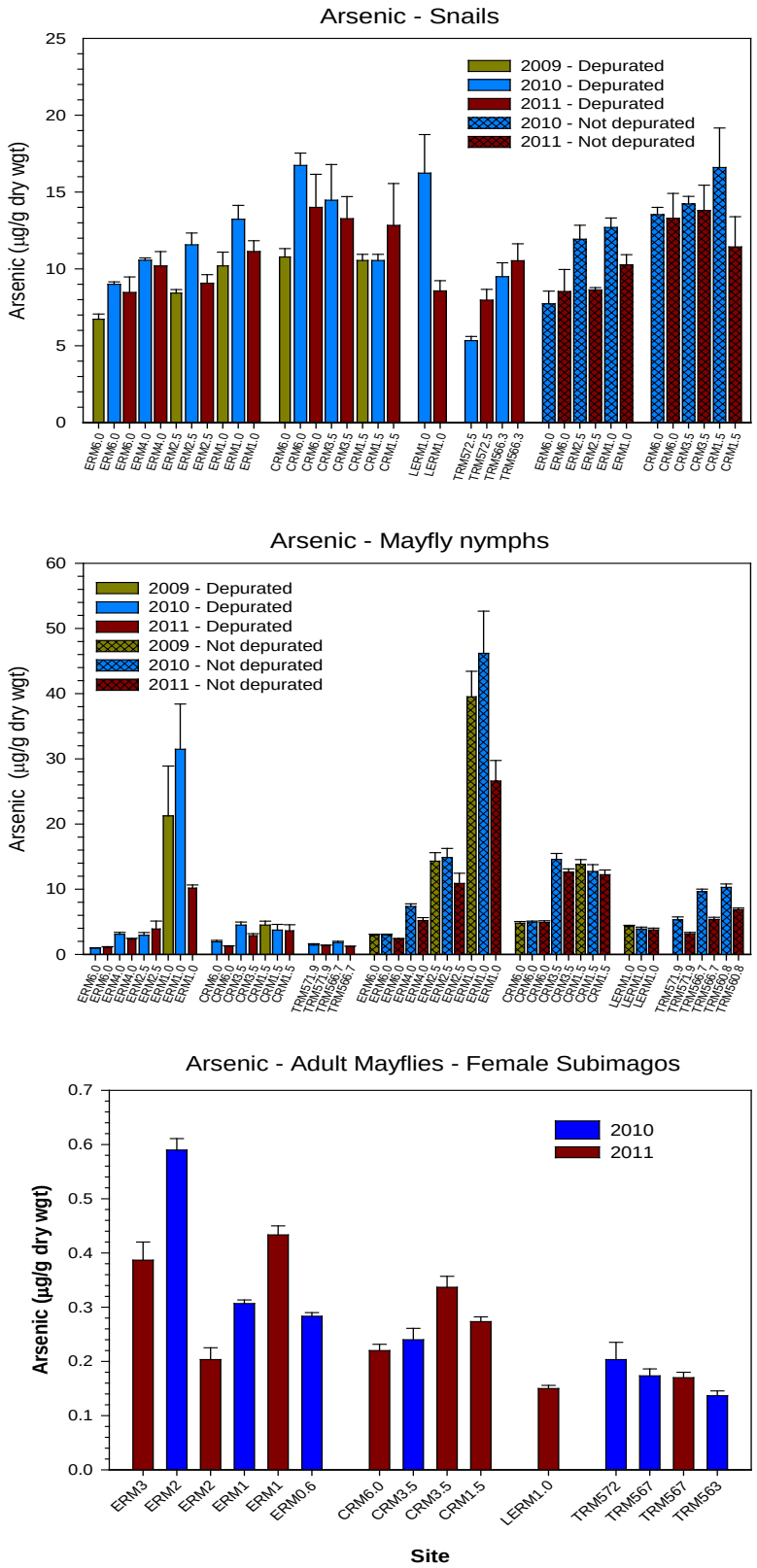

Fig. 1. Mean concentrations (µg/g dry wgt) of arsenic in snails (top), mayfly nymphs (middle), and adult mayfly female subimagos (bottom) from sites in the Emory River, Clinch River, Tennessee River, and Little Emory River, 2009-2011. Values are means ± 1 SE.

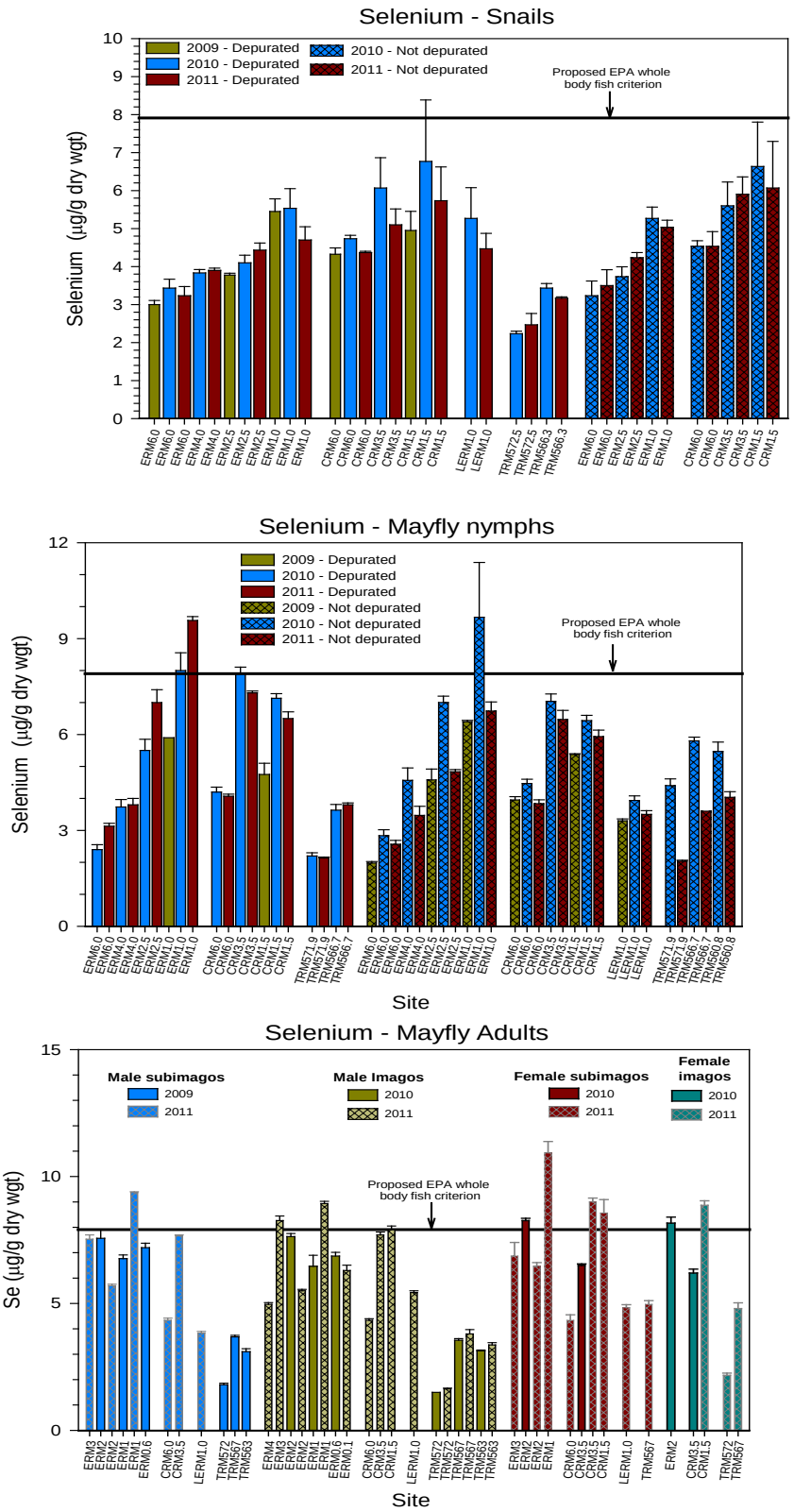

Fig. 2. Mean concentrations (µg/g dry wgt) of selenium in snails (top), mayfly nymphs (middle), and adult mayflies (bottom) from sites in the Emory River, Clinch River, Tennessee River, and Little Emory River, 2009-2011. The horizontal line in each graph shows the proposed EPA whole body fish criterion for reference. Values are means ± 1 SE

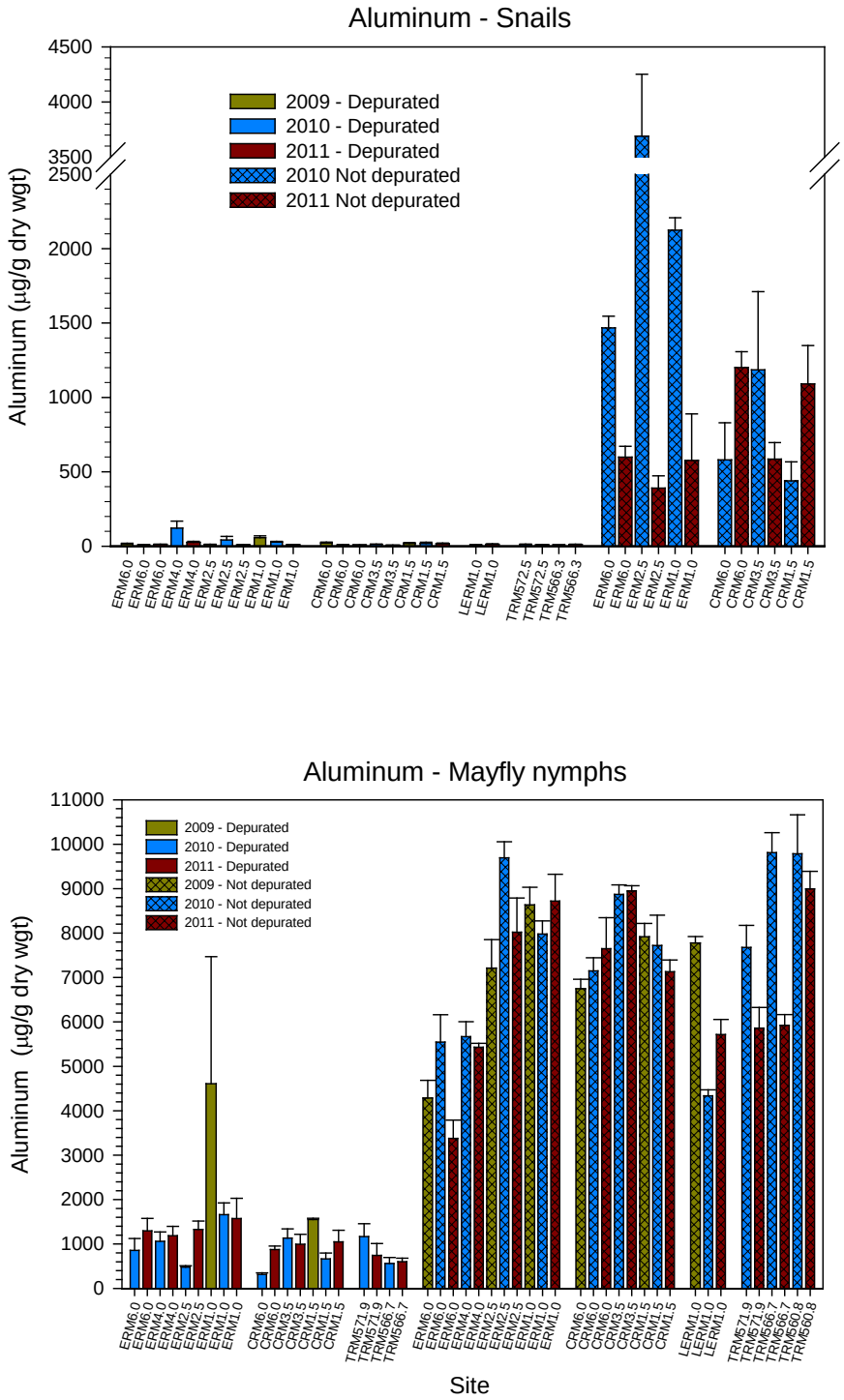

Fig. 3. Mean concentrations (µg/g dry wgt) of aluminum in snails (top) and mayfly nymphs (bottom) from sites in the Emory River, Clinch River, Tennessee River, and Little Emory River, 2009-2011. Values are means ± 1 SE.

Table 1. Mean, standard deviation of the mean (SD), and percent difference between concentrations (total metal) in 2010 and 2011 (%Diff) (µg/g dry weight) of bioaccumulative constituents of potential ecological concern (COPECs) and aluminum in snails (*Pleurocera canaliculatum*) from the Emory River, Clinch River, and Tennessee River, 2011. N = Number of replicate samples.

River/site	Subgroup[1]	N	Statistic[2]	Al	As	Cr	Cu	Pb	Hg[3]	Ni	Se	Zn
Emory River												
			Mean	597.7	8.5	1.57	87.7	1.08	0.138	28.4	3.50	154.3
ERM6.0	NP	3	SD	126.3	2.47	0.21	6.5	0.71	0.048	10.6	0.42	5.5
			%Diff	-21.0	2.6	-25.8	-5.4	-31.2	0.7	2.2	2.0	0.4
			Mean	11.5	8.5	0.58	117.0	0.47	0.111	32.5	3.23	146.3
ERM6.0	P	3	SD	1.72	1.75	0.16	16.5	0.34	0.044	12.5	0.42	22.0
			%Diff	6.7	-1.5	-12.9	-5.1	-2.2	-9.5	-7.0	-1.5	0.8
			Mean	25.4	10.2	0.97	91.6	0.33	0.097	32.0	3.90	194.0
ERM4.0	P	3	SD	11.3	1.6	0.81	24.9	0.05	0.022	12.0	0.1	11.3
			%Diff	-32.7	-1.0	7.4	-7.9	-2.6	3.3	0.5	0.5	-1.4
			Mean	389.7	8.6	1.17	85.3	0.51	0.081	13.5	4.23	100.7
ERM2.5	NP	3	SD	142.6	0.25	0.38	18.3	0.2	0.004	1.6	0.23	9.0
			%Diff	-40.4	-8.0	-32.6	-7.0	-36.6	-4.7	-15.9	3.2	-3.7
			Mean	8.1	9.1	0.58	90.3	0.26	0.092	13.8	4.43	116.7
ERM2.5	P	3	SD	2.7	0.96	0.18	11.3	0.01	0.011	4.2	0.32	4.0
			%Diff	-34.0	-6.1	-5.5	-11.6	-9.1	2.2	-11.7	2.0	-1.8
			Mean	576.0	10.3	2.57	102.7	0.58	0.103	24.5	5.03	181.0
ERM1.0	NP	3	SD	540.6	1.14	1.26	16.6	0.46	0.006	10.9	0.32	53.1
			%Diff	-28.7	-5.3	-9.9	-6.7	-25.4	-2.1	-1.7	-1.1	3.3
			Mean	9.0	11.1	2.12	137.3	0.20	0.102	17.3	4.70	150.7
ERM1.0	P	3	SD	4.0	1.21	1.09	33.0	0.01	0.007	7.4	0.6	39.8
			%Diff	-25.5	-4.2	1.3	0.4	-8.3	4.0	-17.9	-4.1	-10.1
Clinch River												
			Mean	1200.0	13.3	4.40	150.3	1.87	0.293	16.9	4.53	146.3
CRM6.0	NP	3	SD	185.2	2.79	0.96	40.7	0.47	0.094	4.5	0.67	14.6
			%Diff	17.4	-0.4	8.4	-0.8	4.5	1.8	-0.1	0.0	1.8
			Mean	8.5	14.0	2.80	165.0	0.56	0.260	13.1	4.37	146.7
CRM6.0	P	3	SD	1.7	3.73	1.31	21.8	0.09	0.111	1.4	0.06	20.4
			%Diff	-0.2	-4.4	-3.1	-5.0	-0.7	-1.9	-15.6	-2.0	-4.3
			Mean	584.3	13.8	4.40	127.3	0.69	0.167	17.6	5.90	141.7
CRM3.5	NP	3	SD	192.2	2.85	0.95	15.4	0.15	0.038	0.9	0.79	15.9
			%Diff	-17.0	-0.7	3.9	-4.9	-17.5	6.2	0.7	1.3	-3.1
			Mean	6.2	13.3	2.60	123.0	0.30	0.130	13.4	5.10	129.3
CRM3.5	P	3	SD	1.0	2.48	0.5	19.7	0.02	0.017	1.9	0.72	15.0
			%Diff	-16.8	-2.2	-4.1	-8.3	-3.4	-2.4	-17.7	-4.3	-11.7
			Mean	1089.7	11.4	3.90	126.2	1.23	0.140	21.4	6.07	140.3
CRM1.5	NP	3	SD	446.9	3.4	1.91	38.2	0.15	0.036	8.0	2.12	19.0
			%Diff	21.3	-9.2	-7.6	-2.4	-18.9	-11.1	-12.4	-2.2	-7.8
			Mean	16.0	12.8	3.07	151.7	0.40	0.143	22.8	5.73	140.3
CRM1.5	P	3	SD	8.6	4.71	2.39	18.0	0.07	0.042	9.5	1.54	10.6
			%Diff	-2.8	-5.8	-3.8	-5.6	-12.4	-5.3	-11.8	-4.1	-7.7
Little Emory River												
			Mean	12.0	8.6	0.50	115.0	0.23	0.098	14.9	4.47	149.7
LERM1.0	P	3	SD	5.9	1.15	0.12	11.3	0.06	0.014	3.6	0.7	23.8
			%Diff	8.2	-6.0	-19.1	-2.5	2.6	-15.6	-1.1	-4.1	0.2

Tennessee River												
			Mean	7.8	8.0	0.64	112.2	0.43	0.070	9.9	2.47	144.0
TRM571.9	P	3	SD	3.7	1.21	0.07	25.0	0.15	0.013	3.2	0.51	32.7
			%Diff	-5.7	10.1	10.8	0.4	11.2	11.8	13.4	2.5	4.9
			Mean	10.6	10.5	1.20	109.0	0.37	0.103	13.6	3.17	138.7
TRM566.3	P	3	SD	4.1	1.9	0.17	15.6	0.04	0.006	3.7	0.06	25.7
			%Diff	4.3	2.6	-1.4	0.4	8.9	-4.8	7.3	-2.0	-0.9

[1]NP = Not purged (depurated); P = Purged (depurated).
[2]%Diff = % Difference between 2010 and 2011 concentrations. A negative value indicates that the concentration was lower in 2011 and a positive value indicates the concentration was higher.
[3]Mercury in samples collected in 2011 was analyzed with EPA Methods 6020 and 7473, but only the results from EPA 6020 are presented since 2010 samples were analyzed with EPA 6020.

Table 2. Mean, standard deviation of the mean (SD), and percent difference between concentrations (total metal) in 2010 and 2011 (%Diff) (µg/g dry weight) of bioaccumulative constituents of potential ecological concern (COPECs) and aluminum in mayfly nymphs (*Hexagenia bilineata*) from the Emory River, Clinch River, and Tennessee River, 2011. N = Number of replicate samples.

River/site	Subgroup[1]	N	Statistic[2]	Al	As	Cr	Cu	Pb	Hg[3]	Ni	Se	Zn
Emory River												
ERM6.0	NP	3	Mean	3376.7	2.37	3.67	10.6	3.7	0.055	4.57	2.57	197.3
			SD	712.9	0.15	0.55	0.29	0.36	0.006	0.96	0.21	13.9
			%Diff	-12.2	-5.9	-11.6	1.1	-12.0	-1.6	-8.0	-2.4	2.7
ERM6.0	P	3	Mean	1295.3	1.08	1.43	12.3	1.36	0.049	1.73	3.13	216.0
			SD	483.7	0.19	0.51	1.5	0.48	0.009	0.45	0.15	1.0
			%Diff	10.2	3.2	8.9	-22.1	-13.6	3.3	3.6	6.6	-3.7
ERM4.0	NP	3	Mean	5430.0	5.20	6.1	11.8	5.27	0.068	8.13	3.47	178.3
			SD	151.3	0.78	0.37	0.06	0.74	0.004	0.68	0.49	6.8
			%Diff	-1.1	-8.6	-1.7	-0.7	-3.7	0.1	-2.0	-6.9	-1.3
ERM4.0	P	3	Mean	1186.7	2.33	1.43	11.3	1.63	0.068	2.57	3.80	185.0
			SD	363.0	0.25	0.4	0.61	0.68	0.001	0.23	0.35	20.4
			%Diff	2.8	-7.1	2.2	-26.0	-15.3	3.8	7.5	0.5	-6.2
ERM2.5	NP	3	Mean	8020.0	10.90	9.6	16.5	7.8	0.074	12.3	4.83	180.3
			SD	1332.3	2.69	1.51	1.0	1.23	0.004	1.97	0.11	19.0
			%Diff	-4.7	-7.7	-4.8	-3.3	-3.9	-1.1	-4.6	-9.2	0.0
ERM2.5	P	3	Mean	1328.3	3.90	1.8	17.8	1.77	0.065	2.37	7.0	186.3
			SD	323.7	2.09	0.44	1.39	0.32	0.007	0.59	0.49	4.7
			%Diff	23.5	7.1	19.5	-9.4	0.0	6.5	18.3	6.0	-4.7
ERM1.0	NP	3	Mean	8720.0	26.60	12.37	22.1	8.4	0.108	13.13	6.73	164.0
			SD	1047.3	5.46	1.8	0.91	1.01	0.013	1.62	0.49	6.9
			%Diff	2.2	-13.5	2.7	2.0	-3.3	-0.9	0.6	-9.0	2.9
ERM1.0	P	3	Mean	1573.3	10.17	2.53	20.3	2.33	0.058	2.83	9.57	170.7
			SD	786.8	0.85	1.18	2.24	0.84	0.009	1.27	0.21	7.4
			%Diff	-1.3	-25.6	0.0	-14.4	-21.4	6.2	-0.6	4.5	-1.8
Clinch River												
CRM6.0	NP	3	Mean	7646.7	4.93	9.63	17.3	9.47	0.943	9.7	3.83	190.3
			SD	1210.8	0.42	1.3	0.66	1.5	0.395	1.45	0.21	6.7
			%Diff	1.7	-0.2	0.7	-2.2	-0.1	-2.4	-0.5	-3.8	0.8
CRM6.0	P	3	Mean	875.3	1.27	1.33	18.4	1.53	0.167	1.8	4.07	242.7
			SD	133.5	0.12	0.23	1.78	0.32	0.021	0.17	0.15	14.5
			%Diff	23.5	-10.4	17.9	-17.3	-16.2	2.6	12.1	-0.8	-3.2
CRM3.5	NP	3	Mean	8946.7	12.63	11.97	25.4	9.67	0.383	12.27	6.47	182.0
			SD	207.9	0.85	0.5	1.5	0.32	0.049	0.72	0.49	4.6
			%Diff	0.2	-3.6	1.4	5.5	3.0	8.4	0.3	-2.1	0.7
CRM3.5	P	3	Mean	993.7	2.87	1.57	25.3	1.9	0.113	1.97	7.30	221.0
			SD	386.8	0.55	0.64	1.72	0.61	0.033	0.55	0.35	7.2
			%Diff	-3.3	-11.1	-3.0	-5.7	-11.0	5.6	-1.6	-2.0	2.3
CRM1.5	NP	3	Mean	7130.0	12.23	9.33	21.6	7.73	0.347	10.3	5.93	163.0
			SD	454.3	1.26	0.47	2.11	0.47	0.021	0.53	0.11	15.6
			%Diff	-2.0	-1.0	-1.5	0.7	-0.3	5.9	-1.4	-2.0	-3.3
CRM1.5	P	3	Mean	1048.3	3.63	1.57	32.5	2.03	0.098	2.1	6.50	226.3
			SD	454.1	1.58	0.5	4.38	0.65	0.02	0.75	0.36	10.7
			%Diff	11.2	-0.7	9.2	-0.4	-6.8	4.8	8.3	-2.3	2.9
Little Emory River												
LERM1.0	NP	3	Mean	5716.7	3.77	6.43	12.7	5.67	0.067	9.03	3.50	225.0
			SD	584.0	0.46	0.51	0.67	0.4	0.003	0.78	0.2	18.7
			%Diff	6.9	-0.9	6.8	2.2	4.3	3.3	6.0	-2.9	-5.4

Tennessee River												
			Mean	5860.0	3.17	6.57	13.8	7.0	0.051	5.63	2.03	295.3
TRM571.9	NP	3	SD	807.3	0.38	0.93	0.8	1.08	0.003	0.85	0.06	12.4
			%Diff	-6.7	-12.6	-6.6	1.7	-8.3	-2.1	-4.0	-18.4	8.9
			Mean	742.3	1.37	1.04	17.4	1.04	0.028	0.9	2.13	280.0
TRM571.9	P	3	SD	466.1	0.11	0.51	1.26	0.48	0.002	0.36	0.06	22.6
			%Diff	-11.2	-1.1	-9.5	-10.7	-30.5	-6.6	-10.9	-0.8	-3.5
			Mean	5923.3	5.37	7.4	17.3	7.3	0.120	7.03	3.60	256.7
TRM566.3	NP	3	SD	420.6	0.57	0.5	0.49	0.5	0.01	0.5	0.0	13.7
			%Diff	-12.4	-14.2	-10.2	-4.6	-6.1	-0.6	-8.2	-11.7	3.8
			Mean	602.7	1.23	1.05	19.3	1.0	0.044	1.02	3.80	295.3
TRM566.3	P	3	SD	136.1	0.06	0.13	1.04	0.17	0.003	0.15	0.1	25.9
			%Diff	1.8	-9.7	1.7	-10.8	-23.0	1.8	-1.8	1.1	-1.6
			Mean	8993.3	6.87	9.97	18.4	9.03	0.180	9.2	4.03	255.7
TRM560.8	NP	3	SD	687.2	0.45	0.61	1.56	0.67	0.01	0.62	0.31	36.0
			%Diff	-2.1	-10.0	-2.6	-3.2	-1.3	2.9	-1.8	-7.6	0.5

[1]NP = Not purged (depurated); P = Purged (depurated).
[2]%Diff = % Difference between 2010 and 2011 concentrations. A negative value indicates that the concentration was lower in 2011 and a positive value indicates the concentration was higher.
[3]Mercury in samples collected in 2011 was analyzed with EPA Methods 6020 and 7473, but only the results from EPA 6020 are presented since 2010 samples were analyzed with EPA 6020.

Table 3. Mean, standard deviation of the mean (SD), and percent difference between concentrations (total metal) in 2010 and 2011 (%Diff) (µg/g dry weight) of bioaccumulative constituents of potential ecological concern (COPECs) in adult mayflies (*Hexagenia bilineata*) from the Emory River, Clinch River, and Tennessee River, 2011. Only those sites and subgroups with results from 2010 and 2011 are included. The elements Al, Cr, Pb, and Ni were excluded due to a high proportion of concentration below the analytical method detection limit. N = Number of replicate samples.

River/site	Subgroup[1]	N	Statistic[2]	As	Cu	Hg[3]	Se	Zn
Emory River								
			Mean	0.25	27.2	0.064	8.27	90.5
ERM3	MI	3	SD	0.015	0.68	0.005	0.31	3.49
			%Diff	-10.0	0.3	13.7	5.1	1.4
			Mean	0.13	28.9	0.053	5.50	85.5
ERM2	MI	3	SD	0.011	0.35	0.002	0.1	3.26
			%Diff	-23.2	5.8	13.2	-8.1	-1.8
			Mean	0.18	22.7	0.055	5.70	100.4
ERM2	MS	3	SD	0.011	0.85	0.001	0.1	1.4
			%Diff	-20.1	2.1	15.3	-7.0	1.8
			Mean	0.20	13.5	0.042	6.47	220.7
ERM2	FS	3	SD	0.038	0.4	0.003	0.78	7.23
			%Diff	-24.4	0.5	10.8	-6.1	1.6
			Mean	0.27	29.3	0.056	8.93	92.2
ERM1	MI	3	SD	0.011	0.21	0.004	0.15	2.62
			%Diff	-4.5	4.1	3.7	8.0	-1.2
			Mean	0.28	23.3	0.050	9.37	101.2
ERM1	MS	3	SD	0.035	0.83	0.001	0.06	1.71
			%Diff	-2.8	2.7	4.2	8.1	-0.2
			Mean	0.43	13.3	0.042	10.93	234.0
ERM1	FS	3	SD	0.029	0.62	0.001	0.78	9.64
			%Diff	8.6	2.4	2.1	9.7	2.0
Clinch River								
			Mean	0.14	29.1	0.150	4.33	96.8
CRM6.0	MI	3	SD	0.011	1.10	0.0	0.11	6.58
			%Diff	3.8	1.6	7.0	2.7	0.8
			Mean	0.20	29.7	0.080	7.70	90.0
CRM3.5	MI	3	SD	0.015	0.31	0.005	0.2	6.62
			%Diff	-1.6	2.2	0.6	6.3	-1.1
			Mean	0.34	14.0	0.059	9.00	224.0
CRM3.5	FS	3	SD	0.035	0.7	0.003	0.26	12.29
			%Diff	8.4	1.5	0.3	8.1	3.2
			Mean	0.17	25.7	0.091	7.90	89.3
CRM1.5	MI	3	SD	0.01	0.91	0.01	0.26	0.83
			%Diff	1.0	-0.7	13.7	9.7	1.0

Tennessee River								
TRM567	MI	3	Mean	0.127	24.3	0.054	3.80	89.8
			SD	0.025	0.29	0.003	0.11	1.85
			%Diff	0.0	-1.1	0.7	1.7	-0.8
TRM567	FS	3	Mean	0.17	13.9	0.051	4.97	203.0
			SD	0.017	1.01	0.006	0.25	7.21
			%Diff	-0.5	3.2	12.6	2.7	-0.2
TRM563	MI	3	Mean	0.10	28.0	0.043	3.37	92.8
			SD	0.017	0.78	0.003	0.15	3.81
			%Diff	2.2	0.6	-2.9	1.8	-0.2

[1]MI = Male imago; MS = male subimago; FS = Female subimago.
[2]%Diff = % Difference between 2010 and 2011 concentrations. A negative value indicates that the concentration was lower in 2011 and a positive value indicates the concentration was higher.
[3]Mercury in samples collected in 2011 was analyzed with EPA Methods 6020 and 7473, but only the results from EPA 6020 are presented since 2010 samples were analyzed with EPA 6020.