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Trace Element Concentrations and Productivity in Tree Swallows: 2009-2010

Tennessee Valley Authority
Ash Recovery Project
Kingston, Tennessee

May 2012

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Our Ref.:
TNTVAKIP.ECA1

Date:
May 9, 2012

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Acronyms

ANOVA	Analysis of Variance
CRM	Clinch River mile
cy	cubic yard
dw	dry weight
ERM	Emory River mile
FLD	Fort Loudoun Dam
KIF	Kingston Fossil Plant
LERM	Little Emory River mile
MHD	Melton Hill Dam
mg/kg	milligram per kilogram
n	number
Pace	Pace Analytical Services, Inc.
TRM	Tennessee River mile
TVA	Tennessee Valley Authority

1. Introduction

The Tennessee Valley Authority (TVA) Kingston Fossil Plant (KIF), one of TVA's larger fossil plants, is located at the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir in Roane County, Tennessee. Ash, a by-product of a coal-fired power plant, is stored in unlined containment areas, including a former Dredge Cell. Failure of the Dredge Cell dike released about 5.4 million cubic yards (cy) of coal ash covering approximately 300 acres. Fly ash also entered the channel and overbank areas of the riverine section of the Emory River. While the released fly ash itself is primarily composed of fine silica particles very similar to sand, it also contains trace amounts of arsenic, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, zinc, and other metals which occur naturally in the coal.

Evaluations of the spatial extent of ash deposition indicate that ash may have traveled upstream as far as Emory River mile (ERM) 6.0, and as far downstream as Tennessee River mile (TRM) 566 (Jacobs 2010). In the upstream direction, the thickness of ash appeared to diminish quickly beyond about ERM 3.5. In the downstream direction, ash deposition generally diminishes quickly below about ERM 1.0, with pockets of greater depth occurring in depositional areas in the lower Emory River and Clinch River. Downstream of Clinch River mile (CRM) 2.0, ash deposits generally vary from trace amounts to 2 inches. Ash deposition of 0.5 to 1 inch was observed in the Tennessee River at TRM 566 (south of the Clinch River). Only trace amounts of ash have been observed further downstream (Jacobs 2010).

Dredging efforts in the Emory River began on March 20, 2009 and continued until May 29, 2010, and was completed in several phases. Hydraulic dredging in the river began during the first phase, which was an initial dredging pilot program on March 20, 2009. This pilot study continued until July 20, 2009 (during the time-critical removal action). Phase I production dredging began in August 2009 and focused on removing the greatest volume of ash in the quickest time frame to reduce the potential for upstream flooding by clearing the river channel and to minimize downriver migration risk. At the end of the pilot and Phase I dredging, approximately 1.96 million cy of ash had been removed from the river. Phase II dredging began in February 2010 in order to further minimize the potential future ash migration down river. This period of dredging was considered "precision" dredging and was focused on returning the river channel to its original (pre-spill) depths while minimizing disturbance of legacy sediment. An estimated 780,000 cy of ash was removed during the Phase II dredging. During dredging operations, turbidity was expected to increase in the immediate area of the dredging. Engineering controls (silt curtains) and operational controls (i.e., reduce cutter head speed, reduce rate of advance, and reverse cutter head rotation) were implemented to minimize suspending solids during the dredging operations.

As an initial assessment of the ash-related contaminant exposure to avian species, concentrations of contaminants and productivity were studied in tree swallows (*Tachycineta bicolor*) nesting near the TVA Kingston fly ash spill. Eggs, eggshells, and 15-day nestlings were analyzed for metals and metalloids found in coal ash to determine accumulation and extent of maternal transfer of pollutants. It was hypothesized that birds foraging and breeding in ash-contaminated areas would transfer more metals and metalloids to their offspring and have poorer productivity than birds in reference areas, and that metal and metalloid

concentrations would be higher in 2010 than in 2009, as these elements bioconcentrated and accumulated in prey items for both egg-laying adults and 15-day nestlings. Within impacted areas, it was hypothesized locations close to the ash spill (Emory River) would have higher concentrations in eggs and nestlings than locations farther away. Furthermore, it was hypothesized that increases in metals and metalloids would decrease egg dimensions and weight, nestling feather and tarsus lengths and weight, hatching, and nestling success, and female fledglings produced per nesting female.

2. Methods

The methods used for selecting insectivorous bird species are described below, along with a description of the study sites, field collections, trace element analysis, and statistical analysis.

2.1 Species Selection

Tree swallows were selected for this study for several reasons. Tree swallows are widely used as indicator species of local sediment contamination (Bishop et al. 1995; Nichols et al. 1995; Secord et al. 1999). They readily use nest boxes, which can be established at specific sites of interest. They feed near their nest box, primarily on emergent aquatic insects. As a result, residues in their tissues reflect those concentrations of constituents in local sediments that accumulate in the insect biota.

Tree swallows are insectivorous passerines that inhabit standing cavities of dead trees, bluebird boxes, or other artificial structures (Nicholson 1997; Robinson 1990). They are a breeding migratory resident in Tennessee, typically arriving in March and April. Nests are typically cup-shaped, mainly comprised of dead grasses and lined with feathers. Eggs are usually laid in April and May, with peak egg laying in mid-May. Tree swallow clutch sizes in Tennessee range from four to six eggs, with an average of 4.92. Eggs are incubated by the female for approximately 13 to 16 days and nestlings are fed by both adults for approximately 20 days before they fledge (Nicholson 1997; Robinson 1990). Tree swallows prey on a variety of insects, primarily emergent aquatic insects such as mayflies. They catch their prey while flying over the water or in nearly open areas (U.S. Geological Survey 2003; Blancher and McNicol 1991; Quinney and Ankney 1985). Foraging distances from nesting sites typically range from 100 to 200 meters, thus providing good spatial resolution for results (McCarty and Winkler 1999).

Tree swallows may be exposed to constituents of potential ecological concern through bioaccumulation of trace elements in prey that emerges from the water and sediment, as well as through incidental surface water ingestion when foraging. Tree swallow eggs and eggshells were collected to evaluate the transfer of contaminants from the parent to the offspring. In addition, 15-day nestlings were also collected. Adult tree swallows are migratory and subsequently have a history of contamination from multiple sources with varying lengths of exposure, while eggs and eggshells are likely to reflect the exposure history of the laying adult females, as well as the extent of sediment contamination in the area near the nest box. Nestlings that were 15 days old were collected because these offspring are fed emergent benthic invertebrates, and therefore tend to more directly reflect concentrations of contaminants in prey items and sediments near the vicinity of the nest box.

2.2 Study Sites

In 2009, five colonies of tree swallow boxes were established at two potentially-impacted areas immediately around the ash spill, including ERM 3.0 and ERM 3.5, and at one location downstream on the Clinch River at CRM 2.5. In addition, two colonies were established at areas not impacted by the TVA Kingston ash spill.

These included one upstream impoundment on the Tennessee River [Fort Loudoun Dam (FLD)], and one positive control site on the upstream Clinch River [Melton Hill Dam (MHD)] which has known historical contamination from coal ash. The positive control was included to evaluate whether concentrations in the impacted site exceeded those of a highly-impacted area. Colony sites consisted of newly-installed boxes and existing bird boxes. A total of 81 boxes were monitored in 2009.

In 2010, the tree swallow study was expanded to colonies at a total of nine potentially-impacted areas, including locations on the Emory River directly around the spill, areas downstream on the Clinch and Tennessee Rivers, and a total of five unimpacted (reference) areas at nearby impoundment locations. Impacted locations included ERM 3.0 (two colonies), ERM 3.5, several embayments surrounding the KIF plant (East Embayment, West Embayment, and North Embayment), CRM 2.5, CRM 1.0, and TRM 566. The number of reference sites was increased from two (FLD and MHD) to five, adding upstream islands of the Tennessee River (TRM 569.5 and TRM 571.5), another upstream impoundment (Tellico Dam) on the Tennessee River, and one upstream location on the Little Emory River at river mile (LERM) 2.0. In addition to increasing the number of established colonies, predator guards were also placed around the poles of each bird box in an effort to reduce predation. The number of monitored boxes increased from 81 in 2009 to 530 in 2010. All 2009 and 2010 colony locations are depicted on Figure 1. Boxes monitored for productivity data are depicted in Figure 2.

2.3 Field Collections

Tree swallow egg and nestling sampling efforts began in May 2009, approximately 5 months after the spill, and were continued in May 2010. One egg was collected from each occupied, accessible nest with target numbers of ten eggs per area in 2009 and 15 eggs per area in 2010. In addition, one 15-day nestling was collected from each occupied, accessible nest, with target numbers of ten nestlings per area in 2009 and 15 nestlings per area in 2010. When possible, egg and nestling collections were co-located from the same nest. In addition to these collections, efforts were made in 2010 to collect un-hatched “dud” eggs remaining in tree swallow nests at the end of the breeding season.

Tree swallow nests were accessed by foot or by boat (Figure 3a). In 2009, all of the boxes were typically monitored weekly or bi-weekly. During 2010, most boxes were monitored bi-weekly or monthly; however, a subset of boxes at the five original 2009 sites were monitored daily. While these five sites were the focus for egg and nestling collections, when possible, eggs were collected from all established colonies. One egg was randomly selected from each nest, sealed in a labeled plastic bag, placed in a labeled plastic container for transport, and cooled on ice. Clutch size was recorded at the time of collection. Eggs were weighed and measured (length and width) (Figure 3a), and egg volume was calculated (length x width^2 x 0.51) (Hoyt 1979). Each egg was then repackaged in a labeled plastic bag, placed in a labeled glass jar and custody sealed, and then frozen. Samples were shipped to the lab on dry ice for chemical analysis. A subset of 20 eggshells was selected and also analyzed for metals. This included 13 eggshells from potentially-impacted areas and seven eggshells from reference areas.

Similarly, one nestling greater than or equal to 15 days old was randomly selected from each nest and placed individually in a labeled, plastic bag (Figure 3b). The open bag with the nestling was placed in an insulated box with dry ice for euthanasia. Once the specimen was euthanized, the bag was sealed and cooled on ice until processing. Nestlings were processed (weighed, measured length of tarsus and third primary feather) within 24 hours of collection. After processing, each specimen was repackaged in a clean plastic bag, sealed, and frozen. In addition, nestlings that were found dead in nest boxes during monitoring activities were also collected, sealed in labeled plastic bags, placed on ice, and, if possible, processed in the same manner as other nestlings. A summary of the egg, eggshell, and nestling collections by year and location is presented in Table 1. Hatching success and nestling survival (assumed to be equivalent to fledging success) were recorded in 2010 at the time of egg and nestling collections for a subset of the nests. Nests destroyed by predators were excluded from estimates of hatching and nestling survival to focus only on the effects of contamination.

2.4 Trace Element Analysis

Tree swallow egg contents from the impacted and reference sites were separated from shells and the egg contents were analyzed for trace elements. Egg content samples were homogenized prior to analysis. Egg homogenates were digested and analyzed for 26 trace elements (aluminum, antimony, arsenic, barium, beryllium, boron, calcium, cadmium, chromium, cobalt, copper, iron, potassium, lead, magnesium, manganese, mercury, molybdenum, nickel, sodium, selenium, strontium, silver, thallium, vanadium, and zinc) according to Method SW-846 6020. Results were reported in milligrams per kilogram (mg/kg) wet weight. Percent moisture was used to convert results to mg/kg dry weight (dw). All trace element and percent moisture analyses were conducted at Pace Analytical Services, Inc. (Pace) located in Green Bay, Wisconsin or in Minneapolis, Minnesota.

Similarly, nestlings were analyzed for trace elements as whole body samples. Each nestling was homogenized and analyzed for the same set of 26 trace elements using Method SW-846 6020. Results were reported in the same manner as for egg contents.

Tree swallow eggshells were also analyzed for trace elements. After the yolk and egg white were removed from the egg (at the laboratory), the shell was homogenized and analyzed for the same set of 26 trace element concentrations according to Method SW-846 6020. Shells were not rinsed prior to analysis. Results were reported in mg/kg wet weight. Percent moisture was not measured; literature estimates were used to convert results to dw. All trace element analysis was conducted at Pace.

Percent recoveries of spiked samples and certified reference materials were within the Quality Assurance Project Plan-specified or laboratory-derived acceptance limits in most cases. Data associated with recoveries outside these limits were qualified as estimated (J flagged). In addition, a few aluminum results were rejected due to very low recoveries of the quality control samples.

Percent moisture was performed according to Pace standard operating procedures. In some instances, sample volumes were too small or samples were held too long to accurately measure percent moisture (ESI 2011). All but two tree swallow egg percent moistures were rejected (R flagged); therefore, a default literature-based value of 81.6 percent was applied when converting concentrations to dw (Brasso et al. 2010). Percent moisture was not calculated for eggshells; a default percent moisture of 3 percent was used based on literature values of chicken egg membrane water content and considering the water in residual egg white on the eggshell (Ning and Tao 2011). For nestlings with valid percent moisture estimates, the average of percent moisture (67 percent) in all nestling samples with valid moisture results was used as a default percent moisture value.

2.5 Statistical Comparisons

Statistical analyses were conducted to determine whether there were spatial and/or temporal trends in tree swallow eggs, eggshells (spatial trends only), or nestlings. Tree swallow sampling locations were grouped into reference nests and various sets of impacted nests for statistical comparisons. In 2009, the reference site evaluated was FLD. In 2010, reference sites for egg and eggshell data included FLD, Tellico Dam, the upstream Tennessee River (above TRM 568), and the Little Emory River, while only FLD was used as a reference site for nestlings. Impacted sites in 2009 included CRM 2.5, ERM 3.5, and ERM 3.0. In 2010, three more impacted sites were evaluated in addition to those monitored in 2009, including CRM 1.0, TRM 566, and the East, West, and North Embayments, hereafter referred to as the “Embayments.” In addition, a positive control site with known historical contamination (MHD) was evaluated both years.

Summary statistics were calculated for eggs, eggshells, and nestlings (sample size, frequency of detection, mean, standard deviation minimum and maximum detection and detection limits) for each year and location for the 26 metals and metalloids and for egg and nestling biometrics and nest productivity. Spatial and temporal trends were evaluated for all metals, metalloids, biometrics, and nest productivity. For all statistical tests, the null hypothesis of no difference was rejected when p-values were less than 0.05; however, p-values between 0.05 and 0.1 were also evaluated and discussed for conservative measures. Statistical evaluations of calcium, magnesium, potassium, and sodium were not included as these elements are essential nutrients with little to no information available for toxicity in birds.

For all constituents detected in eggs, eggshells, and nestlings with normal or lognormal distribution, two-way analysis of variance (ANOVA) tests were conducted for similar locations (e.g., sites identified as sampled in both 2009 and 2010, including ERM 3.0, ERM 3.5, CRM 2.5, FLD, and MHD) between 2009 and 2010 using Statistical Analysis Software (SAS, v. 9.3), evaluating year, location, and the interaction of year and location using parametric tests. The data for each of these constituents were tested for normality and homogeneity of variance to ensure a parametric test was appropriate. All metals best fit a lognormal distribution for all three tissue types and were natural-log transformed for statistical analyses. Biometric data for eggs and nestlings best fit a normal distribution. Clutch size in 2009 and 2010 did not fit a normal distribution and was evaluated using Scheirer-Ray-Hare extension of the Kruskal-Wallis non-parametric two-way ANOVA.

For locations for which 2009 data were not available, one-way ANOVA tests were used to evaluate differences between locations in 2010 when data were normally distributed. One-way ANOVA tests were conducted for eggs collected from all nine locations in 2010, for eggshells collected from five locations in 2010, and for nestlings collected from five locations in 2010. Both one-way and two-way ANOVAs were followed by a post-hoc test using Tukey-Kramer for unequal sample sizes. In addition, post-hoc Dunnett's test, a test designed to compare each "treatment" site to one "control", was performed on locations to test whether impacted site concentrations were higher (lower for egg and nestling biometrics) than reference sites. For the Dunnett's test, the reference site was FLD for the two-way ANOVA for 2009 and 2010 data. The reference for the Dunnett's test was a composite of FLD, Tellico Dam, and upstream TRM sites when data from 2010 were evaluated in a one-way ANOVA among locations. The composite excluded the two samples collected from LERM and the samples from the positive control at MHD.

To evaluate productivity of the nests, measured in 2010, the 2010 clutch size was multiplied by hatching success and nestling survival and divided by 2 to obtain female fledglings successfully produced per nesting female. None of the productivity metrics (hatching success, nestling survival, and female fledglings per nesting female met assumptions of a parametric test (non-normal distributions), and thus were compared among locations and with reference sites using the non-parametric Kruskal-Wallis test.

Finally, Pearson correlation analyses were conducted for eggs, nestlings, and productivity metrics to determine whether any relationships were evident among trace elements and/or between trace elements and egg or nestling biometrics. Spearman correlation analyses were conducted when parametric assumptions were not met, specifically for clutch size, hatching success, nestling survival, and fledglings produced per nesting female. In addition, Pearson correlation analyses were conducted for eggs and eggshells from the same nest and eggs and nestlings from the same nest.

3. Results

3.1 Frequency of Detections

The frequency of detection, range of detected concentrations, and range of sample-specific detection limits for all analytes in tree swallow eggs, eggshells, and nestlings are presented by year and by location in Appendices A, B, and C, respectively. The frequency of detection for each analyte was determined by combining all sites and years in order to identify which analytes were detected with sufficient frequency to evaluate trends. Analytes that were all non-detects or had many (≥ 25 percent) non-detects in eggs, eggshells, and nestlings were excluded from the statistical analyses. All analytical results for tree swallow eggs, eggshells, nestlings, and productivity data can be found in Appendices D, E, and F, respectively.

In tree swallow eggs, barium and strontium were above detection limits in all samples. Copper, iron, manganese, selenium, and zinc were mostly above detection limits, with frequency of detections between 79 and 99.5 percent. For statistical testing, sample-specific detection limits were substituted for non-detects for these analytes as a conservative measure. Cobalt was only detected in 2010 samples; as a result, data analysis for this metal compared ranges and means among locations in 2010 only. Similarly, mercury was detected at too low a frequency in 2009 (less than 12 percent) for statistical analysis; however, frequency of detection was approximately 50 percent in 2010. Consequently, comparisons for mercury were made between locations in 2010. For statistical testing, sample-specific detection limits were substituted for non-detects for both cobalt and mercury. Tree swallow egg concentrations of aluminum, antimony, arsenic, beryllium, boron, cadmium, chromium, lead, molybdenum, nickel, silver, thallium, and vanadium were below detection limits in most samples (less than 12 percent detection rate) and were not included in further analysis.

In tree swallow eggshells, barium, copper, selenium, and strontium were above detection limits in all samples. Arsenic, manganese, mercury, and zinc had detection frequencies between 25 and 95 percent. For statistical testing, sample-specific detection limits were substituted for these non-detects. Tree swallow eggshell concentrations of aluminum, antimony, beryllium, boron, cadmium, cobalt, lead, molybdenum, silver, thallium, and vanadium were below detection limits in all samples and were not included in further analysis. In addition, concentrations of chromium, iron, and nickel were each detected in only one sample, with estimated values (J flagged), and therefore were also not included in further analysis.

In tree swallow nestlings, barium, copper, iron, selenium, strontium, and zinc were above detection limits in all samples. The dataset for manganese contained a few non-detects in 2009 samples, but had an overall frequency of detection of 97 percent. For statistical testing, sample-specific detection limits were substituted for non-detects. Cadmium and molybdenum were only detected in 2010 samples with frequency of detections of 85 and 77 percent, respectively; as a result, comparisons for these analytes were only made between locations in 2010. Similarly, mercury was detected at too low a frequency in 2009 to evaluate (less than 25 percent); however, frequency of detection was approximately 88 percent in 2010. As a result, comparisons for mercury were made between locations in 2010. For statistical testing of cadmium,

molybdenum, and mercury, sample-specific detection limits were substituted for non-detects. Tree swallow nestling concentrations of antimony, beryllium, and thallium were below detection limits and were not included in further analysis. In addition, concentrations of aluminum, arsenic, boron, chromium, cobalt, lead, nickel, silver, and vanadium were detected in only a few samples (detection frequencies were all below 12 percent) or they were only detected in 2010 with estimated values (J flagged), and therefore were not included in further analysis.

A summary of sample sizes, numbers of detections, means, standard deviations, and ranges of metal and metalloid concentrations analyzed in tree swallow eggs, eggshells, and nestlings and egg biometrics and productivity metrics are presented in Tables 2, 3, and 4, respectively. Spatial trends, evaluation of impacted areas compared to reference areas, gradients with distance from the source, and temporal evaluations of metal concentrations in tree swallow eggs, eggshells, and nestlings are presented in the subsections below and in Figures 4 through 48. Differences between the reference site and the positive control site (MHD) were evaluated, but used for comparison purposes only.

3.2 Tree Swallow Egg Concentrations

Results of the spatial and temporal trend analysis for tree swallow eggs are presented in Tables 5 through 8. Boxplots showing the distribution of data and the median concentrations for each location and year are presented in Figures 4 through 17, and graphs depicting mean concentrations with standard error are presented in Figures 30 through 39. Results are discussed in the subsections below, divided into 1) differences among locations sampled in both 2009 and 2010, allowing the effect over 2 years to be included; 2) differences among the locations only sampled in 2010 combined with other 2010 location data, where only data from 1 year could be evaluated; and (3) differences between years identifying temporal trends.

3.2.1 Spatial Trends between Locations Sampled in Both 2009 and 2010

Tree swallow eggs concentrations were compared among the locations, FLD (reference site), CRM 2.5, ERM 3.5, ERM 3.0, and MHD (positive control). Locations were compared individually and grouped into impacted and reference locations. The two-way ANOVA found significant differences in tree swallow eggs among individual locations only for selenium, strontium, and egg weight (Table 5). In addition, significant differences were also identified for copper when comparing impacted sites to the reference site, FLD, and were close to the level of significance for manganese (Table 6). No significant differences were found among locations for barium, iron, zinc, egg length, egg width, or egg volume. The specific locations and magnitude of the significant differences are discussed below.

- In 2009 and 2010, copper concentrations were less than 1 mg/kg dw higher in impacted eggs than reference concentrations (at FLD), and significant differences were only at CRM 2.5 when employing the Dunnett's post-hoc one-tailed test (Table 6, Table 2; Figure 31). Other two-tailed pairwise comparisons using Tukey-Kramer post-hoc did not identify impacted sites as having higher concentrations than the

reference site (Table 5). Two-tailed tests provide all pairwise comparisons of year/location combinations, but have less power to detect differences than the one-tailed test, which combines years.

- Manganese concentrations were close to the level of significance, with higher concentrations in impacted eggs in ERM 3.0 than in FLD reference eggs using Dunnett's one-tailed post-hoc tests (Table 6), but differences were not close to significant using two-tailed post-hoc tests (Table 5). Mean concentrations of manganese in ERM 3.0 eggs were no more than 2 mg/kg dw higher in manganese than FLD eggs in 2009 and in 2010 (Figure 8, Figure 33).
- Selenium concentrations were significantly different between locations, with higher concentrations in eggs in all impacted sites than in FLD reference eggs (Table 6) using Dunnett's post-hoc one-tailed test and in eggs at ERM 3.0 compared to FLD eggs using the two-tailed Tukey-Kramer post-hoc test (Table 5). Mean concentrations of impacted eggs were about 1.0 to 1.5 mg/kg dw higher in selenium than FLD eggs in 2009, while 2010 impacted eggs were 0.3 to approximately 2 mg/kg dw higher in selenium concentrations than 2010 FLD eggs (Table 2; Figure 36).
- Strontium concentrations were significantly different between locations, with higher concentrations in impacted eggs only at CRM 2.5 than in FLD reference eggs using the one-tailed post-hoc test (Tables 5 and 6). However, ERM 3.0 eggs were close to being significantly higher compared to FLD eggs (Table 6) using the one-tailed test. Mean concentrations of strontium in CRM 2.5 eggs were approximately 12 mg/kg dw greater than FLD reference eggs in 2009; however, mean concentrations were similar in 2010, with the reference FLD location concentration being only about 0.4 mg/kg dw lower than CRM 2.5 (Table 2; Figure 38).
- Egg weights were close to the level of significance, with lower weights in impacted eggs than in reference eggs. CRM 2.5 had significantly lower egg weights than FLD using the Dunnett's one-tailed test. Using the two-tailed post-hoc test, CRM 2.5 in 2009 was lower than FLD in 2009. However, the 2009 measurements had low precision and possibly low accuracy due to weighing to the nearest gram rather than nearest 0.1 gram, as was done in 2010 (values for CRM 2.5 were either 1 or 2, Table 2). The egg weight result for 2009 has much uncertainty and no post-hoc significant differences were observed between impacted and FLD reference sites in 2010 (Table 5) when measurements were more precise (see Section 3.1.2 on 2010 egg weight results).

3.1.2 Spatial Trends between 2010 Locations

Evaluation of differences for the 2010 tree swallow egg data indicated significant differences for barium, iron, manganese, mercury, selenium, and zinc, and close to the level of significance for clutch size and egg weight. No significant differences were found among 2010 locations for cobalt, copper, strontium, egg length, egg width, or egg volume. Unlike 2009 which only had FLD as a non-positive control reference site, the 2010 locations included a composite reference site (FLD, Tellico Dam, and upstream Tennessee River) and a second reference site, LERM 2.0. Due to the small sample size [number (n) = 2], LERM 2.0 was not considered representative of the area, and was therefore not used as a reference site for statistical

comparisons. The potentially-impacted sites included TRM 566, CRM 1.0, CRM 2.5, ERM 3.5, ERM 3.0, Embayments, and MHD (positive control). Details of the comparisons are discussed below.

- Significant Dunnett's post-hoc comparisons indicated higher mean barium, iron, manganese, and zinc concentrations in TRM 566 eggs compared to the composite reference site, as well as compared to other impacted sites (Tables 2 and 8). The mean barium concentration in TRM 566 eggs (Table 7) was three times the mean barium concentration in the more upstream CRM 2.5 eggs (Table 2; Figure 30). Dunnett's post-hoc comparisons also indicated higher iron concentrations in eggs in the impacted site, TRM 566, compared to the composite reference site (Table 8). Tukey-Kramer post-hoc comparisons showed significantly higher concentrations in eggs from TRM 566 than from CRM 2.5, ERM 3.5, and the composite reference site (Table 7). The mean iron concentration in TRM 566 eggs was almost double the mean iron concentration in CRM 2.5 and ERM 3.5 eggs (approximately 140 mg/kg dw more), and was approximately 107 mg/kg dw greater than the reference site (Table 2; Figure 32). The mean manganese concentration in TRM 566 eggs was more than double the mean manganese concentrations in CRM 2.5, ERM 3.5, and composite reference site eggs (Table 2; Figure 34). Zinc concentrations were significantly higher at TRM 566, with double the mean zinc concentration compared to CRM 2.5 eggs (Tables 2 and 7). Furthermore, the mean concentration of zinc at TRM 566 was approximately 45 mg/kg dw greater than the mean zinc concentration for the composite reference site (Table 2; Figure 39). Given the distance of TRM 566 from the ash spill and the lower levels of barium, iron, manganese, and zinc in impacted sites found closer to the spill, it is unlikely that the increases in these four constituents are attributed to potential effects of the ash release and could possibly be caused by a historical source or a source unrelated to the ash spill.
- Mercury concentrations were significantly higher in impacted eggs at a number of sites than in reference eggs (Table 7). Specifically, Dunnett's post-hoc testing found significantly higher concentrations of mercury in ERM 3.5, ERM 3.0, and the Embayment eggs compared to FLD reference eggs (Table 8). Tukey-Kramer post-hoc comparisons found significantly higher concentrations of mercury in eggs from ERM 3.0, ERM 3.5, and the Embayments compared to TRM 566 eggs, MHD positive control eggs, and the composite reference site. Comparisons of mercury concentrations at CRM 1.0 and CRM 2.5 could not be made because all mercury concentrations were below the detection limits for those two locations. Although the ranges of mercury concentrations were similar between impacted sites and the composite reference sites (Figure 35), mean mercury concentrations in eggs from ERM 3.5 and ERM 3.0 the Embayments were approximately 0.07 mg/kg dw higher than the concentrations of mercury in eggs from the composite reference sites (Table 2; Figure 35). The frequency of detection for mercury was relatively low (less than 50 percent) in both reference and impacted sites. Sample-specific detection limits were substituted for non-detects, which could have inflated the mean concentrations.
- Selenium concentrations were significantly higher in impacted eggs at many sites than in reference eggs (Table 8). Dunnett's one-tailed post-hoc comparisons found significantly higher concentrations in TRM 566, CRM 1.0, CRM 2.5, ERM 3.0, and Embayments compared to the composite reference site (Table 8). When evaluating all two-tailed pairwise post-hoc comparisons (Table 7), selenium concentrations in TRM 566, ERM 3.0, Embayments, and MHD eggs were significantly higher than

concentrations in the composite reference eggs, and higher selenium concentrations in CRM 2.5 were close to the level of significance compared to the composite reference. Mean concentrations of selenium in impacted eggs were approximately 0.7 to 1.7 mg/kg dw higher than the concentrations of selenium in composite reference site eggs (Table 2; Figure 37).

- Clutch size was not significantly smaller in impacted than reference locations (Table 6) and 2010 comparisons showed significant differences were only observed between the composite reference and positive control (MHD) locations (Table 7). Such a difference is not considered to be an effect of the ash release and is not discussed further.
- Egg weights were close to the level of significance, with lower weights in impacted eggs than in reference eggs (Table 7). However, when post-hoc comparisons were evaluated, no specific comparisons were identified as significant using the Tukey-Kramer or Dunnett's tests. As a result, these differences are likely an artifact of natural variability among eggs and habitats.

3.1.3 Temporal Trends

Evaluations of tree swallow eggs comparing differences between years 2009 and 2010 found significant differences for copper, iron, strontium, and egg weight as discussed below. No significant differences in year were found for barium, manganese, selenium, zinc, clutch size, egg length, egg width, or egg volume (Table 5).

- Copper concentrations were significantly different between 2009 and 2010 locations, with higher concentrations in 2009 than in 2010 (Table 5), opposite of the hypothesis that it takes time to bioaccumulate up the food chain, and 2010 should be higher. The Tukey-Kramer post-hoc comparisons found significantly higher concentrations in 2009 MHD eggs compared to 2010 eggs from MHD, FLD, ERM 3.0, and ERM 3.5 (Table 5); however, a significant interaction was identified between years and locations. The ranges of copper concentrations in MHD 2009 eggs were approximately 1 to 2 mg/kg dw higher than concentrations in FLD and ERM 3.5 eggs; however, in 2010 copper concentrations shifted down in all eggs, including MHD (Table 2; Figure 31). Given that the significant driver between concentrations is higher copper values at MHD, this is not considered to be an effect of the ash release and is not discussed further.
- Iron concentrations were significantly different between years, with higher concentrations in 2009 eggs than in 2010 eggs (Table 5), opposite of the hypothesis that 2010 should be higher. However, when post-hoc comparisons were evaluated, no specific comparisons were identified as significant using the Tukey-Kramer test (Table 2; Figure 32).
- Strontium concentrations were significantly different between years, with higher concentrations in 2009 eggs than in 2010 eggs (Table 5), opposite of what was hypothesized. When evaluating post-hoc comparisons, strontium concentrations were significantly higher in 2009 CRM 2.5 eggs compared to FLD, ERM 3.5, CRM 2.5, and MHD 2010 eggs. Mean concentrations of strontium in CRM 2.5 eggs had approximately 11 mg/kg dw more strontium than CRM 2.5 eggs in 2010 (Table 2). Although strontium

concentrations were significantly higher in CRM 2.5 2009 eggs, these differences appear to be driven by one egg with a strontium concentration of 51.45 mg/kg dw (Figure 11).

- Egg weights were significantly different between years, with lower weights in 2009 eggs than in 2010 eggs at several locations. In 2009, CRM 2.5 had significantly lower egg weights than ERM 3.5 and MHD 2010 eggs. In addition, MHD 2009 eggs had significantly lower weights than ERM 3.0, ERM 3.5, FLD, and MHD 2010 eggs (Table 2; Figure 14). As previously discussed, egg weight measurements had low precision and possibly low accuracy in 2009 due to measurement to nearest gram rather than nearest 0.1 gram, as was done in 2010 and differences may be an artifact of imprecise measurements in 2009.

3.2 Tree Swallow Eggshell Concentrations

Results of the spatial and temporal trend analysis for tree swallow eggshells are presented in Tables 9 and 10. Boxplots showing the distribution of data and the median concentrations for each location and year are presented in Figures 18 through 22, and graphs depicting mean concentrations with standard error are presented in Figures 40 and 41. Eggshells were only collected in 2010. Results are discussed in the subsections below, which only discuss 2010 results because eggshells were not collected in 2009.

3.2.1 Spatial Trends between 2010 Locations

Significant differences in tree swallow eggshells were evaluated by comparing locations in 2010. These locations included a composite reference site (FLD, Tellico Dam, and upstream Tennessee River), potentially-impacted sites (TRM 566, ERM 3.0, and Embayments), and MHD (positive control). Significant differences in tree swallow eggshells between these locations were found for barium and strontium, as discussed below. Zinc was also significantly different between locations, but only in the direction of reference sites having higher concentrations than impacted sites. No significant differences were found between 2010 locations for arsenic, copper, manganese (see Section 3.6), mercury, or selenium.

- Barium concentrations were significantly higher in eggshells in impacted locations than in reference locations (Tables 9 and 10). Dunnett's post-hoc comparisons indicated higher barium concentrations in TRM 566 eggshells compared to the composite reference site. Post-hoc Tukey-Kramer pairwise comparisons showed significantly higher barium concentrations at TRM 566 compared to ERM 3.0 and the composite reference site. While the mean eggshell concentration at TRM 566 was based on a sample size of two, both concentrations were the highest values from all of the impacted and reference sites combined (Table 3; Figure 40), and TRM 566 also was highest in egg content (based upon higher sample sizes). Given the distance of TRM 566 from the ash spill and the lower levels of barium in impacted sites found closer to the spill, it is unlikely that the increases in barium in eggs and eggshells are attributed to potential effects of the ash release, but probably are due to a historical source or factors unrelated to the ash spill.
- Strontium concentrations in eggshells were almost significantly higher in impacted sites than in than reference sites (Tables 9 and 10). Using Dunnett's post-hoc test, strontium concentrations were close to

the level of significance when comparing TRM 566 and the Embayments to the composite reference site, with the impacted sites having higher strontium concentrations than the reference sites. Post-hoc Tukey-Kramer comparisons also showed significantly higher strontium concentrations at the Embayments compared to the positive control, MHD. Although the sample sizes were small, strontium concentrations from eggshells in the Embayments and TRM 566 even had higher ranges compared to the composite reference site, ERM 3.0, and MHD (Table 3; Figure 41).

- No differences were identified for zinc concentrations in eggshells between impacted locations and reference sites using the Dunnett's post-hoc tests (Table 10). Tukey-Kramer post-hoc comparisons indicated significantly higher concentrations for the composite reference site compared to ERM 3.0 and MHD eggshells (Table 9), the opposite of what was expected. Zinc was not detected in any of the samples from ERM 3.0 and was detected in only one sample from MHD. Given that zinc concentrations were higher in reference eggs than in impacted eggshells, these differences were not attributed to potential effects of the ash spill (Table 3).

3.2.2 Temporal Trends

Evaluations by year could not be determined as eggshells were only analyzed in 2010.

3.3 Tree Swallow Nestling Concentrations

Results of the spatial and temporal trend analysis for tree swallow nestlings are presented in Tables 11 and 12. Boxplots showing the distribution of data and the median concentrations for each location and year are presented in Figures 23 through 29, and graphs depicting mean concentrations with standard error are presented in Figures 42 through 48. Results are discussed in the subsections below when examining 1) effects of location on concentrations of nestlings collected from the same sites in 2009 and 2010, and 2) effect of year on concentrations of nestlings collected in 2009 and 2010.

3.3.1 Spatial Trends between Locations Sampled in Both 2009 and 2010

Significant differences in tree swallow nestlings were evaluated by comparing locations measured in both 2009 and 2010, where FLD is the reference site for comparison to impacted sites. The locations evaluated included FLD (reference site), CRM 2.5, ERM 3.5, ERM 3.0, and MHD (positive control). Significant differences in tree swallow nestlings between these locations with higher concentrations in the impacted sites than the reference sites were only found for cadmium, manganese, mercury, selenium, and strontium, as discussed below. P-values were close to the level of significance for zinc with higher concentrations in the impacted sites than the positive control MHD. P-values were also close to the level of significance for iron, but the reference site concentrations were higher in iron than the impacted sites, opposite of what is expected if ash increased iron. No significant differences were found between locations for barium, copper, molybdenum, clutch size, nestling weight, feather length, or tarsus length.

- Cadmium was only detected in 2010; therefore, comparisons were made only between locations in 2010. Dunnett's post-hoc tests found that concentrations of cadmium in ERM 3.5 were close to the level of significance, with higher concentrations in the impacted ERM 3.5 nestlings than FLD reference nestlings (Table 12). Post-hoc comparisons using Tukey-Kramer indicated that cadmium concentrations in nestlings from the positive control, MHD, were greater than nestlings from the impacted ERM 3.0 site. The ranges of cadmium concentrations were similar between locations (Figure 23); however, the mean cadmium concentration in ERM 3.5 nestlings was only 0.03 mg/kg dw higher than in FLD nestlings (Table 4; Figure 42).
- Iron concentrations were close to the level of significance when evaluating location, but higher concentrations were observed in the reference location FLD and positive control MHD than impacted locations (Table 11; Figure 43), opposite of what was hypothesized. Dunnett's test, which only evaluates if impacted sites have greater concentrations than reference sites, showed no significant differences (Table 12).
- For manganese, no pairwise comparisons between ERM 3.0 or any other impacted site compared to the FLD reference site resulted in significant differences using the Dunnett's test (Table 12). Post-hoc pairwise comparisons using the Tukey-Kramer test indicated that concentrations of manganese in ERM 3.0 nestlings in 2009 were significantly higher than for nestlings at the positive control, MHD, in 2009 (Table 11; Figure 44), but not compared to the reference site (Table 12).
- Mercury was only detected with sufficient frequency for comparisons in 2010; therefore, statistical evaluations were made only between locations in 2010. Mercury concentrations were significantly higher in impacted nestlings than in reference nestlings (Table 11). Dunnett's post-hoc testing found significantly higher concentrations of mercury in CRM 2.5, ERM 3.5, ERM 3.0, and MHD nestlings compared to FLD nestlings (Table 12). Tukey-Kramer post-hoc pairwise comparisons found significantly higher concentrations of mercury in nestlings from ERM 3.0, ERM 3.5, and CRM 2.5 compared to MHD nestlings and FLD nestlings. Mean mercury concentrations in nestlings from CRM 2.5, ERM 3.5, and ERM 3.0 were more than double the concentrations of mercury in nestlings from FLD (Table 4; Figure 45).
- Selenium concentrations in nestlings were not significantly higher in impacted sites than reference sites (Tables 11 and 12) unless MHD was removed from the Dunnett's post-hoc analysis and then ERM 3.0 was significantly higher (by 0.3 to 0.4 mg/kg) than FLD (Table 2, Table 21). In Section 3.6, the results from removing MHD from the post-hoc analysis are discussed further. Tukey-Kramer post-hoc comparison testing indicated that concentrations of selenium at the positive control (MHD) in 2009 and 2010 were significantly higher than at all other impacted sites in 2009 and 2010 (ERM 3.0, ERM 3.5, and CRM 2.5) and at FLD in 2009 and 2010 (Table 4; Figure 46).
- Strontium concentrations were almost significantly higher in impacted nestlings than in reference nestlings (Tables 11 and 12). Dunnett's post-hoc comparisons indicated that only ERM 3.0 was close to the level of significance when comparing strontium concentrations in nestlings to the FLD reference site (Table 12). All significant post-hoc Tukey-Kramer pairwise comparisons showed higher strontium concentrations at impacted site locations (ERM 3.0, ERM 3.5, and CRM 2.5) compared to strontium

concentrations in nestlings from the positive control, MHD. Mean concentrations of strontium in ERM 3.0 nestlings were approximately 6 to 7 mg/kg dw higher than strontium concentrations in FLD nestlings in 2009 and 2010 (Table 2; Figure 47).

- No differences in zinc concentrations in nestlings were identified between impacted locations and reference sites using the Dunnett's post-hoc tests (Table 12; Figure 48). Post-hoc Tukey-Kramer pairwise comparisons indicated that zinc concentrations in CRM 2.5 and ERM 3.5 nestlings in 2010 were higher than zinc concentrations in 2009 nestlings from the positive control, MHD.

3.3.2 Temporal Trends

The evaluations of tree swallow nestlings comparing similar locations by year found significant differences for iron, zinc, and tarsus length, as discussed below. No significant differences in year were found for barium, cadmium, copper, manganese, mercury, molybdenum, selenium, strontium, clutch size, nestling weight, or feather length. No interaction terms were significant in the two-way ANOVA for nestlings, indicating that trends observed among locations in 2009 were similar in 2010.

- Iron concentrations were significantly different between years, with higher concentrations in 2010 than 2009 nestlings (Table 11), which would support the hypothesis that bioaccumulation into the eggs takes time, except for the finding in Section 3.3.1 above that the reference site had more iron in the eggs than the impacted sites. Post-hoc comparisons indicated that iron concentrations in nestlings from FLD in 2010 were significantly greater than iron concentrations in nestlings from CRM 2.5 and ERM 3.5 in 2009, and the positive control, MHD, in 2009. In addition, iron concentrations in MHD 2010 nestlings were significantly higher than iron concentrations in 2009 CRM 2.5 nestlings. These higher concentrations in the reference sites are not likely attributed to potential effects of the ash spill and will not be discussed further (Table 4; Figures 24 and 43).
- Zinc concentrations were significantly different between years, with higher concentrations in 2010 than 2009 nestlings (Table 11). Post-hoc comparisons indicated that zinc concentrations in nestlings from CRM 2.5 and ERM 3.0 were significantly higher than zinc concentrations in 2009 MHD nestlings, but not higher than the FLD reference site. Given that the significant driver between concentrations is lower concentrations of zinc at the positive control, MHD, this is not considered to be an effect of the ash release and is not discussed further (Table 4; Figure 48).
- Tarsus lengths were significantly different between years, with longer tarsus lengths in 2010 than in 2009 nestlings (Tables 4 and 11; Figure 29). However, tarsus lengths were not significantly different among locations (Section 3.3.1). The expectation, if constituents reduce tarsus length, would be that 2010 nestlings would have shorter tarsus lengths than 2009 nestlings due to lag in bioaccumulation of chemicals through the food chain. The data do not support that hypothesis and the results do not implicate ash as the cause of the temporal difference.

3.4 Correlations Between Metal Concentrations and Egg or Nestling Metrics

Pearson and Spearman correlation tests were conducted for eggs, eggshells, and nestlings in order to evaluate relationships between metal concentrations and egg or nestling metrics. These tests assess how well the relationship between two variables can be described, as well as indicating the degree of linear dependence between the two variables. The sign of the correlation indicates the direction of association between the two variables, with positive coefficients indicating a positive correlation and negative coefficients indicating a negative correlation.

3.4.1 Tree Swallow Eggs

In tree swallow eggs, while several metals indicated a significant positive correlation with each other, barium, copper, iron, and strontium were the only metals or metalloids that showed a significant (or close to significant) correlation with the egg biometric data in the hypothesized direction (negative correlation of egg metrics with metals, Table 13). Copper and strontium both showed a negative correlation with egg weight ($R = -0.24$ and $R = -0.14$), indicating that as copper and strontium increased, egg weight decreased. Barium showed a negative correlation with clutch size ($R = -0.14$), but a positive correlation with egg width and egg volume ($R = 0.20$ and $R = 0.18$, respectively). Iron showed a negative correlation with clutch size ($R = -0.19$), but a positive correlation with egg weight ($R = 0.12$). Opposite of the hypotheses, zinc showed a positive correlation with egg weight ($R = 0.14$). Of these metals, only copper and strontium and possibly barium (see Section 3.6) egg concentrations were elevated above reference egg concentrations, however.

3.4.2 Tree Swallow Nestlings

In tree swallow nestlings, while several metals indicated a significant positive correlation with each other, barium, copper, iron, manganese, selenium, and zinc showed a significant (or close to significant) correlation with the nestling biometric data (Table 14). Copper, iron, and zinc all showed a negative correlation with nestling weight ($R = -0.44$, $R = -0.29$, and $R = -0.40$, respectively) and feather length ($R = -0.24$, $R = -0.30$, $R = -0.34$, respectively), indicating that as copper, iron, and zinc increased, nestling weight and feather length decreased. Barium and manganese showed a negative correlation with feather length ($R = -0.16$ for both), indicating that as barium and manganese concentrations increased, feather length decreased. None of these metals in nestlings was elevated above reference concentrations in nestlings.

3.4.3 Tree Swallow Eggs versus Eggshells from the Same Nest

Eggshells were analyzed primarily to evaluate strontium concentrations in impacted eggs compared to reference eggs, as this analyte is often used as a tracer for ash exposure. However, given that analytical data were available for all other metals and metalloids, an exploratory analysis of potential correlations between eggs and eggshells coming from the same nest was also conducted. This analysis indicated several positive correlations between metals. Barium, iron, selenium, and zinc were all positively correlated, indicating that as each metal concentration increased in eggs, it also increased in eggshells (Table 15).

3.4.4 Tree Swallow Eggs versus Nestlings from the Same Nest

Tree swallow eggs and nestlings collected from the same nest indicated several positive correlations between metals. Cobalt, mercury, and strontium were all positively correlated, indicating that as each metal concentration increased in eggs, it also increased in nestlings (Table 16).

3.5 Nest Productivity

Of the three metrics used to calculate fledglings produced per nest in 2010 (clutch size, hatching success, nestling survival), only hatching success and clutch size significantly differed among locations (Table 17, Figure 49). No impacted sites had lower clutch size than the reference site, FLD. The impacted sites, ERM 3.0 and ERM 3.5, had significantly lower hatching success than the reference site, FLD, but did not differ significantly from the positive control, MHD. Within the impacted reaches, ERM 3.5 had significantly lower clutch size and almost significantly lower hatching success than the more downstream impacted site CRM 2.5 (Table 17). ERM 3.0 also had significantly lower clutch size than the more downstream CRM 2.5. When these metrics were combined into fledglings produced per nesting female, none of the locations showed significant differences, although ERM 3.5 almost had significantly lower fledglings per nesting female than the more downstream impacted site CRM 2.5 (Table 17, Figure 50).

Mean productivity measurements for each site are presented in Figure 51. When nests were combined into two larger groups: impacted ($n = 38$) and reference sites ($n = 19$), no differences were significant ($p > 0.05$, Kruskal Wallis non-parametric test). (Note: MHD was included as a reference site in this analysis since it produced higher productivity than FLD, the established reference site.) However, nestling survival was almost significantly lower by 6 percent in the impacted sites than the reference sites ($p = 0.082$, Kruskal Wallis test, Figure 52). The other three metrics showed a smaller reduction of 3 to 5 percent, but the reduction was far from significant ($p > 0.27$, Kruskal-Wallis test, Figure 52).

Very few trace element concentrations in eggs were negatively and significantly correlated to productivity metrics (Table 18). Strontium was significantly and negatively correlated to nestling survival. Manganese and zinc in eggs were significantly correlated to reductions in female fledglings produced per nesting female ($R = -0.29$ and -0.33, respectively). However, of these three metals, only manganese and strontium in eggs were possibly elevated above reference levels due to the ash. Sample sizes were large ($n > 57$) for correlations (compared to ANOVAs), and thus power to detect correlations is high and "almost significant" results ($0.05 < p < 0.1$) with R values in 0.2 to 0.29 range (Table 18) are unlikely to be meaningful relationships. No significant or even close to significant correlations of eggshell concentrations with productivity metrics were found but sample sizes were small ($n < 9$).

For nestlings, some element concentrations were negatively and significantly correlated to productivity metrics (Table 19). None were significantly correlated to hatching success, but barium and zinc nestling concentrations were significantly correlated or close to the level of significance, with reductions in nestling survival ($R = -0.24$ to -0.31). However, none of these metals had nestling concentrations potentially elevated

above reference sites by the ash. Selenium was slightly negatively correlated to hatching success, nestling survival, and fledglings produced when measured in eggs (R = -0.17, -0.10, and -0.01, respectively, Table 19), but the Spearman correlation coefficients were not significant (P > 0.19), despite large sample sizes of 71, 57, and 57, respectively. Consequently, selenium in nestlings was not negatively correlated with any productivity metrics.

3.6 Removal of Melton Hill Dam from Analyses

MHD, the positive control site, has known historical contamination from non-spill related events. Results from this location were used for comparative purposes only. However, after all statistical analyses were completed, it was discovered that removing MHD from the analyses could potentially change the results of the spatial and temporal trends for the remaining sites. As a result, all analyses were repeated excluding this site for each tissue type and for nest productivity (Tables 20 through 28). A summary of the changes that occurred compared to the original results is discussed below for each tissue type and for nest productivity.

3.6.1 Tree Swallow Eggs

Results of the spatial and temporal trend analysis for tree swallow eggs when MHD is removed from the statistical analysis are presented in Tables 20 through 23. Only results that changed interpretation from the previous analysis with MHD are discussed. When MHD was removed from the two-way Kruskal Wallis test, Table 21), changes in barium temporal and spatial results were observed with almost significantly higher concentrations in 2009 than 2010, opposite of the hypothesis it takes time to bioaccumulate metals. However, Tukey-Kramer post-hoc comparisons indicated no significant differences for barium. Spatially, ERM 3.0 had significantly higher barium concentrations than the FLD reference site. In addition, egg lengths were no longer significantly different when MHD was excluded.

Comparisons with eggs collected in 2010 only are presented in Tables 22 and 23. Results of the one-way ANOVA (and Kruskal-Wallis test for clutch size) were similar to the original analyses, with the exception that no significant differences were observed for clutch size.

3.6.2 Tree Swallow Eggshells

Results of the spatial trend analysis for tree swallow eggshells are presented in Tables 24 and 25. Results of the one-way ANOVA were similar to the original analyses, with the exception of manganese and strontium. When MHD was removed from the analysis, ERM 3.0 had significantly lower concentrations of manganese than the composite reference site and TRM 566, opposite of what is expected if ash were having an effect, Strontium concentrations did not show any significant differences between locations.

3.6.3 Tree Swallow Nestlings

Results of the spatial and temporal trend analysis for tree swallow nestlings are presented in Tables 26 and 27. When MHD was removed, no significant differences were identified between sites or years for cadmium, manganese, strontium, and zinc, except difference between years (higher in 2010) was close to significant for zinc. No specific differences were identified with Tukey-Kramer post-hoc comparisons but a significant difference in selenium concentrations was identified between ERM 3.0 and the reference site, with higher concentrations of selenium in ERM 3.0 than the reference (FLD).

3.6.4 Tree Swallow Nest Productivity

Results of the spatial and temporal trend analysis for tree swallow nestlings are presented in Table 28. No differences were observed in the nest productivity analyses when MHD was removed.

4. Discussion of Findings

Several differences were observed for insectivorous birds nesting among ash-impacted stretches of the Emory, Clinch, and Tennessee Rivers and reference areas. To summarize the statistically significant or almost significant results, selenium and mercury were higher for impacted site tree swallow eggs than reference sites, but neither was higher in eggshells, and only mercury was higher in nestlings. Copper, strontium, barium, and manganese were higher in eggs than one reference site (FLD) but not the composite reference site. Strontium was also higher in eggshells and nestlings. It was the only element higher in eggshells possibly due to ash. Strontium is known to replace calcium in shells and can be transferred from the shell to the nestling (Mora 2003). Nestlings had cadmium concentrations that were elevated relative to reference areas, but that relationship was not observed for eggs or eggshells.

Concentrations were not increasing over time in eggs as hypothesized, but rather decreased over time for a few metals. Barium, strontium, and iron were significantly higher in eggs in 2009 than 2010; otherwise, metals and metalloids did not differ among years. Of the metals showing temporal changes in eggs, only strontium concentrations were higher than reference sites and thus possibly due to the ash.

None of the trace elements that were elevated in the impacted reaches potentially from the ash in eggs, eggshells, or nestlings were significantly and negatively correlated to the reproductive measures of hatching success, nestling survival, or fledglings produced per nesting female, except strontium and barium, which were negatively correlated to nestling survival, barium was negatively correlated to clutch size, and manganese was negatively correlated to fledglings per female. Copper and strontium in eggs were associated with decreases in egg weight. Copper in nestlings was also associated with decreases in nestling weight.

Other differences showing higher levels in impacted sites do not appear to be related to the ash. Manganese and zinc were higher in nestlings in impacted areas than the positive control, but not higher than at other reference sites; thus, the difference does not appear to be related to the ash. Other trace elements, including barium, iron, manganese, and zinc, were unusually high in eggs at TRM 566, but were probably from a historical source or due to other non-ash related factors since upstream areas with greater ash deposition did not have elevation of these elements. Similarly, barium in eggshells was elevated at TRM 566, but not in other areas. Manganese and zinc were elevated in nestlings relative to the positive control, but not the other reference sites, and thus the difference may not be related to the ash.

Of egg and nestling parameters measured, only egg weight at impacted sites was significantly lower than reference sites. Egg weight data have low precision in 2009 making this result less certain. Of elements with elevated egg levels above reference sites, only copper and strontium were associated with decreases in egg weight. Copper was also associated with decreases in nestling weight. In contrast, mercury, selenium, and manganese were not associated with measured egg or nestling parameters.

A literature review was conducted to evaluate whether concentrations observed at the sites with elevated levels relative to reference sites were of concern. Studies indicated a range of mercury effects levels for birds. Mercury can cause reproductive impairment in birds, deformities such as short legs, extra toes, spoon-shaped bills (Heinz and Hoffman 2003). Thompson (1996) concluded that mercury concentrations in bird eggs up to approximately 2.5 mg/kg dw appear to have little detrimental effect on reproduction. Means of mercury in impacted tree swallow eggs were 0.15 and 0.22 mg/kg dw, which are well below the suggested threshold level of mercury concentrations in egg tissue (Table 2; Figure 32). The maximum concentration of mercury was 0.37 mg/kg dw, which is also well below the effects value of 2.5 mg/kg dw. For nestling tissue, less information is available. Young and Heeson (1977) found that mercury concentrations in breast and liver tissue of adult Brandts cormorants, brown pelicans, and California gulls ranged from 1.4 to 12.2 mg/kg dw (assumed 75 percent moisture), without causing mortality. Mean concentrations of whole body nestlings from impacted sites ranged from 0.05 to 0.1 mg/kg dw (Table 4; Figure 37), which are well below the lower end of the effects range presented by Young and Heeson (1977). The maximum detected concentration of mercury in nestling tissue was 0.15 mg/kg dw, which was also well below this effects value.

Selenium is an essential nutrient at low doses; however, it readily accumulates in birds and can be transferred to developing offspring (Heinz 1996). When accumulated above the required amount, studies have shown effects of selenium on bird reproduction through teratogenesis and offspring mortality, as well as other kinds of sublethal effects. Teratogenic deformities in birds include anophthalmy (missing eyes), spinal and bill deformations, defects in internal organs, and histological abnormalities (Harding et al. 2005; Heinz 1996; Hoffman 2002). Selenium has been evaluated in various field and laboratory studies. Maternal transfer of selenium to avian offspring has been well documented in various species of wild aquatic birds from both Kesterson National Wildlife Refuge (Ohlendorf et al. 1986) and Martins Reservoir (King 1988; King et al. 1994). These field studies have also been corroborated by several laboratory studies using dietary exposures of selenium-dosed food in mallards (Heinz et al. 1987 and 1989).

Selenium concentrations known to cause reproductive or teratogenic effects in birds vary, possibly due to differences in each species' ability to maternally transfer selenium to their young or from species-specific differences in responses to maternally transferred selenium (Fairbrother et al. 1999; Ohlendorf et al. 1986). As a result of this variability, background concentrations and known levels of selenium causing adverse effects in birds also differs. While selenium has been studied for a number of years and there are many reviews in relation to exposure and effects of selenium in birds, the most recent compilation of selenium effects data in avian eggs (Ohlendorf and Heinz 2011) was used in this evaluation of tissue concentrations. Mean background concentrations of selenium in eggs are generally thought to be below 3 mg/kg dw, with individual egg concentrations of less than 5 mg/kg dw (Ohlendorf and Heinz 2011). Ohlendorf et al. (1986) found that selenium concentrations of 5 mg/kg dw in black-necked stilt (*Himantopus mexicanus*) eggs resulted in 20 percent mortality or deformity in embryos, but a re-analysis of the stilt field data indicated only 10 percent mortality results at 21 to 31 mg/kg (Adams et al. 2003) and ≤ 5 mg/kg is useful for estimating background levels but not adverse effects. Studies on other species recently have been reviewed and suggest threshold effects (EC_{10}) concentrations ranging from 7.7 to 60 mg/kg dw in various species of avian

eggs (Janz et al. 2010). The red-winged blackbird (*Agelaius phoeniceus*), a species that also feeds on terrestrial insects in riparian areas, had a threshold (EC_{10}) for adverse effects of 22 mg Se/kg.

Mean concentrations of selenium in impacted eggs ranged from 3.15 to 4.75 mg/kg dw (Table 2; Figures 33 and 34). All but two of the impacted sites (TRM 566 and ERM 3.0) had mean concentrations that fall around the suggested background concentrations (Ohlendorf and Heinz 2011) (Table 2). When evaluating individual selenium concentrations, 20 concentrations were above the background values and individual egg values of 5 mg/kg dw. Of these, only three eggs in impacted sites exceeded the lowest benchmark for reported adverse impacts of 7.7 mg Se/kg. The benchmark of 7.7 mg/kg in eggs is based on mallards (*Anas platyrhynchos*), and this benchmark was exceeded by one egg in ERM3.5, two eggs in ERM3.0, as well as one egg in the positive control, MHD. The two eggs in the Emory River represent 1.7 percent of all eggs evaluated in the impacted reaches, and these eggs do not exceed the red-winged blackbird adverse effect concentration, a species with a diet more similar to a tree swallow. Consequently, it is not surprising that no significant effects of selenium on egg weight, clutch size, nestling weight, feather and tarsus length, hatching success, nestling survival, or fledglings produced per nesting female were observed.

Whole body tissue concentrations of selenium in impacted nestlings were not significantly higher than selenium concentrations in reference nestlings. Whole-body tissue concentrations of selenium that likely adversely affect nestlings range from 8 to 12 mg/kg (range of grackle nestling carcass, liver, and feather concentrations with adverse effects, Bryan et al. 2012). No nestlings in the impacted sites exceeded this threshold (maximum was 6.67 mg/kg dw), although the positive control had one nestling with 9 mg/kg dw.

Strontium was elevated in eggs, eggshells, and nestlings. Elevated levels of strontium in eggshells have been found to reduce eggshell strength and increase the number of cracked eggs, in turn reducing hatching success and increasing embryonic mortality (Mora 2003). Strontium in eggshells has also been shown to cause an interference with calcium transfer from the eggshell into the embryo, which in turn can lead to insufficient levels of calcium for bone formation (Mora et al. 2007). Strontium in eggs was negatively correlated to nestling survival, but levels causing adverse effect need to be evaluated to determine if concentrations are high enough to adversely affect tree swallows.

No toxicity reference value has been established for strontium in avian eggs. Mora (2003) presents mean metal concentrations in eggs from several passerine birds in Arizona. Mean concentrations of strontium in yellow-breasted chat eggs and willow flycatcher eggs were 23.9 and 35.1 mg/kg dw, respectively. These strontium concentrations were somewhat lower than those presented by Schwarzbach et al. (2006), where the mean concentration of strontium in normal clapper rail embryos was 66.10 mg/kg dw (range 30.2 to 94.6 mg/kg dw). While there is not enough information in the literature to determine effects levels of strontium in eggs based on laboratory studies, Ridgway and Karnofsky (1952) presented data for calculation of an LD_{50} of 73 mg/kg dw based on chicken egg injection, assuming a 55 gram egg and 80 percent moisture. Schwarzbach et al. (2006) estimated mean concentration in deformed clapper rail embryos at 121.40 mg/kg dw (range 82.2 to 176 mg/kg dw). Mean strontium concentrations in eggs from sites impacted by the ash spill ranged from 4.78 to 17.85 mg/kg dw, with a maximum concentration of 51.45 mg/kg dw. All

of the impacted site concentrations were below reported effects levels, and thus probably are not of concern.

Mean strontium concentrations found in eggshells considered to be "somewhat elevated" were 299 mg/kg dw for willow flycatchers (Mora 2003), 826 mg/kg dw for yellow-breasted chats (Mora 2003), and 265 mg/kg dw for black-throated blue warblers (Blum et al. 2000). Reduced egg production in Pekin ducks (*Anas peking*) was reported when eggshell strontium concentrations were 120,000 mg/kg (Wheeler 1919). Mean strontium concentrations in impacted site eggshells were well below these levels, ranging from 101.89 to 125.26 mg/kg dw, with a maximum concentration of 176.29 mg/kg dw (Table 3; Figure 36).

For nestlings, mean concentrations of strontium in their whole bodies (9.4 to 14 mg/kg dw) at the impacted sites were lower than the mean of common grackle (*Quiscalus quiscula*) carcasses (Bryan et al. 2012) of nestlings that had feather strontium concentrations below that of healthy, normal heron populations (Golden et al.2003). Pipping chicks with 11.3 mg/kg dw had hepatic oxidative stress in black-crowned night herons (Rattner et al. 2000), but such effects may have no impact on chick survival. It is unknown what concentration would have caused mortality, but 11.3 mg/kg dw is not believed to be embryotoxic (Rattner et al. 2000). Strontium concentrations in nestlings in impacted sites ranged from 3.8 to 50.6 mg/kg dw. Strontium was below levels producing adverse impacts for eggs and eggshells, and nestling strontium concentrations were not correlated to any productivity metrics. Because of these findings and that mean values were lower than effects levels for means in Bryan et al. (2002, effects values for individual eggs is not provided), strontium probably is below a level of concern for nestlings, also.

A literature review of copper hazards to fish, wildlife, and invertebrates by Eisler (1998) found no available data for defining a toxicity reference value based on bird egg tissue. Copper is a micronutrient, but at high levels can be toxic and reduce reproduction (Eisler 1998). Toxicity studies have been conducted on domesticated birds. Ridgway and Karnofsky (1952) evaluated the effects of copper sulfate on chicken embryos through injection into the yolk sac. Using data in that study and assumptions of a 55 gram egg and 80 percent moisture, a median lethal injected dose would be 20 mg/kg dw; however, there is a high uncertainty in using this concentration as an effects value because the route of exposure (injection) can overestimate effects of some chemicals (Heinz et al. 2009) and the egg weights and percent moistures were not reported. Mean copper concentrations in all site-impacted tree swallow eggs ranged from 2.43 to 3.61 mg/kg dw, with a maximum concentration of 11.96 mg/kg dw (Table 2; Figure 30). All of these impacted means, as well as the maximum concentration, are below this suggested median lethal threshold of 20 mg/kg dw for copper in egg tissue. The lowest adverse effect level is unknown but may be lower than 20 mg/kg dw. Although copper is negatively correlated with egg and nestling weights, such correlations are not important because copper cannot be strongly linked to changes in egg hatchability or nestling survival or most importantly, fledglings produced per female, which affect population viability.

Manganese is an essential micronutrient in birds; however, it can be toxic in high doses. Although it is an important cofactor in metabolism, adverse effects of manganese toxicity are similar to those caused by lead, including neurobehavioral defects and other nervous system dysfunction. Unfortunately, effects levels for

manganese in eggs have not yet been determined (Burger and Gochfeld 2003), but concentrations measured at a variety of geographical locations ranged between 1 and 5 mg/kg dw in bird eggs (Howe and Malcolm 2004). In Arizona, Bell's vireo (*Vireo bellii*) eggs contained a mean similar to the impacted sites of 12.5 mg/kg dw of manganese with maximum of 20.6 mg/kg dw, yet such levels were not mentioned as a cause of concern (Mora 2003). Manganese in tree swallow eggs in impacted sites ranged from 6.6 to 14 mg/kg dw, lower than these estimates. However, manganese concentration in eggs was negatively correlated to fledglings produced per female and has the potential to have a negative effect if too high in eggs. Mean concentrations of manganese in ERM 3.0 eggs, which was the site with elevated manganese that was almost significantly higher than the FLD reference, were 6.61 and 7.98 mg/kg dw in 2009 and 2010, respectively. These concentrations were only slightly higher than mean concentrations in FLD eggs of 4.94 and MHD mean concentrations in eggs of 6.26 mg/kg dw (Table 2; Figure 33). Thus, manganese concentrations are probably not high enough in eggs to be of great concern that its presence in ash is strongly affecting productivity, particularly given the fledglings produced per female are similar between impacted and reference sites.

No toxicity reference value has been established for barium in avian eggs, but reference sites had up to 40 mg/kg barium in eggs. Field studies published on barium in egg tissue have indicated barium concentrations are associated with embryo deformities at 2.2 mg/kg dw in clapper rail eggs (Schwarzbach et al. 2006). The effects level of 2.2 mg/kg dw was from a field study with a mixture of metals. As a result, the deformities associated with this concentration of barium potentially could be attributed to the effects from other metals found in the embryos. Another field study reported concentrations of barium in passerine birds up to 14.3 mg/kg dw without reporting that concentration as a level of concern (Mora 2003). If 40 mg/kg barium is the reference level, then only one outlier egg, located in ERM 3.0 exceeds that threshold and may have been affected by the ash. Barium in eggs is not significantly and strongly correlated to any productivity metrics, which suggests it is not an important factor affecting tree swallows. Barium concentrations in nestlings were negatively correlated to nestling survival, but barium in nestlings was no higher than reference sites. Barium in eggs was also negatively correlated to clutch size, as well as barium in nestlings to feather length, but clutch size and feather length were not significantly smaller than the reference locations. Overall, the results for barium do not strongly implicate ash as affecting tree swallow productivity.

Cadmium was higher in nestlings in impacted sites than reference sites. Cadmium can reduce growth in chicks. Cadmium concentrations in nestling livers of 0.004 to 0.03 mg/kg wet weight, converted to dry weight of 0.02 to 0.15 mg/kg dw assuming 80 percent moisture were considered to have no adverse effects to nestlings (Central Science Library 2003). Cadmium concentrations in whole body nestlings of < 2 mg/kg dw were well below levels of concern (Bryan et al. 2012). Cadmium in nestlings in impacted sites had mean concentrations ranging from 0.05 to 0.08 mg/kg dw. The maximum observed concentration in a nestling in an impacted site was 0.09, which is lower than the concentrations considered to have no adverse effects on nestlings.

Of interest, very few trace elements that might be elevated from ash in the impacted reaches discussed above were significantly and negatively correlated to the productivity metrics of hatching success, nestling survival, or fledglings produced per nesting female. The few were strontium, manganese, and barium for which benchmarks of adverse effects are unavailable, and more research is needed on these to establish effects levels. Notably, selenium in eggs, which exceeded a potential adverse benchmark in some locations, had a weak and non-significant relationship to productivity metrics. Such finding, combined with no significant differences in production of fledglings between impacted and reference locations indicates tree swallows and possibly other songbirds that feed on aerial insects are not as sensitive as ducks, for which effects levels are well established.

4.1. Summary and Conclusions

Consistent with other field surveys, uncertainties exist when evaluating species that have the ability to migrate, or in systems of complex analyte mixtures. The evaluations in this study focused on comparisons among sites, between years, and with literature-derived concentrations in order to assess the relationship between the ash release and trace elements in tree swallow egg contents, eggshells, and whole body nestlings. Natural variability or historical contamination associated with the sample sites may have contributed to some of the differences found among sites. Of 26 metals and metalloids investigated, selenium, strontium, copper, and manganese showed spatial trends that potentially could be related to ash rather than historical or factors unrelated to ash. However, only selenium had concentration increases to levels exceeding a known benchmark (EC_{10}) suggestive of adverse effects to the most sensitive bird species tested, the mallard. No eggs exceeded the EC_{10} of a bird with feeding habits more similar to the tree swallow, specifically the red-winged blackbird. Selenium concentrations in eggs exceeded the adverse benchmark value for mallards in individual eggs in approximately 1.7 percent of the impacted eggs sampled. These exceedances appear to be limited to areas directly adjacent to the ash spill (ERM 3.0 and ERM 3.5). Tree swallow size, hatching success, nestling survival, and fledglings produced per nesting female were not significantly correlated to selenium concentrations in eggs or nestlings. A comprehensive evaluation of tree swallows will be completed in the Baseline Ecological Risk Assessment using additional lines of evidence in order to interpret the differences between locations and years, but this assessment did not identify any trace elements that could be strongly associated with adverse effects on the tree swallow population.

4.2. Future Studies

Monitoring efforts for tree swallows were continued in 2011 by researchers from Virginia Polytechnic Institute and State University. Several of the same colonies were evaluated, as well as newly established colonies along impacted stretches of the Emory and Clinch Rivers and in unimpacted upstream locations. In addition, full-scale physiological and reproductive studies were also conducted within each colony. Samples from 2011 are currently being analyzed. These monitoring efforts are scheduled to be repeated in 2012.

5. Acknowledgments

The authors would like to thank the following individuals and agencies for their assistance with collecting, processing, and analyzing samples for this project: T. Hill Henry, William Hopkins, Wes James, Ken Weisz, Adam Johnson, Jackie Iannuzzi, Elizabeth Burton, Jesse Morris, Environmental Standards, Inc., Pace Analytical Services, Inc., ARCADIS, Restoration Services Inc., Jacobs Engineering, Kingston Parks and Recreation, personnel from the Kingston Fossil Plant, U.S. Fish and Wildlife Services, and Tennessee Wildlife Resources Agency.

6. References

Adams, W.J., K.V. Brix, M. Edwards, L.M. Tear, D.K. DeForest, and A. Fairbrother. 2003. Analysis of field and laboratory data to derive selenium toxicity thresholds for birds. Environ. Toxicol. and Chem. 9: 2020-2029.

Bishop, C.A., M.D. Koster, A.A. Chek, D.J.T. Hussell, and K. Jock. 1995. Chlorinated hydrocarbons and mercury in sediments, red-winged blackbirds (*Agelaius phoeniceus*) and tree swallows (*Tachycineta bicolor*) from wetlands in the Great Lakes St. Lawrence River basin. *Environ Toxicol Chem* 14: 491-501.

Blancher, P.J., and D.K. McNicol. 1991. Tree swallow diet in relation to wetland acidity. Can. J. Zool. 66:842-849.

Blum, J.D., E.H. Taliaferro, M.T. Weisse, and R.T. Holmes. 2000. Changes in Sr/Ca, Ba/Ca, and $^{87}Sr/^{86}Sr$ ratios between trophic levels in two forest ecosystems in the northeastern U.S.A. Biogeochemistry. 49: 87-101.

Brasso, R., M. Abdel Latif, and D. Cristol. 2010. Relationship between laying sequence and mercury concentration in tree swallow eggs. Environmental Toxicology and Chemistry. 29(5): 1155-1159.

Burger, J. and M. Gochfeld. 2003. Spatial and temporal patterns in metal levels in eggs of common terns (*Sterna hirundo*) in New Jersey. The Science of the Total Environment. 311: 91-100.

Bryan, A., W. Hopkins, J. Parikh, B. Jackson, and J. Unrine. 2012. Coal fly ash basins as an attractive nuisance to birds: Parental provisioning exposes nestlings to harmful trace elements. *Environ. Poll.* 161:170-177.

Central Science Library. 2003. Investigation of deformities in herons in North Nottinghamshire. Department of Environment, Food, and Rural Affairs, London. http://webcache.googleusercontent.com/search?q=cache:P9kPPSVJNsgJ:randd.defra.gov.uk/Document.aspx%3FDocument%3DWM0101_926_FRP.doc+Ohlendorf+nestlings+cadmium+chicks&cd=3&hl=en&ct=clnk&gl=us.

Environmental Standards, Incorporated (ESI). 2011. Memorandum: Percent Moisture Data for Biological Samples. March 2011.

Eisler, R. 1998. Copper hazards to fish, wildlife, and invertebrates: a synoptic review. Biological/Contaminant Hazard Review Report 33. National Biological Service, U.S. Department of the Interior. January 1998.

Fairbrother, A., Brix, K.V., Toll, J.E., McKay, S., Adams, W.J., 1999. Egg selenium concentrations as predictors of avian toxicity. Hum. Ecol. Risk Assess. 5 (6), 1229–1253.

Golden, N.H., Rattner, B.A., McGowan, P.C., Parsons, K.C., Ottinger, M.A., 2003. Concentrations of metals in feathers and blood of nestling Black-crowned Night-herons (*Nycticorax nycticorax*) in Chesapeake and Delaware Bays. Bulletin of Environmental Contamination and Toxicology 70, 385-393.

Harding, L., M. Graham, and D. Paton. 2005. Accumulation of selenium and lack of severe effects on productivity of American dippers (*Cinclus mexicanus*) and spotted sandpipers (*Actitis macularia*). Arch. Environ. Contam. Toxicol. 48: 414-423.

Heinz, G. 1996. Selenium in birds. In: W. Beyer, G. Heinz, and A. Redmon-Norwood (Eds), Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations, (pp.447-458). Boca Raton, FL: CRC Press.

Heinz, G. and D. Hoffman. 2003. Embryotoxic Thresholds of Mercury: Estimates from Individual Mallard Eggs. Arch. Environ. Contam. Toxicol. 44: 257-264.

Heinz, G., D. Hoffman, and L. Gold. 1989. Impaired reproduction in mallards fed an organic form of selenium. J. Wildlife Management. 53: 418-428.

Heinz, G., D. Hoffman, J. Klimstra, K. Stebbins, S. Kondrad, and C. Erwin. 2009. Species Differences in the Sensitivity of Avian Embryos to Methylmercury. Arch. Environ. Contam. Toxicol. 56: 129-138.

Heinz, G., D. Hoffman, A. Krynitsky, and D. Weller. 1987. Reproduction in mallards fed selenium. Environ. Toxicol. Chem. 6: 423-433.

Hoffman, D. 2002. Role of selenium toxicity and oxidative stress in aquatic birds. Aquat. Toxicol. 57: 11-26.

Howe, P. and H. Malcolm. 2004. Manganese and its compounds: environmental aspects. World Health Organization

Hoyt, D. 1979. Practical Methods of Estimating Volume and Fresh Weight of Bird Eggs. The Auk. 96(1): 73-77.

Jacobs. 2010. Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP). Document No. EPA-AO-021. May 2010.

Janz, D.M., D.K. DeForest, J.L. Brooks, P.M. Chapman, G. Gilron, D. Hoff, W.A. Hopkins, D.O. McIntyre, C.A. Mebane, V.P. Palace, J.P. Skorupa, and M. Wayland. 2010. Chapter 6: Selenium toxicity in aquatic organisms. In P.M. Chapman, W.J. Adams, M.L. Brooks, C.G. Delos, S.N. Luoma, W.A. Maher, H.M. Ohlendorf, T.S. Presser, D.P. Shaw, (Eds.), Ecological Assessment of Selenium in the Aquatic Environment (Pages 141-232). Pensacola, Florida: CRC Press and Society of Environmental Toxicology and Chemistry.

King, K. 1988. Elevated selenium concentrations are detected in wildlife near a power plant. U.S. Department of Interior, Fish and Wildlife Service Research Information Bulletin. 88-31.

King, K., T. Custer, and D. Weaver. 1994. Reproductive success of barn swallows nestling near a selenium-contaminated lake in east Texas, USA. Environ Pollut. 84: 53-58.

McCarty, J.P. and D.W. Winkler. 1999. Foraging ecology and diet of tree swallows feeing selectivity of nestlings. The Cooper Ornithological Society. The Condor, 101: 246-254.

Mora, M. 2003. Heavy metals and metalloids in egg contents and eggshells of passerine birds from Arizona. Environmental Pollution. 125: 393-400.

Mora, M., R. Taylor, and B. Brattin. 2007. Potential Ecotoxicological Significance of Elevated Concentrations of Strontium in Eggshells of Passerine Birds. The Condor. 109: 199-205.

Nichols, J., C. Larsen, M. McDonald, G. Niemi, and G. Ankley. 1995. Bioenergetics-Based Model for Accumulation of Polychlorinated Biphenyls by Nestling Tree Swallows, *Tachycineta bicolor*. Environ. Sci. Technol. 29: 604-612.

Nicholson, C. 1997. Atlas of the Breeding Birds of Tennessee. Knoxville, Tennessee: The University of Tennessee Press.

Ning, L. and L. Tao. 2011. Absorption and Decoloration of Nitroso Dye Based on Eggshell Membrane. Advanced Materials Research. Vols. 183-185: pp. 963-966. January.

Ohlendorf, H. and G. Heinz. 2011. In W. Beyer and J. Meador (Eds), Environmental Contaminants in Biota: Interpreting Tissue Concentrations, Second Edition (pp.669-701). Boca Raton, FL: CRC Press.

Ohlendorf, H., R. Hothem, C. Bunck, T. Aldich, and J. Moore. 1986. Relationships between selenium concentrations and avian reproduction. Trans North Am Wildl Nat Resour Conf. 51: 330-342.

Quinney, T.E. and C.D. Ankney. 1985. Prey size selection by Tree Swallows. Auk 102: 245-250.

Rattner, B.A., D.J. Hoffman, M.J. Melancon, G.H. Olsen, S.R. Schmidt, and K. Parsons. 2000. Organochlorine and metal contaminant exposure and effects in hatchling black-crowned night herons (*Nycticorax nycticorax*) in Delaware Bay. Arch. Environ. Contam. Toxicol. 39(1): 38-45.

Ridgway, L.P. and D.A. Karnofsky. 1952. The Effects of Metals on the Chick Embryo: Toxicity and Production of Abnormalities in Development. Division of Experimental Chemotherapy, Sloan-Kettering Institute for Cancer Research, New York, New York.

Robinson, J. 1990. An Annotated Checklist of the Birds of Tennessee. Knoxville, Tennessee: The University of Tennessee Press.

Schwarzbach, S., J. Albertson, and C. Thomas. 2006. Effects of Predation, Flooding, and Contamination on Reproductive Success of California Clapper Rails (*Rallus longirostris obsoletus*) in San Francisco Bay. The Auk. 123(1): 45-60.

Secord, A.L., J.P. McCarty, K.R. Echols, J.C. Meadows, R.W. Gale, and D.E. Tillitt. 1999. Polychlorinated biphenyls and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin equivalents in tree swallows from the upper Hudson River, New York state, USA. *Environ Toxicol Chem* 18:2519-2525.

Thompson, D.R. 1996. Mercury in Birds and Terrestrial Mammals. In W. Beyer, G. Heinz, and A. Redmon-Norwood (Eds), Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations (pp.341-356). Boca Raton, FL: Lewis Publishers, CRC Press.

U.S. Geological Survey. 2003. Tree Swallows: A Nationwide Sentinel Species for Assessing and Monitoring Aquatic Contamination. Fact Sheet FS 2004-3042.

Wheeler, W.P. 1919. Some Studies Relating to Calcium Metabolism. New York Agricultural Experiment Station, Bulletin No. 468, Geneva, New York. December 1919.

Young, D.R. and T.C. Heeson. 1977. Coastal Water Research Program Annual Report. Southern California Coastal.

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Table 1. Summary of Tree Swallow Egg, Eggshell, and Nestling Collections for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Location			Tissue Type [1]				
Site Name	River	Type	2009 Eggs	2010 Eggs	2010 Eggshells	2009 Nestlings	2010 Nestlings
Ft. Loudoun Dam	Tennessee River	Reference Sites	9	16 (+1)	2	3	10
Tennessee River Mile 569.5 to 571.5	Tennessee River		NC	15	NC	NC	NC
Tellico Dam	Tennessee River		NC	15	2	NC	NC
Little Emory River Mile 2.0	Little Emory River		NC	2	NC	NC	NC
Emory River Mile 3.5	Emory River	Potentially Affected Sites	13 (+2)	12	1	11 (+1)	10
Emory River Mile 3.0- Right Bank	Emory River	Potentially Affected Sites	10	15	4	9 (+2)	15
Emory River Mile 3.0- Islands and Left Bank	Emory River	Potentially Affected Sites	NC	15	2	NC	NC
West Embayment	Embayment	Potentially Affected Sites	NC	2	1	NC	NC
North Embayment	Embayment	Potentially Affected Sites	NC	4	1	NC	NC
East Embayment	Embayment	Potentially Affected Sites	NC	4	2	NC	NC
Clinch River Mile 2.5	Clinch River	Potentially Affected Sites	11 (+1)	15	NC	12	15 (+1)
Clinch River Mile 1.0	Clinch River	Potentially Affected Sites	NC	15	NC	NC	NC
Tennessee River Mile 566.0	Tennessee River	Potentially Affected Sites	NC	9	3	NC	NC
Melton Hill Dam	Clinch River	Positive Control [2]	16 (+1)	16 (+4)	2	9	15 (+1)

[1] Tissue types include eggs, eggshells, and nestlings. Values shown in (+) behind egg and nestling samples indicate unhatched "dud" eggs and dead nestlings, respectively.

[2] Historically contaminated site, not related to the ash spill.

NC - Not collected.

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Aluminum	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	0	46	NC ± NC	17.94 - 48.91
	Fort Loudoun Dam	0	9	NC ± NC	134.17 - 135.85	0	16	NC ± NC	17.94 - 44.02
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	22.83 - 67.39
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	20.65 - 46.2
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	NA	NA	NC ± NC	NA - NA
	Clinch River (CRM 2.5)	0	11	NC ± NC	132.01 - 265.22	NA	NA	NC ± NC	NA - NA
	Emory River (ERM 3.5)	0	13	NC ± NC	134.52 - 260.33	1	12	NC ± NC	19.57 - 33.7
	Emory River (ERM 3.0)	0	10	NC ± NC	134.33 - 158.15	0	25	NC ± NC	20.11 - 57.61
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	20.11 - 36.41
	Melton Hill Dam	0	16	NC ± NC	134.9 - 407.07	0	16	NC ± NC	19.57 - 53.26
Antimony	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	1	46	NC ± NC	0.07 - 0.20
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	0	16	NC ± NC	0.07 - 0.16
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.08 - 0.24
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.08 - 0.17
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.08 - 0.15
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	0	15	NC ± NC	0.07 - 0.22
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	0	12	NC ± NC	0.07 - 0.08
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	1	30	NC ± NC	0.08 - 0.24
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.07 - 0.13
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	0	16	NC ± NC	0.07 - 0.20
Arsenic	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	0	46	NC ± NC	0.13 - 0.35
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	0	16	NC ± NC	0.13 - 0.32
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.32 - 0.92
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.16 - 0.33
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.15 - 0.29
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	0	15	NC ± NC	0.13 - 0.44
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	0	12	NC ± NC	0.15 - 0.32
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	0	30	NC ± NC	0.15 - 0.82
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.15 - 0.32
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	0	16	NC ± NC	0.14 - 0.38
Barium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	9.18 ± 7.98	1.79 - 40.22
	Fort Loudoun Dam	9	9	6.52 ± 3.64	1.49 - 12.29	16	16	8.36 ± 7.33	1.79 - 30.98
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	20.92 ± 12.68	11.96 - 29.89
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	15.98 ± 7.72	4.57 - 24.46
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	12.22 ± 8.13	1.52 - 35.33
	Clinch River (CRM 2.5)	11	11	8.94 ± 3.19	3.43 - 13.8	15	15	5.72 ± 3.52	1.85 - 14.13
	Emory River (ERM 3.5)	12	13	8.69 ± 6.08	0.65 - 22.28	12	12	6.28 ± 3.78	2.23 - 15.22
	Emory River (ERM 3.0)	10	10	17.38 ± 25.63	3.36 - 89.22	30	30	8.67 ± 6.55	1.63 - 26.09
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	8.8 ± 4.63	1.98 - 15.76
	Melton Hill Dam	16	16	8.38 ± 5.02	1.96 - 19.02	16	16	10.46 ± 11.11	1.96 - 35.87

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Beryllium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	0	46	NC ± NC	0.07 - 0.71
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	0	16	NC ± NC	0.07 - 0.35
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.33 - 0.49
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	1	9	NC ± NC	0.16 - 0.71
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.15 - 0.31
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	0	15	NC ± NC	0.14 - 0.46
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	0	12	NC ± NC	0.14 - 0.33
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	0	30	NC ± NC	0.15 - 0.42
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.15 - 0.54
	Melton Hill Dam	0	16	0.7 ± 0.32	0.54 - 1.63	0	16	NC ± NC	0.16 - 0.82
Boron	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	0	46	NC ± NC	1.85 - 5.05
	Fort Loudoun Dam	0	9	NC ± NC	10.74 - 10.95	0	16	NC ± NC	1.85 - 4.57
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	2.34 - 7.07
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	2.12 - 4.78
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	2.17 - 4.35
	Clinch River (CRM 2.5)	0	11	NC ± NC	10.61 - 21.2	0	15	NC ± NC	1.9 - 6.52
	Emory River (ERM 3.5)	0	13	NC ± NC	10.74 - 20.65	1	12	NC ± NC	2.01 - 6.85
	Emory River (ERM 3.0)	0	10	NC ± NC	10.76 - 12.5	0	30	NC ± NC	2.12 - 5.98
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	2.07 - 6.36
	Melton Hill Dam	0	16	NC ± NC	10.78 - 32.61	0	16	NC ± NC	2.01 - 5.44
Cadmium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	1	46	NC ± NC	0.04 - 0.19
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	1	16	NC ± NC	0.04 - 0.09
	TRM 566	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.08 - 0.13
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.04 - 0.18
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.04 - 0.12
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	0	15	NC ± NC	0.04 - 0.12
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	0	12	NC ± NC	0.04 - 0.09
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	1	30	NC ± NC	0.04 - 0.26
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.01 - 0.14
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	0	16	NC ± NC	0.04 - 0.21
Chromium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	2	46	0.82 ± 0.23	0.6 - 1.58
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.61	2	16	0.8 ± 0.21	0.6 - 1.41
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	1	2	NC ± NC	1.9 - 2.12
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	1	9	NC ± NC	0.65 - 1.47
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	8	15	0.95 ± 0.23	0.65 - 1.52
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.31	0	15	NC ± NC	0.6 - 1.96
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	3	12	1.13 ± 1.37	0.6 - 5.44
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.71	4	30	0.85 ± 0.33	0.65 - 1.85
	Embayments [3]	NA	NA	NA ± NA	NA - NA	1	10	NC ± NC	0.65 - 1.14
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	0	16	NC ± NC	0.6 - 1.69

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Cobalt	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	33	46	0.11 ± 0.04	0.07 - 0.23
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	11	16	0.1 ± 0.03	0.08 - 0.17
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	1	2	NC ± NC	0.15 - 0.23
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	7	9	0.15 ± 0.08	0.07 - 0.29
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	11	15	0.12 ± 0.05	0.08 - 0.26
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	10	15	0.12 ± 0.05	0.07 - 0.22
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	9	12	0.1 ± 0.02	0.08 - 0.14
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	20	30	0.13 ± 0.08	0.07 - 0.41
	Embayments [3]	NA	NA	NA ± NA	NA - NA	7	10	0.13 ± 0.04	0.08 - 0.20
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	10	16	0.13 ± 0.08	0.07 - 0.41
Copper	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	45	46	3.22 ± 2.37	1.85 - 16.3
	Fort Loudoun Dam	4	9	2.93 ± 0.6	2.62 - 4.5	16	16	2.57 ± 0.45	1.85 - 3.59
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	2.58 ± 0.04	2.55 - 2.61
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	2.43 ± 0.34	1.9 - 2.83
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	2.79 ± 0.51	2.07 - 3.97
	Clinch River (CRM 2.5)	5	11	3.52 ± 1.07	2.67 - 5.4	15	15	3.27 ± 0.89	1.85 - 5.05
	Emory River (ERM 3.5)	5	13	3.61 ± 2.53	2.66 - 11.96	12	12	2.68 ± 0.73	2.01 - 4.35
	Emory River (ERM 3.0)	1	10	NC ± NC	2.65 - 3.37	30	30	2.96 ± 0.48	2.07 - 4.02
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	2.55 ± 0.3	2.12 - 3.1
	Melton Hill Dam	6	16	4.69 ± 4.15	2.67 - 19.02	16	16	2.54 ± 0.4	1.9 - 3.32
Iron	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	43	46	195.49 ± 71.11	68.48 - 366.3
	Fort Loudoun Dam	6	9	198.75 ± 80.79	134.17 - 343.6	15	16	178.97 ± 71.86	68.48 - 300.54
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	402.17 ± 261.32	217.39 - 586.96
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	302.84 ± 143.2	161.41 - 657.61
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	14	15	201.56 ± 72.62	125 - 361.41
	Clinch River (CRM 2.5)	5	11	199.79 ± 92.4	132.01 - 431.74	13	15	159.02 ± 51.53	72.83 - 251.63
	Emory River (ERM 3.5)	9	13	215.42 ± 102.58	134.52 - 513.04	12	12	159.78 ± 51.31	92.39 - 259.78
	Emory River (ERM 3.0)	8	10	218.71 ± 88.91	134.33 - 400.6	30	30	219.44 ± 125.5	100.54 - 717.39
	Embayments	NA	NA	NA ± NA	NA - NA	10	10	204.55 ± 73.09	111.41 - 329.35
	Melton Hill Dam	10	16	235.13 ± 103.38	135.67 - 407.07	16	16	202.75 ± 100.21	80.98 - 443.48
Lead	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	1	46	NC ± NC	0.13 - 1.96
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	0	16	NC ± NC	0.13 - 0.3
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.46 - 0.47
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.16 - 0.45
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.28 - 0.54
	Clinch River (CRM 2.5)	1	11	NC ± NC	0.53 - 1.09	0	15	NC ± NC	0.13 - 0.43
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	0	12	NC ± NC	0.14 - 0.45
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	0	30	NC ± NC	0.15 - 0.4
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.14 - 0.45
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	1	16	NC ± NC	0.14 - 0.38

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Manganese	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	41	46	6.99 ± 3.19	1.9 - 15.22
	Fort Loudoun Dam	7	9	4.94 ± 2.39	2.64 - 9.31	11	16	6.26 ± 3.22	1.9 - 12.5
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	14.13 ± 3.07	11.96 - 16.3
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	14.07 ± 11.79	5.98 - 44.57
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	8.12 ± 4.3	4.24 - 16.85
	Clinch River (CRM 2.5)	7	11	6.88 ± 4.93	2.59 - 18.35	15	15	5.42 ± 2.11	3.32 - 9.78
	Emory River (ERM 3.5)	10	13	7.18 ± 5.01	2.71 - 19.57	12	12	6.15 ± 2.22	3.32 - 9.78
	Emory River (ERM 3.0)	10	10	6.61 ± 2.46	4.06 - 11.15	30	30	7.98 ± 5.32	2.94 - 31.52
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	9.71 ± 5.12	2.28 - 20.11
	Melton Hill Dam	13	16	6.63 ± 3.1	2.69 - 14.24	10	16	8.89 ± 6.32	2.72 - 26.09
Mercury	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	34	46	0.14 ± 0.05	0.08 - 0.33
	Fort Loudoun Dam	0	9	NC ± NC	0.11 - 0.11	10	16	0.11 ± 0.03	0.08 - 0.18
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	1	2	NC ± NC	0.15 - 0.2
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	8	9	0.12 ± 0.02	0.09 - 0.15
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.13 - 0.37
	Clinch River (CRM 2.5)	2	11	0.15 ± 0.04	0.1 - 0.21	0	15	NC ± NC	0.13 - 0.3
	Emory River (ERM 3.5)	3	13	0.16 ± 0.11	0.11 - 0.5	6	12	0.21 ± 0.04	0.15 - 0.28
	Emory River (ERM 3.0)	1	10	NC ± NC	0.11 - 0.2	7	30	0.22 ± 0.05	0.14 - 0.37
	Embayments [3]	NA	NA	NA ± NA	NA - NA	6	10	0.21 ± 0.04	0.14 - 0.29
	Melton Hill Dam	1	16	NC ± NC	0.11 - 0.33	11	16	0.13 ± 0.02	0.09 - 0.19
Molybdenum	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	4	46	0.23 ± 0.06	0.16 - 0.43
	Fort Loudoun Dam	0	9	NC ± NC	5.37 - 5.48	0	16	NC ± NC	0.16 - 0.39
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.2 - 0.6
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	2	9	0.24 ± 0.07	0.18 - 0.41
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	2	15	0.24 ± 0.05	0.19 - 0.37
	Clinch River (CRM 2.5)	0	11	NC ± NC	5.3 - 10.87	0	15	NC ± NC	0.32 - 1.09
	Emory River (ERM 3.5)	0	13	NC ± NC	5.39 - 10.33	0	12	NC ± NC	0.17 - 0.2
	Emory River (ERM 3.0)	0	10	NC ± NC	5.33 - 6.52	5	30	0.26 ± 0.1	0.18 - 0.51
	Embayments [3]	NA	NA	NA ± NA	NA - NA	2	10	0.22 ± 0.06	0.17 - 0.32
	Melton Hill Dam	0	16	NC ± NC	5.35 - 16.3	0	16	NC ± NC	0.17 - 0.47
Nickel	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	2	46	0.97 ± 1.52	0.44 - 8.15
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	2	16	1.6 ± 2.49	0.44 - 8.15
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	1	2	NC ± NC	0.65 - 1.63
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.5 - 1.14
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	1	15	NC ± NC	0.51 - 2.07
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	0	15	NC ± NC	0.46 - 1.52
	Emory River (ERM 3.5)	1	13	NC ± NC	0.54 - 1.03	2	12	1.21 ± 1.79	0.47 - 6.52
	Emory River (ERM 3.0)	0	10	0.55 ± 0.03	0.53 - 0.65	11	30	4.97 ± 9	0.5 - 33.7
	Embayments [3]	NA	NA	NA ± NA	NA - NA	4	10	5.44 ± 10.38	0.5 - 34.24
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	2	16	1.52 ± 2.49	0.47 - 8.15

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Selenium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	3.04 ± 0.91	1.3 - 5.98
	Fort Loudoun Dam	9	9	2.64 ± 0.81	1.61 - 3.77	16	16	2.87 ± 0.91	1.3 - 5.05
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	5.52 ± 2.19	3.97 - 7.07
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	4.37 ± 0.95	2.88 - 5.98
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	3.71 ± 0.88	2.5 - 5.98
	Clinch River (CRM 2.5)	11	11	3.58 ± 1.3	2.47 - 6.84	15	15	3.84 ± 0.94	2.45 - 5.98
	Emory River (ERM 3.5)	12	13	3.88 ± 2.25	1.3 - 10.87	12	12	3.15 ± 0.66	2.12 - 4.19
	Emory River (ERM 3.0)	10	10	4.13 ± 1.54	2.72 - 6.99	30	30	4.75 ± 2.13	2.45 - 13.04
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	4.38 ± 0.86	2.83 - 5.98
	Melton Hill Dam	15	16	3.91 ± 1.06	2.28 - 5.98	16	16	4.11 ± 1.38	2.61 - 8.15
Silver	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	4	46	0.03 ± 0.03	0.01 - 0.21
	Fort Loudoun Dam	0	9	NC ± NC	0.26 - 0.27	3	16	0.03 ± 0.02	0.02 - 0.05
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.02 - 0.05
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.02 - 0.03
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	2	15	0.02 ± 0.01	0.02 - 0.05
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.26 - 0.54	0	15	NC ± NC	0.01 - 0.05
	Emory River (ERM 3.5)	0	13	NC ± NC	0.27 - 0.52	0	12	NC ± NC	0.01 - 0.05
	Emory River (ERM 3.0)	0	10	NC ± NC	0.26 - 0.32	2	30	0.02 ± 0.01	0.02 - 0.04
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.02 - 0.05
	Melton Hill Dam	0	16	NC ± NC	0.27 - 0.82	0	16	NC ± NC	0.02 - 0.13
Strontium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	7.71 ± 8.96	1.85 - 47.83
	Fort Loudoun Dam	9	9	5.93 ± 2.16	2.29 - 8.67	16	16	6.9 ± 8.89	1.85 - 39.67
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	12.23 ± 5.76	8.15 - 16.3
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	6.51 ± 2.46	3.75 - 10.87
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	6.68 ± 3.24	3.59 - 16.85
	Clinch River (CRM 2.5)	11	11	17.85 ± 15.91	3.49 - 51.45	15	15	7.33 ± 7.69	3.37 - 27.72
	Emory River (ERM 3.5)	13	13	10.98 ± 7.24	1.09 - 23.5	12	12	4.78 ± 1.33	3.21 - 7.61
	Emory River (ERM 3.0)	10	10	8.52 ± 4.7	3.85 - 20.16	30	30	9.05 ± 6.45	3.1 - 33.15
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	7.75 ± 5.04	3.47 - 20.11
	Melton Hill Dam	16	16	6.7 ± 4.66	2.23 - 19.95	16	16	5.9 ± 4.23	2.07 - 15.76
Thallium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	0	46	NC ± NC	0.06 - 0.17
	Fort Loudoun Dam	0	9	NC ± NC	0.54 - 0.55	0	16	NC ± NC	0.06 - 0.15
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.08 - 0.23
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.07 - 0.16
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	1	15	NC ± NC	0.07 - 0.14
	Clinch River (CRM 2.5)	0	11	NC ± NC	0.53 - 1.09	1	15	NC ± NC	0.07 - 0.21
	Emory River (ERM 3.5)	0	13	NC ± NC	0.54 - 1.03	0	12	NC ± NC	0.07 - 0.22
	Emory River (ERM 3.0)	0	10	NC ± NC	0.53 - 0.65	0	30	NC ± NC	0.07 - 0.2
	Embayments [3]	NA	NA	NA ± NA	NA - NA	1	10	NC ± NC	0.07 - 0.21
	Melton Hill Dam	0	16	NC ± NC	0.54 - 1.63	0	16	NC ± NC	0.07 - 0.19

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Vanadium	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	0	46	NC ± NC	0.21 - 3.21
	Fort Loudoun Dam	0	9	NC ± NC	1.05 - 1.11	0	16	NC ± NC	0.21 - 0.52
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	0	2	NC ± NC	0.51 - 1.52
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	0	9	NC ± NC	0.26 - 0.53
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	0	15	NC ± NC	0.24 - 0.48
	Clinch River (CRM 2.5)	0	11	NC ± NC	1.04 - 2.12	0	15	NC ± NC	0.42 - 1.41
	Emory River (ERM 3.5)	0	13	NC ± NC	1.05 - 2.07	0	12	NC ± NC	0.24 - 0.51
	Emory River (ERM 3.0)	0	10	NC ± NC	1.07 - 1.25	0	30	NC ± NC	0.07 - 1.3
	Embayments [3]	NA	NA	NA ± NA	NA - NA	0	10	NC ± NC	0.23 - 0.51
	Melton Hill Dam	0	16	NC ± NC	1.07 - 3.26	0	16	NC ± NC	0.22 - 0.6
Zinc	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	110.7 ± 46.86	18.48 - 266.3
	Fort Loudoun Dam	9	9	98.00 ± 46.29	33.83 - 170.4	16	16	99.5 ± 41.82	18.48 - 163.04
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	204.4 ± 112.21	125 - 283.7
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	155.5 ± 45.15	118.48 - 262.5
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	119.5 ± 37.08	68.48 - 195.65
	Clinch River (CRM 2.5)	11	11	97.21 ± 55.79	37.63 - 237.1	15	15	84.0 ± 25.22	57.07 - 138.59
	Emory River (ERM 3.5)	12	13	112.46 ± 70.89	13.04 - 315.76	12	12	96.6 ± 27.63	63.59 - 147.83
	Emory River (ERM 3.0)	10	10	119.62 ± 42.78	64.55 - 192.93	30	30	121.9 ± 70.43	46.74 - 386.41
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	111.5 ± 37.56	64.67 - 174.46
	Melton Hill Dam	16	16	104.02 ± 47.98	42.39 - 198.37	16	16	114.5 ± 56.19	56.52 - 297.83
Clutch Size	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	4.86957 ± 0.97999	2 - 7
	Fort Loudoun Dam	9	9	5 ± 1.22	2 - 6	16	16	4.4375 ± 1.15289	2 - 7
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	5 ± 0	5 - 5
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	5 ± 0.86603	3 - 6
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	5.26667 ± 0.70373	4 - 6
	Clinch River (CRM 2.5)	11	11	4.81818 ± 0.98165	3 - 6	15	15	5.53333 ± 0.5164	5 - 6
	Emory River (ERM 3.5)	13	13	4.38462 ± 1.26085	2 - 6	12	12	4.75 ± 0.75378	4 - 6
	Emory River (ERM 3.0)	10	10	4.9 ± 0.99443	3 - 6	30	30	5.03333 ± 0.7184	4 - 6
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	5.2 ± 1.0328	4 - 7
	Melton Hill Dam[4]	14	15	4.86 ± 1.56	1 - 7	15	15	5.53 ± 1.55	4 - 10
Egg Length (cm)	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	1.90 ± 0.08	1.72 - 2.04
	Fort Loudoun Dam	9	9	1.92 ± 0.09	1.75 - 2.03	16	16	1.90 ± 0.08	1.74 - 2.04
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	1.86 ± 0.11	1.79 - 1.94
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	1.94 ± 0.06	1.89 - 2.07
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	1.92 ± 0.11	1.74 - 2.15
	Clinch River (CRM 2.5)	11	11	1.95618 ± 0.10787	1.688 - 2.045	15	15	1.87 ± 0.08	1.71 - 2.00
	Emory River (ERM 3.5)	13	13	1.90462 ± 0.10293	1.728 - 2.101	12	12	1.93 ± 0.09	1.79 - 2.14
	Emory River (ERM 3.0)	10	10	1.886 ± 0.07039	1.792 - 2.002	30	30	1.90 ± 0.09	1.71 - 2.09
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	1.90 ± 0.10	1.76 - 2.08
	Melton Hill Dam	16	16	1.87 ± 0.08	1.73 - 1.98	16	16	1.93 ± 0.09	1.81 - 2.11

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Table 2. Tree Swallow Egg Summary Statistics for 2009 and 2010
Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Tree Swallow Egg Results (mg/kg dw)				2010 Tree Swallow Egg Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Egg Width (cm)	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	1.33 ± 0.05	1.08 - 1.42
	Fort Loudoun Dam	9	9	1.34 ± 0.03	1.3 - 1.379	16	16	1.32 ± 0.08	1.08 - 1.41
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	1.36 ± 0.01	1.36 - 1.37
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	1.35 ± 0.04	1.29 - 1.41
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	1.35 ± 0.02	1.30 - 1.40
	Clinch River (CRM 2.5)	11	11	1.35455 ± 0.04257	1.287 - 1.416	15	15	1.33 ± 0.04	1.23 - 1.40
	Emory River (ERM 3.5)	13	13	1.32846 ± 0.06291	1.19 - 1.417	12	12	1.36 ± 0.02	1.32 - 1.39
	Emory River (ERM 3.0)	10	10	1.3408 ± 0.03769	1.288 - 1.409	30	30	1.33 ± 0.04	1.25 - 1.42
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	1.33 ± 0.03	1.29 - 1.37
	Melton Hill Dam	16	16	1.35 ± 0.05	1.255 - 1.42	16	16	1.33 ± 0.05	1.21 - 1.41
Egg Volume (cm^3)	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	1.7 ± 0.17	1.0 - 2.0
	Fort Loudoun Dam	9	9	1.76 ± 0.14	1.58 - 1.97	16	16	1.7 ± 0.23	1.0 - 2.0
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	1.8 ± 0.07	1.7 - 1.8
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	1.8 ± 0.12	1.6 - 1.9
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	1.8 ± 0.14	1.5 - 2.0
	Clinch River (CRM 2.5)	11	11	1.83564 ± 0.19078	1.426 - 2.081	15	15	1.7 ± 0.14	1.3 - 1.9
	Emory River (ERM 3.5)	13	13	1.72377 ± 0.22921	1.248 - 1.998	12	12	1.8 ± 0.11	1.6 - 2.1
	Emory River (ERM 3.0)	10	10	1.7304 ± 0.1153	1.553 - 1.869	30	30	1.7 ± 0.14	1.4 - 2.0
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	1.7 ± 0.12	1.5 - 2.0
	Melton Hill Dam	16	16	1.74 ± 0.18	1.47 - 2.04	16	16	1.7 ± 0.15	1.4 - 2.0
Egg Weight (g)	Composite Reference [2]	NA	NA	NA ± NA	NA - NA	46	46	1.8 ± 0.20	0.9 - 2.1
	Fort Loudoun Dam	9	9	1.88889 ± 0.78	1 - 3	16	16	1.8 ± 0.14	1.5 - 2.0
	Little Emory River (LERM 2.0)	NA	NA	NA ± NA	NA - NA	2	2	1.8 ± 0.00	1.8 - 1.8
	Tennessee River (TRM 566)	NA	NA	NA ± NA	NA - NA	9	9	1.9 ± 0.14	1.7 - 2.0
	Clinch River (CRM 1.0)	NA	NA	NA ± NA	NA - NA	15	15	1.8 ± 0.19	1.4 - 2.1
	Clinch River (CRM 2.5)	11	11	1.36364 ± 0.50452	1 - 2	15	15	1.7 ± 0.15	1.4 - 1.9
	Emory River (ERM 3.5)	13	13	1.46154 ± 0.51887	1 - 2	12	12	1.9 ± 0.11	1.7 - 2.1
	Emory River (ERM 3.0)	10	10	1.5 ± 0.70711	1 - 3	30	30	1.8 ± 0.17	1.4 - 2.1
	Embayments [3]	NA	NA	NA ± NA	NA - NA	10	10	1.8 ± 0.10	1.6 - 2.0
	Melton Hill Dam	16	16	1.375 ± 0.50	1 - 2	16	16	1.8 ± 0.19	1.5 - 2.2

[1] Mean calculations include reporting limits substituted for non-detects.

[2] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

[3] Embayments include samples from the East, West, and North Embayments.

[4] Clutch size measurements were inadvertently not recorded for one nest in 2009.

cm - Centimeter.

CRM - Clinch River Mile.

ERM - Emory River Mile.

g - Gram.

LERM - Little Emory River Mile.

mg/kg dw - Milligrams per kilogram dry weight.

NA - Not applicable.

NC - Not calculated; not enough detections to calculate mean. Range includes reporting limits.

SD - Standard deviation.

TRM - Tennessee River Mile

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Table 3. Tree Swallow Eggshell Summary Statistics for 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2010 Tree Swallow Eggshell Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range
Aluminum	Composite Reference [2]	0	4	NC ± NC	8.14 - 17.22
	Tennessee River (TRM 566)	0	2	NC ± NC	10.62 - 14.85
	Emory River (ERM 3.0)	0	7	NC ± NC	6.29 - 13.61
	Embayments [3]	0	4	NC ± NC	11.65 - 18.97
	Melton Hill Dam	0	3	NC ± NC	7.84 - 10.62
Antimony	Composite Reference [2]	0	4	NC ± NC	0.03 - 0.06
	Tennessee River (TRM 566)	0	2	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.0)	0	7	NC ± NC	0.02 - 0.05
	Embayments [3]	0	4	NC ± NC	0.04 - 0.07
	Melton Hill Dam	0	3	NC ± NC	0.03 - 0.04
Arsenic	Composite Reference [2]	1	4	NC ± NC	0.07 - 0.24
	Tennessee River (TRM 566)	1	2	NC ± NC	0.1 - 0.14
	Emory River (ERM 3.0)	5	7	0.09 ± 0.03	0.06 - 0.15
	Embayments [3]	2	4	0.16 ± 0.08	0.1 - 0.27
	Melton Hill Dam	2	3	0.09 ± 0.02	0.08 - 0.11
Barium	Composite Reference [2]	4	4	11.75 ± 3.44	8.87 - 16.7
	Tennessee River (TRM 566)	2	2	70.72 ± 41.7	41.24 - 100.21
	Emory River (ERM 3.0)	7	7	13.55 ± 6.47	5.26 - 22.68
	Embayments [3]	4	4	21.93 ± 12.28	9.07 - 38.56
	Melton Hill Dam	3	3	20.52 ± 11.7	8.76 - 32.16
Beryllium	Composite Reference [2]	0	4	NC ± NC	0.12 - 0.26
	Tennessee River (TRM 566)	0	2	NC ± NC	0.15 - 0.23
	Emory River (ERM 3.0)	0	7	NC ± NC	0.09 - 0.21
	Embayments [3]	0	4	NC ± NC	0.18 - 0.28
	Melton Hill Dam	0	3	NC ± NC	0.11 - 0.15
Boron	Composite Reference [2]	0	4	NC ± NC	0.85 - 1.75
	Tennessee River (TRM 566)	0	2	NC ± NC	1.13 - 1.55
	Emory River (ERM 3.0)	0	7	NC ± NC	0.65 - 1.44
	Embayments [3]	0	4	NC ± NC	1.24 - 1.96
	Melton Hill Dam	0	3	NC ± NC	0.81 - 1.13
Cadmium	Composite Reference [2]	0	4	NC ± NC	0.03 - 0.07
	Tennessee River (TRM 566)	0	2	NC ± NC	0.04 - 0.06
	Emory River (ERM 3.0)	0	7	NC ± NC	0.02 - 0.05
	Embayments [3]	0	4	NC ± NC	0.04 - 0.07
	Melton Hill Dam	0	3	NC ± NC	0.03 - 0.04
Chromium	Composite Reference [2]	1	4	NC ± NC	0.26 - 0.79
	Tennessee River (TRM 566)	0	2	NC ± NC	0.34 - 0.47
	Emory River (ERM 3.0)	0	7	NC ± NC	0.2 - 0.43
	Embayments [3]	0	4	NC ± NC	0.37 - 0.6
	Melton Hill Dam	0	3	NC ± NC	0.25 - 0.34
Cobalt	Composite Reference [2]	0	4	NC ± NC	0.03 - 0.06
	Tennessee River (TRM 566)	0	2	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.0)	0	7	NC ± NC	0.02 - 0.05
	Embayments [3]	0	4	NC ± NC	0.04 - 0.07
	Melton Hill Dam	0	3	NC ± NC	0.03 - 0.04

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Table 3. Tree Swallow Eggshell Summary Statistics for 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2010 Tree Swallow Eggshell Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range
Copper	Composite Reference [2]	4	4	1.26 ± 0.63	0.74 - 2.16
	Tennessee River (TRM 566)	2	2	1.24 ± 0.15	1.13 - 1.34
	Emory River (ERM 3.0)	7	7	0.96 ± 0.16	0.82 - 1.24
	Embayments [3]	4	4	1.05 ± 0.31	0.75 - 1.44
	Melton Hill Dam	3	3	0.99 ± 0.26	0.71 - 1.24
Iron	Composite Reference [2]	1	4	NC ± NC	33.09 - 51.96
	Tennessee River (TRM 566)	0	2	NC ± NC	31.86 - 44.74
	Emory River (ERM 3.0)	0	7	NC ± NC	18.97 - 41.03
	Embayments [3]	0	4	NC ± NC	35.05 - 57.01
	Melton Hill Dam	0	3	NC ± NC	23.61 - 31.86
Lead	Composite Reference [2]	0	4	NC ± NC	0.06 - 0.12
	Tennessee River (TRM 566)	0	2	NC ± NC	0.07 - 0.1
	Emory River (ERM 3.0)	0	7	NC ± NC	0.04 - 0.09
	Embayments [3]	0	4	NC ± NC	0.08 - 0.13
	Melton Hill Dam	0	3	NC ± NC	0.05 - 0.07
Manganese	Composite Reference [2]	4	4	1.44 ± 0.55	0.82 - 1.96
	Tennessee River (TRM 566)	2	2	1.75 ± 0.73	1.24 - 2.27
	Emory River (ERM 3.0)	7	7	0.72 ± 0.39	0.29 - 1.44
	Embayments [3]	3	4	1.12 ± 0.38	0.8 - 1.65
	Melton Hill Dam	3	3	1.04 ± 0.8	0.48 - 1.96
Mercury	Composite Reference [2]	0	4	NC ± NC	0.02 - 0.05
	Tennessee River (TRM 566)	0	2	NC ± NC	0.03 - 0.04
	Emory River (ERM 3.0)	5	7	0.03 ± 0.01	0.03 - 0.04
	Embayments [3]	0	4	NC ± NC	0.03 - 0.05
	Melton Hill Dam	1	3	NC ± NC	0.03 - 0.03
Molybdenum	Composite Reference [2]	0	4	NC ± NC	0.07 - 0.15
	Tennessee River (TRM 566)	0	2	NC ± NC	0.09 - 0.13
	Emory River (ERM 3.0)	0	7	NC ± NC	0.06 - 0.12
	Embayments [3]	0	4	NC ± NC	0.1 - 0.16
	Melton Hill Dam	0	3	NC ± NC	0.07 - 0.09
Nickel	Composite Reference [2]	1	4	NC ± NC	0.2 - 0.42
	Tennessee River (TRM 566)	0	2	NC ± NC	0.26 - 0.36
	Emory River (ERM 3.0)	0	7	NC ± NC	0.15 - 0.33
	Embayments [3]	0	4	NC ± NC	0.29 - 0.46
	Melton Hill Dam	0	3	NC ± NC	0.2 - 0.26
Selenium	Composite Reference [2]	4	4	0.51 ± 0.13	0.39 - 0.63
	Tennessee River (TRM 566)	2	2	0.34 ± 0.1	0.27 - 0.41
	Emory River (ERM 3.0)	7	7	0.38 ± 0.1	0.29 - 0.6
	Embayments [3]	4	4	0.38 ± 0.06	0.32 - 0.45
	Melton Hill Dam	3	3	0.43 ± 0.14	0.34 - 0.6
Silver	Composite Reference [2]	0	4	NC ± NC	0.01 - 0.01
	Tennessee River (TRM 566)	0	2	NC ± NC	0.01 - 0.01
	Emory River (ERM 3.0)	0	7	NC ± NC	0 - 0.01
	Embayments [3]	0	4	NC ± NC	0.01 - 0.01
	Melton Hill Dam	0	3	NC ± NC	0.01 - 0.01
Strontium	Composite Reference [2]	4	4	77.42 ± 12.65	58.76 - 86.19
	Tennessee River (TRM 566)	2	2	125.26 ± 2.19	123.71 - 126.8
	Emory River (ERM 3.0)	7	7	101.89 ± 32.55	62.16 - 147.42
	Embayments [3]	4	4	123.07 ± 37.75	87.11 - 176.29
	Melton Hill Dam	3	3	64.95 ± 14.07	52.89 - 80.41

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Table 3. Tree Swallow Eggshell Summary Statistics for 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2010 Tree Swallow Eggshell Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range
Thallium	Composite Reference [2]	0	4	NC ± NC	0.03 - 0.06
	Tennessee River (TRM 566)	0	2	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.0)	0	7	NC ± NC	0.03 - 0.06
	Embayments [3]	0	4	NC ± NC	0.05 - 0.14
	Melton Hill Dam	0	3	NC ± NC	0.03 - 0.05
Vanadium	Composite Reference [2]	0	4	NC ± NC	0.19 - 0.39
	Tennessee River (TRM 566)	0	2	NC ± NC	0.24 - 0.34
	Emory River (ERM 3.0)	0	7	NC ± NC	0.14 - 0.31
	Embayments [3]	0	4	NC ± NC	0.27 - 0.43
	Melton Hill Dam	0	3	NC ± NC	0.18 - 0.24
Zinc	Composite Reference [2]	3	4	13.3 ± 4.98	8.66 - 18.25
	Tennessee River (TRM 566)	1	2	NC ± NC	5.77 - 10.31
	Emory River (ERM 3.0)	0	7	NC ± NC	3.4 - 7.42
	Embayments [3]	0	4	NC ± NC	6.29 - 10.31
	Melton Hill Dam	1	3	NC ± NC	4.23 - 10.21

[1] Mean calculations include reporting limits substituted for non-detects.

[2] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

[3] Embayments include samples from the East, West, and North Embayments.

ERM - Emory River Mile.

mg/kg dw - Milligrams per kilogram dry weight.

NC - Not calculated; not enough detections to calculate mean. Range includes reporting limits.

TRM - Tennessee River Mile.

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Table 4. Tree Swallow Nestling Summary Statistics for 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Nestling Results (mg/kg dw)				2010 Nestling Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Aluminum	Fort Loudoun Dam	0	3	NC ± NC	67.9 - 78	0	10	NC ± NC	10.2 - 14.7
	Clinch River (CRM 2.5)	0	12	NC ± NC	60.1 - 124.24	0	15	NC ± NC	11 - 15.3
	Emory River (ERM 3.5)	0	11	NC ± NC	62 - 89.1	0	10	NC ± NC	11.2 - 14.6
	Emory River (ERM 3.0)	0	9	NC ± NC	72 - 96.3	1	15	NC ± NC	11.1 - 14.3
	Melton Hill Dam	0	9	NC ± NC	61.1 - 81.3	0	15	NC ± NC	10.7 - 15.1
Antimony	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	0	10	NC ± NC	0.04 - 0.05
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.24 - 0.48	0	15	NC ± NC	0.04 - 0.06
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	0	10	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	0	15	NC ± NC	0.04 - 0.05
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	0	15	NC ± NC	0.04 - 0.05
Arsenic	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	0	10	NC ± NC	0.07 - 0.2
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.24 - 0.48	0	15	NC ± NC	0.08 - 0.21
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	3	10	0.11 ± 0.04	0.08 - 0.2
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	0	15	NC ± NC	0.08 - 0.1
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	2	15	0.1 ± 0.04	0.08 - 0.19
Barium	Fort Loudoun Dam	3	3	3.93 ± 2.78	1.4 - 6.9	10	10	4.22 ± 2.76	0.87 - 9.8
	Clinch River (CRM 2.5)	12	12	5.72 ± 6.85	1.2 - 23.33	15	15	4.75 ± 1.49	2.9 - 7.6
	Emory River (ERM 3.5)	11	11	4.36 ± 3.06	0.45 - 11.7	10	10	3.87 ± 1.42	1.6 - 6.2
	Emory River (ERM 3.0)	9	9	12.92 ± 19	2.19 - 56.2	15	15	6.09 ± 4.79	2.1 - 17.7
	Melton Hill Dam	9	9	2.6 ± 1.11	1 - 4.9	15	15	4.87 ± 1.98	1.7 - 8.7
Beryllium	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	0	10	NC ± NC	0.08 - 0.11
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.24 - 0.48	0	15	NC ± NC	0.08 - 0.18
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	0	10	NC ± NC	0.08 - 0.11
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	0	15	NC ± NC	0.08 - 0.21
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	0	15	NC ± NC	0.08 - 0.11
Boron	Fort Loudoun Dam	0	3	NC ± NC	5.4 - 6.2	0	10	NC ± NC	1.1 - 1.5
	Clinch River (CRM 2.5)	0	12	NC ± NC	4.8 - 10	0	15	NC ± NC	1.1 - 1.6
	Emory River (ERM 3.5)	0	11	NC ± NC	5 - 7.1	0	10	NC ± NC	1.2 - 1.5
	Emory River (ERM 3.0)	0	9	NC ± NC	5.8 - 7.7	1	15	NC ± NC	0.4 - 1.5
	Melton Hill Dam	0	9	NC ± NC	4.9 - 6.5	0	15	NC ± NC	1.1 - 1.6
Cadmium	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	7	10	0.05 ± 0.01	0.03 - 0.07
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.24 - 0.48	13	15	0.06 ± 0.02	0.02 - 0.09
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	9	10	0.08 ± 0.05	0.03 - 0.17
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	13	15	0.05 ± 0.02	0.02 - 0.1
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	14	15	0.08 ± 0.04	0.02 - 0.18

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Table 4. Tree Swallow Nestling Summary Statistics for 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Nestling Results (mg/kg dw)				2010 Nestling Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Chromium	Fort Loudoun Dam	0	3	NC ± NC	0.33 - 0.37	0	10	NC ± NC	0.32 - 0.92
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.25 - 0.69	3	15	0.66 ± 0.96	0.35 - 4.1
	Emory River (ERM 3.5)	1	11	NC ± NC	0.27 - 0.83	3	10	0.5 ± 0.19	0.36 - 0.99
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.53	1	15	NC ± NC	0.35 - 1.4
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.71	4	15	0.81 ± 1.03	0.34 - 4.1
Cobalt	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	0	10	NC ± NC	0.04 - 0.05
	Clinch River (CRM 2.5)	1	12	NC ± NC	0.25 - 0.86	1	15	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	0	10	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	0	15	NC ± NC	0.04 - 0.05
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	2	15	0.04 ± 0	0.04 - 0.05
Copper	Fort Loudoun Dam	3	3	8.93 ± 2.8	6.1 - 11.7	10	10	7.23 ± 0.76	5.8 - 8.1
	Clinch River (CRM 2.5)	12	12	7.59 ± 2.01	5.3 - 11.7	15	15	8.45 ± 1.74	6.2 - 11.4
	Emory River (ERM 3.5)	11	11	7.56 ± 1.79	5.5 - 10.8	10	10	8.44 ± 1.6	5.9 - 11.2
	Emory River (ERM 3.0)	9	9	7.61 ± 1.47	5.5 - 10.4	15	15	8.27 ± 1.52	6.6 - 12.7
	Melton Hill Dam	9	9	6.7 ± 1.38	5.2 - 10	15	15	7.89 ± 1.58	5.9 - 10.7
Iron	Fort Loudoun Dam	3	3	221.67 ± 39.95	177 - 254	10	10	250.9 ± 69.17	183 - 399
	Clinch River (CRM 2.5)	12	12	180.38 ± 31.87	137 - 264.55	15	15	206.07 ± 44.7	132 - 327
	Emory River (ERM 3.5)	11	11	193.09 ± 28.61	167 - 264	10	10	212.3 ± 31.52	162 - 267
	Emory River (ERM 3.0)	9	9	201.21 ± 37.46	166.89 - 287	15	15	212.93 ± 33.1	143 - 264
	Melton Hill Dam	9	9	185.78 ± 51.9	144 - 315	15	15	224.73 ± 35.9	180 - 308
Lead	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	2	10	0.35 ± 0.83	0.08 - 2.7
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.24 - 0.48	2	15	0.1 ± 0.06	0.08 - 0.31
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	1	10	NC ± NC	0.08 - 0.12
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	1	15	NC ± NC	0.08 - 0.11
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	0	15	NC ± NC	0.07 - 0.1
Manganese	Fort Loudoun Dam	3	3	4.97 ± 2.28	2.5 - 7	10	10	3.65 ± 1.01	2.5 - 5.6
	Clinch River (CRM 2.5)	12	12	5.37 ± 4.94	1.7 - 17.27	15	15	4.95 ± 2.05	2 - 9.6
	Emory River (ERM 3.5)	8	11	3.78 ± 1.73	1.6 - 6.4	10	10	5.04 ± 3.82	2.1 - 14.7
	Emory River (ERM 3.0)	9	9	11.24 ± 16.01	1.83 - 47.6	15	15	5.01 ± 2.04	2.3 - 9.2
	Melton Hill Dam	9	9	2.38 ± 0.64	1.5 - 3.4	15	15	3.93 ± 1.54	1.6 - 7
Mercury	Fort Loudoun Dam	0	3	NC ± NC	0.05 - 0.06	3	10	0.04 ± 0	0.03 - 0.05
	Clinch River (CRM 2.5)	6	12	0.09 ± 0.05	0.05 - 0.23	15	15	0.09 ± 0.02	0.06 - 0.15
	Emory River (ERM 3.5)	1	11	NC ± NC	0.06 - 0.11	10	10	0.1 ± 0.02	0.06 - 0.12
	Emory River (ERM 3.0)	2	9	0.09 ± 0.02	0.07 - 0.12	15	15	0.1 ± 0.02	0.06 - 0.12
	Melton Hill Dam	1	9	NC ± NC	0.05 - 0.07	14	15	0.06 ± 0.02	0.02 - 0.08

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Table 4. Tree Swallow Nestling Summary Statistics for 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Nestling Results (mg/kg dw)				2010 Nestling Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Molybdenum	Fort Loudoun Dam	0	3	NC ± NC	2.7 - 3.1	9	10	0.22 ± 0.05	0.15 - 0.32
	Clinch River (CRM 2.5)	0	12	NC ± NC	2.4 - 4.85	14	15	0.21 ± 0.05	0.11 - 0.31
	Emory River (ERM 3.5)	0	11	NC ± NC	2.5 - 3.6	10	10	0.21 ± 0.04	0.15 - 0.28
	Emory River (ERM 3.0)	0	9	NC ± NC	2.9 - 3.9	7	15	0.18 ± 0.03	0.13 - 0.24
	Melton Hill Dam	0	9	NC ± NC	2.4 - 3.3	10	15	0.21 ± 0.06	0.11 - 0.34
Nickel	Fort Loudoun Dam	0	3	NC ± NC	0.3 - 0.59	0	10	NC ± NC	0.25 - 0.71
	Clinch River (CRM 2.5)	1	12	NC ± NC	0.25 - 1.2	2	15	0.35 ± 0.14	0.27 - 0.77
	Emory River (ERM 3.5)	1	11	NC ± NC	0.25 - 1.8	2	10	0.35 ± 0.08	0.27 - 0.54
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	2	15	0.32 ± 0.08	0.28 - 0.58
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.46	3	15	0.47 ± 0.46	0.26 - 1.9
Selenium	Fort Loudoun Dam	3	3	3.1 ± 1.61	1.8 - 4.9	10	10	2.99 ± 0.86	1.9 - 4.8
	Clinch River (CRM 2.5)	12	12	3.64 ± 1.1	2.5 - 6.67	15	15	2.95 ± 0.43	2.2 - 3.7
	Emory River (ERM 3.5)	11	11	3.12 ± 0.57	2.3 - 4.1	10	10	3.44 ± 0.56	2.6 - 4.3
	Emory River (ERM 3.0)	9	9	3.41 ± 0.31	3 - 4.1	15	15	3.41 ± 0.46	2.8 - 4.4
	Melton Hill Dam	9	9	6.22 ± 2.08	3.3 - 9	15	15	5.23 ± 1.8	1.6 - 8.5
Silver	Fort Loudoun Dam	0	3	NC ± NC	0.14 - 0.16	2	10	0.01 ± 0.01	0.01 - 0.04
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.12 - 0.25	1	15	NC ± NC	0.01 - 0.01
	Emory River (ERM 3.5)	0	11	NC ± NC	0.12 - 0.18	2	10	0.02 ± 0.01	0.01 - 0.04
	Emory River (ERM 3.0)	0	9	NC ± NC	0.14 - 0.19	0	15	NC ± NC	0.01 - 0.03
	Melton Hill Dam	0	9	NC ± NC	0.12 - 0.16	1	15	NC ± NC	0.01 - 0.01
Strontium	Fort Loudoun Dam	3	3	11.77 ± 5.09	5.9 - 15	10	10	7.19 ± 2.88	3.8 - 12.8
	Clinch River (CRM 2.5)	12	12	14.08 ± 13.26	3.8 - 50.61	15	15	10.32 ± 3.21	5.6 - 17.7
	Emory River (ERM 3.5)	11	11	9.37 ± 4.68	2 - 19.1	10	10	12.34 ± 3.7	7.3 - 17.4
	Emory River (ERM 3.0)	9	9	17.85 ± 15.16	3.53 - 47.7	15	15	14.04 ± 8.6	4.3 - 36.2
	Melton Hill Dam	9	9	5.11 ± 2.54	3 - 11.2	15	15	6.77 ± 2.23	2.2 - 10.6
Thallium	Fort Loudoun Dam	0	3	NC ± NC	0.27 - 0.31	0	10	NC ± NC	0.04 - 0.05
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.24 - 0.48	0	15	NC ± NC	0.04 - 0.07
	Emory River (ERM 3.5)	0	11	NC ± NC	0.25 - 0.36	0	10	NC ± NC	0.04 - 0.05
	Emory River (ERM 3.0)	0	9	NC ± NC	0.29 - 0.39	0	15	NC ± NC	0.04 - 0.05
	Melton Hill Dam	0	9	NC ± NC	0.24 - 0.33	0	15	NC ± NC	0.04 - 0.12
Vanadium	Fort Loudoun Dam	0	3	NC ± NC	0.54 - 0.62	0	10	NC ± NC	0.12 - 0.33
	Clinch River (CRM 2.5)	0	12	NC ± NC	0.48 - 1	0	15	NC ± NC	0.13 - 0.17
	Emory River (ERM 3.5)	0	11	NC ± NC	0.5 - 0.71	1	10	NC ± NC	0.13 - 0.33
	Emory River (ERM 3.0)	0	9	NC ± NC	0.58 - 0.77	0	15	NC ± NC	0.13 - 0.29
	Melton Hill Dam	0	9	NC ± NC	0.49 - 0.65	2	15	0.25 ± 0.25	0.12 - 1.1

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Table 4. Tree Swallow Nestling Summary Statistics for 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Site	2009 Nestling Results (mg/kg dw)				2010 Nestling Results (mg/kg dw)			
		Number of Detects	Number of Samples	Mean ± SD[1]	Range	Number of Detects	Number of Samples	Mean ± SD[1]	Range
Zinc	Fort Loudoun Dam	3	3	90.73 ± 14.96	76.1 - 106	10	10	94.62 ± 13.69	64.5 - 113
	Clinch River (CRM 2.5)	12	12	98.08 ± 23.31	69.3 - 149.09	15	15	108.03 ± 20.86	82 - 161
	Emory River (ERM 3.5)	11	11	92.23 ± 21.05	54.7 - 123	10	10	108.07 ± 10.82	88.1 - 124
	Emory River (ERM 3.0)	9	9	100.73 ± 12.19	90.75 - 125	15	15	102.6 ± 20.58	82 - 158
	Melton Hill Dam	9	9	83.93 ± 13.71	64.1 - 98.6	15	15	96.09 ± 16.71	49.9 - 127
Nestling Weight (g)	Fort Loudoun Dam	3	3	20.3333 ± 3.05505	17 - 23	10	10	21.8809 ± 2.64831	17.833 - 25.518
	Clinch River (CRM 2.5)	12	12	21.3333 ± 2.83912	15 - 25	15	15	20.0151 ± 3.07072	11.935 - 25.215
	Emory River (ERM 3.5)	11	11	22.4545 ± 1.86353	18 - 25	10	10	21.4687 ± 1.9295	17.132 - 24.245
	Emory River (ERM 3.0)	9	9	22.3333 ± 2.91548	19 - 28	15	15	20.8839 ± 2.16657	14.61 - 24.265
	Melton Hill Dam	9	9	21.78 ± 1.30	19 - 23	15	15	22.21 ± 2.12	17.481 - 24.43
Feather Length (cm)	Fort Loudoun Dam	3	3	4.35 ± 0.15	4.181 - 4.476	10	10	4.35 ± 0.67	2.618 - 5.079
	Clinch River (CRM 2.5)	12	12	4.62 ± 0.59	3.279 - 5.268	15	15	4.44 ± 0.47	3.15 - 5.072
	Emory River (ERM 3.5)	11	11	4.55 ± 0.52	3.809 - 5.476	10	10	4.64 ± 0.68	3.874 - 5.784
	Emory River (ERM 3.0)	9	9	4.42 ± 0.42	3.826 - 5.071	15	15	4.63 ± 0.36	3.97 - 5.283
	Melton Hill Dam	9	9	4.6736 ± 0.61	3.656 - 5.414	15	15	4.4061 ± 0.54	3.381 - 5.154
Tarsus Length (cm)	Fort Loudoun Dam	3	3	1.1 ± 0.07	1.1 - 1.2	10	10	1.3 ± 0.07	1.1 - 1.4
	Clinch River (CRM 2.5)	12	12	1.2 ± 0.08	1.0 - 1.3	15	15	1.3 ± 0.07	1.1 - 1.4
	Emory River (ERM 3.5)	11	11	1.1 ± 0.07	1.0 - 1.3	10	10	1.3 ± 0.10	1.1 - 1.5
	Emory River (ERM 3.0)	9	9	1.2 ± 0.11	1.0 - 1.4	15	15	1.3 ± 0.04	1.2 - 1.4
	Melton Hill Dam	9	9	1.1 ± 0.11	1.0 - 1.3	15	15	1.3 ± 0.07	1.2 - 1.4
Hatching Success	Fort Loudoun Dam	NA	NA	NC ± NC	NC ± NC	13	13	0.99 ± 0.06	0.8 - 1
	Clinch River (CRM 2.5)	NA	NA	NC ± NC	NC ± NC	15	15	0.93 ± 0.13	0.6 - 1
	Emory River (ERM 3.5)	NA	NA	NC ± NC	NC ± NC	10	10	0.78 ± 0.25	0.33 - 1
	Emory River (ERM 3.0)	NA	NA	NC ± NC	NC ± NC	15	15	0.84 ± 0.17	0.5 - 1
	Melton Hill Dam	NA	NA	NC ± NC	NC ± NC	14	14	0.83 ± 0.18	0.33 - 1
Nestilng Survival (Fledging success)	Fort Loudoun Dam	NA	NA	NC ± NC	NC ± NC	9	9	1 ± 0.00	1 - 1
	Clinch River (CRM 2.5)	NA	NA	NC ± NC	NC ± NC	15	15	0.93 ± 0.13	0.67 - 1
	Emory River (ERM 3.5)	NA	NA	NC ± NC	NC ± NC	8	8	0.96 ± 0.12	0.67 - 1
	Emory River (ERM 3.0)	NA	NA	NC ± NC	NC ± NC	15	15	0.91 ± 0.16	0.5 - 1
	Melton Hill Dam	NA	NA	NC ± NC	NC ± NC	10	10	0.98 ± 0.08	0.75 - 1
Female Fledglings Produced per Nesting Female	Fort Loudoun Dam	NA	NA	NC ± NC	NC ± NC	9	9	2.22 ± 0.71	1 - 3.5
	Clinch River (CRM 2.5)	NA	NA	NC ± NC	NC ± NC	15	15	2.41 ± 0.59	1.25 - 3
	Emory River (ERM 3.5)	NA	NA	NC ± NC	NC ± NC	8	8	1.82 ± 0.66	0.67 - 2.5
	Emory River (ERM 3.0)	NA	NA	NC ± NC	NC ± NC	15	15	1.95 ± 0.57	0.5 - 2.5
	Melton Hill Dam	NA	NA	NC ± NC	NC ± NC	10	10	2.22 ± 0.76	0.67 - 3

[1] Mean calculations include reporting limits substituted for non-detects.

[2] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

ERM - Emory River Mile.

cm - Centimeter.

CRM - Clinch River Mile.

g - Gram.

mg/kg dw - Milligrams per kilogram dry weight.

NC - Not calculated; not enough detections to calculate mean. Range includes reporting limits.

SD - Standard deviation.

TRM - Tennessee River Mile

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Table 5. Tree Swallow Egg ANOVAs – Comparisons Between Years and Locations in 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Year	Location*Year	Location by Year Post-hoc Comparisons [1]
Barium	148	0.06	0.32	0.10	0.46	—
Copper	148	0.19	0.14	0.001	0.02	range: 0.001 - 0.047 MHD 2009 > ERM 3.0, 3.5, MHD, and FLD 2010
Iron	148	0.08	0.35	0.03	0.89	—
Manganese	148	0.07	0.16	0.38	0.80	—
Selenium	148	0.22	< 0.0001	0.44	0.70	**0.05** ERM 3.0 2010 > ERM 3.5 2010 0.0007 ERM 3.0 2010 > FLD 2009 0.0002 ERM 3.0 2010 > FLD 2010 0.04 MHD 2010 > FLD 2009 **0.05** MHD 2010 > FLD 2010
Strontium	148	0.16	0.03	0.004	0.10	0.01 CRM 2.5 2009 > ERM 3.5 2010 0.02 CRM 2.5 2009 > FLD 2010 0.01 CRM 2.5 2009 > MHD 2010 **0.07** CRM 2.5 2009 > CRM 2.5 2010
Zinc	148	0.05	0.21	0.95	0.96	—
Clutch Size	145	—	0.10	0.53	0.15	—
Egg Length	148	0.07	0.90	0.97	0.04	—
Egg Width	148	0.06	0.88	0.39	0.19	—
Egg Volume	148	0.06	0.83	0.47	0.12	—
Egg Weight	148	0.20	**0.06**	0.0001	0.13	**range: 0.06 - 0.08** ERM 3.5 and MHD 2010 > CRM 2.5 2009 **0.09** FLD 2009 > CRM 2.5 2009 **0.06** FLD 2009 > MHD 2009 range: 0.04 - 0.07 ERM 3.0, ERM 3.5, FLD, and MHD 2010 > MHD 2009

Note: Comparisons of years/locations using 2-way ANOVAs except clutch size, which used 2-way non-parametric Kruskal Wallis test with Scheirer-Ray-Hare extension.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test.

BOLD denotes poter Shading denotes statistical significance ($p<0.05$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

MHD - Melton Hill Dam.

R^2 - Correlation coefficient.

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Table 6. Tree Swallow Egg Dunnett's – Comparisons Between Reference (Fort Loudoun Dam) and Locations in 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [1]			
		ERM 3.0 vs. FLD	ERM 3.5 vs. FLD	CRM 2.5 vs. FLD	MHD vs. FLD
Barium	148	0.11	0.78	0.63	0.44
Copper	148	0.46	0.42	0.03	**0.09**
Iron	148	0.29	0.79	0.89	0.30
Manganese	148	**0.07**	0.32	0.58	**0.06**
Selenium	148	< 0.0001	0.03	0.003	< 0.0001
Strontium	148	**0.06**	0.39	0.03	0.78
Zinc	148	0.12	0.62	0.89	0.37
Clutch Size	145	1.00	0.34	1.00	1.00
Egg Length	148	0.49	0.82	0.80	0.65
Egg Width	148	0.74	0.96	0.92	0.82
Egg Volume	148	0.89	0.98	0.95	0.90
Egg Weight	148	**0.06**	0.15	0.007	0.03

[1] Significant differences from the post-hoc Dunnett's one-tailed test except clutch size, which used one-tailed Wilcoxon Rank Sum test.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

MHD - Melton Hill Dam.

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Table 7. Tree Swallow Egg ANOVAs – Comparisons Between Locations in 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Location Post-hoc Comparisons [1]
Barium	155	0.12	0.02	0.03 TRM 566 > CRM 2.5
Cobalt	155	0.06	0.33	—
Copper	155	0.07	0.18	—
Iron	155	0.13	0.007	0.01 TRM 566 > CRM 2.5
				0.02 TRM 566 > ERM 3.5
				0.09 TRM 566 > REF
Manganese	155	0.14	0.003	0.004 TRM 566 > CRM 2.5
				0.045 TRM 566 > ERM 3.5
Mercury	155	0.48	< 0.001	range: < 0.0001 - 0.0005 ERM 3.5, ERM 3.0, Embayments > MHD
				range: < 0.0001 - 0.0002 ERM 3.5, ERM 3.0, Embayments > TRM 566
				< 0.0001 ERM 3.5, ERM 3.0, Embayments > REF
Selenium	155	0.28	< 0.001	0.01 ERM 3.0 > ERM 3.5
				< 0.0001 ERM 3.0 > REF
				0.004 Embayments > REF
				0.01 MHD > REF
				0.09 CRM 2.5 > REF
				0.009 TRM 566 > REF
Strontium	155	0.08	0.11	—
Zinc	155	0.12	0.01	0.01 TRM 566 > CRM 2.5
Clutch Size	154	NA	**0.05**	0.03 MHD > FLD
Egg Length	155	0.05	0.54	—
Egg Width	155	0.06	0.31	—
Egg Volume	155	0.07	0.26	—
Egg Weight	155	0.09	**0.07**	—

Note: Comparisons between locations were conducted using 1-way ANOVA or Kruskal-Wallis test for clutch size

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test or, for clutch size

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

MHD - Melton Hill Dam.

NA - Not applicable.

R^2 - Correlation coefficient.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River

TRM - Tennessee River Mile.

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Table 8. Tree Swallow Egg Dunnett's – Comparisons Between Composite Reference[1] and Locations in 2010

Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [2]							
		LERM 2.0 vs. REF	ERM 3.0 vs. REF	Embayments vs. REF	ERM 3.5 vs. REF	CRM 1.0 vs. REF	CRM 2.5 vs. REF	TRM 566 vs. REF	MHD vs. REF
Barium	155	0.19	0.98	0.92	1.00	0.34	1.00	0.04	0.98
Cobalt	155	0.16	0.63	0.65	1.00	0.84	0.96	0.37	0.88
Copper	155	1.00	0.93	1.00	1.00	1.00	0.57	1.00	1.00
Iron	155	**0.08**	0.78	0.90	1.00	0.91	1.00	0.01	0.96
Manganese	155	0.10	0.72	0.29	1.00	0.65	1.00	0.004	0.62
Mercury	155	0.35	< 0.0001	< 0.0001	< 0.0001	NC	NC	1.00	0.90
Selenium	155	0.02	< 0.0001	0.0006	0.83	0.04	0.01	0.001	0.001
Strontium	155	0.27	0.12	0.78	1.00	0.89	0.99	0.92	1.00
Zinc	155	0.11	0.77	0.91	1.00	0.61	1.00	0.03	0.89
Clutch Size	154	1.00	1.00	1.00	0.27	1.00	1.00	1.00	1.00
Egg Length	155	0.81	0.97	0.97	1.00	1.00	0.50	1.00	1.00
Egg Width	155	0.99	0.93	0.96	1.00	1.00	0.58	1.00	0.98
Egg Volume	155	1.00	0.93	0.97	1.00	1.00	0.87	1.00	0.83
Egg Weight	155	0.99	0.85	0.99	1.00	1.00	0.23	1.00	1.00

[1] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

[2] Significant differences from the post-hoc Dunnett's one-tailed test or one-tailed Wilcoxon rank sum test for clutch size.

Shading denotes statistical significance ($p \leq 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

LERM - Little Emory River Mile.

MHD - Melton Hill Dam.

NC - Not calculated.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

TRM - Tennessee River Mile.

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Table 9. Tree Swallow Egg Shell ANOVAs – Comparisons Between Locations in 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Location Post-hoc Comparisons [1]
Arsenic	20	0.36	0.14	–
Barium	20	0.54	0.02	0.01 TRM 566 > ERM 3.0
				0.02 TRM 566 > REF
Copper	20	0.13	0.70	–
Manganese	20	0.38	0.10	–
Mercury	20	0.31	0.20	–
Selenium	20	0.26	0.32	–
Strontium	20	0.47	0.04	**0.06** Embayments > MHD
Zinc	20	0.59	0.01	0.003 REF > ERM 3.0
				0.09 REF > MHD

Note: Comparisons between years were conducted using 1-way ANOVA.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test.

Shading denotes statistical significance ($p<0.05$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

MHD - Melton Hill Dam.

R^2 - Correlation coefficient.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568)

TRM - Tennessee River Mile.

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Table 10. Tree Swallow Eggshell Dunnett's – Comparisons Between Composite Reference[1] and Locations in 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [2]			
		ERM 3.0 vs. REF	Embayments vs. REF	TRM 566 vs. REF	MHD vs. REF
Arsenic	20	1.00	0.88	0.96	1.00
Barium	20	0.75	0.24	0.004	0.35
Copper	20	0.98	0.95	0.72	0.97
Manganese	20	1.00	0.95	0.63	0.99
Mercury	20	0.98	0.58	0.84	1.00
Selenium	20	1.00	1.00	1.00	0.97
Strontium	20	0.24	**0.06**	**0.08**	0.97
Zinc	20	1.00	1.00	1.00	1.00

[1] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

[2] Significant differences from the post-hoc Dunnett's one-tailed test.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

MHD - Melton Hill Dam.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

TRM - Tennessee River Mile.

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Table 11. Tree Swallow Nestling ANOVAs – Comparisons Between Years and Locations in 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Year	Location*Year	Location by Year Comparisons [1]
Barium	109	0.11	0.11	0.26	0.36	—
Cadmium [2]	65	0.16	0.03	—	—	**0.07** MHD 2010 > ERM 3.0 2010
Copper	109	0.12	0.46	0.158	0.27	—
Iron	109	0.207494	**0.09**	0.003	0.73	0.005 FLD 2010 > CRM 2.5 2009 **0.07** MHD 2010 > CRM 2.5 2009 **0.09** FLD 2010 > ERM 3.5 2009 0.02 FLD 2010 > MHD 2009
Manganese	109	0.141214	0.02	0.52	0.27	0.03 ERM 3.0 2009 > MHD 2009
Mercury [2]	65	0.71	< 0.0001	—	—	< 0.0001 CRM 2.5, ERM 3.5, and ERM 3.0 2010 > MHD 2010 < 0.0001 CRM 2.5, ERM 3.5, ERM 3.0, and MHD 2010 > FLD 2010
Molybdenum [2]	65	0.06	0.40	—	—	—
Selenium	109	0.445685	< 0.0001	0.33	0.25	range: < 0.0001 - 0.04 MHD 2009 and 2010 > ERM 3.0, ERM 3.5, CRM 2.5 and FLD 2009 and 2010
Strontium	109	0.27	< 0.0001	0.90	0.20	range: 0.002 - 0.04 CRM 2.5 and ERM 3.0 2009 and 2010 > MHD 2009 0.009 ERM 3.5 2009 > MHD 2009 range 0.04 - 0.06 ERM 3.0 2009 and 2010 > MHD 2010
Zinc	109	0.15	**0.08**	0.02	0.60	**0.06** CRM 2.5 2010 > MHD 2009 **0.08** ERM 3.5 2010 > MHD 2009
Nestling Weight	109	0.11	0.29	0.49	0.38	—
Feather Length	109	0.05	0.86	0.80	0.56	—
Tarsus Length	109	0.40	0.80	< 0.0001	0.93	range: 0.03 - 0.07 FLD, CRM 2.5, and ERM 3.0 2010 > CRM 2.5 2009 range: 0.0008 - 0.008 FLD, CRM 2.5, ERM 3.5, ERM 3.0, and MHD 2010 > ERM 3.5 2009 range: 0.03 - 0.08 FLD, ERM 3.0, and MHD 2010 > ERM 3.0 2009 **0.08** CRM 2.5 and ERM 3.0 2010 > FLD 2009 range: 0.003 - 0.02 FLD, CRM 2.5, ERM 3.5, ERM 3.0, MHD 2010 > MHD 2009 0.04 ERM 3.0 2010 > CRM 2.5 2010

Note: Comparisons between years and locations were conducted using 2-way ANOVAs.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test.

[2] Constituents could not be evaluated in 2009 due to low frequency of detection; therefore, 1-way ANOVAs were conducted to evaluate differences between locations in 2010. Significant differences from the post-hoc Tukey-Kramer two-tailed test presented.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

NC - Not calculated.

MHD - Melton Hill Dam.

R^2 - Correlation coefficient.

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Table 12. Tree Swallow Nestling Dunnett's – Comparisons Between Reference (Fort Loudoun Dam) and Locations in 2009 and 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [1]			
		ERM 3.0 vs. FLD	ERM 3.5 vs. FLD	CRM 2.5 vs. FLD	MHD vs. FLD
Barium	109	**0.09**	0.67	0.48	0.75
Cadmium [2]	65	0.80	0.09	0.49	0.04
Copper	109	0.76	0.75	0.76	0.97
Iron	109	0.99	1.00	1.00	1.00
Manganese	109	0.26	0.81	0.64	0.99
Mercury [2]	65	< 0.0001	< 0.0001	< 0.0001	0.0001
Molybdenum [2]	65	1.00	0.82	0.92	0.91
Selenium	109	0.11	0.25	0.26	< 0.0001
Strontium	109	**0.08**	0.45	0.37	1.00
Zinc	109	0.22	0.33	0.20	0.87
Nestling Weight	109	0.87	0.48	0.93	0.91
Feather Length	109	0.91	0.75	0.92	0.75
Tarsus Length	109	0.88	0.94	0.54	0.95

[1] Significant differences from the post-hoc Dunnett's one-tailed test.

[2] Constituents could not be evaluated in 2009 due to low frequency of detection; therefore, significant differences from the post-hoc Dunnett's one-tailed test were conducted between locations in 2010.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

MHD - Melton Hill Dam.

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Table 13. Tree Swallow Egg Correlation Coefficients[1]

Tennessee Valley Authority **Kingston, Tennessee**

Analyte		Egg Weight	ClutchSize	Egg Length	Egg Width	Egg Volume
Barium	R^2	0.01552	-0.13595	0.06579	0.20233	0.17779
	p-value	0.82	**0.05**	0.34	0.003	0.009
Copper	R^2	-0.24412	0.0453	0.0091	0.01171	0.0124
	p-value	0.0003	0.51	0.89	0.86	0.86
Iron	R^2	0.11943	-0.19275	0.0617	0.05041	0.06351
	p-value	**0.08**	0.005	0.37	0.46	0.36
Manganese	R^2	0.11257	-0.09528	-0.00638	-0.01424	-0.01864
	p-value	0.10	0.17	0.93	0.84	0.79
Selenium	R^2	-0.00042	-0.0657	0.03576	0.00007	0.01237
	p-value	1.00	0.34	0.60	1.00	0.86
Strontium	R^2	-0.13785	-0.0533	0.00384	0.03938	0.03028
	p-value	0.04	0.44	0.96	0.57	0.66
Zinc	R^2	0.14368	-0.0906	0.05147	0.08301	0.08078
	p-value	0.04	0.45	0.45	0.23	0.24

Note: All analytes are log transformed unless otherwise noted.

[1]Pearson correlation coefficients were used for all except clutch size, which used Spearman's correlation coefficient because it was not normally distributed.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

R^2 - Correlation coefficient.

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Table 14. Tree Swallow Nestling Correlation Coefficients[1]

Tennessee Valley Authority **Kingston, Tennessee**

Analyte		Nestling Weight	Feather Length	Tarsus Length
Barium	R^2	-0.06277	-0.16234	0.15057
	p-value	0.52	**0.09**	0.12
Copper	R^2	-0.44082	-0.23828	0.01144
	p-value	< 0.0001	0.01	0.91
Iron	R^2	-0.28641	-0.29794	0.04361
	p-value	0.003	0.002	0.65
Manganese	R^2	-0.12727	-0.16068	0.10347
	p-value	0.19	**0.09**	0.28
Selenium	R^2	-0.03727	-0.08301	-0.11378
	p-value	0.70	0.39	0.24
Strontium	R^2	-0.11073	-0.14962	0.07314
	p-value	0.25	0.12	0.45
Zinc	R^2	-0.39606	-0.344	0.18453
	p-value	< 0.0001	0.0002	**0.05**

Note: All analytes are log transformed unless otherwise noted.

[1] Pearson correlation coefficients were used for all except clutch size, which used Spearman's correlation coefficient because it was not normally distributed.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

R^2 - Correlation coefficient.

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Table 15. Tree Swallow Egg vs. Eggshell from the Same Nest – Pearson Correlation Coefficients
Tennessee Valley Authority Kingston, Tennessee

Analyte	R^2	p-value
Barium	0.6170	0.005
Copper	0.0861	0.73
Iron	-0.5299	0.02
Manganese	-0.3597	0.13
Mercury	0.2263	0.35
Selenium	-0.5213	0.02
Strontium	-0.0144	0.95
Zinc	-0.7796	< 0.0001

Note: All analytes are log transformed unless otherwise noted.

Shading denotes statistical significance ($p<0.05$).

R^2 - Correlation coefficient.

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Table 16. Tree Swallow Egg vs. Nestling from the Same Nest – Pearson Correlation Coefficients

Tennessee Valley Authority Kingston, Tennessee

Analyte	R^2	p-value
Barium	-0.0034	0.98
Cobalt	0.8944	< 0.0001
Copper	-0.1722	0.11
Iron	-0.1499	0.16
Manganese	0.0568	0.60
Mercury	0.4053	< 0.0001
Selenium	0.1598	0.13
Strontium	0.2662	0.01
Zinc	-0.0104	0.92

Note: All analytes are log transformed unless otherwise noted.

Shading denotes statistical significance ($p < 0.05$).

R^2 - Correlation coefficient.

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Table 17. Tree Swallow Productivity ANOVAs – Comparisons Between Locations in 2010

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Location	Location Post-hoc Comparisons [1]
Clutch Size	69	0.02	0.02 CRM 2.5 > ERM 3.5
			0.03 CRM 2.5 > ERM 3.0
			0.04 MHD > FLD
			0.08 MHD > ERM 3.5
Hatching Success	67	0.02	0.003 FLD > MHD
			0.006 FLD > ERM 3.5
			0.01 FLD > ERM3.0
			0.08 CRM 2.5 > ERM 3.5
			0.08 CRM 2.5 > MHD
Fledgling Success	57	0.40	–
Female Fledglings per Nesting Female[2]	57	0.25	**0.06** CRM 2.5 > ERM 3.5

Note: Clutch size was only for nests with other productivity measures evaluated, whereas Table 7 includes all nests.

[1]Comparisons between locations (all groups and then pairwise) were conducted using non-parametric Kruskal-Wallis test.

[2] Calculated as (clutch size x (hatching success/100) x (nestling success/100))/2.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

MHD - Melton Hill Dam.

ERM - Emory River Mile.

CRM - Clinch River Mile.

FLD - Fort Loudoun Dam.

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Table 18. Tree Swallow Egg vs. Nest Productivity – Spearman Correlation Coefficients[1]

Tennessee Valley Authority **Kingston, Tennessee**

Analyte		Hatching Success	Nestling Survival	Female Fledglings per Nesting Female
Barium	R^2	0.0671	-0.1728	-0.2378
	p-value	0.58	0.20	**0.07**
Copper	R^2	0.2656	-0.2463	0.2160
	p-value	0.03	**0.06**	0.11
Iron	R^2	-0.0922	-0.1661	-0.2385
	p-value	0.445	0.217	**0.07**
Manganese	R^2	-0.1446	-0.0882	-0.2898
	p-value	0.23	0.51	0.03
Selenium	R^2	-0.1675	-0.1919	-0.1608
	p-value	0.16	0.15	0.23
Strontium	R^2	0.1008	-0.2781	-0.2229
	p-value	0.40	0.04	0.10
Zinc	R^2	-0.0906	-0.2258	-0.3350
	p-value	0.45	**0.09**	0.01

Note: All analytes are log transformed unless otherwise noted.

[1] Spearman's correlation coefficient was used because the nest productivity data were not normally distributed.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

R^2 - Correlation coefficient.

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Table 19. Tree Swallow Nestling vs. Nest Productivity – Spearman Correlation Coefficients[1]

Tennessee Valley Authority Kingston, Tennessee

Analyte		Hatching Success	Nestling Survival	Female Fledglings per Nesting Female
Barium	R^2	-0.1054	-0.2770	0.0963
	p-value	0.44	0.04	0.48
Copper	R^2	0.1233	-0.1318	0.1138
	p-value	0.36	0.33	0.40
Iron	R^2	0.0488	-0.1608	-0.2309
	p-value	0.72	0.23	**0.08**
Manganese	R^2	0.1129	-0.1256	0.1668
	p-value	0.40	0.35	0.21
Selenium	R^2	-0.1671	-0.0972	-0.0116
	p-value	0.21	0.47	0.93
Strontium	R^2	-0.0340	-0.2408	-0.0474
	p-value	0.80	**0.07**	0.73
Zinc	R^2	-0.0007	-0.3119	-0.1783
	p-value	1.00	0.02	0.18

[1] Spearman's correlation coefficient was used because the nest productivity data were not normally distributed.

Note: All analytes are log transformed unless otherwise noted.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

R^2 - Correlation coefficient.

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Table 20. Tree Swallow Egg ANOVAs – Comparisons Between Years and Locations in 2009 and 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Year	Location*Year	Location by Year Post-hoc Comparisons [1]
Barium	116	0.22	0.19	**0.08**	0.36	—
Copper	116	0.02	0.04	0.04	0.27	0.04 CRM 2.5 2009 > FLD 2010
Iron	116	0.28	0.38	**0.05**	0.77	—
Manganese	116	0.37	0.20	0.63	0.76	—
Selenium	116	<.0001	< 0.0001	0.53	0.56	**0.05** ERM 3.0 2010 > ERM 3.5 2010 0.0009 ERM 3.0 2010 > FLD 2009 0.0003 ERM 3.0 2010 > FLD 2010
Strontium	116	0.01	**0.08**	0.005	**0.08**	0.01 CRM 2.5 2009 > ERM 3.5 2010 0.02 CRM 2.5 2009 > FLD 2010 **0.06** CRM 2.5 2009 > CRM 2.5 2010
Zinc	116	0.52	0.16	0.81	0.99	—
Clutch Size	116	—	0.11	0.38	0.12	—
Egg Length	116	0.43	0.81	0.38	0.12	—
Egg Width	116	0.40	0.76	0.67	0.14	—
Egg Volume	116	0.23	0.71	0.44	**0.06**	—
Egg Weight	116	0.01	0.04	0.005	0.17	**range: 0.05 - 0.08** ERM 3.5, FLD 2010 > CRM 2.5 2009 **0.07** FLD 2009 > CRM 2.5 2009

Note: Comparisons of years/locations using 2-way ANOVAs except clutch size, which used 2-way non-parametric Kruskal Wallis test with Scheirer-Ray-Hare extension.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

R^2 - Correlation coefficient.

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Table 21. Tree Swallow Egg Dunnett's – Comparisons Between Reference (Fort Loudoun Dam) and Locations in 2009 and 2010, Excluding Melton Hill Dam

Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [1]		
		ERM 3.0 vs. FLD	ERM 3.5 vs. FLD	CRM 2.5 vs. FLD
Barium	116	**0.08**	0.74	0.58
Copper	116	0.35	0.31	0.009
Iron	116	0.25	0.75	0.86
Manganese	116	**0.05**	0.27	0.52
Selenium	116	< 0.0001	0.03	0.003
Strontium	116	**0.05**	0.35	0.03
Zinc	116	0.11	0.57	0.85
Clutch Size	116	1.00	0.34	1.00
Egg Length	116	0.44	0.78	0.76
Egg Width	116	0.86	0.96	0.93
Egg Volume	116	0.69	0.94	0.90
Egg Weight	116	**0.05**	0.13	0.006

[1] Significant differences from the post-hoc Dunnett's one-tailed test except clutch size which used one-tailed Wilcoxon Rank Sum test.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

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Table 22. Tree Swallow Egg ANOVAs – Comparisons Between Locations in 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Location Post-hoc Comparisons [1]
Barium	139	0.14	0.006	0.01 TRM 566 > CRM 2.5
				0.06 TRM 566 > ERM 3.5
Cobalt	139	0.07	0.23	—
Copper	139	0.06	0.30	—
Iron	139	0.15	0.003	range: 0.007 - 0.08 TRM 566 > CRM 2.5, ERM 3.5, REF
				0.08 LERM 2.0 > CRM 2.5
Manganese	139	0.17	0.001	range: 0.002 - 0.10 TRM 566 > CRM 2.5, ERM 3.0, ERM 3.5, REF
Mercury	139	0.47	< 0.001	< 0.0001 CRM 1.0, CRM 2.5, ERM 3.5, ERM 3.0, Embayments > REF
				range: < 0.0001 - 0.003 CRM 1.0, CRM 2.5, ERM 3.5, ERM 3.0, Embayments > TRM 566
Selenium	139	0.30	< 0.001	0.008 ERM 3.0 > ERM 3.5
				< 0.0001 ERM 3.0 > REF
				0.004 Embayments > REF
				0.08 LERM 2.0 > REF
				0.08 CRM 2.5 > REF
				0.008 TRM 566 > REF
Strontium	139	0.08	0.15	—
Zinc	139	0.13	0.008	0.009 TRM 566 > CRM 2.5
Clutch Size	139	—	0.16	—
Egg Length	139	0.04	0.58	—
Egg Width	139	0.06	0.29	—
Egg Volume	139	0.07	0.18	—
Egg Weight	139	0.10	**0.06**	—

Note: Comparisons between locations were conducted using 1-way ANOVA or Kruskal-Wallis test for clutch size.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test or, for clutch size Wilcoxon rank sum test.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

MHD - Melton Hill Dam.

R^2 - Correlation coefficient.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

TRM - Tennessee River Mile.

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Table 23. Tree Swallow Egg Dunnett's – Comparisons Between Composite Reference[1] and Locations in 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [2]						
		LERM 2.0 vs. REF	ERM 3.0 vs. REF	Embayments vs. REF	ERM 3.5 vs. REF	CRM 1.0 vs. REF	CRM 2.5 vs. REF	TRM 566 vs. REF
Barium	139	0.15	0.97	0.90	1.00	0.28	1.00	0.03
Cobalt	139	0.13	0.58	0.60	1.00	0.81	0.95	0.32
Copper	139	1.00	0.92	1.00	1.00	1.00	0.56	1.00
Iron	139	**0.06**	0.74	0.88	1.00	0.89	1.00	0.01
Manganese	139	**0.07**	0.67	0.24	1.00	0.59	1.00	0.002
Mercury	139	0.34	< 0.0001	< 0.0001	< 0.0001	NC	NC	1.00
Selenium	139	0.01	< 0.0001	0.001	0.80	0.04	0.01	0.001
Strontium	139	0.24	0.11	0.75	1.00	0.87	0.98	0.90
Zinc	139	0.10	0.74	0.89	1.00	0.58	1.00	0.02
Clutch Size	139	1.00	1.00	1.00	0.27	1.00	1.00	1.00
Egg Length	139	0.79	0.96	0.96	1.00	1.00	0.46	1.00
Egg Width	139	1.00	0.92	0.96	1.00	1.00	0.84	1.00
Egg Volume	139	0.99	0.91	0.95	1.00	1.00	0.55	1.00
Egg Weight	139	0.98	0.82	0.99	1.00	1.00	0.20	1.00

[1] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

[2] Significant differences from the post-hoc Dunnett's one-tailed test or one-tailed Wilcoxon rank sum test for clutch size.

Shading denotes statistical significance ($p \leq 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

LERM - Little Emory River Mile.

NC - Not calculated.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

TRM - Tennessee River Mile.

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Table 24. Tree Swallow Eggshell ANOVAs – Comparisons Between Locations in 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	R^2	Location	Location Post-hoc Comparisons [1]
Arsenic	17	0.34	0.14	–
Barium	17	0.59	0.007	0.009 - 0.08 TRM 566 > ERM 3.0, ERM 3.5, REF
Copper	17	0.13	0.59	–
Manganese	17	0.46	0.04	**0.09** REF > ERM 3.0 **0.09** TRM 566 > ERM 3.0
Mercury	17	0.18	0.44	–
Selenium	17	0.30	0.19	–
Strontium	17	0.33	0.14	–
Zinc	17	0.65	0.003	0.001 REF > ERM 3.0

Note: Comparisons between years were conducted using 1-way ANOVA.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test.

Shading denotes statistical significance ($p < 0.05$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

ERM - Emory River Mile.

R^2 - Correlation coefficient.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

TRM - Tennessee River Mile.

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Table 25. Tree Swallow Eggshell Dunnett's – Comparisons Between Composite Reference[1] and Locations in 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [2]		
		ERM 3.0 vs. REF	Embayments vs. REF	TRM 566 vs. REF
Arsenic	17	1.00	0.83	0.93
Barium	17	0.69	0.19	0.003
Copper	17	0.97	0.92	0.65
Manganese	17	1.00	0.93	0.54
Mercury	17	0.96	0.53	0.79
Selenium	17	1.00	1.00	1.00
Strontium	17	0.22	**0.06**	**0.08**
Zinc	17	1.00	1.00	1.00

[1] Composite reference includes Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

[2] Significant differences from the post-hoc Dunnett's one-tailed test.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

REF - Composite reference, including Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River (above TRM 568).

TRM - Tennessee River Mile.

ARCADIS

Table 26. Tree Swallow Nestling ANOVAs – Comparisons Between Years and Locations in 2009 and 2010, Excluding Melton Hill Dam

Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Number of Samples	R^2	Location	Year	Location*Year	Location by Year Comparisons [1]
Barium	85	0.51	0.18	0.76	0.70	—
Cadmium [2]	50	0.12	0.12	—	—	—
Copper	85	0.38	1.00	0.48	0.24	—
Iron	85	0.01	**0.05**	0.03	0.94	0.003 FLD 2010 > CRM 2.5 2009 **0.06** FLD 2010 > ERM 3.5 2009
Manganese	85	0.61	0.38	0.90	0.54	—
Mercury [2]	50	0.80	< 0.0001	—	—	< 0.0001 CRM 2.5, ERM 3.5, and ERM 3.0 2010 > FLD 2010
Molybdenum [2]	50	0.10	0.19	—	—	—
Selenium	85	0.10	0.21	0.70	0.10	—
Strontium	85	0.16	0.29	0.67	0.25	—
Zinc	85	0.22	0.56	**0.06**	0.46	—
Nestling Weight	85	0.28	0.35	0.38	0.47	—
Feather Length	85	0.82	0.72	0.81	0.63	—
Tarsus Length	85	< 0.0001	0.73	< 0.0001	0.84	range: 0.01 - 0.07 FLD, CRM 2.5, ERM 3.5, and ERM 3.0 2010 > CRM 2.5 2009 range: 0.0004 - 0.004 FLD, CRM 2.5, ERM 3.5, and ERM 3.0 2010 > ERM 3.5 2009 range: 0.02 - 0.08 FLD, ERM 3.5, and ERM 3.0 2010 > ERM 3.0 2009 range: **0.05 - 0.10** FLD, CRM 2.5, ERM 3.5, and ERM 3.0 2010 > FLD 2009

Note: Comparisons between years and locations were conducted using 2-way ANOVAs.

[1] Significant differences from the post-hoc Tukey-Kramer two-tailed test.

[2] Constituents could not be evaluated in 2009 due to low frequency of detection; therefore, 1-way ANOVAs were conducted to evaluate differences between locations in 2010. Significant differences from the post-hoc Tukey-Kramer two-tailed test presented.

Shading denotes statistical significance ($p<0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

ANOVA - Analysis of Variance.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

NC - Not calculated.

MHD - Melton Hill Dam.

R^2 - Correlation coefficient.

ARCADIS

Table 27. Tree Swallow Nestling Dunnett's – Comparisons Between Reference (Fort Loudoun Dam) and Locations in 2009 and 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Impacted vs. Reference Post-hoc Comparisons [1]		
		ERM 3.0 vs. FLD	ERM 3.5 vs. FLD	CRM 2.5 vs. FLD
Barium	85	**0.10**	0.63	0.46
Cadmium [2]	50	0.76	**0.06**	0.43
Copper	85	0.72	0.71	0.73
Iron	85	0.99	0.99	1.00
Manganese	85	0.26	0.77	0.61
Mercury [2]	50	< 0.0001	< 0.0001	< 0.0001
Molybdenum [2]	50	1.00	0.78	0.90
Selenium	85	0.04	0.13	0.14
Strontium	85	**0.09**	0.43	0.35
Zinc	85	0.19	0.29	0.17
Nestling Weight	85	0.85	0.92	0.50
Feather Length	85	0.92	0.96	0.92
Tarsus Length	85	0.89	0.72	0.91

[1] Significant differences from the post-hoc Dunnett's one-tailed test.

[2] Constituents could not be evaluated in 2009 due to low frequency of detection; therefore, significant differences from the post-hoc Dunnett's one-tailed test were conducted between locations in 2010.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

CRM - Clinch River Mile.

ERM - Emory River Mile.

FLD - Fort Loudoun Dam; reference site.

ARCADIS

Table 28. Tree Swallow Productivity ANOVAs – Comparisons Between Locations in 2010, Excluding Melton Hill Dam

Tennessee Valley Authority Kingston, Tennessee

Analyte	Number of Samples	Location	Location Post-hoc Comparisons [1]
Clutch Size	54	0.02	0.02 CRM2.5 > ERM3.5
			0.03 CRM2.5 > ERM3.0
Hatching Success	53	0.02	0.006 FLD > ERM3.5
			0.01 FLD > ERM3.0
			0.08 CRM2.5 > ERM3.5
Fledgling Success	47	0.36	–
Female Fledglings per Nesting Female[2]	47	0.19	**0.06** CRM2.5 > ERM 3.5

Note: Clutch size was only for nests with other productivity measures evaluated, whereas Table 22 includes all nests (excluding MHD).

[1]Comparisons between locations (all groups and then pairwise) were conducted using non-parametric Kruskal-Wallis test.

[2] Calculated as (clutch size x (hatching success/100) x (nestling success/100))/2.

Shading denotes statistical significance ($p < 0.05$).

BOLD denotes potential statistical significance ($0.05 \leq p \leq 0.1$).

– - Indicates no statistical differences.

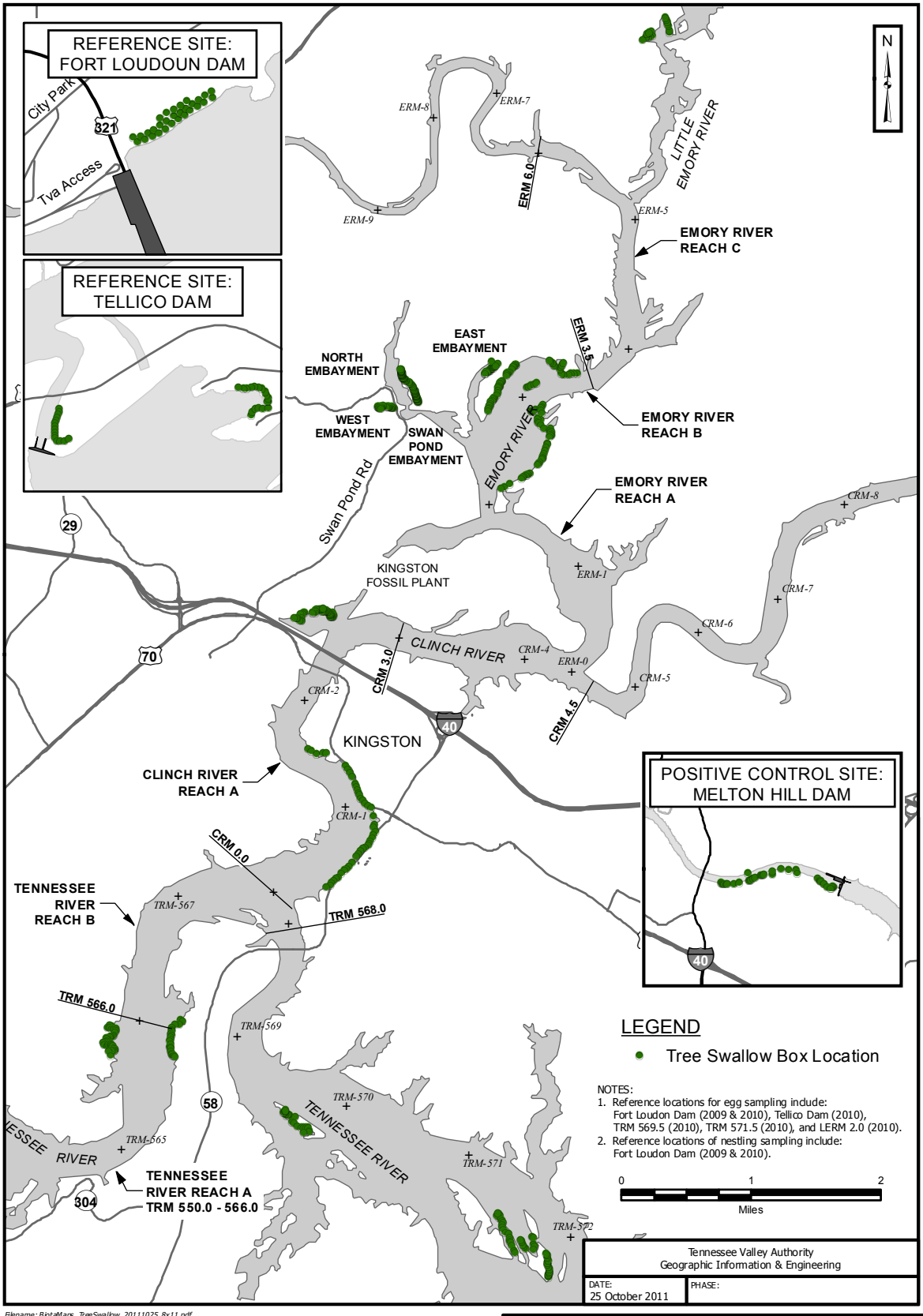
ANOVA - Analysis of Variance.

MHD - Melton Hill Dam.

ERM - Emory River Mile.

CRM - Clinch River Mile.

FLD - Fort Loudoun Dam.



Filename: BiotaMaps_TreeSwallow_20111025_8x11.pdf

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009- 2010

TREE SWALLOW NEST BOX LOCATIONS

ARCADIS

FIGURE
1

CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: D.JONES TM: S.YOUNG
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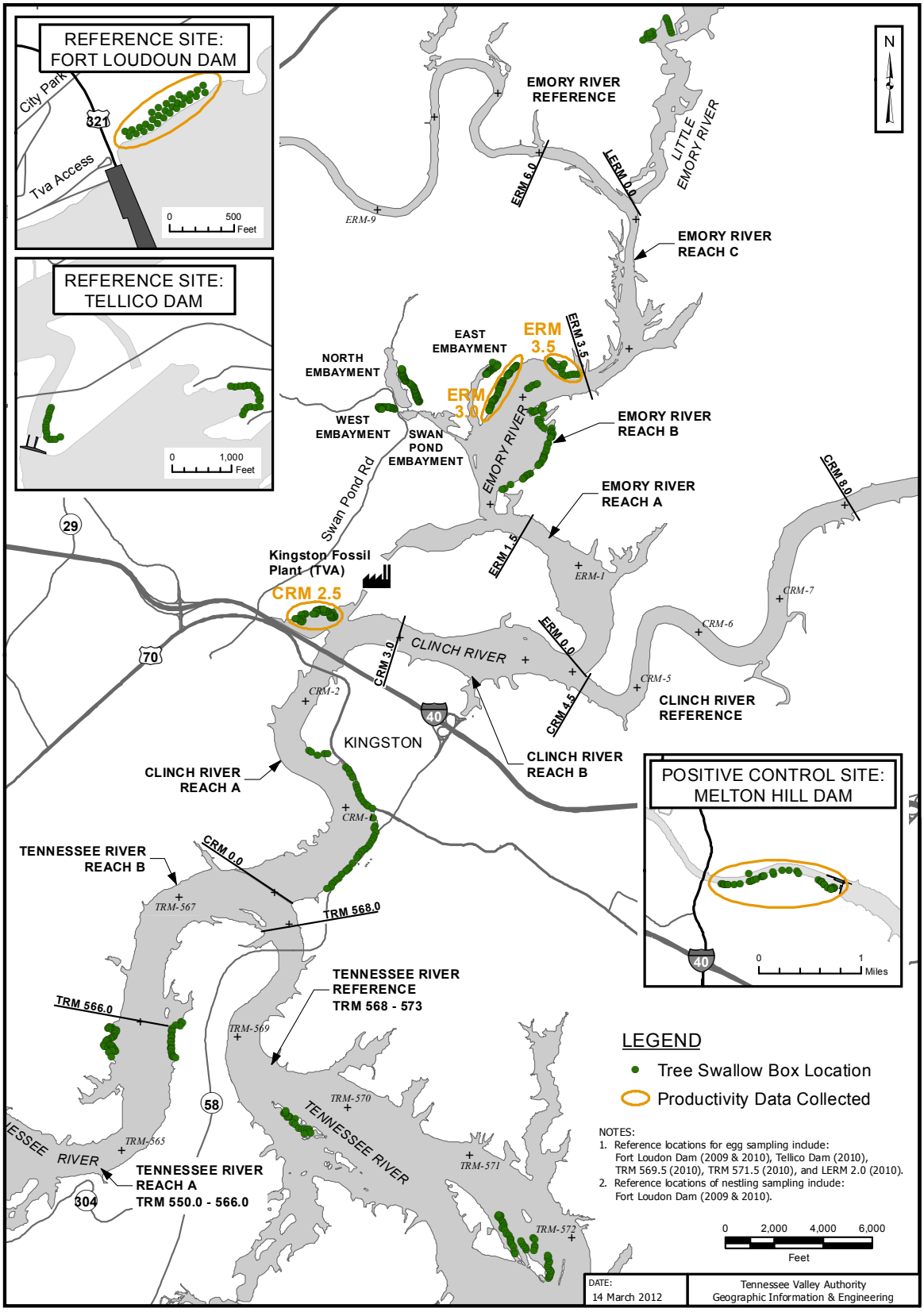

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009- 2010

TREE SWALLOW PRODUCTIVITY DATA LOCATIONS

ARCADIS

FIGURE
2

CITY: KNX DIV/GROUP: ENV/GIS DB: C.SMITH PIC: B.ILGNER PM: D.JONES TM: S.YOUNG
PROJECT: TNTVAKIP.ERA4.00007 PATH: G:\GIS\TVA\KIF\Amphibians-Bird data\Tree Swallow\F2_TreeSwallow_ProductivityDataLocs.pdf

Tree swallow nest with eggs.

Measuring tree swallow egg with digital micrometers.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009- 2010

TREE SWALLOW EGG COLLECTIONS

ARCADIS

FIGURE
3a

Fifteen-day tree swallow nestling.

Examining 15-day tree swallow nestling feathers.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009- 2010

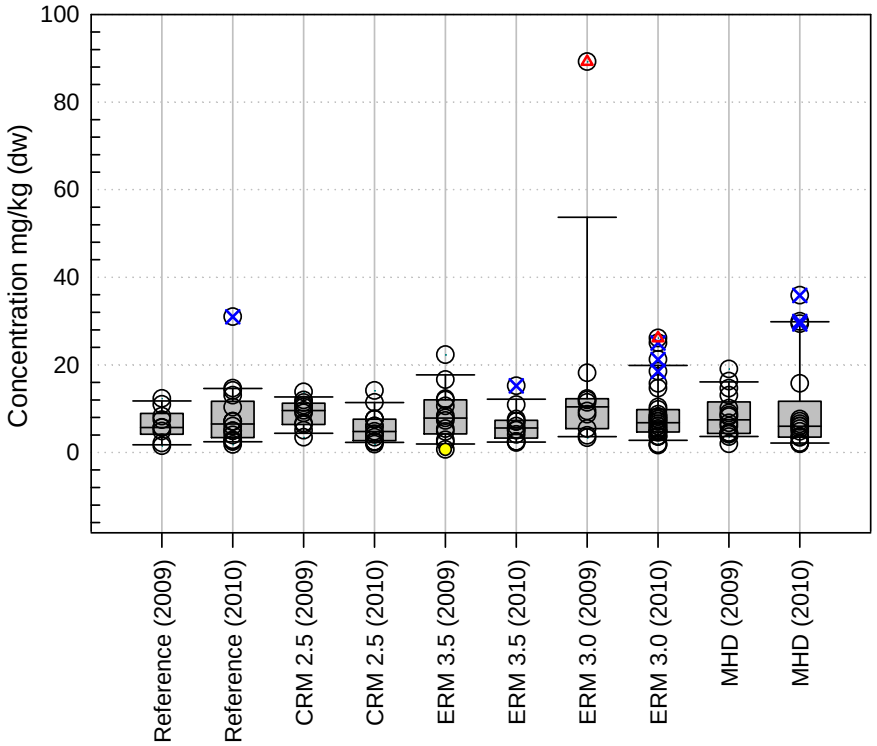
TREE SWALLOW NESTLING COLLECTIONS

ARCADIS

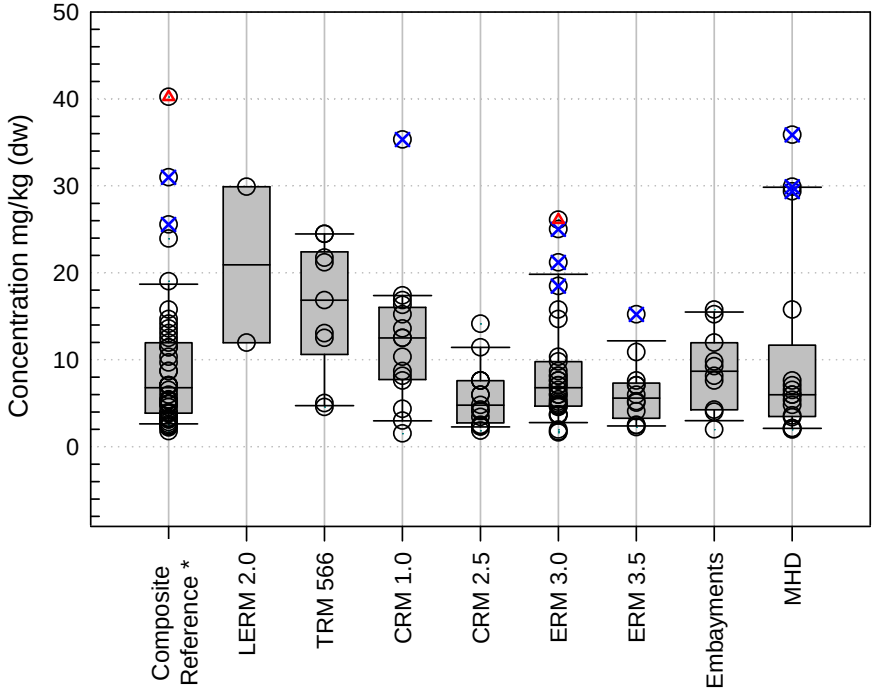
FIGURE 3b

Barium

2009 and 2010 Locations



2010 Locations



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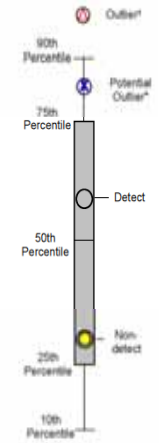


Notes:
Egg content concentrations in mg/kg (dw) = milligrams per kilogram (dry weight).

* – Composite reference site, including samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.
† – Data points identified as outliers or potential outliers were included in all statistical analyses.
CRM – Clinch River Mile.
Embayments – Includes samples from East, West, and North Embayments
ERM – Emory River Mile.
LERM – Little Emory River.
MHD – Melton Hill Dam, positive control site.
Reference – Fort Loudoun Dam.
TRM – Tennessee River Mile.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

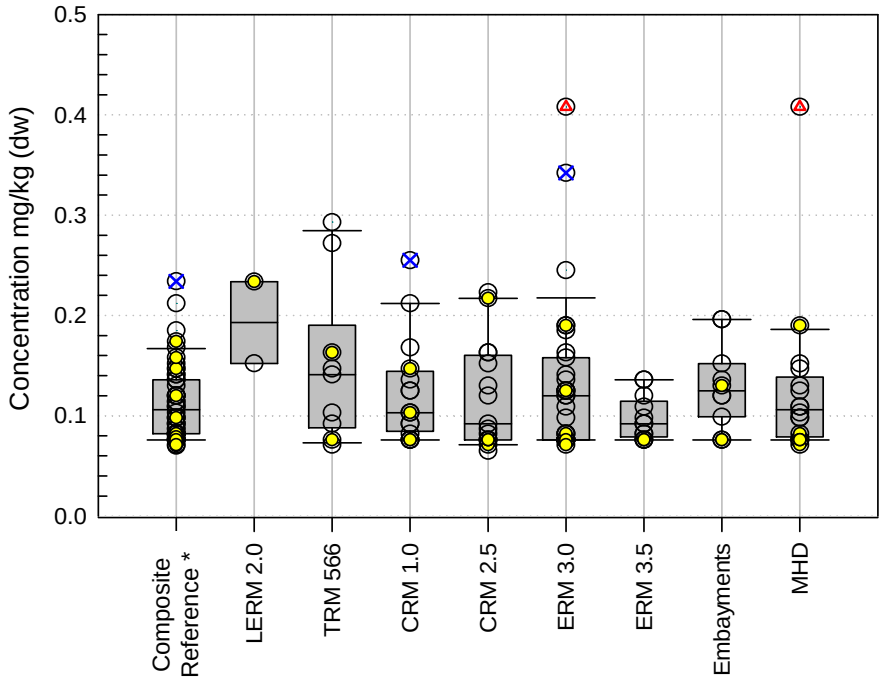
TRACE ELEMENT CONCENTRATIONS IN EGGS – BARIUM

ARCADIS

FIGURE
4

Cobalt

2010 Locations



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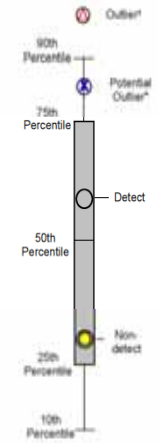

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Reference – Fort Loudoun Dam.
TRM – Tennessee River Mile.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

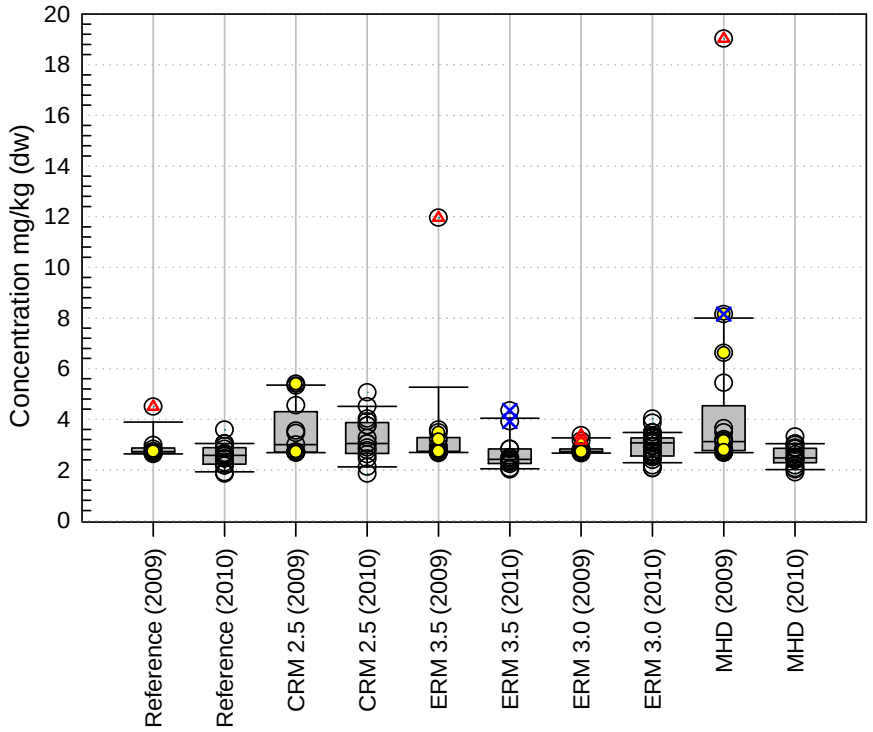
TRACE ELEMENT CONCENTRATIONS IN EGGS – COBALT (2010)

ARCADIS

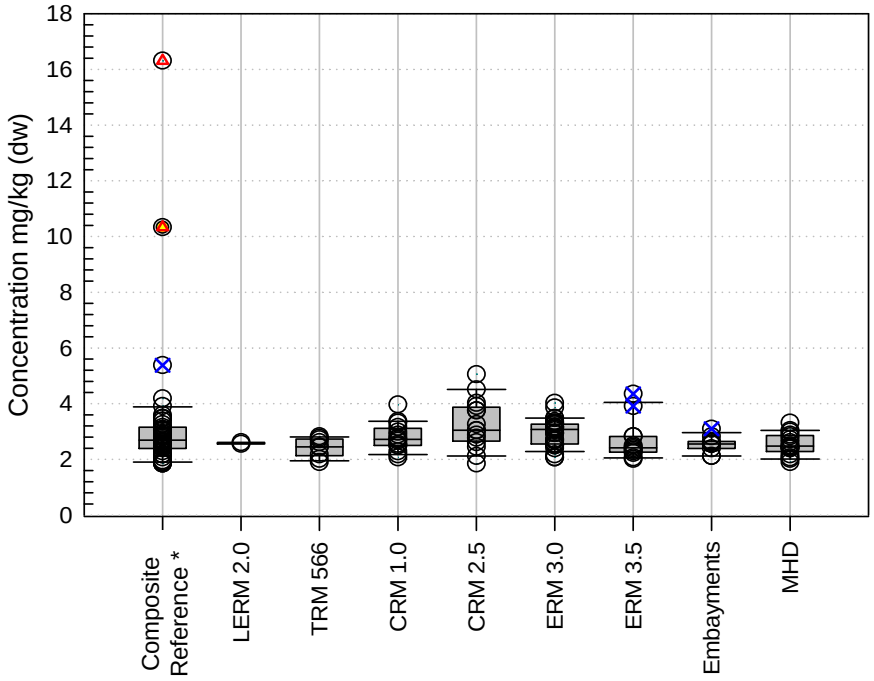
FIGURE
5

Copper

2009 and 2010 Locations



2010 Locations



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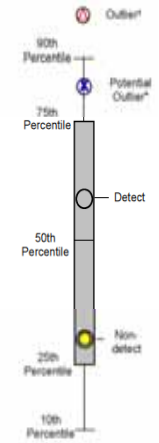

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

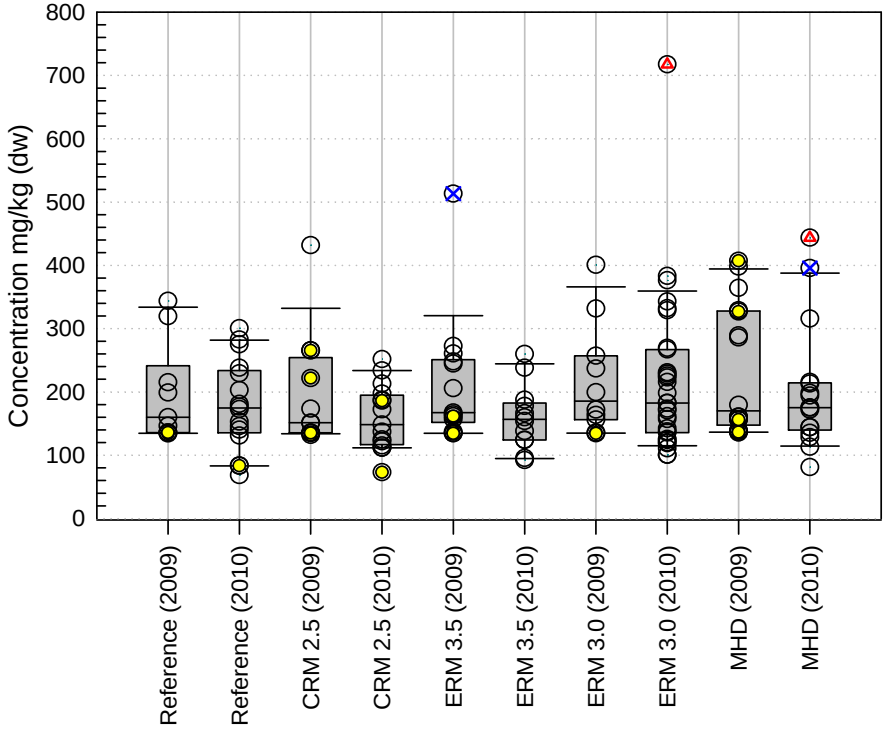
TRACE ELEMENT CONCENTRATIONS IN EGGS – COPPER

ARCADIS

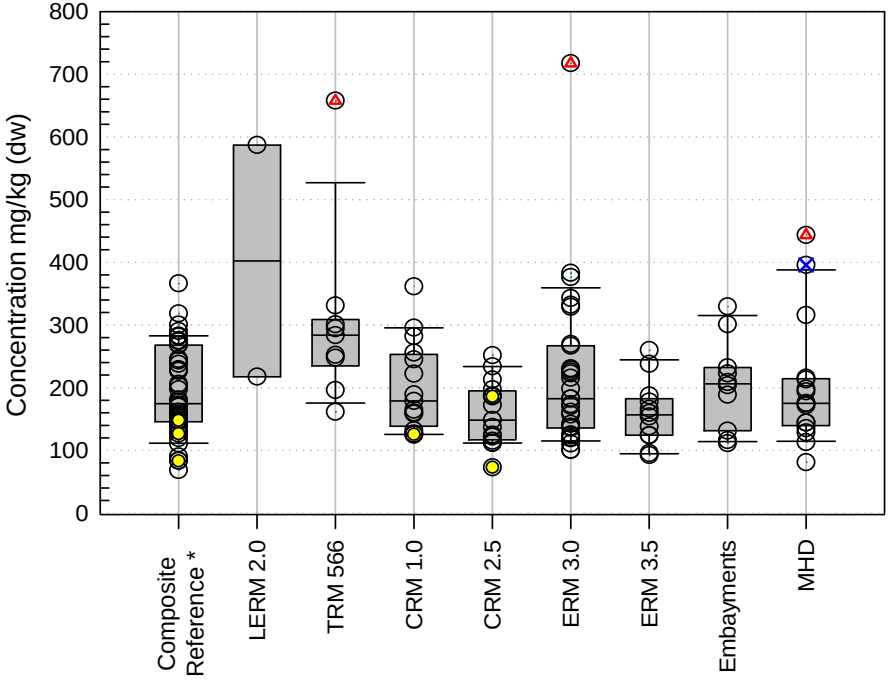
FIGURE
6

Iron

2009 and 2010 Locations



2010 Locations



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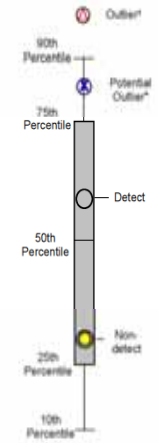

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

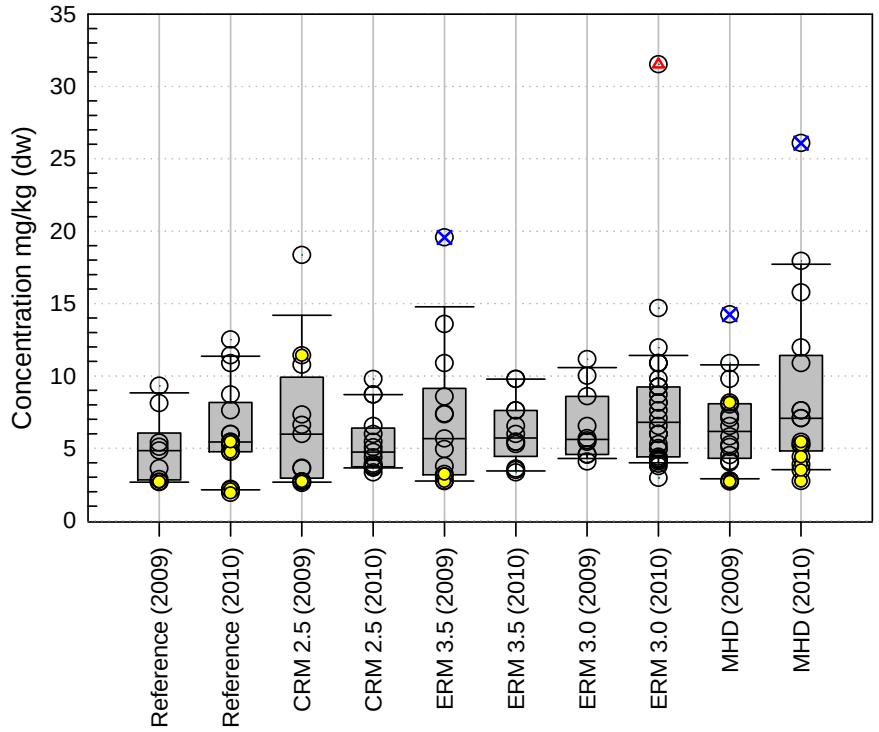
TRACE ELEMENT CONCENTRATIONS IN EGGS – IRON

ARCADIS

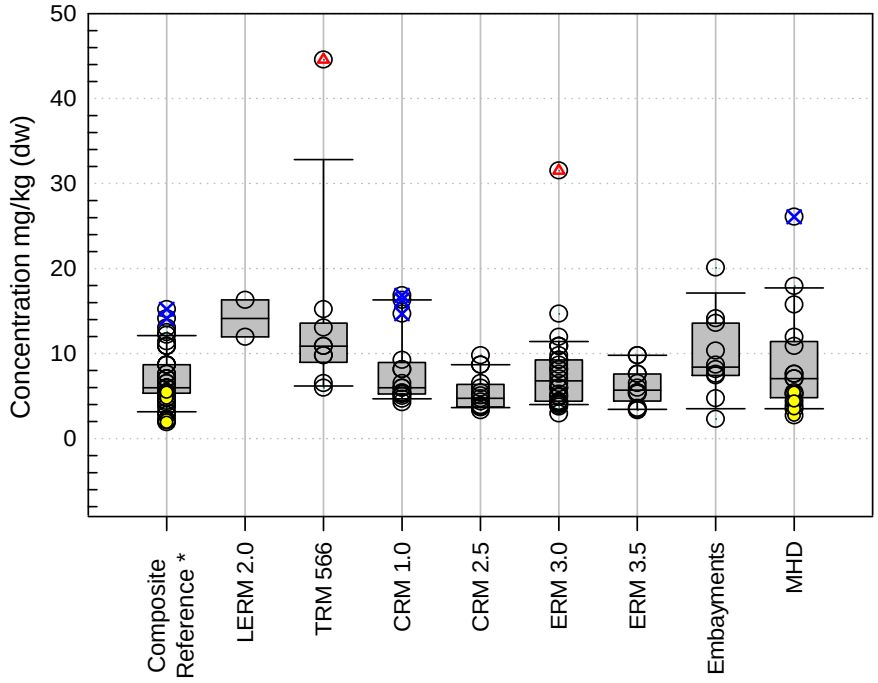
FIGURE
7

Manganese

2009 and 2010 Locations



2010 Locations



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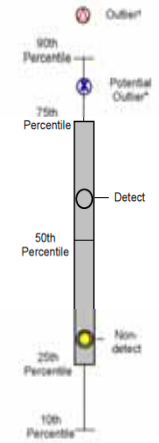

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

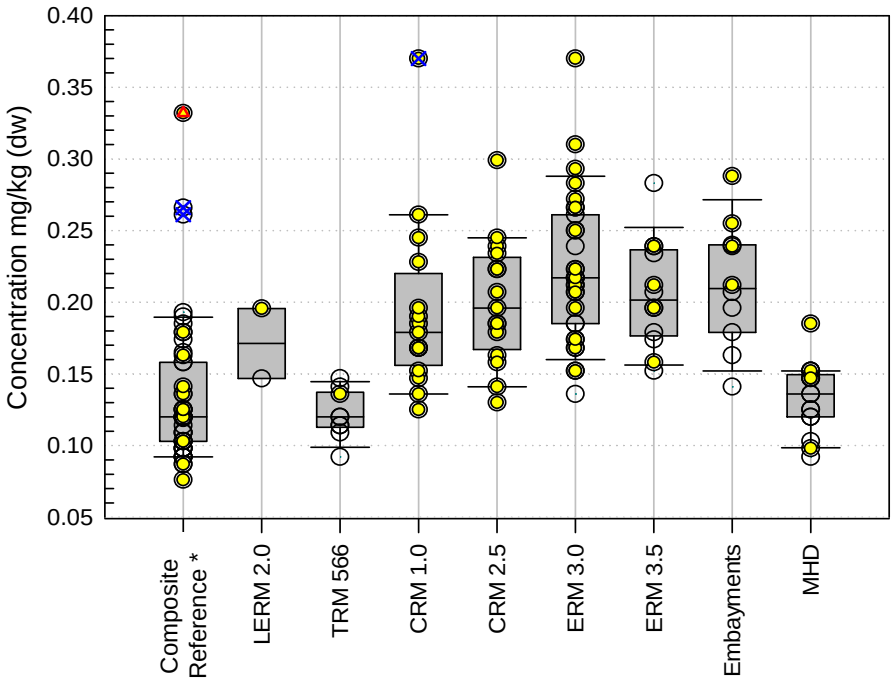
TRACE ELEMENT CONCENTRATIONS IN EGGS – MANGANESE

ARCADIS

FIGURE
8

Mercury

2010 Locations



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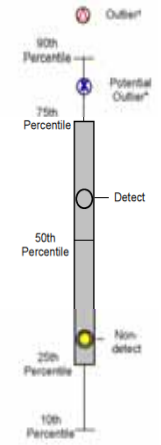

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

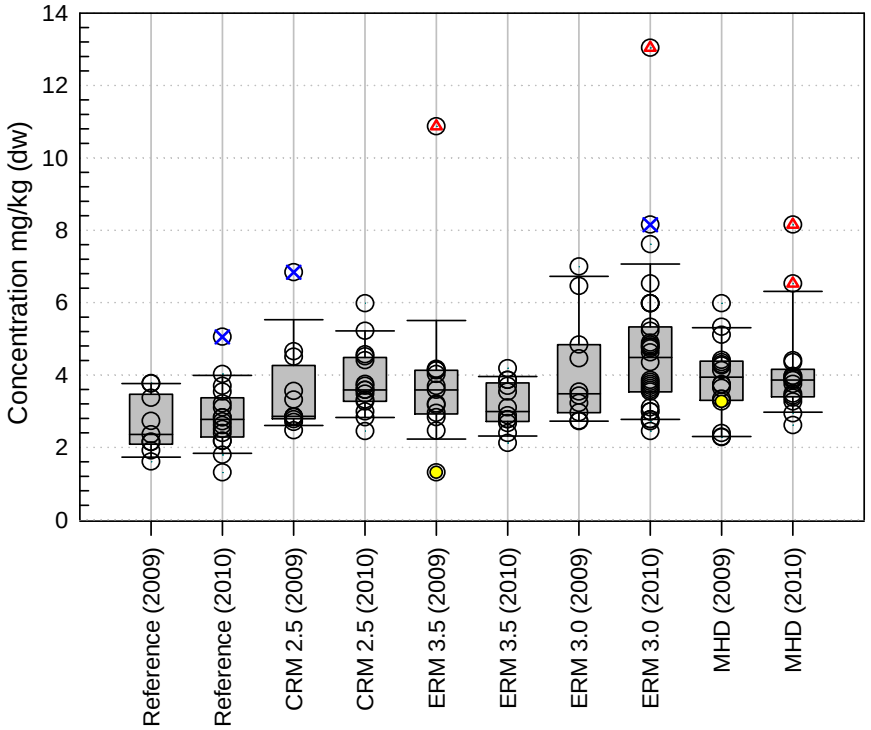
TRACE ELEMENT CONCENTRATIONS IN EGGS – MERCURY (2010)

ARCADIS

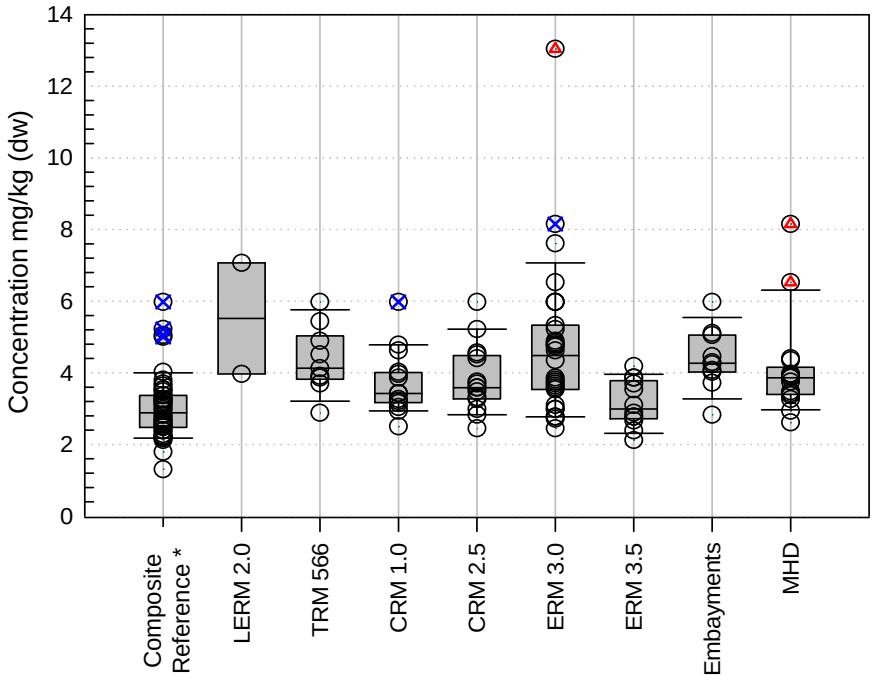
FIGURE
9

Selenium

2009 and 2010 Locations



2010 Locations



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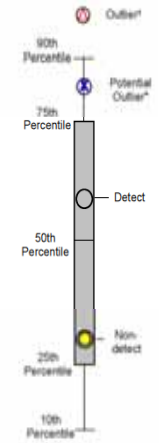

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TRM – Tennessee River Mile.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

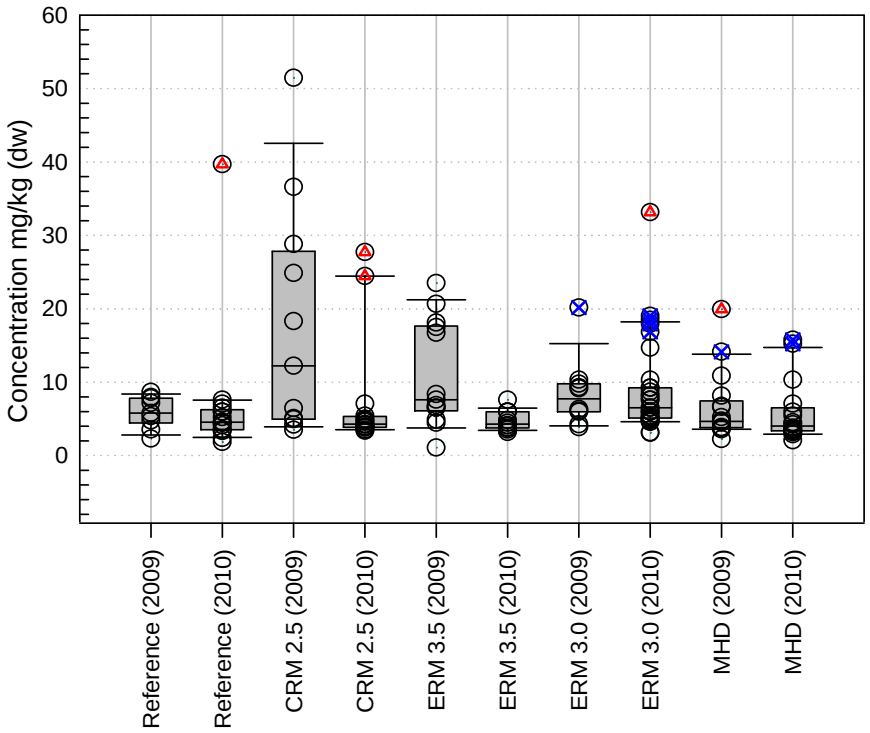
TRACE ELEMENT CONCENTRATIONS IN EGGS – SELENIUM

ARCADIS

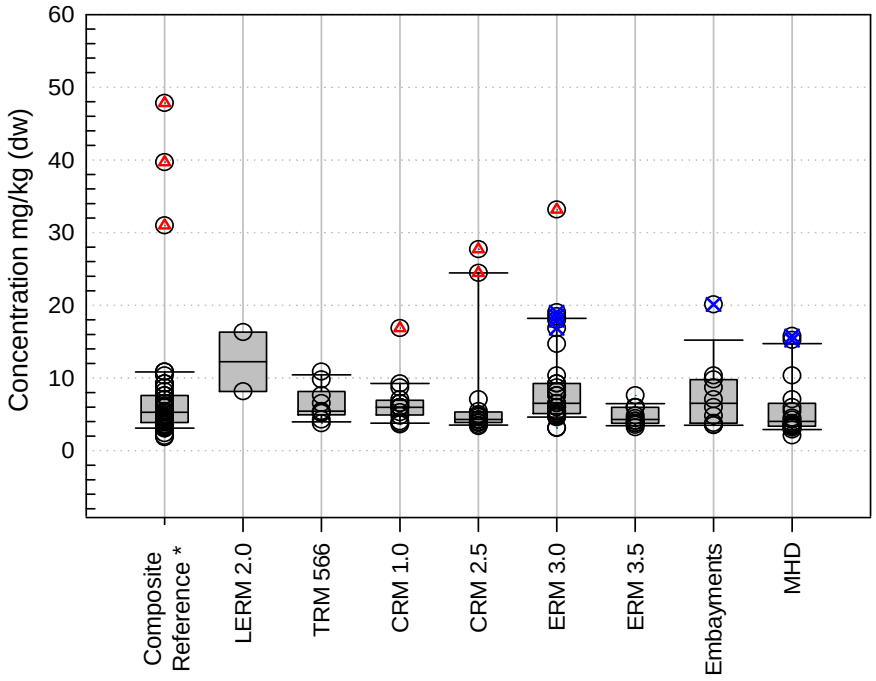
FIGURE
10

Strontium

2009 and 2010 Locations



2010 Locations



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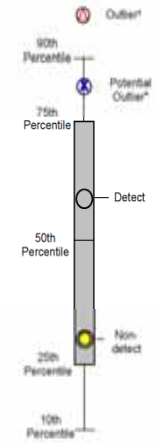

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Reference – Fort Loudoun Dam.
TRM – Tennessee River Mile.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

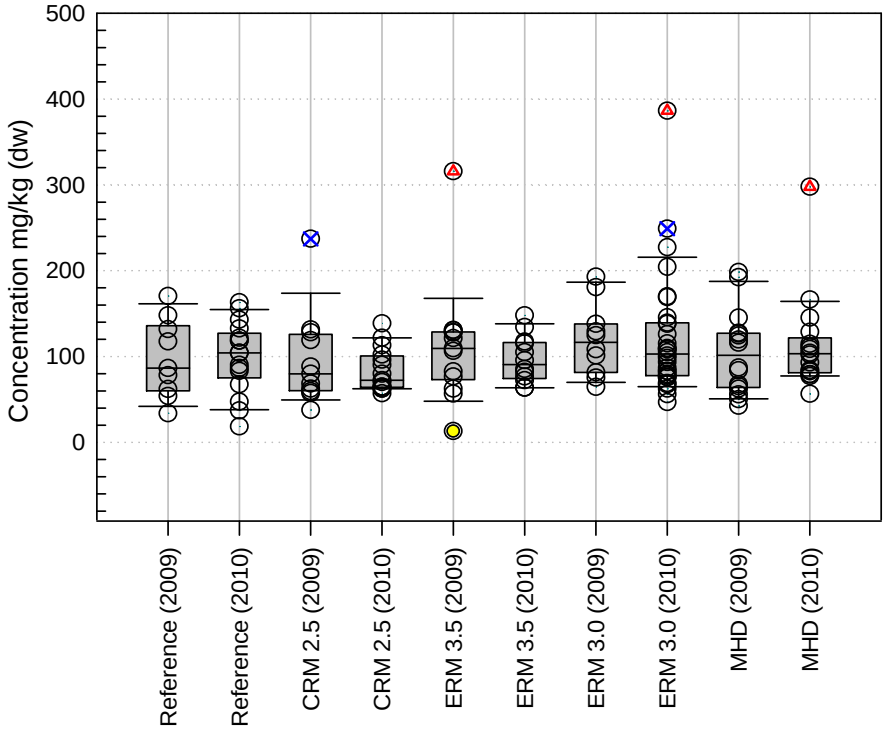
TRACE ELEMENT CONCENTRATIONS IN EGGS – STRONTIUM

ARCADIS

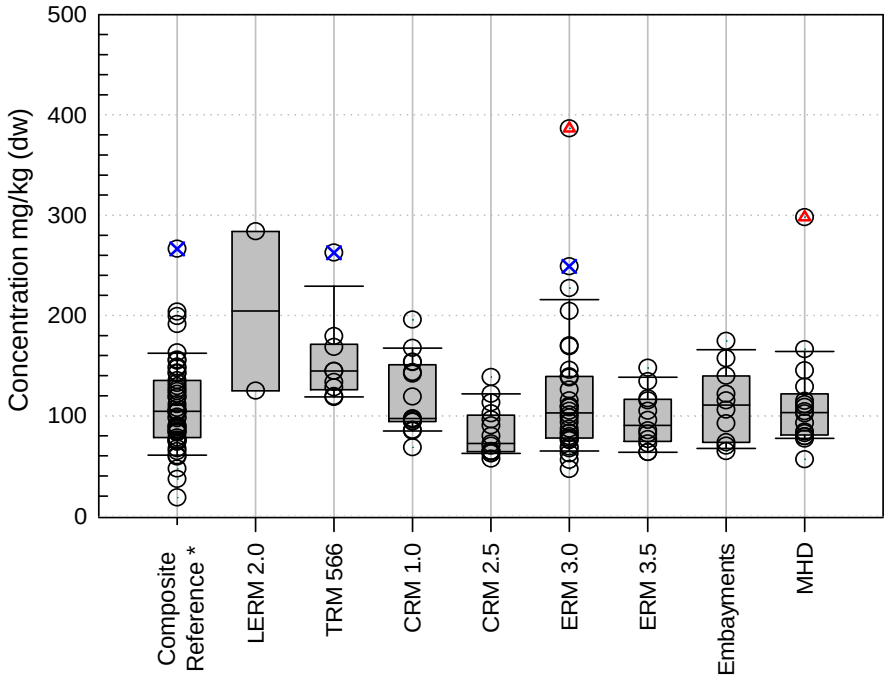
FIGURE
11

Zinc

2009 and 2010 Locations



2010 Locations



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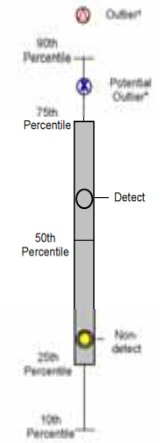

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

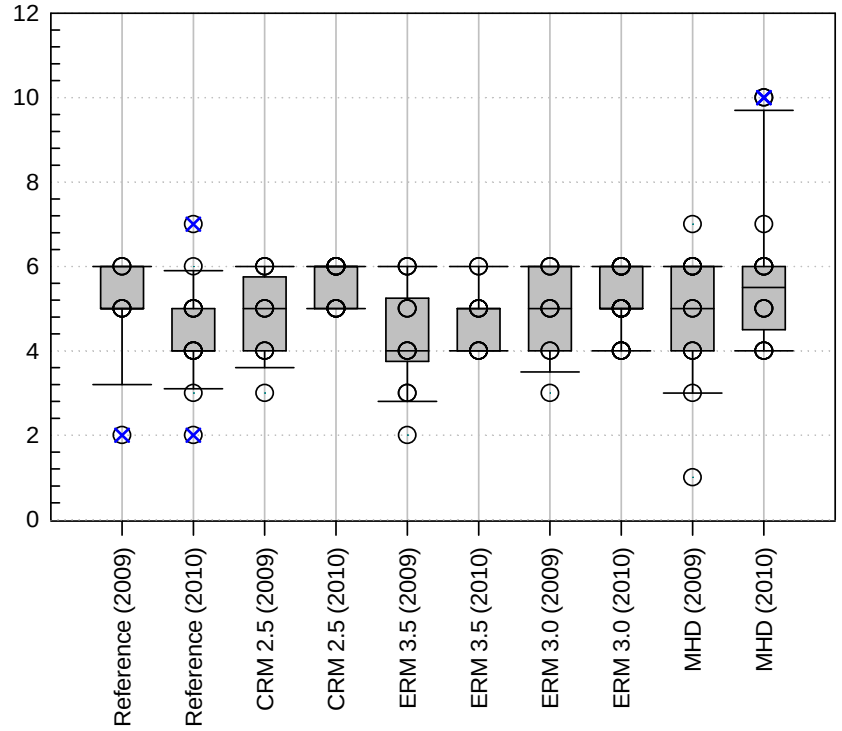
TRACE ELEMENT CONCENTRATIONS IN EGGS – ZINC

ARCADIS

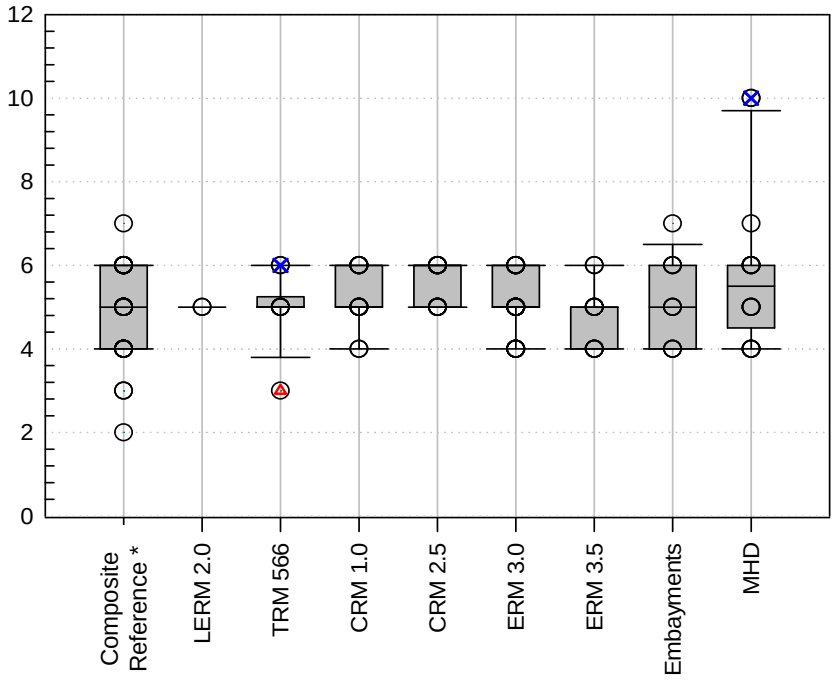
FIGURE
12

Clutch Size

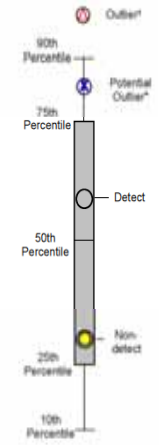
2009 and 2010 Locations



2010 Locations



Box Plot Legend



Notes:

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KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

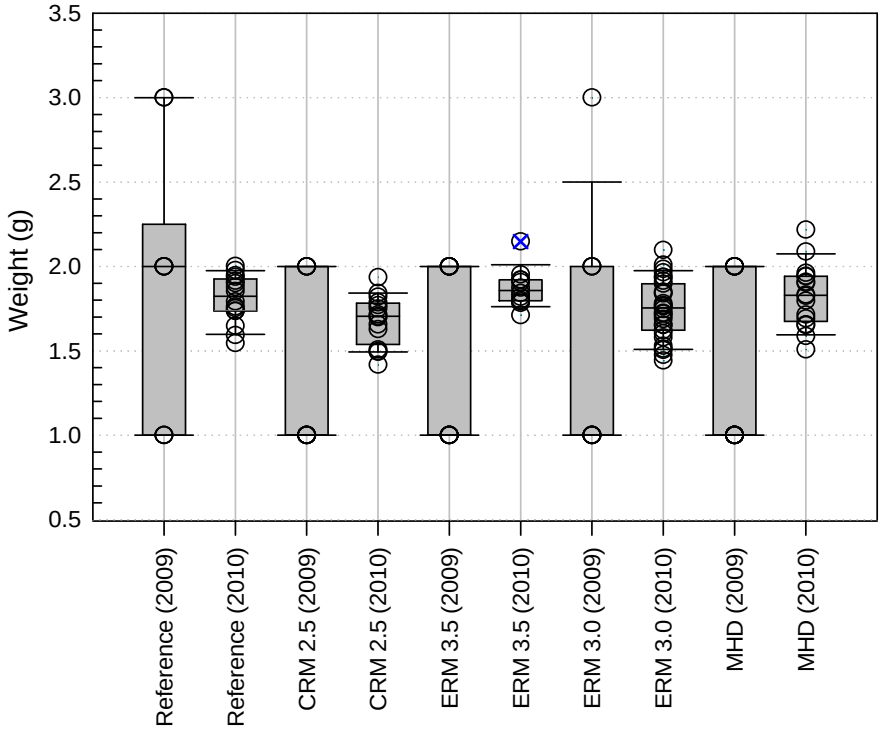
TRACE ELEMENT CONCENTRATIONS IN EGGS – CLUTCH SIZE

ARCADIS

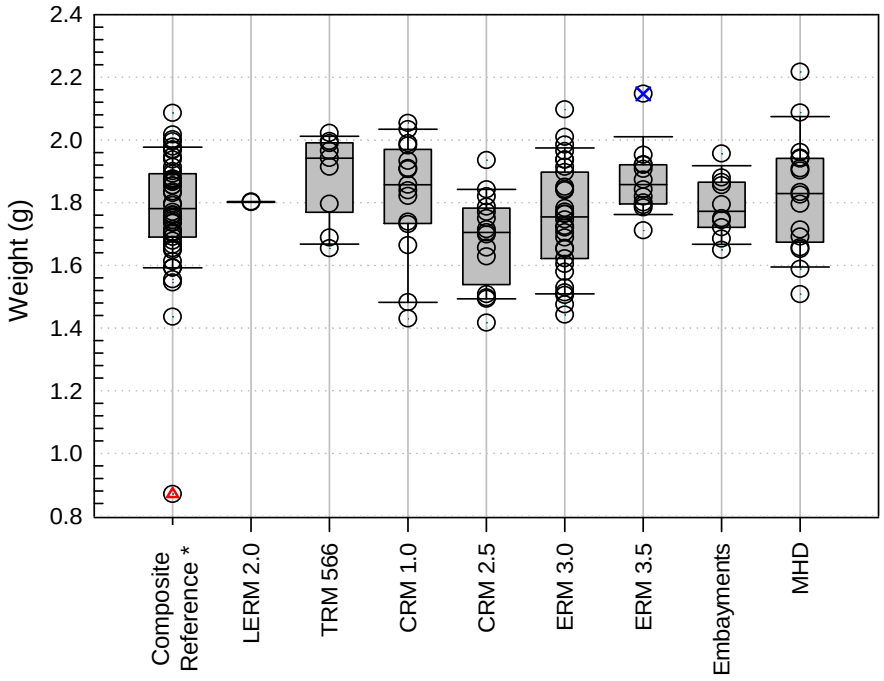
FIGURE
13

Egg Weight

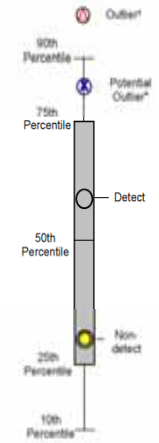
2009 and 2010 Locations



2010 Locations



Box Plot Legend



Notes:
Egg weight presented in g = grams .

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

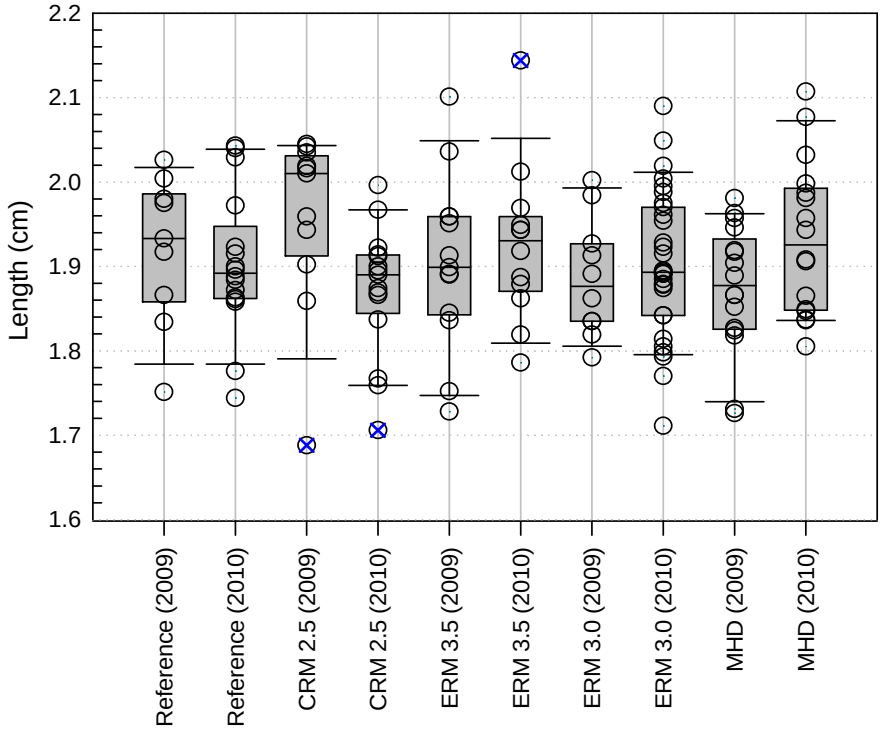
TRACE ELEMENT CONCENTRATIONS IN EGGS – EGG WEIGHT

ARCADIS

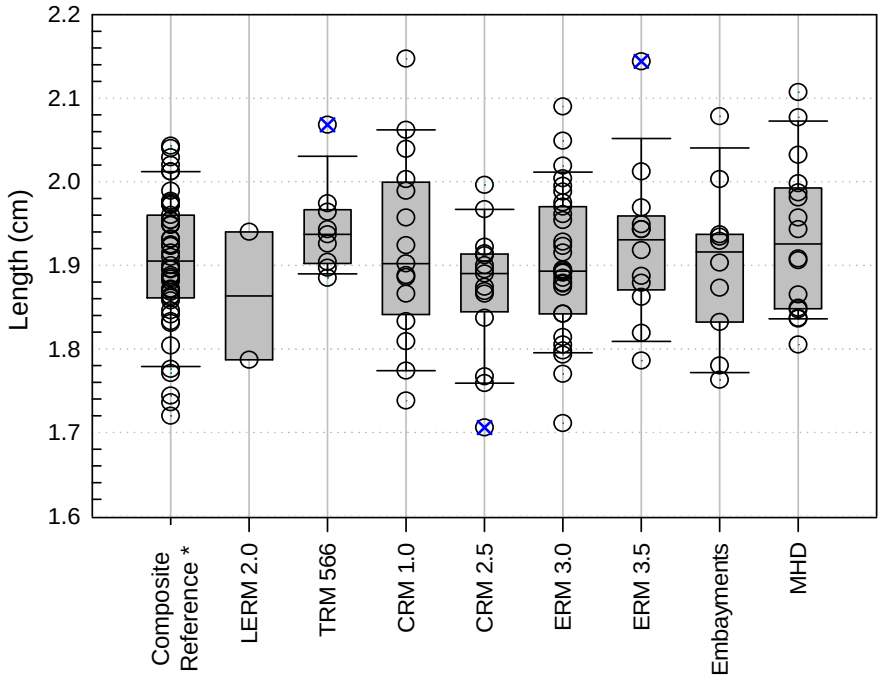
FIGURE
14

Egg Length

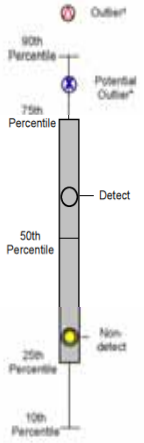
2009 and 2010 Locations



2010 Locations



Box Plot Legend



Notes:
Egg length presented in cm = centimeter.

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

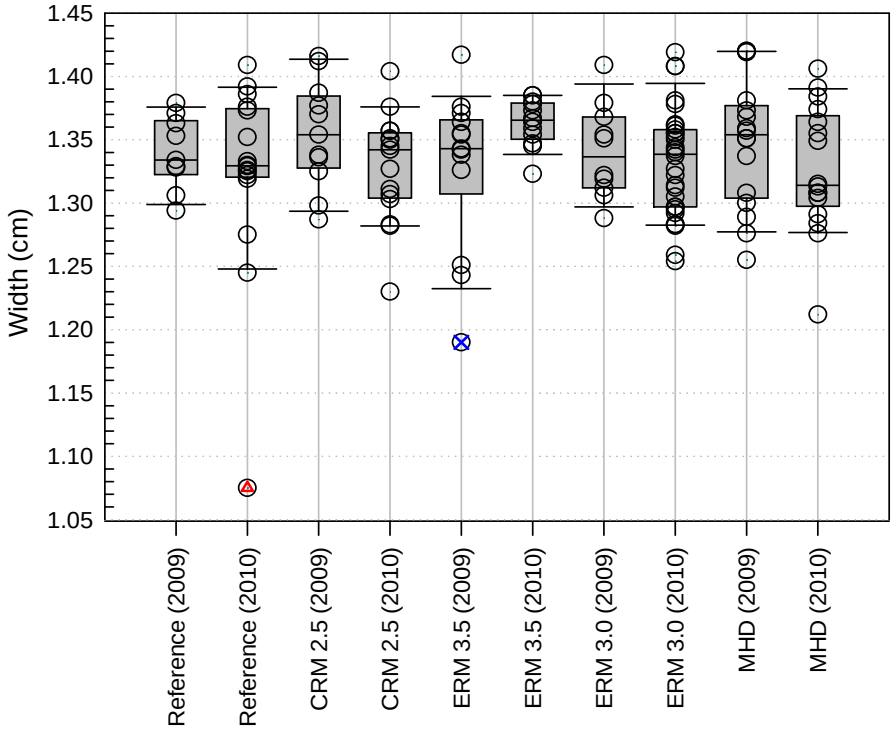
TRACE ELEMENT CONCENTRATIONS IN EGGS – EGG LENGTH

ARCADIS

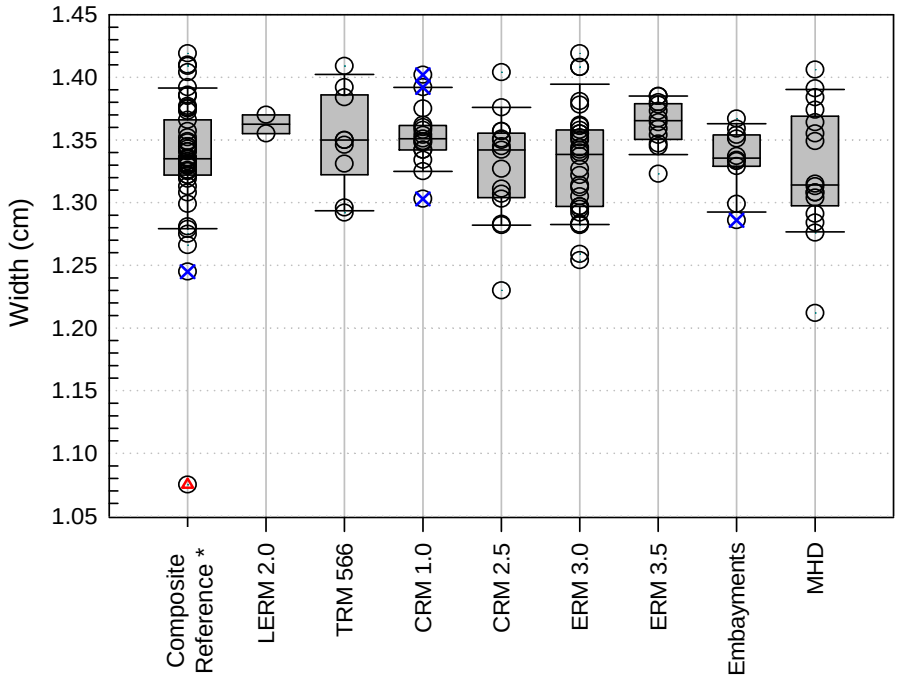
FIGURE
15

Egg Width

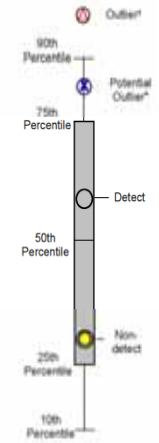
2009 and 2010 Locations



2010 Locations



Box Plot Legend



Notes:
Egg width presented in cm = centimeter.

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KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

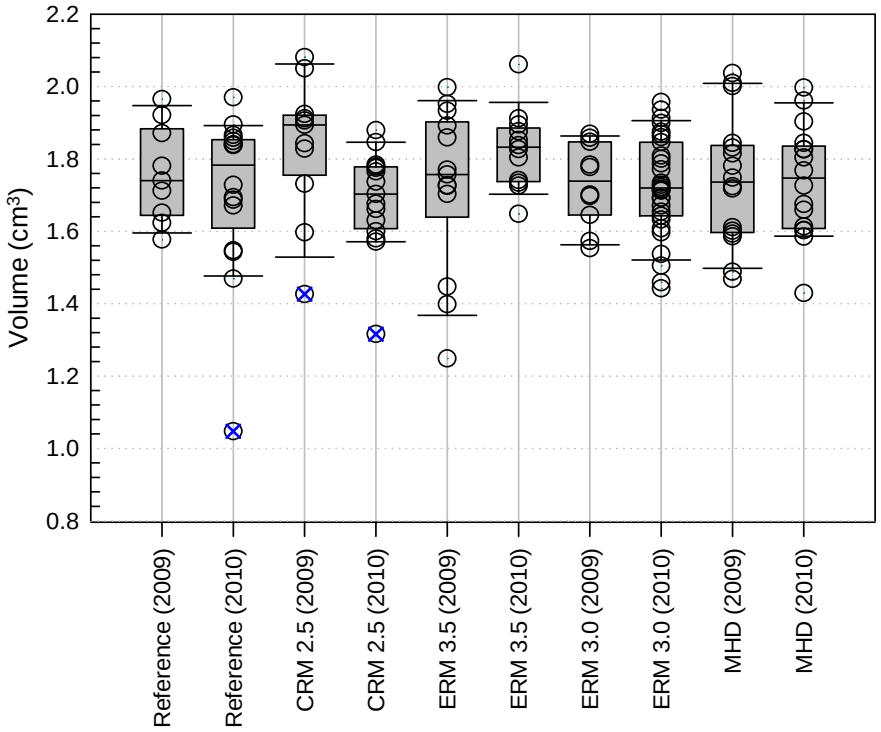
TRACE ELEMENT CONCENTRATIONS IN EGGS – EGG WIDTH

ARCADIS

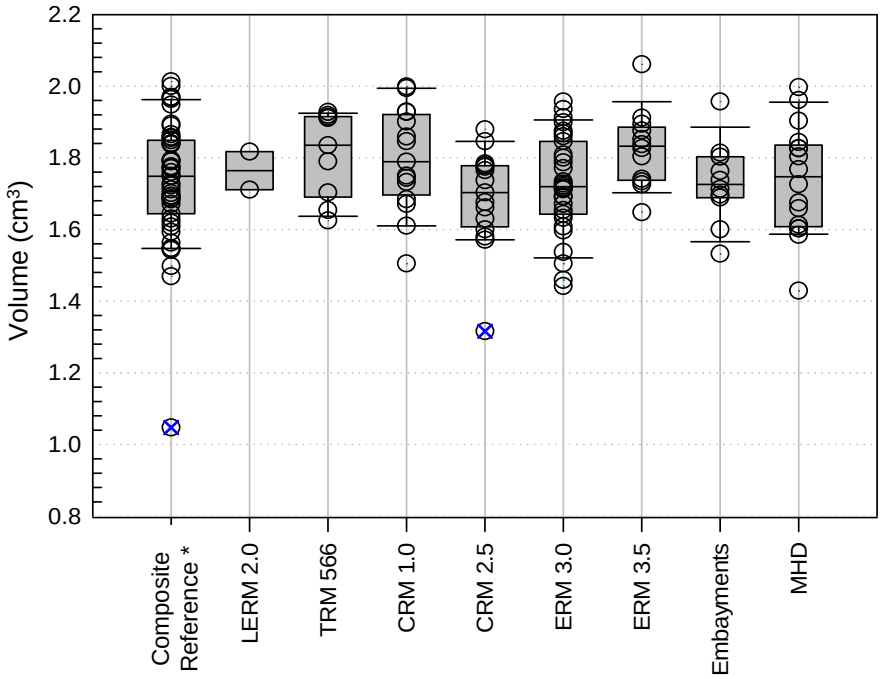
FIGURE
16

Egg Volume

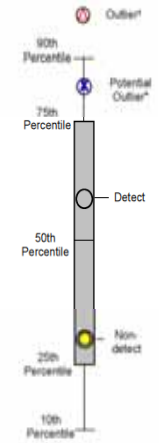
2009 and 2010 Locations



2010 Locations



Box Plot Legend



Notes:
Egg volume presented in cm^3 = cubic centimeter.

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TENNESSEE VALLEY AUTHORITY
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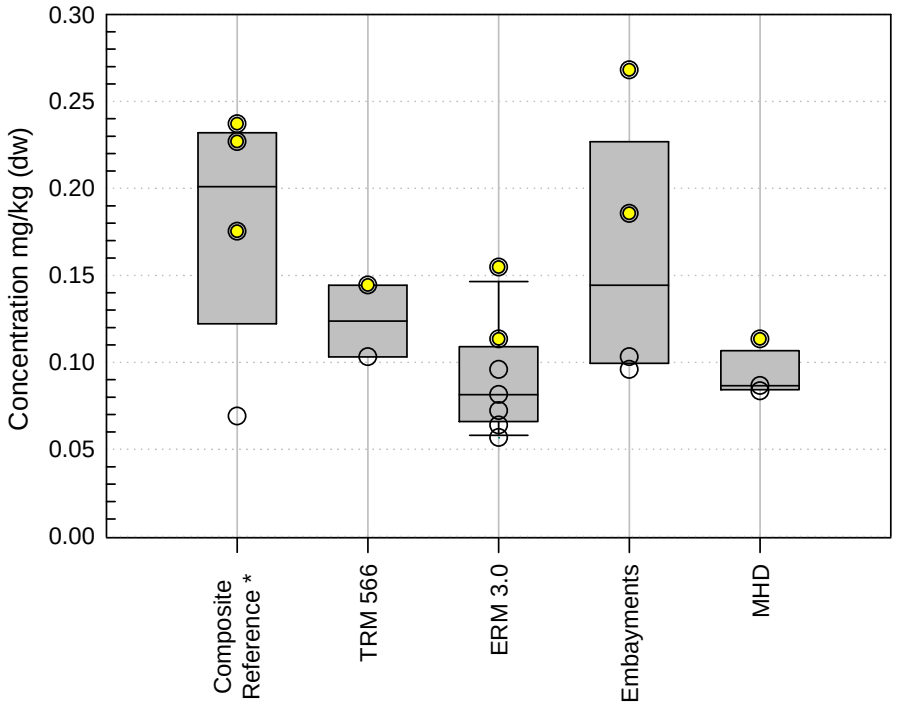
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN EGGS – EGG VOLUME

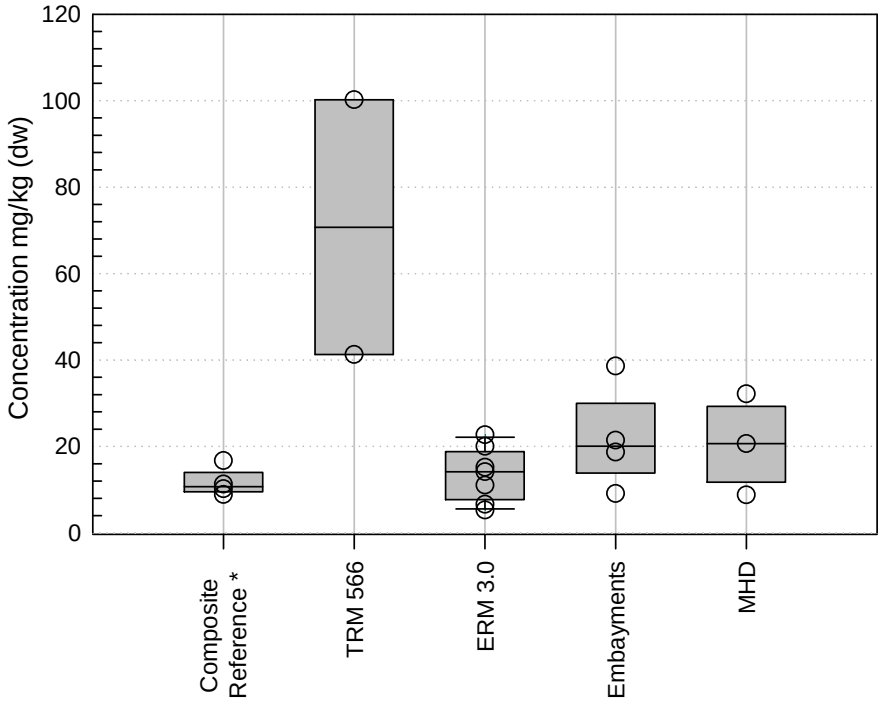
ARCADIS

FIGURE
17

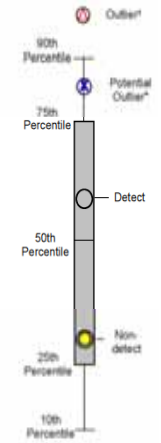
Arsenic



Barium



Box Plot Legend



Notes:
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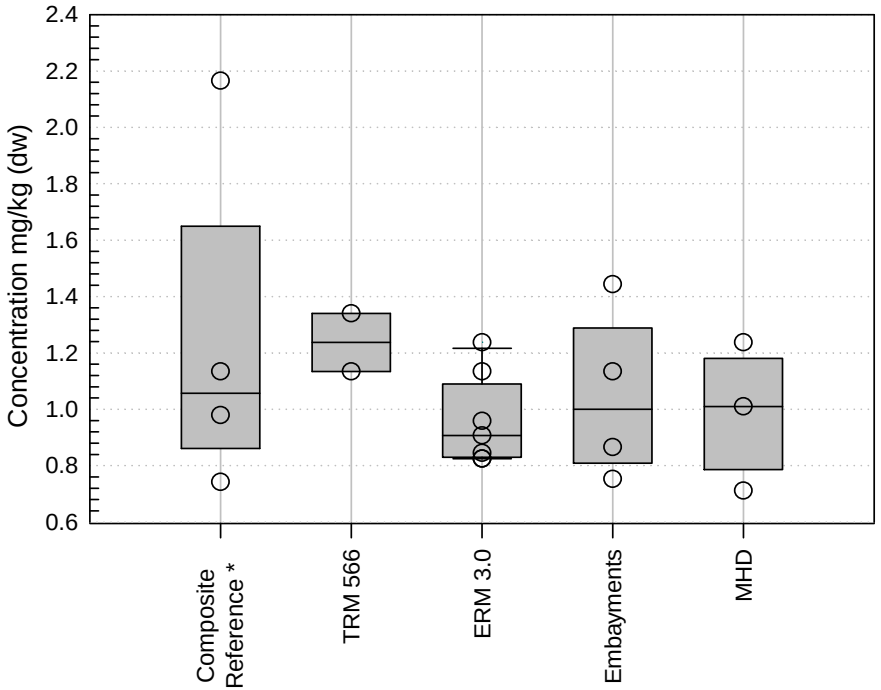
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN EGGSHELLS – ARSENIC AND BARIUM

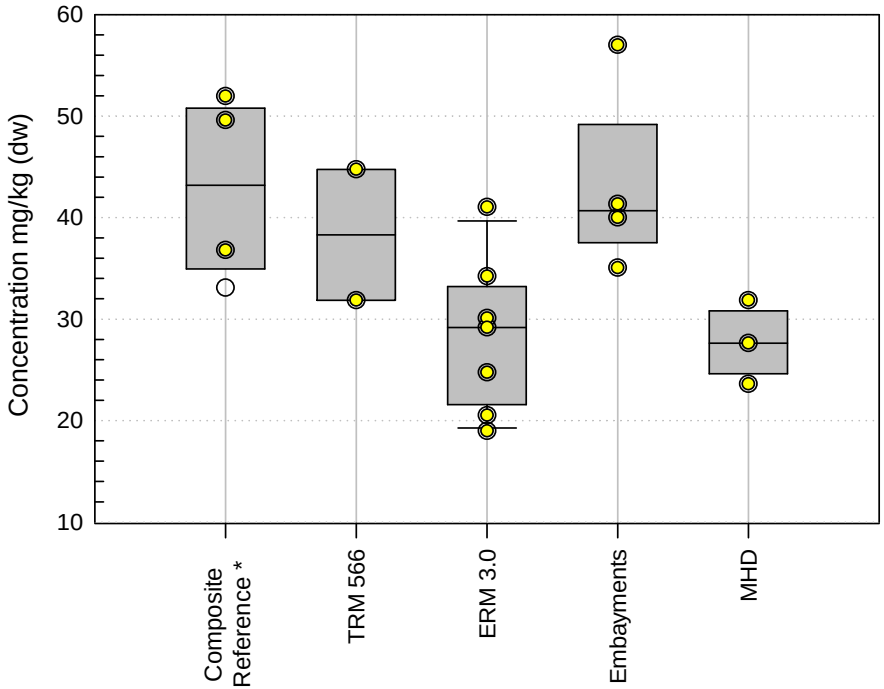
ARCADIS

FIGURE
18

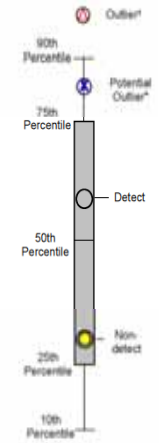
Copper



Iron



Box Plot Legend



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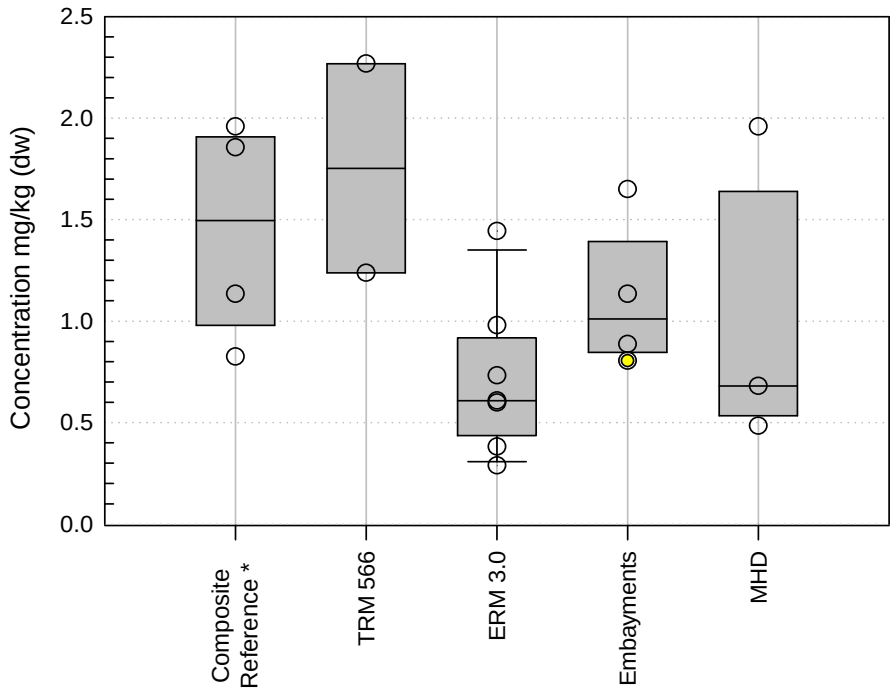
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN EGGSHELLS – COPPER AND IRON

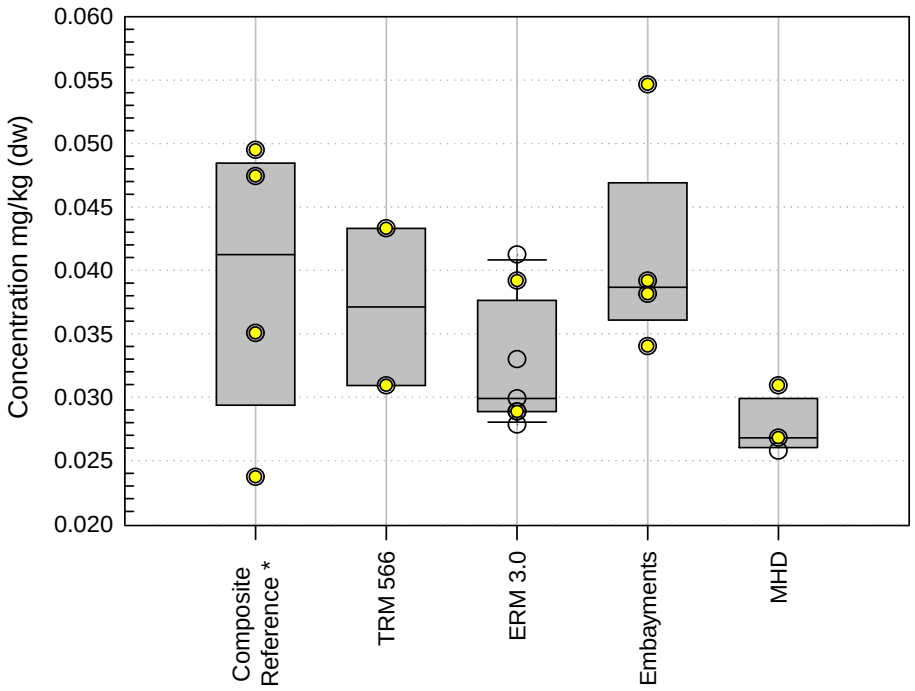
ARCADIS

FIGURE
19

Manganese



Mercury



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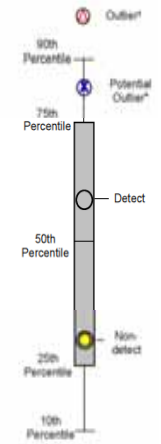

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KINGSTON, TENNESSEE

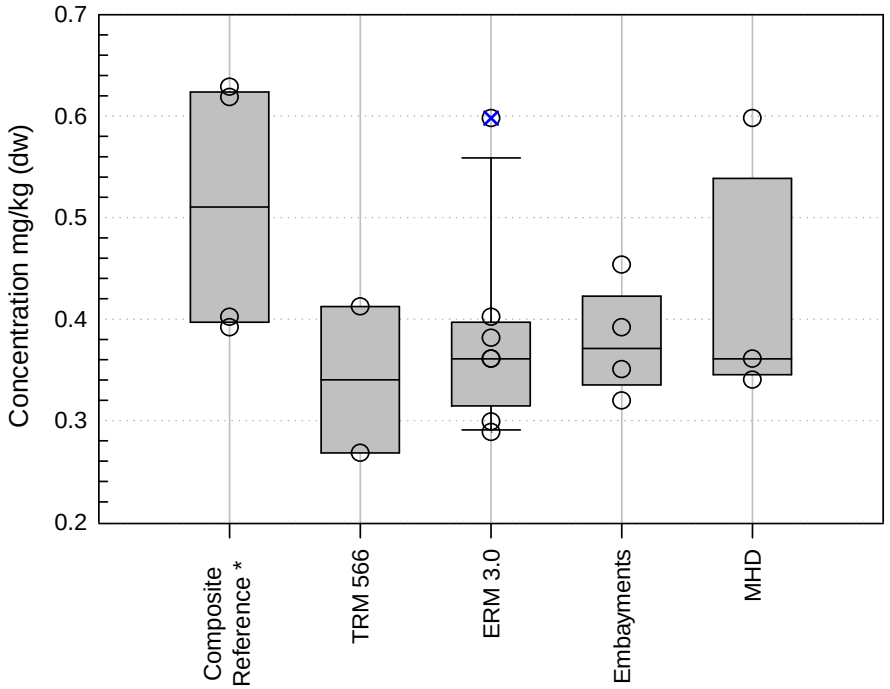
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN EGGSHELLS – MANGANESE AND MERCURY

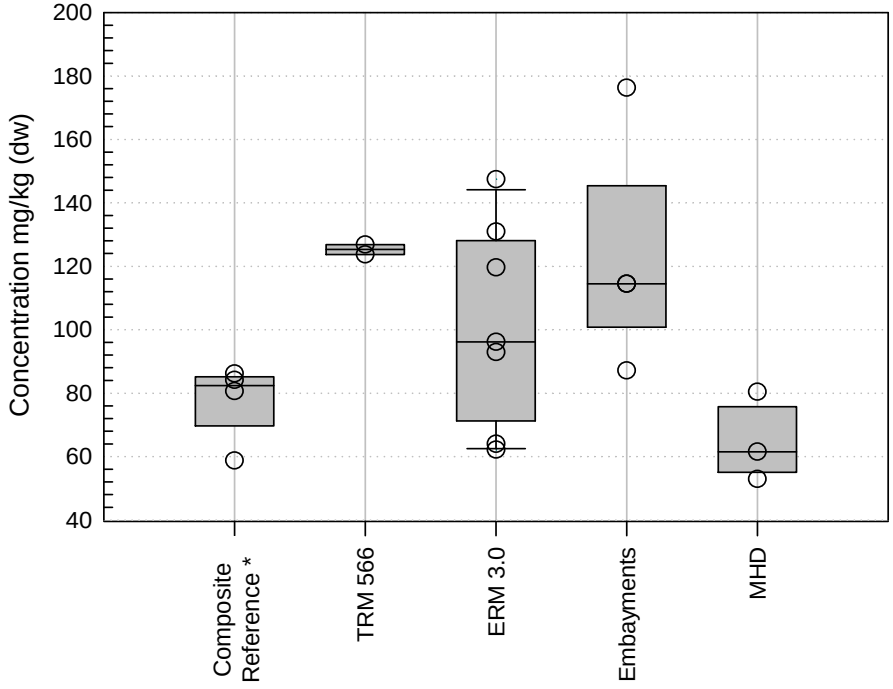
ARCADIS

FIGURE
20

Selenium



Strontium



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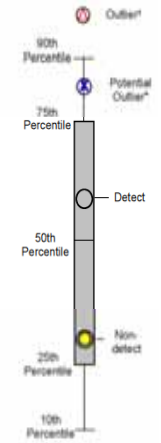

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TENNESSEE VALLEY AUTHORITY
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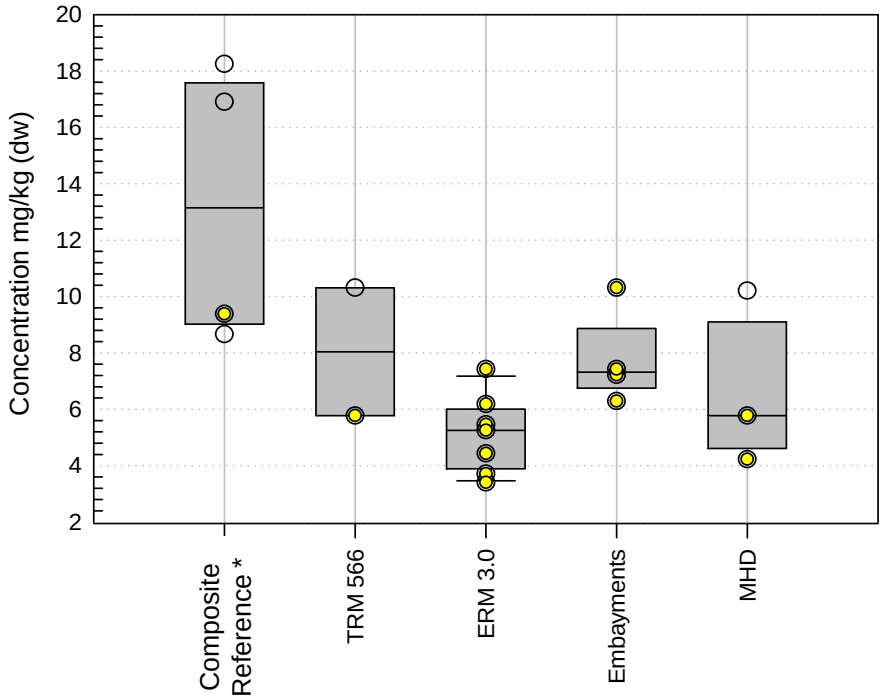
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN EGGSHELLS – SELENIUM AND STRONTIUM

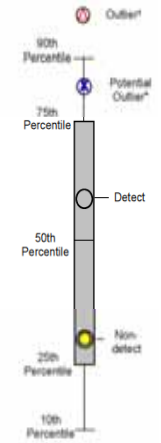
ARCADIS

FIGURE
21

Zinc



Box Plot Legend



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TENNESSEE VALLEY AUTHORITY
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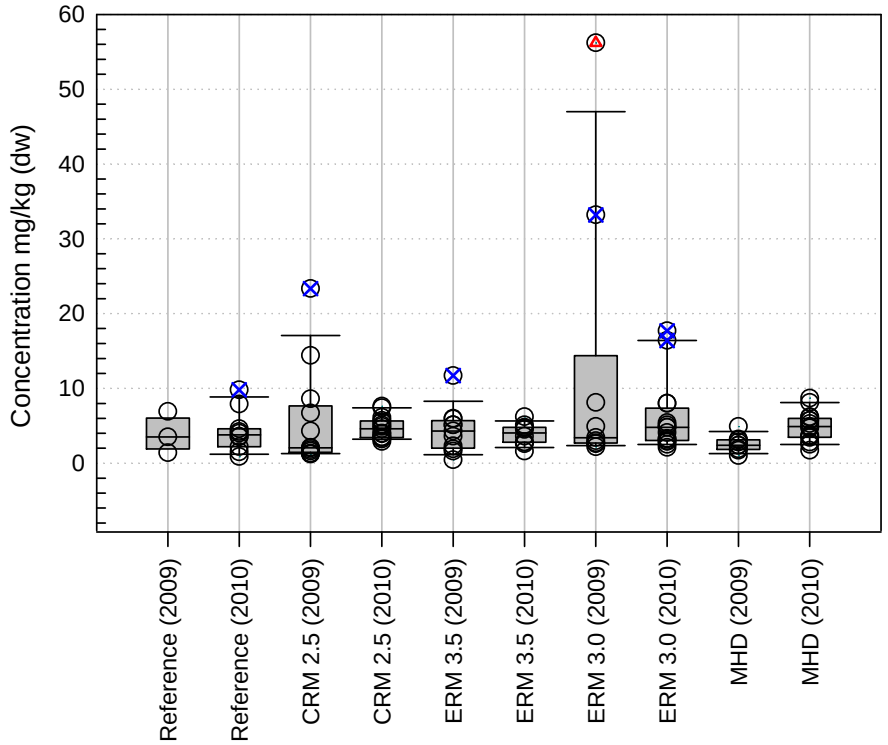
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN EGGSHELLS – ZINC

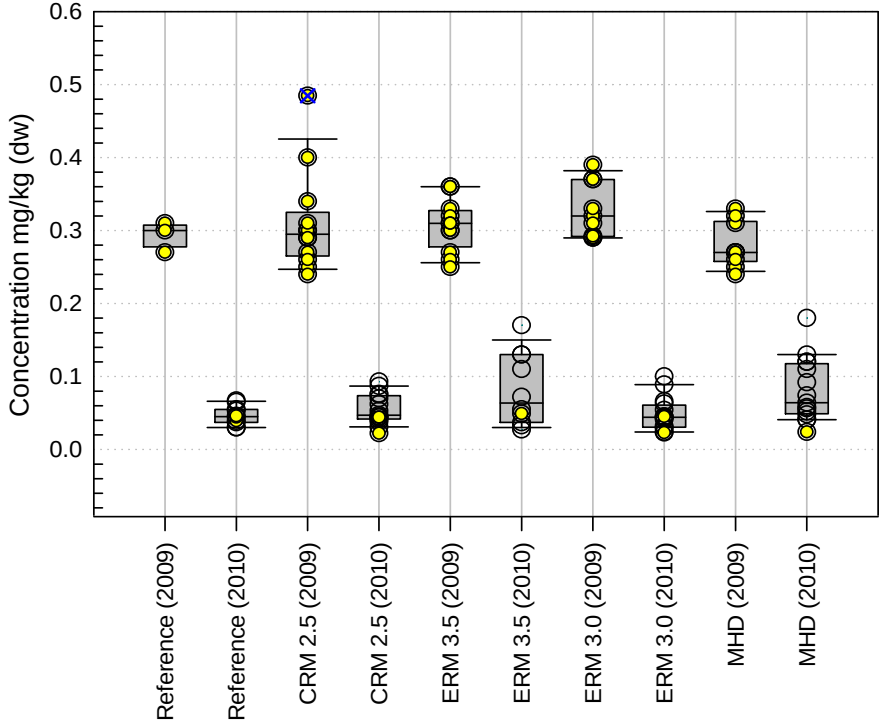
ARCADIS

FIGURE
22

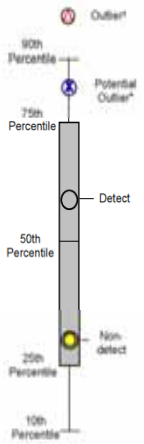
Barium



Cadmium



Box Plot Legend



Notes:
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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

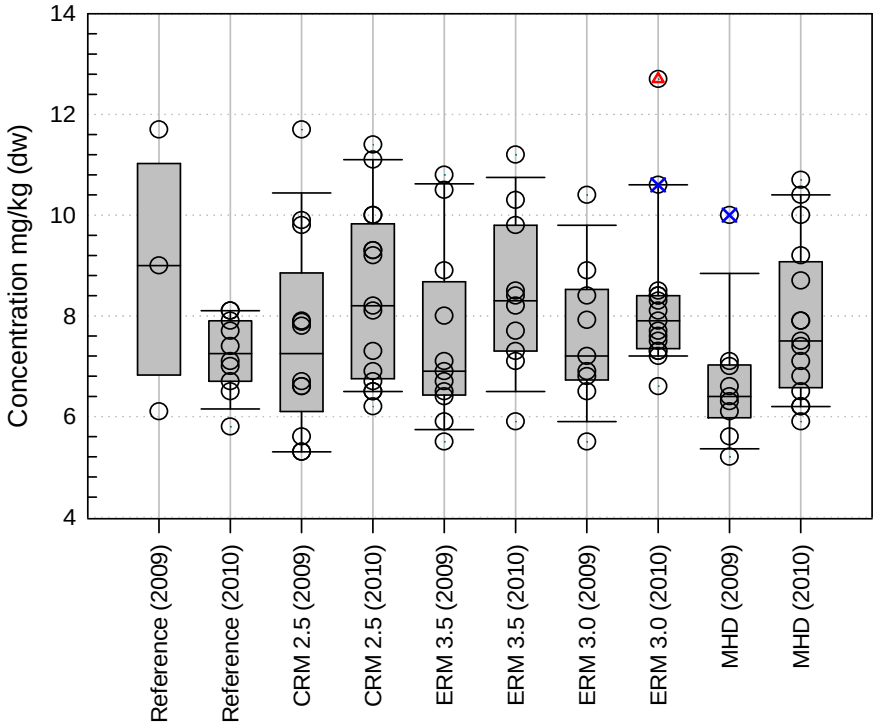
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – BARIUM AND CADMIUM

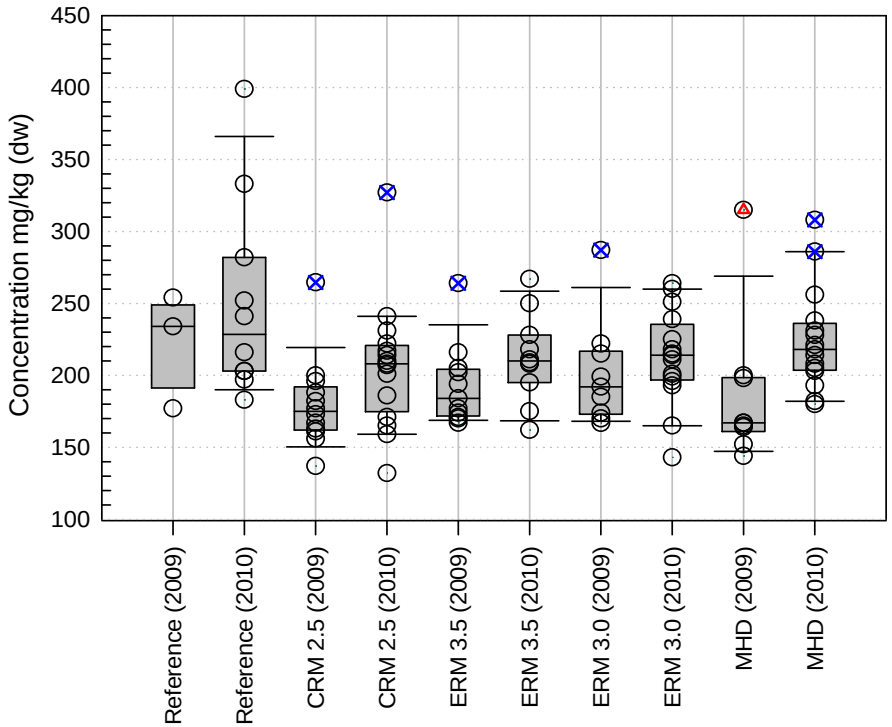
ARCADIS

FIGURE
23

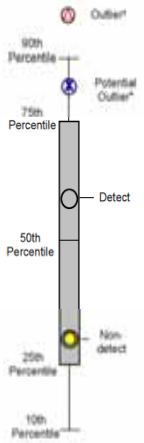
Copper



Iron



Box Plot Legend



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TENNESSEE VALLEY AUTHORITY
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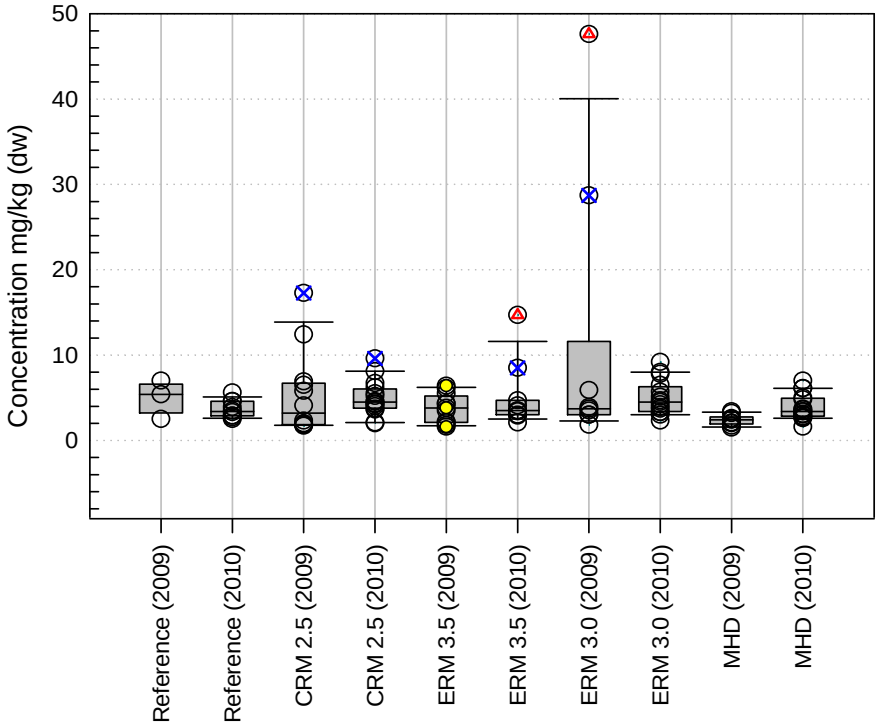
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – COPPER AND IRON

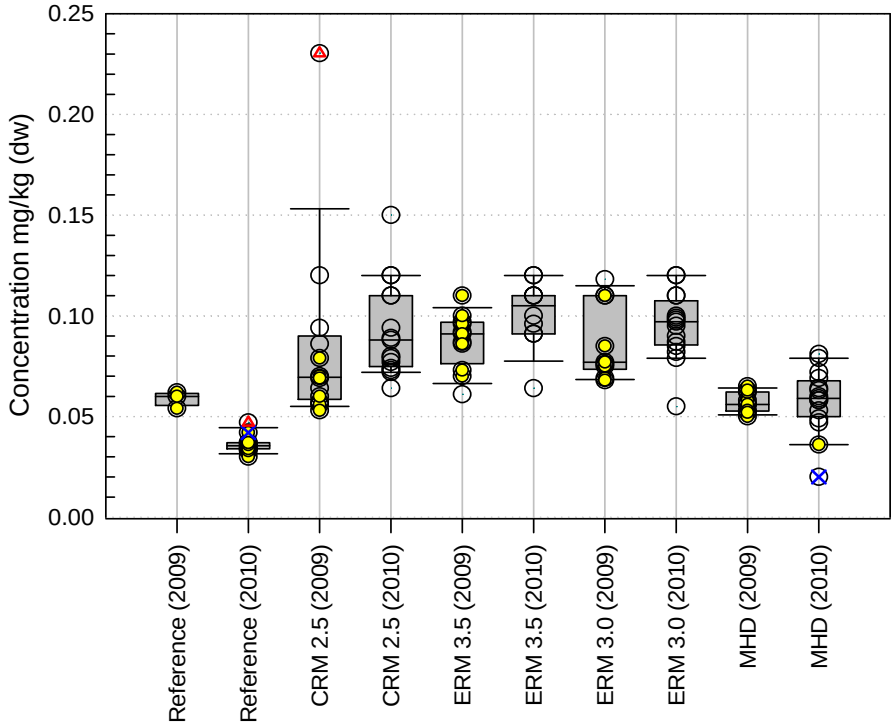
ARCADIS

FIGURE
24

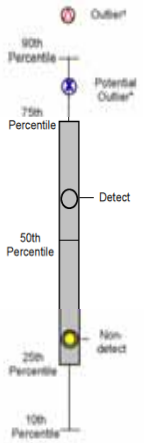
Manganese



Mercury



Box Plot Legend



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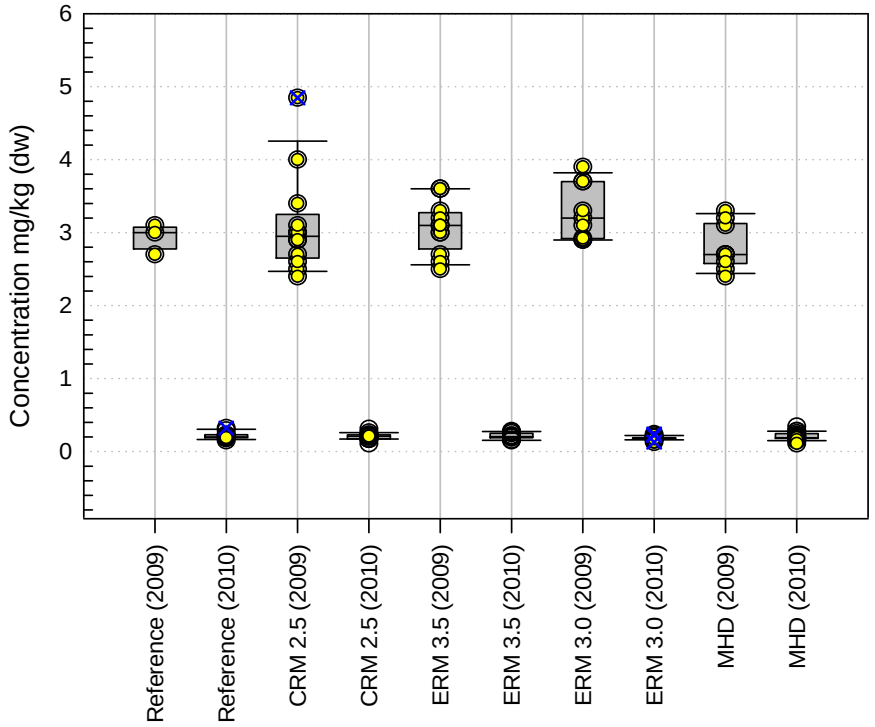
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – MANGANESE AND MERCURY

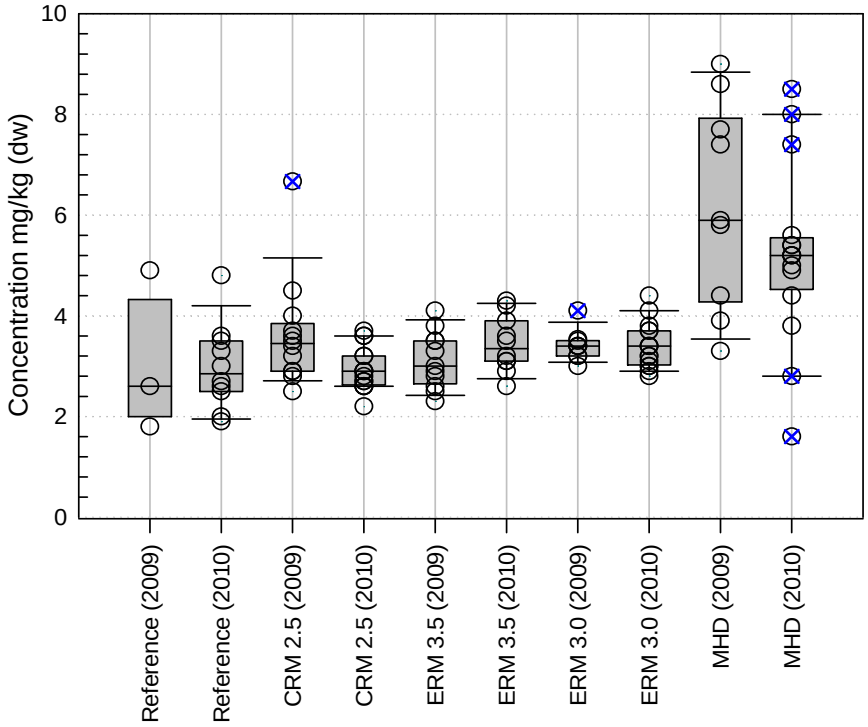
ARCADIS

FIGURE
25

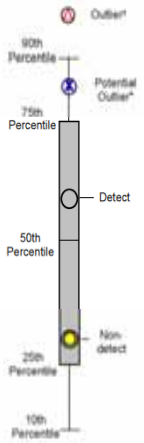
Molybdenum



Selenium



Box Plot Legend



Notes:
Nestling concentrations in mg/kg (dw) = milligrams per kilogram (dry weight).

† – Data points identified as outliers or potential outliers were included in all statistical analyses.
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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

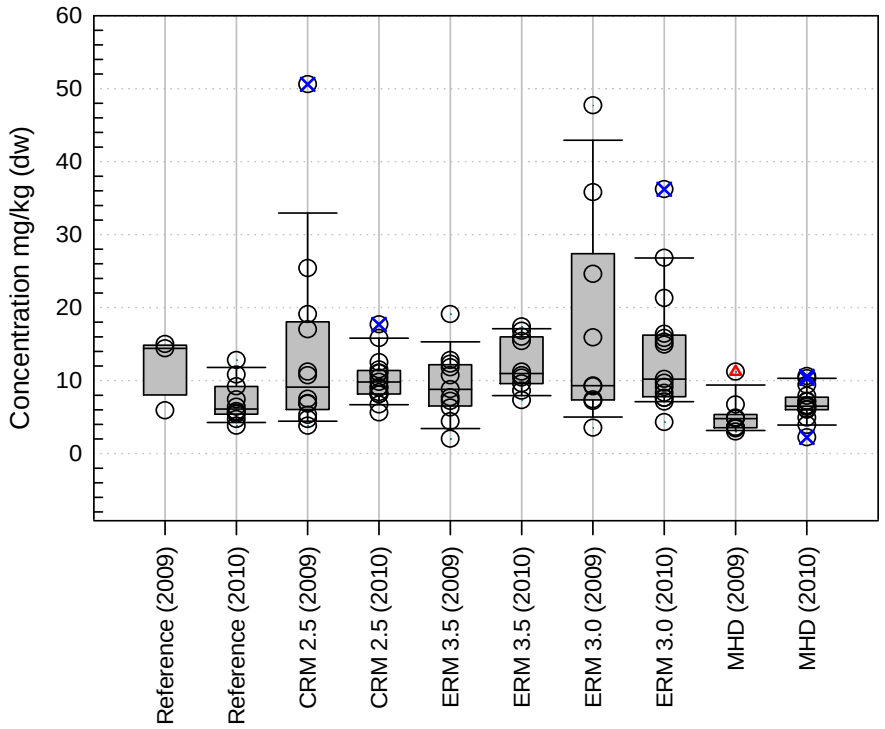
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – MOLYBDENUM AND SELENIUM

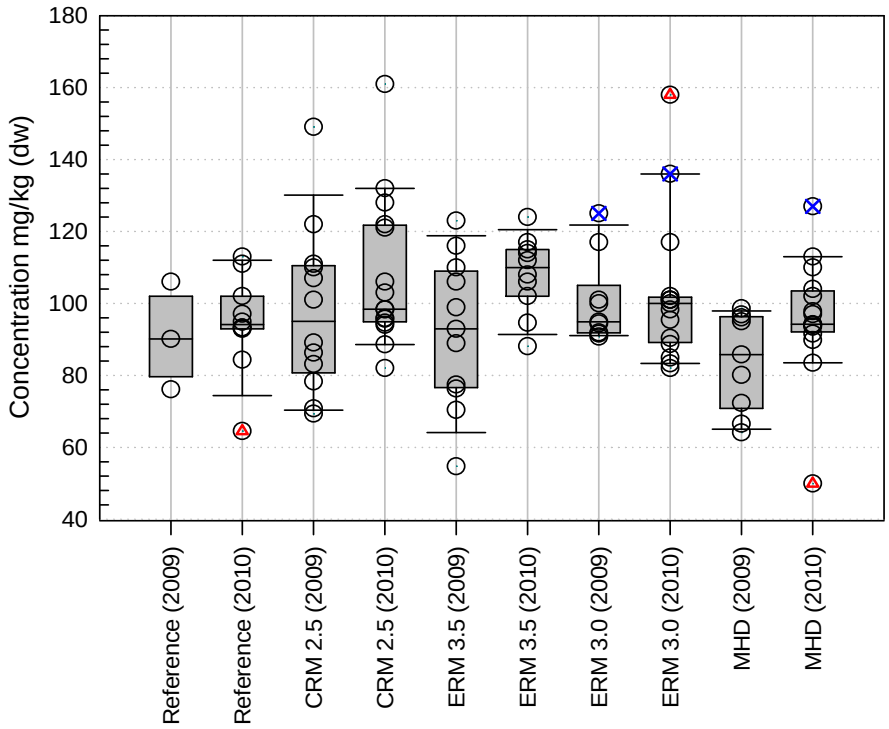
ARCADIS

FIGURE
26

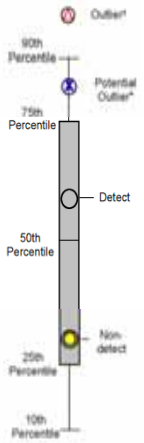
Strontium



Zinc



Box Plot Legend



Notes:
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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

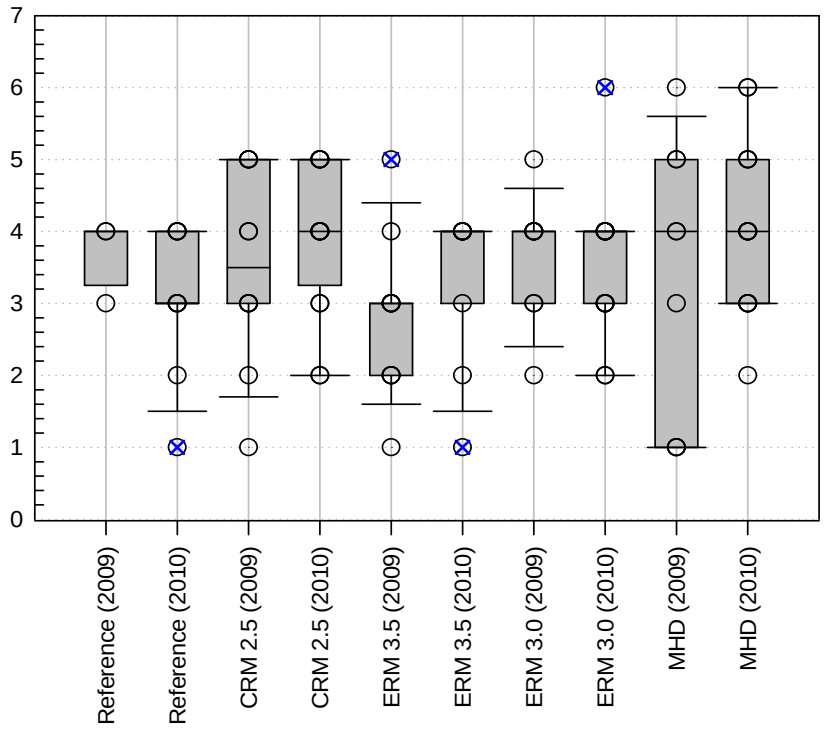
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – STRONTIUM AND ZINC

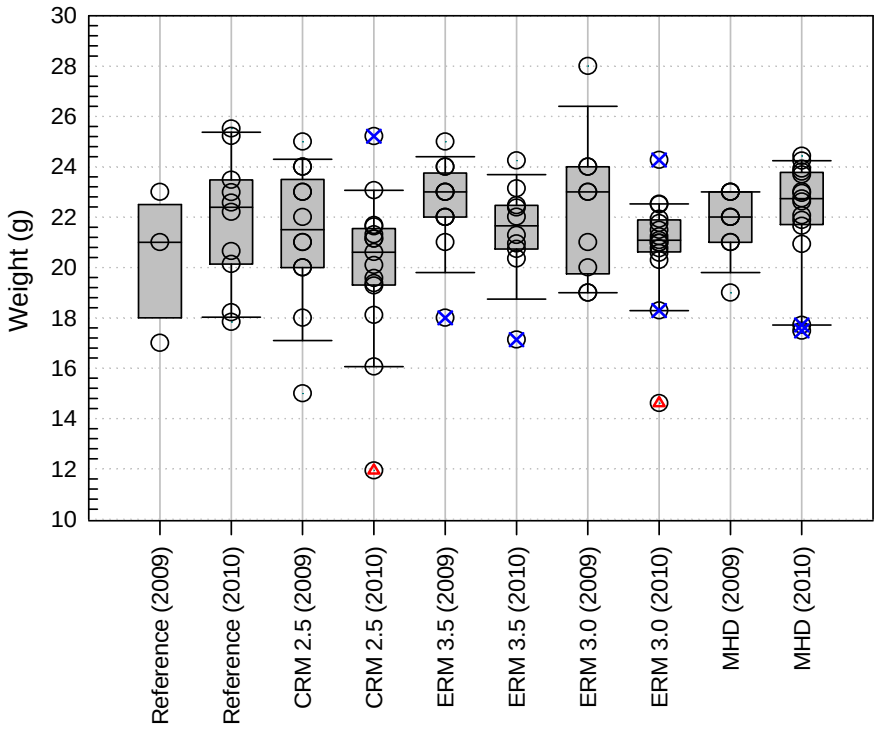
ARCADIS

FIGURE
27

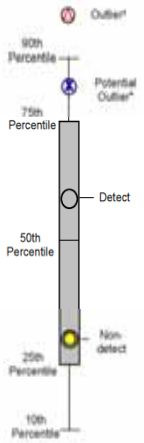
Clutch Size



Nestling Weight



Box Plot Legend



Notes:
Nestling weight presented in g = gram.

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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

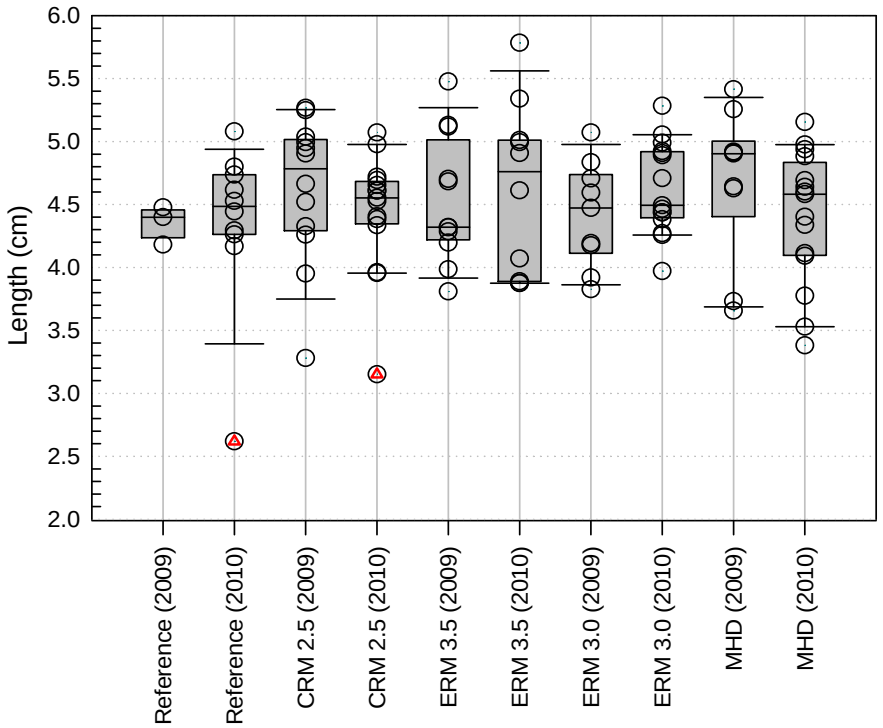
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – CLUTCH SIZE AND NESTLING WEIGHT

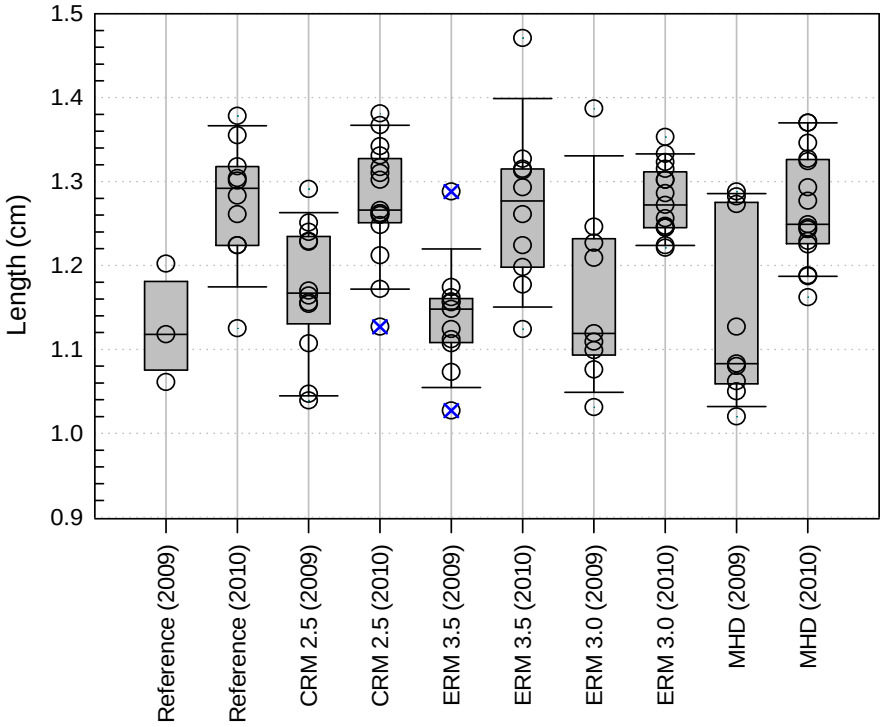
ARCADIS

FIGURE
28

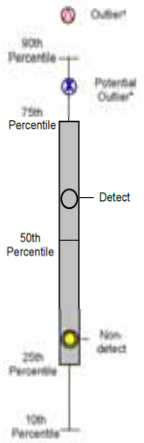
Feather Length



Tarsus Length



Box Plot Legend



Notes:
Nestling feather and tarsus length in cm = centimeter.

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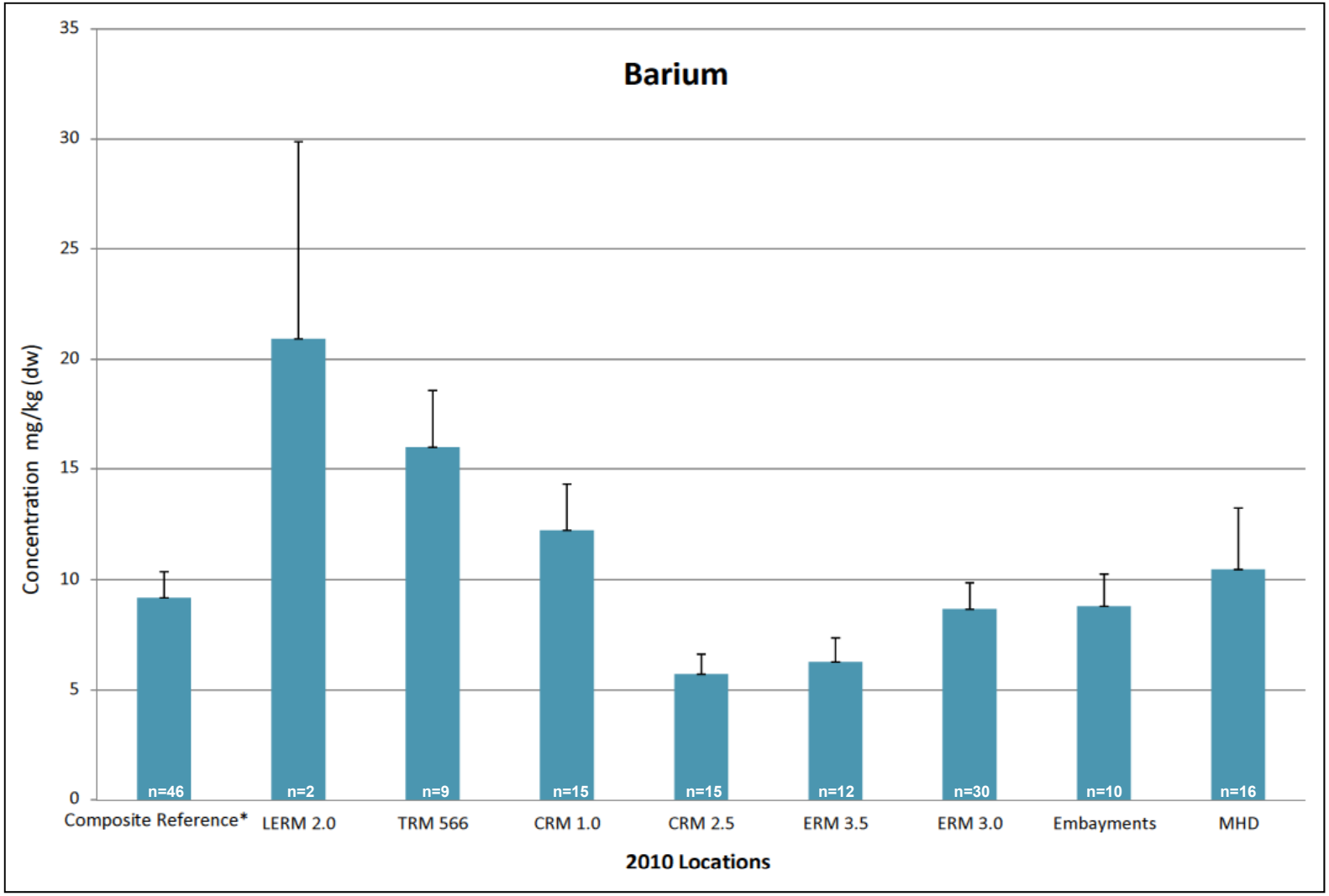
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

TRACE ELEMENT CONCENTRATIONS IN NESTLINGS – FEATHER AND TARSUS LENGTH

ARCADIS

FIGURE
29



Notes: Mean ± standard error.
Egg content concentrations in mg/kg (dw) = milligrams per kilogram (dry weight).

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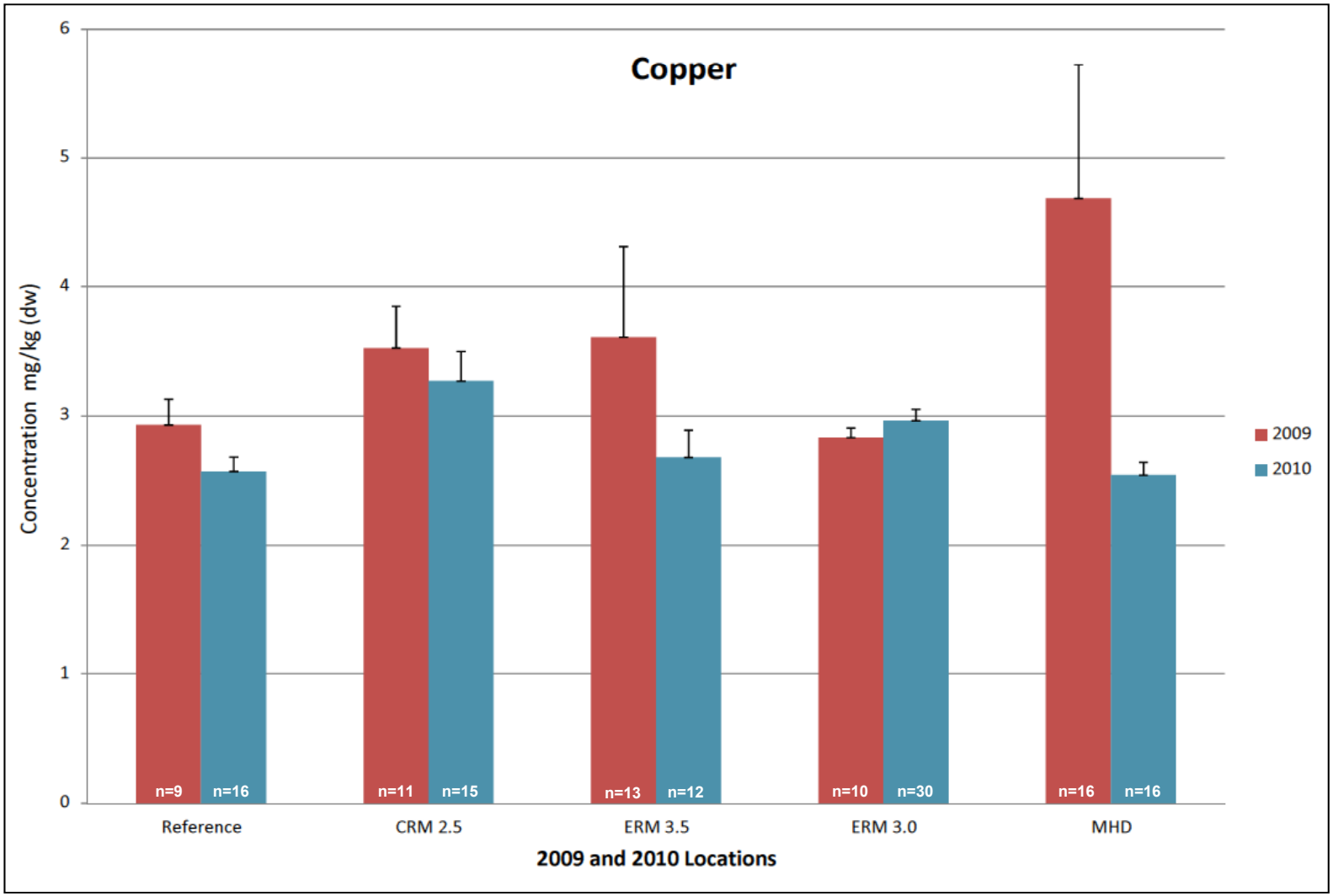
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN BARIUM (2010)

ARCADIS

FIGURE
30



Notes: Mean ± standard error.
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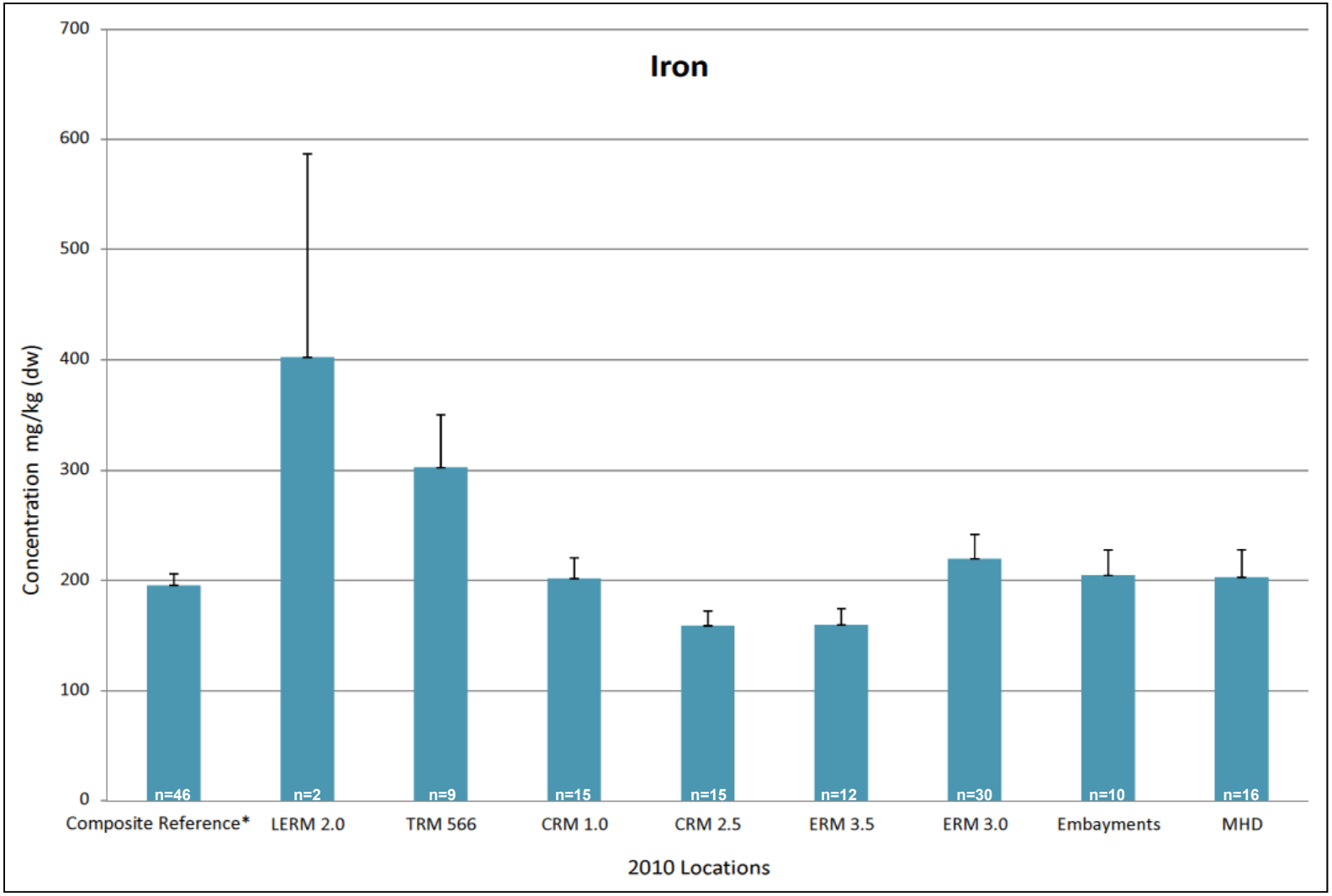
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN COPPER

ARCADIS

FIGURE
31



Notes: Mean ± standard error.
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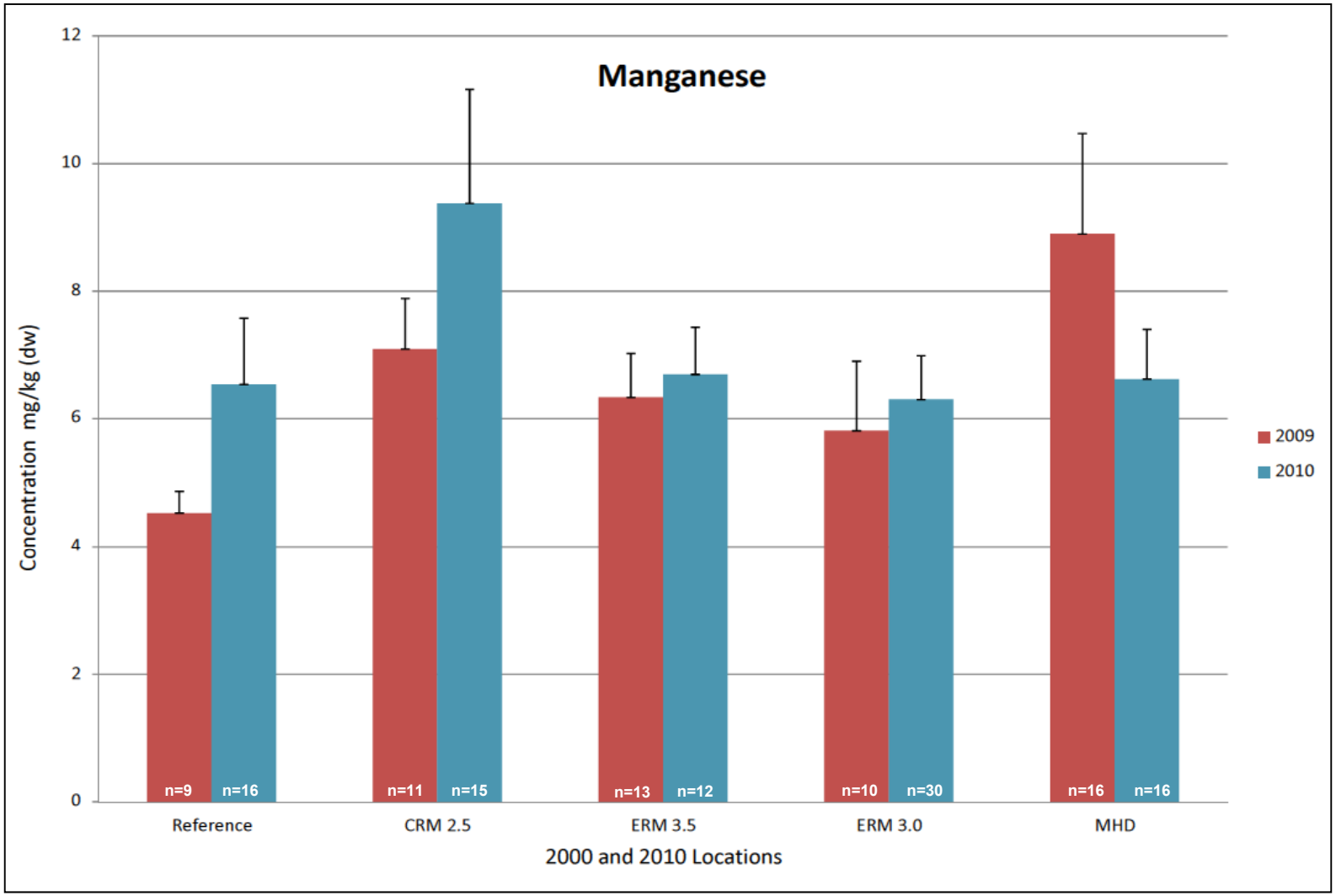
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN IRON (2010)

ARCADIS

FIGURE
32



Notes: Mean ± standard error.
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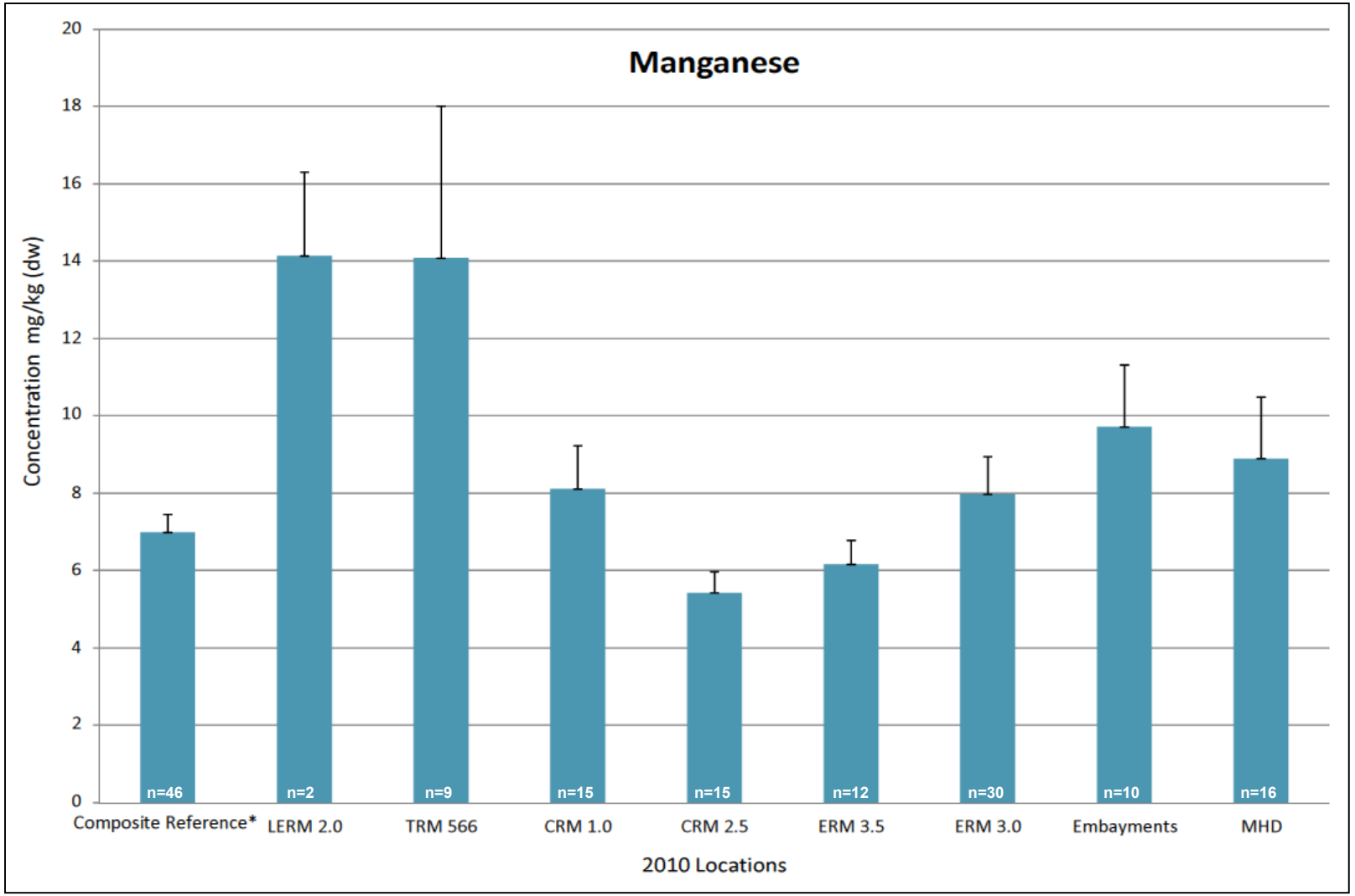
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN MANGANESE

ARCADIS

FIGURE
33



Notes: Mean ± standard error.
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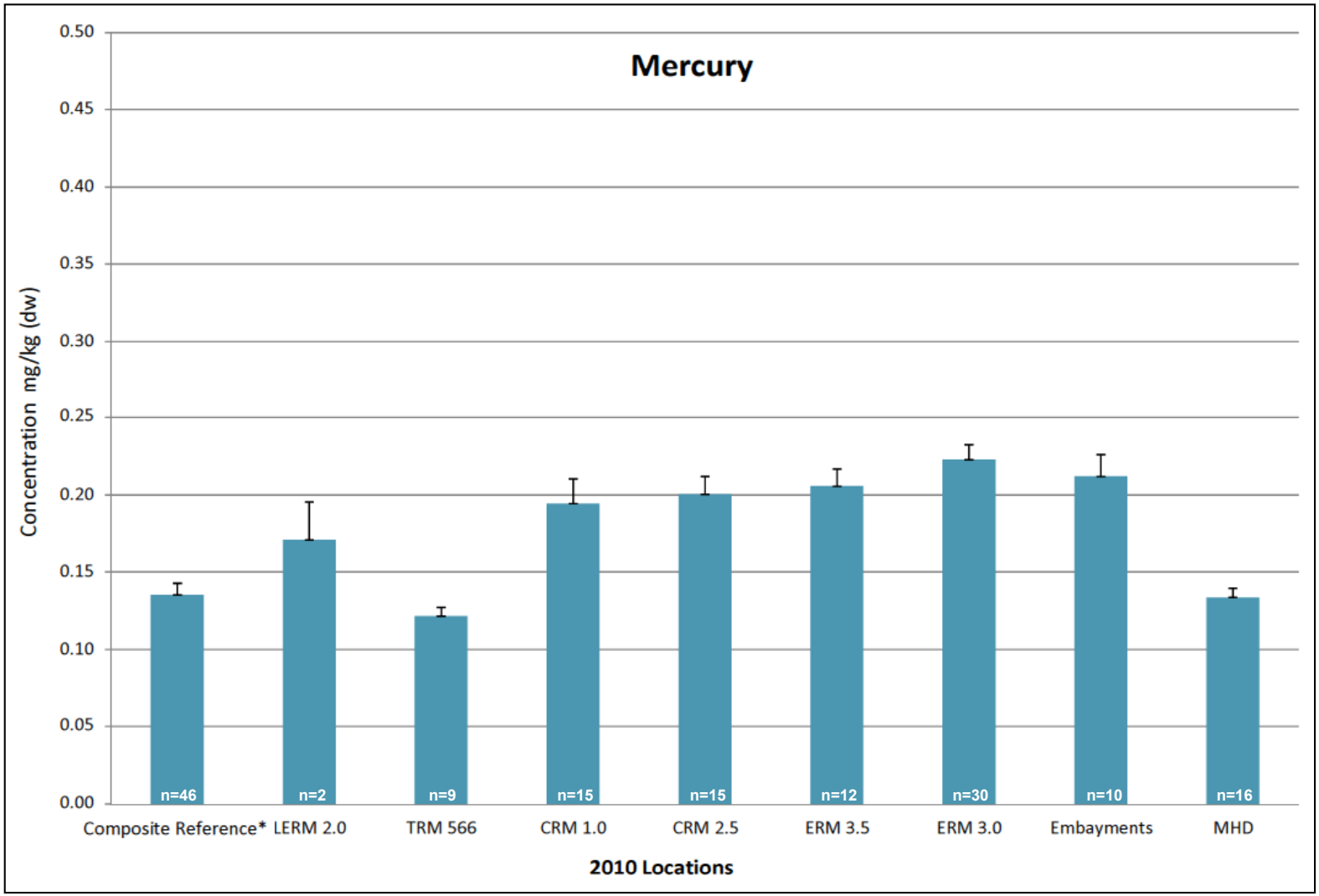
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN MANGANESE (2010)

ARCADIS

FIGURE
34



Notes: Mean ± standard error.
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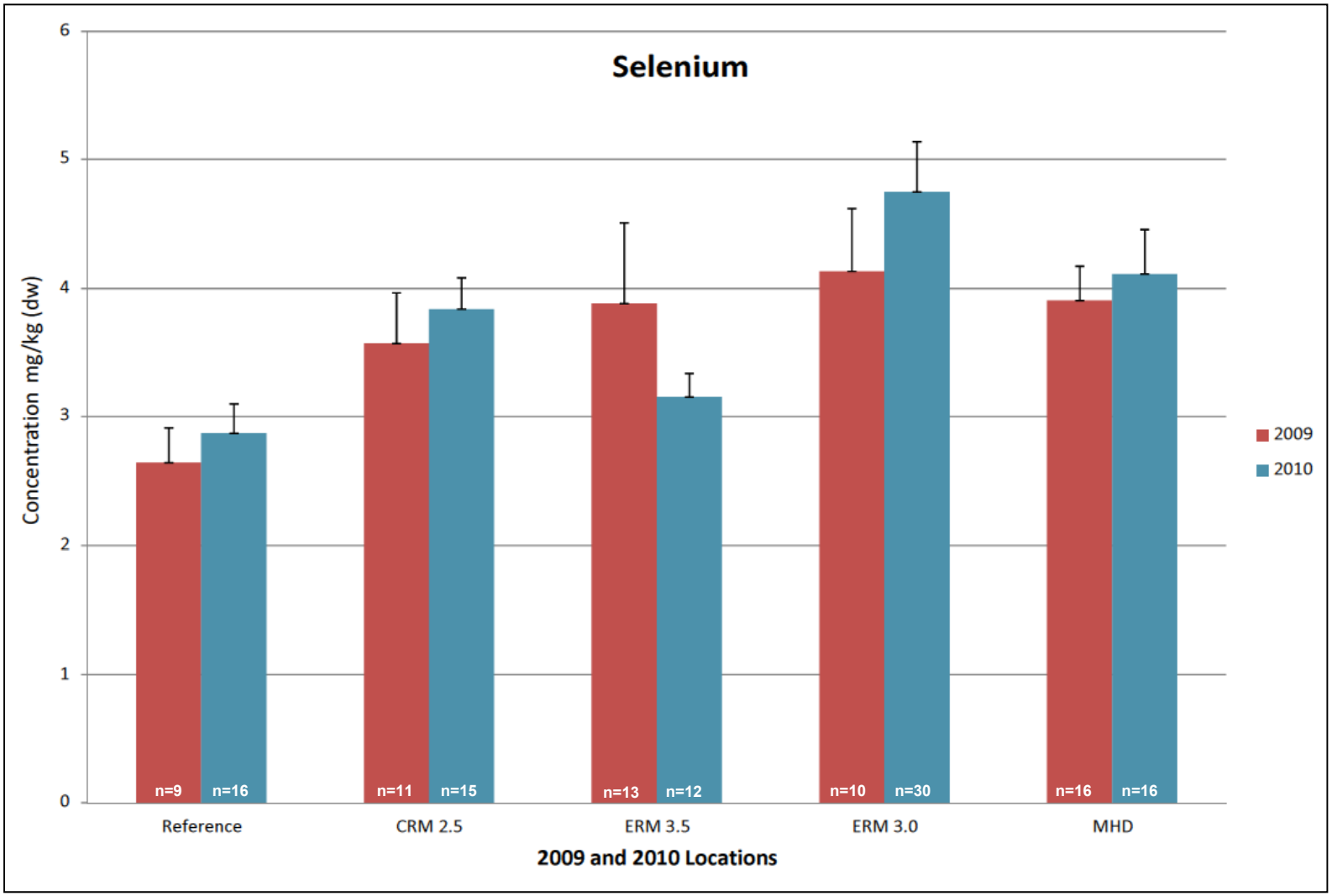
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN MERCURY (2010)

ARCADIS

FIGURE
35



Notes: Mean ± standard error.
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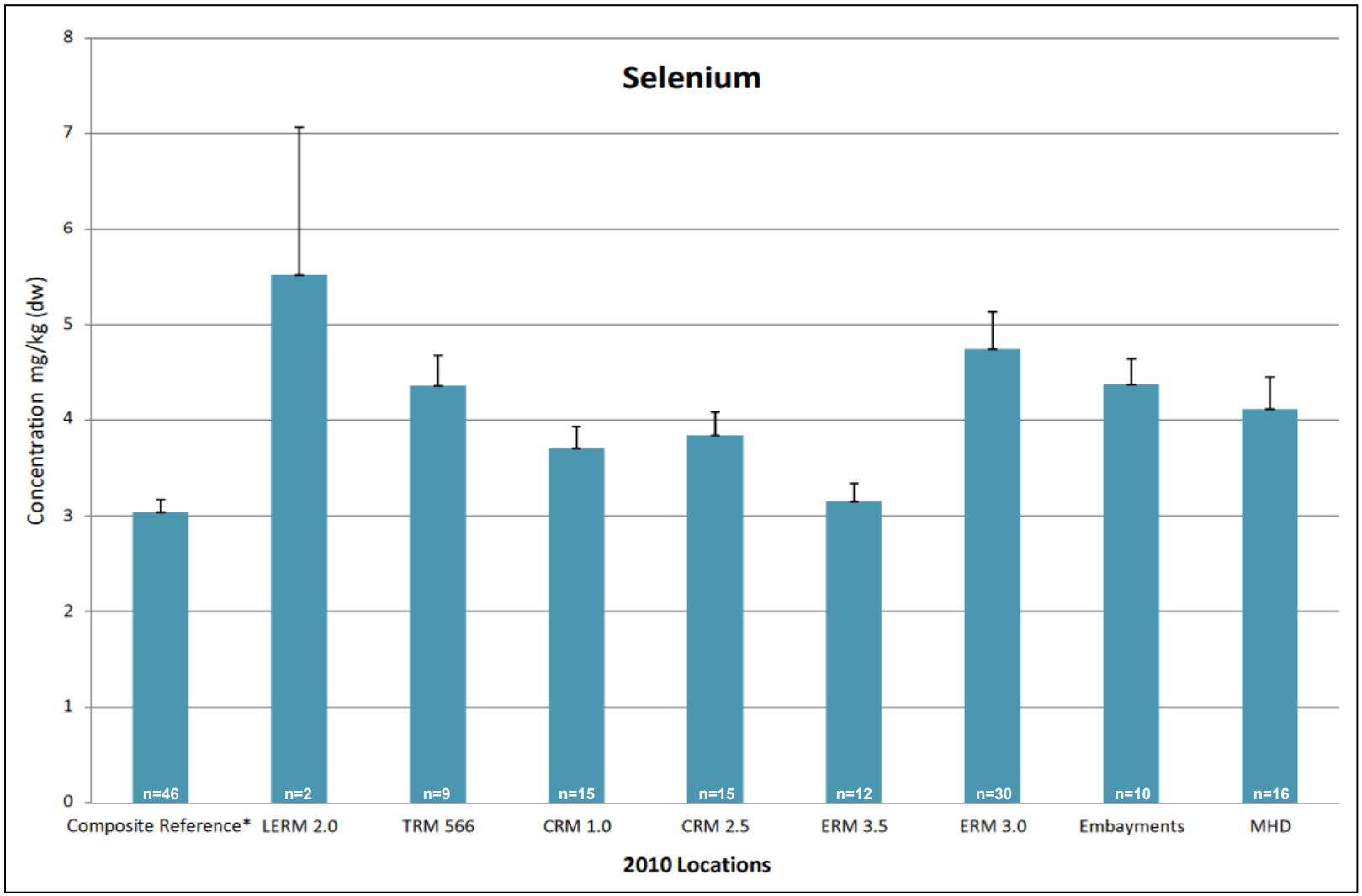
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN SELENIUM

ARCADIS

FIGURE
36



Notes: Mean ± standard error.
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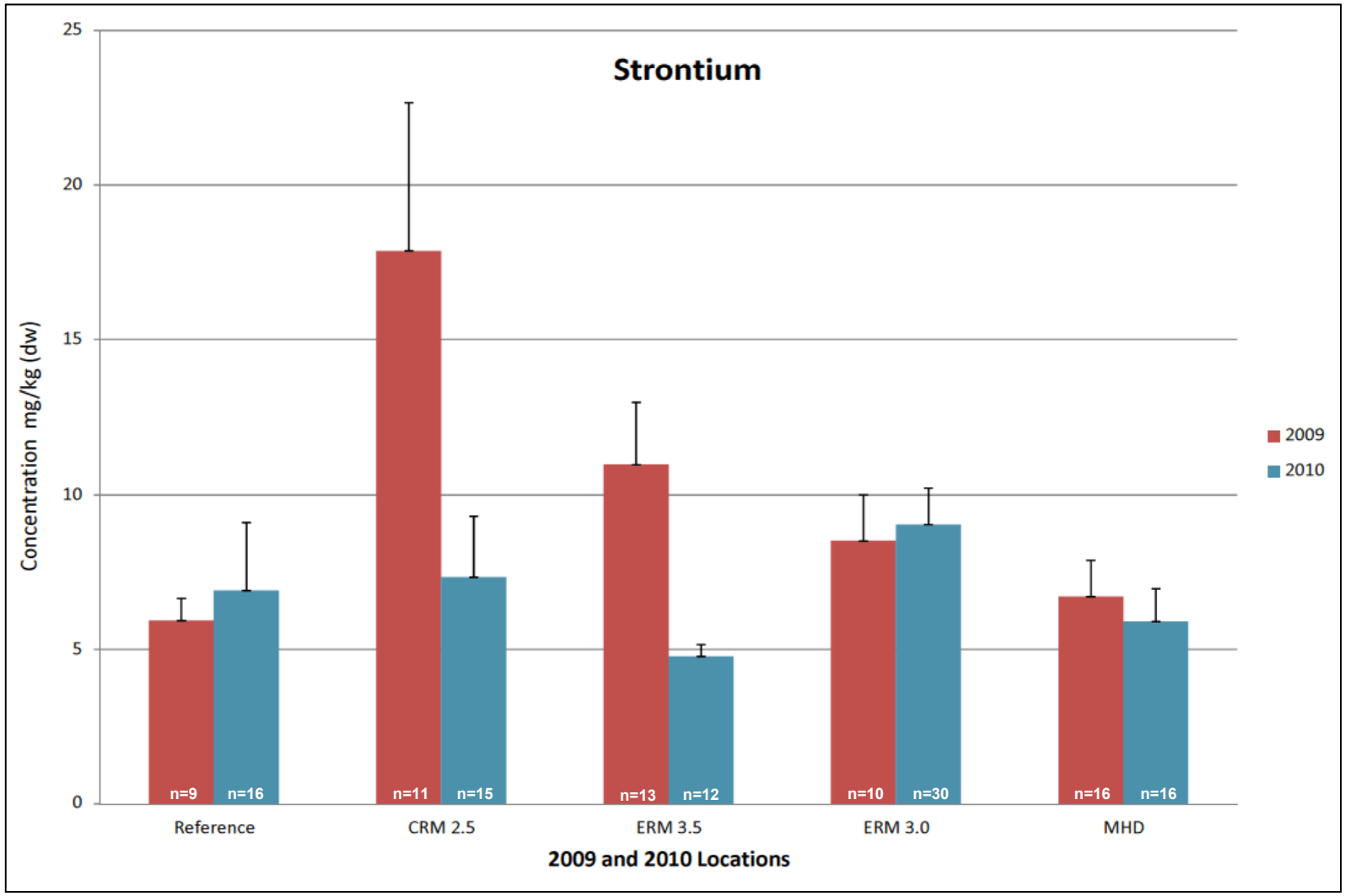
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN SELENIUM (2010)

ARCADIS

FIGURE
37



Notes: Mean ± standard error.
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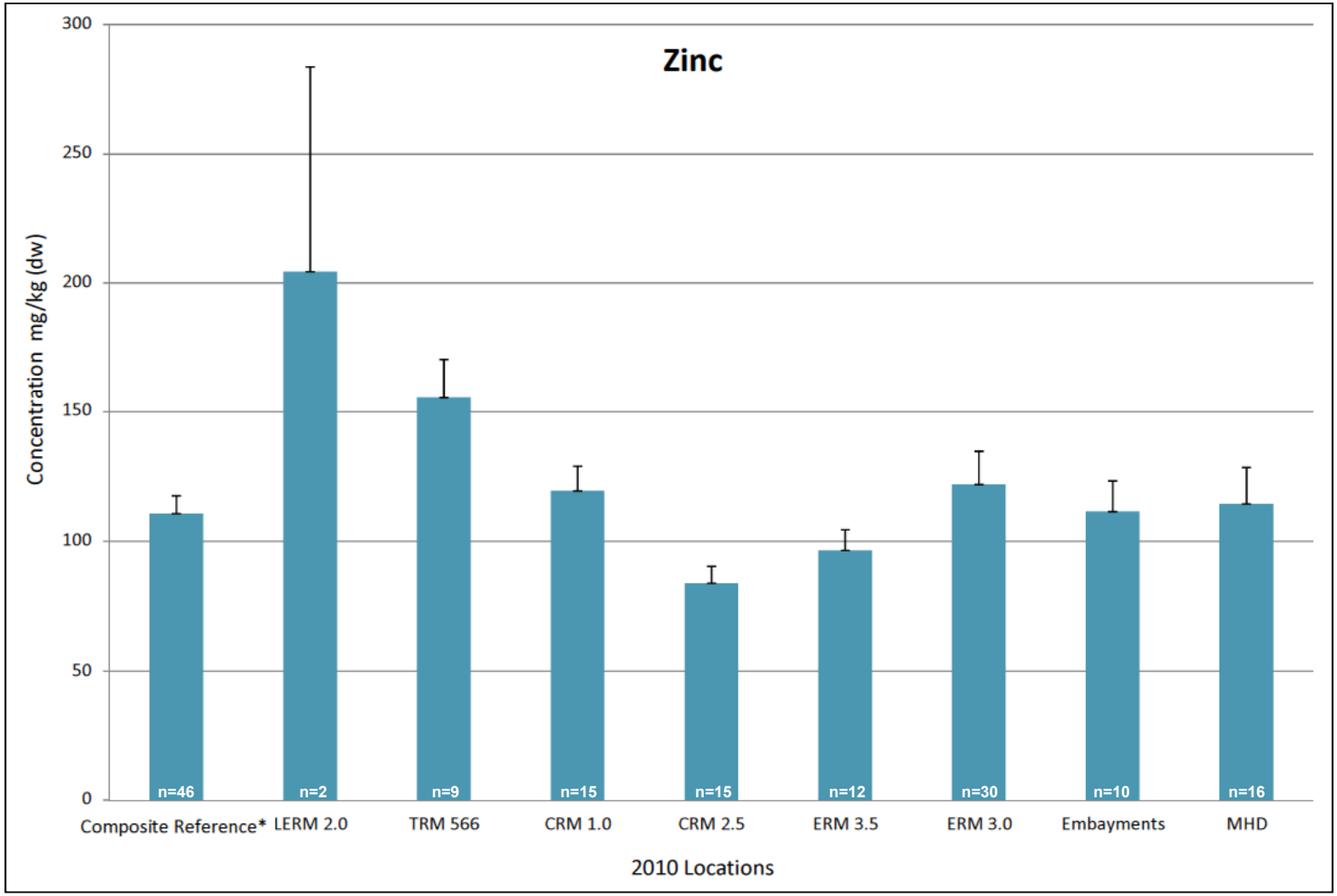
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN STRONTIUM

ARCADIS

FIGURE
38



Notes: Mean ± standard error.
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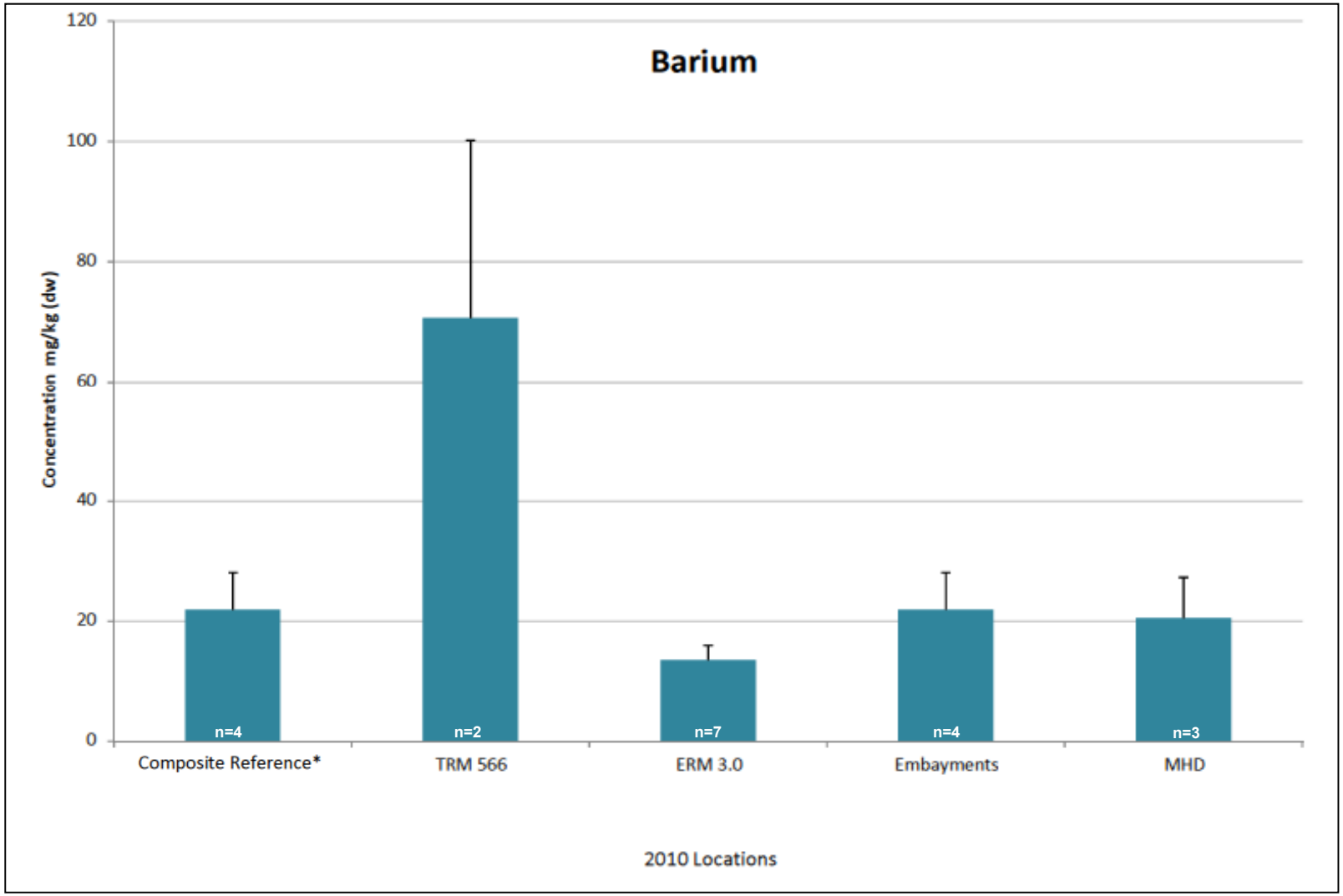
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGS:
MEAN CONCENTRATIONS IN ZINC (2010)

ARCADIS

FIGURE
39



Notes: Mean ± standard error.
Eggshell concentrations in mg/kg (dw) = milligrams per kilogram (dry weight).

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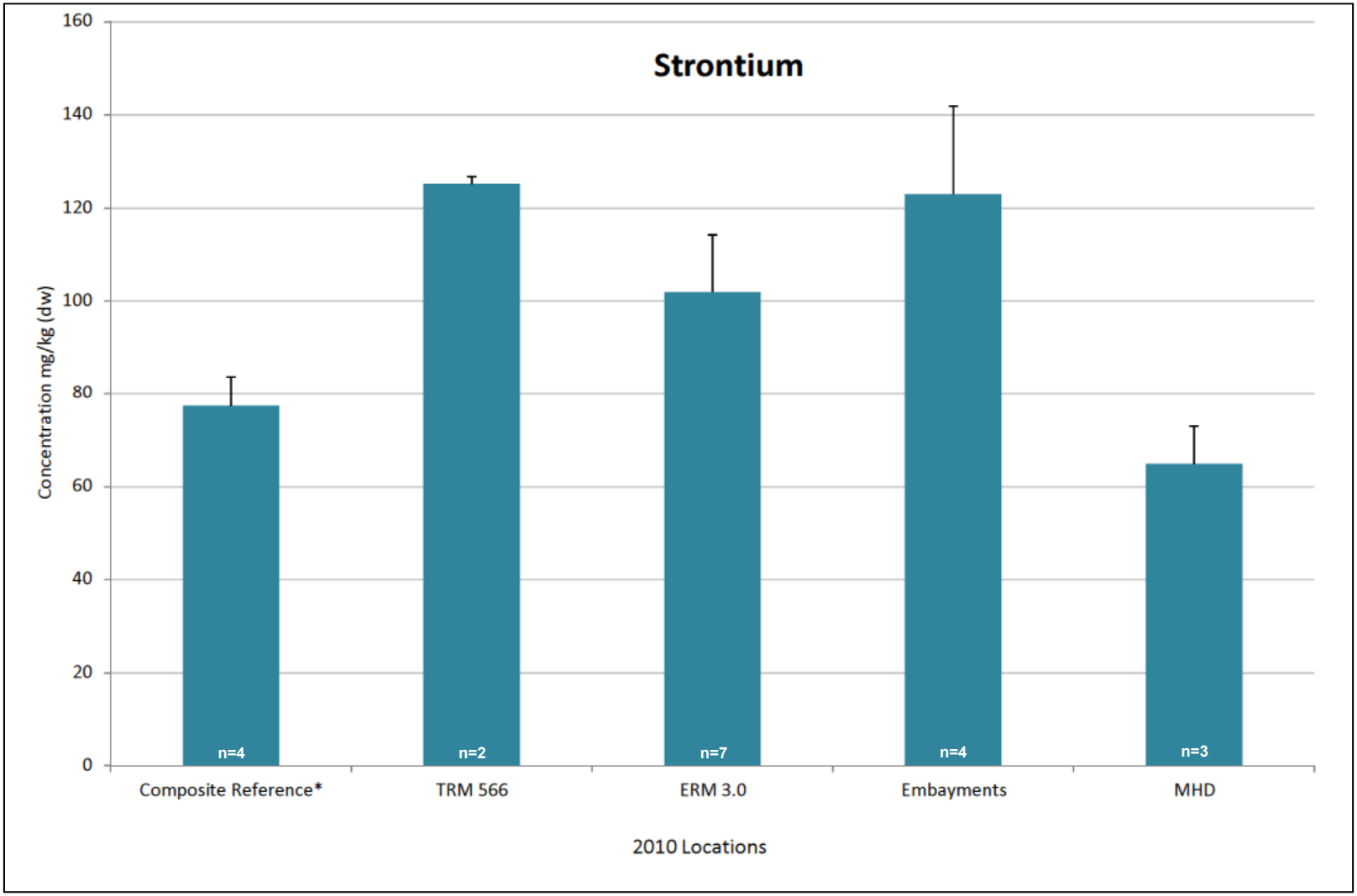
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGSHELLS:
MEAN CONCENTRATIONS IN BARIUM

ARCADIS

FIGURE
40



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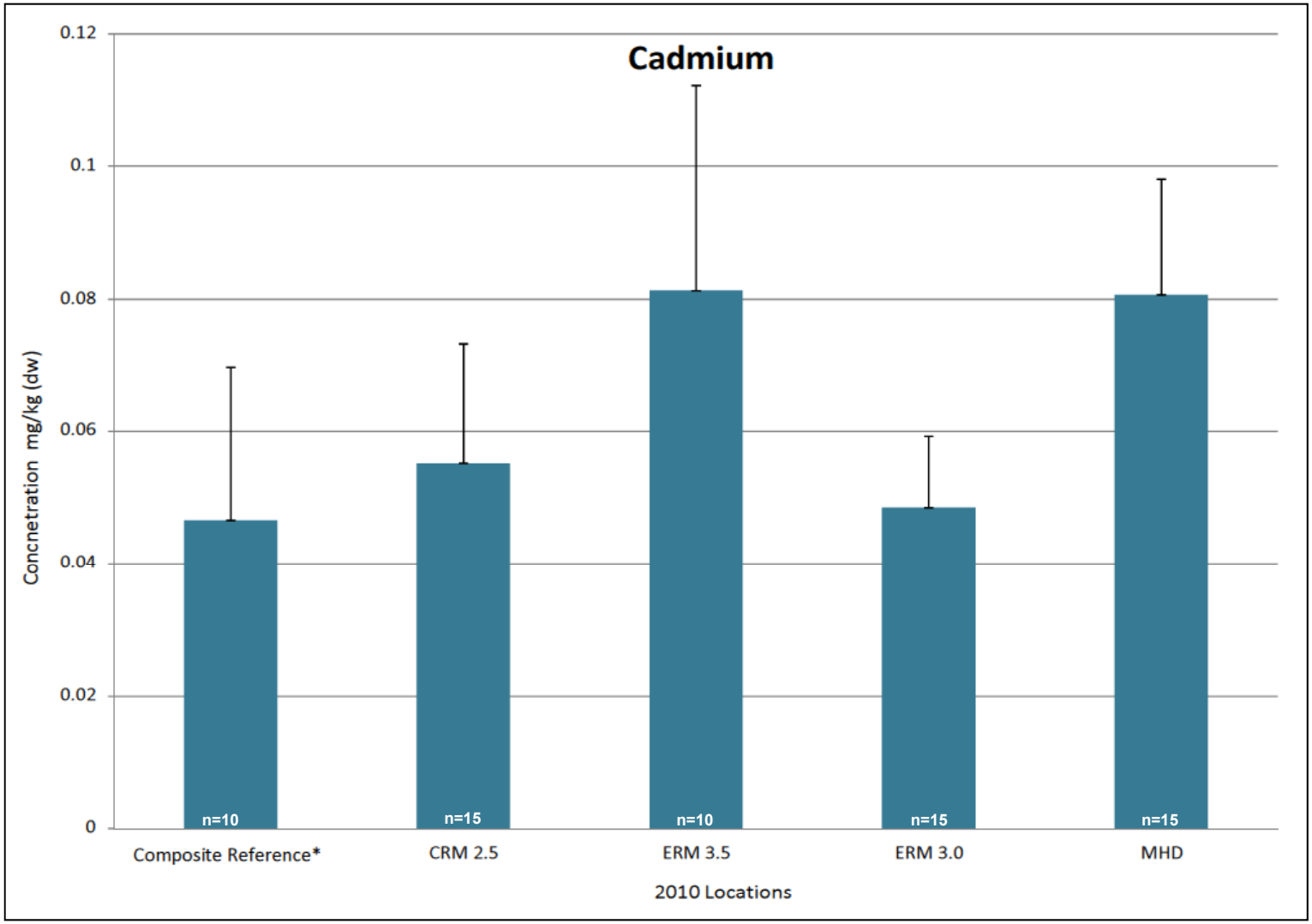
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

EGGSHELLS:
MEAN CONCENTRATIONS IN STRONTIUM

ARCADIS

FIGURE
41



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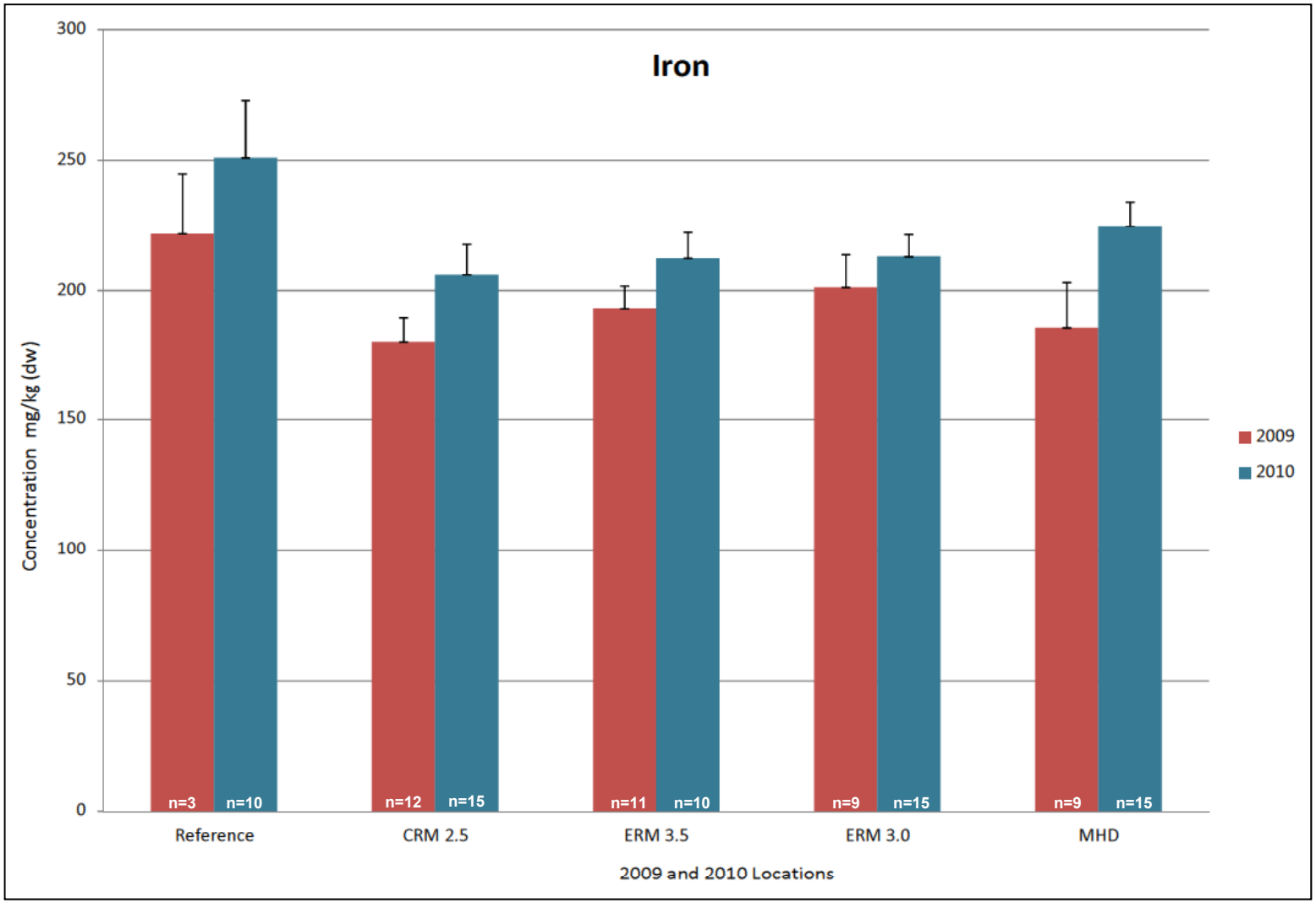
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN CADMIUM (2010)

ARCADIS

FIGURE
42



Notes: Mean ± standard error.
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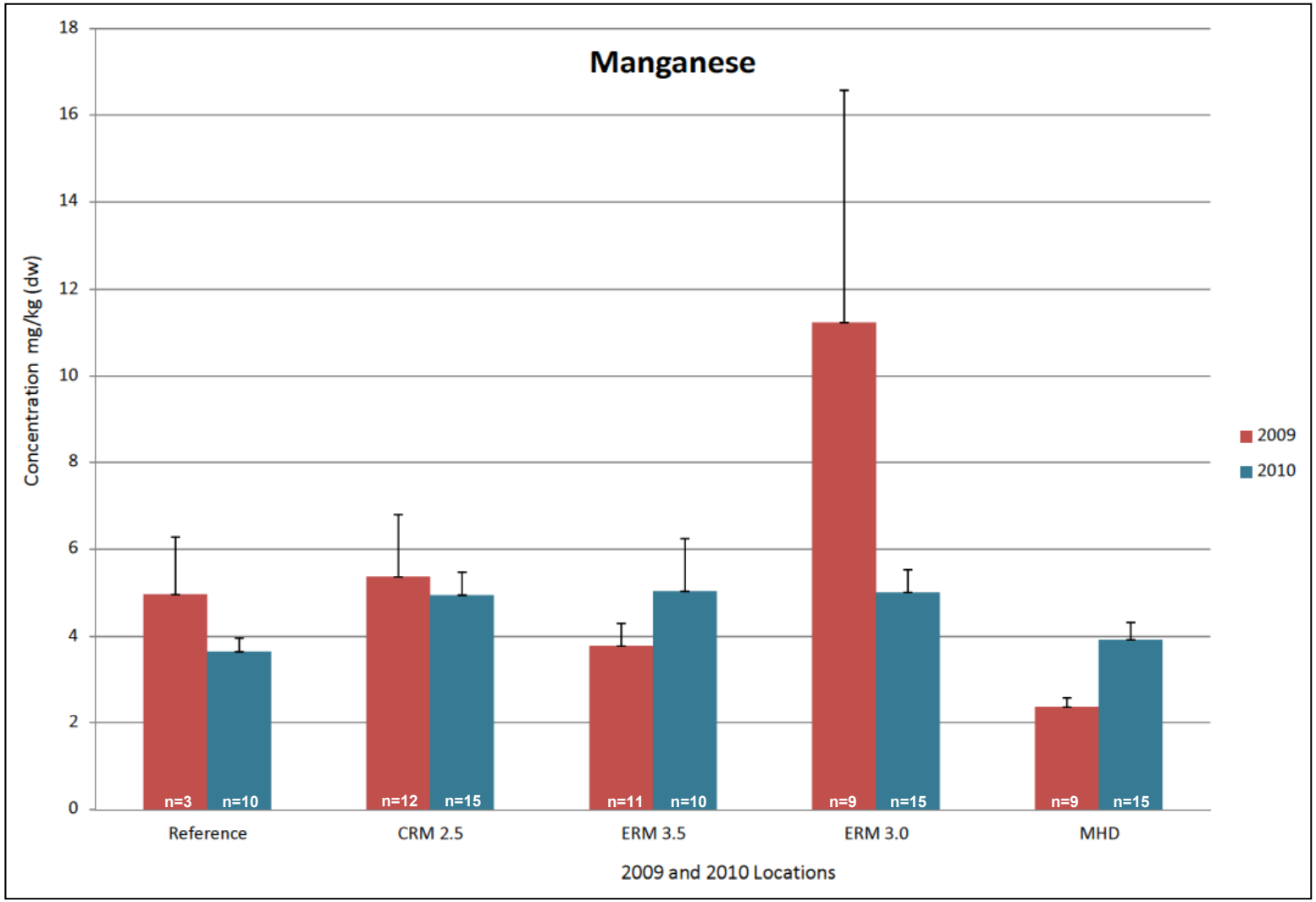
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN IRON

ARCADIS

FIGURE
43



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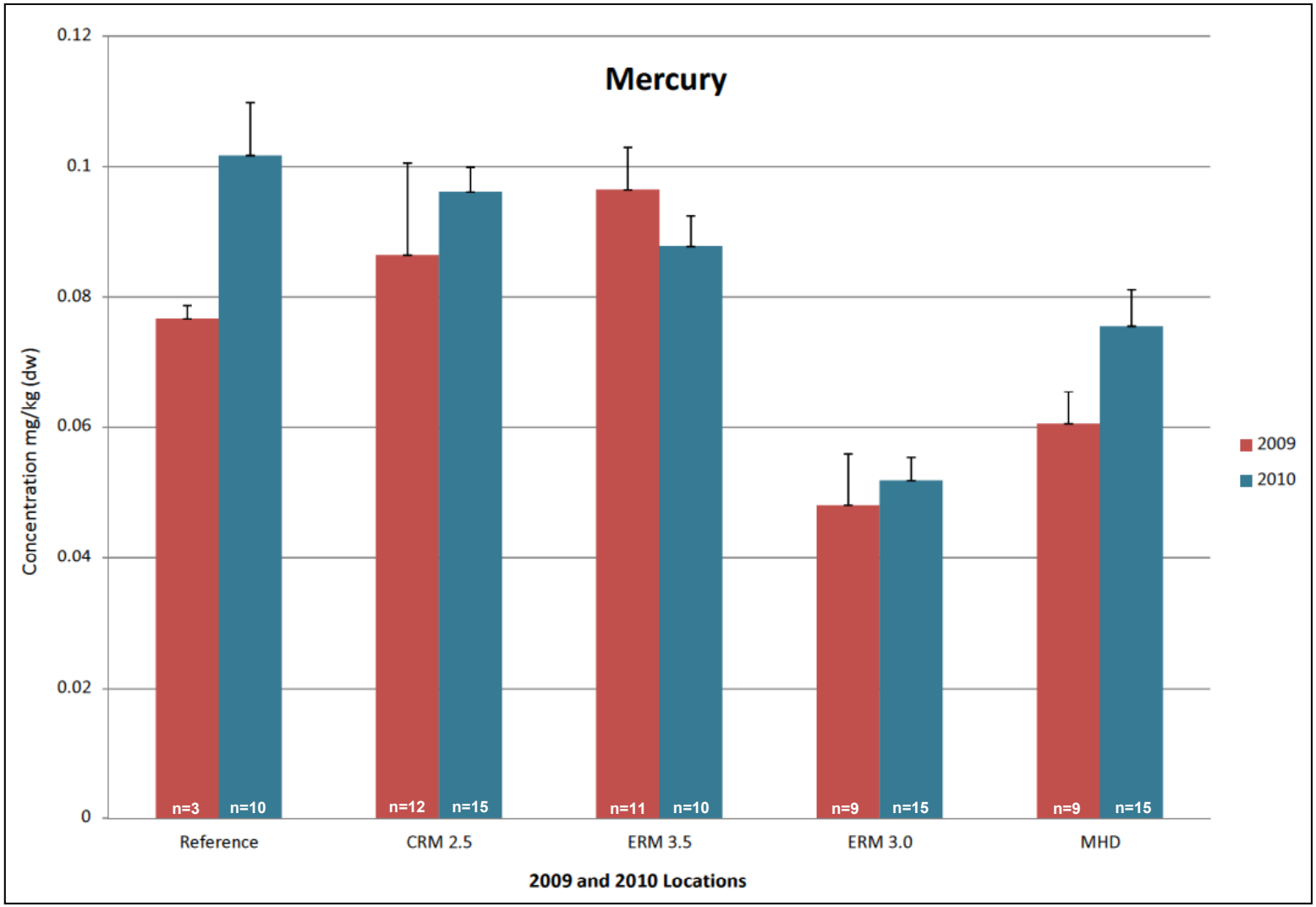
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN MANGANESE

ARCADIS

FIGURE
44



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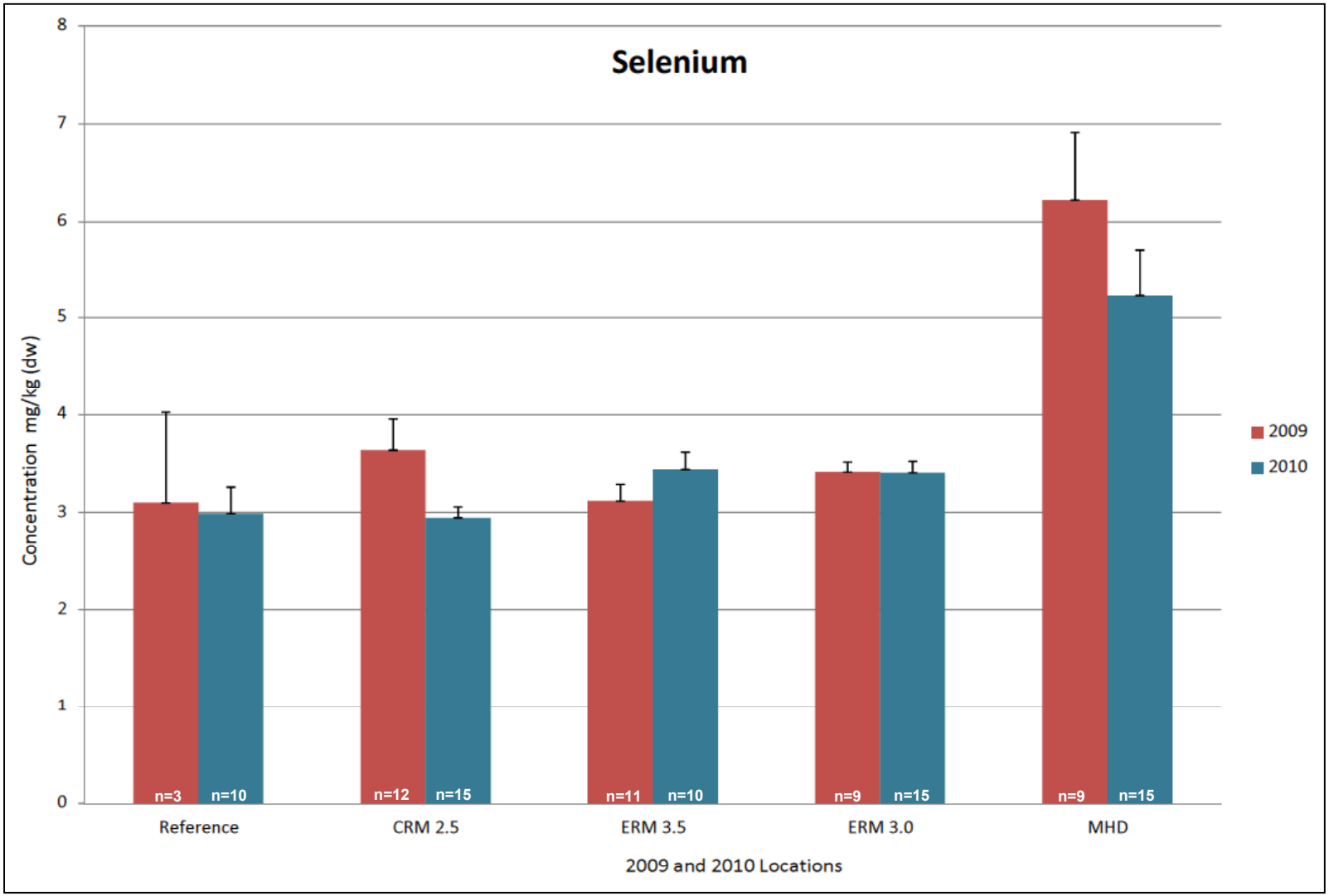
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN MERCURY

ARCADIS

FIGURE
45



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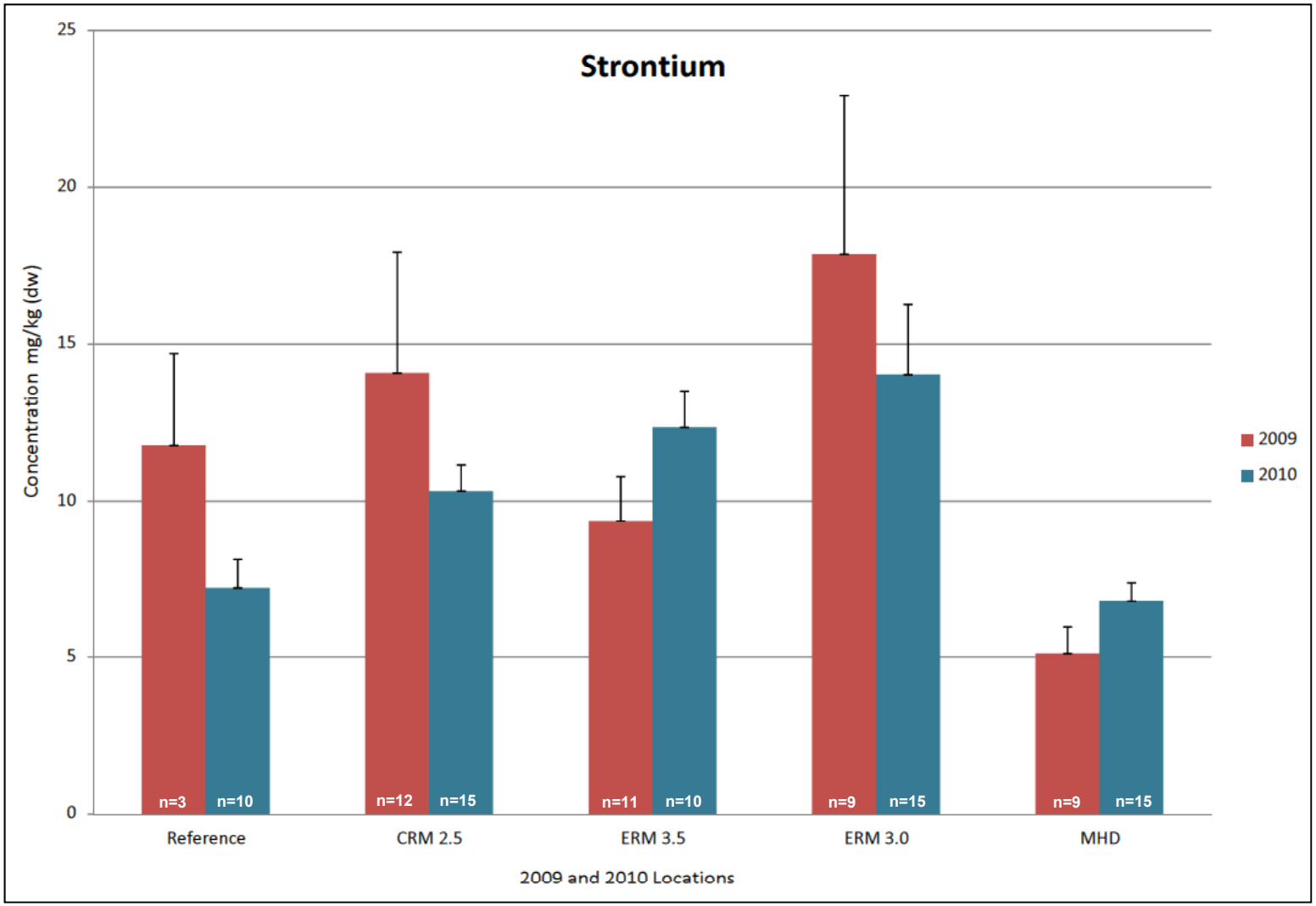
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN SELENIUM

ARCADIS

FIGURE
46



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TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN STRONTIUM

ARCADIS

FIGURE
47

Notes: Mean ± standard error.
Nestling concentrations in mg/kg (dw) = milligrams per kilogram (dry weight).

CRM – Clinch River Mile.
ERM – Emory River Mile.
MHD – Melton Hill Dam, positive control site.
n = Number of samples.
Reference – Fort Loudoun Dam.
TRM – Tennessee River Mile.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

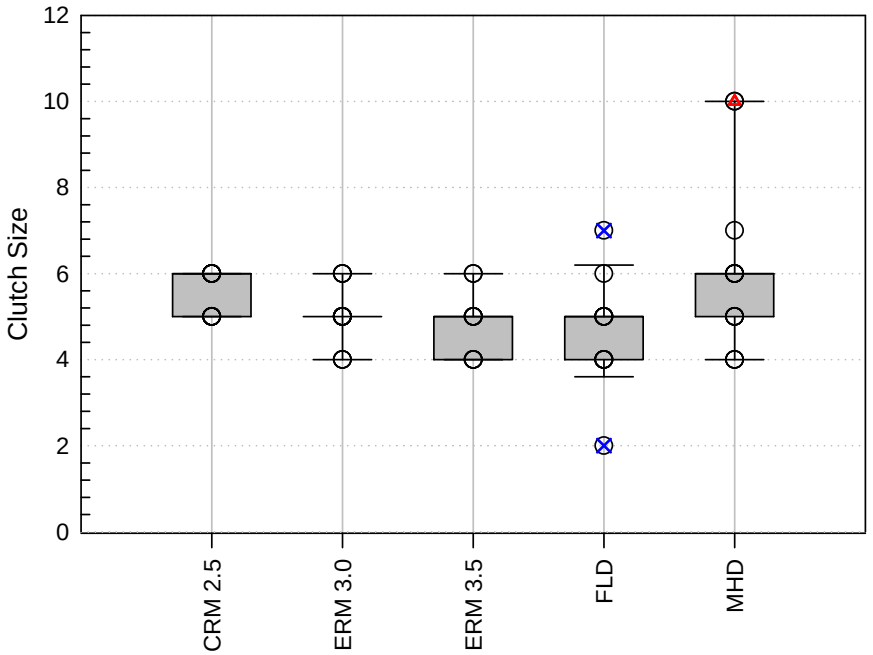
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

NESTLINGS:
MEAN CONCENTRATIONS IN ZINC

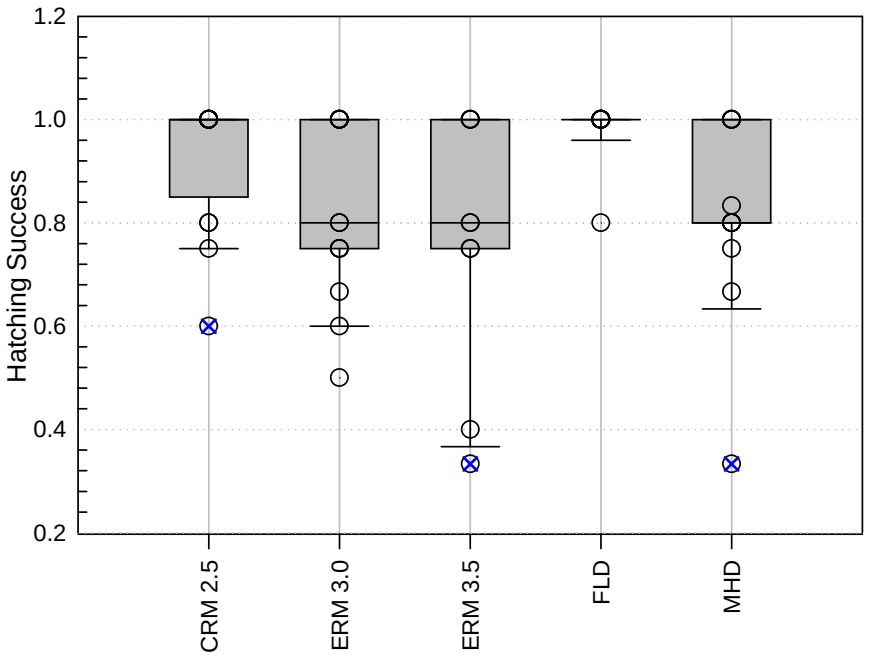
ARCADIS

FIGURE
48

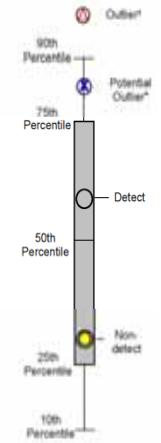
2010 Clutch Size



2010 Hatching Success



Box Plot Legend



Notes:
Hatching success in percent.

† – Data points identified as outliers or potential outliers were included in all statistical analyses.
CRM – Clinch River Mile.
ERM – Emory River Mile.
FLD – Fort Loudoun Dam, reference.
MHD – Melton Hill Dam, positive control site.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

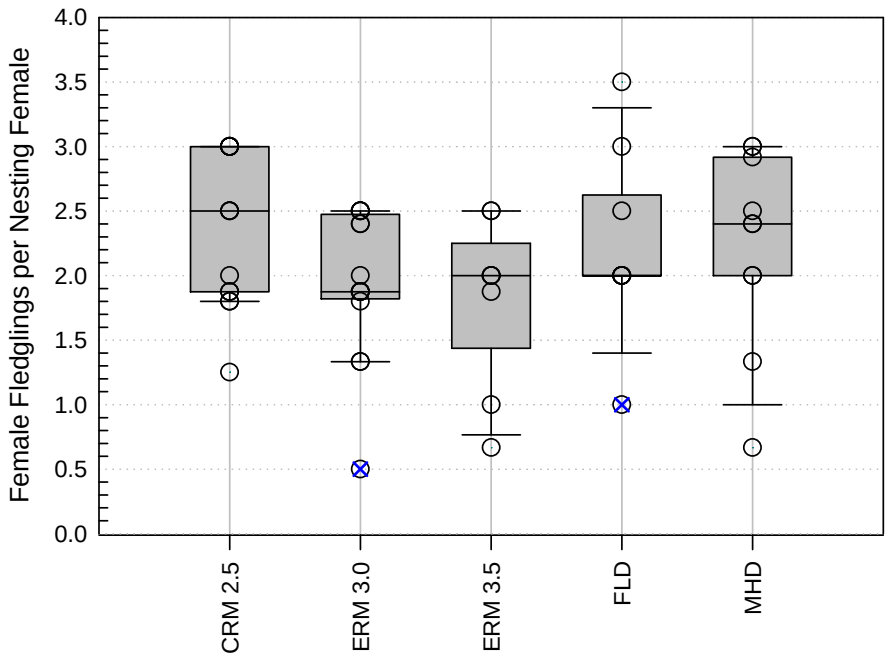
TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

2010 PRODUCTIVITY DATA – CLUTCH SIZE AND HATCHING SUCCESS

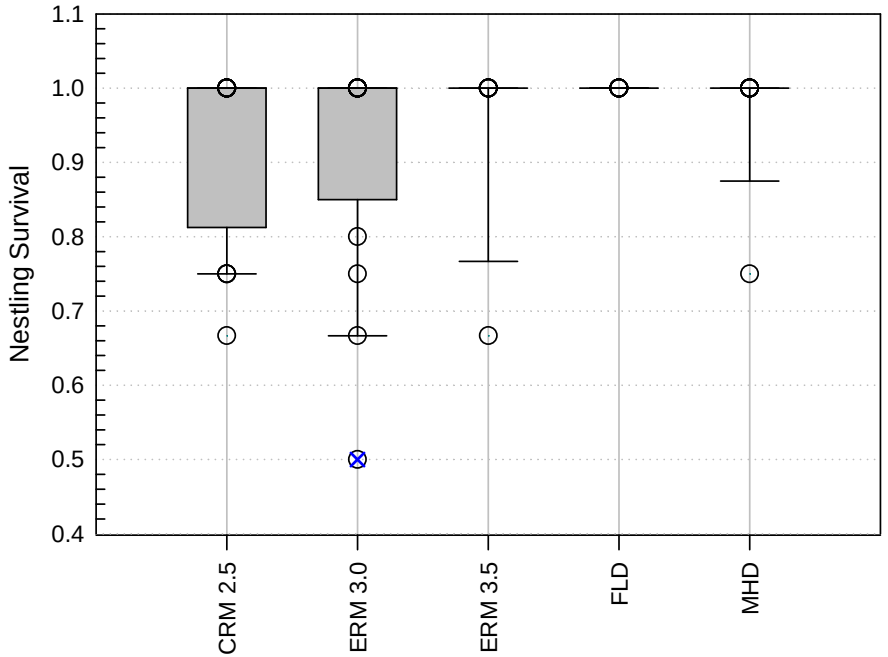
ARCADIS

FIGURE
49

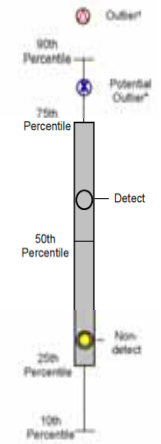
2010 Female Fledglings per Nesting Female



2010 Nestling Survival



Box Plot Legend



Notes:
Nestling survival in percent.

† – Data points identified as outliers or potential outliers were included in all statistical analyses.
CRM – Clinch River Mile.
ERM – Emory River Mile.
FLD – Fort Loudoun Dam, reference.
MHD – Melton Hill Dam, positive control site.

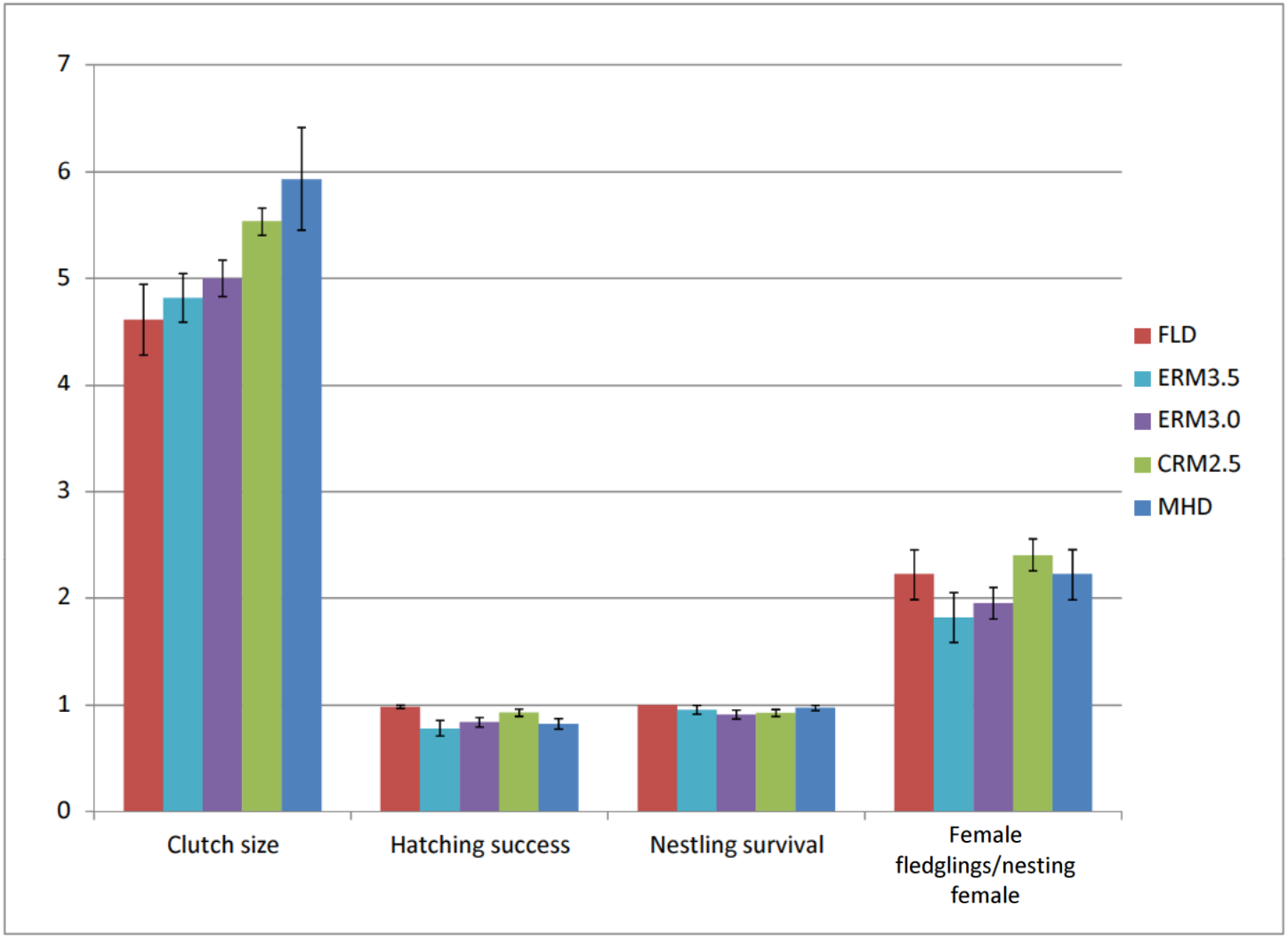
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

2010 PRODUCTIVITY DATA – FEMALE FLEDGLINGS PER NESTING FEMALE AND NESTLING SURVIVAL

ARCADIS

FIGURE
50



Notes: Mean ± standard error.

CRM – Clinch River Mile.
ERM – Emory River Mile.
FLD – Fort Loudoun Dam, reference site.
MHD – Melton Hill Dam, positive control site.

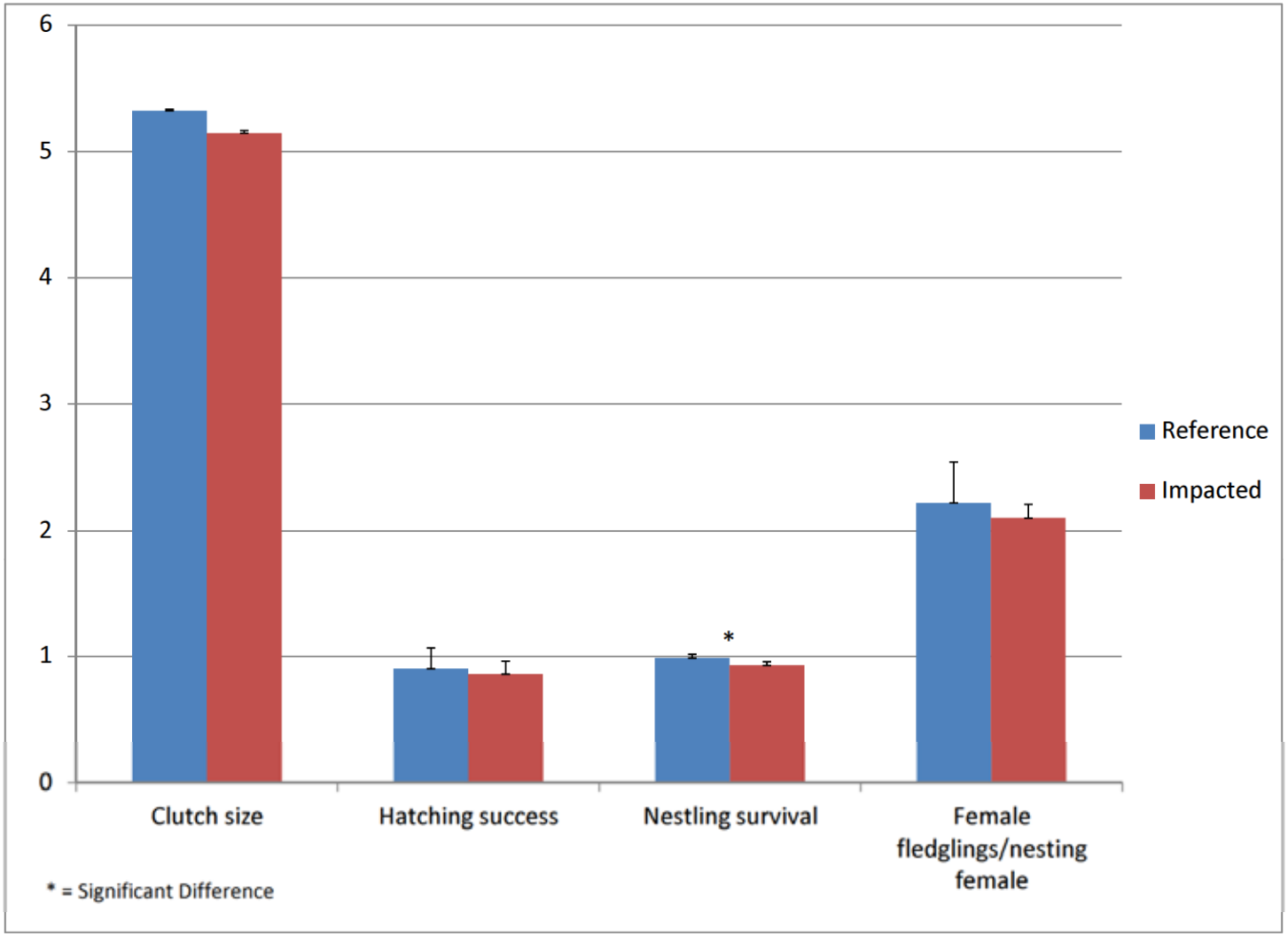
TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

2010 TREE SWALLOW PRODUCTIVITY MEASUREMENTS BY LOCATION

ARCADIS

FIGURE
51



Notes: Mean ± standard error.
Impacted locations include ERM 3.0, ERM, 3.5, and CRM 2.5.
Reference locations include FLD and MHD.

CRM – Clinch River Mile.
ERM – Emory River Mile.
FLD – Fort Loudoun Dam.
MHD – Melton Hill Dam.
n = Number of samples.

TENNESSEE VALLEY AUTHORITY
KINGSTON, TENNESSEE

TRACE ELEMENT CONCENTRATIONS AND PRODUCTIVITY IN TREE SWALLOWS: 2009-2010

2010 TREE SWALLOW PRODUCTIVITY MEASUREMENTS BY GROUP

ARCADIS

FIGURE
52

ARCADIS

Appendix A

Tree Swallow Egg
Occurrence Tables

Table A-1
Tree Swallow Egg Dataset
Reference Site - Fort Loudoun Dam - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 9	0	–	–	134.2	135.9	–
Antimony	0 - 9	0	–	–	0.537	0.5475	–
Arsenic	0 - 9	0	–	–	0.537	0.5475	–
Barium	9 - 9	100	1.491	12.29	–	–	KIF-FLD.CONTROL05-TS.E.01-BD-050809(5/8/2009)
Beryllium	0 - 9	0	–	–	0.537	0.5475	–
Boron	0 - 9	0	–	–	10.74	10.95	–
Cadmium	0 - 9	0	–	–	0.537	0.5475	–
Calcium	9 - 9	100	2179	10822	–	–	KIF-FLD.CONTROL06-TS.E.01-BD-050809(5/8/2009)
Chromium	0 - 9	0	–	–	0.537	0.6061	–
Cobalt	0 - 9	0	–	–	0.537	0.5475	–
Copper	3 - 9	33.3	2.826	4.496	2.618	2.735	KIF-FLD.CONTROL07-TS.E.01-BD-050809(5/8/2009)
Iron	6 - 9	66.7	146.2	343.6	134.2	135.8	KIF-FLD.CONTROL05-TS.E.01-BD-050809(5/8/2009)
Lead	0 - 9	0	–	–	0.537	0.5475	–
Magnesium	2 - 9	22.2	567.4	585.2	537.8	543.3	KIF-FLD.CONTROL05-TS.E.01-BD-050809(5/8/2009)
Manganese	7 - 9	77.8	2.857	9.313	2.638	2.678	KIF-FLD.CONTROL25-TS.E.01-BD-050809(5/8/2009)
Mercury	0 - 9	0	–	–	0.1052	0.1109	–
Molybdenum	0 - 9	0	–	–	5.37	5.475	–
Nickel	0 - 9	0	–	–	0.537	0.5475	–
Potassium	9 - 9	100	6327	8761	–	–	KIF-FLD23-TS.E.01-BD-060109(6/1/2009)
Selenium	9 - 9	100	1.605	3.771	–	–	KIF-FLD.CONTROL05-TS.E.01-BD-050809(5/8/2009)
Silver	0 - 9	0	–	–	0.2618	0.2735	–
Sodium	9 - 9	100	6950	9224	–	–	KIF-FLD23-TS.E.01-BD-060109(6/1/2009)
Strontium	9 - 9	100	2.293	8.674	–	–	KIF-FLD.CONTROL06-TS.E.01-BD-050809(5/8/2009)
Thallium	0 - 9	0	–	–	0.537	0.5475	–
Vanadium	0 - 9	0	–	–	1.052	1.109	–
Zinc	9 - 9	100	33.83	170.4	–	–	KIF-FLD.CONTROL05-TS.E.01-BD-050809(5/8/2009)

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-2
Tree Swallow Egg Dataset
Reference Site - Fort Loudoun Dam - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 16	0	– – –		17.93 - 44.02		–
Antimony	0 - 16	0	– – –		0.06522 - 0.1576		–
Arsenic	0 - 16	0	– – –		0.125 - 0.3152		–
Barium	16 - 16	100	1.793 - 30.98		– – –		KIF-FLD.BH100_TS.E.G.01-BD-050810(5/8/2010 9:38:00 AM)
Beryllium	0 - 16	0	– – –		0.07065 - 0.3478		–
Boron	0 - 16	0	– – –		1.848 - 4.565		–
Cadmium	1 - 16	6.25	0.04728 - 0.04728		0.04293 - 0.09239		KIF-FLD.BH098_TS.E.G.01-BD-061710(6/17/2010 7:26:00 AM)
Calcium	16 - 16	100	1565 - 70652		– – –		KIF-FLD.BH097_TS.E.G.01-BD-061110(6/11/2010 7:32:00 AM)
Chromium	2 - 16	12.5	0.8152 - 0.8696		0.5978 - 1.413		KIF-FLD.BH097_TS.E.G.01-BD-061110(6/11/2010 7:32:00 AM)
Cobalt	11 - 16	68.8	0.07609 - 0.1685		0.07609 - 0.09783		KIF-FLD.BH109_TS.E.G.01-BD-061510(6/15/2010 7:25:00 AM)
Copper	16 - 16	100	1.848 - 3.587		– – –		KIF-FLD.BH111_TS.E.G.07-BD-050410(5/4/2010 12:20:00 PM)
Iron	15 - 16	93.8	68.48 - 300.5		83.15 - 83.15		KIF-FLD.BH116_TS.E.G.01-BD-061410(6/14/2010 8:00:00 AM)
Lead	0 - 16	0	– – –		0.125 - 0.3043		–
Magnesium	15 - 16	93.8	346.7 - 760.9		270.1 - 270.1		KIF-FLD.BH116_TS.E.G.01-BD-061410(6/14/2010 8:00:00 AM)
Manganese	11 - 16	68.8	2.12 - 12.5		1.902 - 5.435		KIF-FLD.BH100_TS.E.G.01-BD-050810(5/8/2010 9:38:00 AM)
Mercury	10 - 16	62.5	0.08696 - 0.1359		0.07609 - 0.1793		KIF-FLD.BH109_TS.E.G.06-BD-050410(5/4/2010 12:20:00 PM)
Molybdenum	0 - 16	0	– – –		0.1576 - 0.3859		–
Nickel	2 - 16	12.5	7.609 - 8.152		0.4402 - 2.065		KIF-FLD.BH100_TS.E.G.01-BD-050810(5/8/2010 9:38:00 AM)
Potassium	16 - 16	100	7065 - 9185		– – –		KIF-FLD.BH109_TS.E.G.01-BD-061510(6/15/2010 7:25:00 AM)
Selenium	16 - 16	100	1.304 - 5.054		– – –		KIF-FLD.BH110_TS.E.G.01-BD-050710(5/7/2010 10:58:00 AM)
Silver	3 - 16	18.8	0.01522 - 0.0337		0.01522 - 0.05435		KIF-FLD.BH100_TS.E.G.01-BD-050810(5/8/2010 9:38:00 AM)
Sodium	16 - 16	100	8043 - 10000		– – –		KIF-FLD.BH105_TS.E.G.01-BD-050610(5/6/2010 2:16:00 PM)
Strontium	16 - 16	100	1.848 - 39.67		– – –		KIF-FLD.BH097_TS.E.G.01-BD-061110(6/11/2010 7:32:00 AM)
Thallium	0 - 16	0	– – –		0.05978 - 0.1522		–
Vanadium	0 - 16	0	– – –		0.2065 - 0.5163		–
Zinc	16 - 16	100	18.48 - 163		– – –		KIF-FLD.BH109_TS.E.G.01-BD-061510(6/15/2010 7:25:00 AM)

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-3
Tree Swallow Egg Dataset
Reference Site - Fort Loudoun Dam, Tellico Dam, Upstream Tenneessee River - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 46	0	– - –		17.93 - 48.91		–
Antimony	1 - 46	2.17	0.2011 - 0.2011		0.06522 - 0.1793		KIF-TLD.BH128_TS.E.G.01-BD-050710(5/7/2010 11:25:00 AM)
Arsenic	0 - 46	0	– - –		0.125 - 0.3478		–
Barium	46 - 46	100	1.793 - 40.22		– - –		KIF-TRM569.5.BH514_TS.E.G.01-BD-051910(5/19/2010 11:55:00 AM)
Beryllium	0 - 46	0	– - –		0.07065 - 0.7065		–
Boron	0 - 46	0	– - –		1.848 - 5.054		–
Cadmium	1 - 46	2.17	0.04728 - 0.04728		0.0375 - 0.1902		KIF-FLD.BH098_TS.E.G.01-BD-061710(6/17/2010 7:26:00 AM)
Calcium	46 - 46	100	1565 - 81522		– - –		KIF-TLD.BH148_TS.E.G.05-BD-050710(5/7/2010 11:25:00 AM)
Chromium	2 - 46	4.35	0.8152 - 0.8696		0.5978 - 1.576		KIF-FLD.BH097_TS.E.G.01-BD-061110(6/11/2010 7:32:00 AM)
Cobalt	33 - 46	71.7	0.07609 - 0.2337		0.07022 - 0.1739		KIF-TLD.BH139_TS.E.G.02-BD-050410(5/4/2010 1:27:00 PM)
Copper	45 - 46	97.8	1.848 - 16.3		10.33 - 10.33		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)
Iron	43 - 46	93.5	68.48 - 366.3		83.15 - 147.8		KIF-TRM571.5.BH489_TS.E.G.03-BD-051910(5/19/2010 12:40:00 PM)
Lead	1 - 46	2.17	0.5978 - 0.5978		0.125 - 1.957		KIF-TRM569.5.BH519_TS.E.G.02-BD-051310(5/13/2010 10:54:00 AM)
Magnesium	45 - 46	97.8	331 - 826.1		270.1 - 270.1		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)
Manganese	41 - 46	89.1	2.12 - 15.22		1.902 - 5.435		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)
Mercury	34 - 46	73.9	0.08696 - 0.2663		0.07609 - 0.3315		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)
Molybdenum	4 - 46	8.7	0.1739 - 0.2663		0.1576 - 0.4293		KIF-TLD.BH139_TS.E.G.02-BD-050410(5/4/2010 1:27:00 PM)
Nickel	2 - 46	4.35	7.609 - 8.152		0.4402 - 2.065		KIF-FLD.BH100_TS.E.G.01-BD-050810(5/8/2010 9:38:00 AM)
Potassium	46 - 46	100	6848 - 17446		– - –		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)
Selenium	46 - 46	100	1.304 - 5.978		– - –		KIF-TLD.BH139_TS.E.G.02-BD-050410(5/4/2010 1:27:00 PM)
Silver	4 - 46	8.7	0.01522 - 0.0337		0.01404 - 0.2065		KIF-FLD.BH100_TS.E.G.01-BD-050810(5/8/2010 9:38:00 AM)
Sodium	46 - 46	100	6630 - 19185		– - –		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)
Strontium	46 - 46	100	1.848 - 47.83		– - –		KIF-TLD.BH148_TS.E.G.05-BD-050710(5/7/2010 11:25:00 AM)
Thallium	0 - 46	0	– - –		0.05978 - 0.1685		–
Vanadium	0 - 46	0	– - –		0.2065 - 3.207		–
Zinc	46 - 46	100	18.48 - 266.3		– - –		KIF-TRM571.5.BH498_TS.E.G.02-BD-051910(5/19/2010 12:40:00 PM)

Note: Composite Reference Site made up of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-4
Tree Swallow Egg Dataset
Reference Site - Little Emory River Mile 2.0 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 2	0	– – –		22.83 - 67.39		–
Antimony	0 - 2	0	– – –		0.08152 - 0.2446		–
Arsenic	0 - 2	0	– – –		0.3152 - 0.9239		–
Barium	2 - 2	100	11.96 - 29.89		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Beryllium	0 - 2	0	– – –		0.3261 - 0.4946		–
Boron	0 - 2	0	– – –		2.337 - 7.065		–
Cadmium	0 - 2	0	– – –		0.08152 - 0.1304		–
Calcium	2 - 2	100	5435 - 9837		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Chromium	1 - 2	50	1.902 - 1.902		2.12 - 2.12		KIF-LERM2.0.BH002_TS.E.G.01-BD-051110(5/11/2010)
Cobalt	1 - 2	50	0.1522 - 0.1522		0.2337 - 0.2337		KIF-LERM2.0.BH002_TS.E.G.01-BD-051110(5/11/2010)
Copper	2 - 2	100	2.554 - 2.609		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Iron	2 - 2	100	217.4 - 587		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Lead	0 - 2	0	– – –		0.4565 - 0.4674		–
Magnesium	2 - 2	100	570.7 - 837		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Manganese	2 - 2	100	11.96 - 16.3		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Mercury	1 - 2	50	0.1467 - 0.1467		0.1957 - 0.1957		KIF-LERM2.0.BH002_TS.E.G.01-BD-051110(5/11/2010)
Molybdenum	0 - 2	0	– – –		0.1957 - 0.5978		–
Nickel	1 - 2	50	0.6522 - 0.6522		1.63 - 1.63		KIF-LERM2.0.BH002_TS.E.G.01-BD-051110(5/11/2010)
Potassium	2 - 2	100	8152 - 8261		– – –		KIF-LERM2.0.BH002_TS.E.G.01-BD-051110(5/11/2010)
Selenium	2 - 2	100	3.967 - 7.065		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Silver	0 - 2	0	– – –		0.0163 - 0.04837		–
Sodium	2 - 2	100	7391 - 8478		– – –		KIF-LERM2.0.BH002_TS.E.G.01-BD-051110(5/11/2010)
Strontium	2 - 2	100	8.152 - 16.3		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)
Thallium	0 - 2	0	– – –		0.07609 - 0.2337		–
Vanadium	0 - 2	0	– – –		0.5109 - 1.522		–
Zinc	2 - 2	100	125 - 283.7		– – –		KIF-LERM2.0.BH010_TS.E.G.01-BD-051710(5/17/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-5
Tree Swallow Egg Dataset
Impacted Site - Tennessee River Mile 566 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 9	0	– – –		20.65	46.2	–
Antimony	0 - 9	0	– – –		0.07609	0.1685	–
Arsenic	0 - 9	0	– – –		0.1576	0.3261	–
Barium	9 - 9	100	4.565	24.46	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM),KIF-TRM566.0.BH464_TS.E.G.03-BD-051110(5/11/2010 1:16:00 PM)
Beryllium	1 - 9	11.1	0.163	0.163	0.1685	0.7065	KIF-TRM566.0.BH465_TS.E.G.04-BD-051110(5/11/2010 1:16:00 PM)
Boron	0 - 9	0	– – –		2.12	4.783	–
Cadmium	0 - 9	0	– – –		0.04293	0.1793	–
Calcium	9 - 9	100	3761	8859	– – –		KIF-TRM566.0.BH417_TS.E.G.01-BD-050410(5/4/2010 1:50:00 PM)
Chromium	1 - 9	11.1	0.7065	0.7065	0.6522	1.467	KIF-TRM566.0.BH456_TS.E.G.01-BD-051110(5/11/2010 1:16:00 PM)
Cobalt	7 - 9	77.8	0.07065	0.2935	0.07609	0.163	KIF-TRM566.0.BH421_TS.E.G.05-BD-051110(5/11/2010 1:16:00 PM)
Copper	9 - 9	100	1.902	2.826	– – –		KIF-TRM566.0.BH461_TS.E.G.02-BD-051110(5/11/2010 1:16:00 PM)
Iron	9 - 9	100	161.4	657.6	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)
Lead	0 - 9	0	– – –		0.1576	0.4511	–
Magnesium	9 - 9	100	461.4	1005	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)
Manganese	9 - 9	100	5.978	44.57	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)
Mercury	8 - 9	88.9	0.09239	0.1467	0.1359	0.1359	KIF-TRM566.0.BH421_TS.E.G.05-BD-051110(5/11/2010 1:16:00 PM)
Molybdenum	2 - 9	22.2	0.2228	0.2663	0.1793	0.4076	KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)
Nickel	0 - 9	0	– – –		0.5	1.141	–
Potassium	9 - 9	100	7174	9837	– – –		KIF-TRM566.0.BH461_TS.E.G.02-BD-051110(5/11/2010 1:16:00 PM)
Selenium	9 - 9	100	2.88	5.978	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)
Silver	0 - 9	0	– – –		0.01467	0.0337	–
Sodium	9 - 9	100	7880	10054	– – –		KIF-TRM566.0.BH461_TS.E.G.02-BD-051110(5/11/2010 1:16:00 PM)
Strontium	9 - 9	100	3.75	10.87	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)
Thallium	0 - 9	0	– – –		0.07065	0.1576	–
Vanadium	0 - 9	0	– – –		0.2554	0.5326	–
Zinc	9 - 9	100	118.5	262.5	– – –		KIF-TRM566.0.BH440_TS.E.G.03-BD-050410(5/4/2010 1:50:00 PM)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-6
Tree Swallow Egg Dataset
Impacted Site - Clinch River Mile 1.0 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	– - –	–	– - –		– - –		–
Antimony	0 - 15	0	– - –		0.07609 - 0.1522		–
Arsenic	0 - 15	0	– - –		0.1467 - 0.2935		–
Barium	15 - 15	100	1.522 - 35.33		– - –		KIF-CRM1.0.BH390_TS.E.G.08-BD-051010(5/10/2010 3:00:00 PM)
Beryllium	0 - 15	0	– - –		0.1522 - 0.3098		–
Boron	0 - 15	0	– - –		2.174 - 4.348		–
Cadmium	0 - 15	0	– - –		0.04239 - 0.1196		–
Calcium	15 - 15	100	3043 - 18098		– - –		KIF-CRM1.0.BH401_TS.E.G.12-BD-051010(5/10/2010 3:00:00 PM)
Chromium	8 - 15	53.3	0.7609 - 1.522		0.6522 - 1.304		KIF-CRM1.0.BH373_TS.E.G.02-BD-051010(5/10/2010 3:00:00 PM)
Cobalt	11 - 15	73.3	0.07609 - 0.2554		0.07609 - 0.1467		KIF-CRM1.0.BH393_TS.E.G.10-BD-051010(5/10/2010 3:00:00 PM)
Copper	15 - 15	100	2.065 - 3.967		– - –		KIF-CRM1.0.BH389_TS.E.G.07-BD-051010(5/10/2010 3:00:00 PM)
Iron	14 - 15	93.3	125 - 361.4		125.5 - 125.5		KIF-CRM1.0.BH391_TS.E.G.09-BD-051010(5/10/2010 3:00:00 PM)
Lead	0 - 15	0	– - –		0.2826 - 0.5435		–
Magnesium	14 - 15	93.3	390.8 - 706.5		503.3 - 503.3		KIF-CRM1.0.BH391_TS.E.G.09-BD-051010(5/10/2010 3:00:00 PM)
Manganese	15 - 15	100	4.239 - 16.85		– - –		KIF-CRM1.0.BH391_TS.E.G.09-BD-051010(5/10/2010 3:00:00 PM)
Mercury	0 - 15	0	– - –		0.125 - 0.3696		–
Molybdenum	2 - 15	13.3	0.2772 - 0.2826		0.1848 - 0.3696		KIF-CRM1.0.BH373_TS.E.G.02-BD-051010(5/10/2010 3:00:00 PM)
Nickel	1 - 15	6.67	2.065 - 2.065		0.5109 - 1.033		KIF-CRM1.0.BH370_TS.E.G.01-BD-051010(5/10/2010 3:00:00 PM)
Potassium	15 - 15	100	7120 - 10326		– - –		KIF-CRM1.0.BH389_TS.E.G.07-BD-051010(5/10/2010 3:00:00 PM)
Selenium	15 - 15	100	2.5 - 5.978		– - –		KIF-CRM1.0.BH391_TS.E.G.09-BD-051010(5/10/2010 3:00:00 PM)
Silver	2 - 15	13.3	0.01685 - 0.05435		0.01522 - 0.03043		KIF-CRM1.0.BH373_TS.E.G.02-BD-051010(5/10/2010 3:00:00 PM)
Sodium	15 - 15	100	7880 - 11196		– - –		KIF-CRM1.0.BH388_TS.E.G.06-BD-051010(5/10/2010 3:00:00 PM)
Strontium	15 - 15	100	3.587 - 16.85		– - –		KIF-CRM1.0.BH401_TS.E.G.12-BD-051010(5/10/2010 3:00:00 PM)
Thallium	1 - 15	6.67	0.1196 - 0.1196		0.07065 - 0.1413		KIF-CRM1.0.BH373_TS.E.G.02-BD-051010(5/10/2010 3:00:00 PM)
Vanadium	0 - 15	0	– - –		0.2391 - 0.4783		–
Zinc	15 - 15	100	68.48 - 195.7		– - –		KIF-CRM1.0.BH391_TS.E.G.09-BD-051010(5/10/2010 3:00:00 PM)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-7
Tree Swallow Egg Dataset
Impacted Site - Clinch River Mile 2.5 - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 11	0	– – –		132	265.2	–
Antimony	0 - 11	0	– – –		0.5305	1.087	–
Arsenic	0 - 11	0	– – –		0.5305	1.087	–
Barium	11 - 11	100	3.426	13.8	– – –		KIF-DISCHARGE08-TS.E.01-BD-050809(5/8/2009)
Beryllium	0 - 11	0	– – –		0.5305	1.087	–
Boron	0 - 11	0	– – –		10.61	21.2	–
Cadmium	0 - 11	0	– – –		0.5305	1.087	–
Calcium	11 - 11	100	2311	80700	– – –		KIF-DISCHARGE08-TS.E.01-BD-050809(5/8/2009)
Chromium	0 - 11	0	– – –		0.5305	1.314	–
Cobalt	0 - 11	0	– – –		0.5305	1.087	–
Copper	5 - 11	45.5	2.714	4.549	2.671	5.397	KIF-DISCHARGE04-TS.E.01-BD-060109(6/1/2009)
Iron	5 - 11	45.5	150.6	431.7	132	265.2	KIF-DISCHARGE03-TS.E.03-BD-061609(6/16/2009)
Lead	1 - 11	9.09	0.8943	0.8943	0.5305	1.087	KIF-DISCHARGE06-TS.E.01-BD-050809(5/8/2009)
Magnesium	5 - 11	45.5	538	867	529.3	1060	KIF-DISCHARGE08-TS.E.01-BD-050809(5/8/2009)
Manganese	7 - 11	63.6	3.595	18.35	2.591	11.41	KIF-DISCHARGE03-TS.E.03-BD-061609(6/16/2009)
Mercury	2 - 11	18.2	0.113	0.1974	0.1038	0.212	KIF-DISCHARGE05-TS.E.02-BD-061609(6/16/2009)
Molybdenum	0 - 11	0	– – –		5.305	10.87	–
Nickel	0 - 11	0	– – –		0.5305	1.087	–
Potassium	11 - 11	100	5805	11221	– – –		KIF-DISCHARGE04-TS.E.01-BD-060109(6/1/2009)
Selenium	11 - 11	100	2.465	6.836	– – –		KIF-DISCHARGE03-TS.E.03-BD-061609(6/16/2009)
Silver	0 - 11	0	– – –		0.2591	0.5397	–
Sodium	11 - 11	100	6630	12333	– – –		KIF-DISCHARGE04-TS.E.01-BD-060109(6/1/2009)
Strontium	11 - 11	100	3.492	51.45	– – –		KIF-DISCHARGE08-TS.E.01-BD-050809(5/8/2009)
Thallium	0 - 11	0	– – –		0.5305	1.087	–
Vanadium	0 - 11	0	– – –		1.038	2.12	–
Zinc	11 - 11	100	37.63	237.1	– – –		KIF-DISCHARGE03-TS.E.03-BD-061609(6/16/2009)

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-8
Tree Swallow Egg Dataset
Impacted Site - Clinch River Mile 2.5 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	– - –	–	– - –		– - –		–
Antimony	0 - 15	0	– - –		0.06522 - 0.2228		–
Arsenic	0 - 15	0	– - –		0.1304 - 0.4348		–
Barium	15 - 15	100	1.848 - 14.13		– - –		KIF-CRM2.5.BH350_TS.E.G.14-BD-050510(5/5/2010 12:52:00 PM)
Beryllium	0 - 15	0	– - –		0.1359 - 0.4565		–
Boron	0 - 15	0	– - –		1.902 - 6.522		–
Cadmium	0 - 15	0	– - –		0.03533 - 0.1196		–
Calcium	15 - 15	100	3228 - 51087		– - –		KIF-CRM2.5.BH344_TS.E.G.13-BD-050510(5/5/2010 12:52:00 PM)
Chromium	0 - 15	0	– - –		0.5978 - 1.957		–
Cobalt	10 - 15	66.7	0.06522 - 0.2228		0.07065 - 0.2174		KIF-CRM2.5.BH342_TS.E.G.12-BD-050510(5/5/2010 12:52:00 PM)
Copper	15 - 15	100	1.848 - 5.054		– - –		KIF-CRM2.5.BH333_TS.E.G.07-BD-050510(5/5/2010 12:52:00 PM)
Iron	13 - 15	86.7	112 - 251.6		72.83 - 185.9		KIF-CRM2.5.BH350_TS.E.G.14-BD-050510(5/5/2010 12:52:00 PM)
Lead	0 - 15	0	– - –		0.1304 - 0.4293		–
Magnesium	14 - 15	93.3	335.9 - 603.3		744.6 - 744.6		KIF-CRM2.5.BH342_TS.E.G.12-BD-050510(5/5/2010 12:52:00 PM)
Manganese	15 - 15	100	3.315 - 9.783		– - –		KIF-CRM2.5.BH352_TS.E.G.15-BD-050510(5/5/2010 12:52:00 PM)
Mercury	0 - 15	0	– - –		0.1304 - 0.2989		–
Molybdenum	0 - 15	0	– - –		0.3207 - 1.087		–
Nickel	0 - 15	0	– - –		0.4565 - 1.522		–
Potassium	15 - 15	100	7989 - 12337		– - –		KIF-CRM2.5.BH336_TS.E.G.09-BD-050510(5/5/2010 12:52:00 PM)
Selenium	15 - 15	100	2.446 - 5.978		– - –		KIF-CRM2.5.BH322_TS.E.G.01-BD-050510(5/5/2010 12:52:00 PM)
Silver	0 - 15	0	– - –		0.01359 - 0.04457		–
Sodium	15 - 15	100	8261 - 12609		– - –		KIF-CRM2.5.BH342_TS.E.G.12-BD-050510(5/5/2010 12:52:00 PM)
Strontium	15 - 15	100	3.37 - 27.72		– - –		KIF-CRM2.5.BH344_TS.E.G.13-BD-050510(5/5/2010 12:52:00 PM)
Thallium	1 - 15	6.67	0.09239 - 0.09239		0.06522 - 0.212		KIF-CRM2.5.BH323_TS.E.G.02-BD-050510(5/5/2010 12:52:00 PM)
Vanadium	0 - 15	0	– - –		0.4239 - 1.413		–
Zinc	15 - 15	100	57.07 - 138.6		– - –		KIF-CRM2.5.BH350_TS.E.G.14-BD-050510(5/5/2010 12:52:00 PM)

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-9
Tree Swallow Egg Dataset
Impacted Site - Emory River Mile 3.5 - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 13	0	– – –		134.5 - 260.3		–
Antimony	0 - 13	0	– – –		0.5387 - 1.033		–
Arsenic	0 - 13	0	– – –		0.5387 - 1.033		–
Barium	12 - 13	92.3	2.25 -	22.28	0.6522 -	0.6522	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Beryllium	0 - 13	0	– – –		0.5387 - 1.033		–
Boron	0 - 13	0	– – –		10.74 - 20.65		–
Cadmium	0 - 13	0	– – –		0.5387 - 1.033		–
Calcium	13 - 13	100	673.9 -	27799	– – –		KIF-FARM03-TS.E.01-BD-050809(5/8/2009)
Chromium	0 - 13	0	– – –		0.5391 - 1.033		–
Cobalt	0 - 13	0	– – –		0.5387 - 1.033		–
Copper	5 - 13	38.5	2.715 -	11.96	2.656 -	3.478	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Iron	9 - 13	69.2	157.1 -	513	134.5 -	161.4	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Lead	0 - 13	0	– – –		0.5387 - 1.033		–
Magnesium	4 - 13	30.8	552.3 -	1793	537 -	701.1	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Manganese	10 - 13	76.9	3.043 -	19.57	2.713 -	3.207	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Mercury	3 - 13	23.1	0.1809 -	0.5	0.105 -	0.1413	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Molybdenum	0 - 13	0	– – –		5.387 - 10.33		–
Nickel	1 - 13	7.69	0.5661 -	0.5661	0.5391 -	1.033	KIF-FARM10-TS.E.01-BD-050809(5/8/2009)
Potassium	13 - 13	100	5304 -	33043	– – –		KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Selenium	12 - 13	92.3	2.459 -	10.87	1.304 -	1.304	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Silver	0 - 13	0	– – –		0.2656 - 0.5217		–
Sodium	13 - 13	100	6837 -	43587	– – –		KIF-FARM06-TS.E.02-BD-060409(6/4/2009)
Strontium	13 - 13	100	1.087 -	23.5	– – –		KIF-FARM03-TS.E.01-BD-050809(5/8/2009)
Thallium	0 - 13	0	– – –		0.5387 - 1.033		–
Vanadium	0 - 13	0	– – –		1.05 - 2.065		–
Zinc	12 - 13	92.3	56.63 -	315.8	13.04 -	13.04	KIF-FARM06-TS.E.02-BD-060409(6/4/2009)

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-10
Tree Swallow Egg Dataset
Impacted Site - Emory River Mile 3.5 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	1 - 12	8.33	33.7	33.7	19.57	22.28	KIF-ERM3.5.BH044_TS.E.G.01-BD-051210(5/12/2010 11:52:00 AM)
Antimony	0 - 12	0	–	–	0.07065	0.08152	–
Arsenic	0 - 12	0	–	–	0.1467	0.3152	–
Barium	12 - 12	100	2.228	15.22	–	–	KIF-ERM3.5.BH041_TS.E.G.02-BD-051810(5/18/2010 2:46:00 PM)
Beryllium	0 - 12	0	–	–	0.1413	0.3261	–
Boron	1 - 12	8.33	6.522	6.522	2.011	6.848	KIF-ERM3.5.BH044_TS.E.G.01-BD-051210(5/12/2010 11:52:00 AM)
Cadmium	0 - 12	0	–	–	0.03967	0.08696	–
Calcium	12 - 12	100	2826	5092	–	–	KIF-ERM3.5.BH041_TS.E.G.02-BD-051810(5/18/2010 2:46:00 PM)
Chromium	3 - 12	25	0.7609	5.435	0.5978	0.7065	KIF-ERM3.5.BH040_TS.E.G.01-BD-060310(6/3/2010 2:17:00 PM)
Cobalt	9 - 12	75	0.08152	0.1359	0.07609	0.07609	KIF-ERM3.5.BH039_TS.E.G.01-BD-050710(5/7/2010 8:46:00 AM),KIF-ERM3.5.BH044_TS.E.G.01-BD-051210(5/12/2010 11:52:00 AM)
Copper	12 - 12	100	2.011	4.348	–	–	KIF-ERM3.5.BH049_TS.E.G.01-BD-050610(5/6/2010 9:38:00 AM)
Iron	12 - 12	100	92.39	259.8	–	–	KIF-ERM3.5.BH041_TS.E.G.02-BD-051810(5/18/2010 2:46:00 PM)
Lead	0 - 12	0	–	–	0.1359	0.4511	–
Magnesium	12 - 12	100	322.8	581.5	–	–	KIF-ERM3.5.BH039_TS.E.G.01-BD-050710(5/7/2010 8:46:00 AM)
Manganese	12 - 12	100	3.315	9.783	–	–	KIF-ERM3.5.BH042_TS.E.G.01-BD-051110(5/11/2010 10:27:00 AM),KIF-ERM3.5.BH041_TS.E.G.02-BD-051810(5/18/2010 2:46:00 PM)
Mercury	6 - 12	50	0.1522	0.2826	0.1576	0.2391	KIF-ERM3.5.BH049_TS.E.G.02-BD-060310(6/3/2010 2:17:00 PM)
Molybdenum	0 - 12	0	–	–	0.1685	0.1957	–
Nickel	2 - 12	16.7	2.717	6.522	0.4728	0.5435	KIF-ERM3.5.BH039_TS.E.G.01-BD-050710(5/7/2010 8:46:00 AM)
Potassium	12 - 12	100	6739	9130	–	–	KIF-ERM3.5.BH049_TS.E.G.01-BD-050610(5/6/2010 9:38:00 AM)
Selenium	12 - 12	100	2.12	4.185	–	–	KIF-ERM3.5.BH042_TS.E.G.02-BD-051210(5/12/2010 11:52:00 AM)
Silver	0 - 12	0	–	–	0.01413	0.05435	–
Sodium	12 - 12	100	7337	10815	–	–	KIF-ERM3.5.BH036_TS.E.G.01-BD-051810(5/18/2010 2:46:00 PM)
Strontium	12 - 12	100	3.207	7.609	–	–	KIF-ERM3.5.BH039_TS.E.G.01-BD-050710(5/7/2010 8:46:00 AM)
Thallium	0 - 12	0	–	–	0.06522	0.2228	–
Vanadium	0 - 12	0	–	–	0.2391	0.5109	–
Zinc	12 - 12	100	63.59	147.8	–	–	KIF-ERM3.5.BH041_TS.E.G.02-BD-051810(5/18/2010 2:46:00 PM)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-11
Tree Swallow Egg Dataset
Impacted Site - Emory River Mile 3.0 - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 10	0	– – –		134.3	158.2	–
Antimony	0 - 10	0	– – –		0.5327	0.6522	–
Arsenic	0 - 10	0	– – –		0.5327	0.6522	–
Barium	10 - 10	100	3.356	89.22	– – –		KIF-RESIDENTIAL10-TS.E.01-BD-050809(5/8/2009)
Beryllium	0 - 10	0	– – –		0.5327	0.6522	–
Boron	0 - 10	0	– – –		10.76	12.5	–
Cadmium	0 - 10	0	– – –		0.5327	0.6522	–
Calcium	10 - 10	100	2606	7011	– – –		KIF-RESIDENTIAL01-TS.E.01-BD-050809(5/8/2009)
Chromium	0 - 10	0	– – –		0.5327	0.7109	–
Cobalt	0 - 10	0	– – –		0.5327	0.6522	–
Copper	1 - 10	10	3.37	3.37	2.649	3.152	KIF-RESIDENTIAL02-TS.E.01-BD-052809(5/28/2009)
Iron	8 - 10	80	156.1	400.6	134.3	135.8	KIF-RESIDENTIAL04-TS.E.01-BD-050809(5/8/2009)
Lead	0 - 10	0	– – –		0.5327	0.6522	–
Magnesium	3 - 10	30	547.4	750	537.9	559.8	KIF-RESIDENTIAL01-TS.E.01-BD-050809(5/8/2009)
Manganese	10 - 10	100	4.063	11.15	– – –		KIF-RESIDENTIAL10-TS.E.01-BD-050809(5/8/2009)
Mercury	1 - 10	10	0.1745	0.1745	0.1066	0.1957	KIF-RESIDENTIAL07-TS.E.01-BD-050809(5/8/2009)
Molybdenum	0 - 10	0	– – –		5.327	6.522	–
Nickel	0 - 10	0	– – –		0.5327	0.6522	–
Potassium	10 - 10	100	6009	9674	– – –		KIF-RESIDENTIAL02-TS.E.01-BD-052809(5/28/2009)
Selenium	10 - 10	100	2.72	6.995	– – –		KIF-RESIDENTIAL04-TS.E.01-BD-050809(5/8/2009)
Silver	0 - 10	0	– – –		0.2649	0.3152	–
Sodium	10 - 10	100	6739	8302	– – –		KIF-RESIDENTIAL06-TS.E.01-BD-050809(5/8/2009)
Strontium	10 - 10	100	3.853	20.16	– – –		KIF-RESIDENTIAL10-TS.E.01-BD-050809(5/8/2009)
Thallium	0 - 10	0	– – –		0.5327	0.6522	–
Vanadium	0 - 10	0	– – –		1.066	1.25	–
Zinc	10 - 10	100	64.55	192.9	– – –		KIF-RESIDENTIAL01-TS.E.01-BD-050809(5/8/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-12
Tree Swallow Egg Dataset
Impacted Site - Emory River Mile 3.0 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Detected Concentrations (mg/kg dw) Max	Detection Limits (mg/kg dw) Min	Detection Limits (mg/kg dw) Max	Location of Maximum Detection
Aluminum	0 - 25	0	– – –		20.11 - 57.61		–
Antimony	1 - 30	3.33	0.2391 - 0.2391		0.07609 - 0.2065		KIF-ERM3.0.BH297_TS.E.G.02-BD-051210(5/12/2010 1:35:00 PM)
Arsenic	0 - 30	0	– – –		0.1467 - 0.8152		–
Barium	30 - 30	100	1.63 - 26.09		– – –		KIF-ERM3.0.BH310_TS.E.G.04-BD-051210(5/12/2010 1:35:00 PM)
Beryllium	0 - 30	0	– – –		0.1522 - 0.4239		–
Boron	0 - 30	0	– – –		2.12 - 5.978		–
Cadmium	1 - 30	3.33	0.05435 - 0.05435		0.03967 - 0.2609		KIF-ERM3.0.BH300_TS.E.G.01-BD-060310(6/3/2010 12:50:00 PM)
Calcium	30 - 30	100	2527 - 28533		– – –		KIF-ERM3.0.BH026_TS.E.G.04-BD-051810(5/18/2010 3:13:00 PM)
Chromium	4 - 30	13.3	0.7065 - 1.467		0.6522 - 1.848		KIF-ERM3.0.BH310_TS.E.G.04-BD-051210(5/12/2010 1:35:00 PM)
Cobalt	20 - 30	66.7	0.07609 - 0.4076		0.07065 - 0.1902		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)
Copper	30 - 30	100	2.065 - 4.022		– – –		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)
Iron	30 - 30	100	100.5 - 717.4		– – –		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)
Lead	0 - 30	0	– – –		0.1467 - 0.4022		–
Magnesium	29 - 30	96.7	326.1 - 1489		657.6 - 657.6		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)
Manganese	30 - 30	100	2.935 - 31.52		– – –		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)
Mercury	7 - 30	23.3	0.1359 - 0.2609		0.1522 - 0.3696		KIF-ERM3.0.BH310_TS.E.G.04-BD-051210(5/12/2010 1:35:00 PM)
Molybdenum	5 - 30	16.7	0.1957 - 0.2989		0.1793 - 0.5054		KIF-ERM3.0.BH172_TS.E.G.10-BD-050510(5/5/2010 9:54:00 AM)
Nickel	11 - 30	36.7	0.6522 - 33.7		0.4946 - 1.304		KIF-ERM3.0.BH188_TS.E.G.01-BD-050510(5/5/2010 9:54:00 AM)
Potassium	30 - 30	100	6902 - 11033		– – –		KIF-ERM3.0.BH308_TS.E.G.03-BD-051210(5/12/2010 1:35:00 PM)
Selenium	30 - 30	100	2.446 - 13.04		– – –		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)
Silver	2 - 30	6.67	0.025 - 0.04076		0.01467 - 0.04185		KIF-ERM3.0.BH297_TS.E.G.02-BD-051210(5/12/2010 1:35:00 PM)
Sodium	30 - 30	100	8261 - 12446		– – –		KIF-ERM3.0.BH188_TS.E.G.01-BD-050510(5/5/2010 9:54:00 AM)
Strontium	30 - 30	100	3.098 - 33.15		– – –		KIF-ERM3.0.BH026_TS.E.G.04-BD-051810(5/18/2010 3:13:00 PM)
Thallium	0 - 30	0	– – –		0.07065 - 0.1957		–
Vanadium	0 - 30	0	– – –		0.06522 - 1.304		–
Zinc	30 - 30	100	46.74 - 386.4		– – –		KIF-ERM3.0.BH173_TS.E.G.09-BD-050510(5/5/2010 9:54:00 AM)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-13
Tree Swallow Egg Dataset
Impacted Site - Embayments - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 10	0	- - -		20.11	36.41	-
Antimony	0 - 10	0	- - -		0.07065	0.1304	-
Arsenic	0 - 10	0	- - -		0.1467	0.3152	-
Barium	10 - 10	100	1.983	15.76	- - -		KIF-EEMBAY.BH197_TS.E.G.03-BD-050510(5/5/2010 11:11:00 AM)
Beryllium	0 - 10	0	- - -		0.1467	0.5435	-
Boron	0 - 10	0	- - -		2.065	6.359	-
Cadmium	0 - 10	0	- - -		0.01322	0.1413	-
Calcium	10 - 10	100	3098	24565	- - -		KIF-NEMBAY.BH215_TS.E.G.02-BD-050610(5/6/2010 12:02:00 PM)
Chromium	1 - 10	10	0.7065	0.7065	0.6522	1.141	KIF-NEMBAY.BH243_TS.E.G.01-BD-051110(5/11/2010 10:31:00 AM)
Cobalt	7 - 10	70	0.09913	0.1957	0.07609	0.1304	KIF-EEMBAY.BH201_TS.E.G.02-BD-050510(5/5/2010 11:11:00 AM),KIF-EEMBAY.BH202_TS.E.G.01-BD-051110(5/11/2010 11:50:00 AM)
Copper	10 - 10	100	2.12	3.098	- - -		KIF-NEMBAY.BH248_TS.E.G.01-BD-050610(5/6/2010 12:02:00 PM)
Iron	10 - 10	100	111.4	329.3	- - -		KIF-NEMBAY.BH243_TS.E.G.01-BD-051110(5/11/2010 10:31:00 AM)
Lead	0 - 10	0	- - -		0.1413	0.4511	-
Magnesium	10 - 10	100	385.9	880.4	- - -		KIF-EEMBAY.BH197_TS.E.G.03-BD-050510(5/5/2010 11:11:00 AM)
Manganese	10 - 10	100	2.283	20.11	- - -		KIF-EEMBAY.BH201_TS.E.G.02-BD-050510(5/5/2010 11:11:00 AM)
Mercury	6 - 10	60	0.1413	0.2396	0.212	0.288	KIF-EEMBAY.BH208_TS.E.G.01-BD-050510(5/5/2010 11:11:00 AM)
Molybdenum	2 - 10	20	0.212	0.2313	0.1739	0.3207	KIF-EEMBAY.BH208_TS.E.G.01-BD-050510(5/5/2010 11:11:00 AM)
Nickel	4 - 10	40	4.402	34.24	0.5	0.8696	KIF-NEMBAY.BH215_TS.E.G.02-BD-050610(5/6/2010 12:02:00 PM)
Potassium	10 - 10	100	7446	9185	- - -		KIF-WEMBAY.BH272_TS.E.G.02-BD-050610(5/6/2010 1:00:00 PM)
Selenium	10 - 10	100	2.826	5.978	- - -		KIF-NEMBAY.BH243_TS.E.G.01-BD-051110(5/11/2010 10:31:00 AM)
Silver	0 - 10	0	- - -		0.01467	0.04891	-
Sodium	10 - 10	100	8370	11250	- - -		KIF-EEMBAY.BH197_TS.E.G.03-BD-050510(5/5/2010 11:11:00 AM)
Strontium	10 - 10	100	3.47	20.11	- - -		KIF-NEMBAY.BH215_TS.E.G.02-BD-050610(5/6/2010 12:02:00 PM)
Thallium	1 - 10	10	0.07065	0.07065	0.07065	0.2065	KIF-WEMBAY.BH268_TS.E.G.01-BD-050610(5/6/2010 1:00:00 PM)
Vanadium	0 - 10	0	- - -		0.2337	0.5054	-
Zinc	10 - 10	100	64.67	174.5	- - -		KIF-EEMBAY.BH197_TS.E.G.03-BD-050510(5/5/2010 11:11:00 AM)

Note: Embayments include samples from East, West, and North Embayments.

- - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-14
Tree Swallow Egg Dataset
Positive Control - Melton Hill Dam - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 16	0	– – –		134.9	407.1	–
Antimony	0 - 16	0	– – –		0.5353	1.63	–
Arsenic	0 - 16	0	– – –		0.5353	1.63	–
Barium	16 - 16	100	1.959	19.02	– – –		KIF-MHD02-TS.E.01-BD-060409(6/4/2009)
Beryllium	0 - 16	0	– – –		0.5353	1.63	–
Boron	0 - 16	0	– – –		10.78	32.61	–
Cadmium	0 - 16	0	– – –		0.5353	1.63	–
Calcium	16 - 16	100	2016	31317	– – –		KIF-MHD.CONTROL18-TS.E.01-BD-050809(5/8/2009)
Chromium	0 - 16	0	– – –		0.5353	1.63	–
Cobalt	0 - 16	0	– – –		0.5353	1.63	–
Copper	6 - 16	37.5	3.083	19.02	2.671	8.152	KIF-MHD24-TS.E.01-BD-061409(6/14/2009)
Iron	10 - 16	62.5	138.3	397.8	135.7	407.1	KIF-MHD.CONTROL18-TS.E.01-AD-050809(5/8/2009)
Lead	0 - 16	0	– – –		0.5353	1.63	–
Magnesium	3 - 16	18.8	587	766.3	540.1	1625	KIF-MHD.CONTROL18-TS.E.01-AD-050809(5/8/2009)
Manganese	13 - 16	81.3	4.022	14.24	2.685	8.152	KIF-MHD11-TS.E.02-BD-060109(6/1/2009)
Mercury	1 - 16	6.25	0.2228	0.2228	0.1071	0.3261	KIF-MHD17-TS.E.01-BD-061409(6/14/2009)
Molybdenum	0 - 16	0	– – –		5.353	16.3	–
Nickel	0 - 16	0	– – –		0.5353	1.63	–
Potassium	16 - 16	100	5924	10652	– – –		KIF-MHD03-TS.E.01-BD-060409(6/4/2009)
Selenium	15 - 16	93.8	2.275	5.978	3.261	3.261	KIF-MHD24-TS.E.01-BD-061409(6/14/2009)
Silver	0 - 16	0	– – –		0.2671	0.8152	–
Sodium	16 - 16	100	5924	13750	– – –		KIF-MHD03-TS.E.01-BD-060409(6/4/2009)
Strontium	16 - 16	100	2.228	19.95	– – –		KIF-MHD.CONTROL18-TS.E.01-BD-050809(5/8/2009)
Thallium	0 - 16	0	– – –		0.5353	1.63	–
Vanadium	0 - 16	0	– – –		1.071	3.261	–
Zinc	16 - 16	100	42.39	198.4	– – –		KIF-MHD.CONTROL18-TS.E.01-AD-050809(5/8/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table A-15
Tree Swallow Egg Dataset
Positive Control - Melton Hill Dam - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a] number of detects / number of samples	FOD %	Detected Concentrations (mg/kg dw) Min	Max	Detection Limits (mg/kg dw) Min	Max	Location of Maximum Detection
Aluminum	0 - 16	0	- - -		19.57	53.26	-
Antimony	0 - 16	0	- - -		0.07065	0.1957	-
Arsenic	0 - 16	0	- - -		0.1359	0.375	-
Barium	16 - 16	100	1.957	35.87	- - -		KIF-MHD.BH087_TS.E.G.01-BD-050510(5/5/2010 1:24:00 PM)
Beryllium	0 - 16	0	- - -		0.1576	0.8152	-
Boron	0 - 16	0	- - -		2.011	5.435	-
Cadmium	0 - 16	0	- - -		0.04076	0.2065	-
Calcium	16 - 16	100	2141	26304	- - -		KIF-MHD.BH059_TS.E.G.04-BD-050410(5/4/2010 9:58:00 AM)
Chromium	0 - 16	0	- - -		0.5978	1.685	-
Cobalt	10 - 16	62.5	0.09783	0.4076	0.07065	0.1902	KIF-MHD.BH061_TS.E.G.06-BD-050410(5/4/2010 9:58:00 AM)
Copper	16 - 16	100	1.902	3.315	- - -		KIF-MHD.BH063_TS.E.G.07-BD-050410(5/4/2010 9:58:00 AM)
Iron	16 - 16	100	80.98	443.5	- - -		KIF-MHD.BH063_TS.E.G.07-BD-050410(5/4/2010 9:58:00 AM)
Lead	1 - 16	6.25	0.375	0.375	0.1359	0.3696	KIF-MHD.BH079_TS.E.G.10-BD-050410(5/4/2010 9:58:00 AM)
Magnesium	16 - 16	100	311.4	1168	- - -		KIF-MHD.BH063_TS.E.G.07-BD-050410(5/4/2010 9:58:00 AM)
Manganese	10 - 16	62.5	5.217	26.09	2.717	5.435	KIF-MHD.BH061_TS.E.G.06-BD-050410(5/4/2010 9:58:00 AM)
Mercury	11 - 16	68.8	0.09239	0.1522	0.09783	0.1848	KIF-MHD.BH056_TS.E.G.03-BD-050410(5/4/2010 9:58:00 AM),KIF-MHD.BH074_TS.E.G.09-BD-050410(5/4/2010 9:58:00 AM)
Molybdenum	0 - 16	0	- - -		0.1685	0.4674	-
Nickel	2 - 16	12.5	7.609	8.152	0.4728	1.304	KIF-MHD.BH064_TS.E.G.01-BD-050810(5/8/2010 8:34:00 AM)
Potassium	16 - 16	100	7011	9674	- - -		KIF-MHD.BH087_TS.E.G.01-BD-050510(5/5/2010 1:24:00 PM)
Selenium	16 - 16	100	2.609	8.152	- - -		KIF-MHD.BH061_TS.E.G.06-BD-050410(5/4/2010 9:58:00 AM)
Silver	0 - 16	0	- - -		0.01576	0.1304	-
Sodium	16 - 16	100	7663	11685	- - -		KIF-MHD.BH087_TS.E.G.01-BD-050510(5/5/2010 1:24:00 PM)
Strontium	16 - 16	100	2.065	15.76	- - -		KIF-MHD.BH059_TS.E.G.04-BD-050410(5/4/2010 9:58:00 AM)
Thallium	0 - 16	0	- - -		0.06522	0.1848	-
Vanadium	0 - 16	0	- - -		0.2228	0.5978	-
Zinc	16 - 16	100	56.52	297.8	- - -		KIF-MHD.BH063_TS.E.G.07-BD-050410(5/4/2010 9:58:00 AM)

- - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

ARCADIS

Appendix B

Tree Swallow Eggshell
Occurrence Tables

Table B-1
Tree Swallow Eggshells Dataset
Reference Site - Composite Reference - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	4	0	–	–	8.144	17.22	–
Antimony	0	-	4	0	–	–	0.0299	0.06186	–
Arsenic	1	-	4	25	0.06907	0.06907	0.1753	0.2371	KIF-FLD.BH097_TS.V.G.04-BD-050410(5/4/2010)
Barium	4	-	4	100	8.866	16.7	–	–	KIF-TLD.BH119_TS.V.G.05-BD-050410(5/4/2010)
Beryllium	0	-	4	0	–	–	0.1237	0.2577	–
Boron	0	-	4	0	–	–	0.8454	1.753	–
Cadmium	0	-	4	0	–	–	0.03093	0.06701	–
Calcium	4	-	4	100	95464	186598	–	–	KIF-TLD.BH119_TS.V.G.05-BD-050410(5/4/2010)
Chromium	1	-	4	25	0.7938	0.7938	0.2577	0.5464	KIF-TLD.BH120_TS.V.G.04-BD-050410(5/4/2010)
Cobalt	0	-	4	0	–	–	0.02887	0.06082	–
Copper	4	-	4	100	0.7423	2.165	–	–	KIF-TLD.BH119_TS.V.G.05-BD-050410(5/4/2010)
Iron	1	-	4	25	33.09	33.09	36.8	51.96	KIF-FLD.BH097_TS.V.G.04-BD-050410(5/4/2010)
Lead	0	-	4	0	–	–	0.0567	0.1237	–
Magnesium	4	-	4	100	429.9	742.3	–	–	KIF-TLD.BH119_TS.V.G.05-BD-050410(5/4/2010)
Manganese	4	-	4	100	0.8247	1.959	–	–	KIF-FLD.BH097_TS.V.G.01-BD-051110(5/11/2010)
Mercury	0	-	4	0	–	–	0.02371	0.04948	–
Molybdenum	0	-	4	0	–	–	0.07113	0.1546	–
Nickel	1	-	4	25	0.3918	0.3918	0.1959	0.4227	KIF-TLD.BH120_TS.V.G.04-BD-050410(5/4/2010)
Potassium	0	-	4	0	–	–	1474	3113	–
Selenium	4	-	4	100	0.3918	0.6289	–	–	KIF-FLD.BH097_TS.V.G.04-BD-050410(5/4/2010)
Silver	0	-	4	0	–	–	0.005876	0.01237	–
Sodium	4	-	4	100	1371	2124	–	–	KIF-TLD.BH119_TS.V.G.05-BD-050410(5/4/2010)
Strontium	4	-	4	100	58.76	86.19	–	–	KIF-TLD.BH119_TS.V.G.05-BD-050410(5/4/2010)
Thallium	0	-	4	0	–	–	0.02784	0.05979	–
Vanadium	0	-	4	0	–	–	0.1856	0.3918	–
Zinc	3	-	4	75	8.66	18.25	9.381	9.381	KIF-FLD.BH097_TS.V.G.01-BD-051110(5/11/2010)

Note: Composite Reference Site made up of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table B-2
Tree Swallow Eggshells Dataset
Impacted Site - Tennessee River Mile 566 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations		Detection Limits		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	(mg/kg dw)		(mg/kg dw)		
					Min	Max	Min	Max	
Aluminum	0	-	2	0	–	–	10.62	14.85	–
Antimony	0	-	2	0	–	–	0.03814	0.05361	–
Arsenic	1	-	2	50	0.1031	0.1031	0.1443	0.1443	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)
Barium	2	-	2	100	41.24	100.2	–	–	KIF-TRM566.0.BH464_TS.V.G.03-BD-051110(5/11/2010)
Beryllium	0	-	2	0	–	–	0.1546	0.2268	–
Boron	0	-	2	0	–	–	1.134	1.546	–
Cadmium	0	-	2	0	–	–	0.04124	0.05773	–
Calcium	2	-	2	100	165979	174227	–	–	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)
Chromium	0	-	2	0	–	–	0.3402	0.4742	–
Cobalt	0	-	2	0	–	–	0.03711	0.05258	–
Copper	2	-	2	100	1.134	1.34	–	–	KIF-TRM566.0.BH464_TS.V.G.03-BD-051110(5/11/2010)
Iron	0	-	2	0	–	–	31.86	44.74	–
Lead	0	-	2	0	–	–	0.07423	0.1031	–
Magnesium	2	-	2	100	653.6	668	–	–	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)
Manganese	2	-	2	100	1.237	2.268	–	–	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)
Mercury	0	-	2	0	–	–	0.03093	0.0433	–
Molybdenum	0	-	2	0	–	–	0.09278	0.134	–
Nickel	0	-	2	0	–	–	0.2577	0.3608	–
Potassium	0	-	2	0	–	–	1918	2680	–
Selenium	2	-	2	100	0.268	0.4124	–	–	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)
Silver	0	-	2	0	–	–	0.007629	0.01031	–
Sodium	2	-	2	100	1309	1588	–	–	KIF-TRM566.0.BH464_TS.V.G.03-BD-051110(5/11/2010)
Strontium	2	-	2	100	123.7	126.8	–	–	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)
Thallium	0	-	2	0	–	–	0.03608	0.05155	–
Vanadium	0	-	2	0	–	–	0.2371	0.3402	–
Zinc	1	-	2	50	10.31	10.31	5.773	5.773	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110(5/11/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table B-3
Tree Swallow Eggshells Dataset
Impacted Site - Emory River Mile 3.0 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	7	0	–	–	6.289	13.61	–
Antimony	0	-	7	0	–	–	0.02268	0.04948	–
Arsenic	5	-	7	71.4	0.0567	0.09588	0.1134	0.1546	KIF-ERM3.0.BH178_TS.V.G.06-BD-050510(5/5/2010)
Barium	7	-	7	100	5.258	22.68	–	–	KIF-ERM3.0.BH178_TS.V.G.06-BD-050510(5/5/2010)
Beryllium	0	-	7	0	–	–	0.09381	0.2062	–
Boron	0	-	7	0	–	–	0.6495	1.443	–
Cadmium	0	-	7	0	–	–	0.02474	0.05258	–
Calcium	7	-	7	100	101443	196907	–	–	KIF-ERM3.0.BH178_TS.V.G.06-BD-050510(5/5/2010)
Chromium	0	-	7	0	–	–	0.1959	0.433	–
Cobalt	0	-	7	0	–	–	0.02268	0.04742	–
Copper	7	-	7	100	0.8247	1.237	–	–	KIF-ERM3.0.BH293_TS.V.G.01-BD-051210(5/12/2010)
Iron	0	-	7	0	–	–	18.97	41.03	–
Lead	0	-	7	0	–	–	0.04433	0.09485	–
Magnesium	7	-	7	100	363.9	712.4	–	–	KIF-ERM3.0.BH178_TS.V.G.06-BD-050510(5/5/2010)
Manganese	7	-	7	100	0.2887	1.443	–	–	KIF-ERM3.0.BH178_TS.V.G.06-BD-050510(5/5/2010)
Mercury	5	-	7	71.4	0.02784	0.04124	0.02887	0.03918	KIF-ERM3.0.BH293_TS.V.G.01-BD-051210(5/12/2010)
Molybdenum	0	-	7	0	–	–	0.05567	0.1237	–
Nickel	0	-	7	0	–	–	0.1546	0.3299	–
Potassium	2	-	7	28.6	1340	1402	1485	2464	KIF-ERM3.0.BH173_TS.V.G.09-BD-050510(5/5/2010)
Selenium	7	-	7	100	0.2887	0.5979	–	–	KIF-ERM3.0.BH293_TS.V.G.01-BD-051210(5/12/2010)
Silver	0	-	7	0	–	–	0.004536	0.009897	–
Sodium	7	-	7	100	1247	1598	–	–	KIF-ERM3.0.BH173_TS.V.G.09-BD-050510(5/5/2010)
Strontium	7	-	7	100	62.16	147.4	–	–	KIF-ERM3.0.BH172_TS.V.G.10-BD-050510(5/5/2010)
Thallium	0	-	7	0	–	–	0.0268	0.05979	–
Vanadium	0	-	7	0	–	–	0.1443	0.3093	–
Zinc	0	-	7	0	–	–	3.402	7.423	–

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table B-4
Tree Swallow Eggshells Dataset
Impacted Site - Embayments - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	4	0	–	–	11.65	18.97	–
Antimony	0	-	4	0	–	–	0.04227	0.06804	–
Arsenic	2	-	4	50	0.09588	0.1031	0.1856	0.268	KIF-WEMBAY.BH268_TS.V.G.01-BD-050610(5/6/2010)
Barium	4	-	4	100	9.072	38.56	–	–	KIF-WEMBAY.BH268_TS.V.G.01-BD-050610(5/6/2010)
Beryllium	0	-	4	0	–	–	0.1753	0.2784	–
Boron	0	-	4	0	–	–	1.237	1.959	–
Cadmium	0	-	4	0	–	–	0.04433	0.0732	–
Calcium	4	-	4	100	151546	208247	–	–	KIF-WEMBAY.BH268_TS.V.G.01-BD-050610(5/6/2010)
Chromium	0	-	4	0	–	–	0.3711	0.5979	–
Cobalt	0	-	4	0	–	–	0.04124	0.06701	–
Copper	4	-	4	100	0.7526	1.443	–	–	KIF-NEMBAY.BH243_TS.V.G.01-BD-051110(5/11/2010)
Iron	0	-	4	0	–	–	35.05	57.01	–
Lead	0	-	4	0	–	–	0.08144	0.134	–
Magnesium	4	-	4	100	584.5	826.8	–	–	KIF-NEMBAY.BH243_TS.V.G.01-BD-051110(5/11/2010)
Manganese	3	-	4	75	0.8866	1.649	0.8041	0.8041	KIF-EEMBAY.BH197_TS.V.G.03-BD-050510(5/5/2010)
Mercury	0	-	4	0	–	–	0.03402	0.05464	–
Molybdenum	0	-	4	0	–	–	0.1021	0.1649	–
Nickel	0	-	4	0	–	–	0.2887	0.4639	–
Potassium	0	-	4	0	–	–	2103	3423	–
Selenium	3	-	4	75	0.3505	0.4536	–	–	KIF-EEMBAY.BH208_TS.V.G.01-BD-050510(5/5/2010)
Silver	0	-	4	0	–	–	0.008454	0.0134	–
Sodium	4	-	4	100	1443	1701	–	–	KIF-NEMBAY.BH243_TS.V.G.01-BD-051110(5/11/2010)
Strontium	4	-	4	100	87.11	176.3	–	–	KIF-WEMBAY.BH268_TS.V.G.01-BD-050610(5/6/2010)
Thallium	0	-	4	0	–	–	0.04536	0.1443	–
Vanadium	0	-	4	0	–	–	0.268	0.433	–
Zinc	0	-	4	0	–	–	6.289	10.31	–

Note: Embayment site made up of samples from the East, West, and North Embayments.

– - Not detected/ not analyzed/ not applicable.

mg/kg dw - Milligram per kilogram dry weight.

[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table B-5
Tree Swallow Eggshells Dataset
Positive Control - Melton Hill Dam - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	3	0	–	–	7.835	10.62	–
Antimony	0	-	3	0	–	–	0.02784	0.03814	–
Arsenic	2	-	3	66.7	0.08351	0.0866	0.1134	0.1134	KIF-MHD.BH061_TS.V.G.06-BD-050410(5/4/2010)
Barium	3	-	3	100	8.763	32.16	–	–	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)
Beryllium	0	-	3	0	–	–	0.1134	0.1546	–
Boron	0	-	3	0	–	–	0.8144	1.134	–
Cadmium	0	-	3	0	–	–	0.0299	0.04124	–
Calcium	3	-	3	100	104124	149485	–	–	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)
Chromium	0	-	3	0	–	–	0.2474	0.3402	–
Cobalt	0	-	3	0	–	–	0.02784	0.03711	–
Copper	3	-	3	100	0.7113	1.237	–	–	KIF-MHD.BH063_TS.V.G.07-BD-050410(5/4/2010)
Iron	0	-	3	0	–	–	23.61	31.86	–
Lead	0	-	3	0	–	–	0.05464	0.07423	–
Magnesium	3	-	3	100	424.7	548.5	–	–	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)
Manganese	3	-	3	100	0.4845	1.959	–	–	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)
Mercury	1	-	3	33.3	0.02577	0.02577	0.0268	0.03093	KIF-MHD.BH063_TS.V.G.07-BD-050410(5/4/2010)
Molybdenum	0	-	3	0	–	–	0.06907	0.09278	–
Nickel	0	-	3	0	–	–	0.1959	0.2577	–
Potassium	1	-	3	33.3	1423	1423	1660	1918	KIF-MHD.BH063_TS.V.G.07-BD-050410(5/4/2010)
Selenium	3	-	3	100	0.3402	0.5979	–	–	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)
Silver	0	-	3	0	–	–	0.00567	0.007629	–
Sodium	3	-	3	100	1299	1567	–	–	KIF-MHD.BH063_TS.V.G.07-BD-050410(5/4/2010)
Strontium	3	-	3	100	52.89	80.41	–	–	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)
Thallium	0	-	3	0	–	–	0.03093	0.05258	–
Vanadium	0	-	3	0	–	–	0.1753	0.2371	–
Zinc	1	-	3	33.3	10.21	10.21	4.227	5.773	KIF-MHD.BH079_TS.V.G.10-BD-050410(5/4/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

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Appendix C

Tree Swallow Nestling Occurrence Tables

Table C-1
Tree Swallow Nestling Dataset
Reference Site - Fort Loudoun Dam - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]			Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	3	0	–	–	67.9	78	–
Antimony	0	-	3	0	–	–	0.27	0.31	–
Arsenic	0	-	3	0	–	–	0.27	0.31	–
Barium	3	-	3	100	1.4	6.9	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Beryllium	0	-	3	0	–	–	0.27	0.31	–
Boron	0	-	3	0	–	–	5.4	6.2	–
Cadmium	0	-	3	0	–	–	0.27	0.31	–
Calcium	3	-	3	100	11300	22500	–	–	KIF-FLD18-TS.N.01-BD-060109(6/1/2009)
Chromium	0	-	3	0	–	–	0.33	0.37	–
Cobalt	0	-	3	0	–	–	0.27	0.31	–
Copper	3	-	3	100	6.1	11.7	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Iron	3	-	3	100	177	254	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Lead	0	-	3	0	–	–	0.27	0.31	–
Magnesium	3	-	3	100	651	985	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Manganese	3	-	3	100	2.5	7	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Mercury	0	-	3	0	–	–	0.054	0.062	–
Molybdenum	0	-	3	0	–	–	2.7	3.1	–
Nickel	0	-	3	0	–	–	0.3	0.59	–
Potassium	3	-	3	100	5170	8110	–	–	KIF-FLD18-TS.N.01-BD-060109(6/1/2009)
Selenium	3	-	3	100	1.8	4.9	–	–	KIF-FLD18-TS.N.01-BD-060109(6/1/2009)
Silver	0	-	3	0	–	–	0.14	0.16	–
Sodium	3	-	3	100	2840	3730	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Strontium	3	-	3	100	5.9	15	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)
Thallium	0	-	3	0	–	–	0.27	0.31	–
Vanadium	0	-	3	0	–	–	0.54	0.62	–
Zinc	3	-	3	100	76.1	106	–	–	KIF-FLD02-TS.N.01-BD-062109(6/21/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-2
Tree Swallow Nestling Dataset
Reference Site - Fort Loudoun Dam - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	10	0	–	–	10.2	14.7	–
Antimony	0	-	10	0	–	–	0.037	0.053	–
Arsenic	0	-	10	0	–	–	0.072	0.2	–
Barium	10	-	10	100	0.87	9.8	–	–	KIF-FLD.BH089_TS.N.G.01-BD-060110(6/1/2010)
Beryllium	0	-	10	0	–	–	0.075	0.11	–
Boron	0	-	10	0	–	–	1.1	1.5	–
Cadmium	7	-	10	70	0.03	0.067	0.039	0.046	KIF-FLD.BH110_TS.N.G.01-BD-060510(6/5/2010)
Calcium	10	-	10	100	8890	30800	–	–	KIF-FLD.BH089_TS.N.G.01-BD-060110(6/1/2010)
Chromium	0	-	10	0	–	–	0.32	0.919	–
Cobalt	0	-	10	0	–	–	0.036	0.052	–
Copper	10	-	10	100	5.8	8.1	–	–	KIF-FLD.BH.092_TS.N.G.01-BD-053110(5/31/2010),KIF-FLD.BH098_TS.N.G.01-BD-071210(7/12/2010)
Iron	10	-	10	100	183	399	–	–	KIF-FLD.BH098_TS.N.G.01-BD-071210(7/12/2010)
Lead	2	-	10	20	0.08	2.7	0.076	0.1	KIF-FLD.BH109_TS.N.G.01-BD-052810(5/28/2010)
Magnesium	10	-	10	100	700	1290	–	–	KIF-FLD.BH089_TS.N.G.01-BD-060110(6/1/2010)
Manganese	10	-	10	100	2.5	5.6	–	–	KIF-FLD.BH098_TS.N.G.01-BD-071210(7/12/2010)
Mercury	3	-	10	30	0.034	0.047	0.03	0.042	KIF-FLD.BH.092_TS.N.G.01-BD-053110(5/31/2010)
Molybdenum	9	-	10	90	0.15	0.32	0.19	0.19	KIF-FLD.BH.092_TS.N.G.01-BD-053110(5/31/2010)
Nickel	0	-	10	0	–	–	0.25	0.707	–
Potassium	10	-	10	100	7340	11400	–	–	KIF-FLD.BH098_TS.N.G.01-BD-071210(7/12/2010)
Selenium	10	-	10	100	1.9	4.8	–	–	KIF-FLD.BH.092_TS.N.G.01-BD-053110(5/31/2010)
Silver	2	-	10	20	0.0084	0.012	0.0076	0.035	KIF-FLD.BH103_TS.N.G.01-BD-070610(7/6/2010)
Sodium	10	-	10	100	3770	6380	–	–	KIF-FLD.BH098_TS.N.G.01-BD-071210(7/12/2010)
Strontium	10	-	10	100	3.8	12.8	–	–	KIF-FLD.BH089_TS.N.G.01-BD-060110(6/1/2010)
Thallium	0	-	10	0	–	–	0.035	0.051	–
Vanadium	0	-	10	0	–	–	0.12	0.33	–
Zinc	10	-	10	100	64.5	113	–	–	KIF-FLD.BH098_TS.N.G.01-BD-071210(7/12/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-3
Tree Swallow Nestling Dataset
Impacted Site - Clinch River Mile 2.5 - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	12	0	–	–	60.1	124.2	–
Antimony	0	-	12	0	–	–	0.24	0.4848	–
Arsenic	0	-	12	0	–	–	0.24	0.4848	–
Barium	12	-	12	100	1.2	23.33	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Beryllium	0	-	12	0	–	–	0.24	0.4848	–
Boron	0	-	12	0	–	–	4.8	10	–
Cadmium	0	-	12	0	–	–	0.24	0.4848	–
Calcium	12	-	12	100	5740	90303	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Chromium	0	-	12	0	–	–	0.25	0.69	–
Cobalt	1	-	12	8.33	0.86	0.86	0.25	0.4848	KIF-DISCHARGE05-TS.N.02-BD-071209(7/12/2009)
Copper	12	-	12	100	5.3	11.7	–	–	KIF-DISCHARGE10-TS.N.01-BD-070609(7/6/2009)
Iron	12	-	12	100	137	264.5	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Lead	0	-	12	0	–	–	0.24	0.4848	–
Magnesium	12	-	12	100	590	1350	–	–	KIF-DISCHARGE06-TS.N.01-BD-060109(6/1/2009)
Manganese	12	-	12	100	1.7	17.27	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Mercury	6	-	12	50	0.057	0.2303	0.053	0.079	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Molybdenum	0	-	12	0	–	–	2.4	4.848	–
Nickel	1	-	12	8.33	1.2	1.2	0.25	0.4848	KIF-DISCHARGE06-TS.N.01-BD-060109(6/1/2009)
Potassium	12	-	12	100	4730	16576	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Selenium	12	-	12	100	2.5	6.667	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Silver	0	-	12	0	–	–	0.12	0.2485	–
Sodium	12	-	12	100	2730	19303	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Strontium	12	-	12	100	3.8	50.61	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)
Thallium	0	-	12	0	–	–	0.24	0.4848	–
Vanadium	0	-	12	0	–	–	0.48	1	–
Zinc	12	-	12	100	69.3	149.1	–	–	KIF-DISCHARGE03-TS.N.01-BD-060409(6/4/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-4
Tree Swallow Nestling Dataset
Impacted Site - Clinch River Mile 2.5 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	15	0	–	–	11	15.3	–
Antimony	0	-	15	0	–	–	0.04	0.055	–
Arsenic	0	-	15	0	–	–	0.077	0.21	–
Barium	15	-	15	100	2.9	7.6	–	–	KIF-CRM2.5.BH332_TS.N.G.03-BD-060110(6/1/2010)
Beryllium	0	-	15	0	–	–	0.081	0.175	–
Boron	0	-	15	0	–	–	1.1	1.6	–
Cadmium	13	-	15	86.7	0.031	0.093	0.022	0.044	KIF-CRM2.5.BH338_TS.N.G.04-BD-053110(5/31/2010)
Calcium	15	-	15	100	9810	24500	–	–	KIF-CRM2.5.BH332_TS.N.G.03-BD-060110(6/1/2010)
Chromium	3	-	15	20	0.57	4.1	0.35	0.46	KIF-CRM2.5.BH328_TS.N.G.02-BD-052810(5/28/2010)
Cobalt	1	-	15	6.67	0.05	0.05	0.039	0.054	KIF-CRM2.5.BH327_TS.N.G.01-BD-053110(5/31/2010)
Copper	15	-	15	100	6.2	11.4	–	–	KIF-CRM2.5.BH328_TS.N.G.02-BD-052810(5/28/2010)
Iron	15	-	15	100	132	327	–	–	KIF-CRM2.5.BH336_TS.N.G.03-BD-053110(5/31/2010)
Lead	2	-	15	13.3	0.096	0.31	0.077	0.11	KIF-CRM2.5.BH325_TS.N.G.01-BD-052810(5/28/2010)
Magnesium	15	-	15	100	827	1170	–	–	KIF-CRM2.5.BH332_TS.N.G.03-BD-060110(6/1/2010)
Manganese	15	-	15	100	2	9.6	–	–	KIF-CRM2.5.BH332_TS.N.G.03-BD-060110(6/1/2010)
Mercury	15	-	15	100	0.064	0.15	–	–	KIF-CRM2.5.BH327_TS.N.G.01-BD-053110(5/31/2010)
Molybdenum	14	-	15	93.3	0.11	0.31	0.21	0.21	KIF-CRM2.5.BH328_TS.N.G.02-BD-052810(5/28/2010)
Nickel	2	-	15	13.3	0.6	0.77	0.27	0.37	KIF-CRM2.5.BH328_TS.N.G.02-BD-052810(5/28/2010)
Potassium	15	-	15	100	7100	9370	–	–	KIF-CRM2.5.BH350_TS.N.G.01-BD-060210(6/2/2010)
Selenium	15	-	15	100	2.2	3.7	–	–	KIF-CRM2.5.BH327_TS.N.G.01-BD-053110(5/31/2010)
Silver	1	-	15	6.67	0.0097	0.0097	0.008	0.011	KIF-CRM2.5.BH325_TS.N.G.01-BD-052810(5/28/2010)
Sodium	15	-	15	100	3680	6380	–	–	KIF-CRM2.5.BH336_TS.N.G.03-BD-053110(5/31/2010)
Strontium	15	-	15	100	5.6	17.7	–	–	KIF-CRM2.5.BH332_TS.N.G.03-BD-060110(6/1/2010)
Thallium	0	-	15	0	–	–	0.038	0.07	–
Vanadium	0	-	15	0	–	–	0.13	0.17	–
Zinc	15	-	15	100	82	161	–	–	KIF-CRM2.5.BH336_TS.N.G.03-BD-053110(5/31/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-5
Tree Swallow Nestling Dataset
Impacted Site - Emory River Mile 3.5 - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	11	0	–	–	62	89.1	–
Antimony	0	-	11	0	–	–	0.25	0.36	–
Arsenic	0	-	11	0	–	–	0.25	0.36	–
Barium	11	-	11	100	0.45	11.7	–	–	KIF-FARM08-TS.N.01-BD-060109(6/1/2009)
Beryllium	0	-	11	0	–	–	0.25	0.36	–
Boron	0	-	11	0	–	–	5	7.1	–
Cadmium	0	-	11	0	–	–	0.25	0.36	–
Calcium	11	-	11	100	3920	24800	–	–	KIF-FARM08-TS.N.01-BD-060109(6/1/2009)
Chromium	1	-	11	9.09	0.48	0.48	0.27	0.83	KIF-FARM02-TS.N.01-BD-060809(6/8/2009)
Cobalt	0	-	11	0	–	–	0.25	0.36	–
Copper	11	-	11	100	5.5	10.8	–	–	KIF-FARM10-TS.N.01-BD-060109(6/1/2009)
Iron	11	-	11	100	167	264	–	–	KIF-FARM10-TS.N.01-BD-060109(6/1/2009)
Lead	0	-	11	0	–	–	0.25	0.36	–
Magnesium	11	-	11	100	510	1150	–	–	KIF-FARM07-TS.N.01-BD-060409(6/4/2009)
Manganese	8	-	11	72.7	1.8	6.1	1.6	6.4	KIF-FARM10-TS.N.01-BD-060109(6/1/2009)
Mercury	1	-	11	9.09	0.061	0.061	0.07	0.11	KIF-FARM05-TS.N.01-BD-072409(7/24/2009)
Molybdenum	0	-	11	0	–	–	2.5	3.6	–
Nickel	1	-	11	9.09	1.8	1.8	0.25	0.36	KIF-FARM10-TS.N.01-BD-060109(6/1/2009)
Potassium	11	-	11	100	4960	9090	–	–	KIF-FARM10-TS.N.01-BD-060109(6/1/2009)
Selenium	11	-	11	100	2.3	4.1	–	–	KIF-FARM07-TS.N.01-BD-060409(6/4/2009)
Silver	0	-	11	0	–	–	0.12	0.18	–
Sodium	11	-	11	100	2310	4930	–	–	KIF-FARM07-TS.N.01-BD-060409(6/4/2009)
Strontium	11	-	11	100	2	19.1	–	–	KIF-FARM08-TS.N.01-BD-060109(6/1/2009)
Thallium	0	-	11	0	–	–	0.25	0.36	–
Vanadium	0	-	11	0	–	–	0.5	0.71	–
Zinc	11	-	11	100	54.7	123	–	–	KIF-FARM07-TS.N.01-BD-060409(6/4/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-6
Tree Swallow Nestling Dataset
Impacted Site - Emory River Mile 3.5 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	10	0	–	–	11.2	14.6	–
Antimony	0	-	10	0	–	–	0.04	0.053	–
Arsenic	3	-	10	30	0.089	0.12	0.079	0.2	KIF-ERM3.5.BH041_TS.N.G.01-BD-061510(6/15/2010)
Barium	10	-	10	100	1.6	6.2	–	–	KIF-ERM3.5.BH050_TS.N.G.01-BD-052810(5/28/2010)
Beryllium	0	-	10	0	–	–	0.083	0.11	–
Boron	0	-	10	0	–	–	1.2	1.5	–
Cadmium	9	-	10	90	0.027	0.17	0.049	0.049	KIF-ERM3.5.BH037_TS.N.G.02-BD-061310(6/13/2010)
Calcium	10	-	10	100	9600	42600	–	–	KIF-ERM3.5.BH039_TS.N.G.01-BD-060610(6/6/2010)
Chromium	3	-	10	30	0.46	0.99	0.36	0.46	KIF-ERM3.5.BH049.TS.N.G.01-BD-062810(6/28/2010)
Cobalt	0	-	10	0	–	–	0.039	0.052	–
Copper	10	-	10	100	5.9	11.2	–	–	KIF-ERM3.5.BH049.TS.N.G.01-BD-062810(6/28/2010)
Iron	10	-	10	100	162	267	–	–	KIF-ERM3.5.BH040_TS.N.G.01-BD-062510(6/25/2010)
Lead	1	-	10	10	0.12	0.12	0.078	0.1	KIF-ERM3.5.BH036_TS.N.G.01-BD-061310(6/13/2010)
Magnesium	10	-	10	100	833	1540	–	–	KIF-ERM3.5.BH042_TS.N.G.01-BD-060910(6/9/2010)
Manganese	10	-	10	100	2.1	14.7	–	–	KIF-ERM3.5.BH036_TS.N.G.01-BD-061310(6/13/2010)
Mercury	10	-	10	100	0.064	0.12	–	–	KIF-ERM3.5.BH042_TS.N.G.01-BD-060910(6/9/2010),KIF-ERM3.5.BH037_TS.N.G.02-BD-061310(6/13/2010)
Molybdenum	10	-	10	100	0.15	0.28	–	–	KIF-ERM3.5.BH040_TS.N.G.01-BD-062510(6/25/2010)
Nickel	2	-	10	20	0.43	0.54	0.27	0.36	KIF-ERM3.5.BH049.TS.N.G.01-BD-062810(6/28/2010)
Potassium	10	-	10	100	7760	10400	–	–	KIF-ERM3.5.BH042_TS.N.G.01-BD-060910(6/9/2010)
Selenium	10	-	10	100	2.6	4.3	–	–	KIF-ERM3.5.BH049.TS.N.G.01-BD-062810(6/28/2010)
Silver	2	-	10	20	0.017	0.042	0.0085	0.023	KIF-ERM3.5.BH036_TS.N.G.01-BD-061310(6/13/2010)
Sodium	10	-	10	100	3860	5900	–	–	KIF-ERM3.5.BH042_TS.N.G.01-BD-060910(6/9/2010)
Strontium	10	-	10	100	7.3	17.4	–	–	KIF-ERM3.5.BH050_TS.N.G.01-BD-052810(5/28/2010)
Thallium	0	-	10	0	–	–	0.041	0.05	–
Vanadium	1	-	10	10	0.17	0.17	0.13	0.33	KIF-ERM3.5.BH049.TS.N.G.01-BD-062810(6/28/2010)
Zinc	10	-	10	100	88.1	124	–	–	KIF-ERM3.5.BH042_TS.N.G.01-BD-060910(6/9/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-7
Tree Swallow Nestling Dataset
Impacted Site - Emory River Mile 3.0 - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	9	0	–	–	72	96.3	–
Antimony	0	-	9	0	–	–	0.29	0.39	–
Arsenic	0	-	9	0	–	–	0.29	0.39	–
Barium	9	-	9	100	2.193	56.2	–	–	KIF-RESIDENTIAL07-TS.N.01-BD-060109(6/1/2009)
Beryllium	0	-	9	0	–	–	0.29	0.39	–
Boron	0	-	9	0	–	–	5.8	7.7	–
Cadmium	0	-	9	0	–	–	0.29	0.39	–
Calcium	9	-	9	100	6067	44200	–	–	KIF-RESIDENTIAL05-TS.N.01-BD-060409(6/4/2009)
Chromium	0	-	9	0	–	–	0.2924	0.53	–
Cobalt	0	-	9	0	–	–	0.29	0.39	–
Copper	9	-	9	100	5.5	10.4	–	–	KIF-RESIDENTIAL10-TS.N.01-BD-052809(5/28/2009)
Iron	9	-	9	100	166.9	287	–	–	KIF-RESIDENTIAL01-TS.N.01-BD-060409(6/4/2009)
Lead	0	-	9	0	–	–	0.29	0.39	–
Magnesium	9	-	9	100	603	1470	–	–	KIF-RESIDENTIAL05-TS.N.01-BD-060409(6/4/2009)
Manganese	9	-	9	100	1.827	47.6	–	–	KIF-RESIDENTIAL07-TS.N.01-BD-060109(6/1/2009)
Mercury	2	-	9	22.2	0.076	0.1182	0.068	0.11	KIF-RESIDENTIAL08-TS.N.01-BD-062509(6/25/2009)
Molybdenum	0	-	9	0	–	–	2.9	3.9	–
Nickel	0	-	9	0	–	–	0.29	0.39	–
Potassium	9	-	9	100	5830	9600	–	–	KIF-RESIDENTIAL10-TS.N.01-BD-052809(5/28/2009)
Selenium	9	-	9	100	3	4.1	–	–	KIF-RESIDENTIAL01-TS.N.01-BD-060409(6/4/2009)
Silver	0	-	9	0	–	–	0.14	0.19	–
Sodium	9	-	9	100	3120	5200	–	–	KIF-RESIDENTIAL05-TS.N.01-BD-060409(6/4/2009)
Strontium	9	-	9	100	3.533	47.7	–	–	KIF-RESIDENTIAL07-TS.N.01-BD-060109(6/1/2009)
Thallium	0	-	9	0	–	–	0.29	0.39	–
Vanadium	0	-	9	0	–	–	0.58	0.77	–
Zinc	9	-	9	100	90.75	125	–	–	KIF-RESIDENTIAL10-TS.N.01-BD-052809(5/28/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-8
Tree Swallow Nestling Dataset
Impacted Site - Emory River Mile 3.0 - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	1	-	15	6.67	13.2	13.2	11.1	14.3	KIF-ERM3.0.BH186_TS.N.G.01-BD-052710(5/27/2010)
Antimony	0	-	15	0	–	–	0.04	0.052	–
Arsenic	0	-	15	0	–	–	0.078	0.1	–
Barium	15	-	15	100	2.1	17.7	–	–	KIF-ERM3.0.BH188_TS.N.G.01-BD-052410(5/24/2010)
Beryllium	0	-	15	0	–	–	0.082	0.21	–
Boron	1	-	15	6.67	1.3	1.3	0.4	1.5	KIF-ERM3.0.BH186_TS.N.G.01-BD-052710(5/27/2010)
Cadmium	13	-	15	86.7	0.024	0.1	0.023	0.045	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)
Calcium	15	-	15	100	2810	37200	–	–	KIF-ERM3.0.BH171_TS.N.G.02-BD-060210(6/2/2010)
Chromium	1	-	15	6.67	1.4	1.4	0.35	0.45	KIF-ERM3.0.BH173_TS.N.G.04-BD-060210(6/2/2010)
Cobalt	0	-	15	0	–	–	0.039	0.05	–
Copper	15	-	15	100	6.6	12.7	–	–	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)
Iron	15	-	15	100	143	264	–	–	KIF-ERM3.0.BH171_TS.N.G.02-BD-060210(6/2/2010)
Lead	1	-	15	6.67	0.11	0.11	0.077	0.1	KIF-ERM3.0.BH188_TS.N.G.01-BD-052410(5/24/2010)
Magnesium	15	-	15	100	756	1500	–	–	KIF-ERM3.0.BH171_TS.N.G.02-BD-060210(6/2/2010)
Manganese	15	-	15	100	2.3	9.2	–	–	KIF-ERM3.0.BH189_TS.N.G.06-BD-060210(6/2/2010)
Mercury	15	-	15	100	0.055	0.12	–	–	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010),KIF-ERM3.0.BH185_TS.N.G.01-BD-060310(6/3/2010)
Molybdenum	7	-	15	46.7	0.16	0.24	0.13	0.22	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)
Nickel	2	-	15	13.3	0.34	0.58	0.28	0.35	KIF-ERM3.0.BH173_TS.N.G.04-BD-060210(6/2/2010)
Potassium	15	-	15	100	6960	10200	–	–	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)
Selenium	15	-	15	100	2.8	4.4	–	–	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)
Silver	0	-	15	0	–	–	0.008	0.031	–
Sodium	15	-	15	100	3160	5570	–	–	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)
Strontium	15	-	15	100	4.3	36.2	–	–	KIF-ERM3.0.BH188_TS.N.G.01-BD-052410(5/24/2010)
Thallium	0	-	15	0	–	–	0.038	0.049	–
Vanadium	0	-	15	0	–	–	0.13	0.29	–
Zinc	15	-	15	100	82	158	–	–	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610(5/26/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-9
Tree Swallow Nestling Dataset
Positive Control - Melton Hill Dam - 2009
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]			Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples		FOD %	Min	Max	Min	Max	
Aluminum	0	9	0	–	–	61.1	81.3	–
Antimony	0	9	0	–	–	0.24	0.33	–
Arsenic	0	9	0	–	–	0.24	0.33	–
Barium	9	9	100	1	4.9	–	–	KIF-MHD25-TS.N.01-BD-052809(5/28/2009)
Beryllium	0	9	0	–	–	0.24	0.33	–
Boron	0	9	0	–	–	4.9	6.5	–
Cadmium	0	9	0	–	–	0.24	0.33	–
Calcium	9	9	100	4970	25000	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Chromium	0	9	0	–	–	0.24	0.71	–
Cobalt	0	9	0	–	–	0.24	0.33	–
Copper	9	9	100	5.2	10	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Iron	9	9	100	144	315	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Lead	0	9	0	–	–	0.24	0.33	–
Magnesium	9	9	100	518	985	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Manganese	9	9	100	1.5	3.4	–	–	KIF-MHD25-TS.N.01-BD-052809(5/28/2009)
Mercury	1	9	11.1	0.056	0.056	0.05	0.065	KIF-MHD03-TS.N.01-BD-071609(7/16/2009)
Molybdenum	0	9	0	–	–	2.4	3.3	–
Nickel	0	9	0	–	–	0.24	0.46	–
Potassium	9	9	100	5170	8570	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Selenium	9	9	100	3.3	9	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Silver	0	9	0	–	–	0.12	0.16	–
Sodium	9	9	100	2590	3570	–	–	KIF-MHD24-TS.N.01-BD-052809(5/28/2009)
Strontium	9	9	100	3	11.2	–	–	KIF-MHD02-TS.N.01-BD-052809(5/28/2009)
Thallium	0	9	0	–	–	0.24	0.33	–
Vanadium	0	9	0	–	–	0.49	0.65	–
Zinc	9	9	100	64.1	98.6	–	–	KIF-MHD12-TS.N.01-BD-060109(6/1/2009)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

Table C-10
Tree Swallow Nestling Dataset
Positive Control - Melton Hill Dam - 2010
Tennessee Valley Authority (TVA)
Kingston Ash Recovery Project

Constituent	Frequency of Detection (FOD) [a]				Detected Concentrations (mg/kg dw)		Detection Limits (mg/kg dw)		Location of Maximum Detection
	Number of Detects / Number of Samples			FOD %	Min	Max	Min	Max	
Aluminum	0	-	15	0	–	–	10.7	15.1	–
Antimony	0	-	15	0	–	–	0.039	0.054	–
Arsenic	2	-	15	13.3	0.11	0.15	0.075	0.19	KIF-MHD.BH082_TS.N.G.01-BD-061610(6/16/2010)
Barium	15	-	15	100	1.7	8.7	–	–	KIF-MHD.BH059_TS.N.G.02-BD-060210(6/2/2010)
Beryllium	0	-	15	0	–	–	0.079	0.11	–
Boron	0	-	15	0	–	–	1.1	1.6	–
Cadmium	14	-	15	93.3	0.041	0.18	0.024	0.024	KIF-MHD.BH082_TS.N.G.01-BD-061610(6/16/2010)
Calcium	15	-	15	100	7470	22800	–	–	KIF-MHD.BH059_TS.N.G.02-BD-060210(6/2/2010)
Chromium	4	-	15	26.7	0.48	4.1	0.34	0.43	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Cobalt	2	-	15	13.3	0.047	0.052	0.037	0.053	KIF-MHD.BH085_TS.N.G.01-BD-061410(6/14/2010)
Copper	15	-	15	100	5.9	10.7	–	–	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Iron	15	-	15	100	180	308	–	–	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Lead	0	-	15	0	–	–	0.074	0.1	–
Magnesium	15	-	15	100	734	1640	–	–	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Manganese	15	-	15	100	1.6	7	–	–	KIF-MHD.BH059_TS.N.G.02-BD-060210(6/2/2010)
Mercury	14	-	15	93.3	0.02	0.081	0.036	0.036	KIF-MHD.BH084_TS.N.G.02-BD-052810(5/28/2010)
Molybdenum	10	-	15	66.7	0.18	0.34	0.11	0.19	KIF-MHD.BH082_TS.N.G.01-BD-061610(6/16/2010)
Nickel	3	-	15	20	0.28	1.9	0.26	0.33	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Potassium	15	-	15	100	6130	10200	–	–	KIF-MHD.BH085_TS.N.G.01-BD-061410(6/14/2010)
Selenium	15	-	15	100	1.6	8.5	–	–	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Silver	1	-	15	6.67	0.009	0.009	0.0077	0.013	KIF-MHD.BH084_TS.N.G.02-BD-052810(5/28/2010)
Sodium	15	-	15	100	3410	5270	–	–	KIF-MHD.BH082_TS.N.G.01-BD-061610(6/16/2010)
Strontium	15	-	15	100	2.2	10.6	–	–	KIF-MHD.BH059_TS.N.G.02-BD-060210(6/2/2010)
Thallium	0	-	15	0	–	–	0.037	0.12	–
Vanadium	2	-	15	13.3	0.35	1.1	0.12	0.3	KIF-MHD.BH083_TS.N.G.01-BD-060810(6/8/2010)
Zinc	15	-	15	100	49.9	127	–	–	KIF-MHD.BH082_TS.N.G.01-BD-061610(6/16/2010)

– - Not detected/ not analyzed/ not applicable.
mg/kg dw - Milligram per kilogram dry weight.
[a] - Frequency of detection (FOD) = number of detects / total number of samples analyzed.

ARCADIS

Appendix D

Tree Swallow Egg 2009 and 2010 Sample Results

Table D-1. Tree Swallow Egg 2009 and 2010 Sample Results, Fort Loudoun Dam (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-FLD.CONTROL01-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL05-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL06-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL07-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL08-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL09-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL10-TS.E.01-BD-050809 5/8/2009	KIF-FLD.CONTROL25-TS.E.01-BD-050809 5/8/2009	KIF-FLD23-TS.E.01-BD-060109 6/1/2009
Aluminum		<134.2	<135.3	<135.5	<135.8	<134.6	<135.4	<135.9	<135.3	<135.7
Antimony		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Arsenic		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Barium		1.491	12.29	7.435	2.104	5.635	5.713	4.833	10.94	8.252
Beryllium		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Boron		<10.78	<10.75	<10.74	<10.9	<10.8	<10.95	<10.74	<10.79	<10.85
Cadmium		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Calcium		2179	6425	10822	3070	5439	3785	5611	7258	9349
Chromium		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.6061	<0.5426
Cobalt		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Copper		2.982	<2.654	<2.726	4.496	<2.661	<2.618	<2.685	<2.735	2.826
Iron		<134.2	343.6	159.8	<135.8	215.2	146.2	319.5	198.8	<135.7
Lead		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Magnesium		<537.8	585.2	<541.1	<543.3	567.4	<542.7	<542.3	<540.3	<540.3
Manganese		<2.638	8.101	5.37	<2.678	3.6	2.857	4.833	9.313	5.087
Mercury		<0.1078	<0.1075	<0.1074	<0.1052	<0.1096	<0.1095	<0.1074	<0.1109	<0.1085
Molybdenum		<5.39	<5.447	<5.37	<5.452	<5.4	<5.475	<5.37	<5.396	<5.426
Nickel		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Potassium		8268	6327	7022	7681	6621	7808	6390	7347	8761
Selenium		1.605	3.771	2.726	1.913	3.365	2.357	3.759	2.143	2.148
Silver		<0.2638	<0.2654	<0.2726	<0.2678	<0.2661	<0.2618	<0.2685	<0.2735	<0.2713
Sodium		9071	7403	8137	9106	6950	8546	7437	7539	9224 J
Strontium		2.293	7.961	8.674	3.539	5.791	4.761	5.37	7.17	7.8 J
Thallium		<0.539	<0.5447	<0.537	<0.5452	<0.54	<0.5475	<0.537	<0.5396	<0.5426
Vanadium		<1.078	<1.075	<1.074	<1.052	<1.096	<1.095	<1.074	<1.109	<1.085
Zinc		33.83	170.4	78.07	53.95	147.9	86.41	131.8	117.5	62.06
Egg Weight (g)		2	3	1	2	2	1	3	2	1
Clutch Size		6	6	5	5	6	5	2	5	5
Egg Length (cm)		1.834	1.975	2.026	1.866	1.98	2.004	1.917	1.751	1.933
Egg Width (cm)		1.353	1.363	1.379	1.306	1.328	1.371	1.334	1.329	1.294
Egg Volume (cm^3)		1.712	1.871	1.965	1.623	1.781	1.921	1.74	1.577	1.651

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-1. Tree Swallow Egg 2009 and 2010 Sample Results, Fort Loudoun Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-FLD.BH089_TS.E.G.01-BD-050410 5/4/2010	KIF-FLD.BH092_TS.E.G.02-BD-050410 5/4/2010	KIF-FLD.BH096_TS.E.G.03-BD-050410 5/4/2010	KIF-FLD.BH097_TS.E.G.04-BD-050410 5/4/2010	KIF-FLD.BH101_TS.E.G.05-BD-050410 5/4/2010	KIF-FLD.BH109_TS.E.G.06-BD-050410 5/4/2010	KIF-FLD.BH111_TS.E.G.07-BD-050410 5/4/2010	KIF-FLD.BH105_TS.E.G.01-BD-050610 5/6/2010	KIF-FLD.BH110_TS.E.G.01-BD-050710 5/7/2010
Aluminum		<23.37	<17.93	<22.28	<22.28	<21.2	<21.74	<22.28	<22.28	<22.28
Antimony		<0.08696	<0.06522	<0.08152	<0.08152	<0.07609	<0.08152	<0.08152	<0.08152	<0.08152
Arsenic		<0.163	<0.125	<0.1522	<0.1576	<0.1467	<0.1522	<0.1576	<0.3152	<0.3152
Barium		7.065	3.967	2.826	2.446	4.946	1.793	2.609	14.67	14.13
Beryllium		<0.3478	<0.07065	<0.3315	<0.337	<0.3152	<0.3261	<0.337	<0.163	<0.1685
Boron		<2.446	<1.848	<2.283	<2.337	<2.174	<2.283	<2.337	<2.337	<2.337
Cadmium		<0.09239	<0.07065	<0.08696	<0.08696	<0.08152	<0.08696	<0.08696	<0.04293	<0.04293
Calcium		4087	3207	3533	1565	2777	2663	3462	3685	5277
Chromium		<0.7609	<0.5978	<0.7065	<0.7065	<0.6522	<0.7065	<0.7065	0.8152 J	<0.7065
Cobalt		<0.08152	0.07609 J	<0.07609	<0.08152	<0.07609	0.1033 J	0.09239 J	0.08696 J	0.1522 J
Copper		2.663 J	1.902 J	2.826	2.935	2.609	3.043	3.587	2.446 J	2.609 J
Iron		202.7	140.2	83.7 J	68.48 J	152.7	131 J	145.7	176.6	275
Lead		<0.163	<0.125	<0.1522	<0.1576	<0.1467	<0.1522	<0.1576	<0.1576	<0.1576
Magnesium		619.6	428.3 J	346.7 J	<270.1	395.7 J	385.9 J	416.8 J	487.5 J	502.2 J
Manganese		<4.783	5.435	<2.174	<1.902	5.978	<4.728	<5.435	5.978	7.609
Mercury		0.09239 J	0.09239	0.125	0.125	0.1196	0.1359	0.09783 J	<0.1196	<0.07609
Molybdenum		<0.2065	<0.1576	<0.1957	<0.1957	<0.1848	<0.1902	<0.1957	<0.1957	<0.1957
Nickel		<0.5978	<0.4402	<0.538	<0.5435	<0.5163	<0.5326	<0.5435	<0.5435	7.609 J
Potassium		7065	7663	7228	8750	7772	8315	8152	7935	8261
Selenium		4.022	2.609	2.174	1.793	2.391	2.5	3.098	3.207	5.054
Silver		0.02554 J	0.01522 J	<0.05326	<0.05435	<0.05054	<0.05272	<0.05435	<0.0163	<0.0288
Sodium		8043	8261	8804	9457	9239	9402	9674	10000	9891
Strontium		6.522	4.13	3.587	1.848	3.478	2.391	3.315	4.457 J	4.457 J
Thallium		<0.08152	<0.05978	<0.07609	<0.07609	<0.07065	<0.07609	<0.07609	<0.07609	<0.07609
Vanadium		<0.2663	<0.2065	<0.25	<0.2554	<0.2446	<0.25	<0.2554	<0.5109	<0.5163
Zinc		132.6	86.41	47.28	36.96	83.15	67.39	90.22	104.3	156
Egg Weight (g)		2.002	1.914	1.735	1.792	1.877	1.737	1.9	1.937	1.762
Clutch Size		5	4	5	7	5	6	5	5	4
Egg Length (cm)		2.04	1.888	1.863	1.915	1.923	1.776	1.872	1.896	1.9
Egg Width (cm)		1.376	1.392	1.326	1.33	1.373	1.075	1.409	1.386	1.322
Egg Volume (cm^3)		1.97	1.866	1.671	1.728	1.849	1.047	1.895	1.858	1.694

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-1. Tree Swallow Egg 2009 and 2010 Sample Results, Fort Loudoun Dam (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-FLD.BH100_TS.E.G.01-BD-050810 5/8/2010	KIF-FLD.BH103_TS.E.G.01-BD-060910 6/9/2010	KIF-FLD.BH097_TS.E.G.01-BD-061110 6/11/2010	KIF-FLD.BH116_TS.E.G.01-BD-061410 6/14/2010	KIF-FLD.BH109_TS.E.G.01-BD-061510 6/15/2010	KIF-FLD.BH098_TS.E.G.01-BD-061710 6/17/2010	KIF-FLD.BH111_TS.E.G.02-BD-061710 6/17/2010
Aluminum		<22.28	<21.2	<27.72	<35.33	<44.02	<21.74	<29.89
Antimony		<0.08152	<0.07609	<0.09783	<0.125	<0.1576	<0.07609	<0.1087
Arsenic		<0.3136	<0.1467	<0.1957	<0.2446	<0.3098	<0.1522	<0.212
Barium		30.98	5.978	7.065	13.04	10.33	4.891	7.065
Beryllium		<0.163	<0.1576	<0.2065	<0.2609	<0.3261	<0.1576	<0.2228
Boron		<2.337	<2.174	<2.88	<3.641	<4.565	<2.228	<3.098
Cadmium		<0.04293	<0.08152	<0.05272	<0.06522	<0.08152	0.04728 J	<0.05435
Calcium		5815	5435	70652	7880	6739	5761	5288
Chromium		<0.7065	<0.6522	0.8696 J	<1.141	<1.413	<0.7065	<0.9239
Cobalt		0.1196 J	0.08152 J	<0.09783	0.1413 J	0.1685 J	0.09783 J	0.1141 J
Copper		2.174 J	2.283 J	2.554 J	2.174 J	2.446 J	3.043	1.848 J
Iron		181	229.3 J	<83.15	300.5	282.6	172.8	238
Lead		<0.1576	<0.1467	<0.1902	<0.2446	<0.3043	<0.1522	<0.2065
Magnesium		480.4 J	581.5	473.4 J	760.9 J	690.2 J	592.4	657.6 J
Manganese		12.5	10.87	2.12 J	8.696	11.41	5.217	5.38
Mercury		<0.1793	0.09239 J	0.08696 J	<0.1033	<0.125	0.1196	<0.08696
Molybdenum		<0.1957	<0.1848	<0.2446	<0.3098	<0.3859	<0.1902	<0.2609
Nickel		8.152	<0.5163	<0.6522	<2.065	<1.087	<0.5272	<0.7065
Potassium		8696	8207	8098	7120	9185	8696	7500
Selenium		3.696	2.174	1.304 J	2.717	3.533	2.826	2.826
Silver		0.0337 J	<0.01522	<0.02011	<0.02554	<0.03152	<0.01576	<0.02174
Sodium		9402	8967	9239	8587	8043	8750	8641
Strontium		5.978 J	5.217	39.67	7.609	7.065	4.62	5.978
Thallium		<0.07609	<0.07065	<0.09783	<0.1196	<0.1522	<0.07609	<0.1033
Vanadium		<0.5054	<0.2446	<0.3152	<0.4022	<0.5	<0.25	<0.3424
Zinc		118.5	118.5 J	18.48 J	142.9	163	104.3	121.7
Egg Weight (g)		1.854	1.592	1.545	1.648	1.947	1.752	1.978
Clutch Size		4	4	4	4	3	2	4
Egg Length (cm)		2.029	1.861	1.858	1.744	1.972	1.884	2.043
Egg Width (cm)		1.333	1.275	1.245	1.319	1.352	1.325	1.329
Egg Volume (cm^3)		1.839	1.543	1.469	1.547	1.838	1.687	1.84

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-2. Tree Swallow Egg 2010 Sample Results, Composite Reference Site[1] (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID:	KIF-FLD.BH089_TS.E.G.01-BD-050410	KIF-FLD.BH092_TS.E.G.02-BD-050410	KIF-FLD.BH096_TS.E.G.03-BD-050410	KIF-FLD.BH097_TS.E.G.04-BD-050410	KIF-FLD.BH101_TS.E.G.05-BD-050410	KIF-FLD.BH109_TS.E.G.06-BD-050410	KIF-FLD.BH111_TS.E.G.07-BD-050410	KIF-FLD.BH105_TS.E.G.01-BD-050610	KIF-FLD.BH110_TS.E.G.01-BD-050710	KIF-FLD.BH100_TS.E.G.01-BD-050810
	Sample Date:	5/4/2010	5/4/2010	5/4/2010	5/4/2010	5/4/2010	5/4/2010	5/4/2010	5/6/2010	5/7/2010	5/8/2010
Aluminum		<23.37	<17.93	<22.28	<22.28	<21.2	<21.74	<22.28	<22.28	<22.28	<22.28
Antimony		<0.08696	<0.06522	<0.08152	<0.08152	<0.07609	<0.08152	<0.08152	<0.08152	<0.08152	<0.08152
Arsenic		<0.163	<0.125	<0.1522	<0.1576	<0.1467	<0.1522	<0.1576	<0.3152	<0.3152	<0.3136
Barium		7.065	3.967	2.826	2.446	4.946	1.793	2.609	14.67	14.13	30.98
Beryllium		<0.3478	<0.07065	<0.3315	<0.337	<0.3152	<0.3261	<0.337	<0.163	<0.1685	<0.163
Boron		<2.446	<1.848	<2.283	<2.337	<2.174	<2.283	<2.337	<2.337	<2.337	<2.337
Cadmium		<0.09239	<0.07065	<0.08696	<0.08696	<0.08152	<0.08696	<0.08696	<0.04293	<0.04293	<0.04293
Calcium		4087	3207	3533	1565	2777	2663	3462	3685	5277	5815
Chromium		<0.7609	<0.5978	<0.7065	<0.7065	<0.6522	<0.7065	<0.7065	0.8152 J	<0.7065	<0.7065
Cobalt		<0.08152	0.07609 J	<0.07609	<0.08152	<0.07609	0.1033 J	0.09239 J	0.08696 J	0.1522 J	0.1196 J
Copper		2.663 J	1.902 J	2.826	2.935	2.609	3.043	3.587	2.446 J	2.609 J	2.174 J
Iron		202.7	140.2	83.7 J	68.48 J	152.7	131 J	145.7	176.6	275	181
Lead		<0.163	<0.125	<0.1522	<0.1576	<0.1467	<0.1522	<0.1576	<0.1576	<0.1576	<0.1576
Magnesium		619.6	428.3 J	346.7 J	<270.1	395.7 J	385.9 J	416.8 J	487.5 J	502.2 J	480.4 J
Manganese		<4.783	5.435	<2.174	<1.902	5.978	<4.728	<5.435	5.978	7.609	12.5
Mercury		0.09239 J	0.09239	0.125	0.125	0.1196	0.1359	0.09783 J	<0.1196	<0.07609	<0.1793
Molybdenum		<0.2065	<0.1576	<0.1957	<0.1957	<0.1848	<0.1902	<0.1957	<0.1957	<0.1957	<0.1957
Nickel		<0.5978	<0.4402	<0.538	<0.5435	<0.5163	<0.5326	<0.5435	<0.5435	7.609 J	8.152
Potassium		7065	7663	7228	8750	7772	8315	8152	7935	8261	8696
Selenium		4.022	2.609	2.174	1.793	2.391	2.5	3.098	3.207	5.054	3.696
Silver		0.02554 J	0.01522 J	<0.05326	<0.05435	<0.05054	<0.05272	<0.05435	<0.0163	<0.0288	0.0337 J
Sodium		8043	8261	8804	9457	9239	9402	9674	10000	9891	9402
Strontium		6.522	4.13	3.587	1.848	3.478	2.391	3.315	4.457 J	4.457 J	5.978 J
Thallium		<0.08152	<0.05978	<0.07609	<0.07609	<0.07065	<0.07609	<0.07609	<0.07609	<0.07609	<0.07609
Vanadium		<0.2663	<0.2065	<0.25	<0.2554	<0.2446	<0.25	<0.2554	<0.5109	<0.5163	<0.5054
Zinc		132.6	86.41	47.28	36.96	83.15	67.39	90.22	104.3	156	118.5
Egg Weight (g)		2.002	1.914	1.735	1.792	1.877	1.737	1.9	1.937	1.762	1.854
Clutch Size		5	4	5	7	5	6	5	5	4	4
Egg Length (cm)		2.04	1.888	1.863	1.915	1.923	1.776	1.872	1.896	1.9	2.029
Egg Width (cm)		1.376	1.392	1.326	1.33	1.373	1.075	1.409	1.386	1.322	1.333
Egg Volume (cm^3)		1.97	1.866	1.671	1.728	1.849	1.047	1.895	1.858	1.694	1.839

[1] Composite reference site comprised of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-2. Tree Swallow Egg 2010 Sample Results, Composite Reference Site[1] (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-FLD.BH103_TS.E.G.01-BD-060910 6/9/2010	KIF-FLD.BH097_TS.E.G.01-BD-061110 6/11/2010	KIF-FLD.BH116_TS.E.G.01-BD-061410 6/14/2010	KIF-FLD.BH109_TS.E.G.01-BD-061510 6/15/2010	KIF-FLD.BH098_TS.E.G.01-BD-061710 6/17/2010	KIF-FLD.BH111_TS.E.G.02-BD-061710 6/17/2010	KIF-TLD.BH118_TS.E.G.06-BD-050410 5/4/2010	KIF-TLD.BH119_TS.E.G.05-BD-050410 5/4/2010	KIF-TLD.BH120_TS.E.G.04-BD-050410 5/4/2010
Aluminum		<21.2	<27.72	<35.33	<44.02	<21.74	<29.89	<22.53	<22.64	<41.85
Antimony		<0.07609	<0.09783	<0.125	<0.1576	<0.07609	<0.1087	<0.07935	<0.08126	<0.1522
Arsenic		<0.1467	<0.1957	<0.2446	<0.3098	<0.1522	<0.212	<0.1587	<0.1587	<0.2935
Barium		5.978	7.065	13.04	10.33	4.891	7.065	2.222	9.674	3.098
Beryllium		<0.1576	<0.2065	<0.2609	<0.3261	<0.1576	<0.2228	<0.3412	<0.3289	<0.6522
Boron		<2.174	<2.88	<3.641	<4.565	<2.228	<3.098	<2.301	<2.322	<4.348
Cadmium		<0.08152	<0.05272	<0.06522	<0.08152	0.04728 J	<0.05435	<0.08728	<0.08707	<0.163
Calcium		5435	70652	7880	6739	5761	5288	2730	5708	3158
Chromium		<0.6522	0.8696 J	<1.141	<1.413	<0.7065	<0.9239	<0.7141	<0.7159	<1.359
Cobalt		0.08152 J	<0.09783	0.1413 J	0.1685 J	0.09783 J	0.1141 J	<0.07935	0.1103 J	<0.1467
Copper		2.283 J	2.554 J	2.174 J	2.446 J	3.043	1.848 J	2.857	3.483	3.098 J
Iron		229.3 J	<83.15	300.5	282.6	172.8	238	145.2	268.9	<126.6
Lead		<0.1467	<0.1902	<0.2446	<0.3043	<0.1522	<0.2065	<0.1587	<0.1567	<0.2935
Magnesium		581.5	473.4 J	760.9 J	690.2 J	592.4	657.6 J	372.9 J	783.6	522.8 J
Manganese		10.87	2.12 J	8.696	11.41	5.217	5.38	3.095	12.19	3.696 J
Mercury		0.09239 J	0.08696 J	<0.1033	<0.125	0.1196	<0.08696	0.119	0.1935	0.1576 J
Molybdenum		<0.1848	<0.2446	<0.3098	<0.3859	<0.1902	<0.2609	<0.1984	0.1935 J	<0.3696
Nickel		<0.5163	<0.6522	<2.065	<1.087	<0.5272	<0.7065	<0.5475	<0.5417	<1.033
Potassium		8207	8098	7120	9185	8696	7500	8887	12828	7989
Selenium		2.174	1.304 J	2.717	3.533	2.826	2.826	2.222	5.224	2.228
Silver		<0.01522	<0.02011	<0.02554	<0.03152	<0.01576	<0.02174	<0.01666	<0.01625	<0.03043
Sodium		8967	9239	8587	8043	8750	8641	8570	14008	9076
Strontium		5.217	39.67	7.609	7.065	4.62	5.978	3.015	6.191	3.152
Thallium		<0.07065	<0.09783	<0.1196	<0.1522	<0.07609	<0.1033	<0.07776	<0.07739	<0.1467
Vanadium		<0.2446	<0.3152	<0.4022	<0.5	<0.25	<0.3424	<0.2539	<0.2515	<0.4783
Zinc		118.5 J	18.48 J	142.9	163	104.3	121.7	64.59	199.3	78.26
Egg Weight (g)		1.592	1.545	1.648	1.947	1.752	1.978	1.701	1.436	1.613
Clutch Size		4	4	4	3	2	4	5	6	5
Egg Length (cm)		1.861	1.858	1.744	1.972	1.884	2.043	1.977	2.02	1.72
Egg Width (cm)		1.275	1.245	1.319	1.352	1.325	1.329	1.333	1.375	1.335
Egg Volume (cm^3)		1.543	1.469	1.547	1.838	1.687	1.84	1.792	1.948	1.563

[1] Composite reference site comprised of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-2. Tree Swallow Egg 2010 Sample Results, Composite Reference Site[1] (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-TLD.BH122_TS.E.G.03-BD-050410 5/4/2010	KIF-TLD.BH124_TS.E.G.07-BD-050410 5/4/2010	KIF-TLD.BH126_TS.E.G.08-BD-050410 5/4/2010	KIF-TLD.BH135_TS.E.G.09-BD-050410 5/4/2010	KIF-TLD.BH139_TS.E.G.02-BD-050410 5/4/2010	KIF-TLD.BH144_TS.E.G.01-BD-050410 5/4/2010	KIF-TLD.BH128_TS.E.G.01-BD-050710 5/7/2010	KIF-TLD.BH132_TS.E.G.02-BD-050710 5/7/2010	KIF-TLD.BH133_TS.E.G.03-BD-050710 5/7/2010
Aluminum		<19.91	<32.61	<32.07	<45.11	<23.37	<33.7	<19.02	<22.28	<25
Antimony		<0.07187	<0.1196	<0.1141	<0.163	<0.08152	<0.125	0.2011 J	<0.08152	<0.09239
Arsenic		<0.1404	<0.2283	<0.2283	<0.3152	<0.163	<0.2391	<0.2663	<0.3098	<0.3478
Barium		3.8	7.065	2.337	4.946	3.152	7.065	4.565	3.261	25.54
Beryllium		<0.2974	<0.4891	<0.4837	<0.6522	<0.3478	<0.5054	<0.1413	<0.163	<0.1848
Boron		<2.065	<3.37	<3.315	<4.674	<2.391	<3.533	<1.957	<2.283	<2.554
Cadmium		<0.07683	<0.125	<0.125	<0.1739	<0.08696	<0.1304	<0.07609	<0.04239	<0.04728
Calcium		3106	7120	4457	4315	5027	4565	3777	5761	12228
Chromium		<0.6278	<1.033	<1.033	<1.413	<0.7609	<1.087	<0.5978	<0.7065	<0.8152
Cobalt		<0.07022	0.1141 J	0.1196 J	<0.1576	0.2337 J	<0.1196	0.1413 J	0.09239 J	0.1359 J
Copper		3.387	2.391 J	3.913	3.478 J	2.88	2.446 J	2.5	2.554 J	2.663 J
Iron		110.7 J	206	171.7 J	152.7 J	273.9	282.6	161.4	197.3	281.5
Lead		<0.1404	<0.2283	<0.2228	<0.3152	<0.163	<0.2337	<0.1304	<0.1576	<0.1739
Magnesium		425.4 J	635.9 J	576.1 J	630.4 J	641.3	717.4 J	373.4 J	592.4	570.7 J
Manganese		4.213	5.978	5.326	7.065	14.13	5.978	7.065	5.978	13.04
Mercury		0.1652	0.1141 J	0.1793	0.1848 J	0.1739	0.1576 J	<0.125	<0.1359	<0.3315
Molybdenum		<0.1735	<0.288	<0.2826	<0.3967	0.2663 J	<0.2989	0.2228 J	<0.1957	<0.2174
Nickel		<0.4874	<0.8152	<0.7609	<1.087	<0.5435	<0.8152	<0.4674	<0.5435	<0.5978
Potassium		7831	8750	11685	9511	9239	7880	8859	7609	6902
Selenium		2.478	2.283	3.804	3.152	5.978	3.261	3.043	3.478	3.641
Silver		<0.01404	<0.02337	<0.02337	<0.03261	<0.01685	<0.02446	<0.03043	<0.0163	<0.01793
Sodium		10243	8696	10924	10707	9511	9402	9728	9076	9185
Strontium		3.139	7.065	4.076	5.38	4.511	5.978	2.011 J	5.435 J	10.33 J
Thallium		<0.06857	<0.1141	<0.1087	<0.1522	<0.08152	<0.1141	<0.06522	<0.07609	<0.08696
Vanadium		<0.2313	<0.3696	<0.3696	<0.5109	<0.2663	<0.3859	<0.4076	<0.5054	<0.5652
Zinc		75.34	142.4	84.78	104.9	107.6	148.9	75	98.91	154.9
Egg Weight (g)		1.969	1.69	1.715	1.743	1.593	1.875	1.759	1.995	1.967
Clutch Size		6	6	6	5	5	6	6	4	4
Egg Length (cm)		2.012	1.841	2.012	1.975	1.736	1.925	1.881	1.954	1.954
Egg Width (cm)		1.385	1.313	1.281	1.308	1.322	1.345	1.336	1.404	1.377
Egg Volume (cm^3)		1.968	1.619	1.684	1.723	1.547	1.776	1.712	1.964	1.89

[1] Composite reference site comprised of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-2. Tree Swallow Egg 2010 Sample Results, Composite Reference Site[1] (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-TLD.BH138_TS.E.G.04-BD-050710 5/7/2010	KIF-TLD.BH146_TS.E.G.06-BD-050710 5/7/2010	KIF-TLD.BH148_TS.E.G.05-BD-050710 5/7/2010	KIF-TRM569.5.BH515_TS.E.G.01-BD-051310 5/13/2010	KIF-TRM569.5.BH519_TS.E.G.02-BD-051310 5/13/2010	KIF-TRM569.5.BH520_TS.E.G.03-BD-051310 5/13/2010	KIF-TRM569.5.BH527_TS.E.G.04-BD-051310 5/13/2010	KIF-TRM569.5.BH514_TS.E.G.01-BD-051910 5/19/2010	KIF-TRM571.5.BH478_TS.E.G.01-BD-050410 5/4/2010
Aluminum		<22.28	<22.28	<19.57	<24.46	<21.74	<21.2	<21.2	<22.28	<48.91
Antimony		<0.08152	<0.08152	<0.07065	<0.08696	<0.07609	<0.07609	<0.07609	<0.08152	<0.1793
Arsenic		<0.3152	<0.3152	<0.2772	<0.1739	<0.1522	<0.1467	<0.1467	<0.1576	<0.3424
Barium		11.41	11.41	12.5	23.91	8.696	4.946	3.859	40.22	6.522 J
Beryllium		<0.163	<0.163	<0.1467	<0.3696	<0.3207	<0.3152	<0.3152	<0.3315	<0.7065
Boron		<2.337	<2.337	<2.011	<2.554	<2.228	<2.174	<2.174	<2.283	<5.054
Cadmium		<0.04293	<0.04293	<0.0375	<0.04674	<0.0413	<0.04022	<0.04022	<0.04185	<0.1902
Calcium		4951	3027	81522	9130	10000	3375	4734	3913	43859
Chromium		<0.7065	<0.7065	<0.5978	<0.7609	<0.7065	<0.6522	<0.6522	<0.7065	<1.576
Cobalt		0.1304 J	0.09783 J	0.1087 J	0.08696 J	0.08152 J	<0.07609	0.1467 J	0.08152 J	<0.1739
Copper		2.5 J	2.065 J	2.772	1.902 J	3.261 J	1.848 J	3.478 J	1.957 J	1.902 J
Iron		275	152.7	158.2	228.8	169.6	119.6 J	245.7	267.9	<147.8
Lead		<0.1576	<0.1576	<0.1359	<0.1739	0.5978 J	<0.1467	<0.5978	<0.1522	<0.3424
Magnesium		619.6	407.6 J	587	619.6	554.3	331 J	471.2 J	570.7	597.8 J
Manganese		8.696	8.696	8.696	10.87	7.609	5.978	10.87	5.978	2.772 J
Mercury		<0.1033	<0.1413	<0.163	0.09783 J	0.09783 J	0.1087	0.1196	0.1033 J	0.1902 J
Molybdenum		<0.1957	<0.1957	0.1739 J	<0.2174	<0.1902	<0.1848	<0.1848	<0.1957	<0.4293
Nickel		<0.5435	<0.5435	<0.4783	<0.5978	<0.5272	<0.5163	<0.5163	<0.538	<1.196
Potassium		9076	7609	8587	7391	6957	7228	6848	7228	7989
Selenium		3.37	2.5	2.609	2.989	2.717	2.5	3.37	3.261	2.228 J
Silver		<0.0163	<0.0163	<0.01413	<0.01793	<0.03913	<0.01522	<0.05978	<0.01576	<0.03533
Sodium		10707	9946	9511	8696	7772	7880	7880	6630	9511
Strontium		5 J	3.967 J	47.83 J	9.239	7.609	3.587	4.402	9.239	30.98
Thallium		<0.07609	<0.07609	<0.06522	<0.08696	<0.07609	<0.07065	<0.07065	<0.07609	<0.1685
Vanadium		<0.5109	<0.5109	<0.4457	<0.2826	<0.5978	<0.2391	<0.9239	<0.25	<0.5435
Zinc		129.3	111.4	60.33	147.3 J	126.6	73.91 J	88.04 J	97.28 J	59.24
Egg Weight (g)		1.872	1.865	1.835	1.654	2.017	1.892	1.869	2.086	1.83
Clutch Size		4	5	5	5	5	5	4	5	6
Egg Length (cm)		1.931	1.846	1.895	1.868	1.973	1.949	1.989	1.96	1.886
Egg Width (cm)		1.348	1.341	1.345	1.299	1.41	1.366	1.33	1.419	1.357
Egg Volume (cm^3)		1.79	1.693	1.748	1.608	2	1.855	1.794	2.013	1.771

[1] Composite reference site comprised of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

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cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-2. Tree Swallow Egg 2010 Sample Results, Composite Reference Site[1] (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID:	KIF-TRM571.5.BH481_TS.E.G.01-BD-051310	KIF-TRM571.5.BH485_TS.E.G.02-BD-051310	KIF-TRM571.5.BH486_TS.E.G.03-BD-051310	KIF-TRM571.5.BH494_TS.E.G.04-BD-051310	KIF-TRM571.5.BH501_TS.E.G.05-BD-051310	KIF-TRM571.5.BH506_TS.E.G.06-BD-051310	KIF-TRM571.5.BH484_TS.E.G.01-BD-051910	KIF-TRM571.5.BH489_TS.E.G.03-BD-051910	KIF-TRM571.5.BH498_TS.E.G.02-BD-051910
	Sample Date:	5/13/2010	5/13/2010	5/13/2010	5/13/2010	5/13/2010	5/13/2010	5/19/2010	5/19/2010	5/19/2010
Aluminum		<20.65	<24.46	<22.28	<21.74	<21.74	<22.28	<31.52	<23.91	<27.17
Antimony		<0.07609	<0.08696	<0.08152	<0.07609	<0.08152	<0.08152	<0.1141	<0.08696	<0.09783
Arsenic		<0.1467	<0.1685	<0.1576	<0.1522	<0.1522	<0.1576	<0.2228	<0.1685	<0.1902
Barium		11.96	3.315	5.435	5.38	5.272	8.696	13.59	15.76	19.02
Beryllium		<0.3043	<0.3641	<0.3315	<0.3261	<0.3261	<0.337	<0.4674	<0.3587	<0.4076
Boron		<2.12	<2.5	<2.283	<2.228	<2.283	<2.337	<3.261	<2.446	<2.826
Cadmium		<0.03913	<0.0462	<0.04185	<0.0413	<0.04185	<0.04239	<0.05978	<0.04565	<0.05217
Calcium		5000	5435	3527	2978	3332	7065	7772	6304	67935
Chromium		<0.6522	<0.7609	<0.7065	<0.7065	<0.7065	<0.7065	<0.9783	<0.7609	<0.8696
Cobalt		<0.07065	0.1848 J	0.08152 J	0.1196 J	0.09239 J	0.07609 J	0.1087 J	0.212 J	0.1359 J
Copper		2.717 J	1.848 J	2.826 J	3.043 J	4.185 J	<10.33	3.152 J	5.38 J	16.3 J
Iron		157.6	226.6	154.3	138.6	90.22 J	290.2	242.9	366.3	318.5
Lead		<0.1576	<0.1685	<0.3098	<0.4946	<0.3967	<1.957	<0.2174	<0.1685	<0.1902
Magnesium		457.1 J	523.9 J	494.6 J	348.9 J	354.3 J	548.9	663 J	608.7	826.1
Manganese		7.065	6.522	5.435	5.978	4.402	6.522	5.38	7.065	15.22
Mercury		0.1196	0.1087 J	0.1087	0.2609	0.1196	0.09239 J	0.09783 J	0.1033 J	0.2663
Molybdenum		<0.1793	<0.212	<0.1957	<0.1902	<0.1902	<0.1957	<0.2772	<0.212	<0.2391
Nickel		<0.5054	<0.5978	<0.538	<0.5326	<0.5326	<0.5435	<0.7609	<0.5978	<0.6522
Potassium		8587	7011	7391	8152	6848	8315	7283	7391	17446
Selenium		2.12	3.152	2.663	2.554	2.391	3.261	2.935	3.533	5
Silver		<0.01685	<0.01739	<0.03261	<0.05163	<0.0413	<0.2065	<0.02283	0.02011 J	<0.01957
Sodium		8587	7500	7880	8967	7609	8696	9022	8098	19185
Strontium		6.522	5.435	4.783	3.859	3.098	8.696	10.87	10.87	8.152
Thallium		<0.07065	<0.08152	<0.07609	<0.07609	<0.07609	<0.07609	<0.1087	<0.08152	<0.09239
Vanadium		<0.2609	<0.2772	<0.5109	<0.8152	<0.6522	<3.207	<0.3587	<0.2717	<0.3152
Zinc		76.09	124.5 J	89.67	103.3	83.7	191.3 J	203.8 J	135.3 J	266.3 J
Egg Weight (g)		1.77	1.555	1.798	1.702	1.665	1.854	1.706	1.678	0.87
Clutch Size		5	5	6	5	5	6	6	4	3
Egg Length (cm)		1.924	1.833	1.948	1.831	1.871	1.932	1.771	1.91	1.804
Egg Width (cm)		1.335	1.266	1.331	1.343	1.335	1.341	1.349	1.279	1.331
Egg Volume (cm^3)		1.749	1.498	1.76	1.684	1.701	1.772	1.644	1.593	1.63

[1] Composite reference site comprised of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-3. Tree Swallow Egg 2010 Sample Results, Little Emory River Mile 2.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-LERM2.0.BH002_TS.E.G.01-BD-051110 5/11/2010	KIF-LERM2.0.BH010_TS.E.G.01-BD-051710 5/17/2010
Aluminum		<22.83	<67.39
Antimony		<0.08152	<0.2446
Arsenic		<0.3152	<0.9239
Barium		11.96	29.89
Beryllium		<0.3261	<0.4946
Boron		<2.337	<7.065
Cadmium		<0.08152	<0.1304
Calcium		5435	9837
Chromium		1.902 J	<2.12
Cobalt		0.1522 J	<0.2337
Copper		2.554 J	2.609 J
Iron		217.4	587
Lead		<0.4565	<0.4674
Magnesium		570.7	837 J
Manganese		11.96	16.3
Mercury		0.1467	<0.1957
Molybdenum		<0.1957	<0.5978
Nickel		0.6522 J	<1.63
Potassium		8261	8152
Selenium		3.967	7.065
Silver		<0.0163	<0.04837
Sodium		8478	7391
Strontium		8.152	16.3 J
Thallium		<0.07609	<0.2337
Vanadium		<0.5109	<1.522
Zinc		125	283.7
Egg Weight (g)		1.801	1.803
Clutch Size		5	5
Egg Length (cm)		1.787	1.94
Egg Width (cm)		1.37	1.355
Egg Volume (cm^3)		1.711	1.817

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-4. Tree Swallow Egg 2010 Sample Results, Tennessee River Mile 566 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-TRM566.0.BH417_TS.E.G.01-BD-050410 5/4/2010	KIF-TRM566.0.BH431_TS.E.G.02-BD-050410 5/4/2010	KIF-TRM566.0.BH440_TS.E.G.03-BD-050410 5/4/2010	KIF-TRM566.0.BH421_TS.E.G.05-BD-051110 5/11/2010	KIF-TRM566.0.BH456_TS.E.G.01-BD-051110 5/11/2010	KIF-TRM566.0.BH461_TS.E.G.02-BD-051110 5/11/2010	KIF-TRM566.0.BH464_TS.E.G.03-BD-051110 5/11/2010	KIF-TRM566.0.BH465_TS.E.G.04-BD-051110 5/11/2010	KIF-TRM566.0.BH423_TS.E.G.01-BD-060210 6/2/2010
Aluminum		<46.2	<33.15	<28.8	<20.65	<22.28	<22.28	<20.65	<22.28	<22.28
Antimony		<0.1685	<0.1196	<0.1033	<0.07609	<0.08152	<0.08152	<0.07609	<0.08152	<0.08152
Arsenic		<0.3261	<0.2337	<0.2011	<0.288	<0.3098	<0.3098	<0.288	<0.3098	<0.1576
Barium		16.85	12.5	24.46	5	21.74	13.04	24.46	21.2	4.565
Beryllium		<0.7065	<0.4946	<0.4293	<0.2989	<0.3207	<0.3207	<0.2989	0.163 J	<0.1685
Boron		<4.783	<3.424	<2.989	<2.12	<2.283	<2.283	<2.12	<2.283	<2.337
Cadmium		<0.1793	<0.1304	<0.1087	<0.07609	<0.07609	<0.07609	<0.07065	<0.07065	<0.04293
Calcium		8859	6413	8043	6250	4902	3761	4005	5489	5359
Chromium		<1.467	<1.033	<0.9239	<0.6522	0.7065 J	<0.7065	<0.6522	<0.7065	<0.7065
Cobalt		<0.163	0.1413 J	0.2717 J	0.2935 J	0.09239 J	<0.07609	0.07065 J	0.1033 J	0.1467 J
Copper		2.174 J	2.609 J	2.446 J	2.446 J	2.011 J	2.826	1.902 J	2.772	2.717
Iron		247.8 J	294.6	657.6	331	283.7	161.4	196.2	301.1	252.2
Lead		<0.3207	<0.2283	<0.2011	<0.4185	<0.4457	<0.4511	<0.4185	<0.4511	<0.1576
Magnesium		657.6 J	788 J	1005	625	587	463 J	461.4 J	597.8	520.1 J
Manganese		10.87	6.522	44.57	13.04	15.22	9.783	9.783	10.87	5.978
Mercury		<0.1359	0.1196 J	0.1141 J	0.1467	0.1141 J	0.1196 J	0.1413	0.09239 J	0.1087
Molybdenum		<0.4076	<0.2935	0.2663 J	0.2228 J	<0.1957	<0.1957	<0.1793	<0.1957	<0.1957
Nickel		<1.141	<0.8152	<0.7065	<0.5	<0.538	<0.5435	<0.5	<0.5435	<0.5435
Potassium		7989	7772	7826	7500	7446	9837	7717	8478	7174
Selenium		3.913	4.891	5.978	5.435	3.859	2.88	3.696	4.511	4.13
Silver		<0.0337	<0.02391	<0.02065	<0.01467	<0.01576	<0.0163	<0.01467	<0.0163	<0.0163
Sodium		8859	8859	8261	9728	8478	10054	10000	8424	7880
Strontium		9.783	7.609	10.87	3.75	5.163	4.239	5.435	6.522	5.217
Thallium		<0.1576	<0.1141	<0.09783	<0.07065	<0.07609	<0.07609	<0.07065	<0.07609	<0.07609
Vanadium		<0.5326	<0.3804	<0.3261	<0.4674	<0.5	<0.5054	<0.4674	<0.5054	<0.2554
Zinc		144.6	168.5	262.5	144.6	133.7	128.3	118.5	179.3	119.6
Egg Weight (g)		2.022	1.996	1.942	1.965	1.914	1.654	1.989	1.688	1.796
Clutch Size		6	5	5	5	5	6	5	5	3
Egg Length (cm)		1.964	1.937	1.926	2.068	1.974	1.897	1.904	1.943	1.885
Egg Width (cm)		1.384	1.392	1.35	1.346	1.35	1.296	1.409	1.292	1.331
Egg Volume (cm^3)		1.919	1.914	1.79	1.911	1.835	1.625	1.928	1.654	1.703

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-5. Tree Swallow Egg 2010 Sample Results, Clinch River Mile 1.0 (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-CRM1.0.BH370_TS.E.G.01-BD-051010 5/10/2010	KIF-CRM1.0.BH373_TS.E.G.02-BD-051010 5/10/2010	KIF-CRM1.0.BH374_TS.E.G.03-BD-051010 5/10/2010	KIF-CRM1.0.BH381_TS.E.G.04-BD-051010 5/10/2010	KIF-CRM1.0.BH384_TS.E.G.05-BD-051010 5/10/2010	KIF-CRM1.0.BH388_TS.E.G.06-BD-051010 5/10/2010	KIF-CRM1.0.BH389_TS.E.G.07-BD-051010 5/10/2010	KIF-CRM1.0.BH390_TS.E.G.08-BD-051010 5/10/2010
Aluminum		R	R	R	R	R	R	R	R
Antimony		<0.09783	<0.1141	<0.08152	<0.07609	<0.09239	<0.08152	<0.1033	<0.1033
Arsenic		<0.1848	<0.2283	<0.1576	<0.1522	<0.1793	<0.1522	<0.1957	<0.2011
Barium		17.39	8.696	12.5	7.609	16.3	2.989	1.522	35.33
Beryllium		<0.1957	<0.2391	<0.163	<0.1576	<0.1848	<0.163	<0.2065	<0.212
Boron		<2.717	<3.37	<2.337	<2.228	<2.609	<2.283	<2.935	<2.989
Cadmium		<0.07609	<0.1141	<0.05978	<0.04946	<0.06522	<0.04783	<0.0538	<0.06522
Calcium		3799 J	5022 J	7174 J	3630 J	3712 J	13478 J	4935 J	5652 J
Chromium		0.8696 J	1.522 J	<0.7065	<0.7065	0.8696 J	1.087 J	0.9239 J	0.9239 J
Cobalt		0.09239 J	0.1685 J	0.125 J	<0.07609	0.09239 J	0.08152 J	0.1359 J	0.1033 J
Copper		3.37	2.065 J	2.88	2.663	3.152	2.989	3.967	3.315 J
Iron		164.7	245.1	256	178.8	160.3	132.1	158.7 J	282.1
Lead		<0.3587	<0.4348	<0.2989	<0.2935	<0.3424	<0.2935	<0.3804	<0.3859
Magnesium		413 J	559.8 J	679.3	447.3 J	390.8 J	587	506.5 J	597.8 J
Manganese		5.326	9.239	8.152	4.674	5.217	5 J	5.978	14.67
Mercury		<0.1685	<0.1848	<0.1467	<0.2609	<0.1685	<0.2446	<0.3696	<0.1902
Molybdenum		<0.2337	0.2826 J	<0.1957	<0.1902	<0.2228	<0.1957	<0.25	<0.2554
Nickel		2.065 J	<0.8152	<0.5435	<0.5272	<0.5978	<0.538	<0.7065	<0.7065
Potassium		8859 J	8424 J	7772 J	9946 J	8478 J	10163 J	10326 J	8207 J
Selenium		3.424	3.859	3.261	3.207	2.935	3.043	4.783	4.022
Silver		<0.01902	0.05435 J	0.01685 J	<0.01576	<0.01848	<0.01576	<0.02065	<0.02065
Sodium		9837	9620	10272	11087	9565	11196	11141	10000
Strontium		5.978 J	5.978 J	8.696 J	3.804 J	5.978 J	7.065 J	3.587 J	6.522 J
Thallium		<0.09239	0.1196 J	<0.07609	<0.07609	<0.08696	<0.07609	<0.09783	<0.09783
Vanadium		<0.3043	<0.3696	<0.2554	<0.2446	<0.288	<0.25	<0.3207	<0.3261
Zinc		85.87	143.5	141.8	96.74	84.78	68.48	94.02	167.4
Egg Weight (g)		1.857	1.982	1.839	1.731	1.989	1.43	1.482	1.664
Clutch Size		5	5	6	5	6	4	4	6
Egg Length (cm)		1.809	2.039	1.888	1.886	1.989	1.738	1.866	1.774
Egg Width (cm)		1.375	1.362	1.348	1.342	1.402	1.303	1.325	1.334
Egg Volume (cm^3)		1.744	1.929	1.75	1.732	1.994	1.505	1.671	1.61

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.
R - Rejected data.

Table D-5. Tree Swallow Egg 2010 Sample Results, Clinch River Mile 1.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-CRM1.0.BH391_TS.E.G.09-BD-051010 5/10/2010	KIF-CRM1.0.BH393_TS.E.G.10-BD-051010 5/10/2010	KIF-CRM1.0.BH396_TS.E.G.11-BD-051010 5/10/2010	KIF-CRM1.0.BH401_TS.E.G.12-BD-051010 5/10/2010	KIF-CRM1.0.BH402_TS.E.G.13-BD-051010 5/10/2010	KIF-CRM1.0.BH403_TS.E.G.14-BD-051010 5/10/2010	KIF-CRM1.0.BH407_TS.E.G.15-BD-051010 5/10/2010
Aluminum		R	R	R	R	R	R	R
Antimony		<0.125	<0.1033	<0.08696	<0.07609	<0.1087	<0.07609	<0.1522
Arsenic		<0.2446	<0.2065	<0.1739	<0.1522	<0.212	<0.1467	<0.2935
Barium		16.85	8.152	4.348	13.59	12.5	15.22	10.33
Beryllium		<0.2609	<0.2174	<0.1848	<0.1576	<0.2228	<0.1522	<0.3098
Boron		<3.641	<3.043	<2.554	<2.228	<3.098	<2.174	<4.348
Cadmium		<0.1141	<0.06522	<0.0538	<0.05217	<0.06522	<0.04239	<0.1196
Calcium		7446 J	7174 J	5082 J	18098 J	3734 J	4739 J	3043 J
Chromium		<1.141	<0.9239	0.8696 J	0.7609 J	<0.9783	<0.6522	<1.304
Cobalt		0.212 J	0.2554 J	0.125 J	<0.07609	<0.1033	0.07609 J	<0.1467
Copper		2.717 J	2.554 J	2.283 J	2.5 J	2.5 J	2.174 J	2.772 J
Iron		361.4	295.7	189.1	126.6 J	125 J	222.3	<125.5
Lead		<0.4891	<0.3913	<0.337	<0.2935	<0.4076	<0.2826	<0.5435
Magnesium		706.5 J	614.1 J	535.3 J	481 J	439.1 J	451.1 J	<503.3
Manganese		16.85	16.3	6.522	5.978 J	4.239	8.152	5.435
Mercury		<0.125	<0.1359	<0.1685	<0.1957	<0.2283	<0.1793	<0.1522
Molybdenum		<0.3098	0.2772 J	<0.2174	<0.1902	<0.2663	<0.1848	<0.3696
Nickel		<0.8696	<0.7065	<0.5978	<0.5326	<0.7609	<0.5109	<1.033
Potassium		7228 J	7120 J	8207 J	7935 J	8533 J	8804 J	7826 J
Selenium		5.978	4.62	3.967	3.152	3.424	3.424	2.5
Silver		<0.02554	<0.0212	<0.01793	<0.01576	<0.02174	<0.01522	<0.03043
Sodium		8043	7880	10109	10598	10380	8967	9185
Strontium		9.239 J	5.978 J	4.783 J	16.85 J	5.272 J	6.522 J	4.022 J
Thallium		<0.1196	<0.09783	<0.08696	<0.07609	<0.1033	<0.07065	<0.1413
Vanadium		<0.4022	<0.3315	<0.2826	<0.25	<0.3424	<0.2391	<0.4783
Zinc		195.7	153.3	119	96.2	97.28	153.8	94.57
Egg Weight (g)		1.91	1.739	1.933	2.034	1.821	2.054	1.906
Clutch Size		5	5	6	6	6	5	5
Egg Length (cm)		1.957	1.833	1.924	2.147	1.902	2.062	2.003
Egg Width (cm)		1.36	1.342	1.392	1.351	1.358	1.354	1.349
Egg Volume (cm^3)		1.846	1.684	1.901	1.999	1.789	1.928	1.859

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.
R - Rejected data.

Table D-6. Tree Swallow Egg 2009 and 2010 Sample Results, Clinch River Mile 2.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID:	KIF-DISCHARGE03-TS.E.01-BD-050809	KIF-DISCHARGE03-TS.E.03-BD-061609	KIF-DISCHARGE04-TS.E.01-BD-060109	KIF-DISCHARGE05-TS.E.01-BD-050809	KIF-DISCHARGE05-TS.E.02-BD-061609	KIF-DISCHARGE06-TS.E.01-BD-050809	KIF-DISCHARGE06-TS.E.02-BD-061609	KIF-DISCHARGE07-TS.E.01-BD-060109	KIF-DISCHARGE08-TS.E.01-BD-050809	KIF-DISCHARGE09-TS.E.01-BD-050809	KIF-DISCHARGE10-TS.E.01-BD-060809
	Sample Date:	5/8/2009	6/16/2009	6/1/2009	5/8/2009	6/16/2009	5/8/2009	6/16/2009	6/1/2009	5/8/2009	5/8/2009	6/8/2009
Aluminum		<265.2	<262.3	<135.5	<136	<132	<135.4	<135.6	<135.1	<135.3	<134.5	<135.3
Antimony		<1.087	<1.043	<0.5358	<0.5398	<0.5305	<0.5488	<0.5444	<0.5402	<0.54	<0.538	<0.538
Arsenic		<1.087	<1.043	<0.5358	<0.5398	<0.5305	<0.5488	<0.5444	<0.5402	<0.54	<0.538	<0.538
Barium		10.33	10.79	8.997	3.426	5.058	11.38	6.677	6.328	13.8	9.577	11.96
Beryllium		<1.087	<1.043	<0.5358	<0.5398	<0.5305	<0.5488	<0.5444	<0.5402	<0.54	<0.538	<0.538
Boron		<21.2	<20.87	<10.82	<10.8	<10.61	<10.77	<10.89	<10.8	<10.8	<10.76	<10.87
Cadmium		<1.087	<1.043	<0.5358	<0.5398	<0.5305	<0.5488	<0.5444	<0.5402	<0.54	<0.538	<0.538
Calcium		41196	9498	22643	4339	2480	48783	2311	22535	80700	5079	4397
Chromium		<1.087	<1.043	<1.314	<0.5398	<0.5305	<0.6911	<0.5444	<1.003	<0.54	<0.5596	<0.7065
Cobalt		<1.087	<1.043	<0.5358	<0.5398	<0.5305	<0.5488	<0.5444	<0.5402	<0.54	<0.538	<0.538
Copper		<5.326	<5.397	4.549	<2.699	2.714	3.455	<2.671	3.55	3	<2.69	<2.717
Iron		<265.2	431.7	150.6	151.6	<132	<135.4	<135.6	<135.1	265.5	173.3	<221.7
Lead		<1.087	<1.043	<0.5358	<0.5398	<0.5305	0.8943	<0.5444	<0.5402	<0.54	<0.538	<0.538
Magnesium		<1060	<1051	678.3	566.8	<529.3	<542.7	<544.4	689.2	867	538	<540.2
Manganese		5.978	18.35	3.639	<2.699	<2.591	7.317	3.595	<2.701	6.6	10.76	<11.41
Mercury		<0.212	<0.2087	<0.182	<0.1038	0.1974 J	<0.1077	0.113 J	<0.1312	<0.108	<0.1076	<0.1467
Molybdenum		<10.87	<10.43	<5.358	<5.398	<5.305	<5.488	<5.444	<5.402	<5.4	<5.38	<5.38
Nickel		<1.087	<1.043	<0.9401	<0.5398	<0.5305	<0.5488	<0.5444	<0.7717	<0.54	<0.538	<0.538
Potassium		8587	6188	11221	8232	7883	8151	7930	8566	5805	7350	7174
Selenium		2.772	6.836 J	4.65	2.699	2.838 J	2.846	2.465 J	2.855	4.5	3.551	3.315
Silver		<0.5326	<0.5397	<0.2729	<0.2699	<0.2591	<0.2642	<0.2671	<0.2701	<0.27	<0.269	<0.2717
Sodium		9511	6728	12333 J	9467	9598	8151	8176	10187 J	6630	8307	7935
Strontium		28.8	12.23	18.3 J	5.086	4.195	36.59	3.492	24.85 J	51.45	6.457	4.946
Thallium		<1.087	<1.043	<0.5358	<0.5398	<0.5305	<0.5488	<0.5444	<0.5402	<0.54	<0.538	<0.538
Vanadium		<2.12	<2.087	<1.112	<1.038	<1.061	<1.077	<1.13	<1.08	<1.08	<1.076	<1.087
Zinc		79.89	237.1	88.25	59.48	37.63	68.5	62.45	57.49	131.4	128.1	119
Egg Weight (g)		2	2	1	1	1	1	2	1	1	2	1
Clutch Size		5	4	5	6	5	5	4	6	3	6	4
Egg Length (cm)		1.902	2.042	2.045	2.035	1.943	1.859	2.016	2.01	1.959	2.019	1.688
Egg Width (cm)		1.336	1.325	1.354	1.416	1.387	1.298	1.412	1.37	1.377	1.338	1.287
Egg Volume (cm^3)		1.731	1.828	1.912	2.081	1.906	1.597	2.05	1.924	1.894	1.843	1.426

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-6. Tree Swallow Egg 2009 and 2010 Sample Results, Clinch River Mile 2.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID:	KIF-CRM2.5.BH328_TS.E.G.05-BD-050510	KIF-CRM2.5.BH332_TS.E.G.06-BD-050510	KIF-CRM2.5.BH333_TS.E.G.07-BD-050510	KIF-CRM2.5.BH334_TS.E.G.08-BD-050510	KIF-CRM2.5.BH336_TS.E.G.09-BD-050510	KIF-CRM2.5.BH338_TS.E.G.10-BD-050510	KIF-CRM2.5.BH339_TS.E.G.11-BD-050510	KIF-CRM2.5.BH342_TS.E.G.12-BD-050510	KIF-CRM2.5.BH344_TS.E.G.13-BD-050510	KIF-CRM2.5.BH350_TS.E.G.14-BD-050510	KIF-CRM2.5.BH352_TS.E.G.15-BD-050510
	Sample Date:	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010	5/5/2010
Aluminum		R	R	R	R	R	R	R	R	R	R	R
Antimony		<0.08152	<0.07609	<0.2228	<0.08152	<0.08152	<0.07065	<0.06522	<0.1359	<0.08152	<0.1141	<0.07609
Arsenic		<0.1576	<0.1467	<0.4348	<0.1576	<0.1522	<0.1413	<0.1304	<0.2663	<0.1576	<0.2228	<0.1467
Barium		4.076	5.978	7.609	2.391	7.609	2.283	4.239	2.5	11.41	14.13	4.783
Beryllium		<0.163	<0.1522	<0.4565	<0.163	<0.163	<0.1467	<0.1359	<0.2772	<0.163	<0.2337	<0.1576
Boron		<2.337	<2.174	<6.522	<2.283	<2.283	<2.12	<1.902	<3.913	<2.283	<3.315	<2.174
Cadmium		<0.04239	<0.03967	<0.1196	<0.04239	<0.04185	<0.03859	<0.03533	<0.07065	<0.04185	<0.05978	<0.04022
Calcium		3239	3984	3402	4761	4832	4158	5266	5870	51087	5147	3929
Chromium		<0.7065	<0.6522	<1.957	<0.7065	<0.7065	<0.6522	<0.5978	<1.196	<0.7065	<1.033	<0.6522
Cobalt		<0.07609	<0.07609	<0.2174	0.09239 J	0.08152 J	0.1522 J	0.06522 J	0.2228 J	<0.07609	0.1196 J	0.163 J
Copper		2.772	3.043	5.054 J	4.022	3.75	2.88	4.511	3.913 J	3.043	2.12 J	1.848 J
Iron		121.7 J	172.3	<185.9	115.2 J	137	148.4	125	233.7	112 J	251.6	213
Lead		<0.1576	<0.1467	<0.4293	<0.1522	<0.1522	<0.1413	<0.1304	<0.2609	<0.1522	<0.2228	<0.1467
Magnesium		448.9 J	441.3 J	<744.6	385.3 J	515.2 J	481 J	469	603.3 J	565.2	576.1 J	472.3 J
Manganese		3.315	5.054	3.804 J	3.641	6.522	5.978	3.696	8.696	3.696 J	8.696	9.783
Mercury		<0.1793	<0.163	<0.2446	<0.2228	<0.2065	<0.1957	<0.1576	<0.2989	<0.1413	<0.1848	<0.1848
Molybdenum		<0.3859	<0.3641	<1.087	<0.3859	<0.3804	<0.3533	<0.3207	<0.6522	<0.3859	<0.5435	<0.3696
Nickel		<0.5435	<0.5109	<1.522	<0.5435	<0.538	<0.4946	<0.4565	<0.9239	<0.538	<0.7609	<0.5163
Potassium		8804	8859	11087	10707	12337	10217	9457	11848	8098	9022	8967
Selenium		2.989	2.826	3.587	3.75	4.511	4.402	3.261	5.217	2.446	4.565	3.587
Silver		<0.0163	<0.01522	<0.04457	<0.01576	<0.01576	<0.01467	<0.01359	<0.02717	<0.01576	<0.02283	<0.01522
Sodium		9402	9946	11033	10380	12065	10815	9837	12609	8967	8261	9511
Strontium		3.533	4.185	4.293	4.783	5.435	3.804	5	4.62	27.72	7.065	3.859
Thallium		<0.07609	<0.07065	<0.212	<0.07609	<0.07609	<0.07065	<0.06522	<0.1304	<0.07609	<0.1087	<0.07065
Vanadium		<0.5054	<0.4728	<1.413	<0.5	<0.4946	<0.4565	<0.4239	<0.8696	<0.5	<0.7065	<0.4783
Zinc		62.5	79.89	64.67 J	62.5	113	72.28	64.13	121.7	64.67	138.6	96.2
Egg Weight (g)		1.75	1.935	1.77	1.508	1.493	1.497	1.698	1.628	1.82	1.417	1.656
Clutch Size		6	6	6	6	5	6	5	5	6	6	5
Egg Length (cm)		1.9	1.912	1.967	1.874	1.89	1.759	1.996	1.837	1.914	1.706	1.767
Egg Width (cm)		1.357	1.376	1.303	1.282	1.357	1.327	1.283	1.307	1.35	1.23	1.345
Egg Volume (cm^3)		1.784	1.846	1.703	1.571	1.775	1.58	1.676	1.6	1.779	1.316	1.63

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.
R - Rejected data.

Table D-7. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-FARM01-TS.E.01-BD-061409 6/14/2009	KIF-FARM02-TS.E.01-BD-050809 5/8/2009	KIF-FARM03-TS.E.01-BD-050809 5/8/2009	KIF-FARM03-TS.E.04-BD-062109 6/21/2009	KIF-FARM04-TS.E.01-BD-050809 5/8/2009	KIF-FARM04-TS.E.02-BD-062109 6/21/2009	KIF-FARM05-TS.E.01-BD-062109 6/21/2009	KIF-FARM06-TS.E.01-BD-050809 5/8/2009	KIF-FARM06-TS.E.02-BD-060409 6/4/2009
Aluminum		<135.3	<135	<135.6	<137.1	<134.8	<134.5	<134.8	<135.6	<260.3
Antimony		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Arsenic		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Barium		11.96	2.25	16.6	7.849	4.722	2.826	8.37	7.239	22.28
Beryllium		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Boron		<10.87	<10.8	<10.78	<10.97	<10.82	<10.74	<10.87	<10.86	<20.65
Cadmium		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Calcium		4429	4763	27799	2695	24789	10253	4576	26785	22500
Chromium		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.6104	<0.5435	<0.5429	<1.033
Cobalt		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Copper		<2.717	<2.7	2.78	3.593	<2.656	2.939	<2.717	2.715	11.96
Iron		157.1	244.5	205.5	<137.1	<134.8	<134.5	167.4	260.6	513
Lead		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Magnesium		<541.3	<540	657.1	<547.5	<540	<537	<541.3	689.5	1793
Manganese		3.043	3.75	7.329	<2.742	8.558	<2.713	7.391	13.57	19.57
Mercury		<0.1196	<0.105	<0.1095	0.2175 J	<0.1082	0.1809 J	<0.1304	<0.1086	0.5 J
Molybdenum		<5.435	<5.4	<5.391	<5.485	<5.41	<5.426	<5.435	<5.429	<10.33
Nickel		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Potassium		8533	6068	7548	6657	7791	8026	5304	6189	33043
Selenium		4.022	4.125	3.201	2.459	2.951	3.165	3.587	4.163	10.87
Silver		<0.2717	<0.27	<0.2696	<0.2742	<0.2656	<0.2713	<0.2717	<0.2715	<0.5217
Sodium		9674	7875	8845	8795	7771	8919	6837	7384	43587
Strontium		6.522 J	4.875	23.5	4.445	16.72	8.365	7.609	18.1	20.65 J
Thallium		<0.5435	<0.54	<0.5391	<0.5485	<0.541	<0.5426	<0.5435	<0.5429	<1.033
Vanadium		<1.087	<1.05	<1.095	<1.135	<1.082	<1.074	<1.087	<1.086	<2.065
Zinc		76.63	109.5	128	62.41	82.53	56.63	106.4	130.8	315.8 J
Egg Weight (g)		1	2	2	1	1	1	1	2	1
Clutch Size		5	3	4	4	6	5	2	6	3
Egg Length (cm)		1.913	2.101	1.959	1.89	1.728	1.752	1.951	1.899	1.959
Egg Width (cm)		1.342	1.343	1.376	1.355	1.19	1.251	1.417	1.326	1.364
Egg Volume (cm^3)		1.757	1.933	1.892	1.77	1.248	1.398	1.998	1.703	1.859

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-7. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte / Sample ID: / Sample Date:	KIF-FARM07-TS.E.01-BD-050809 5/8/2009	KIF-FARM08-TS.E.01-BD-050809 5/8/2009	KIF-FARM09-TS.E.01-BD-050809 5/8/2009	KIF-FARM10-TS.E.01-BD-050809 5/8/2009	KIF-ERM3.5.BH046_TS.E.G.04-BD-050610 5/6/2010	KIF-ERM3.5.BH047_TS.E.G.03-BD-050610 5/6/2010	KIF-ERM3.5.BH049_TS.E.G.01-BD-050610 5/6/2010	KIF-ERM3.5.BH050_TS.E.G.02-BD-050610 5/6/2010
Aluminum	<135.4	<174.5	<161.4	<135.1	<19.57	<22.28	<21.74	<21.74
Antimony	<0.5416	<0.7065	<0.6522	<0.5387	<0.07065	<0.08152	<0.07609	<0.07609
Arsenic	<0.5416	<0.7065	<0.6522	<0.5387	<0.2717	<0.3152	<0.3043	<0.3043
Barium	12.23	5.38	<0.6522	10.59	2.446	2.5	5.054	4.076
Beryllium	<0.5416	<0.7065	<0.6522	<0.5387	<0.1413	<0.163	<0.1576	<0.1576
Boron	<10.83	<14.13	<13.04	<10.77	<2.011	<2.337	<2.228	<2.228
Cadmium	<0.5416	<0.7065	<0.6522	<0.5387	<0.04728	<0.05435	<0.04565	<0.0413
Calcium	22650	6576	673.9	4912	4130	3533	4277	2967
Chromium	<0.5416	<0.7065	<0.6522	<0.5661	<0.5978	0.7609 J	<0.7065	<0.7065
Cobalt	<0.5416	<0.7065	<0.6522	<0.5387	0.1087 J	0.09783 J	<0.07609	<0.07609
Copper	<2.708	<3.478	<3.207	<2.739	2.337	2.826	4.348	2.5 J
Iron	247.8	272.3	<161.4	164.3	177.7	123.9 J	92.39 J	95.65 J
Lead	<0.5416	<0.7065	<0.6522	<0.5387	<0.1359	<0.1576	<0.1522	<0.1522
Magnesium	552.3	<701.1	<646.7	<540.5	497.8	384.2 J	335.3 J	322.8 J
Manganese	4.924	10.87	<3.207	5.661	7.609	5.272	3.478	3.587
Mercury	<0.1067	<0.1413	<0.1304	<0.1096	<0.212	<0.2391	<0.2391	<0.1957
Molybdenum	<5.416	<7.065	<6.522	<5.387	<0.1685	<0.1957	<0.1902	<0.1902
Nickel	<0.5416	<0.7065	<0.6522	0.5661 J	<0.4728	<0.5435	<0.5272	<0.5272
Potassium	7952	6957	7391	7843	7989	6739	9130	7554
Selenium	3.693	4.13	<1.304	2.83	3.533	2.772	2.772	2.391
Silver	<0.2708	<0.3478	<0.3207	<0.2739	<0.01413	<0.0163	<0.01576	<0.01576
Sodium	7583	7609	9565	7551	9891	9239	10000	10326
Strontium	17.48	6.522	1.087	6.848	3.804 J	3.533 J	4.076 J	3.207 J
Thallium	<0.5416	<0.7065	<0.6522	<0.5387	<0.06522	<0.07609	<0.07609	<0.07609
Vanadium	<1.067	<1.413	<1.304	<1.096	<0.4402	<0.5109	<0.4946	<0.4946
Zinc	130.5	128.3	<13.04	121.4	85.33	63.59	63.59	72.28
Egg Weight (g)	1	2	2	2	1.842	1.873	2.147	1.8
Clutch Size	5	4	4	6	6	4	6	5
Egg Length (cm)	1.836	1.845	2.036	1.891	1.887	1.918	2.144	1.943
Egg Width (cm)	1.243	1.354	1.371	1.338	1.378	1.385	1.373	1.323
Egg Volume (cm^3)	1.447	1.725	1.952	1.727	1.827	1.876	2.061	1.734

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-7. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-ERM3.5.BH039_TS.E.G.01-BD-050710 / 5/7/2010	KIF-ERM3.5.BH042_TS.E.G.01-BD-051110 / 5/11/2010	KIF-ERM3.5.BH042_TS.E.G.02-BD-051210 / 5/12/2010	KIF-ERM3.5.BH044_TS.E.G.01-BD-051210 / 5/12/2010	KIF-ERM3.5.BH036_TS.E.G.01-BD-051810 / 5/18/2010	KIF-ERM3.5.BH041_TS.E.G.02-BD-051810 / 5/18/2010	KIF-ERM3.5.BH040_TS.E.G.01-BD-060310 / 6/3/2010	KIF-ERM3.5.BH049_TS.E.G.02-BD-060310 / 6/3/2010
Aluminum		<20.65	<21.2	<21.74	33.7 J	<21.74	<22.28	<20.65	<22.28
Antimony		<0.07609	<0.07609	<0.08152	<0.08152	<0.08152	<0.08152	<0.07609	<0.08152
Arsenic		<0.2935	<0.2935	<0.1522	<0.3043	<0.3098	<0.3098	<0.1467	<0.1576
Barium		10.87	5.978	7.065	7.609	2.228	15.22	5.217	7.065
Beryllium		<0.1522	<0.3043	<0.3261	<0.163	<0.3152	<0.3207	<0.1522	<0.163
Boron		<2.174	<2.174	<2.283	6.522 J	<2.283	<2.283	<6.467	<6.848
Cadmium		<0.03967	<0.07065	<0.0413	<0.04185	<0.07609	<0.07609	<0.08152	<0.08696
Calcium		4793	4598	4826	4663	3451	5092	2826	3750
Chromium		<0.6522	<0.6522	<0.7065	<0.7065	1.25 J	<0.7065	5.435	<0.7065
Cobalt		0.1359 J	0.09239 J	0.1196 J	0.1359 J	0.08152 J	0.09239 J	0.08152 J	<0.07609
Copper		2.011 J	2.065 J	2.228 J	2.283 J	3.913	2.446 J	2.826	2.391 J
Iron		238	166.3	187.5	159.8	153.8	259.8	124.5 J	138 J
Lead		<0.1467	<0.4239	<0.1522	<0.1522	<0.4457	<0.4511	<0.2935	<0.3098
Magnesium		581.5	464.7 J	483.7 J	479.9 J	446.7 J	542.4	397.8 J	482.6 J
Manganese		6.522	9.783	7.609	5.435	5.978	9.783	3.315	5.435
Mercury		<0.1576	0.1739	0.1522 J	<0.1957	0.2337	0.1793	0.2065	0.2826
Molybdenum		<0.1848	<0.1848	<0.1902	<0.1902	<0.1957	<0.1957	<0.1848	<0.1957
Nickel		6.522 J	<0.5109	<0.5326	<0.5326	<0.538	<0.5435	2.717	<0.538
Potassium		8043	8098	7663 J	9022	9076	8098	8424	8098
Selenium		3.696	3.859	4.185	2.88	3.098	3.859	2.12	2.663
Silver		<0.01522	<0.01522	<0.01576	<0.01576	<0.01576	<0.01576	<0.04891	<0.05435
Sodium		9511	8804	7337	9457	10815	8750	9565	9565
Strontium		7.609 J	4.837	5.978	5.978 J	4.13	5.978	3.75	4.457
Thallium		<0.07065	<0.07065	<0.07609	<0.07609	<0.07609	<0.07609	<0.212	<0.2228
Vanadium		<0.4783	<0.4728	<0.4946	<0.4946	<0.5	<0.5	<0.2391	<0.25
Zinc		134.2	104.9	117.4	115.2	76.63	147.8	95.65 J	82.07 J
Egg Weight (g)		1.92	1.792	1.784	1.711	1.922	1.819	1.907	1.952
Clutch Size		4	4	4	4	5	5	5	5
Egg Length (cm)		1.943	1.862	1.819	1.786	2.012	1.949	1.879	1.969
Egg Width (cm)		1.367	1.354	1.364	1.345	1.359	1.347	1.385	1.38
Egg Volume (cm^3)		1.852	1.741	1.726	1.648	1.895	1.804	1.838	1.912

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-8. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-RESIDENTIAL01-TS.E.01-BD-050809 5/8/2009	KIF-RESIDENTIAL02-TS.E.01-BD-052809 5/28/2009	KIF-RESIDENTIAL03-TS.E.01-BD-050809 5/8/2009	KIF-RESIDENTIAL04-TS.E.01-BD-050809 5/8/2009	KIF-RESIDENTIAL05-TS.E.01-BD-050809 5/8/2009	KIF-RESIDENTIAL06-TS.E.01-BD-050809 5/8/2009	KIF-RESIDENTIAL07-TS.E.01-BD-050809 5/8/2009	KIF-RESIDENTIAL08-TS.E.01-BD-052809 5/28/2009	KIF-RESIDENTIAL09-TS.E.01-BD-060409 6/4/2009	KIF-RESIDENTIAL10-TS.E.01-BD-050809 5/8/2009
Aluminum		<158.2	<135.9	<136.3	<135.4	<140.2	<135.8	<134.3	<134.9	<135.1	<136.3
Antimony		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Arsenic		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Barium		11.96	8.696	5.45	9.411	11.41	3.356	3.896	18.15	12.24	89.22
Beryllium		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Boron		<12.5	<10.87	<10.9	<10.81	<11.41	<10.77	<10.76	<10.85	<10.88	<10.9
Cadmium		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Calcium		7011	4141	5645	6995	5598	3462	3350	4143	2606	5056
Chromium		<0.6522	<0.5435	<0.7109	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Cobalt		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Copper		<3.152	3.37	<2.725	<2.734	<2.826	<2.649	<2.675	<2.762	<2.72	<2.726
Iron		331.5	171.7	237	400.6	257.1	<135.8	<134.3	199.3	163.6	156.1
Lead		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Magnesium		750	<543.5	547.4	654.9	<559.8	<542.3	<537.9	<540.6	<539.4	<544.4
Manganese		6.522	4.565	5.687	8.584	5.435	4.063	10	5.524	4.533	11.15
Mercury		<0.125	<0.1957	<0.1066	<0.1081	<0.1141	<0.1077	0.1745 J	<0.1282	<0.1314	<0.1074
Molybdenum		<6.522	<5.435	<5.45	<5.405	<5.435	<5.476	<5.408	<5.327	<5.439	<5.452
Nickel		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Potassium		6413	9674	7049	6009	7609	7683	7385	8069	7751	6923
Selenium		4.457	4.837	6.457	6.995	3.424	3.533	2.733	2.959	2.72	3.222
Silver		<0.3152	<0.2717	<0.2725	<0.2734	<0.2826	<0.2649	<0.2675	<0.2762	<0.272	<0.2726
Sodium		6739	8043	6753	7440	7174	8302	8199	7832	8136	7864
Strontium		9.783	5.978	9.301	9.157	10.33	4.239	6.339	6.116	3.853 J	20.16
Thallium		<0.6522	<0.5435	<0.545	<0.5405	<0.5435	<0.5476	<0.5408	<0.5327	<0.5439	<0.5452
Vanadium		<1.25	<1.087	<1.066	<1.081	<1.141	<1.077	<1.105	<1.085	<1.088	<1.074
Zinc		192.9	101.1	129.1	180.6	138	75.42	64.55	108.3	81.36 J	124.7
Egg Weight (g)		1	3	2	1	2	2	1	1	1	1
Clutch Size		5	3	5	6	6	6	5	4	4	5
Egg Length (cm)		2.002	1.927	1.835	1.819	1.891	1.984	1.792	1.862	1.913	1.835
Egg Width (cm)		1.322	1.379	1.288	1.354	1.306	1.351	1.312	1.368	1.319	1.409
Egg Volume (cm^3)		1.784	1.869	1.553	1.701	1.645	1.847	1.573	1.777	1.697	1.858

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-8. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-ERM3.0.BH162_TS.E.G.15-BD-050510 5/5/2010	KIF-ERM3.0.BH165_TS.E.G.14-BD-050510 5/5/2010	KIF-ERM3.0.BH167_TS.E.G.13-BD-050510 5/5/2010	KIF-ERM3.0.BH169_TS.E.G.12-BD-050510 5/5/2010	KIF-ERM3.0.BH171_TS.E.G.11-BD-050510 5/5/2010	KIF-ERM3.0.BH172_TS.E.G.10-BD-050510 5/5/2010	KIF-ERM3.0.BH173_TS.E.G.09-BD-050510 5/5/2010	KIF-ERM3.0.BH174_TS.E.G.08-BD-050510 5/5/2010	KIF-ERM3.0.BH176_TS.E.G.07-BD-050510 5/5/2010	KIF-ERM3.0.BH178_TS.E.G.06-BD-050510 5/5/2010
Aluminum		NA	NA	NA	NA	NA	<29.35	<57.61	<31.52	<23.37	<21.2
Antimony		<0.07609	<0.07609	<0.08152	<0.07609	<0.08696	<0.1087	<0.2065	<0.1141	<0.08152	<0.07609
Arsenic		<0.1467	<0.1467	<0.1576	<0.1467	<0.1739	<0.413	<0.8152	<0.4402	<0.3261	<0.2935
Barium		3.587	4.783	9.783	4.674	4.946	7.065	15.76	8.696	3.696	7.065
Beryllium		<0.1576	<0.1522	<0.163	<0.1576	<0.1793	<0.2174	<0.4239	<0.2337	<0.1685	<0.1522
Boron		<2.174	<2.174	<2.283	<2.174	<2.554	<3.043	<5.978	<3.261	<2.391	<2.174
Cadmium		<0.04022	<0.03967	<0.04239	<0.04022	<0.04674	<0.05435	<0.1087	<0.05978	<0.04402	<0.03967
Calcium		3897	2527	4022	4522	7880	6739	15543	7989	4424	4293
Chromium		<0.6522	<0.6522	<0.7065	<0.6522	<0.7609	<0.9239	<1.848	<0.9783	<0.7609	<0.6522
Cobalt		<0.07609	<0.07609	0.07609 J	0.125 J	0.125 J	0.3424 J	0.4076 J	0.2446 J	0.1359 J	<0.07609
Copper		2.065 J	2.065 J	3.859	3.098	2.717 J	3.152 J	4.022 J	3.315 J	3.152	3.478
Iron		119 J	100.5 J	222.8	228.8	215.8	383.2	717.4	342.9	110.9 J	157.1
Lead		<0.1467	<0.1467	<0.1522	<0.1467	<0.1685	<0.2065	<0.4022	<0.2174	<0.163	<0.1467
Magnesium		409.2 J	353.3 J	512.5 J	576.1	449.5 J	853.3	1489	880.4	422.3 J	517.9
Manganese		4.891	3.75	6.522	7.065	8.152	10.87	31.52	14.67	9.239	5
Mercury		<0.212	<0.1685	<0.1957	<0.2228	<0.2065	<0.2663	<0.1685	<0.2174	<0.212	<0.25
Molybdenum		<0.3641	<0.3641	<0.3859	<0.3696	<0.4239	0.2989 J	<0.5054	<0.2772	<0.2011	<0.1848
Nickel		<0.5163	<0.5109	<0.5435	<0.5163	<0.5978	9.783	21.74	11.41	6.522	5.978
Potassium		9728	9022	9076	9565	8859	9565	8207	10109	10761	10707
Selenium		3.098	2.717	3.859	4.783	5.978	7.609	13.04	8.152	4.348	4.783
Silver		<0.01522	<0.01522	<0.01576	<0.01522	<0.01793	<0.0212	<0.04185	<0.02283	<0.01685	<0.01522
Sodium		9130	9728	9674	10163	8967	11467	8478	11957	11413	11413
Strontium		4.674	4.946	8.152	5.435	7.609	14.67 J	17.93 J	10.33 J	5.109 J	5.978 J
Thallium		<0.07065	<0.07065	<0.07609	<0.07065	<0.08696	<0.1033	<0.1957	<0.1087	<0.08152	<0.07065
Vanadium		<0.4783	<0.4728	<0.5	<0.4837	<0.5435	<0.6522	<1.304	<0.7065	<0.5272	<0.4728
Zinc		77.72	55.98	108.2	109.8	115.2	170.1	386.4	227.2	69.02	109.2
Egg Weight (g)		1.725	1.937	1.936	1.914	1.652	1.655	1.763	1.764	1.442	1.604
Clutch Size		5	5	4	5	5	5	4	6	5	6
Egg Length (cm)		1.77	1.975	1.995	1.923	1.814	1.988	1.961	1.842	1.805	1.879
Egg Width (cm)		1.378	1.362	1.352	1.358	1.314	1.292	1.312	1.35	1.259	1.305
Egg Volume (cm^3)		1.714	1.868	1.86	1.809	1.597	1.692	1.722	1.712	1.459	1.632

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.
NA - Not applicable.

Table D-8. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-ERM3.0.BH183_TS.E.G.05-BD-050510 5/5/2010	KIF-ERM3.0.BH185_TS.E.G.04-BD-050510 5/5/2010	KIF-ERM3.0.BH186_TS.E.G.03-BD-050510 5/5/2010	KIF-ERM3.0.BH188_TS.E.G.01-BD-050510 5/5/2010	KIF-ERM3.0.BH189_TS.E.G.02-BD-050510 5/5/2010	KIF-ERM3.0.BH028_TS.E.G.02-BD-051110 5/11/2010	KIF-ERM3.0.BH029_TS.E.G.03-BD-051110 5/11/2010	KIF-ERM3.0.BH032_TS.E.G.01-BD-051110 5/11/2010	KIF-ERM3.0.BH293_TS.E.G.01-BD-051210 5/12/2010	KIF-ERM3.0.BH297_TS.E.G.02-BD-051210 5/12/2010
Aluminum		<22.28	<21.74	<20.65	<22.28	<22.28	<21.2	<21.74	<21.74	<22.28	<22.28
Antimony		<0.08152	<0.07609	<0.07609	<0.08152	<0.08152	<0.07609	<0.08152	<0.07609	<0.08152	0.2391 J
Arsenic		<0.3098	<0.3043	<0.2935	<0.3098	<0.3098	<0.2935	<0.3043	<0.2989	<0.3098	<0.3098
Barium		5.163	7.609	8.152	5.435	1.739	8.152	10.33	1.63	1.957	3.696
Beryllium		<0.163	<0.1576	<0.1522	<0.163	<0.163	<0.1576	<0.163	<0.1576	<0.3152	<0.3207
Boron		<2.283	<2.228	<2.174	<2.283	<2.283	<2.174	<2.283	<2.228	<2.283	<2.283
Cadmium		<0.04185	<0.0413	<0.03967	<0.04239	<0.04239	<0.04022	<0.04185	<0.0413	<0.2609	<0.1141
Calcium		23750	3603	2902	24076	3870	3962	5391	2696	9511	2864
Chromium		<0.7065	<0.7065	<0.6522	<0.7065	<0.7065	<0.6522	<0.7065	<0.7065	0.7609 J	<0.7065
Cobalt		0.1087 J	0.09783 J	<0.07609	<0.07609	0.1413 J	0.07609 J	0.1576 J	0.08152 J	0.1196 J	0.08152 J
Copper		2.391 J	2.5 J	3.152	2.935	3.043	2.5 J	2.554 J	2.663	3.37	3.478
Iron		173.4	182.6	137.5	123.9 J	225.5	120.1 J	266.8	100.5 J	182.6	135.9
Lead		<0.1522	<0.1522	<0.1467	<0.1576	<0.1522	<0.1467	<0.1522	<0.1522	<0.2989	<0.2989
Magnesium		458.7 J	454.3 J	363.6 J	657.6	441.3 J	439.7 J	559.8	326.1 J	527.2 J	386.4 J
Manganese		5.978 J	8.152	4.076	2.935 J	5.978	5.272	9.239	4.402	9.239	4.293
Mercury		<0.2174	<0.2663	<0.2065	<0.2228	<0.3696	<0.1522	<0.1739	<0.3098	<0.2826	0.2391
Molybdenum		<0.1957	<0.1902	<0.1848	<0.1957	0.1957 J	<0.1848	<0.1902	<0.1902	0.2011 J	<0.1957
Nickel		33.15 J	5.163	4.185	33.7 J	5.435	<0.5109	<0.5326	<0.5272	<0.538	<0.538
Potassium		8913	9239	10761	10815	9511	7717	8641	8587	8587	8424
Selenium		4.62	3.696	3.533	5.978	5.978	2.772	3.75	3.641	5.326	2.989
Silver		<0.01576	<0.01576	<0.01522	<0.0163	<0.01576	<0.01522	<0.01576	<0.01576	0.025 J	0.04076 J
Sodium		9348	10761	10489	12446	11957	10163	8478	10598	9185	9565
Strontium		16.85 J	5.435 J	4.565 J	19.02 J	4.837 J	5.978 J	6.522 J	3.152 J	6.522	3.098
Thallium		<0.07609	<0.07609	<0.07065	<0.07609	<0.07609	<0.07065	<0.07609	<0.07609	<0.07609	<0.07609
Vanadium		<0.5	<0.4891	<0.4728	<0.5054	<0.5	<0.4783	<0.4946	<0.4891	<0.5	<0.5
Zinc		86.96	93.48	76.09	75.54	98.37	83.15	138	46.74	126.1	67.39
Egg Weight (g)		1.72	1.771	1.529	1.513	1.897	1.843	1.622	1.85	1.579	1.688
Clutch Size		5	4	6	5	5	6	6	4	5	6
Egg Length (cm)		1.895	1.842	1.793	1.711	2.004	1.892	1.874	1.928	1.97	1.894
Egg Width (cm)		1.337	1.342	1.283	1.327	1.344	1.361	1.297	1.381	1.283	1.34
Egg Volume (cm^3)		1.728	1.692	1.505	1.537	1.846	1.787	1.608	1.875	1.654	1.734

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-8. Tree Swallow Egg 2009 and 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-ERM3.0.BH308_TS.E.G.03-BD-051210 5/12/2010	KIF-ERM3.0.BH310_TS.E.G.04-BD-051210 5/12/2010	KIF-ERM3.0.BH315_TS.E.G.05-BD-051210 5/12/2010	KIF-ERM3.0.BH319_TS.E.G.06-BD-051210 5/12/2010	KIF-ERM3.0.BH302_TS.E.G.03-BD-051810 5/18/2010	KIF-ERM3.0.BH016_TS.E.G.02-BD-051810 5/18/2010	KIF-ERM3.0.BH019_TS.E.G.01-BD-051810 5/18/2010	KIF-ERM3.0.BH026_TS.E.G.04-BD-051810 5/18/2010	KIF-ERM3.0.BH300_TS.E.G.01-BD-060310 6/3/2010	KIF-ERM3.0.BH306_TS.E.G.02-BD-060310 6/3/2010
Aluminum		<21.2	<28.8	<22.28	<20.11	<23.91	<21.2	<54.35	<35.33	<21.2	<22.28
Antimony		<0.07609	<0.1033	<0.08152	<0.07609	<0.08696	<0.07609	<0.1957	<0.125	<0.07609	<0.08152
Arsenic		<0.2935	<0.4022	<0.3152	<0.2826	<0.1685	<0.1522	<0.3804	<0.2446	<0.1467	<0.1576
Barium		4.565	26.09	14.67	5.978	25	18.48	7.609	21.2	6.522	5.978
Beryllium		<0.3043	<0.4185	<0.3261	<0.2935	<0.3424	<0.1576	<0.4022	<0.2609	<0.1576	<0.1685
Boron		<2.174	<2.989	<2.337	<2.12	<2.446	<2.228	<5.435	<3.641	<2.174	<2.337
Cadmium		<0.08152	<0.09783	<0.07609	<0.06522	<0.05	<0.06522	<0.1141	<0.08152	0.05435 J	<0.04293
Calcium		8152	8533	5870	5815	6848 J	7337 J	5147 J	28533 J	7065	4033
Chromium		1.413 J	1.467 J	<0.7065	<0.6522	<0.7609	0.7065 J	<1.739	<1.141	<0.6522	<0.7065
Cobalt		<0.07609	0.1902 J	0.1196 J	<0.07065	0.163 J	0.125 J	<0.1902	<0.125	0.1848 J	<0.08152
Copper		3.261	3.315 J	2.935	2.174 J	2.717 J	2.935	3.261 J	3.152 J	2.554	3.098
Iron		142.4	376.1	269.6	125.5	231	328.8	198.4 J	161.4 J	332.1	170.7
Lead		<0.2826	<0.3913	<0.3043	<0.2717	<0.1685	<0.1467	<0.3804	<0.2446	<0.1467	<0.1576
Magnesium		375.5 J	994.6	684.8	353.3 J	690.2	722.8	<657.6	527.7 J	820.7	451.6 J
Manganese		4.185	7.609	11.96	3.913	9.783	10.87	8.696	5.978 J	10.87	4.239
Mercury		0.25	0.2609	0.1848	0.2174	<0.1739	<0.1522	<0.2935	<0.2717	0.1359	0.1848
Molybdenum		<0.1848	0.2609 J	<0.1957	<0.1793	<0.212	0.2446 J	<0.4783	<0.3098	<0.2554	<0.1957
Nickel		0.6522 J	<0.7065	<0.5435	<0.4946	<0.5978	<0.5217	<1.304	<0.8696	<0.5163	<0.5435
Potassium		11033	9674	9022	9674	7609 J	9076 J	8098 J	7826 J	6902	8533
Selenium		3.804	6.522	4.891	2.772	4.837	4.728	3.587	2.446	5.217	2.989
Silver		<0.01522	<0.02065	<0.0163	<0.01467	<0.01739	<0.01576	<0.03913	<0.02554	<0.01848	<0.0163
Sodium		10978	10217	10435	10707	10272	8533	9022	9130	8261	8967
Strontium		5.978	18.48	8.696	5.163	9.239 J	9.239 J	7.609 J	33.15 J	8.152	4.946
Thallium		<0.07065	<0.09783	<0.07609	<0.07065	<0.08152	<0.07609	<0.1902	<0.1196	<0.1087	<0.07609
Vanadium		<0.4783	<0.06522	<0.5109	<0.462	<0.2717	<0.2446	<0.5978	<0.4022	<0.4783	<0.5109
Zinc		79.35	248.9	145.7	62.5	169	204.3	101.1	104.9	139.1	82.61
Egg Weight (g)		1.505	1.964	2.097	1.746	1.839	2.009	1.782	1.985	1.705	1.475
Clutch Size		6	5	4	5	4	4	6	5	5	5
Egg Length (cm)		1.954	1.885	2.09	2.049	2.019	1.878	1.891	1.892	1.915	1.798
Egg Width (cm)		1.295	1.419	1.355	1.282	1.322	1.408	1.355	1.408	1.297	1.254
Egg Volume (cm^3)		1.671	1.936	1.957	1.717	1.8	1.899	1.771	1.913	1.643	1.442

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-9. Tree Swallow Egg 2010 Sample Results, Embayments[1] (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-EEMBAY.BH197_TS.E.G.03-BD-050510 5/5/2010	KIF-EEMBAY.BH201_TS.E.G.02-BD-050510 5/5/2010	KIF-EEMBAY.BH208_TS.E.G.01-BD-050510 5/5/2010	KIF-EEMBAY.BH202_TS.E.G.01-BD-051110 5/11/2010	KIF-NEMBAY.BH215_TS.E.G.02-BD-050610 5/6/2010	KIF-NEMBAY.BH248_TS.E.G.01-BD-050610 5/6/2010	KIF-NEMBAY.BH243_TS.E.G.01-BD-051110 5/11/2010	KIF-NEMBAY.BH231_TS.E.G.01-BD-060310 6/3/2010	KIF-WEMBAY.BH268_TS.E.G.01-BD-050610 5/6/2010	KIF-WEMBAY.BH272_TS.E.G.02-BD-050610 5/6/2010
Aluminum		<36.41	<36.41	<21.89	<22.28	<20.65	<20.65	<21.74	<20.65	<20.11	<22.28
Antimony		<0.1304	<0.1304	<0.0793	<0.08152	<0.07609	<0.07609	<0.07609	<0.07609	<0.07065	<0.08152
Arsenic		<0.2554	<0.2554	<0.157	<0.3152	<0.2935	<0.2935	<0.3043	<0.1467	<0.2772	<0.3098
Barium		15.76	8.152	1.983	11.96	9.783	7.609	15.22	4.022	9.239	4.239
Beryllium		<0.5435	<0.5435	<0.3271	<0.3207	<0.1522	<0.1522	<0.3152	<0.1522	<0.1467	<0.163
Boron		<3.75	<3.804	<2.23	<2.337	<2.174	<2.174	<2.228	<6.359	<2.065	<2.283
Cadmium		<0.1413	<0.1413	<0.01322	<0.08152	<0.03967	<0.03967	<0.07065	<0.08152	<0.03804	<0.04185
Calcium		6359	17283	3486	5174	24565	4196	8043	3370	4408	3098
Chromium		<1.141	<1.141	<0.6939	<0.7065	<0.6522	<0.6522	0.7065 J	<0.6522	<0.6522	<0.7065
Cobalt		<0.1304	0.1957 J	0.09913 J	0.1957 J	<0.07609	0.1522 J	0.1196 J	0.1359 J	0.1196 J	<0.07609
Copper		2.554 J	2.554 J	2.643	2.12 J	2.826	3.098	2.609	2.12 J	2.391	2.554 J
Iron		203.8 J	301.1	131.3 J	222.8	111.4 J	188.6	329.3	232.1 J	208.7	116.3 J
Lead		<0.2554	<0.2554	<0.1487	<0.4511	<0.1467	<0.1467	<0.4402	<0.288	<0.1413	<0.1522
Magnesium		880.4	728.3 J	437.8 J	490.2 J	385.9 J	523.9	663	464.7 J	519.6	401.1 J
Manganese		13.59	20.11	7.435	14.13	4.728 J	8.696	10.33	8.152	7.609	2.283 J
Mercury		0.1793 J	0.163 J	0.2396 J	0.1413	<0.2554	<0.2391	0.2065	0.1957	<0.212	<0.288
Molybdenum		<0.3207	<0.3207	0.2313 J	0.212 J	<0.1848	<0.1848	<0.1902	<0.1793	<0.1739	<0.1957
Nickel		<0.8696	<0.8696	<0.537	<0.5435	34.24 J	5.978	<0.5272	<0.5	5.978	4.402
Potassium		9076	8750	8839	8478	8859	8207	9022	7446	7989	9185
Selenium		4.239	5.109	3.717	4.457	2.826	4.076	5.978	4.022	5.054	4.293
Silver		<0.02609	<0.02663	<0.0157	<0.0163	<0.01522	<0.01522	<0.01576	<0.04891	<0.01467	<0.01576
Sodium		11250	9565	10491	8967	10272	9946	10380	8370	9130	10707
Strontium		8.696	10.33	3.47	5.978	20.11 J	4.783 J	9.783	3.533	7.065 J	3.804 J
Thallium		<0.125	<0.125	<0.07517	<0.07609	<0.07065	<0.07065	<0.07609	<0.2065	0.07065 J	<0.07609
Vanadium		<0.413	<0.4185	<0.2478	<0.5054	<0.4728	<0.4728	<0.4891	<0.2337	<0.4511	<0.5
Zinc		174.5	139.7	73.52	115.2	64.67	106	157.1	92.39 J	121.7	70.11
Egg Weight (g)		1.88	1.956	1.794	1.865	1.721	1.75	1.649	1.685	1.855	1.744
Clutch Size		6	7	5	4	5	5	4	4	6	6
Egg Length (cm)		1.929	2.078	1.934	1.937	2.003	1.873	1.78	1.763	1.903	1.832
Egg Width (cm)		1.329	1.359	1.337	1.351	1.286	1.333	1.299	1.334	1.367	1.354
Egg Volume (cm^3)		1.738	1.957	1.763	1.803	1.689	1.697	1.532	1.6	1.814	1.713

[1] Embayment site comprised of samples from the East, West, and North Embayments.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-10. Tree Swallow Egg 2009 and 2010 Sample Results, Melton Hill Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID:	KIF-MHD.CONTROL08-TS.E.01-BD-050809	KIF-MHD.CONTROL09-TS.E.01-BD-050809	KIF-MHD.CONTROL10-TS.E.01-BD-050809	KIF-MHD.CONTROL11-TS.E.01-BD-050809	KIF-MHD.CONTROL12-TS.E.01-BD-050809	KIF-MHD.CONTROL14-TS.E.01-BD-050809	KIF-MHD.CONTROL16-TS.E.01-BD-050809	KIF-MHD.CONTROL18-TS.E.01-AD-050809	KIF-MHD.CONTROL18-TS.E.01-BD-050809	KIF-MHD.CONTROL19-TS.E.01-BD-050809	KIF-MHD02-TS.E.01-BD-060409
	Sample Date:	5/8/2009	5/8/2009	5/8/2009	5/8/2009	5/8/2009	5/8/2009	5/8/2009	5/8/2009	5/8/2009	5/8/2009	6/4/2009
Aluminum		<135.5	<136	<135.7	<135.5	<407.1	<141.8	<135.7	<156.5	<135.3	<134.9	<146.2
Antimony		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Arsenic		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Barium		10.09	1.959	4.192	6.726	4.511	8.152	4.096	14.67 J	8.948 J	8.458	19.02
Beryllium		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Boron		<10.8	<10.83	<10.92	<10.78	<32.61	<11.41	<10.84	<12.5	<10.81	<10.81	<11.96
Cadmium		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Calcium		4720	9713	5174	3778	2016	5543	9642	7554 J	31317 J	4325	21413
Chromium		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5978	<0.5461	<0.6522	<0.5406	<0.5353	<0.7609
Cobalt		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Copper		<2.679	<2.765	<2.758	<2.671	<8.152	<2.826	<2.73	<3.152	<2.796	3.212	3.641
Iron		289.2	138.3	161.1	160.2	<407.1	285.9	<135.7	397.8	179.3	156.3	328.8
Lead		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Magnesium		<540.6	<542.7	<543.9	<540.1	<1625	<565.2	<542.7	766.3	618.9	<540.7	587
Manganese		4.098	<2.765	5.075	8.012	<8.152	10.87	5.802	7.065	7.27	5.246	9.783
Mercury		<0.1103	<0.1083	<0.1092	<0.1088	<0.3261	<0.1141	<0.1109	<0.125	<0.1081	<0.1071	<0.1196
Molybdenum		<5.438	<5.415	<5.406	<5.44	<16.3	<5.435	<5.461	<6.522	<5.406	<5.353	<5.978
Nickel		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Potassium		6501	8146	7624	6894	6848	6685	7662	5924	6823	6767	6739
Selenium		4.255	3.341	3.641	2.275	<3.261	5.109	2.389	5.326	3.728	3.747	4.293
Silver		<0.2679	<0.2765	<0.2758	<0.2671	<0.8152	<0.2826	<0.273	<0.3152	<0.2796	<0.2677	<0.2935
Sodium		7376	9287	7315	8131	8587	7717	8132	5924	7531	7687	6250
Strontium		3.783	4.493	4.523	4.748	2.228	5.217	6.741	10.87 J	19.95 J	3.854	14.13 J
Thallium		<0.5438	<0.5415	<0.5406	<0.544	<1.63	<0.5435	<0.5461	<0.6522	<0.5406	<0.5353	<0.5978
Vanadium		<1.103	<1.083	<1.092	<1.088	<3.261	<1.141	<1.109	<1.25	<1.081	<1.071	<1.196
Zinc		127.7	55.77	115.8	83.98	67.39	119.6	65.36	198.4 J	87.05 J	124.2	145.1 J
Egg Weight (g)		2	1	1	2	2	2	1	2	1	2	1
Clutch Size		1	6	7	6	5	6	5	6	6	6	4
Egg Length (cm)		1.917	1.889	1.726	1.866	1.866	1.919	1.731	1.963	1.852	1.946	1.818
Egg Width (cm)		1.337	1.289	1.3	1.368	1.381	1.276	1.351	1.357	1.351	1.42	1.308
Egg Volume (cm^3)		1.748	1.601	1.488	1.781	1.815	1.593	1.611	1.844	1.724	2.001	1.586

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-10. Tree Swallow Egg 2009 and 2010 Sample Results, Melton Hill Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-MHD03-TS.E.01-BD-060409 6/4/2009	KIF-MHD03-TS.E.02-BD-062109 6/21/2009	KIF-MHD11-TS.E.02-BD-060109 6/1/2009	KIF-MHD17-TS.E.01-BD-061409 6/14/2009	KIF-MHD24-TS.E.01-BD-061409 6/14/2009	KIF-MHD.BH051_TS.E.G.01-BD-050410 5/4/2010	KIF-MHD.BH052_TS.E.G.02-BD-050410 5/4/2010	KIF-MHD.BH056_TS.E.G.03-BD-050410 5/4/2010	KIF-MHD.BH059_TS.E.G.04-BD-050410 5/4/2010	KIF-MHD.BH060_TS.E.G.05-BD-050410 5/4/2010	KIF-MHD.BH061_TS.E.G.06-BD-050410 5/4/2010
Aluminum		<139.1	<136.3	<326.9	<156	<225	<22.28	<24.46	<21.74	<20.65	<27.17	<33.7
Antimony		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.08152	<0.08696	<0.07609	<0.07609	<0.09783	<0.1196
Arsenic		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.1576	<0.1739	<0.1522	<0.1467	<0.1902	<0.2337
Barium		3.587	4.476	16.24	5.978	13.04	15.76	6.522	3.37	7.065	3.587	4.783
Beryllium		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.337	<0.3641	<0.3261	<0.3098	<0.4076	<0.5
Boron		<10.87	<10.94	<26.07	<12.5	<17.93	<2.337	<2.554	<2.228	<2.174	<2.826	<3.478
Cadmium		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.08696	<0.09239	<0.08152	<0.08152	<0.1033	<0.1304
Calcium		5283	2327	8262	4402	8098	25109	4739	2141	26304	3467	6685
Chromium		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.7065	<0.7609	<0.7065	<0.6522	<0.8696	<1.087
Cobalt		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.08152	0.1467 J	<0.07609	0.1033 J	0.1522 J	0.4076 J
Copper		5.435	3.083	<6.618	3.478	19.02	2.717	2.5 J	2.446 J	2.88	2.989 J	3.043 J
Iron		<139.1	<136.3	<326.9	<156	364.1	171.7	215.8	80.98 J	194	128.3 J	395.7
Lead		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.1576	<0.1685	<0.1522	<0.1467	<0.1902	<0.2337
Magnesium		<554.3	<545	<1308	<625	<902.2	581.5	587 J	330.4 J	603.3	390.8 J	847.8
Manganese		4.022	<2.685	14.24	4.511	6.522	7.065	10.87	<2.717	7.609	7.609	26.09
Mercury		<0.1304	<0.1293	<0.2607	0.2228 J	<0.1793	0.125	0.1359	0.1522	0.1359	0.125 J	<0.09783
Molybdenum		<5.435	<5.47	<13.04	<5.978	<9.239	<0.1957	<0.2174	<0.1902	<0.1848	<0.2391	<0.3152
Nickel		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.5435	<0.5978	<0.5272	<0.5054	<0.6522	<0.8152
Potassium		10652	7509	7340	9402	7717	7826	7120	7772	7011	9185	8152
Selenium		4.348	2.288	4.412	4.13	5.978	3.424	3.967	2.609	4.348	2.935	8.152
Silver		<0.2772	<0.2685	<0.6618	<0.3098	<0.4511	<0.05435	<0.05978	<0.05217	<0.05	<0.06522	<0.08152
Sodium		13750	8474	7340 J	9348	6793	7935	8370	9674	7935	9348	8696
Strontium		3.804 J	3.58	6.618 J	4.565 J	8.152 J	15.22	4.511	2.88	15.76	3.315	5.435
Thallium		<0.5435	<0.547	<1.304	<0.5978	<0.9239	<0.07609	<0.08696	<0.07609	<0.07065	<0.09239	<0.1141
Vanadium		<1.087	<1.094	<2.607	<1.25	<1.793	<0.2554	<0.2826	<0.25	<0.2391	<0.3098	<0.3804
Zinc		62.5 J	50.23	126.5	42.39	192.4	108.7	128.8	56.52	92.93	82.61	166.3
Egg Weight (g)		1	1	1	1	1	1.902	1.943	1.796	2.217	1.508	1.657
Clutch Size			3	4	4	5	5	5	5	7	6	6
Egg Length (cm)		1.957	1.981	1.824	1.827	1.904	1.847	2.032	1.805	1.987	1.908	1.865
Egg Width (cm)		1.419	1.42	1.359	1.255	1.373	1.384	1.355	1.349	1.391	1.212	1.291
Egg Volume (cm^3)		2.01	2.037	1.718	1.468	1.831	1.804	1.903	1.675	1.961	1.429	1.585

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table D-10. Tree Swallow Egg 2009 and 2010 Sample Results, Melton Hill Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte / Sample ID: / Sample Date:	KIF-MHD.BH063_TS.E.G.07-BD-050410 5/4/2010	KIF-MHD.BH073_TS.E.G.08-BD-050410 5/4/2010	KIF-MHD.BH074_TS.E.G.09-BD-050410 5/4/2010	KIF-MHD.BH079_TS.E.G.10-BD-050410 5/4/2010	KIF-MHD.BH080_TS.E.G.11-BD-050410 5/4/2010	KIF-MHD.BH084_TS.E.G.12-BD-050410 5/4/2010	KIF-MHD.BH073_TS.E.G.08-AD-050410 5/4/2010	KIF-MHD.BH087_TS.E.G.01-BD-050510 5/5/2010	KIF-MHD.BH057_TS.E.G.01-BD-050610 5/6/2010	KIF-MHD.BH064_TS.E.G.01-BD-050810 5/8/2010
Aluminum	<53.26	<21.2	<20.65	<21.2	<21.2	<21.2	<19.57	<23.91	<22.83	<21.74
Antimony	<0.1957	<0.07609	<0.07609	<0.07609	<0.07609	<0.07609	<0.07065	<0.08696	<0.08152	<0.07609
Arsenic	<0.375	<0.1467	<0.1467	<0.1467	<0.1467	<0.1467	<0.1359	<0.337	<0.3207	<0.3005
Barium	29.89	5.978 J	5.978	7.609	2.12	1.957	2.12 J	35.87	5.38	29.35
Beryllium	<0.8152	<0.3152	<0.3098	<0.3152	<0.3152	<0.3152	<0.288	<0.1793	<0.1685	<0.1576
Boron	<5.435	<2.174	<2.174	<2.174	<2.174	<2.174	<2.011	<2.5	<2.337	<2.228
Cadmium	<0.2065	<0.08152	<0.08152	<0.08152	<0.08152	<0.08152	<0.07609	<0.04565	<0.04348	<0.04076
Calcium	9565	3370	3924	2848	2783	3516	2598	5152	3995	5652
Chromium	<1.685	<0.6522	<0.6522	<0.6522	<0.6522	<0.6522	<0.5978	<0.7609	<0.7065	<0.7065
Cobalt	<0.1902	<0.07609	0.1087 J	<0.07609	0.09783 J	0.125 J	<0.07065	0.1304 J	0.1087 J	0.09783 J
Copper	3.315 J	2.391 J	2.011 J	2.391 J	2.609	2.826	2.446	2.174 J	1.902 J	2.065 J
Iron	443.5	213	198.4	144	113 J	144	135.3	315.8	175.5	175
Lead	<0.3696	<0.1467	<0.1467	0.375 J	<0.1467	<0.1467	<0.1359	<0.1685	<0.1576	<0.1522
Magnesium	1168 J	384.2 J	429.3 J	360.9 J	396.7 J	383.2 J	311.4 J	690.2	485.3 J	460.3 J
Manganese	15.76	<5.217	7.065	<3.478	<5.435	<4.402	<3.859	17.93	5.217	11.96
Mercury	<0.1522	0.1033	0.1522	0.1196	0.1467	0.09239 J	0.1196	<0.1848	<0.1467	<0.1467
Molybdenum	<0.4674	<0.1848	<0.1848	<0.1848	<0.1848	<0.1848	<0.1685	<0.212	<0.2011	<0.1902
Nickel	<1.304	<0.5163	<0.5054	<0.5163	<0.5109	<0.5163	<0.4728	7.609	<0.5435	8.152
Potassium	7500	7663	8587	8207	7935	8478	8261	9674	8043	8315
Selenium	6.522	3.75	3.478	3.967	4.402	3.859	3.37	3.859	3.913	3.261
Silver	<0.1304	<0.05109	<0.05	<0.05109	<0.05054	<0.05109	<0.04674	<0.01739	<0.0163	<0.01576
Sodium	8261	8098	7935	8587	9728	7663	8804	11685	9022	9022
Strontium	10.33	3.152 J	4.239	3.424	3.533	3.804	2.065 J	7.065 J	3.696 J	5.978 J
Thallium	<0.1848	<0.07065	<0.07065	<0.07065	<0.07065	<0.07065	<0.06522	<0.08152	<0.07609	<0.07609
Vanadium	<0.5978	<0.2446	<0.2391	<0.2446	<0.2391	<0.2446	<0.2228	<0.5435	<0.5217	<0.4891
Zinc	297.8	111.4	104.3	84.24	79.35	77.17	79.35	145.1	102.2	114.7
Egg Weight (g)	2.087	1.909	1.94	1.833	1.825	1.588	1.714	1.691	1.652	1.961
Clutch Size	6	10	5	6	4	6	10	4	4	4
Egg Length (cm)	1.981	2.077	1.943	1.836	1.957	1.837	1.998	1.849	1.906	2.107
Egg Width (cm)	1.406	1.313	1.364	1.374	1.315	1.308	1.276	1.308	1.284	1.304
Egg Volume (cm^3)	1.997	1.826	1.844	1.768	1.726	1.603	1.659	1.613	1.603	1.827

< = Not detected at sample quantitation limit indicated.
cm = Centimeter.
g = Gram.
J = Estimated value.
mg/kg dw = Milligrams per kilogram dry weight.

ARCADIS

Appendix E

Tree Swallow Eggshell 2010
Sample Results

Table E-1. Tree Swallow Eggshell 2010 Sample Results, Composite Reference Sites[1] (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-FLD.BH097_TS.V.G.04-BD-050410 5/4/2010	KIF-FLD.BH097_TS.V.G.01-BD-051110 5/11/2010	KIF-TLD.BH119_TS.V.G.05-BD-050410 5/4/2010	KIF-TLD.BH120_TS.V.G.04-BD-050410 5/4/2010
Aluminum		<8.144	<16.49	<17.22	<12.27
Antimony		<0.0299	<0.05979	<0.06186	<0.04433
Arsenic		0.06907 J	<0.2268	<0.2371	<0.1753
Barium		11.24	8.866	16.7	10.21
Beryllium		<0.1237	<0.2474	<0.2577	<0.1856
Boron		<0.8454	<1.753	<1.753	<1.237
Cadmium		<0.03093	<0.06392	<0.06701	<0.04742
Calcium		129897	95464	186598	160825
Chromium		<0.2577	<0.5258	<0.5464	0.7938 J
Cobalt		<0.02887	<0.05773	<0.06082	<0.0433
Copper		0.7423 J	0.9794 J	2.165	1.134 J
Iron		33.09 J	<49.59	<51.96	<36.8
Lead		<0.0567	<0.1134	<0.1237	<0.08557
Magnesium		511.3	429.9	742.3	687.6
Manganese		0.8247 J	1.959	1.856 J	1.134 J
Mercury		<0.02371	<0.04742	<0.04948	<0.03505
m		<0.07113	<0.1443	<0.1546	<0.1031
Nickel		<0.1959	<0.4021	<0.4227	0.3918 J
Potassium		<1474	<2969	<3113	<2206
Selenium		0.6289	0.6186 J	0.4021 J	0.3918 J
Silver		<0.005876	<0.01237	<0.01237	<0.008866
Sodium		1412	1371	2124	1433
Strontium		84.12	58.76	86.19	80.62
Thallium		<0.02784	<0.0567	<0.05979	<0.04227
Vanadium		<0.1856	<0.3711	<0.3918	<0.2784
Zinc		16.91	18.25 J	<9.381	8.66 J

[1] Composite reference site comprised of samples from Fort Loudoun Dam, Tellico Dam, and upstream Tennessee River Miles 569.5 and 571.5.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table E-2. Tree Swallow Eggshell 2010 Sample Results, Tennessee River Mile 566 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-TRM566.0.BH461_TS.V.G.02-BD-051110 5/11/2010	KIF-TRM566.0.BH464_TS.V.G.03-BD-051110 5/11/2010
Aluminum		<14.85	<10.62
Antimony		<0.05361	<0.03814
Arsenic		0.1031 J	<0.1443
Barium		41.24	100.2
Beryllium		<0.2268	<0.1546
Boron		<1.546	<1.134
Cadmium		<0.05773	<0.04124
Calcium		174227	165979
Chromium		<0.4742	<0.3402
Cobalt		<0.05258	<0.03711
Copper		1.134 J	1.34
Iron		<44.74	<31.86
Lead		<0.1031	<0.07423
Magnesium		668	653.6
Manganese		2.268	1.237
Mercury		<0.0433	<0.03093
m		<0.134	<0.09278
Nickel		<0.3608	<0.2577
Potassium		<2680	<1918
Selenium		0.4124 J	0.268 J
Silver		<0.01031	<0.007629
Sodium		1309	1588
Strontium		126.8	123.7
Thallium		<0.05155	<0.03608
Vanadium		<0.3402	<0.2371
Zinc		10.31 J	<5.773

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table E-3. Tree Swallow Eggshell 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-ERM3.0.BH171_TS.V.G.11-BD-050510 5/5/2010	KIF-ERM3.0.BH172_TS.V.G.10-BD-050510 5/5/2010	KIF-ERM3.0.BH173_TS.V.G.09-BD-050510 5/5/2010	KIF-ERM3.0.BH174_TS.V.G.08-BD-050510 5/5/2010	KIF-ERM3.0.BH178_TS.V.G.06-BD-050510 5/5/2010	KIF-ERM3.0.BH293_TS.V.G.01-BD-051210 5/12/2010	KIF-ERM3.0.BH310_TS.V.G.04-BD-051210 5/12/2010
Aluminum		<10	<8.247	<6.804	<9.691	<13.61	<11.34	<6.289
Antimony		<0.03608	<0.0299	<0.02474	<0.03505	<0.04948	<0.04124	<0.02268
Arsenic		0.08144 J	<0.1134	0.0567 J	0.07216 J	0.09588 J	<0.1546	0.06392 J
Barium		11.03	14.12	6.598	15.15	22.68	5.258	20
Beryllium		<0.1443	<0.1237	<0.1031	<0.1443	<0.2062	<0.1649	<0.09381
Boron		<1.031	<0.8557	<0.701	<1	<1.443	<1.134	<0.6495
Cadmium		<0.03814	<0.03196	<0.02577	<0.03711	<0.05258	<0.04433	<0.02474
Calcium		152577	110309	101443	128866	196907	123711	107216
Chromium		<0.3196	<0.2577	<0.2165	<0.3093	<0.433	<0.3608	<0.1959
Cobalt		<0.03505	<0.02887	<0.02371	<0.03402	<0.04742	<0.04021	<0.02268
Copper		0.8247 J	1.134	0.9072	0.8247 J	0.9588 J	1.237 J	0.8454
Iron		<30.1	<24.74	<20.52	<29.18	<41.03	<34.23	<18.97
Lead		<0.0701	<0.05773	<0.04742	<0.06701	<0.09485	<0.07938	<0.04433
Magnesium		489.7	421.6	391.8	467	712.4	625.8	363.9
Manganese		0.9794 J	0.3814 J	0.732 J	0.5979 J	1.443 J	0.6082 J	0.2887 J
Mercury		<0.02887	0.03299 J	0.02887 J	0.02784 J	<0.03918	0.04124 J	0.0299
m		<0.08763	<0.07216	<0.05979	<0.08557	<0.1237	<0.1	<0.05567
Nickel		<0.2474	<0.1959	<0.1649	<0.2371	<0.3299	<0.2784	<0.1546
Potassium		<1804	<1485	1402 J	<1753	<2464	<2052	1340 J
Selenium		0.3608 J	0.3608 J	0.299 J	0.3814 J	0.4021 J	0.5979	0.2887 J
Silver		<0.007216	<0.005979	<0.004948	<0.00701	<0.009897	<0.008247	<0.004536
Sodium		1381	1536	1598	1536	1247	1454	1474
Strontium		96.19	147.4	64.02	92.89	130.9	62.16	119.6
Thallium		<0.05979	<0.04845	<0.0268	<0.03299	<0.04742	<0.03918	<0.05979
Vanadium		<0.2268	<0.1856	<0.1546	<0.2165	<0.3093	<0.2577	<0.1443
Zinc		<5.464	<4.433	<3.711	<5.258	<7.423	<6.186	<3.402

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table E-4. Tree Swallow Eggshell 2010 Sample Results, Embayments[1] (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-EEMBAY.BH197_TS.V.G.03-BD-050510 5/5/2010	KIF-EEMBAY.BH208_TS.V.G.01-BD-050510 5/5/2010	KIF-NEMBAY.BH243_TS.V.G.01-BD-051110 5/11/2010	KIF-WEMBAY.BH268_TS.V.G.01-BD-050610 5/6/2010
Aluminum		<11.65	<13.3	<18.97	<13.71
Antimony		<0.04227	<0.04845	<0.06804	<0.04948
Arsenic		0.09588 J	<0.1856	<0.268	0.1031 J
Barium		21.44	9.072	18.66	38.56
Beryllium		<0.1753	<0.1959	<0.2784	<0.2062
Boron		<1.237	<1.34	<1.959	<1.443
Cadmium		<0.04433	<0.05155	<0.0732	<0.05258
Calcium		169072	151546	174227	208247
Chromium		<0.3711	<0.4227	<0.5979	<0.433
Cobalt		<0.04124	<0.04639	<0.06701	<0.04845
Copper		0.7526 J	0.866 J	1.443 J	1.134 J
Iron		<35.05	<40	<57.01	<41.34
Lead		<0.08144	<0.09278	<0.134	<0.09588
Magnesium		709.3	595.9	826.8	584.5
Manganese		1.649	0.8866 J	<0.8041	1.134 J
Mercury		<0.03402	<0.03814	<0.05464	<0.03918
m		<0.1021	<0.1134	<0.1649	<0.1237
Nickel		<0.2887	<0.3196	<0.4639	<0.3299
Potassium		<2103	<2402	<3423	<2474
Selenium		0.3918 J	0.4536 J	0 U	0.3505 J
Silver		<0.008454	<0.009588	<0.0134	<0.009897
Sodium		1474	1443	1701	1443
Strontium		114.4	87.11	114.4	176.3
Thallium		<0.04948	<0.04536	<0.06495	<0.1443
Vanadium		<0.268	<0.299	<0.433	<0.3093
Zinc		<6.289	<7.216	<10.31	<7.423

[1] Embayment site comprised of samples from the East, West, and North Embayments.

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table E-5. Tree Swallow Eggshell 2010 Sample Results, Melton Hill Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-MHD.BH061_TS.V.G.06-BD-050410 5/4/2010	KIF-MHD.BH063_TS.V.G.07-BD-050410 5/4/2010	KIF-MHD.BH079_TS.V.G.10-BD-050410 5/4/2010
Aluminum		<10.62	<7.835	<9.175
Antimony		<0.03814	<0.02784	<0.03299
Arsenic		0.0866 J	<0.1134	0.08351 J
Barium		8.763	20.62	32.16
Beryllium		<0.1546	<0.1134	<0.134
Boron		<1.134	<0.8144	<0.9485
Cadmium		<0.04124	<0.0299	<0.03505
Calcium		145361	104124	149485
Chromium		<0.3402	<0.2474	<0.2887
Cobalt		<0.03711	<0.02784	<0.03196
Copper		1.01 J	1.237	0.7113 J
Iron		<31.86	<23.61	<27.63
Lead		<0.07423	<0.05464	<0.06392
Magnesium		547.4	424.7	548.5
Manganese		0.6804 J	0.4845 J	1.959
Mercury		<0.03093	0.02577 J	<0.0268
m		<0.09278	<0.06907	<0.08041
Nickel		<0.2577	<0.1959	<0.2268
Potassium		<1918	1423 J	<1660
Selenium		0.3608 J	0.3402 J	0.5979
Silver		<0.007629	<0.00567	<0.006598
Sodium		1536	1567	1299
Strontium		61.55	52.89	80.41
Thallium		<0.05258	<0.03093	<0.03814
Vanadium		<0.2371	<0.1753	<0.2062
Zinc		<5.773	<4.227	10.21 J

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

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Appendix F

Tree Swallow Nestling 2009 and 2010 Sample Results

Table F-1. Tree Swallow Nestlings 2009 and 2010 Sample Results, Fort Loudoun Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-FLD02-TS.N.01-BD-062109 6/21/2009	KIF-FLD18-TS.N.01-BD-060109 6/1/2009	KIF-FLD23-TS.N.01-BD-062109 6/21/2009	KIF-FLD.BH110_TS.N.G.01-BD-060510 6/5/2010	KIF-FLD.BH100_TS.N.G.01-BD-060710 6/7/2010	KIF-FLD.BH103_TS.N.G.01-BD-070610 7/6/2010	KIF-FLD.BH097_TS.N.G.01-BD-070810 7/8/2010	KIF-FLD.BH098_TS.N.G.01-BD-071210 7/12/2010
Aluminum		<78	<67.9	<74.5	<12.9	<12.3	<12.9	<11.4	<14.7
Antimony		<0.31	<0.27	<0.3	<0.047	<0.045	<0.047	<0.041	<0.053
Arsenic		<0.31	<0.27	<0.3	<0.09	<0.086	<0.09	<0.08	<0.1
Barium		6.9	3.5	1.4 J	3.5	2.2	0.87 J	1.5 J	3.6 J
Beryllium		<0.31	<0.27	<0.3	<0.095	<0.091	<0.095	<0.084	<0.11
Boron		<6.2	<5.4	<6	<1.3	<1.3	<1.3	<1.2	<1.5
Cadmium		<0.31	<0.27	<0.3	0.067 J	0.055 J	0.053 J	<0.044	0.03 J
Calcium		20800	22500	11300	9650	11800	8890	19000	27300
Chromium		<0.34	<0.33	<0.37	<0.41	<0.39	<0.41	<0.711	<0.919
Cobalt		<0.31	<0.27	<0.3	<0.045	<0.043	<0.045	<0.04	<0.052
Copper		11.7	9	6.1	7.9	7.4	6.5	7	8.1
Iron		254	234	177	203	241	216	333	399
Lead		<0.31	<0.27	<0.3	<0.09	<0.086	<0.09	<0.079	<0.1
Magnesium		985	886	651	839	844	700	1010	1240
Manganese		7	5.4	2.5	3.3	4.6	2.5	2.9	5.6
Mercury		<0.062	<0.054	<0.06	<0.037	<0.036	<0.037	<0.033	<0.042
Molybdenum		<3.1	<2.7	<3	0.22 J	<0.19	0.19 J	0.23 J	0.29 J
Nickel		<0.31	<0.59	<0.3	<0.31	<0.3	<0.31	<0.28	<0.707
Potassium		6450	8110	5170	8370	8040	7340	8970	11400
Selenium		2.6	4.9	1.8	2.6	3.3	1.9	2.5	2
Silver		<0.16	<0.14	<0.15	<0.015	<0.0089	0.012	<0.027	<0.035
Sodium		3730	3300 J	2840	4200	3890	3960	4260	6380
Strontium		15	14.4 J	5.9	6.4 J	4.7	3.8	7.4	10.8
Thallium		<0.31	<0.27	<0.3	<0.044	<0.042	<0.044	<0.039	<0.051
Vanadium		<0.62	<0.54	<0.6	<0.15	<0.28	<0.15	<0.257	<0.33
Zinc		106	90.1	76.1	93.3	94.9	64.5	84.3	113
Nestling Weight (g)		17	21	23	23.477	22.986	22.573	20.644	17.833
Feather Length (cm)		4.476	4.181	4.399	4.262	4.528	4.616	4.168	2.618
Tarsus Length (cm)		1.061	1.118	1.202	1.378	1.224	1.261	1.318	1.125

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-2. Tree Swallow Nestlings 2009 and 2010 Sample Results, Clinch River Mile 2.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-DISCHARGE02-TS.N.01-BD-061409 6/14/2009	KIF-DISCHARGE03-TS.N.01-BD-060409 6/4/2009	KIF-DISCHARGE03-TS.N.02-BD-071609 7/16/2009	KIF-DISCHARGE04-TS.N.01-BD-061409 6/14/2009	KIF-DISCHARGE05-TS.N.01-BD-052809 5/28/2009	KIF-DISCHARGE05-TS.N.02-BD-071209 7/12/2009	KIF-DISCHARGE06-TS.N.01-BD-060109 6/1/2009	KIF-DISCHARGE06-TS.N.02-BD-071609 7/16/2009	KIF-DISCHARGE07-TS.N.01-BD-061609 6/16/2009
Aluminum		<67.5	<124.2	<62	<75.8	<72.9	<60.1	<75.2	<65.5	<77.9
Antimony		<0.27	<0.4848	<0.25	<0.3	<0.29	<0.24	<0.3	<0.26	<0.31
Arsenic		<0.27	<0.4848	<0.25	<0.3	<0.29	<0.24	<0.3	<0.26	<0.31
Barium		1.8	23.33	2	1.3	1.6	4.3 J	14.4	1.3	1.2
Beryllium		<0.27	<0.4848	<0.25	<0.3	<0.29	<0.24	<0.3	<0.26	<0.31
Boron		<5.4	<10	<5	<6.1	<5.8	<4.8	<6	<5.2	<6.2
Cadmium		<0.27	<0.4848	<0.25	<0.3	<0.29	<0.24	<0.3	<0.26	<0.31
Calcium		10600	90303	24200	10200	5740	40300	33100	10500	8270
Chromium		<0.27	<0.5455	<0.25	<0.69	<0.39	<0.3	<0.48	<0.26	<0.31
Cobalt		<0.27	<0.4848	<0.25	<0.3	<0.29	0.86	<0.3	<0.26	<0.31
Copper		5.3	7.879	5.3	6.7	9.9	5.6	7.8	6.6	6.6
Iron		137	264.5	161	163	177	173	167	196	182
Lead		<0.27	<0.4848	<0.25	<0.3	<0.29	<0.24	<0.3	<0.26	<0.31
Magnesium		679	1124	858	590	611	816	1350	653	703
Manganese		1.8	17.27	1.9	1.8	1.7	4.1	6.9	2.3	2
Mercury		<0.056	0.2303 J	0.064 J	<0.079	0.12 J	<0.053	<0.06	0.057 J	0.094 J
Molybdenum		<2.7	<4.848	<2.5	<3	<2.9	<2.4	<3	<2.6	<3.1
Nickel		<0.27	<0.4848	<0.25	<0.41	<0.29	<0.32	1.2 J	<0.26	<0.31
Potassium		6410	16576	5990	5410	5980	4730	8360	6440	7290
Selenium		2.8	6.667	2.9 J	3.2	4.5	2.5	3.5	2.9 J	3.6 J
Silver		<0.13	<0.2485	<0.12	<0.15	<0.15	<0.12	<0.15	<0.13	<0.16
Sodium		3620	19303	2980	3100	3180	2730	3950 J	2940	3740
Strontium		6.8 J	50.61 J	10.7	6.9 J	3.8	19.1	25.4 J	5.3	4.7
Thallium		<0.27	<0.4848	<0.25	<0.3	<0.29	<0.24	<0.3	<0.26	<0.31
Vanadium		<0.54	<1	<0.5	<0.61	<0.58	<0.48	<0.6	<0.52	<0.62
Zinc		78.3	149.1 J	86.3	89.1	110	69.3	122	70.8	83.1
Nestling Weight (g)		21	24	21	23	18	25	20	22	20
Feather Length (cm)		4.994	4.26	5.038	4.904	4.947	5.248	4.326	5.268	4.663
Tarsus Length (cm)		1.107	1.24	1.154	1.164	1.047	1.17	1.228	1.156	1.229

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-2. Tree Swallow Nestlings 2009 and 2010 Sample Results, Clinch River Mile 2.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte / Sample ID:	KIF-DISCHARGE09-TS.N.01-BD-060109	KIF-DISCHARGE09-TS.N.02-BD-060109	KIF-DISCHARGE10-TS.N.01-BD-070609	KIF-CRM2.5.BH334_TS.N.G.01-BD-052610	KIF-CRM2.5.BH325_TS.N.G.01-BD-052810	KIF-CRM2.5.BH328_TS.N.G.02-BD-052810	KIF-CRM2.5.BH339_TS.N.G.03-BD-052810	KIF-CRM2.5.BH342_TS.N.G.04-BD-052810	KIF-CRM2.5.BH327_TS.N.G.01-BD-053110
Sample Date:	6/1/2009	6/1/2009	7/6/2009	5/26/2010	5/28/2010	5/28/2010	5/28/2010	5/28/2010	5/31/2010
Aluminum	<73.4	<85.6	<99.1	<11.7	<11.5	<14.3	<15.3	<12	<12.9
Antimony	<0.29	<0.34	<0.4	<0.042	<0.041	<0.052	<0.055	<0.043	<0.047
Arsenic	<0.29	<0.34	<0.4	<0.082	<0.16	<0.2	<0.21	<0.17	<0.18
Barium	8.6	6.7	2.1	5.7	3.2	3.4	6.1	7.4	5.5
Beryllium	<0.29	<0.34	<0.4	<0.175	<0.085	<0.11	<0.11	<0.088	<0.095
Boron	<5.9	<6.9	<7.9	<1.2	<1.2	<1.5	<1.6	<1.2	<1.3
Cadmium	<0.29	<0.34	<0.4	<0.022	0.07 J	0.062 J	0.045 J	0.031 J	0.076 J
Calcium	17300	15700	15600	22100	14600	9810	15500	15600	17300
Chromium	<0.29	<0.44	<0.4	<0.37	<0.36	4.1	0.57 J	<0.38	0.58 J
Cobalt	<0.29	<0.34	<0.4	<0.041	<0.04	<0.05	<0.054	<0.042	0.05 J
Copper	7.9	9.8	11.7	8.1	9.3	11.4	10	6.5	10
Iron	156	188	200	171	201 J	241 J	208 J	207 J	217 J
Lead	<0.29	<0.34	<0.4	<0.082	0.31	<0.1	<0.11	<0.083	<0.09
Magnesium	969	1060	1040	942	880	908	1060	941	1110
Manganese	5.8	12.4	6.5	6.7	4.3	6.2	8.1	3.6	3.7
Mercury	<0.07	<0.069	0.086 J	0.064	0.073	0.12	0.11	0.094	0.15
Molybdenum	<2.9	<3.4	<4	0.18 J	0.21 J	0.31 J	0.23 J	0.17 J	0.22 J
Nickel	<0.29	<0.34	<0.4	<0.29	<0.28	0.77 J	<0.37	<0.29	<0.31
Potassium	7030	8880	9400	7420	7700	8220	9070	7350	8890
Selenium	3.4	3.7	4 J	2.6	2.8	3.6	3.6	2.7	3.7
Silver	<0.15	<0.17	<0.2	<0.0085	0.0097 J	<0.01	<0.011	<0.0087	<0.0093
Sodium	3530 J	4560 J	6060	3890	3880	4600	5770	4100	4460
Strontium	17 J	11.2 J	7.5	15.8	6.7	8.4	12.5	11.5	11
Thallium	<0.29	<0.34	<0.4	<0.04	<0.04	<0.049	<0.053	<0.041	<0.044
Vanadium	<0.59	<0.69	<0.79	<0.13	<0.13	<0.16	<0.17	<0.14	<0.15
Zinc	107	111	101	95.9	94.6 J	128 J	121 J	106 J	132 J
Nestling Weight (g)	23	24	15	21.314	21.149	19.28	16.059	21.138	20.093
Feather Length (cm)	3.951	4.52	3.279	4.654	4.552	4.334	3.15	4.406	4.693
Tarsus Length (cm)	1.291	1.251	1.039	1.31	1.342	1.302	1.262	1.266	1.248

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-2. Tree Swallow Nestlings 2009 and 2010 Sample Results, Clinch River Mile 2.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-CRM2.5.BH333_TS.N.G.02-BD-053110 5/31/2010	KIF-CRM2.5.BH336_TS.N.G.03-BD-053110 5/31/2010	KIF-CRM2.5.BH338_TS.N.G.04-BD-053110 5/31/2010	KIF-CRM2.5.BH344_TS.N.G.05-BD-053110 5/31/2010	KIF-CRM2.5.BH322_TS.N.G.01-BD-060110 6/1/2010	KIF-CRM2.5.BH323_TS.N.G.02-BD-060110 6/1/2010	KIF-CRM2.5.BH332_TS.N.G.03-BD-060110 6/1/2010	KIF-CRM2.5.BH350_TS.N.G.01-BD-060210 6/2/2010	KIF-CRM2.5.BH352_TS.N.G.01-BD-060410 6/4/2010
Aluminum		<11.8	<12.2	<11.2	<11.9	<11.4	<11	<14	<14.4	<11.8
Antimony		<0.043	<0.044	<0.04	<0.043	<0.041	<0.04	<0.051	<0.052	<0.043
Arsenic		<0.17	<0.17	<0.16	<0.17	<0.08	<0.077	<0.098	<0.1	<0.083
Barium		4	3.9	3.4	3.5	2.9	4.9	7.6	5.1 J	4.6
Beryllium		<0.087	<0.09	<0.082	<0.088	<0.084	<0.081	<0.1	<0.11	<0.087
Boron		<1.2	<1.3	<1.2	<1.2	<1.2	<1.1	<1.5	<1.5	<1.2
Cadmium		0.038 J	0.075 J	0.093 J	0.053 J	<0.044	0.044 J	0.041 J	0.087 J	0.047 J
Calcium		11700	23300	12200	12300	14200	19500	24500	15800	10700
Chromium		<0.38	<0.39	<0.35	<0.38	<0.36	<0.35	<0.45	<0.46	<0.37
Cobalt		<0.042	<0.043	<0.039	<0.042	<0.04	<0.039	<0.049	<0.051	<0.041
Copper		6.5	9.2	6.7	6.9	6.2	11.1	9.3	8.2	7.3
Iron		186 J	327 J	214 J	231 J	159 J	165 J	210 J	222	132 J
Lead		<0.082	<0.085	0.096 J	<0.083	<0.079	<0.077	<0.098	<0.1	<0.082
Magnesium		827	1140	891	868	899	1040	1170	1060	884
Manganese		4	2.1	4.2	4.5	2	5.5	9.6	5.2	4.6
Mercury		0.089	0.12	0.088	0.11	0.08	0.077	0.072	0.074	0.079
Molybdenum		0.2 J	0.26 J	0.23 J	0.21 J	0.11 J	0.17 J	0.17 J	<0.21	0.22 J
Nickel		<0.29	0.6 J	<0.27	<0.29	<0.28	<0.27	<0.34	<0.35	<0.29
Potassium		7100	8180	7950	7150	7770	8030	8650	9370	8300
Selenium		2.6	3.2	2.9	2.7	2.9	2.6	3.2	2.9	2.2
Silver		<0.0085	<0.0088	<0.0081	<0.0086	<0.0082	<0.008	<0.01	<0.01	<0.0085
Sodium		3990	6380	3980	3680	3900	3780	4630	5280	4160
Strontium		9	9.1	5.6	8.1	9.8	11.1	17.7	10.4	8.1
Thallium		<0.041	<0.042	<0.038	<0.041	<0.062	<0.057	<0.06	<0.07	<0.041
Vanadium		<0.14	<0.14	<0.13	<0.14	<0.13	<0.13	<0.16	<0.16	<0.13
Zinc		98.4 J	161 J	95.7 J	94 J	82	88.6	103	122	98.3
Nestling Weight (g)		21.679	11.935	19.578	18.114	23.068	19.37	20.61	21.624	25.215
Feather Length (cm)		4.383	4.526	4.61	4.977	3.955	5.072	4.72	3.961	4.609
Tarsus Length (cm)		1.367	1.127	1.172	1.212	1.317	1.262	1.381	1.26	1.331

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-3. Tree Swallow Nestlings 2009 and 2010 Sample Results, Emory River Mile 3.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID:	KIF-FARM01-TS.N.01-BD-060809	KIF-FARM02-TS.N.01-BD-060809	KIF-FARM03-TS.N.01-BD-060109	KIF-FARM03-TS.N.02-BD-071209	KIF-FARM04-TS.N.01-BD-071209	KIF-FARM05-TS.N.01-BD-072409	KIF-FARM06-TS.N.01-BD-061409	KIF-FARM07-TS.N.01-BD-060409	KIF-FARM07-TS.N.02-BD-061409	KIF-FARM08-TS.N.01-BD-060109	KIF-FARM09-TS.N.01-BD-060109
	Sample Date:	6/8/2009	6/8/2009	6/1/2009	7/12/2009	7/12/2009	7/24/2009	6/14/2009	6/4/2009	6/14/2009	6/1/2009	6/1/2009
		BIOBD0608Y09a Bird Tree Swallow Nestling N Dry	BIOBD0608Y09a Bird Tree Swallow Nestling N Dry	BIOBD0601Y09a Bird Tree Swallow Nestling N Dry	BIOBD0712Y09a Bird Tree Swallow Nestling N Dry	BIOBD0712Y09a Bird Tree Swallow Nestling N Dry	BIOBD0724Y09a Bird Tree Swallow Nestling N Dry	BIOBD0614Y09a Bird Tree Swallow Nestling N Dry	BIOBD0604Y09a Bird Tree Swallow Nestling N Dry	BIOBD0604Y09a Bird Tree Swallow Nestling N Dry	BIOBD0601Y09a Bird Tree Swallow Nestling N Dry	BIOBD0601Y09a Bird Tree Swallow Nestling N Dry
Analyte		Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier
Aluminum		<81.8	<68.1	<63.9	<78.9	<62	<75.1	<76.2	<89.1	<74.23	<77.8	<77.8
Antimony		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Arsenic		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Barium		5.1	2.3	4.3	0.45	1.6 J	1.9	5.1	6	13.73	11.7	3.6
Beryllium		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Boron		<6.5	<5.4	<5.1	<6.3	<5	<6	<6.1	<7.1	<6.007	<6.2	<6.2
Cadmium		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Calcium		14700	9760	20900	3920	9320	10400	19000	18300	38046	24800	13900
Chromium		<0.33	0.48 J	<0.27	<0.36	<0.3	<0.3	<0.35	<0.42	<0.3004	<0.34	<0.83
Cobalt		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Copper		8.9	6.7	6.4	6.5	5.5	5.9	6.9	10.5	18.74	7.1	8
Iron		171	202	194	167	177	174	170	205	427.7	184	216
Lead		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Magnesium		966	684	886	510	533	683	887	1150	1816	1070	901
Manganese		<6.4	<3.8	2.1	<1.6	2.2	1.8	3.5	5.5	8.439	4.3	4.3
Mercury		<0.11	<0.097	<0.092	<0.096	<0.07	0.061 J	<0.087	<0.1	0.1716 J	<0.073	<0.091
Molybdenum		<3.3	<2.7	<2.6	<3.2	<2.5	<3	<3	<3.6	<3.004	<3.1	<3.1
Nickel		<0.33	<0.29	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.33
Potassium		7400	5710	6550	5380	4960	6870	6980	7660	13373	7460	7720
Selenium		3	2.6	3.5	2.9	2.5	2.3 J	2.8	4.1	6.865 J	3.5	3.3
Silver		<0.16	<0.14	<0.13	<0.16	<0.12	<0.15	<0.15	<0.18	<0.143	<0.16	<0.16
Sodium		4010	2940	2540 J	2850	2310	3520	3510	4930	9040	4020 J	3850 J
Strontium		8.8	4.4	10.7 J	2	6.3	7.2	12.8 J	12.3 J	26.32	19.1 J	7.7 J
Thallium		<0.33	<0.27	<0.26	<0.32	<0.25	<0.3	<0.3	<0.36	<0.3004	<0.31	<0.31
Vanadium		<0.65	<0.54	<0.51	<0.63	<0.5	<0.6	<0.61	<0.71	<0.6007	<0.62	<0.62
Zinc		106	77.4	88.9	76.3	54.7	70.4	92.9	123 J	200.2	116	98.9
Nestling Weight (g)		21	23	23	25	23	24	22	18	18	24	22
Feather Length (cm)		4.703	5.131	4.683	4.196	5.476	5.118	4.286	4.32	4.32	4.319	3.985
Tarsus Length (cm)		1.112	1.157	1.073	1.027	1.174	1.162	1.107	1.148	1.148	1.124	1.288

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-3. Tree Swallow Nestlings 2009 and 2010 Sample Results, Emory River Mile 3.5 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID:	KIF-FARM10-TS.N.01-BD-060109	KIF-ERM3.5.BH050_TS.N.G.01-BD-052810	KIF-ERM3.5.BH039_TS.N.G.01-BD-060610	KIF-ERM3.5.BH047_TS.N.G.02-BD-060610	KIF-ERM3.5.BH042_TS.N.G.01-BD-060910	KIF-ERM3.5.BH044_TS.N.G.01-BD-061110	KIF-ERM3.5.BH036_TS.N.G.01-BD-061310	KIF-ERM3.5.BH037_TS.N.G.02-BD-061310	KIF-ERM3.5.BH041_TS.N.G.01-BD-061510	KIF-ERM3.5.BH040_TS.N.G.01-BD-062510	KIF-ERM3.5.BH049.TS.N.G.01-BD-062810
	Sample Date:	6/1/2009	5/28/2010	6/6/2010	6/6/2010	6/9/2010	6/11/2010	6/13/2010	6/13/2010	6/15/2010	6/25/2010	6/28/2010
		BIOBD0601Y09a Bird Tree Swallow Nestling N Dry	BIOBD0528Y10A Bird Tree Swallow Nestling N Dry	BIOBD0606Y10A Bird Tree Swallow Nestling N Dry	BIOBD0606Y10A Bird Tree Swallow Nestling N Dry	BIOBD0609Y10A Bird Tree Swallow Nestling N Dry	BIOBD0611Y10A Bird Tree Swallow Nestling N Dry	BIOBD0613Y10A Bird Tree Swallow Nestling N Dry	BIOBD0613Y10A Bird Tree Swallow Nestling N Dry	BIOBD0615Y10A Bird Tree Swallow Nestling N Dry	BIOBD0625Y10A Bird Tree Swallow Nestling N Dry	BIOBD0628Y10A Bird Tree Swallow Nestling N Dry
Analyte		Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier	Result / Qualifier
Aluminum		<88.9	<13	<11.2	<12.4	<13.6	<13.9	<14.2	<11.8	<11.8	<14.6	<12.4
Antimony		<0.36	<0.047	<0.04	<0.045	<0.049	<0.05	<0.051	<0.043	<0.043	<0.053	<0.045
Arsenic		<0.36	<0.18	<0.079	<0.087	<0.095	<0.097	<0.1	0.089 J	0.12 J	<0.2	0.098 J
Barium		5.9	6.2	4.5	2.8	5.1	2.8	3.6	4.7	4.8	2.6	1.6 J
Beryllium		<0.36	<0.096	<0.083	<0.091	<0.1	<0.1	<0.1	<0.087	<0.087	<0.11	<0.091
Boron		<7.1	<1.3	<1.2	<1.3	<1.4	<1.4	<1.5	<1.2	<1.2	<1.5	<1.3
Cadmium		<0.36	0.055 J	0.027 J	0.13 J	<0.049	0.11 J	0.13 J	0.17 J	0.072 J	0.037 J	0.033 J
Calcium		15300	22400	42600	19600	29000	20500	11500	17200	26600	13300	9600
Chromium		<0.39	<0.41	<0.36	<0.39	<0.43	0.63 J	<0.45	0.46 J	<0.37	<0.46	0.99 J
Cobalt		<0.36	<0.046	<0.039	<0.044	<0.048	<0.049	<0.05	<0.042	<0.041	<0.052	<0.044
Copper		10.8	7.1	5.9	8.5	7.7	10.3	9.8	8.2	7.3	8.4	11.2
Iron		264	195 J	162	208	209	218	228	211	175	267	250
Lead		<0.36	<0.091	<0.078	<0.086	<0.095	<0.097	0.12 J	<0.082	<0.082	<0.1	<0.086
Magnesium		1070	1090	1510	1040	1540	1090	1020	1030	1140	981	833
Manganese		6.1	4.1	3.5	3.4	4.7	3	14.7	8.5	2.9	3.5	2.1
Mercury		<0.086	0.091	0.064	0.11	0.12	0.091	0.096	0.12	0.11	0.1	0.11
Molybdenum		<3.6	0.2 J	0.15 J	0.2 J	0.22 J	0.27 J	0.25 J	0.21 J	0.16 J	0.28 J	0.19 J
Nickel		1.8	<0.32	<0.27	0.43 J	<0.33	<0.34	<0.35	<0.29	<0.29	<0.36	0.54 J
Potassium		9090	7760	8320	8450	10400	9400	9060	8340	8440	9360	8790
Selenium		3.8	3.2	2.6	3.6	3.1	3.5	3.1	4.2	2.9	3.9	4.3
Silver		<0.18	<0.0094	<0.013	<0.023	<0.0098	<0.01	0.042 J	0.017 J	<0.0085	<0.011	<0.009
Sodium		4410 J	4240	4160	4340	5900	4990	4280	3920	4100	4810	3860
Strontium		11.8 J	17.4	16.8	11.2	16	9.6	7.3	10.7	15.4	10.4	8.6
Thallium		<0.36	<0.045	<0.05	<0.043	<0.047	<0.048	<0.049	<0.041	<0.041	<0.05	<0.043
Vanadium		<0.71	<0.15	<0.13	<0.14	<0.16	<0.16	<0.16	<0.13	<0.13	<0.33	0.17 J
Zinc		110	115 J	114	108	124	106	102	112	88.1	117	94.6
Nestling Weight (g)		22	22.468	20.949	20.349	23.136	22.016	22.372	24.245	21.287	17.132	20.733
Feather Length (cm)		3.809	3.874	4.908	5.34	4.07	3.876	5.784	4.994	4.612	3.889	5.011
Tarsus Length (cm)		1.156	1.471	1.261	1.315	1.177	1.293	1.327	1.313	1.198	1.224	1.124

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-4. Tree Swallow Nestlings 2009 and 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority **Kingston, Tennessee**

Analyte	Sample ID: / Sample Date:	KIF-RESIDENTIAL01-TS.N.01-BD-060409 / 6/4/2009	KIF-RESIDENTIAL03-TS.N.01-BD-060409 / 6/4/2009	KIF-RESIDENTIAL04-TS.N.01-BD-060409 / 6/4/2009	KIF-RESIDENTIAL05-TS.N.01-BD-060409 / 6/4/2009	KIF-RESIDENTIAL06-TS.N.01-BD-060409 / 6/4/2009	KIF-RESIDENTIAL07-TS.N.01-BD-060109 / 6/1/2009	KIF-RESIDENTIAL08-TS.N.01-BD-062509 / 6/25/2009	KIF-RESIDENTIAL09-TS.N.01-BD-070109 / 7/1/2009	KIF-RESIDENTIAL10-TS.N.01-BD-052809 / 5/28/2009	KIF-ERM3.0.BH188_TS.N.G.01-BD-052410 / 5/24/2010	KIF-ERM3.0.BH162_TS.N.G.01-BD-052610 / 5/26/2010	KIF-ERM3.0.BH186_TS.N.G.01-BD-052710 / 5/27/2010
Aluminum		<92.9	<73.3	<79.4	<93.3	<72	<76.6	<74.43	<83.5	<96.3	<12.2	<14.3	13.2 J
Antimony		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	<0.044	<0.052	<0.044
Arsenic		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	<0.085	<0.1	<0.085
Barium		3	4.9	2.6	8.1	2.7	56.2	2.193	3.4	33.2	17.7	16.4	2.5
Beryllium		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	<0.18	<0.21	<0.18
Boron		<7.4	<5.9	<6.3	<7.5	<5.8	<6.1	<5.969	<6.7	<7.7	<1.3	<1.5	1.3 J
Cadmium		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	<0.023	0.1 J	0.029 J
Calcium		9170	14800	10600	44200	9050	17900	6067	23700	15700	2810	26600	9530
Chromium		<0.4	<0.41	<0.43	<0.38	<0.48	<0.53	<0.2924	<0.33	<0.39	<0.39	<0.45	<0.38
Cobalt		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	<0.043	<0.05	<0.042
Copper		8.9	6.9	6.5	5.5	6.8	8.4	7.918	7.2	10.4	10.6	12.7	8.1
Iron		287	215	199	170	192	185	166.9	174	222	239	260	214
Lead		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	0.11 J	<0.1	<0.087
Magnesium		883	835	819	1470	674	783	603	1050	1110	1140	1330	761
Manganese		5.9	3.9	3.5	3	3	47.6	1.827	3.7	28.7	4.5	8	3
Mercury		<0.11	<0.069	<0.068	<0.075	<0.11	<0.085	0.1182 J	0.076 J	<0.077	0.055 J	0.12	0.099
Molybdenum		<3.7	<2.9	<3.2	<3.7	<2.9	<3.1	<2.924	<3.3	<3.9	0.18 J	0.24 J	0.17 J
Nickel		<0.37	<0.29	<0.32	<0.37	<0.29	<0.36	<0.2924	<0.33	<0.39	<0.3	<0.35	<0.29
Potassium		7930	6680	7210	8720	5830	7150	6298	7270	9600	7630	10200	7070
Selenium		4.1	3.4	3.5	3.2	3.4	3.2	3.533 J	3	3.4	4.1	4.4	3.4
Silver		<0.19	<0.15	<0.16	<0.19	<0.14	<0.15	<0.1462	<0.17	<0.19	<0.012	<0.025	<0.0091
Sodium		4710	3630	3930	5200	3320	3120 J	3338	3680	4980	3950	5570	3850
Strontium		7.2 J	15.9 J	9.3 J	24.6 J	7.4 J	47.7 J	3.533	9.2	35.8	36.2	26.8	8.3
Thallium		<0.37	<0.29	<0.32	<0.37	<0.29	<0.31	<0.2924	<0.33	<0.39	<0.042	<0.049	<0.042
Vanadium		<0.74	<0.59	<0.63	<0.75	<0.58	<0.61	<0.5969	<0.67	<0.77	<0.13	<0.17	<0.14
Zinc		100 J	94.4 J	91.6 J	117 J	91.9 J	94.9	90.75	101	125	101	158	117
Nestling Weight (g)		23	21	28	24	19	20	24	19	23	20.983	14.61	22.525
Feather Length (cm)		4.835	3.919	4.473	4.193	4.706	4.593	5.071	4.176	3.826	4.437	4.493	4.257
Tarsus Length (cm)		1.119	1.246	1.209	1.387	1.227	1.031	1.109	1.099	1.076	1.221	1.315	1.286

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-4. Tree Swallow Nestlings 2009 and 2010 Sample Results, Emory River Mile 3.0 (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Sample Date:	KIF-ERM3.0.BH176_TS.N.G.01-BD-060110 / 6/1/2010	KIF-ERM3.0.BH178_TS.N.G.02-BD-060110 / 6/1/2010	KIF-ERM3.0.BH183_TS.N.G.03-BD-060110 / 6/1/2010	KIF-ERM3.0.BH169_TS.N.G.01-BD-060210 / 6/2/2010	KIF-ERM3.0.BH171_TS.N.G.02-BD-060210 / 6/2/2010	KIF-ERM3.0.BH172_TS.N.G.03-BD-060210 / 6/2/2010	KIF-ERM3.0.BH173_TS.N.G.04-BD-060210 / 6/2/2010	KIF-ERM3.0.BH174_TS.N.G.05-BD-060210 / 6/2/2010	KIF-ERM3.0.BH189_TS.N.G.06-BD-060210 / 6/2/2010	KIF-ERM3.0.BH185_TS.N.G.01-BD-060310 / 6/3/2010	KIF-ERM3.0.BH165_TS.N.G.01-BD-060410 / 6/4/2010	KIF-ERM3.0.BH167_TS.N.G.01-BD-060710 / 6/7/2010
Aluminum		<11.1	<11.5	<11.7	<13.1	<14.2	<12	<12.3	<12.2	<11.6	<12.9	<12	<11.6
Antimony		<0.04	<0.042	<0.042	<0.047	<0.051	<0.043	<0.045	<0.044	<0.042	<0.047	<0.043	<0.042
Arsenic		<0.078	<0.081	<0.082	<0.092	<0.099	<0.084	<0.087	<0.086	<0.081	<0.091	<0.084	<0.082
Barium		3.3	5.1	4.1	3.2 J	8	2.9 J	4.8 J	8	4.8 J	2.1	3	5.4
Beryllium		<0.082	<0.085	<0.086	<0.096	<0.1	<0.088	<0.091	<0.09	<0.085	<0.095	<0.088	<0.086
Boron		<1.1	<1.2	<1.2	<1.4	<1.5	<1.2	<1.3	<1.3	<1.2	<0.4	<1.2	<1.2
Cadmium		0.03 J	0.045 J	<0.045	0.066 J	0.089 J	0.041 J	0.043 J	0.063 J	0.044 J	0.054 J	0.024 J	0.032 J
Calcium		16300	19700	11700	15300	37200	16600	18800	24200	20200	8710	13700	23800
Chromium		<0.35	<0.37	<0.37	<0.41	<0.45	<0.38	1.4 J	<0.39	<0.37	<0.41	<0.38	<0.37
Cobalt		<0.039	<0.041	<0.041	<0.046	<0.05	<0.042	<0.043	<0.043	<0.041	<0.045	<0.042	<0.041
Copper		7.3	7.9	7.3	8.4	8.4	7.5	7.2	8.3	7.7	8.5	7.6	6.6
Iron		201	225	199 J	218	264	251	211	143	165	193	196 J	215
Lead		<0.077	<0.08	<0.081	<0.091	<0.099	<0.083	<0.086	<0.085	<0.08	<0.09	<0.083	<0.081
Magnesium		911	1150	807	864	1500	989	941	1130	1060	756	884	1110
Manganese		4.7	7.8	3.9	5.7	5.1	3.3	4.2	6.5	9.2	3.3	2.3	3.7
Mercury		0.079	0.097	0.11	0.11	0.095	0.098	0.1	0.09	0.085	0.12	0.087	0.082
Molybdenum		0.16 J	0.19 J	0.18 J	<0.2	<0.22	<0.18	<0.18	<0.13	<0.17	<0.18	0.17 J	<0.19
Nickel		0.34 J	<0.28	<0.28	<0.32	<0.35	<0.29	0.58 J	<0.3	<0.28	<0.32	<0.29	<0.28
Potassium		7440	8840	6960	8270	9970	8850	7460	8060	8350	8020	8080	7940
Selenium		3.2	3	3.7	3.4	3.8	3.7	3.2	2.8	3.1	3.4	2.9	3
Silver		<0.008	<0.0083	<0.0084	<0.0094	<0.031	<0.0087	<0.0089	<0.0094	<0.0084	<0.015	<0.0087	<0.0084
Sodium		3300	3940	3160	3870	5300	4240	3640	4090	3860	3810	3830	4100
Strontium		7.1	9.1	16.4	7.6	15.8	10.2	9.7	21.3	14.9	4.3	7.6	15.3
Thallium		<0.038	<0.04	<0.04	<0.045	<0.049	<0.041	<0.043	<0.042	<0.04	<0.045	<0.041	<0.04
Vanadium		<0.13	<0.13	<0.13	<0.15	<0.16	<0.14	<0.14	<0.14	<0.13	<0.29	<0.14	<0.26
Zinc		83.3	98.3	82	90.4	136	102	101	101	95.4	88.7	84.9	100
Nestling Weight (g)		20.572	21.08	21.76	22.503	18.287	20.292	21.23	20.76	24.265	21.928	20.973	21.49
Feather Length (cm)		4.907	5.283	4.923	4.708	3.97	4.465	4.382	5.055	4.435	4.99	4.271	4.89
Tarsus Length (cm)		1.302	1.245	1.245	1.302	1.353	1.224	1.333	1.247	1.323	1.272	1.256	1.245

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-5. Tree Swallow Nestlings 2009 and 2010 Sample Results, Melton Hill Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Date:	KIF-MHD01-TS.N.01-BD-060109 6/1/2009	KIF-MHD02-TS.N.01-BD-052809 5/28/2009	KIF-MHD02-TS.N.02-BD-070609 7/6/2009	KIF-MHD03-TS.N.01-BD-071609 7/16/2009	KIF-MHD12-TS.N.01-BD-060109 6/1/2009	KIF-MHD14-TS.N.01-BD-060409 6/4/2009	KIF-MHD24-TS.N.01-BD-052809 5/28/2009	KIF-MHD24-TS.N.02-BD-071209 7/12/2009	KIF-MHD25-TS.N.01-BD-052809 5/28/2009	KIF-MHD.BH056_TS.N.G.01-BD-052810 5/28/2010	KIF-MHD.BH084_TS.N.G.02-BD-052810 5/28/2010	KIF-MHD.BH060_TS.N.G.01-BD-060110 6/1/2010
Aluminum		<66.3	<77.7	<63	<61.1	<81.3	<67	<79.2	<66.4	<65.5	<13.4	<12.4	<10.7
Antimony		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	<0.048	<0.045	<0.039
Arsenic		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	<0.19	<0.17	<0.075
Barium		3.2	2.8	1.7	1.9	3.1	2.4	2.4	1 J	4.9	4.9	4.7	5.3
Beryllium		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	<0.098	<0.092	<0.079
Boron		<5.3	<6.2	<5	<4.9	<6.5	<5.4	<6.3	<5.3	<5.2	<1.4	<1.3	<1.1
Cadmium		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	0.12 J	0.12 J	0.13 J
Calcium		4970	25000	7300	6760	12600	9520	7510	10000	13900	10100	10100	16100
Chromium		<0.32	<0.31	<0.25	<0.24	<0.34	<0.34	<0.38	<0.27	<0.71	1.1 J	<0.39	<0.34
Cobalt		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	<0.047	<0.044	<0.038
Copper		7.1	10	6.4	5.6	6.3	6.6	7	5.2	6.1	8.7	7.5	9.2
Iron		198	315	164	152	144	165	200	167	167	221 J	208 J	193 J
Lead		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	<0.093	<0.087	<0.075
Magnesium		549	985	631	518	821	681	699	596	737	955	745	964
Manganese		2.1	3.2	2.6	2.4	2.5	2	1.7	1.5	3.4	6.1	3	3.7
Mercury		<0.058	<0.062	<0.05	0.056 J	<0.065	<0.056	<0.063	<0.053	<0.052	0.069	0.081	0.064
Molybdenum		<2.7	<3.1	<2.5	<2.4	<3.3	<2.7	<3.2	<2.7	<2.6	0.21 J	0.18 J	0.21 J
Nickel		<0.4	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.46	<0.33	<0.3	<0.26
Potassium		5510	8570	6560	5170	7720	5450	7340	5210	5740	8720	6130	8260
Selenium		7.7	9	3.9 J	3.3 J	7.4	5.8	8.6	4.4	5.9	2.8	4.9	5.2
Silver		<0.13	<0.16	<0.13	<0.12	<0.16	<0.13	<0.16	<0.13	<0.13	<0.0097	0.009 J	<0.013
Sodium		2590 J	3370	2710	2630	3520 J	2960	3570	2630	3060	4430	3560	4270
Strontium		4.8 J	11.2	3.6	3.6	4.9 J	3.4 J	4.8	3	6.7	4.9	6.1	7.1
Thallium		<0.27	<0.31	<0.25	<0.24	<0.33	<0.27	<0.32	<0.27	<0.26	<0.046	<0.043	<0.037
Vanadium		<0.53	<0.62	<0.5	<0.49	<0.65	<0.54	<0.63	<0.53	<0.52	<0.15	<0.14	<0.12
Zinc		85.8	95	66.5	72.3	98.6	96.9 J	96.1	64.1	80.1	110 J	104 J	97
Nestling Weight (g)		22	23	21	19	23	23	22	22	21	21.882	23.019	17.717
Feather Length (cm)		4.643	4.911	5.414	4.904	3.656	4.919	4.628	5.256	3.731	4.091	4.976	4.938
Tarsus Length (cm)		1.273	1.02	1.288	1.05	1.08	1.282	1.062	1.127	1.083	1.37	1.346	1.245

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.

Table F-5. Tree Swallow Nestlings 2009 and 2010 Sample Results, Melton Hill Dam (mg/kg dw)
Tennessee Valley Authority Kingston, Tennessee

Analyte	Sample ID: / Date:	KIF-MHD.BH061_TS.N.G.02-BD-060110 6/1/2010	KIF-MHD.BH073_TS.N.G.03-BD-060110 6/1/2010	KIF-MHD.BH059_TS.N.G.02-BD-060210 6/2/2010	KIF-MHD.BH080_TS.N.G.01-BD-060210 6/2/2010	KIF-MHD.BH057_TS.N.G.01-BD-060310 6/3/2010	KIF-MHD.BH087_TS.N.G.02-BD-060310 6/3/2010	KIF-MHD.BH074_TS.N.G.01-BD-060410 6/4/2010	KIF-MHD.BH077_TS.N.G.01-BD-060710 6/7/2010	KIF-MHD.BH083_TS.N.G.01-BD-060810 6/8/2010	KIF-MHD.BH085_TS.N.G.01-BD-061410 6/14/2010	KIF-MHD.BH082_TS.N.G.01-BD-061610 6/16/2010	KIF-MHD.BH081_TS.N.G.01-BD-070710 7/7/2010
Aluminum		<12.1	<12.6	<11.2	<12.6	<12	<12.5	<12.7	<13.2	<13	<13.7	<15.1	<10.7
Antimony		<0.044	<0.046	<0.04	<0.045	<0.043	<0.045	<0.046	<0.048	<0.047	<0.05	<0.054	<0.039
Arsenic		<0.085	<0.088	<0.078	<0.088	<0.084	<0.088	<0.089	<0.093	<0.091	0.11 J	0.15 J	<0.075
Barium		3.7	8.1	8.7	6.2	5.7	1.7 J	5.7	6.1	3.4	3.6	2.8	2.5
Beryllium		<0.089	<0.093	<0.082	<0.093	<0.088	<0.092	<0.094	<0.097	<0.096	<0.1	<0.11	<0.079
Boron		<1.3	<1.3	<1.2	<1.3	<1.2	<1.3	<1.3	<1.4	<1.4	<1.4	<1.6	<1.1
Cadmium		0.048 J	0.11 J	0.052 J	0.058 J	0.041 J	<0.024	0.074 J	0.064 J	0.092 J	0.056 J	0.18 J	0.041 J
Calcium		7910	14900	22800	17800	12100	7470	15800	17800	16100	20600	14100	16200
Chromium		<0.38	0.48 J	<0.35	<0.4	<0.38	<0.4	<0.4	<0.42	4.1 J	<0.43	2.2 J	<0.34
Cobalt		<0.043	<0.044	<0.039	<0.044	<0.042	<0.044	<0.045	<0.047	0.047 J	0.052 J	<0.053	<0.037
Copper		7.4	10	7.1	6.5	6.2	7.9	7.9	5.9	10.7	6.8	10.4	6.2
Iron		182 J	218 J	214	256	203	286	228	238	308	231	205	180
Lead		<0.084	<0.088	<0.078	<0.088	<0.083	<0.087	<0.089	<0.092	<0.091	<0.095	<0.1	<0.074
Magnesium		734	997	1020	1010	744	833	1010	963	1640	1120	999	808
Manganese		2.7	5	7	3.1	2.8	1.6	4.8	3.4	3.4	3.6	6.1	2.6
Mercury		0.059	0.053 J	0.06	0.063	0.02 J	<0.036	0.058 J	0.047 J	0.072	0.058 J	0.079	0.049 J
Molybdenum		0.19 J	0.23 J	<0.18	<0.16	<0.15	<0.11	0.25 J	<0.19	0.28 J	0.28 J	0.34 J	0.19 J
Nickel		<0.3	<0.31	<0.27	<0.31	<0.29	<0.31	<0.31	<0.32	1.9	<0.33	1.2 J	0.28 J
Potassium		7850	8720	7610	8630	6790	9470	8770	8400	9880	10200	10100	7020
Selenium		5.2	5.4	5.2	7.4	1.6	3.8	5.4	4.4	8.5	5.6	8	5
Silver		<0.0088	<0.013	<0.0081	<0.0091	<0.0086	<0.0091	<0.0092	<0.0096	<0.012	<0.0099	<0.011	<0.0077
Sodium		4320	4660	3510	4610	3860	4900	4690	4500	5250	5150	5270	3410
Strontium		3.9	9.4	10.6	7.9	6.4	2.2	7.2	10.3	6.5	6.6	6.5	6
Thallium		<0.042	<0.043	<0.039	<0.043	<0.041	<0.043	<0.044	<0.046	<0.045	<0.047	<0.12	<0.037
Vanadium		<0.14	<0.14	<0.13	<0.14	<0.27	<0.28	<0.15	<0.3	1.1	<0.16	0.35 J	<0.12
Zinc		89.8	94.2	94	91.6	83.5	49.9	94	97.8	113	102	127	93.5
Nestling Weight (g)		23.689	24.43	22.734	23.801	23.917	24.238	22.065	22.952	20.932	21.65	17.481	22.619
Feather Length (cm)		4.692	4.639	5.154	4.883	4.402	3.529	4.582	4.337	4.112	3.774	3.381	4.601
Tarsus Length (cm)		1.37	1.277	1.249	1.162	1.229	1.188	1.225	1.243	1.293	1.324	1.187	1.327

< - Not detected at sample quantitation limit indicated.
cm - Centimeter.
g - Gram.
J - Estimated value.
mg/kg dw - Milligrams per kilogram dry weight.