Appendix B -
Summary of Biological Populations and Communities

Technical Support Document:
Proposed Site-Specific Selenium Criterion, Sage and Crow Creeks, Idaho

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LIST OF ACRONYMS

ANOVA	Analysis of Variance
CPUE	Catch per Unit Effort
EDDs	Electronic Data Deliverables
EPT	Ephemeroptera, Plecoptera, and Trichoptera
HSC	Habitat Suitability Criteria
HUC	Hydrologic Unit Code
HQI	Habitat Quality Index
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Fish and Game
K	Fulton Condition Factor
NCSS	Number Cruncher Statistical Systems
SMI	Stream Macroinvertebrate Index
SSSC	Site-Specific Selenium Criterion
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
WDEQ	Wyoming Department of Environmental Quality
W_r	Relative weight
YCT	Yellowstone Cutthroat Trout

1.0 INTRODUCTION

The J.R. Simplot Company's (Simplot) Smoky Canyon phosphate mine is located in Southeastern Idaho (Figure 1). Recent investigations revealed that elevated levels of selenium are found in some surface waters and fish tissues from Hoopes Spring, Sage Creek, and Crow Creek (Figure 2). Hoopes Spring is located in Sage Valley near the mine. A chronic site-specific selenium criterion (SSSC) is being developed for Hoopes Spring and its downstream receiving waters, Sage Creek and Crow Creek, in conjunction with measures to control releases of selenium from the mine. The SSSC is being developed cooperatively with the SSSC Workgroup, which is composed of agency personnel from Idaho Department of Environmental Quality (IDEQ), Idaho Fish and Game (IDFG), U.S. Forest Service (USFS), Wyoming Department of Environmental Quality (WDEQ), U.S. Environmental Protection Agency (USEPA) headquarters, and USEPA Region 10. This Workgroup provided review and comments to define the methods and approach for the monitoring studies. The field monitoring studies represent one component of the overall approach for developing a SSSC (NewFields 2008), and are complemented by laboratory studies and supported by an ongoing literature review.

The SSSC field monitoring studies component includes monitoring in-stream biological communities. As part of the biological characterization, fish community and population data were collected during five sampling events: Fall 2006, Spring 2007, Fall 2007, Spring 2008, and Fall 2008, at up to eleven locations as outlined in the Final Work Plan – *Field Monitoring Studies for Developing a Site-Specific Selenium Criterion* (NewFields 2007).

This report presents the biological population and community data collected during the SSSC monitoring effort from 2006 to 2008. Tissue selenium concentration data are also presented. The study area boundaries and monitoring locations are described in Section 2. The sampling methods utilized, a summary of the collected data, and the results of additional analyses that were conducted to compare trout populations at the Simplot study locations with other trout populations in the region are presented in Section 3. Section 4 presents the results of the benthic macroinvertebrate community evaluation and Section 5 concludes the report with a summary and evaluation of the data.

2.0 STUDY AREA AND MONITORING LOCATION DESCRIPTIONS

In the fall of 2006, the first SSSC field monitoring effort was implemented to characterize the chemical, biological, and physical conditions of the monitoring locations as part of a multi-seasonal monitoring effort. Following is a description of the locations visited during the five SSSC sampling events from Fall 2006 through Fall 2008.

2.1 Study Area

The waterbodies investigated are found within the Salt Subbasin, Hydrologic Unit Code (HUC) 17040105, of the Upper Snake River Basin. Three waterbody subunits of the Salt Subbasin, as defined by the Idaho Administrative Code's Water Quality Standards (IDAPA 58.01.02), are found within the area being investigated. These subunits are defined as follows:

- US-8 Crow Creek – source to Idaho/Wyoming border;
- US-9 Sage Creek – source to mouth; and
- US-10 Deer Creek – source to mouth.

2.2 Monitoring Locations

The study area includes four background locations, one reference location, and six downstream locations (Figure 3). All of the locations represent a lotic (flowing) system. The four background locations characterize non-mining conditions within the Crow Creek drainage, while the reference location SFTC-1 (not shown) characterizes non-mining conditions in a separate drainage.

Upstream and reference locations include the following:

- **SFTC-1** – South Fork Tincup Creek upstream of its confluence with Tincup Creek;
- **CC-75** – Crow Creek upstream of Wells Canyon;
- **CC-150** – Crow Creek upstream of Deer Creek;
- **CC-350** – Crow Creek downstream of Deer Creek; and

- **DC-600** – Deer Creek upstream of its confluence with Crow Creek.

The remaining six locations were selected to evaluate decreasing trends in aqueous selenium concentrations with distance from the source. Downstream receiving water locations include:

- **HS** – Hoopes Spring (near discharge);
- **HS-3** – Hoopes Spring channel near its confluence with Sage Creek;
- **LSV-2C** – Sage Creek downstream of Hoopes Spring and upstream of South Fork Sage Creek;
- **LSV-4** – Sage Creek upstream of the confluence with Crow Creek;
- **CC-1A** – Crow Creek downstream of Sage Creek confluence; and
- **CC-3A** – Crow Creek downstream of CC-1A on the Simplot Meade Peak Ranch.

3.0 FISH COMMUNITY AND POPULATION EVALUATIONS

Fish community and population evaluations were conducted at each monitoring location. The sections below provide details on methods used and provide results by monitoring event.

3.1 Electrofishing Methodology and Data Analysis Procedures

Electrofishing methods utilized for the SSSC investigation are presented in Section 4.4.1 of the April 2007 *Final Work Plan – Field Monitoring Studies for Developing a Site-Specific Selenium Criterion* (NewFields 2007) and are briefly described below.

A reach of stream at each location was identified and marked prior to sampling. Upon arriving at a sampling location, a walking visual survey was conducted. Selection of a specific stream reach for sampling considered the following characteristics: channel shape, habitat diversity (e.g., pools, riffles, runs), hydraulic controls and or hydraulic modifications (e.g., irrigation diversions, returns, or tributary inflows), adjacent land use, stream width, and the reach's proximity to roads. Once a prospective reach was identified, the upper and lower bounds of the reach were marked with stakes and the reach was measured. Reaches were 30 times the width of the stream or a minimum of 100 meters.

Block nets were placed at the upper and lower limits of the reach to be fished in order to prevent the population present in the reach from exiting the reach and to block fish from outside the reach from entering the reach. A minimum of three field team members constituted the electrofishing team. Electrofishing was conducted using either a backpack mounted electrofishing unit (e.g., Smith Root or equivalent) capable of emitting sufficient electrical current into the water to stun fish for collection, or a bank unit powered by a separate generator for larger stream areas such as Crow Creek downstream of Sage Creek (CC-1A and CC-3A). Each electrofishing pass began at the downstream limit of the reach, immediately upstream of the block net. The electrofishing unit timer was set to zero prior to each pass in order to record the time spent electrofishing during each pass. An electrofishing pass consisted of the electrofishing crew moving in an upstream direction in a zig-zag pattern with the electrodes in the water and the unit turned on. Stunned fish were netted and immediately placed in buckets filled with stream water for holding until species identifications, counts, and measurements of weight, length, and observations of physical deformities were made. Nets used for fish capture consist of a mesh size of one-eighth to one-quarter inch. An electrofishing pass was completed when the field team reached the upstream limit of the reach where the block net was placed. The time for each pass was recorded in the field log book, together with any observations or counts of fish missed by netters, or observations of where fish tend to be collected (i.e., associated with a particular habitat feature).

Because fish population estimates were desired, a multi-pass removal method was employed. The method requires that three electrofishing passes be conducted. Fish collected during each pass were removed and retained until completion of each subsequent pass. Captured fish were held in flow-through live cars in the stream. All trout collected were identified, counted, weighed, measured for total length, and evaluated for physical condition and abnormalities. Once fish were identified and enumerated, all fish with the exception of those retained for selenium tissue residue analysis were released back to the stream reach where they were collected. Fish retained for selenium residue analysis include sculpin (~n=6) and trout (~n=10 ≤100 mm in length). Adult trout were typically retained unless fish were being collected for special studies.

Because trout in these streams are mobile and may move in and out of areas being monitored during the course of these investigations, trout were tagged for future identification during the SSSC monitoring effort. Juvenile and adult trout greater than about 150 mm in total length were marked with a numerically-coded T-bar anchor tag following identification and measurement of length and weight. The coded tag number was recorded along with species identification, length, weight, and observations of condition and/or deformities. Fish with visible tumors, lesions, or other apparent deformities were photographed and the photograph number was recorded on the fish field data sheet along with species identification, weight, and length data to provide a record of the occurrence and condition of these fish.

All field forms were translated into electronic data (Excel spreadsheets). Chemical data for analysis of selenium were directly integrated from laboratory output of electronic data deliverables (EDDs) into an Access database. Trout and sculpin population estimates and fish condition factors (K) for species collected at each location for each monitoring event were derived using Microfish software (Van Deventer and Platts 1989). Age-length frequency data were generated based on the frequency of occurrence of preselected fish lengths consistent with the literature for age breaks based on fish length.

3.2 Fish Community and Population Data

Fish community and population data presented in this section include data compiled for Crow Creek, Sage Creek, Hoopes Spring, and Deer Creek. Note that the location on Sage Creek upstream of the confluence with Crow Creek (LSV-4) was only sampled in Fall 2006 and Spring 2007.

Fish communities of Crow Creek and its tributaries are consistent with cold water aquatic communities found in Southeast Idaho streams. Larger, lower elevation streams tended to have a higher number of species than smaller, higher elevation streams (Table 1). Table 2 shows the total number of fish taxa collected during the five sampling periods from Fall 2006 to Fall 2008. Taxa numbers have been fairly consistent over time.

Trout species, including brown trout (*Salmo trutta*) and Yellowstone cutthroat trout (YCT) (*Oncorhynchus clarki bouvieri*), and Paiute sculpin (*Cottus beldingi*) were the predominant species collected at nearly every location monitored (Table 2). Dace species, including longnose dace (*Rhinichthys cataractae*) and speckled dace (*Rhinichthys osculus*), mountain whitefish (*Prosopium williamsoni*), redside shiner (*Richardsonius balteatus*), and Utah sucker (*Catostomus ardens*) were found at a smaller number of locations, but typically consistently at the same locations. Mottled sculpin (*Cottus bairdi*) and northern leatherside chub (*Snyderichtys copei*) were only infrequently collected.

The numbers of taxa collected during the monitoring period (2006 - 2008) are presented in Figure 4. Of the locations monitored, reference location SFTC-1 had the highest number of fish taxa, followed by Crow Creek locations, while higher elevation streams such as Deer Creek, Hoopes Spring and Sage Creek had fewer species.

3.2.1 Fall 2006

In total, 5,551 fish were collected at ten locations during the August 31 to September 8, 2006 sampling period, representing four families and at least eight genera and species (Table 1). Cottidae (sculpin family) accounted for 88.8 percent of the total catch, followed by Salmonidae (trout and whitefish) 6.5 percent, Cyprinidae (minnows) 4.6 percent, and Catostomidae (suckers) <0.1 percent. Total fish density across all locations and species was 0.75 fish per m^2.

Salmonids were collected at ten locations, with brown trout found at nine locations, YCT at eight locations, and mountain whitefish at three locations (Table 1). Based upon the trout population estimates, brown trout standing crop was greatest at locations LSV-2C, CC-150, and HS with estimates of 246, 126 and 117 kg/Ha, respectively (Tables 3 and 4). No brown trout were collected at DC-600, while the estimate for CC-350 was 0.1 kg/Ha. Brown trout were generally in good condition, with mean Fulton condition factor (K) values ranging from 0.89 at CC-1A up to 1.08 at CC-75 (a value of 1.0 indicates a fish in “robust” condition). Only one fish was observed to have a physical malformation, a brown trout at LSV-4 with a humpback, but otherwise in good condition. Five or more age classes of brown trout were present at seven of the nine locations where the species was collected based upon the age-length relations presented in Grafe (ed.) 2002. Location CC-350 had one age class of brown trout, while location HS had three. Length-frequency distributions for brown trout collected at each location are presented in Attachment 1.

YCT were found at all locations except HS and HS-3, but generally in lesser abundance than brown trout when sympatric (i.e., more than one population using the same geographic area) (Tables 3 and 4). Where present, YCT standing crop estimates ranged from a high of 83 kg/Ha at DC-600 to 2.4 and 2.2 kg/Ha at CC-75 and CC-350, respectively (Table 4). YCT were generally in good condition with mean K values ranging from 0.83 at CC-75 to 1.12 at LSV-2C

(Table 2). At DC-600, where only YCT were collected, the mean K value was 0.89 (Table 2). No physical deformities were observed on any of the YCT collected. Multiple age classes of YCT were found at seven of the eight locations where the species was collected, based upon the age-length relations presented in Grafe (ed.) 2002, with the most being found at DC-600 (up to 5), CC-1A (up to 4), and CC-3A (up to 4). Length-frequency distributions for YCT collected at each location are presented in Attachment 1 to this appendix.

3.2.2 Spring 2007

In total, 3,096 fish were collected at ten locations during the May 7 to May 14, 2007 sampling period, representing four families and at least eight genera and species. Cottidae (sculpin family) accounted for 75.5 percent of the total catch, followed by Salmonidae (trout and whitefish) at 14.8 percent, Cyprinidae (minnows) at 8.7 percent, and Catostomidae (suckers) at 1.0 percent. Total fish density across all locations and species was 0.42 fish per m^2.

Salmonids were collected at ten locations, with brown trout found at nine locations, YCT found at nine locations, and mountain whitefish found at four locations (Table 2). Based upon the trout population estimates, brown trout standing crop was greatest at locations LSV-2C, LSV-4, and HS, with estimates of 146, 99.6 and 72.5 kg/Ha, respectively (Tables 3 and 4). No brown trout were collected at DC-600. Brown trout were generally in good condition, with mean K values ranging from 0.880 at CC-1A up to 1.09 at CC-75. Five or more age classes of brown trout were present at seven of the ten locations where the species was collected based upon the age-length relations presented in Grafe (ed.) 2002. Locations CC-350 and HS had three brown trout age classes. Length-frequency distributions for brown trout collected at each location are presented in Attachment 1 to this appendix.

YCT were found at all locations except HS, but generally in lesser abundance than brown trout when sympatric (Tables 3 and 4). Where present, YCT standing crop estimates ranged from a high of 116 kg/Ha at LSV-2C to 5.7 and 3.9 kg/Ha at CC-75 and HS-3, respectively (Table 4). YCT were generally in good condition with mean K values ranging from 0.9 at CC-350 to 1.03 at CC-3A. At DC-600 where only YCT were collected, mean K was 0.92. Multiple age classes of YCT were found at seven of the nine locations where the species was collected, based upon the age-length relations presented in Grafe (ed.) 2002, with the most being found at DC-600 (up to 4), CC-1A (up to 4), and CC-3A (up to 3). Length-frequency distributions for YCT collected at each location are presented in Attachment 1 to this appendix.

3.2.3 Fall 2007

In total, 3,748 fish were collected at nine locations during the August 23 to August 29, 2007 sampling period, representing four families and at least nine genera and species. Cottidae (sculpin family) accounted for 73 percent of the total catch, followed by Salmonidae (trout and whitefish) 16 percent, Cyprinidae (minnows) 10.6 percent, and Catostomidae (suckers) less than 1 percent. Total fish density across all locations and species was 0.55 fish per m^2.

Salmonids were collected at nine locations, with brown trout found at eight locations, YCT found at eight locations, mountain whitefish found at three locations, and a brook trout (*Salvelinus fontinalis*) found at one location (Table 2). Based upon the trout population estimates, brown trout standing crop was greatest at locations LSV-2C, HS-3 and CC-150, with estimates of 154.1, 95.5 and 86.6 kg/Ha, respectively (Tables 3 and 4). No brown trout were collected at DC-600. Brown trout were generally in good condition, with mean K values ranging from 0.94 at HS up to 1.09 at CC-3A. Four or more age classes of brown trout were present at six of the ten locations where the species was collected based upon the age-length relations presented in Grafe (ed.) 2002. Locations HS and HS-3 had two and three brown trout age classes, respectively. Length-frequency distributions for brown trout collected at each location are presented in Attachment 1 to this appendix.

YCT were found at all locations except HS, but generally in lesser abundance than brown trout when sympatric (Tables 3 and 4). During Fall 2007, the exception to this occurred at CC-350 and CC-3A where YCT were found in higher abundance than brown trout. Where present, YCT standing crop estimates ranged from a high of 76.2 kg/Ha at DC-600 to 2.0 kg/Ha at CC-75 (Table 4). YCT were generally in good condition with mean K values ranging from 0.82 at CC-150 to 1.11 at LSV-2C (Table 2). Three or more age classes, based upon the age-length relations presented in Grafe (ed.) 2002, were found at LSV-2C, CC-1A, and CC-3A. At least three age classes were found at nine of the ten locations where this species was collected. No YCT were found at HS. Length-frequency distributions for YCT collected at each location are presented in Attachment 1 to this appendix.

3.2.4 Spring 2008

In total, 1,004 fish were collected at nine study locations during the May 12 to May 18, 2008 sampling period, representing four families and at least eight genera and species. Salmonidae (trout and whitefish) accounted for 47 percent of the total catch, followed by Cottidae (sculpin family) 42 percent of the total catch, followed by Cyprinidae (minnows) 9.5 percent, and Catostomidae (suckers) 1.0 percent. Total fish density across all locations and species was 0.15 fish per m^2. Brown trout, YCT, and sculpin were found at most monitoring locations, although brown trout was the predominant species in Crow Creek and Sage Creek, while YCT was the predominant species collected in Deer Creek.

Salmonids were collected at nine locations. Brown trout were found at eight locations, YCT at eight locations, mountain whitefish at four locations, and brook trout at one location (Table 2). Except for location CC-3A, brook trout have not been collected at any location during previous monitoring (Table 1).

Based on the trout population estimates, brown trout standing crop was greatest at locations LSV-2C, CC-150, HS-3, with estimates of 109, 90.2 and 86.7 kg/Ha, respectively (Tables 3 and 4). No brown trout were collected at DC-600. Brown trout were generally in good condition, with mean Fulton condition factor (K) values ranging from 0.08 at CC-350 up to 1.04 at CC-150. Several age classes of brown trout were present at most locations based on length frequency data (Attachment 1). The exceptions include Hoopes Spring (HS), where only a few brown trout were collected, and DC-600 in Deer Creek, where no brown trout were present. Of the age classes present, young of the year appeared to be most prevalent.

YCT were found at all locations except HS, but generally in lesser abundance than brown trout when sympatric (Tables 3 and 4). Where present, YCT standing crop estimates ranged from a high of 54.7 kg/Ha at DC-600 to 5.4 kg/Ha at CC-75. YCT were generally in good condition with mean K values ranging from 0.929 at CC-150 to 1.006 at LSV-2C. At DC-600 where only YCT were collected, the mean K value was 0.99. Length-frequency distributions for YCT collected at each location are presented in Attachment 1 to this appendix. Based on the length-frequency data, multiple age classes of YCT were present at several locations.

3.2.5 Fall 2008

In total, 2,424 fish were collected at ten locations during the September 3 to September 9, 2008 monitoring period, representing four families and at least ten genera and species. Cottidae (sculpin family) accounted for 60 percent of the total catch, followed by Salmonidae (trout and whitefish) accounting for 25 percent, Cyprinidae (minnows) 12.7 percent, and Catostomidae (suckers) 1.9 percent. One northern leatherside chub was collected at CC-350 during Fall 2008 monitoring. Total fish density across all locations and species was 0.36 fish per m^2.

Yellowstone cutthroat trout, brown trout and sculpin were found at most monitoring locations although brown trout is the predominant species in Crow Creek and Sage Creek, while YCT is the predominant species in Deer Creek.

Salmonids were collected at all locations across all the sampling events. Brown trout were found at eight locations, YCT at eight locations and mountain whitefish were found at three locations (Table 2). During Fall 2008 monitoring, only one mountain whitefish was collected at location CC-350, while approximately 50 mountain whitefish were captured at both CC-1A and CC-3A (Table 2). Population estimates were not determined for mountain whitefish.

Based on the trout population estimates, brown trout standing crop was greatest at locations LSV-2C, CC-150 and CC-3A, with estimates of 231.1 kg/Ha, 83.8 kg/Ha and 58.6 kg/Ha, respectively (Tables 3 and 4). No brown trout were collected at DC-600. Brown trout were generally in good condition, with mean K values ranging from 0.908 at CC-350 up to 1.009 at CC-150 (a value of 1.0 indicates a fish in “robust” condition). Several age classes of brown trout were present at most locations based on length frequency data (Attachment 1). The exceptions include Hoopes Spring (HS), where only a few brown trout were collected, and DC-600 in Deer Creek, where no brown trout were present.

YCT were found at all locations except HS, but generally in lesser abundance than brown trout when sympatric (i.e., more than one population using the same geographic area) (Tables 3 and 4). Where present, YCT standing crop estimates ranged from a high of 126.9 kg/Ha at DC-600 to 1.2 kg/Ha at HS-3. YCT were generally in good condition with mean K values ranging from 0.844 at HS-3 to 1.00 at LSV-2C. At DC-600, where only YCT were collected, mean K was 0.937. Based on length-frequency data (Attachment 1 to this appendix), multiple age classes of YCT were present at several locations.

3.2.6 Trout Population Estimates from 2006 - 2008

Total species richness is shown in Figure 4 based on the five monitoring events. The reference location, South Fork Tincup Creek (SFTC-1), has the highest species richness at 10 species. The downgradient Crow Creek locations CC-1A and CC-3A also have high species richness at 9 species each. Upgradient background locations on Crow Creek and Deer Creek have species richness that range from 2 to 8 species. Hoopes Spring locations range from 2 to 3 species, while Sage Creek locations both have 4 total species.

Total fish density (#fish/m^2) for each monitoring period is presented in Figure 5, while Figure 6 consists of three panels showing densities for salmonids (trout and whitefish), cottids (sculpin), and cyprinids and catostomids (minnows and suckers), respectively. Total fish density is highest at location HS, but comprised almost completely of sculpin. Overall, fish density is variable across the seasonal periods sampled. Sculpin (*Cottus spp.*) was the most universally distributed species, with collections at all eleven study locations across all monitoring events (Table 1, Table 2 and Figure 6, panel 2). Members of the family Salmonidae have been collected at all eleven study locations across all the monitoring events. Density of salmonid species at each location is illustrated in Figure 6, panel 1. Cyprinids and catostomids were not present at all locations (Figure 6, panel 3). Both fish families were absent at locations CC-75, DC-600, HS-3, LSV-2C, and LSV-4. Environmental variables that affect why neither of these species have been found at these locations likely range from and include, among other factors, the following: water quality, water quantity, habitat quality, prey variability and density, summer temperatures, predator density. Several of these variables are evaluated below relative to cyprinid and catostomid density. Historical records indicate no dace were found in 1979 in Sage Creek (Heimer 1979).

Trout density is consistently greatest at Deer Creek and is composed solely of YCT (*Oncorhynchus clarki bouvieri*). The biomass or standing crop of trout is consistently greatest LSV-2C and it mostly comprised of brown trout (*Salmo trutta*), but some YCT are found at LSV-

2C as well. Mountain whitefish (*Prosopium williamsoni*) are typically found at CC-350, CC-1A, and CC-3A (Table 2). Population estimates were not determined for mountain whitefish. During the Fall 2008 monitoring event, and for the first time during this project, a fish captured at location CC-350 was positively identified as a leatherside chub (*Snyderichtys copei*).

Population estimates for the trout species collected at each location were derived using Microfish software (Van Deventer and Platts 1989), with standing stock estimates reported by species as number per mile (#/mile), number per kilometer (#/km), pounds per acre (lbs/acre), and kilograms per hectare (kg/Ha). The Microfish software was also used to calculate condition factor (K) for each trout collected and to generate length-frequency distributions. Figure 7 shows the seasonal total trout standing crop percentage for both trout species for each of the five monitoring events. Figure 8 consists of five panels that display the total trout standing crop based on estimates for each monitoring event. Tables 3 and 4 provide the summary statistics for the population estimates, with all relevant data shown in Table 3 and a summary provided in Table 4. As shown in Figure 7, total trout standing crop estimates are consistently highest at LSV-2C. Standing crop estimates were consistently lower at CC-350 when compared to other locations, either upstream or downstream of Sage Creek.

Over the course of the five seasonal monitoring periods, YCT were found at all locations except HS, but generally in lesser abundance than brown trout when sympatric (i.e., more than one population using the same geographic area) (Tables 1 and 2). Based on length-frequency data (Attachment 1), multiple age classes of YCT were present at several locations. Length-frequency distributions for YCT collected at each location and for each monitoring event are presented in Attachment 1. Several age classes of sculpin were also present at most of the locations except at CC-1A and CC-3A, which is consistent with observations from previous monitoring events.

Comparisons of the trout standing crop estimated at all locations for Fall 2006 through Fall 2008 are shown in Table 4 and Figure 8. At some locations, brown trout standing crop was lower in the spring than in the fall, while cutthroat trout standing crop was higher during spring than in fall (Figure 8). Across the five monitoring periods, it appears that where brown trout are the dominant species, they are consistently dominant regardless of season. Similarly, where YCT are dominant, they are consistently dominant regardless of season.

During all sampling events, trout were tagged with T-bar anchor tags. Information on fish from each monitoring event that were captured, tagged and released is presented in Appendix C of the *Final Data Report, Fall 2006-Fall 2008 Field Monitoring Studies for Developing a Site-Specific Selenium Criterion* (NewFields and HabiTech 2009). More than 90 YCT and brown trout were tagged during the Fall 2008 monitoring event. Tagging has shown to be a useful means of tracking fish and collecting growth data, with several fish collected and tagged during 2006 being recaptured in 2007 and/or 2008 (Appendix G, NewFields and HabiTech 2009). In all monitoring events, 173 fish have been tagged and subsequently recaptured. Of these, 50 trout were recaptured in Spring 2007, 43 trout were recaptured in Fall 2007, 38 were recaptured in Spring 2008, and 40 were recaptured in Fall 2008. All trout were recaptured at their initial tagging location.

Two fish were harvested by local fishermen in July of 2008. T-bar anchor tag numbers were reported, but they did not match any of the tag numbers on record associated with this project. The two fish were brown trout harvested from Deer Creek at its confluence with Crow Creek. Two other brown trout, noted in Appendix G (NewFields and HabiTech 2009), were collected in October and November of 2008 and utilized as tissue samples for the brown trout reproduction studies.

Length and weight data for tagged fish which have been recaptured are presented in Appendix G (NewFields and HabiTech 2009). Figure 9 shows mean growth (based on total length) of all trout recaptured. These data are normalized to an annual growth rate for purposes of comparison. At one location (HS-3), only one tagged fish has been recaptured. However, mean values for trout growth (mm/year) at Crow Creek locations upstream of Sage Creek, Sage Creek, and Crow Creek downstream of Sage Creek have sufficient sample size for a reasonable growth estimate. Growth rates for trout at these monitoring locations (excluding HS-3) indicate a similar and consistent rate across monitoring locations.

3.3 Statistical Analysis of Trout Populations

This section evaluates trout population data to determine if significant differences in trout standing crop are observed. Data included in this analysis are shown in Table 4 with the following exceptions. For data consistency between locations and years, two locations (HS and LSV-4) and one sampling season (Fall 2006) were omitted from this analysis. Location HS is a source location for selenium and was excluded because: (1) it is a spring originating location with no watershed influences, and as such its habitat is not directly influenced by highly variable fluvial processes such as stream flow and sediment transport; (2) the dense aquatic vegetation present during all field visits prevented effective fish sampling of the total wetted surface area; (3) vegetation removal efforts to facilitate electrofishing likely re-distributed fish into the remaining wetted marsh-like habitat which could not be effectively sampled; and (4) fish movement into and out of the area is limited by the lack of surface flow upstream of the location and a rock outcrop just downstream that is a likely fish barrier. Location LSV-4 was omitted because it could only be sampled in Fall 2006 and Spring 2007 due to landowner access restrictions. Fall 2006 data were not included because: (1) no data were collected at SFTC-1 (this location was not added to the study until 2007); (2) no water temperature data other than instantaneous measurements were available which resulted in high Habitat Quality Index (HQI) scores at many locations; and (3) sampling at locations CC-1A and CC-3A due to deep water, unwadeable conditions was not as effective as following sampling periods when a larger bank-based unit was used for these locations. All other locations and sampling times were included.

Based upon the analyses (Table 5), the comparisons indicate:

1. No significant differences in total trout standing crop were found between spring and fall sampling seasons.

2. Total trout and YCT standing crop estimates were not significantly different between background and downstream locations. Brown trout standing crop was significantly different between upstream and downstream locations (higher at downstream locations).

Population analyses indicate that downstream areas affected by Hoopes Spring discharge are not substantially reduced when compared to background trout populations.

3.3.1 Statistical Comparisons of Trout Populations Using 2006 to 2010 Data

Since the completion of the 2008 studies and release of the Final Data Report, additional trout population data have been collected as part of the Panels F and G Mitigation Monitoring Plan described in the Smoky Canyon Mine Comprehensive Environmental Monitoring Program Plan (NewFields 2009). These additional data were only collected in the Fall of 2009 and Fall of 2010. Locations HS-3, LSV-4, and CC-3A were not sampled in 2009 as they were not part of the mitigation monitoring plan, but these locations were added in 2010 to continue population monitoring efforts. For comparison purposes, the 2006 to 2008 data together with the 2009 and 2010 data are presented in Table 6. Additional statistical comparisons were conducted including these data with the trout population data collected between 2006 through 2008 using Number Cruncher Statistical Systems (NCSS 2007). For this analysis, only Crow Creek drainage locations were utilized (i.e., SFTC-1 was excluded as it was not sampled in 2009 or 2010). Location HS was also excluded from this analysis due to the reasons listed previously. Also, population monitoring data collected during Spring 2007 and Spring 2008 were not used in this analysis. Electrofishing data collected during these higher flow periods provide for seasonal information, but also contribute to variability due to changes in visibility, capture efficiency, and increased habitat area simply due to higher flow volumes. Kruskal-Wallis non-parametric one-way Analysis of Variance (ANOVA) was used to examine if location-specific trout populations were significantly different, together with the Kruskal-Wallis Multiple Comparison Z-Value Test.

For brown trout, standing crop was significantly different among the locations evaluated ($p = 0.003$), with higher standing crops at LSV-2C compared to CC-1A and CC-350. No other differences were detected (Table 7). For YCT, the Deer Creek location was included, and again, standing crop for YCT was significantly different ($p=0.0014$). Location DC-600 had significantly higher standing crops than CC-75, CC-350, and HS-3, and LSV-2C had significantly higher standing crops than HS-3 (Table 8).

Total trout were also evaluated and were found to be significantly different (p=0.0008). Location LSV-2C had significantly higher total trout standing crop than CC-1A, HS-3, and CC-350 (Table 9). Finally, standing crop was evaluated by grouping locations as follows: Background (CC-75, CC-150, CC-350, and DC-600), Hoopes and Sage Creek (HS-3, LSV-2C, and LSV-4), and downstream Crow Creek (CC-1A and CC-3A) (Table 10). Standing crops were significantly different among these groups (p=0.047), with standing crop being higher for the Hoopes and Sage Creek group as compared to either the background or downstream Crow Creek locales. Background and downstream Crow Creek locales were not significantly different (Table 10).

3.3.2 Relationship between Trout Populations and Selenium Concentrations

As part of this biological community evaluation, total trout population data (standing crop [kg/Ha]) are evaluated relative to total aqueous selenium and mean selenium in trout tissues. Both relationships trend positive, with increased standing crop as aqueous and tissue selenium concentrations increased (Figures 10 and 11). Neither relationship is particularly strong.

Brown trout and YCT standing crop estimates were individually evaluated against total aqueous selenium concentrations (Figure 12). For brown trout, while the relationship was significant (R^2 = 0.135, p=0.025), the slope of the line was positive with increasing standing crop occurring as aqueous selenium increased. Brown trout are the predominant trout species found at the locations evaluated, but are not found at SFTC-1 and DC-600. Similar to brown trout, YCT were not found at all locations. Relating YCT standing crop to aqueous selenium concentrations showed a different trend as the slope of the line was slightly negative, with decreasing YCT standing crop as aqueous selenium increased (Figure 12).

Further investigation of this relationship, using log-transformed data, revealed that YCT standing crop is not significantly related to aqueous selenium concentrations (i.e., the slope of the line is not significantly different than zero) (R^2 = 0.0019, p=0.7767). A similar analysis for YCT standing crop versus YCT tissue concentrations was also conducted. Log YCT tissue concentrations of selenium were not significantly related to log YCT standing crop (R^2 = 0.025, p = 0.4340). This is supported by the fact that one of the highest standing crops was found at a Sage Creek location with some of the highest selenium concentrations.

Several factors influence the distribution, abundance, and biomass of YCT. Two of those factors are described below. Standing crop estimates of YCT regressed against life stage and species-dependent habitat variables from the Habitat Suitability Index (HSI) models indicated relatively strong and significant relationships of YCT standing crop to habitat (as discussed in Appendix C). Examining the data, it is observed that one of the highest YCT standing crop estimates was found at LSV-2C where selenium concentrations tend to be only slightly lower than just upstream where the highest concentrations are found at HS-3 in the Hoopes Spring channel. YCT standing crop was low at location CC-75 where the aqueous selenium concentration was at or below background indicating that habitat quality, among other factors, is a major factor in YCT distribution.

Locations monitored during the 2006 to 2008 effort in the Crow Creek drainage are part of the Salt River Basin. One study found that in the Salt River Basin (Idaho-Wyoming), cutthroat trout densities are elevated in high-gradient reaches with a diversity of pools, riffles, and runs where brook trout (*Salvelinus fontinalis*) and brown trout (*S. trutta*) densities are low (Quist and Hubert 2005). Cutthroat trout density was always low if brown trout and brook trout densities were high, even when habitat conditions were favorable (Quist and Hubert 2005). Consistent with Quist and Hubert (2005) brown trout are the dominant trout species at most locations evaluated in the Crow Creek drainage. Where brown trout are dominant, YCT density is lower.

Evidence that selenium concentrations in aqueous media or diet are limiting trout populations in the Crow Creek drainage is not present based on these data. Overall, YCT standing crop, brown trout standing crop and overall trout standing crop appear to be more highly related to habitat quality, quantity, and competition for those resources (e.g., habitat, food).

3.4 Trout Condition and Growth

Condition factors were also evaluated for brown trout and YCT. The relative robustness, or degree of well-being, of a fish is expressed by “coefficient of condition” (also known as condition factor, or length-weight factor). Figures 13 and 14 show the K values derived from brown trout and YCT collected during population surveys. The relatively narrow range of K values across all locations for both species suggests no major differences in growth. For brown trout collected at locations downstream of Hoopes Spring, K factors ranged from 0.88 to 1.086, while for upstream locations (including the reference location), K factors ranged from 0.803 to 1.09. A similar finding for YCT was also observed, with K factors ranging from 0.844 to 1.11 for downstream locations, and 0.81 to 1.036 from upstream locations. These values are for a mixed age-class structure.

The analysis of condition factors derived from length and weight data for trout illustrate a high degree of similarity between background/reference locales and downstream locales. These findings are further supported by tag and recapture data. During each monitoring event, trout greater than about 175 mm were tagged, weighed, measured for length, and released back to the location of capture. Subsequent monitoring events allowed for recapture of some of these tagged fish. Growth rates were derived for recaptured fish from each location and normalized to a length rate per year (mm/year). Mean growth rates for recaptured fish are shown in Figure 9. A location by location comparison of growth rates was conducted using one way ANOVA. The data were not normally distributed, but variances were equal. The Kruskal-Wallis non-parametric ANOVA was used to assess differences of ranked median value and found that all growth rates were not significantly different from one another, except for DC-600 and LSV-2C. Growth rates in Deer Creek from DC-600 were significantly lower than growth rates from Sage Creek at LSV-2C (Kruskal-Wallis one-way ANOVA and Kruskal-Wallis MCT using Z-values, p = 0.0069). The relative similarities in growth rates for those locales upstream of Sage Creek (except Deer Creek) and those downstream of Hoopes Spring provides further corroboration of the K factors evaluation. Trout are growing at similar rates between the two areas (mean growth rate for trout at upstream locations was 44.8 mm/yr, while the mean growth rate for trout downstream of Hoopes Spring was 54.7 mm/yr), thus selenium concentrations are not likely affecting trout growth in Sage Creek and Crow Creek.

3.5 Trout Age Class Structure

The frequency of brown trout and YCT occurrence at different length intervals was tracked for each monitoring period as a means of evaluating age-class structure. Attachment 1 to this appendix provides length-frequency distribution graphics for each location monitored for both species. Generally, where brown trout are the dominant trout species, several age classes are present. At LSV-2C, several age classes of brown trout are present, indicating reproduction is occurring and young fish are surviving, even though this locale is characterized by elevated selenium concentrations. Where brown trout are dominant, and dominant in the older age classes, YCT abundance is reduced, specifically at the younger age classes (i.e., LSV-2C, CC-1A, CC-75). At location HS-3, higher frequencies of younger YCT were collected despite brown trout being dominant; however, larger brown trout were not as abundant at this location. Habitat at HS-3 is not conducive to abundance of larger fish due to the lack of holding areas, such as pools and deep runs. Overall, these observations suggest that YCT recruitment may be limited due to brown trout predation.

YCT strongholds were apparent at SFTC-1, DC-600, and CC-350. Possible explanations may include cooler water temperatures, stream gradient, habitat, and/or low or no occurrence of brown trout competition.

3.6 Trout Population Comparisons to Ecoregional and Historical Data

3.6.1 Ecoregional Data

Additional analyses were conducted to compare trout populations at the Simplot study locations used to investigate a SSSC with other trout populations in the region. The Simplot trout population data used in this analysis was that collected by electrofishing at the 10 locations on South Fork Tincup Creek, Crow Creek, Sage Creek, Deer Creek and Hoopes Spring in Fall

2007 and Fall 2008. For purposes of regional comparisons, these analyses closely followed the methods described by Brouder et al (2009), Chapter 15 in Bonar et al. editors (2009). Site brown trout and YCT data were compared to Ecoregion 6 population data, inclusive of all of the Site study streams, among others. These comparisons included electrofishing catch per unit effort (CPUE, #/hr) and length-frequency distribution. Relative weight (W_r) was calculated for each trout of sufficient length collected from the Simplot locations as the ratio of its' field-measured weight to that estimated for a fish of the same length using a length-weight relationship developed from species data collected across North America. Thus, a W_r of less than 1.0 indicates the sample fish weighed less than a typical North American fish of that same species and length. Trout standing crop estimates (kg/Ha) for the Simplot locations were also compared to a sample of 44 such estimates made on a suite of Wyoming trout streams by Binns (1979).

CPUE at the Simplot locations (Table 11) compares favorably with that for other Ecoregion 6 streams (Table 12). For brown trout, CPUE at the Simplot locations having brown trout populations exceeded the Ecoregion 6 mean CPUE in all cases except at location HS-3 in Fall 2007. All Simplot locations exceeded the Ecoregion 6 median (50 percentile) brown trout CPUE, while 8 of the 16 Simplot samples exceeded the Ecoregion 6 95th percentile CPUE of 19.5 fish/hr. Brown trout CPUE was greatest at location LSV-2C for both sampling times, with location CC-150 ranking second. Results for cutthroat trout were similar to those for brown trout. Thirteen of 14 Simplot samples containing cutthroat trout exceeded the Ecoregion 6 mean CPUE, while all 14 locations exceeded the regional median. Cutthroat CPUE for 7 of the 14 Simplot samples exceeded the Ecoregion 6 95th percentile value of 10.6 fish/hr. Cutthroat CPUE was greatest at location DC-600 for both sampling times, while location LSV-2C ranked second.

Length frequency distributions for brown and cutthroat trout from the Simplot locations compared favorably with those for other Ecoregion 6 streams (Figures 15 and 16). For brown trout, most Simplot locations tended to have proportionally more "quality" and "preferred" class fish than the Ecoregion 6 streams, while no "trophy" class browns were collected at any of the locations. Almost all cutthroat trout collected at the Simplot locations fell within the "stock" class, as did those from the Ecoregion 6 streams. "Quality" class cutthroat were collected only at locations CC-1A and CC-3A.

Mean W_r for both brown and cutthroat trout was consistently less than 1.0 at all locations and times, with the exception of cutthroat trout at location SFTC-1 in Fall 2008 (1.03) and location LSV-2C in Fall 2007 (1.0) (Table 13). There do not appear to be substantial differences in mean relative weights between sample locations and times.

Comparison of standing crop estimates (kg/Ha) to more localized areas showed that both 2007 and 2008 standing crop estimates at locations CC-150, LSV-2C, and CC-3A exceed the

Wyoming 75th percentile value of 84 kg/Ha, while the Fall 2008 estimate of 277 kg/Ha at LSV-2C exceeds the Wyoming 95th percentile value (data from Binns 1979) (Tables 14 and 15).

3.6.2 Historical Site Data

A number of entities have collected data at locations in Crow, Deer, and Sage Creeks and tributaries for more than 30 years. Some population data are available from relatively consistent locations at varying intervals. Collectively, these data provide baseline fish population estimates prior to mining and population estimates about 10 years after mining commenced for upper and lower Sage Creek, South Fork Sage Creek, and Hoopes Spring that can be used qualitatively to compare population estimates from the SSSC investigations.

3.6.2.1 Late 1970s and Early 1980s

IDFG (Heimer 1979) sampled several locations on Sage Creek and Hoopes Spring during the summer and fall of 1979 and Mariah and Associates sampled several locations in the summer of 1981 as part of pre-mining investigations to evaluate baseline trout population characteristics. Population estimates for trout species collected are reported in Tables 16 and 17. As expected, on average, the Sage Creek locations lower in the drainage have higher trout population estimates than higher elevation locations. YCT are the predominant trout species in Sage Creek above Hoopes Spring, while brown trout dominate in Hoopes Spring, Sage Creek below Hoopes Spring, and South Fork Sage Creek. Constant stream temperatures due to discharge of groundwater from Hoopes and South Fork Sage Creek springs may be an influencing factor in this distribution.

3.6.2.2 Late 1980s, 1990s, and 2000

In 1986 and 1987, and again 10 years later in 1999 and 2000, IDFG sampled four locations: two in Crow Creek, one in Sage Creek, and one in Deer Creek. One location at Hoopes Spring was also sampled in 1987. In 1986 and again in 1999, Sage Creek near the Crow Creek road (similar to location LSV-4) had similar total trout estimates (120 and 140 trout/100 meters) that were nearly four times higher than what was found in the late 1970s and early 1980s. During all time periods, brown trout comprised the largest proportion of the total trout estimate.

At Hoopes Spring (identified in reports as Middle Fork Sage Creek), the total trout population estimate in 1987 (46 trout/100 meters) was more than three times the trout abundance observed from late 1970s. Brown trout was the only trout species collected during 1987.

On Crow Creek upstream of Sage Creek, both locations sampled indicated that YCT were the predominant trout species during both time periods sampled. The location higher in the drainage (at White Dugaway Creek; 85 to 126 trout/100 meters), however, had a substantially higher trout population than the population estimated for the lower location (downstream of Deer Creek; 9 to 43 trout /100 meters).

On Deer Creek near its mouth (downstream of Crow Creek road), total trout estimates were about one-half those observed in Sage Creek and were comprised mostly of YCT. A small percentage of brown trout was found during both sampling years along with one rainbow trout hybrid.

3.6.2.3 Comparison to 2006 - 2010 Data

The longest record for population estimates comes from Sage Creek near the Crow Creek road (LSV-4). Total trout ranged from 20 to 39/100 meters from 1979 to 1981, 120 to 140 trout/100 meters from 1987 to 1999, and 49 to 119 trout/100 meters from 2006 to 2010. These population estimates from varying time periods provide a temporal evaluation spanning more than 30 years, and while not definitive, suggest that recent population estimates fall within the historic range, both pre- and post-mining (Figure 17). Consistent across all time periods is the fact that brown trout have and continue to make up a significant percentage of the total population of trout in Lower Sage Creek. When examining the long-term trends for trout in this system, it becomes apparent that wide variation occurs temporally.

At Hoopes Spring, the 1979 trout estimate of 15 trout/100 meters was more than doubled in 1987 to 46 trout/100 meters. A wide range of population estimates exist for two locations on Hoopes Spring between 2006 and 2008. Nearest the spring, population estimates ranged from 4 to 9 trout/100 meters, whereas near the mouth of the Hoopes Spring channel, trout estimates ranged from 46 to 176 trout/100 meters (at this location, a small portion of trout included in the population estimate were less than 100 mm).

At Crow Creek downstream of Deer Creek, 1986 and 2000 trout population estimates were varied, ranging from 9 to 43 total trout/100 meters. Similarly varied results were found from 2006 to 2008 where the total trout population estimates ranged from 5 to 38 fish/100 meters. During both time periods, both species of trout were somewhat equally distributed.

Collectively, these population estimates spanning a lengthy time period suggest that trout populations have remained stable. Variability in these estimates is likely due to a number of factors including sampling methods, conditions during sampling (flows, water quality and quantity), and fish sizes used in the population estimates. While these comparisons are qualitative, they do provide some insights into long-term trends.

3.7 Sculpin Populations and Habitat

Two species of cottids, Paiute *(Cottus beldingi)* and Mottled sculpin *(Cottus bairdi)*, are present in the Crow Creek drainage. Mottled sculpin are infrequently identified, and have only been positively identified in voucher samples, but in proportionately low numbers compared to the number submitted for taxonomy. In Fall 2006, the field team only identified *Cottus* spp. to genus level. Sculpin were observed at all sampling locations, but with much lower numbers at the downstream Crow Creek locations. Beginning in Spring 2007 and for the remaining monitoring events (2007-2008), the field team was looking at sculpin for identification to species level, but found mostly Paiute sculpin, with only a couple of mottled sculpin (one each at locations SFTC-1, DC-600, and CC-1A). More recently (2009-2010), during monitoring for a different project, one mottled sculpin was also observed at CC-75 and three were observed at CC-1A. Since 2007, voucher specimens were collected at each location and species identifications were verified by a taxonomist. Of all the field-identified Paiute sculpin vouchers, fewer than five percent were identified by a taxonomist as mottled sculpin.

Mean sculpin population density estimates indicate greater than 0.2 sculpin/m^2 at all locations except CC-1A and CC-3A. In fact, at several locations, the mean density is greater than 2 sculpin/m^2 (Figure 18). Cottid density and abundance does not appear to be affected by selenium concentrations and may be more a function of habitat and trout density. Visual comparison of cottid density between stream monitoring locations outside of the influence of Hoopes Spring (SFTC-1, CC-75, CC-150, CC-350, and DC-600) and those influenced by Hoopes Spring (HS-3, LSV-2C, LSV-4, CC-1A, and CC-3A) shows that where selenium concentrations are highest (HS-3, LSV-2C, and LSV-4), sculpin density is as high as locations where selenium concentrations are characterized as background. As noted, CC-1A and CC-3A are noticeably different due to low sculpin abundance at those locations where there appears to be a transition in species (cottids to cyprinids and catostomids). Statistical comparison of sculpin density by locations (inclusive of all seasonal data) indicates that sculpin density at locations are significantly different (One Way ANOVA, p<<<0.05). The Tukey Kramer MCT indicates differences are only noted for locations CC-1A and CC-3A, and all other locations are not significantly different. Sculpin population density and age class structure (discussed below) suggests that there is no difference in sculpin populations between high and low selenium locations; rather, sculpin population density is more likely dictated by habitat conditions.

Low sculpin density was consistently observed at Crow Creek locations CC-1A and CC-3A downstream of Sage Creek, where sculpin appear to be replaced by dace and shiner species. This stretch of Crow Creek is characterized as a lower gradient system (0.22-0.32%), with higher mean summer water temperatures (15-15.7°C) and higher percentages of fine sediment (22.6 -13.8% <2mm). Mebane (2001) found in analysis of state-wide data for Idaho, sculpin density and the number of age classes decreased relative to increases in fine sediment. Quist et al. (2004a) found that physical factors and the density of brown trout affect allopatric and sympatric sculpin populations. Low density of near stream overhead bank cover, erosive banks, low gradient, and predatory brown trout in the lower Crow Creek segments may all contribute to the lower observed sculpin densities.

Both mottled and Paiute sculpin are native and often numerically dominate fish assemblages in Rocky Mountain streams (Quist et al. 2004a). Although these species are often sympatric, Quist et al. (2004a) sampled 110 stream reaches across the Salt River water shed (including Crow, Sage, Deer, and Tincup Creeks) in 1996-1997, and found that Paiute sculpin were more common than mottled sculpin, capturing Paiute sculpin in 64 percent of the reaches (38 percent allopatric and 26 percent sympatric with mottled sculpin). Allopatric Paiute sculpin were observed in high-elevation reaches with low temperatures, including several reaches on Deer Creek and Sage Creek. Field distributions of sculpin observed here support this, with higher numbers of Paiute sculpin found in upstream locations and fewer Paiute sculpin, along with a small number of mottled sculpin, found in downstream locations.

Mottled sculpin can occur in a wide range of habitats, but Quist et al. (2004a) noted that despite their versatility, some streams in the Salt River basin lacked suitable habitat for mottled sculpin. For example, mottled sculpin were completely absent from high-elevation streams on the east side of the Salt River dominated by large rocky substrates and high stream velocities, suggesting that mottled sculpin require relatively slower-water habitats for some portion of their life. Habitat appears to play a large role in the location of the different sculpin species, with Paiute sculpin preferring high gradients, shallow depths, few deep pools, low mean summer water temperatures, large substrates, and low sedimentation (Quist et al. 2004a, Quist et al. 2004b, Johnson 2008, Haro and Brusven 1994), and mottled sculpin utilizing lower-elevation stream segments with low channel slopes and abundant deep pool habitat (Quist et al. 2004b). Quist et al. (2004b) also conducted another study where they grouped their 110 Salt River basin reaches into five dominant fish assemblages (YCT-BRN-MSC; YCT-BRK-PSC; allopatric YCT; CYP-CAT; and other) and found that while 70 percent of the reaches dominated by the YCT-BRN-MSC assemblage also included some number of Paiute sculpin, only 14 percent of the YCT-BRK-PSC reaches had any mottled sculpin.

3.7.1 Sculpin Age Class Structure

Sculpin age classifications based on length are presented in Grafe (2002) for two species of sculpin[1]. Figures in Attachment 2 show the length frequencies for sculpin from each of the seasonal monitoring periods. Figure 19 shows the mean frequency of lengths across all sample periods for each location up to 80 mm. Age breaks from 1 to 4 years, based on length, indicate that multiple age classes are present at each location except at CC-1A and CC-3A where few sculpin were collected. No single age class appears to be absent. However, the sampling

[1] For Paiute sculpin, age breaks are based on only a single set of values with no ranges, due to the limited amount of data classifying age length for this species. Age breaks based on lengths are as follows: ≤1 = 33 mm, 2 = 48 mm, 3 = 58 mm, and 4 = 71 mm.

process does favor disproportionate collection of larger fish. Examining the frequency of 50 mm or less size class sculpin (selected to represent both year 1 and 2 age classes due to low numbers across all locations of 30 mm or less sizes) versus mean selenium concentrations in water indicates a relatively consistent frequency percentage of 50 mm or less size sculpin regardless of selenium concentrations (Figure 20).

3.8 Dace Populations and Habitat

Of three primary cyprinid species present (i.e., redside shiners [*Richardsonius balteatus*], speckled dace [*Rhinichthys osculus*], and longnose dace [*Rhinichthys cataractae*]), speckled dace were the most frequently collected species, on average, followed by longnose dace and redside shiners. At the downstream Crow Creek locations CC-1A and CC-3A, speckled dace were the most abundant cyprinid species. Infrequent captures of dace (i.e., fewer than 15 per sampling event) were made at South Fork Tincup Creek location SFTC-1 and CC-150 on Crow Creek. No dace or redside shiners were observed or captured at any of the other monitoring locations.

Longnose dace are an abundant species with a broad geographic range (Thompson et al. 2001), native in North America from coast to coast, and from the Rocky Mountains in Mexico to the Arctic Circle (Edwards et al. 1983). They are well-adapted for bottom feeding, and feed mostly on benthic insects. Adult longnose dace tend to inhabit the region directly above the substrate, preferring riffle areas in streams (Edwards et al. 1983, Mullen and Burton 1995). Both adults and juveniles prefer riffles with coarse substrate, fast-moving water, and abundant cover, using the large substrates such as boulders, large rocks, logs, or debris as shelter from the current (Edwards et al. 1983, Mullen and Burton 1995). They tend to avoid depositional reaches with low current velocity and large amounts of fine sediment (Thompson et al. 2001). Although longnose dace are predominantly riffle-dwellers, they will occupy quiet, shallow pools when competing species are not present, especially during the summer season (Edwards et al. 1983).

Field crews conducting monitoring for this project tended to find dace in riffles and in near-shore vegetated areas heavy with debris or large boulders. Dace were observed and captured at both upstream and downstream locations along Crow Creek.

3.9 Mountain Whitefish Populations and Habitat

Ten or fewer mountain whitefish (*Prosopium williamsoni*) were observed during one or more monitoring events at South Fork Tincup Creek location SFTC-1, upstream Crow Creek locations CC-150 and CC-350, and Sage Creek location LSV-4. Downstream Crow Creek locations CC-1A and CC-3A hosted an average of approximately 40 mountain whitefish each per sampling event, and generally more individuals in spring sampling events than during fall events. No mountain whitefish were observed or captured at any of the other monitoring locations.

Native to western North America, mountain whitefish prefer cold, clear, deep rivers (WGFD 2010). They are generally found further downstream in the watershed in larger rivers compared to other stream-dwelling salmonids (Meyer et al. 2009), likely because smaller headwater streams do not furnish suitable habitat such as adequate pool size (Sigler 1951). However, they are a widely-distributed, hardy species, and are generally more tolerant of warm water and high turbidity than trout (Behnke 2002). Meyer et al. (2009) conducted a large-scale study across the Snake River basin, including reaches on Crow Creek and Stump Creek in southeast Idaho, and found that stream size was the key environmental factor influencing both abundance and distribution of mountain whitefish. Whitefish were rarely present in streams where the mean wetted width was less than 30 feet wide, but were abundant in low-gradient, main stem streams at least 50 feet wide. During base flow in Utah streams, Sigler (1951) reported that upstream movement of whitefish ceases when streams are less than 16 feet wide and pool depths are less than 4 feet deep. The field distribution of mountain whitefish observed during monitoring for this project support this, with higher numbers of whitefish found in the largest stream reaches with the biggest pools.

The data collected for this project also fit in the context of Habitat Suitability Criteria (HSC) curves developed for the South Saskatchewan River Basin Water Management Plan. According to the HSC curves generated for mountain whitefish, the most suitable stream depth for adults and their eggs ranged from 1.8 feet to greater than 13 feet. Optimum depth ranges for juveniles and fry were 1.5 to 4.6 feet and 1 to 3.8 feet, respectively (Addley et al. 2003).

Mountain whitefish spawn in the fall, and are normally bottom feeders (Sigler 1951, Behnke 2009). In shared habitat, mountain whitefish and trout feed on similar invertebrates, but nuanced differences in their structure and diets reduce competition for food. Unlike most trout, mountain whitefish do not seek cover in areas like deep undercut banks; rather, they prefer open water areas with deeper habitat (Behnke 2009).

4.0 BENTHIC MACROINVERTEBRATE COMMUNITY EVALUATION

The benthic macroinvertebrate community was evaluated during three consecutive fall periods from Fall 2006 to Fall 2008 (Table 18). Similar to the fish population analyses, those conducted for benthic invertebrates also excluded the HS data from analyses, largely for similar reasons such as its dissimilarity to other stream locales, constant temperature, and no upstream influencing watershed.

4.1 Benthic Sample Collection Methodology and Data Analysis Procedures

The methods utilized for the SSSC investigation are presented in Section 4.4.2 of the April 2007 Final Work Plan – Field Monitoring Studies for Developing a Site-Specific Selenium Criterion (NewFields 2007) and are briefly described below.

Benthic macroinvertebrates were collected from streams using a Surber sampler as described in the SOP No. 28A JRS (NewFields 2007, Appendix A, Attachment 2). Benthic community data were only collected during the fall monitoring events because benthic samples collected in early spring have high percentages of invertebrates as early instars, which are small and make identifications more difficult. Furthermore, during later summer or early fall there tends to be less flow variability which allows for better comparisons of communities, where flow is not a factor.

Three benthic invertebrate samples were collected from each established fish monitoring reach and evaluated for benthic community composition, diversity, and biomass. Samples for each location were preserved separately using isopropyl alcohol. Taxonomy and enumeration was conducted as counts of 500 organisms from the composite of the three replicate samples from a location.

Idaho DEQ's *Small Stream Ecological Assessment Framework: An Integrated Approach* (Grafe 2002) provides documentation and methods for deriving a Stream Macroinvertebrate Index (SMI). The following nine metrics were calculated for the benthic community samples in order to derive the SMI:

- Total taxa;
- Trichoptera taxa;
- Percent 5 dominant taxa;
- Ephemeroptera taxa;
- Percent Plecoptera;

- Scraper taxa;
- Plecoptera taxa;
- HBI; and
- Clinger taxa.

The relationships of individual metrics and selenium concentrations at a location were evaluated to assess if benthic community data suggest changes that might be due to water quality limitations. Because of the number of potentially confounding factors, only the strongest relationships are considered to be indicative of potential effects.

4.2 Benthic Density and Number of Benthic Taxa

Visual inspection of the data shows that invertebrate density is variable both temporally and spatially. Benthic taxa numbers were not as variable both temporally and spatially as benthic density. In 2008, density and the number of benthic taxa were lower as compared to the previous fall monitoring periods at all locations (Figures 21 and 22). Because this occurred across all locations it is not considered as important as the relative spatial shifts that may occur (i.e., upstream locations versus downstream locations). Two possible occurrences may explain the across-the-board change in observations for the 2008 data. Benthic community sampling was conducted by a different individual in 2008 and samples were tightly packed which reduced effective preservation solution volume. The taxonomist reported that the samples were not well preserved and some organisms had deteriorated. Second, southeast Idaho experienced high flows during the spring of 2008 (higher than the previous two springs) which may have effectively scoured and deposited sediment from different habitats. Those habitats with higher percentages of fine sediment will be unstable, and thus benthic communities in those unstable habitats will be reduced.

The density of benthic invertebrates and number of benthic taxa were evaluated relative to aqueous selenium, sediment selenium, and benthic tissue selenium concentrations to further evaluate the observations indicated above (Figures 23 through 28). Of the six relationships evaluated, the only significant relationship was for the number of benthic taxa relative to selenium in surface water (R^2 = 0.264, log-transformed data, p = 0.0061). Because several factors can influence the observed relationship, a comparison of upstream and downstream locations was conducted.

Benthic density and number of taxa were log transformed and compared using a one-way ANOVA. Across the three fall periods, benthic invertebrate density was not significantly different between background and reference locations (SFTC-1, CC-75, CC-150, CC-350, and DC-600) and downstream locations (HS-3, LSV-2C, LSV-4, CC-1A, and CC-3A) with mean values of 6,931 and 6,768 invertebrates/m^2 at upstream and downstream locations, respectively

(ANOVA, p=0.93). The number of taxa was similarly evaluated and no differences were found (p=0.16) with upstream mean taxa numbers (22.36) and downstream taxa numbers (20.31) being similar.

One additional analysis was conducted to evaluate if further partitioning of benthic taxa data into smaller location groupings would reduce potential variability among locations and yield differences among locations across the three fall sampling periods. Locations were grouped as follows: upstream (SFTC-1 and DC-600), upstream Crow Creek (CC-75, 150, and 350), Hoopes and Sage Creek (HS-3, LSV-2C, and LSV-4), and downstream Crow Creek (CC-1A and CC-3A). One-way ANOVA found no significant differences between the number of benthic taxa from these grouped locations (p = 0.386).

4.3 Composition Metrics

Five benthic invertebrate composition metrics were evaluated, including the number of ephemeroptera taxa, plecoptera taxa, trichoptera taxa, dipteran taxa, and number of ephemeroptera, plecoptera, and trichoptera (EPT) taxa (Figures 29 through 33). Composition metrics, as shown by location, do not indicate any apparent trends.

The benthic composition metrics described above were evaluated relative to aqueous selenium concentrations (Figures 34 through 38 and Table 19). The numbers of ephemeroptera (R^2 = 0.022, p = 0.4601), plecoptera (R^2 = 0.062, p=0.2169), and dipteran (R^2 = 0.023, p = 0.4486) species were not significantly related to aqueous selenium concentrations. The numbers of trichoptera (R^2 = 0.189, p = 0.0237, Figure 36) and EPT taxa (R^2 = 0.207, p = 0.0172, Figure 38) were both significantly related to aqueous selenium concentrations, with decreasing taxa numbers found at increasing selenium concentrations. Similar to the analyses presented above, upstream versus downstream comparisons were conducted using one-way ANOVA on log-transformed data. Both the number of trichoptera taxa and EPT taxa were not significantly different (p=0.365, p = 0.541, respectively) between the background and reference locations and the downstream locations.

4.4 Functional Feeding Groups

Several individual functional feeding group metrics were also evaluated graphically for locations across the three fall periods to assess the potential for trends (Attachment 3). Functional feeding groups, including predators, shredders, filterers, omnivores, scrapers, and collector-gathers were evaluated graphically using both the abundance of individuals classified into each of these groups as well as the number of taxa classified into each of these groups. Specialized feeders, such as scrapers, are more sensitive organisms and are thought to be well represented in healthy streams. Generalists, such as collectors, have a broader range of acceptable food materials than specialists (Cummins and Klug 1979), and thus are more tolerant to pollution that might alter availability of certain food.

The functional feeding group metrics described above were evaluated relative to aqueous selenium concentrations (Attachment 4 and Table 19). Eleven different regressions were conducted where the functional metric was the dependent variable and total selenium in water was the independent variable. All variables were log transformed. The metric for "number of omnivore taxa" could not be used due to the high number of zero observations at locations. Only one metric out of the 11 evaluated yielded a significant linear relationship to selenium concentrations in surface water. The number of predator taxa was negatively related to selenium concentrations in surface water (R^2 = 0.318, p = 0.0022). It is important to recognize that the lack of significant relationships (10 of 11) is potentially as important as finding one relationship.

The number of predator taxa versus aqueous selenium concentrations was evaluated further by comparing upstream and downstream location data. The downstream predator abundance was significantly lower than the upstream predator abundance (Kruskal –Wallis one-way ANOVA on Ranks, p = 0.00088). Predator taxa abundance data were grouped into smaller location subsets as follows: upstream (SFTC-1 and DC-600), upstream Crow Creek (CC-75, CC-150, and CC-350), Hoopes and Sage Creek (HS-3, LSV-2C, and LSV-4), and downstream Crow Creek (CC-1A and CC-3A). One-way ANOVA indicated that these groups are significantly different (p=0.013), and the Tukey-Kramer multiple comparison test defined the following groups as different from one another: upstream Crow Creek locations were different from the downstream Crow Creek locations and the Hoopes and Sage Creek locations, while the upstream locations (SFTC-1 and DC-600) were not different from any locations. These findings were surprising given that the total number of benthic taxa did not yield similar results. According to Barbour et al. (1999), the response of predators to perturbations is variable and the more specialized feeding groups such as scrapers have been shown to be a more responsive metric to environmental perturbations. However, scrapers, both in terms of abundance of individuals and abundance of taxa were not significantly related to aqueous selenium concentrations at this Site. The benthic functional feeding group data provide a somewhat limited assessment tool. In light of the analyses conducted to this point, the shift in the number of predator taxa is not consistent with overall benthic taxa numbers or the composition metrics.

4.5 Voltinism

Voltinism metrics examine the length of an organism's life cycles. For this assessment, each insecta species was grouped in one of three categories, uni-voltine (those that complete a life cycle in approximately one year), semi-voltine (those that require more than one year to complete a life cycle) and multi-voltine (those with more than one generation or brood during a year). Table 5A in Huryn et al. (2008), supplemented by Wiggins (1996) and Stewart and Stark (1993), was utilized to classify representative organisms by the duration of their life cycles, specifically how long it takes to complete a life cycle from egg to adult in a year's time. The percentage and richness of insecta having uni-voltine, semi-voltine and multi-voltine aquatic life cycles were then calculated by year and location (Figures 39 through 41).

Communities where uni- and semi-voltine organisms are well represented over multiple years indicate that environmental conditions are relatively stable, with perturbations that are either infrequent or mild relative to the organism's parameters for survival and reproduction (Grafe eds. 2002). A community in which no organisms require long residence times for maturation (i.e., semi-voltine) may indicate that perturbations disrupt maturation or reproduction. Similarly, if a shift or significant increase in multi-voltine organisms is observed from one year to another it may be indicative of a specific perturbation. However, a closer look at the individual species and overall composition is additionally required before any conclusion can be drawn, since any observed change may simply be an artifact of sampling that led to a dominance of a specific species or few species, not a community shift.

Relationships of these life cycle measures were evaluated relative to aqueous selenium concentrations (Figures 42 through 44 and Table 19). The percentage of uni-voltine and semi-voltine organism abundance was not significantly related to aqueous selenium concentrations, (R^2 = 0.047, p = 0.2799; and R^2 = 0.09, p = 0.1284, respectively). Further, across the sampling periods at each location, uni- and semi-voltine organisms appear to be well represented. The percentage of multi-voltine organism abundance was significantly related to aqueous selenium concentrations (R^2 = 0.206, p = 0.0174) although the slope of the line was positive.

Comparisons of voltinism metrics were conducted both for upstream and downstream grouped locations, and subsets of the locations. Based on the grouping of data from upstream and downstream locations, multi-, semi-, and uni-voltine percentage abundance between upstream and downstream locations were not significantly different (parametric one-way ANOVA, p= 0.40, p = 0.24, and p = 0.95, respectively). Subset locations were grouped as follows: upstream (SFTC-1 and DC-600), upstream Crow Creek (CC-75, 150, and 350), Hoopes and Sage Creek (HS-3, LSV-2C, and LSV-4), and downstream Crow Creek (CC-1A and 3A). Multi-, semi-, and uni-voltine percentage abundance between the subset locations were not significantly different (parametric one-way ANOVA, p= 0.50, p = 0.07, and p =0.34, respectively).

4.6 Multimetric Indexes

The benthic community is made up of a number of families that includes an even greater number of genera and species. Multiple individual metrics can be used to evaluate preference and tolerance for food and habitat resources as well as changes in water quality. Multimetric indexes that encompass these individual metrics can be used to evaluate the larger community.

The IDEQ SMI encompasses a number of different structural and functional metrics that have been tested state-wide as effective measures when evaluating community condition. Based on this index rating system, benthic community conditions across the three fall monitoring periods indicate that during Fall 2006 and Fall 2007, upstream and reference locations typically scored such that condition ratings fell within the 10th to 25th percentile of the SMI reference condition or higher (here the reference condition is based on a large set of data from a number of locations across the state grouped by bioregion). In Fall 2008, SMI scores resulted in upstream condition ratings that ranked these locations within the minimum to 10th percentile of the reference condition.

At the Hoopes Spring location, condition rankings were consistently low, either between the minimum to 10th percentile of the SMI reference or below the reference condition. Conversely, at LSV-2C, the condition rankings were similar to what was observed for the upstream reaches. At CC-1A the condition ranking was consistently low, ranking from the minimum to the 10th percentile of the SMI reference condition, while at the CC-3A location, Fall 2006 found a condition rating above the 25th percentile of the reference condition, while in the Fall 2007 and Fall 2008 periods, the condition ranking fell to a range from the minimum to 10th percentile of the reference condition.

SMI scores for each location and community evaluated during the three fall periods were evaluated against total aqueous selenium concentrations. Log-transformed data were utilized. SMI scores were significantly related to selenium in surface water with deceasing SMI scores (R^2 = 0.324, p = 0.002) present at higher aqueous selenium concentrations (Figure 45). One-way ANOVA indicates that the mean SMI scores are significantly different between upstream and downstream locations (p=0.0068).

Further dividing the upstream and downstream groups into subsets as defined in previous sections, one-way ANOVA indicates the SMI scores from upstream and downstream groups are significantly different from one another (p = 0.0068). The Tukey-Kramer multiple comparison test showed the mean value for the upstream group is significantly higher than for the downstream group.

The SMI scores for benthic macroinvertebrate communities may be affected by a number of physical or chemical conditions. The significant differences identified above were investigated further by examining a primary habitat feature. Mean percent fines (substrate size < 2 mm) from pebble counts were evaluated relative to mean SMI scores. Mean SMI scores were negatively and significantly related to increased frequency of substrate particles less than 2 mm (R^2 =0.625, p = 0.011) (Figure 46). In other words, as the frequency of particles less than 2 mm increased, the SMI scores decreased.

5.0 SUMMARY

Trout population monitoring in the Crow Creek drainage has been conducted at different points in time for more than 30 years. Recent seasonal monitoring data (2006 to 2008) were collected at a number of locations on Crow Creek, Sage Creek, and Deer Creek, yielding important data concerning trout populations relative to changing selenium exposures in surface water and prey items. Qualitative comparison of the recent trout population estimates to historical population estimates suggests that trout populations have fluctuated widely through time. Variability present in these estimates is likely due to a number of factors including sampling methods, conditions during sampling (flows, water quality and quantity), and fish sizes used in the population estimates. Trout populations are not static from year to year and continued monitoring will enable population trends to be assessed more thoroughly.

Statistical analyses of trout population data from 2007 and 2008 indicated no significant reductions in trout standing crops at locations downstream of Hoopes Spring and Sage Creek when compared to locations upstream of Sage Creek. Brown trout standing crop was significantly higher at downstream locations as compared to upstream locations. These findings are not surprising given the data already presented. Further comparison of trout population data from Crow Creek drainage locations to ecoregional data indicates that Sage Creek and Crow Creek locations monitored have brown trout populations that exceed the Ecoregion 6 mean CPUE in all cases. Brown trout CPUE was greatest at location LSV-2C for both sampling times, with location CC-150 ranking second. The HS-3 location was lower than the Ecoregion 6 mean CPUE in Fall 2007. Results for YCT were similar to those for brown trout (i.e., exceeded the mean CPUE). Almost all locations where YCT were found (i.e., 2007 and 2008 data) exceeded the Ecoregion 6 mean CPUE, while all locations where YCT were found exceeded the regional median. Cutthroat CPUE was greatest at DC-600 for both sampling times, while location LSV-2C ranked second.

Comparison of standing crop estimates (kg/Ha) to nearby Wyoming streams showed that both 2007 and 2008 standing crop estimates at locations CC-150, LSV-2C, and CC-3A exceed the Wyoming 75th percentile value of 84 kg/Ha, while the Fall 2008 estimate of 277 kg/Ha at LSV-2C exceeds the Wyoming 95th percentile value of 238 kg/Ha (data from Binns 1979) (Tables 15 and 16).

Examination of trout population data from Fall 2006 through Fall 2008 indicates that Crow Creek tributaries, such as Sage Creek and Deer Creek, provide important habitats for YCT and brown trout. Despite higher selenium levels in Sage Creek for example, standing crop and density estimates are consistently higher in this tributary when compared to Crow Creek upstream or downstream of Sage Creek.

Overall, trout populations are seasonally variable, but not different in zones influenced by selenium versus those not influenced by selenium. Habitat clearly plays a role in these observations. Extensive habitat quality data have been collected as part of this project, and are presented in Appendix C.

Multiple lines of evidence are presented above concerning trout populations in the streams monitored. Trout populations are highest where elevated selenium concentrations are found. Favorable habitat conditions are likely present that allow for functional and reproducing trout populations such that population estimates derived at locations where selenium is elevated do not differ from those where selenium is not elevated. Sculpin population density and age class structure suggests that there is no difference in sculpin populations between high and low selenium locations; rather, sculpin population density is more likely dictated by habitat conditions.

For Site benthic organisms, biologically relevant relationships to aqueous selenium concentrations that convincingly indicate selenium affects the life cycle of benthic organisms were not evident. Further, lack of significant differences at the larger and smaller location scales of upstream and downstream comparisons suggests the life cycle comparisons are similar between those locations influenced by Hoopes Spring and those that are not influenced by Hoopes Spring discharge.

Using a multimetric approach to evaluate benthic community conditions suggests that while aqueous selenium concentrations may be a factor in benthic invertebrate community structure and function, habitat conditions are as much or more a controlling factor.

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TABLES

Table 1
Presence/Absence of Fish Species by Location, Fall 2006 - Fall 2008

Family/Common Name (Species)	Location										
	Reference	U/S Crow Creek			Deer Creek	Hoopes Spring		Sage Creek		D/S Crow Creek	
	SFTC-1	CC-75	CC-150	CC-350	DC-600	HS	HS-3	LSV-2C	LSV-4	CC-1A	CC-3A
Salmonidae											
Brook Trout *(Salvelinus fontinalis)*											√
Rainbow Trout *(Oncorhynchus mykiss)*	√										
Brown Trout *(Salmo trutta)*		√	√	√		√	√	√	√	√	√
Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	√	√	√	√	√		√	√	√	√	√
Mountain Whitefish *(Prosopium williamsoni)*	√		√	√					√	√	√
Cottidae											
Paiute Sculpin *(Cottus beldingi)*	√	√	√	√	√	√	√	√	√	√	√
Mottled Sculpin *(Cottus bairdi)*	√									√	
Sculpin (*Cottus spp*.)		√	√	√	√	√	√	√	√	√	√
Cyprinidae											
Leatherside Chub *(Snyderichtys copei)*				√							
Longnose Dace *(Rhinichthys cataractae)*	√		√	√						√	√
Speckled Dace (*Rhinichthys osculus*)	√		√	√						√	√
Redside Shiner *(Richardsonius balteatus)*	√		√	√						√	√
Catostomidae											
Utah Sucker *(Catostomus ardens)*	√		√							√	√
Mountain Sucker *(Catostomus platyrhynchus)*	√										

Table 2

Summary of Fish Species, Numbers, Length, Weight and Condition Collected by Electrofishing, Fall 2006 - Fall 2008

Stream	Location	Date	Species	# Caught	Mean Total Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	K
Reference									
SF Tincup Creek	SFTC-1	5/7/07	Rainbow Trout *(Oncorhynchus mykiss)* [1]	2	56.5	52 - 61	1.5	1.5 - 1.5	0.864
		5/7/07	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	19	170.1	54 - 440	126.3	1 - 855	0.805
		8/29/07		91	125.4	73 - 292	28	3.1 - 243.7	0.928
		6/26/08		14	288.3	117-491	282.81	14.9-1,131	0.864
		9/9/08		33	148.9	61-218	41	2.3-121.3	1.036
		5/7/07	Longnose Dace *(Rhinichthys cataractae)*	2	96.5	87 - 106	7.9	5.4 - 10.3	0.842
		8/29/07		5	85.2	54 - 95	7.1	2.1 - 9.1	1.100
		6/26/08		4	72	58-95	4.68	2.1-10.1	1.115
		9/9/08		4	67	55-92	1.7	1.1-2.2	0.672
		5/7/07	Paiute Sculpin *(Cottus beldingi)* [2]	66	58.4	31 - 96	3.4	012 - 12.9	1.171
		8/29/07		211	71	27 - 119	2.9	0.1 - 30.3	1.400
		6/26/08		13	61.3	34-86	3.45	0.4-10.4	1.128
		9/9/08		271	64.6	30-108	4.2	0.5-20.7	1.300
		9/9/08	Mottled Sculpin *(Cottus bairdi)*	1	88	-	9.3	-	1.365
		5/7/07	Speckled Dace (*Rhinichthys osculus*)	1	78	-	4.3	-	0.906
		8/29/07		1	57	-	1.4	-	0.760
		8/29/07	Redside Shiner *(Richardsonius balteatus)*	1	38.5	-	0.5	-	0.760
		8/29/07	Mountain Sucker *(Catostomus platyrhynchus)* [3]	5	87.6	62 - 145	9.8	2.2 - 29.5	1.040
		9/9/08		6	103.2	75-133	13.7	4.4-25.9	1.105
		6/26/08	Mountain Whitefish *(Prosopium williamsoni)*	3	271	222-349	199.6	96-122.9	0.880
		6/26/08	Utah Sucker *(Catostomus ardens)*	2	423.5	418-429	724.3	701.1-747.5	0.953
Upstream of Sage Creek									
Crow Creek	CC-75	9/2/06	Brown Trout *(Salmo trutta)*	19	230.4	98 - 425	173.0	10.1 - 790	1.078
		5/8/07		11	258.6	154-314	204.4	33 - 332.8	1.089
		8/23/07		38	137.6	64 - 325	62.0	2.9 - 358.1	1.002
		5/13/08		9	171.2	120-320	82.5	15.4-340.2	0.935
		9/3/08		22	172.3	74-285	68.2	3.9-244.9	0.996
		9/2/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	2	168.0	163 - 173	39.4	37.9 - 40.9	0.833
		5/8/07		2	217.0	209 - 225	95.6	85.6 - 105.7	0.933
		8/23/07		2	153.5	145 - 162	33.6	24.8 - 42.3	0.904
		5/13/08		1	266.0	-	181.3	-	0.963
		9/3/08		5	215.4	132-294	118.8	15.9-267.1	0.900
		9/2/06	Sculpin *(Cottus spp.)*	570	77.9	9 - 116	1.8	0.2 -22.7	
		5/8/07	Paiute Sculpin *(Cottus beldingi)*	335	50.9	32 - 113	2.7	0.4 - 23.1	1.251
		8/23/07		646	70.2	28 - 113	0.8	0.1 - 23.9	1.169
		5/13/08		120	55.4	34-115	3.0	0.2-24.8	1.086
		9/3/08		225	78.3	60-118	6.6	2.3-22.7	1.261
Crow Creek	CC-150	9/3/06	Brown Trout *(Salmo trutta)*	42	217.4	86 - 409	164.3	5.2 - 701.6	1.038
		5/9/07		20	250.9	143 - 337	183.8	26.8	1.020
		8/24/07		42	171.5	82 - 403	110.4	5.1 - 617	1.013
		5/13/08		28	233.6	116-381	176.7	15.1-594.1	1.040
		9/3/08		31	222.6	82-372	148.3	4.8-522.6	1.009
		9/3/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	5	242.8	108 - 293	151.6	50.2 - 243.5	0.943
		5/9/07		5	249.0	203 - 329	166.8	91.3 - 354.6	0.991
		8/24/07		14	153.6	53 - 308	75.7	1.1 - 316	0.820
		5/13/08		16	215.5	97-335	155.7	5.7-385.6	0.929
		9/3/08		14	217.7	136-339	120.6	19.7-413.8	0.887
		9/3/06	Speckled Dace *(Rhinichthys osculus)*	6	97.0	-	9	-	
		8/24/07		5	72.0	66 - 85	4.3	3.2 - 7	1.091
		5/13/08		1	79.0	-	5.3	-	1.075
		8/24/07	Longnose Dace *(Rhinichthys cataractae)*	7	87.1	68 - 95	6.7	2.8 - 9.6	0.962
		9/3/06	Sculpin *(Cottus spp.)*	849	64.0	33 - 116	0.7	0.1 - 22.5	
		5/9/07	Paiute Sculpin *(Cottus beldingi)*	538	29.9	42 - 116	3.2	1 - 24.5	1.195
		8/24/07		511	68.7	34 - 111	0.9	0.9 - 19.6	1.237
		5/13/08		67	63.7	42-104	4.42	0.6-18.5	1.375
		9/3/08		131	81.2	58-110	6.9	1-19.7	1.219
		9/3/06	Redside Shiner *(Richardsonius balteatus)*	5	-	-	-	-	
		8/24/07		1	82.0	-	3.2	-	0.580
		5/13/08	Mountain Whitefish *(Prosopium williamsoni)*	5	361.6	337-375	433.7	340.4-462.4	0.915
		9/3/08	Utah Sucker *(Catostomus ardens)*	1	162.0	-	45.9	-	1.080
	CC-350	8/31/06	Brown Trout *(Salmo trutta)*	1	89.0	-	6.3	-	0.894
		5/8/07		2	254.0	169 - 339	207.6	48.7 - 366.5	0.957
		8/23/07		15	150.7	36 - 352	95.4	1 - 413	0.957
		5/13/08		1	335.0	-	302	-	0.803
		9/4/08		17	193.1	84-359	115.9	2.9-412.9	0.908
		8/31/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	7	92.4	50 - 230	21.6	1.1 - 117.9	0.921
		5/8/07		8	177.3	76 - 309	103	3.2 - 256.5	0.906
		8/23/07		33	187.2	<50 - 305	79.8	<1.4 - 273	0.899
		5/13/08		17	271.4	178-406	231.4	49.2-674	0.969
		9/4/08		50	165.4	46-305	63.9	0.3-286.3	0.985

Table 2

Summary of Fish Species, Numbers, Length, Weight and Condition Collected by Electrofishing, Fall 2006 - Fall 2008

Stream	Location	Date	Species	# Caught	Mean Total Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	K
Crow Creek	CC-350	5/8/07	Longnose Dace *(Rhinichthys cataractae)*	24	75.1	55 - 93	3.9	2.2 - 8.7	0.868
		8/23/07		49	83.7	68 - 111	5.6	2.3 - 12.3	0.933
		5/13/08		7	89.6	63-105	7	1.9-13.4	0.893
		9/4/08		4	76.8	62-94	5	2-8.1	0.972
		8/31/06	Speckled Dace *(Rhinichthys osculus)*[4]	88	75.4	58 - 95	0.7	2 - 8.8	
		5/8/07		5	60.0	34 - 79	2.5	0.4 - 5	0.935
		8/23/07		5	72.0	65 - 78	4	2.4 - 5.4	1.059
		5/13/08		3	50.3	40-69	1.83	0.3-3.4	1.311
		9/4/08		1	67.0	-	3	-	0.997
		8/31/06	Mountain Whitefish *(Prosopium williamsoni)*	2	-	-	-	-	
		5/8/07		4	186.5	156 - 355	69.4	32.5 - 162.4	0.897
		8/23/07		5	153.2	80 - 199	38.2	3 - 67.3	0.782
		5/13/08		7	267.7	238 - 355	188.8	124.6 - 385.5	0.926
		9/4/08		1	209.0	-	89.5	-	0.980
		8/31/06	Sculpin *(Cottus spp.)*	253	73.2	37 - 95	1.5	0.4 - 16.2	
		5/8/07	Paiute Sculpin *(Cottus beldingi)*	153	67.9	33 - 103	5.5	0.2 - 18.9	1.382
		8/23/07		236	66.8	35 - 101	1.7	0.7 - 13.1	1.135
		5/13/08		43	70.5	41-104	5.65	0.5-17.1	1.292
		9/4/08		113	69.4	32-106	5.4	0.5-15.7	1.184
		8/23/07	Redside Shiner *(Richardsonius balteatus)*	2	97.0	92 - 102	7.3	4.5 - 10.1	0.765
		9/4/08	Leatherside Chub (*Snyderichtys copei*)	1	77.0	-	5.5	-	1.205
Deer Creek	DC-600	9/7/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	71	133.9	35-317.5	29.4	0.5-128	0.886
		5/13/07		61	136.9	57 - 245	35.2	1.4 - 150	0.919
		8/27/07		64	132.6	33 - 275	33.6	0.1 - 230.9	0.842
		5/18/08		27	161.4	69-265	58.1	2.9-207.1	0.994
		9/8/08		84	141.5	34-270	41.9	4.2-231.6	0.937
		9/7/06	Sculpin *(Cottus spp.)*	185	70.0	47-103	1.9	1-16.2	
		5/13/07	Paiute Sculpin (*Cottus beldingi*)[2]	182	57.6	31 - 102	3.4	<1 - 15.3	1.181
		8/27/07		230	68.3	46 - 103	1.8	1.0 - 15	1.098
		5/18/08		31	62.5	40-103	4.5	0.4-17.5	1.328
		9/8/08		145	70.7	19-108	5	1.1-16	1.300
Hoopes Spring and Sage Creek									
Hoopes Spring	HS	9/8/06	Brown Trout *(Salmo trutta)*	4	249.8	184-306	162.1	55.9-260	0.948
		5/14/07		3	225.7	165-257	133.5	43.5 - 183.8	1.033
		8/24/07		5	148.2	101 - 278	53.8	10.1 - 210.5	0.941
		5/17/08		4	177	136-273	68.4	23.1-190.1	0.912
		9/4/08		2	195	184-206	73.2	95-51.3	0.955
		9/8/06	Sculpin *(Cottus spp.)*	321	71.1	28-92	1.5	0.2-10	
		5/14/07	Paiute Sculpin *(Cottus beldingi)*	232	59	35 - 95	3.4	0.5 - 12.1	1.273
		8/24/07		426	66.4	48 - 95	0.9	0.9 - 11.4	1.112
		5/17/08		69	66.93	48-93	3.67	0.6-11.1	1.112
		9/4/08		142	72.9	55-100	5.5	2-12.6	1.375
Hoopes Spring	HS-3	9/6/06	Brown Trout *(Salmo trutta)*	48	132.8	65-332	39.7	2.3-384.2	0.974
		5/12/07		57	169.2	138 - 225	12.2	27.6 - 118.5	1.057
		8/28/07		63	108.4	80 - 278	15	4.4 - 231	0.963
		5/16/08		55	144.15	41-308	56.7	0.6-282.2	1.005
		9/5/08		46	129.5	91-267	27.6	4.5-181.1	0.918
		5/12/07	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	1	248	-	141.5	-	0.928
		8/28/07		12		<50			
		5/16/08		17	132.1	86-160	24.34	4.7-42.1	0.967
		9/5/08		7	58-164	83.2	9.24	1-37.5	0.844
		9/6/06	Sculpin *(Cottus spp.)*	1188	67.7	27-115	0.5	0.2-20.6	
		5/12/07	Paiute Sculpin *(Cottus beldingi)*	237	69.1	48 - 120	4.4	1.5 - 24	1.382
		8/28/07		353	74.5	35 - 117	1.9	0.9 - 28.6	1.352
		5/16/08		73	79.6	52-115	7.3	2.1-21.8	1.270
		9/5/08		643	55.6	35-115	2.8	0.3-21.6	0.815
Sage Creek	LSV-2C	9/6/06	Brown Trout *(Salmo trutta)*	40	195.2	81-485	147.8	5.1-1240	0.989
		5/12/07		49	236.1	142 - 424	173.7	26.3 - 688.8	1.023
		8/28/07		65	186.8	70 - 357	109.1	3.3 - 438.7	1.000
		5/16/08		37	203.9	34-391	142.1	<1-532.9	0.981
		9/5/08		65	213.9	99-380	151.2	9.3-598.7	0.983
		5/12/07	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	23	289.9	201 - 366	261.4	78.6 - 528.5	1.009
		8/28/07		14	257.4	58 - 345	158.4	3.3 - 447.1	1.105
		5/16/08		9	308.2	262-348	302.5	164.5-420.7	1.006
		9/5/08		12	261.3	197-318	197.8	74.6-359.9	1.000
		9/6/06	Sculpin *(Cottus spp.)*	972	69.9	33-126	0.5	0.2 - 29	
		5/12/07	Paiute Sculpin *(Cottus beldingi)*	326	69.2	51 - 112	5.2	1.2 - 22.8	1.501
		8/28/07		311	81.2	46 - 116	2.8	3.1 - 23.6	1.445
		5/16/08		19	84.3	52-106	8.18	1.6-22.2	1.224
		9/5/08		49	86.3	37-124	10.9	0.5-26.5	1.231

Table 2

Summary of Fish Species, Numbers, Length, Weight and Condition Collected by Electrofishing, Fall 2006 - Fall 2008

Stream	Location	Date	Species	# Caught	Mean Total Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	K
Sage Creek	LSV-4	9/5/06	Brown Trout *(Salmo trutta)*	38	177.8	92 - 397	111.2	7.5 - 630	1.009
		5/9/07		37	224.8	118 - 400	157.3	17.3 - 565.9	1.045
		9/5/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	7	266.1	182 - 318	216.5	65.1 - 359	1.045
		5/9/07		14	235.4	83 - 302	168.6	6.4 - 316.8	1.020
		9/5/06	Mountain Whitefish *(Prosopium williamsoni)*	2	363	343 - 383	468.3	383 - 553.5	
		5/9/07		10	344.8	302 - 407	400.4	282 - 691.8	0.953
		9/5/06	Sculpin *(Cottus spp.)*	545	67.3	33 - 108	0.9	0.3 - 18.9	
		5/9/07	Paiute Sculpin *(Cottus beldingi)*	299	65.3	42 - 114	4.6	0.9 - 22.1	1.402
Downstream of Sage Creek									
Crow Creek	CC-1A	9/1/06	Brown Trout *(Salmo trutta)*	13	300.2	96 - 413	304.7	8.0 - 583	0.888
		5/10/07		22	261.1	138 - 416	211.7	15.4 - 558	0.880
		8/25/07		77	159.6	77 - 414	80.7	4.6 - 521	0.952
		5/14/08		23	238.8	108-410	173.4	10.7-524.6	0.897
		9/6/08		53	199.0	76-448	129.4	3.3-700.2	0.959
		9/1/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	4	301.0	146 - 412	353.4	27.6 - 650	0.983
		5/10/07		10	298.0	103 - 497	337.5	9.3 - 1170	0.944
		8/25/07		19	279.1	74 - 483	262.7	1.1 - 908	0.980
		5/14/08		13	315.0	91-441	342.63	9.1-693.1	0.977
		9/6/08		17	294.9	172-376	268	55.7-477.1	0.957
		5/10/07	Longnose Dace *(Rhinichthys cataractae)*	10	70.0	60 - 83	2.5	1.3 - 6.7	1.144
		8/25/07		22	81.0	60 - 119	6	2.4 - 16.8	1.084
		5/14/08		3	86.7	80-98	5.9	3.5-9.4	0.857
		9/6/08		8	83.0	66-94	6.3	2.5-8.6	1.065
		5/10/07	Mountain Whitefish *(Prosopium williamsoni)*	34	327.7	265 - 375	338.1	197.2 - 480	0.948
		8/25/07		23	232.8	104 - 350	149.9	8 - 346	0.816
		5/14/08		56	282.7	133-396	241.24	22.5-486.2	0.907
		9/6/08		52	297.0	117-388	256.7	12.4-481.3	0.913
		9/1/06	Speckled Dace (*Rhinichthys osculus*)	18	61.5	54 - 72	0.8	1.7 - 4.0	
		5/10/07		21	69.5	50 - 89	2.1	<1 - 8.2	1.059
		8/25/07		96	68.7	52 - 88	3.5	1.1 - 7.9	1.041
		5/14/08		4	62.0	45-76	2.53	0.3-5.8	0.748
		9/6/08		51	67.1	47-88	3.5	0.3-8.1	0.980
		9/1/06	Sculpin *(Cottus spp.)*	38	77.5	39 - 100	3.2	1.0 - 11.6	
		5/10/07	Paiute Sculpin (*Cottus beldingi*)[2]	31	76.7	54 - 98	7.4	1.8 - 16.3	1.631
		8/25/07		32	81.9	40 - 105	8.5	0.5 - 16.6	1.362
		5/14/08		3	103.3	90-111	17	10.9-20.9	1.502
		9/6/08		11	58.2	32-107	3.7	0.4-15.1	0.891
		9/6/08	Mottled Sculpin *(Cottus bairdi)*	1	75.0	-	4.4	-	1.043
		9/1/06	Redside Shiner *(Richardsonius balteatus)*	8	105	105	2.4	8.2 - 10.6	
		5/10/07		1	82.0	-	8	-	1.451
		8/25/07		19	74.8	38 - 100	4.7	0.1 - 9.7	0.805
		5/14/08		1	72.0	-	3.3	-	0.884
		9/6/08		16	61.7	32-98	2.7	0.5-10.3	0.726
		9/1/06	Utah Sucker *(Catostomus ardens)*	1	170.0	-	49.8	-	
		5/10/07		2	248.0	140 - 356	282.7	32 - 533.3	1.174
		5/14/08		3	274.0	50-422	400	0.5-758.1	0.813
Crow Creek	CC-3A	9/4/06	Brown Trout *(Salmo trutta)*	34	287.5	108 - 471	284.2	10.6 - 1041.4	0.975
		5/11/07		38	239.3	46 - 415	162.0	10 - 668.5	0.995
		8/27/07		61	222.7	82 - 404	147.7	4.1 - 538.7	1.086
		5/15/08		69	212.8	97-374	122.0	11.3-468.5	0.908
		9/7/08		63	237.4	86-388	160.4	4.4-519.7	0.966
		9/4/06	Cutthroat Trout (*Oncorhynchus clarki bouvieri*)	9	287.7	159 - 385	264.2	37.9 - 542	0.967
		5/11/07		10	297.4	239 - 387	282.4	157 - 515.1	1.030
		8/27/07		28	324.3	208 - 412	347.3	101.5 - 631.3	0.975
		5/15/08		22	335.8	190-458	376.6	63.2-783.3	0.936
		9/7/08		17	302.5	205-424	303.8	81.6-727.6	0.962
		5/11/07	Longnose Dace *(Rhinichthys cataractae)*	30	66.1	55 - 99	1.5	1.5 - 11.4	0.969
		8/27/07		60	69.2	41 - 120	3.1	0.2 - 17.3	0.760
		5/15/08		17	77.6	36-112	5.7	0.1-14	0.972
		9/7/08		48	75.9	58-116	5.3	0.8-15.1	1.096
		9/4/06	Speckled Dace (*Rhinichthys osculus*)	86	57.0	43-80	2.1	0.7-5.6	
		5/11/07		121	60.3	35 - 85	0.9	0.7 - 7.2	0.890
		8/27/07		122	65.0	49 - 90	2.1	0.3 - 7.7	0.848
		5/15/08		44	65.9	36-83	2.8	0.1-6.2	0.904
		9/7/08		152	65.9	43-94	3.5	0.5-8.1	1.108
		9/4/06	Mountain Whitefish *(Prosopium williamsoni)*	10	312.9	274 - 336	249.2	191 - 417	
		5/11/07		37	308.5	178 - 353	283.7	49 - 390	0.935
		8/27/07		15	266.7	207 - 377	179.5	84 - 415.5	0.927
		5/15/08		54	299.3	148-356	256.3	27.8-407.6	0.887
		9/7/08		48	294.7	121-356	254.5	9.1-446.5	0.898
		9/4/06	Sculpin *(Cottus spp.)*	10	73.0	53 - 96	3.1	2.0 - 12.4	

Table 2

Summary of Fish Species, Numbers, Length, Weight and Condition Collected by Electrofishing, Fall 2006 - Fall 2008

Stream	Location	Date	Species	# Caught	Mean Total Length (mm)	Length Range (mm)	Mean Weight (g)	Weight Range (g)	K
Crow Creek	CC-3A	5/11/07	Paiute Sculpin *(Cottus beldingi)*	4	70.3	57 - 78	4.9	2.2 - 8	1.312
		8/27/07		4	91.8	83 - 98	8.5	5.9 - 11.1	1.071
		5/15/08		1	79.0	-	9.1	-	1.846
		9/7/08		5	60.4	46-110	3.9	0.5-15.6	0.878
		9/4/06	Redside Shiner *(Richardsonius balteatus)*	43	77.1	56 - 97	2.0	1.0 - 8.2	
		5/11/07		56	85.6	45 - 99	4.6	0.9 - 12.5	1.025
		8/27/07		8	60.0	35 - 90	2.3	0.1 - 6.5	0.526
		5/15/08		15	83.3	71-96	5.4	1.9-7.7	0.918
		9/7/08		26	73.9	48-107	4.4	0.5-14	0.870
		9/4/06	Utah Sucker *(Catostomus ardens)*	2	96.5	95 - 98	8.4	8.2 - 8.5	
		5/11/07		31	432.5	173 - 540	968.8	57.4 - 1814	1.107
		8/27/07		7	128.4	70 - 178	25.5	5.4 - 56.5	1.013
		5/15/08		8	398.3	312-466	680.2	340.9-1,109.3	1.026
		9/7/08		45	324.2	72-542	527.5	3.4-1,730.8	1.047
		8/27/07	Brook Trout *(Salvelinus fontinalis)*	1	281	-	217.6	-	
		5/15/08		2	283	268-298	216.4	168.7-264	0.937

K - Mean Fulton Condition Factor derived for trout

[1] - 2 YOY specimens were collected, one was submitted for voucher ID and was subsequently identified as a rainbow trout.

[2] - At least one specimen of those submitted for voucher ID from this location has been identified as a mottled sculpin.

[3] - 5 specimens collected and identified in the field as Utah Sucker - subsequent ID of 2 voucher specimens indicate species to be Mountain Sucker at this location.

[4] - At least one specimen of those submitted for voucher ID from this site has been identified as a leatherside chub.

Table 3
Brown and Cutthroat Trout Population Estimates (3-Pass Depletion)
for All Locations Electrofished, Fall 2006 - Fall 2008

Attribute	SFTC-1[4]	CC-75	CC-150	CC-350	DC-600	HS	HS-3[1]	LSV-2C	LSV-4[3]	CC-1A	CC-3A[2]
Site Length - Ft	470	355.0	500.0	600	315	175	360	400	415	720	810
m	143.2	108.2	152.4	182.9	96.0	53.3	109.7	121.9	126.5	219.4	246.9
Site Width - Ft	9.7	10.1	11.8	19.3	9.8	3.4	11.0	13.9	17.2	27.0	23.7
m	3.0	3.1	3.6	5.9	3.0	1.0	3.4	4.2	5.2	8.2	7.2
Site Area - Acres	0.105	0.082	0.135	0.266	0.071	0.014	0.091	0.128	0.164	0.446	0.441
hectare	0.042	0.033	0.055	0.108	0.029	0.006	0.037	0.052	0.066	0.181	0.178
Brown Trout											
Fall 2006											
Estimated #	-	19	42	1	0	4	51	86	55	16	44
95% Confidence Intervals	-	± 2	± 1	± 0	-	± 1	± 6	± 119	± 33	± 11	± 22
Estimated Wt lbs	-	7.25	15.20	0.014		1.43	4.46	28.00	13.48	10.74	27.54
kg	-	3.289	6.895	0.006		0.649	2.023	12.701	6.114	4.872	12.492
#/mile	-	283	444	9		121	748	1135	700	117	287
#/km	-	176	276	5		75	465	705	435	73	178
lbs/acre	-	88.1	112.2	0.1		104.7	49.1	219.4	82.3	24.1	62.5
kg/Ha	-	98.7	125.7	0.1		117.3	55.0	245.8	92.2	27.0	70.0
Spring 2007											
Estimated #	2	11	20	2	0	3	94	52	42	26	42
95% Confidence Intervals	± 0	± 1	± 1	± 13	-	± 1	± 63	± 6	± 10	± 10	± 8
Estimated Wt lbs	0.01	5.0	8.1	0.9		0.9	2.5	16.7	14.6	12.1	15.0
kg	0.003	2.250	3.677	0.415		0.401	1.148	7.559	6.607	5.505	6.803
#/mile	22	164	211	18		91	1379	686	534	191	274
#/km	14	102	131	11		56	857	427	332	118	170
lbs/acre	0.06	60.3	59.8	3.4		64.7	27.8	130.6	88.9	27.2	34.0
kg/Ha	0.07	67.5	67.0	3.9		72.5	31.2	146.3	99.6	30.5	38.1
Fall 2007											
Estimated #	0	39	43	16	0	5	193	73	NS	90	68
95% Confidence Intervals		± 3	± 3	± 5		± 1	± 369	± 12		± 17	± 11
Estimated Wt lbs		5.3	10.5	3.4		0.6	7.8	17.6		16.0	22.1
kg		2.416	4.747	1.527		0.269	3.516	7.966		7.268	10.043
#/mile		580	454	141		151	2831	964		660	443
#/km		360	282	87		94	1759	599		410	275
lbs/acre		64.7	77.3	12.7		43.4	85.3	137.6		35.9	50.2
kg/Ha		72.5	86.6	14.2		48.6	95.5	154.1		40.2	56.3
Spring 2008											
Estimated #	0	9	28	1	0	4	119	42	NS	25	80
95% Confidence Intervals	-	± 1	± 2	± 0		± 5	± 141	± 10		± 6	±15
Estimated Wt lbs		1.64	10.91	0.67		0.60	7.03	12.45		9.56	21.51
kg		0.742	4.947	0.302		0.273	3.191	5.649		4.336	9.758
#/mile		134	296	9		121	1745	554		183	521
#/km		83	184	5		75	1085	345		114	324
lbs/acre		19.9	80.5	2.5		44.1	77.4	97.6		21.4	48.8
kg/Ha		22.3	90.2	2.8		49.4	86.7	109.3		24.0	54.7
Fall 2008											
Estimated #		22	31	17		2	61	79	NS	67	65
95% Confidence Intervals		± 1	± 2	± 2		± 0	± 25	± 19		± 21	± 5
Estimated Wt lbs		3.31	10.14	4.34		0.32	3.72	26.33		19.12	23.05
kg		1.500	4.598	1.970		0.146	1.686	11.942		8.671	10.456
#/mile		327	327	150		60	895	1043		491	424
#/km		203	203	93		37	556	648		305	263
lbs/acre		40.2	74.8	16.3		23.6	40.9	206.3		42.8	52.3
kg/Ha		45.0	83.8	18.3		26.4	45.8	231.1		48.0	58.6

Table 3
Brown and Cutthroat Trout Population Estimates (3-Pass Depletion)
for All Locations Electrofished, Fall 2006 - Fall 2008

Attribute	SFTC-1[4]	CC-75	CC-150	CC-350	DC-600	HS	HS-3[1]	LSV-2C	LSV-4[3]	CC-1A	CC-3A[2]
Site Length - Ft	470	355.0	500.0	600	315	175	360	400	415	720	810
m	143.2	108.2	152.4	182.9	96.0	53.3	109.7	121.9	126.5	219.4	246.9
Site Width - Ft	9.7	10.1	11.8	19.3	9.8	3.4	11.0	13.9	17.2	27.0	23.7
m	3.0	3.1	3.6	5.9	3.0	1.0	3.4	4.2	5.2	8.2	7.2
Site Area - Acres	0.105	0.082	0.135	0.266	0.071	0.014	0.091	0.128	0.164	0.446	0.441
hectare	0.042	0.033	0.055	0.108	0.029	0.006	0.037	0.052	0.066	0.181	0.178
Cutthroat Trout											
Fall 2006											
Estimated #	-	2	5	11	81	0	0	6	7	4	9
95% Confidence Intervals	-	± 5	± 0	± 24	± 13	-	-	± 9	± 1	± 2	± 2
Estimated Wt lbs	-	0.174	1.67	0.52	5.25		0	3.69	3.34	3.11	5.24
kg	-	0.079	0.758	0.238	2.381		0.000	1.674	1.515	1.411	2.377
#/mile	-	30	53	97	1358		0	79	89	29	59
#/km	-	18	33	60	844		0	49	55	18	36
lbs/acre	-	2.1	12.3	2.0	74.1		0.0	28.9	20.4	7.0	11.9
kg/Ha	-	2.4	13.8	2.2	83.0		0.0	32.4	22.8	7.8	13.3
Spring 2007											
Estimated #	19	2	5	8	76	0	1	23	14	10	10
95% Confidence Intervals	± 2	± 13	± 1	± 1	± 21	-	± 0	± 1	± 2	± 1	± 2
Estimated Wt lbs	5.29	0.42	1.84	1.82	5.90		0.31	13.26	5.20	7.44	6.23
kg	2.399	0.191	0.834	0.824	2.677		0.142	6.013	2.360	3.375	2.824
#/mile	213	30	53	70	1274		15	304	178	73	65
#/km	133	18	33	44	792		9	189	111	46	41
lbs/acre	50.5	5.1	13.6	6.8	83.3		3.4	103.9	31.8	16.7	14.1
kg/Ha	56.6	5.7	15.2	7.7	93.3		3.9	116.4	35.6	18.7	15.8
Fall 2007											
Estimated #	95	2	14	39	65	0	0	14	NS	20	32
95% Confidence Intervals	± 6	± 0	± 2	± 12	± 3	-		± 2		± 4	± 9
Estimated Wt lbs	5.86	0.15	2.34	6.87	4.82			4.89		11.58	24.50
kg	2.659	0.07	1.06	3.11	2.19			2.22		5.25	11.11
#/mile	1067	30	148	343	1090			185		147	209
#/km	663	18	92	213	677			115		91	130
lbs/acre	56.0	1.8	17.2	25.8	68.0			38.3		26.0	55.6
kg/Ha	62.8	2.0	19.3	28.9	76.2			42.9		29.1	62.3
Spring 2008											
Estimated #	14	1	16	17	27	0	21	9	NS	13	25
95% Confidence Intervals	±3	± 0	± 2	±3	± 1	-	±12	± 1		± 0	± 8
Estimated Wt lbs	8.73	0.40	5.49	8.67	3.46		1.13	6.00		9.82	20.75
kg	3.959	0.181	2.491	3.934	1.569		0.511	2.722		4.454	9.414
#/mile	157	15	169	150	453		308	119		95	163
#/km	98	9	105	93	281		191	74		59	101
lbs/acre	83.4	4.8	40.5	32.6	48.8		12.4	47.0		22.0	47.1
kg/Ha	93.4	5.4	45.4	36.6	54.7		13.9	52.7		24.7	52.8
Fall 2008											
Estimated #	34	5	14	52	89		7	12	NS	18	17
95% Confidence Intervals	±3	± 2	± 1	±5	± 7		±1	± 2		± 4	± 2
Estimated Wt lbs	2.61	1.31	3.72	7.33	8.02		0.10	5.23		10.01	11.38
kg	1.184	0.594	1.689	3.323	3.640		0.046	2.374		4.539	5.164
#/mile	382	74	148	458	1492		103	158		132	111
#/km	237	46	92	284	927		64	98		82	69
lbs/acre	24.9	15.9	27.5	27.6	113.2		1.1	41.0		22.4	25.8
kg/Ha	27.9	17.8	30.8	30.9	126.9		1.2	45.9		25.1	28.9

Table 3
Brown and Cutthroat Trout Population Estimates (3-Pass Depletion)
for All Locations Electrofished, Fall 2006 - Fall 2008

Attribute	SFTC-1[4]	CC-75	CC-150	CC-350	DC-600	HS	HS-3[1]	LSV-2C	LSV-4[3]	CC-1A	CC-3A[2]
Site Length - Ft	470	355.0	500.0	600	315	175	360	400	415	720	810
m	143.2	108.2	152.4	182.9	96.0	53.3	109.7	121.9	126.5	219.4	246.9
Site Width - Ft	9.7	10.1	11.8	19.3	9.8	3.4	11.0	13.9	17.2	27.0	23.7
m	3.0	3.1	3.6	5.9	3.0	1.0	3.4	4.2	5.2	8.2	7.2
Site Area - Acres	0.105	0.082	0.135	0.266	0.071	0.014	0.091	0.128	0.164	0.446	0.441
hectare	0.042	0.033	0.055	0.108	0.029	0.006	0.037	0.052	0.066	0.181	0.178
Total Trout											
Fall 2006											
#/mile	-	312	496	106	1358	121	748	1214	789	147	345
#/km	-	194	308	66	844	75	465	755	490	91	215
lbs/acre	-	90.2	124.6	2.0	74.1	104.7	49.1	248.3	102.6	31.0	74.4
kg/Ha	-	101.1	139.5	2.3	83.0	117.3	55.0	278.2	115.0	34.8	83.3
Spring 2007											
#/mile	236	193	264	88	1274	91	1393	990	712	264	339
#/km	147	120	164	55	792	56	866	615	443	164	211
lbs/acre	50.6	65.4	73.4	10.3	83.3	64.7	31.3	234.4	120.6	43.9	48.2
kg/Ha	56.7	73.3	82.3	11.5	93.3	72.5	35.1	262.6	135.2	49.1	54.0
Fall 2007											
#/mile	1067	610	602	484	1090	151	2831	1148	NS	807	652
#/km	663	379	374	301	677	94	1759	714		501	405
lbs/acre	56.0	66.5	94.5	38.5	68.0	43.4	85.3	175.9		61.9	105.8
kg/Ha	62.8	74.5	105.9	43.1	76.2	48.6	95.5	197.1		69.3	118.6
Spring 2008											
#/mile	157	149	465	158	453	121	2053	673	NS	279	684
#/km	98	92	289	98	281	75	1276	418		173	425
lbs/acre	83.4	24.7	121.1	35.1	48.8	44.1	89.8	144.6		43.4	95.9
kg/Ha	93.4	27.7	135.6	39.4	54.7	49.4	100.6	162.0		48.6	107.5
Fall 2008											
#/mile	382	402	475	607	1492	60	997	1201	NS	623	535
#/km	237	250	295	377	927	37	620	746		387	332
lbs/acre	24.9	56.1	102.3	43.9	113.2	23.6	42.0	247.3		65.3	78.1
kg/Ha	27.9	62.8	114.7	49.2	126.9	26.4	47.1	277.0		73.1	87.5

Notes:

[1] Fall 2007 -Young-of-year YCT not included in population estimate.

[2] Fall 2007 - The one brook trout capture on pass 3 was included with the brown trout estimates.

[3] Fall 2007-Fall 2008 - NS - Not Sampled due to private landowner access denial.

[4] Vouch identification of one specimen indicates YOY rainbow trout - remaining specimen also assumed to be rainbow trout as well based on voucher ID and historical data. Included under brown trout for population estimates.

Table 4

Trout Standing Crop Estimated (kg/Ha) for Each Location, Fall 2006 - Fall 2008

Standing Crop (kg/Ha)	SFTC-1[1]	CC-75	CC-150	CC-350	DC-600	HS	HS-3	LSV-2C	LSV-4	CC-1A	CC-3A
Brown Trout											
Fall 2006	NM	98.7	125.7	0.1	0.0	117.3	55.0	245.8	92.2	27.0	70.0
Spring 2007	0.1	67.5	67.0	3.9	0.0	72.5	31.2	146.3	99.6	30.5	38.1
Fall 2007	0.0	72.5	86.6	14.2	0.0	48.6	95.1	154.1	NM	40.2	56.3
Spring 2008	0.0	22.3	90.2	2.8	0.0	49.4	86.7	109.3	NM	24.0	54.7
Fall 2008	0.0	45.0	83.8	18.3	0.0	26.4	45.8	231.1	NM	48.0	58.6
Cutthroat Trout											
Fall 2006	NM	2.4	13.8	2.2	83.0	0.0	0.0	32.4	22.8	7.8	13.3
Spring 2007	56.6	5.8	15.2	7.7	93.3	0.0	3.9	116.4	35.6	18.7	15.8
Fall 2007	62.7	2.0	19.3	28.9	76.2	0.0	0.0	42.9	NM	29.1	62.3
Spring 2008	93.4	5.4	45.4	36.6	54.7	0.0	13.9	52.7	NM	24.7	52.8
Fall 2008	27.9	17.8	30.8	30.9	126.9	0.0	1.2	45.9	NM	25.1	28.9
All Trout											
Fall 2006	NM	101.1	139.5	2.3	83.0	117.3	55.0	278.2	115.0	34.8	83.3
Spring 2007	56.7	73.3	82.2	11.6	93.3	72.5	35.1	262.7	135.2	49.2	53.9
Fall 2007	62.7	74.5	105.9	43.1	76.2	48.6	95.1	197.0	NM	69.3	118.6
Spring 2008	93.4	27.7	135.6	39.4	54.7	49.4	100.6	162.0	NM	48.6	107.5
Fall 2008	27.9	62.8	114.7	49.2	126.9	26.4	47.1	277.0	NM	73.1	87.5

NM -Not Measured

[1] Spring 2007 voucher identification of one specimen indicates YOY rainbow trout - remaining specimen also assumed to be rainbow trout based on voucher ID and historical data. Included under brown trout for population estimates.

Table 5
Results of Wilcoxon Rank Sum Tests Comparing Trout Standing Crop (kg/Ha) for Spring and Fall 2007 and 2008 Sampling Periods between Background and Downstream Locations

Comparison	Background		Downstream		Two-tailed p
	N	Mean Rank	N	Mean Rank	
Total Trout - All Seasons	20	16.2	16	21.3	0.1519
Total Trout - Fall 2007 and 2008	10	8.0	8	11.4	0.2592
Total Trout - Spring 2007 and 2008	10	8.6	8	10.6	0.4873
Brown Trout - All Seasons	20	13.8	16	24.4	**0.0028**
Cutthroat Trout - All Seasons	20	19.9	16	16.8	0.3900

Values in bold indicate significance at $p = 0.10$.

Statistical evaluations of trout populations were conducted using STATISTIX 8 software (Analytical Software 2003).

Background locations: SFTC-1, DC-600, CC-75, CC-150 and CC-350.

Downstream locations potentially impacted by selenium: HS, HS-3, LSV-2C, LSV-4, CC-1A, and CC-3A.

The Wilcoxon Rank Sum non-parametric 2-sample T-test was used due to the high variability of the data and the lack of a normal distribution in some cases.

Table 6

Trout Standing Crop Estimates (kg/Ha) for Fall 2006 to Fall 2008 from SSSC Monitoring and Fall 2009 and Fall 2010 from Panels F and G Monitoring

Standing Crop (kg/Ha)	CC-75	CC-150	CC-350	DC-600	HS-3	LSV-2C	LSV-4	CC-1A	CC-3A
Brown Trout									
Fall 2006	98.7	125.7	0.1	0.0	55.0	245.8	92.2	27.0	70.0
Spring 2007	67.5	67.0	3.9	0.0	31.2	146.3	99.6	30.5	38.1
Fall 2007	72.5	86.6	14.2	0.0	95.1	154.1	-	40.2	56.3
Spring 2008	22.3	90.2	2.8	0.0	86.7	109.3	-	24.0	54.7
Fall 2008	45.0	83.8	18.3	0.0	45.8	231.1	-	48.0	58.6
Fall 2009	99.5	121.9	24.1	0.0	-	199.6	-	33.2	-
Fall 2010	193.0	169.3	31.8	0.0	130.0	315.5	523.3	34.6	108.0
Cutthroat Trout									
Fall 2006	2.4	13.8	2.2	83.0	0.0	32.4	22.8	7.8	13.3
Spring 2007	5.8	15.2	7.7	93.3	3.9	116.4	35.6	18.7	15.8
Fall 2007	2.0	19.3	28.9	76.2	0.0	42.9	-	29.1	62.3
Spring 2008	5.4	45.4	36.6	54.7	13.9	52.7	-	24.7	52.8
Fall 2008	17.8	30.8	30.9	126.9	1.2	45.9	-	25.1	28.9
Fall 2009	19.4	23.2	16.7	129.1	-	39.4	-	31.5	-
Fall 2010	36.8	64.4	26.7	264.5	10.7	51.4	97.2	53.9	50.1
All Trout									
Fall 2006	101.1	139.5	2.3	83.0	55.0	278.2	115.0	34.8	83.3
Spring 2007	73.3	82.2	11.6	93.3	35.1	262.7	135.2	49.2	53.9
Fall 2007	74.5	105.9	43.1	76.2	95.1	197.0	-	69.3	118.6
Spring 2008	27.7	135.6	39.4	54.7	100.6	162.0	-	48.6	107.5
Fall 2008	62.8	114.7	49.2	126.9	47.1	277.0	-	73.1	87.5
Fall 2009	118.9	145.1	40.9	129.1	-	239.0	-	64.7	-
Fall 2010	229.7	233.7	58.5	264.5	140.7	366.9	620.5	88.6	158.1

- Not Sampled

Table 7
Kruskal-Wallis Multiple-Comparison Z-Value Test (Dunn's Test) Results for Brown Trout Standing Crop Comparisons
Fall 2006 to Fall 2010

Median	Count	Location	CC-75	CC-150	CC-350	HS-3	LSV-2C	LSV-4	CC-1A	CC-3A
98.7	5	**CC-75**	0							
121.9	5	**CC-150**	0.4629	0						
18.3	5	**CC-350**	2.654	3.1169	0					
75.1	4	**HS-3**	0.3491	0.7856	2.1531	0				
231.1	5	**LSV-2C**	1.7282	1.2653	4.3822	1.9785	0			
307.8	2	**LSV-4**	0.8282	0.4782	2.8344	1.0705	0.4782	0		
34.6	5	**CC-1A**	1.8825	2.3454	0.7715	1.4257	3.6107	2.2512	0	
64.3	4	**CC-3A**	0.4583	0.8947	2.044	0.1035	2.0876	1.155	1.3166	0

Regular Test: Medians significantly different if z-value > 1.9600.
Bonferroni Test: Medians significantly different if z-value > 3.1237.
Spring 2007 and Spring 2008 data not included, DC-600 data not included, HS data not included.
Kruskal-Wallis Non-Parametric one-way ANOVA determined significantly different (p=0.000305).
The Bonferroni Test was used because multiple comparisons are made in this analysis.
Shaded cells indicate significant difference.

Table 8
Kruskal-Wallis Multiple-Comparison Z-Value Test (Dunn's Test) Results for YCT Standing Crop Comparisons
Fall 2006 to Fall 2010

Median	Count	Location	CC-75	CC-150	DC-600	CC-350	HS-3	LSV-2C	LSV-4	CC-1A	CC-3A
17.8	5	**CC-75**	0								
23.2	5	**CC-150**	1.4492	0							
126.9	5	**DC-600**	4.2349	2.7857	0						
26.7	5	**CC-350**	0.8293	0.6199	3.4056	0					
0.6	4	**HS-3**	0.9025	2.2948	4.9712	1.6992	0				
42.9	5	**LSV-2C**	3.0272	1.578	1.2077	2.198	3.8109	0			
60.0	2	**LSV-4**	1.9208	0.7983	1.3595	1.2785	2.5846	0.4241	0		
29.1	5	**CC-1A**	1.3848	0.0644	2.8501	0.5555	2.2329	1.6424	0.8482	0	
39.5	4	**CC-3A**	1.8681	0.4757	2.2007	1.0713	2.6698	1.0404	0.4047	0.5376	0

Regular Test: Medians significantly different if z-value > 1.9600.

Bonferroni Test: Medians significantly different if z-value > 3.1970.

Spring 2007 and Spring 2008 data not included, HS data not included.

Kruskal-Wallis Non-Parametric one-way ANOVA determined significantly different (p=0.001381).

The Bonferroni Test was used because multiple comparisons are made in this analysis.

Shaded cells indicate significant difference.

Table 9
Kruskal-Wallis Multiple-Comparison Z-Value Test (Dunn's Test) Results for Total Trout Stand Crop Comparisons
Fall 2006 to Fall 2010

Median	Count	Location	CC-75	CC-150	DC-600	CC-350	HS-3	LSV-2C	LSV-4	CC-1A	CC-3A
101.1	5	**CC-75**	0								
139.5	5	**CC-150**	0.9468	0							
126.9	5	**DC-600**	0.4869	0.4599	0						
43.1	5	**CC-350**	2.1099	3.0567	2.5968	0					
75.1	4	**HS-3**	0.6376	1.5302	1.0966	1.3517	0				
277.0	5	**LSV-2C**	2.1911	1.2443	1.7042	4.301	2.7033	0			
367.8	2	**LSV-4**	1.1758	0.4601	0.8077	2.7707	1.6298	0.4805	0		
69.3	5	**CC-1A**	1.2714	2.2181	1.7583	0.8386	0.5611	3.4624	2.1368	0	
103.1	4	**CC-3A**	0.255	0.6376	0.204	2.2443	0.8468	1.8107	0.9383	1.4537	0

Regular Test: Medians significantly different if z-value > 1.9600.

Bonferroni Test: Medians significantly different if z-value > 3.1970.

Spring 2007 and Spring 2008 data not included, HS data not included.

Kruskal-Wallis Non-Parametric one-way ANOVA determined significantly different (p=0.000792).

The Bonferroni Test was used because multiple comparisons are made in this analysis.

Shaded cells indicate significant difference.

Table 10

Kruskal-Wallis Multiple-Comparison Z-Value Test (Dunn's Test) Results for Total Trout Standing Crop Comparisons by Grouped Locations

Fall 2006 to Fall 2010

Median	Count	Location	CC-75, CC-150, DC-600, CC-350	HS-3, LSV-2C, LSV-4	CC-1A, CC-3A
103.5	20	**CC-75, CC-150, DC-600, CC-350**	0		
197.0	11	**HS-3, LSV-2C, LSV-4**	2.025	0	
83.3	9	**CC-1A, CC-3A**	0.6571	2.278	0

Regular Test: Medians significantly different if z-value > 1.9600.

Bonferroni Test: Medians significantly different if z-value > 2.3940.

Spring 2007 and Spring 2008 data not included, HS data not included.

Kruskal-Wallis Non-Parametric one-way ANOVA determined significantly different (p=0.047).

The Regular Test was used because few comparisons were made between the grouped locations, and no ties exist between the groups.

Shaded cells indicate significant difference.

Table 11
Catch Per Unit Effort (CPUE) for Brown Trout and Cutthroat Trout (YCT) for 10 Locations Sampled in Fall 2007 and Fall 2008

Location	2007		2008	
	Brown Trout (#/hr)	YCT (#/hr)	Brown Trout (#/hr)	YCT (#/hr)
SFTC-1	0.0	6.2	0.0	2.7
CC-75	28.3	0.0	36.5	9.1
CC-150	28.4	8.7	72.8	17.3
CC-350	13.6	0.0	25.9	29.2
DC-600	0.0	23.7	0.0	36.8
HS	8.1	0.0	16.9	0.0
HS-3	5.7	0.0	12.4	0.0
LSV-2C	48.5	15.4	118.9	34.0
CC-1A	18.0	11.0	18.0	10.0
CC-3A	16.4	10.0	31.7	10.3

CPUE = #/hour of browns >150 mm and YCT >200 mm.
Based on 1st pass electrofishing data.

Table 12
Catch Per Unit Effort (CPUE) Statistics for Brown Trout and Cutthroat (YCT) Trout by One-Pass Electrofishing in Ecoregion 6 Streams

Statistic	Brown Trout (#/hr)	Cutthroat Trout (#/hr)
Sample Size	18	27
Mean	7.5	3.2
Standard Error	1.4	0.7
Percentiles:		
5	1.6	0.1
25	3.3	0.7
50	5.0	2.0
75	12.1	4.3
95	19.5	10.6

CPUE = #/hour of browns >150 mm and YCT >200 mm.
Data are from Brouder et al. 2009.

Table 13

Summary of Relative Weights (W_r) for Brown Trout and Cutthroat Trout (YCT) Collected at the 10 Locations in Fall 2007 and Fall 2008

Location	2007						2008					
	Brown Trout			YCT			Brown Trout			YCT		
	N	Mean	Range	N	Mean	Range	N	Mean	Range	N	Mean	Range
SFTC-1	0			36	0.97	0.81-1.21	0			25	1.03	0.79-1.22
CC-75	11	0.96	0.88-1.06	2	0.91	0.83-1.00	16	0.91	0.80-1.06	5	0.88	0.71-1.04
CC-150	18	0.96	0.82-1.49	8	0.95	0.85-1.03	25	0.92	0.77-1.08	14	0.87	0.78-1.00
CC-350	6	0.93	0.85-1.12	27	0.90	0.57-1.20	10	0.86	0.82-0.92	38	0.93	0.82-1.15
DC-600	0			31	0.92	0.8-1.08	0			34	0.96	0.84-1.14
HS	1	0.90	-	0			2	0.87	0.75-0.99	0		
HS-3	5	0.92	0.86-0.99	0			12	0.88	0.65-1.00	1	0.85	-
LSV-2C	30	0.93	0.82-1.18	9	1.00	0.91-1.15	43	0.91	0.82-1.03	12	0.96	0.88-1.07
CC-1A	25	0.88	0.69-0.98	18	0.98	0.74-1.12	29	0.87	0.71-1.05	15	0.93	0.85-1.09
CC-3A	44	0.90	0.76-1.01	28	0.92	0.64-1.15	52	0.86	0.75-0.97	17	0.92	0.81-1.05

Brown trout ≥ 140mm long
YCT ≥ 130mm long

Table 14
Trout Standing Crop Estimates (kg/Ha) for 10 Locations Sampled in Fall 2007 and Fall 2008

Location	Fall 2007	Fall 2008
SFTC-1	62.8	27.9
CC-75	74.5	62.8
CC-150	105.9	114.7
CC-350	43.1	49.2
DC-600	76.2	126.9
HS	48.6	26.4
HS-3	95.5	47.1
LSV-2C	197.1	277.0
CC-1A	69.3	73.1
CC-3A	118.6	87.5

Table 15

Summary Statistics of 44 Trout Stand Crop Estimates (kg/Ha) for Wyoming Streams Reported by Binns (1979)

Statistic	kg/Ha
Mean	73.4
Standard Error	15.4
Minimum	0
Maximum	634
Percentiles	
5	0
25	26
50	52
75	84
95	238

Table 16
Trout Population Estimates in Sage Creek during 1979 and 1981 Surveys Conducted by IDFG

Location Name as Reported	Approximate Locale	Date	Population Estimate									
			Number of Fish/110 yards					Number of Fish/km				
			Brook	Cutt	Brown	Rainbow	Total Trout	Brook	Cutt	Brown	Rainbow	Total Trout
South Fork Sage Creek	LSS	Jul-79	0	0	36	0	36	0	0	360	0	360
		Sep-79	0	1	29	2	32	0	10	290	20	320
		Jun-81	0	0	8	0	8	0	0	80	0	80
North Fork Sage Creek	US	Jul-79	3	11	0	0	14	30	110	0	0	140
		Sep-79	2	9	0	0	11	20	90	0	0	110
North Fork Sage Creek	LS	Jul-79	0	10	4	0	14	0	100	40	0	140
		Sep-79	0	39	7	0	46	0	390	70	0	460
		Jul-81	0	19	2	0	21	0	190	20	0	210
Lower Sage Creek	LSV-4	Jul-79	0	0	39	0	39	0	0	390	0	390
		Sep-79	0	0	20	0	20	0	0	200	0	200
		Jul-81	0	2	27	0	29	0	20	270	0	290
Middle Fork Sage	Hoopes Springs	Sep-79	0	0	15	0	15	0	0	150	0	150
Main Sage Creek	at Crow Confluence	Jul-81	0	2	66	0	68	0	20	660	0	680

Table 17
Comparison of Trout Abundance Estimates (Fish/100 m for Fish > 10 cm) at Study Locations on Crow, Deer, and Sage Creeks, for the Years 1986 and 1987 and 1999 and 2000 (Meyer et al. 2003)

Approximate Location	Stream	Years	Location Lengths (m)	Trout Abundance (fish/100 m for fish > 10 cm)				
				Total Trout	Yellowstone Cutthroat Trout	Rainbow Trout and Hybrids	Brown Trout	Brook Trout
D/S of Deer Creek, U/S of Quakie Hollow (U/S of Sage Ck) ~ CC-350	Crow Creek (69)	1986	309	9	4	0	5	0
		2000	309	43	10	0	32	0
At White Dugaway Ck.	Crow Creek (70)	1986	111	85	84	0	1	0
		1999	111	126	117	0	9	0
HS and HS-3	Hoopes Spring	1987		46 [1]	0	0	46	0
At Crow Creek Rd (LSV-4)	Sage Creek	1987	215	120	19	0	100	0
		1999	215	140	31	0	109	0
At mouth Near Crow Creek Rd.	Deer Creek	1986	157	45	37	0	8	0
		1999	157	85	79	1	6	0

[1] estimate is for 90+mm fish.
Meyer et al. 2003.
Schill and Heimer 1988.

Table 18

Summary of Benthic Macroinvertebrate Community Data, Fall 2006 - Fall 2008

Order	Genus	Habitat/ Behavior	Functional Feeding Groups	Tolerance	Stream	SF Tincup Creek		Crow Creek									Deer Creek			Hoopes Spring						Sage Creek				Crow Creek					
					Location	SFTC-1		CC-75			CC-150			CC-350			DC-600			HS			HS-3			LSV-2C			LSV-4	CC-1A			CC-3A		
					Date	08/29/07	09/09/08	09/02/06	08/23/07	09/03/08	09/01/06	08/24/07	09/03/08	09/01/06	08/23/07	09/04/08	09/07/06	08/27/07	09/08/08	09/08/06	08/24/07	09/04/08	09/06/06	08/28/07	09/05/08	09/08/06	08/28/07	09/05/08	09/05/06	09/01/06	08/25/07	09/06/08	09/04/06	08/26/07	09/07/08
Ephemeroptera	Atenella margarita	CN	CG	3												2																3			
	Baetis spp.	SW	CG	5		3	5	56	14	85	89	27	90	68	38	61	253	76	67	76	9	2	56	249	7	316	27	53	46	57	32	62	56		61
	Centroptilum conturbatum	SW	CG	2																											1				
	Cinygmula spp.	CN	SC	4													2	14																	
	Diphetor hageni	SW	CG	5													1				11						9	6	3						
	Drunella coloradensis	CN	P	0				1				7		7			1						1		3				5	3			1		
	Drunella grandis	CN	P	0		2	4		9	3			3		4	7								1			4							1	
	Epeorus longimanus	CN	SC	0													4	5	3																
	Ephemerella dorothea infrequens	CN	CG	1		5	3							1							5		1	5	2	2							1		
	Ephemerella aurivillii	CN	CG	1					5									7																	
	Paraleptophlebia spp.	SW	CG	1		2	12	3	9		11	4		1	1		11				5	7				4			2			2	1		
	Tricorythodes minutus	CN	CG	4												2																8	7	5	3
Plecoptera	Hesperoperla pacifica	CN	P	1		21	12	3	11								21	62	13	20	23			9	4							3			15
	Isoperla sp.	CN	P	2						7	11	5							7				1		3		2	6	1		3				
	Malenka sp.	CN/SP	SH	2		10	33	5	25	16		5	14	3	2	4	14	30					2	1		4	9	3	29	1		2			
	Pteronarcys sp.	CN/SP	SH	0			21																												3
	Skwala sp.	CN	P	2		3		4	14			1		1	8																2			4	
	Sweltsa sp.	CN	P	1		7					1		3				13	35		14	2					2									
Trichoptera	Agapetus sp.	CN	SC	0																2															
	Arctopsyche sp.	CN	P	1					4	18		9	35			2		14	6					13	33		34	23							
	Brachycentrus sp.	CN	F	1				4	4	29		3		88	4	13			3				3	17	65	6	153	29	4	20	73	11	27	61	18
	Cheumatopsyche sp.	CN	F																											8			13		
	Dicosmoecus sp.	BU	SH	1		3	2																			2									
	Dolophilodes sp.	CN	F	1														25	3																
	Glossoma sp.	CN	SC	0														4																	
	Helicopsyche sp.	CN	SC	3				3			5	4		5	93									2			2						19	81	
	Hesperophylax sp.	CN	SH	5																			3	1	48		14	4							
	Hydropsyche sp.	CN	F	4			5	47	50	23	29	17	11	74	97	41	1	14		2				2		8	9	11	53	63	91	29	105	79	151
	Hydroptila sp.	CN	SC	6				8	9	1	1												1			16				1			2		
	Lepidostoma spp.	SP/CB	SH	1		1	3		7		6	8			67	6		16				2									13	4		2	6
	Micrasema sp.	CN	SH	1				8		9	65	1	18	14			3			28			5			4			76	3	3		36		
	Neothremma sp.	CN	SC	0														4																	
	Oecetis disjuncta	CN	P	8		2								2	3																	3		7	
	Onocosmoecus sp.	CB	SH	1		1																													
	Oligophlebodes sp.	CN	SC	1				11																									2		
	Parapsyche sp.	CN	P	1				16			5						7						1			2			1						
	Psychoglypha sp.	SP/CB	CG	1					3																										
	Rhyacophila spp.	CN	P	0		7	3	4	5	5	9	17	16	3	5	9	16	23	83					11	13		7								
	Wormaldia spp.	CN	F	3			3				1	8	15	2	5	6	7							3	9				1			3	1	2	11
Coleoptera	Ametor sp.	SW	P	5																		1													
	Brychius sp.	CB	SC	7		2			1	3																10									
	Cleptelmis sp.	CN	CG/SC	4		3	26									4												5		1			1		6
	Dubiraphia sp.	CN	CG/SC	4		3																													
	Heterlimnius corpulentus	CN/BU	CG/SC	4														30	32			5													
	Optioservus quadrimaculatus	CN	CG/SC	4		97	267	43	109	68	40	205	153	78	162	167	7	2	5	12			5	21	33	18	132	151	27	153	74	246	69	83	129
	Oreodytes sp.	SW/DV	P	5		6		1																											
	Paracymus sp.	CN	P/OM	5								1																							
	Zaitzevia paravula	CN/BU	CG/SC	4		170	57	5	4		1	1	7	23	5	18							3	3		2	2	7	2	6	16	11	8	2	13
Megaloptera	Sialis sp.	BU/CB	P	4		1			1	3		1																							
Odonata	Ophiogomphus sp.	BU	P	1																												2		7	
Hemiptera	Sigara sp.	SW	P	10		5																													
Diptera	Anopheles sp.	SW	F	8									1																						
	Antocha sp.	BU	CG	3			5	1			4			6															18		2		1		
	Atherix sp.	BU	P	2																											26	22	24	3	44
	Chelifera sp.	SP/BU	CG	6				2			1						7			4									1				5		
	Dixa sp.	BU	CG	1																	13														
	Empididae	SP/BU	P	6									1						5			2													
	Ephydridae	BU	CG	6							1								1			1													
	Glutops sp.	BU	P	3				1	2									1																	
	Hexatoma	BU	P	2		19				9		1			5	4		1						9			4				5			16	1
	Limnophila sp.	BU	P	4							1			3			3						5						5	3			9		
	Muscidae	BU	P	6																						1		3							
	Pericoma sp.							2			1																								
	Probezzia sp.	BU	P	6						3					2		1	1								2							2		
	Ptychoptera sp.		CG	7																												1			
	Simulium sp.	CN	F	6			18	78	5	30	26	49	17	17	5	102	9	15	8		5	4	13	21	38	24	25	24	12	114	35	8	1	26	31
	Tipula sp.	BU	SH	4					7	3				1					3					3			2			2		3	3		
Chironomidae (family)	Chironomidae	BU/SP	CG/SH/P	6				188	195	173	143	99	143	68	10	30	33	88	151	92	124	25	23	83		20	43	91	149	36	56	35	41	21	8
Hirudinea (class)	Helobdella sp.		PA/P	6								1																							
Collembola	Collembola										2																								
Oligochaeta (class)	Oligochaeta		CG	5			5	15	7	2	6	4	7	8	3	5	3	5	19	72	101	5	3			34		9	8	9			19	56	
Bivalvia (class)	Pisidium sp.	BU	F	8		2		2	4		2						2	6		2	5	2	2			12					3	1	1	23	
Gastropoda (class)	Fossaria sp.	CN	SC	8			2			1					2					52	57	27	4	4			8				15		1	1	
	Amnicola sp.	CN	SC	5										2	2	1	1													3			1		
	Gyraulus sp.	CN	SC																											1					
	Mentus sp.	CN	SC																	6															
	Physella sp.	CN	SC	8		19		3	2	1					3	1				114	55	7	2	6		14	32		1	2			3	23	
	Valvata sp.	CN	SC																			1													
Amphipoda	Gammarus sp.	SW/BU	OM	6																2			2	4	13	8	1	12				2			
Ostracoda	Ostracoda	SW	CG	8							1												460	2	9	30	13	8	1	1					
Tricladida	Polycelis coronata		OM	1											4																				
Acari (subclass)	Acari		P	8				2		2	3	4		2	6	7															2	2	5		
					% Subsampled	**50**	**50**	**12.5**	**12.5**	**66.6**	**12.5**	**25.0**	**50.0**	**25.0**	**12.5**	**50.0**	**100**	**33.3**	**75**	**50.0**	**33.3**	**100.0**	**12.5**	**33.3**	**100**	**25.0**	**25.0**	**75.0**	**12.5**	**25.0**	**25.0**	**50.0**	**25.0**	**25**	**50**
					Total abundance	**394**	**486**	**516**	**506**	**494**	**465**	**482**	**534**	**477**	**536**	**492**	**420**	**478**	**409**	**498**	**415**	**91**	**596**	**470**	**280**	**541**	**532**	**445**	**445**	**487**	**452**	**463**	**465**	**503**	**500**
					Total taxa	**24**	**19**	**27**	**25**	**22**	**26**	**24**	**16**	**23**	**24**	**21**	**23**	**23**	**16**	**15**	**13**	**14**	**21**	**22**	**14**	**23**	**21**	**17**	**21**	**20**	**18**	**22**	**30**	**20**	**15**
					Total Counts	**788**	**972**	**4128**	**4048**	**741.7417**	**3720**	**1928**	**1068**	**1908**	**4288**	**984**	**420**	**1435.435**	**545.3333**	**996**	**1246.246**	**91**	**4768**	**1411.411**	**280**	**2164**	**2128**	**593.3333**	**3560**	**1948**	**1808**	**926**	**1860**	**2012**	**1000**
					Density (#/1m²)	**2,835**	**3,496**	**14,849**	**14,561**	**2,668**	**13,381**	**6,935**	**3,842**	**6,863**	**15,424**	**3,540**	**1,511**	**5,163**	**1,962**	**3,583**	**4,483**	**327**	**17,151**	**5,077**	**1,007**	**7,784**	**7,655**	**2,134**	**12,806**	**7,007**	**6,504**	**3,331**	**6,691**	**7,237**	**3,597**

Functional Feeding Groups (FFG): CG = Collector-Gatherer, SC = Scraper, F = Filterer, P = Predator, SH = Shredder, OM = Omnivore **Habitat/Behavior (Hab/Beh):** BU = Burrower, SW = Swimmer, CN = Clinger, CB = Climber, SP = Sprawler, DV = Diver

Table 19
Relationships between Aqueous Selenium Concentrations (mg/L) and Benthic Macroinvertebrate Community Metrics

	Benthic Density (#/m^2)	Benthic Taxa	# Ephemeroptera	# Plecoptera	# Trichoptera	# Diptera	# EPT	Predators	Shredders	Filterers	Scrapers	Collector-Gatherers
Significant?	no	yes	no	no	yes	no	yes	no	no	no	no	no
p value	0.0729	0.0061	0.4601	0.2169	0.0237	0.4486	0.0172	0.4308	0.2794	0.6655	0.6402	0.368
R^2	0.123	0.2643	0.022	0.0628	0.1885	0.0232	0.2068	0.025	0.0466	0.0076	0.011	0.0325
normal	yes	yes	no	no	yes	no	no	yes	yes	no	yes	no
variance	yes	no	yes	yes	yes	yes	yes	no	yes	yes	yes	no
linear	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes

	# Predator Taxa	# Shredder Taxa	# Filterer Taxa	# Scraper Taxa	# Collector-Gatherer Taxa	% Uni-voltine	% Semi-voltine	% Multi-voltine
Significant?	yes	no	no	no	no	no	no	yes
p value	0.0022	0.4058	0.8356	0.8045	0.4859	0.2799	0.1284	0.0174
R^2	0.318	0.0278	0.0018	0.0031	0.0196	0.0465	0.09	0.2061
normal	no	no	no	no	yes	no	yes	yes
variance	yes	yes	yes	yes	yes	yes	no	yes
linear	yes	no	no	yes	yes	no	yes	yes

Note: Data were log-transformed to better meet assumptions of normality and equal variances, although transformations did not always improve the data distributions.

FIGURES

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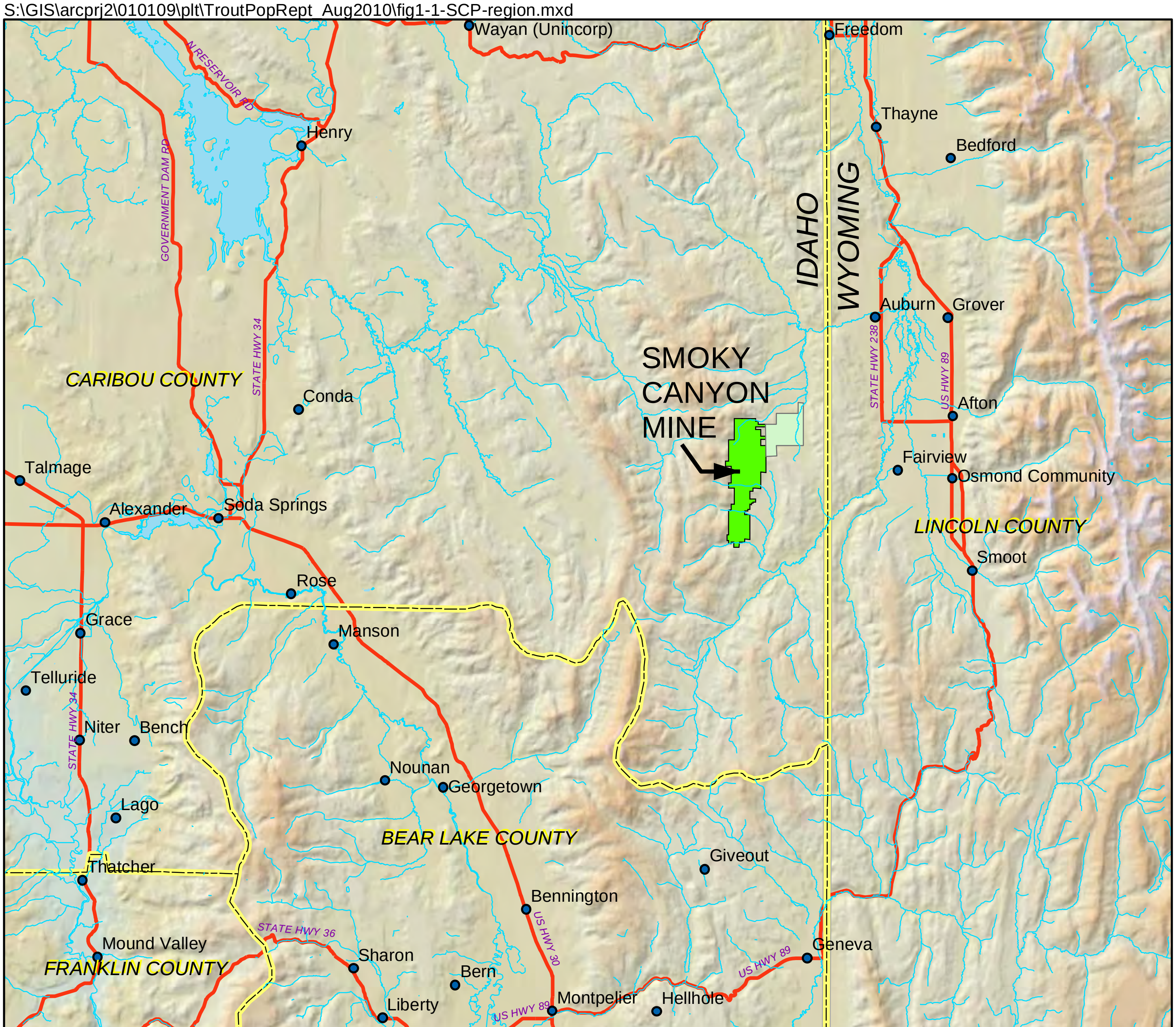
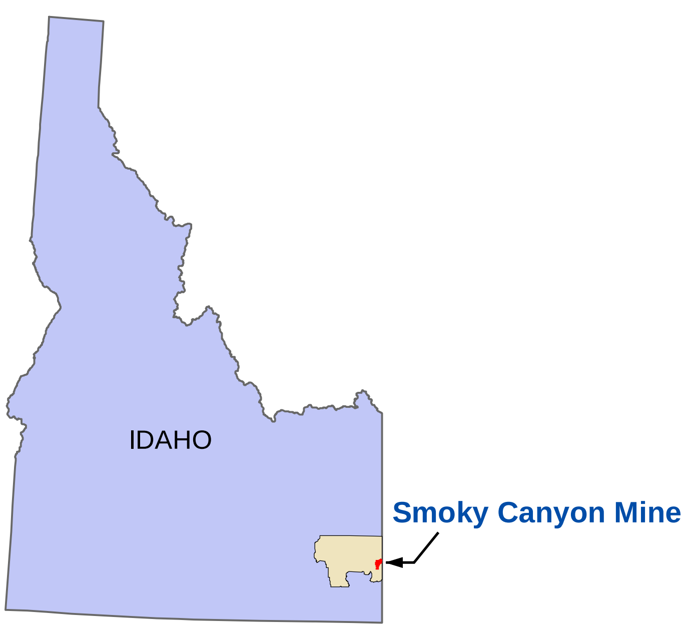
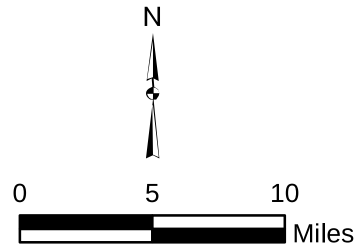






J.R. SIMPLOT COMPANY

SMOKY CANYON MINE

FIGURE 1

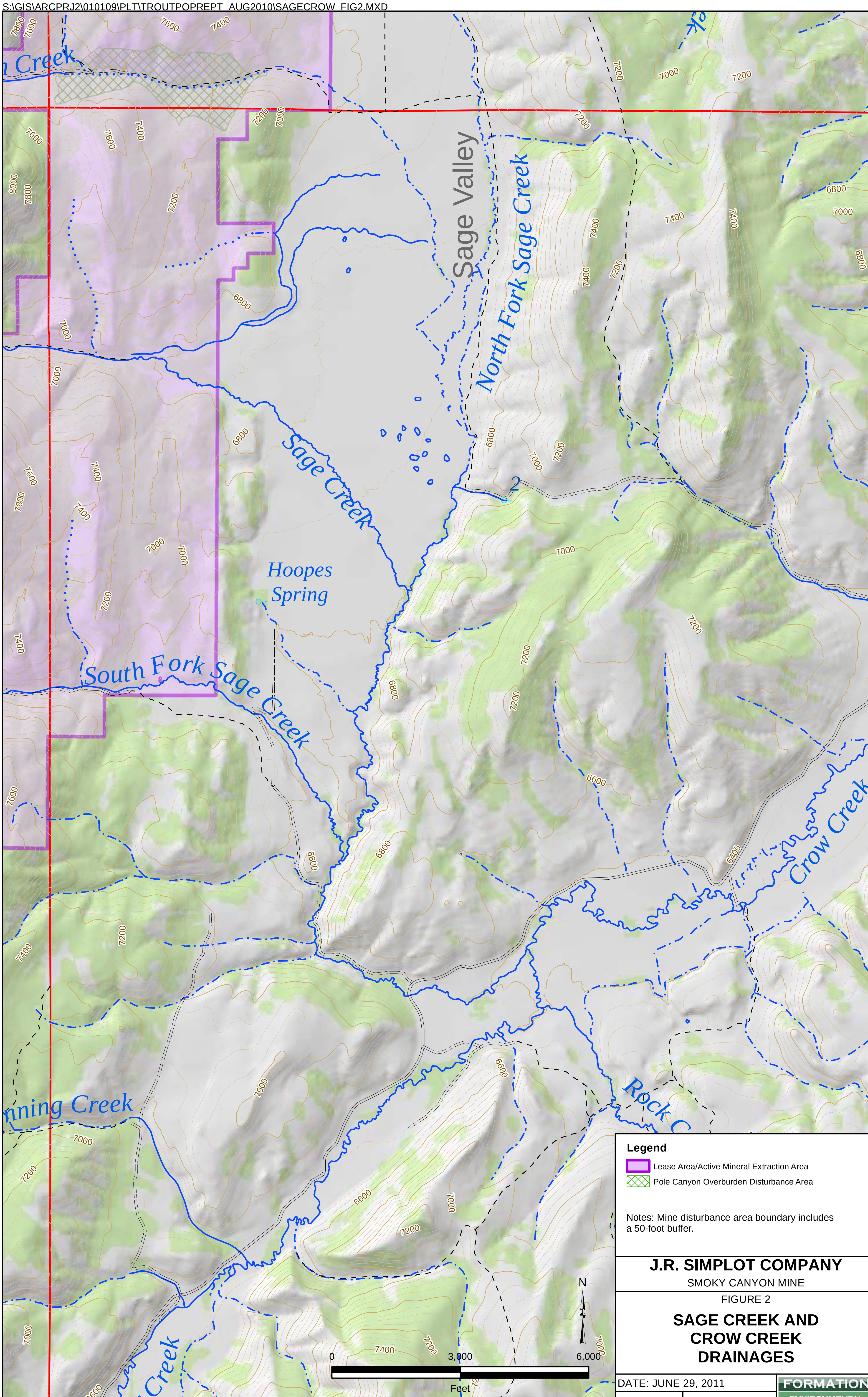
LOCATION OF THE
SMOKY CANYON MINE

DATE: JUNE 29, 2011

BY: KSR

FOR: SMC

FORMATION ENVIRONMENTAL



J.R. SIMPLOT COMPANY

SMOKY CANYON MINE

FIGURE 2

SAGE CREEK AND CROW CREEK DRAINAGES

DATE: JUNE 29, 2011

BY: KSR FOR: SMC

FORMATION ENVIRONMENTAL

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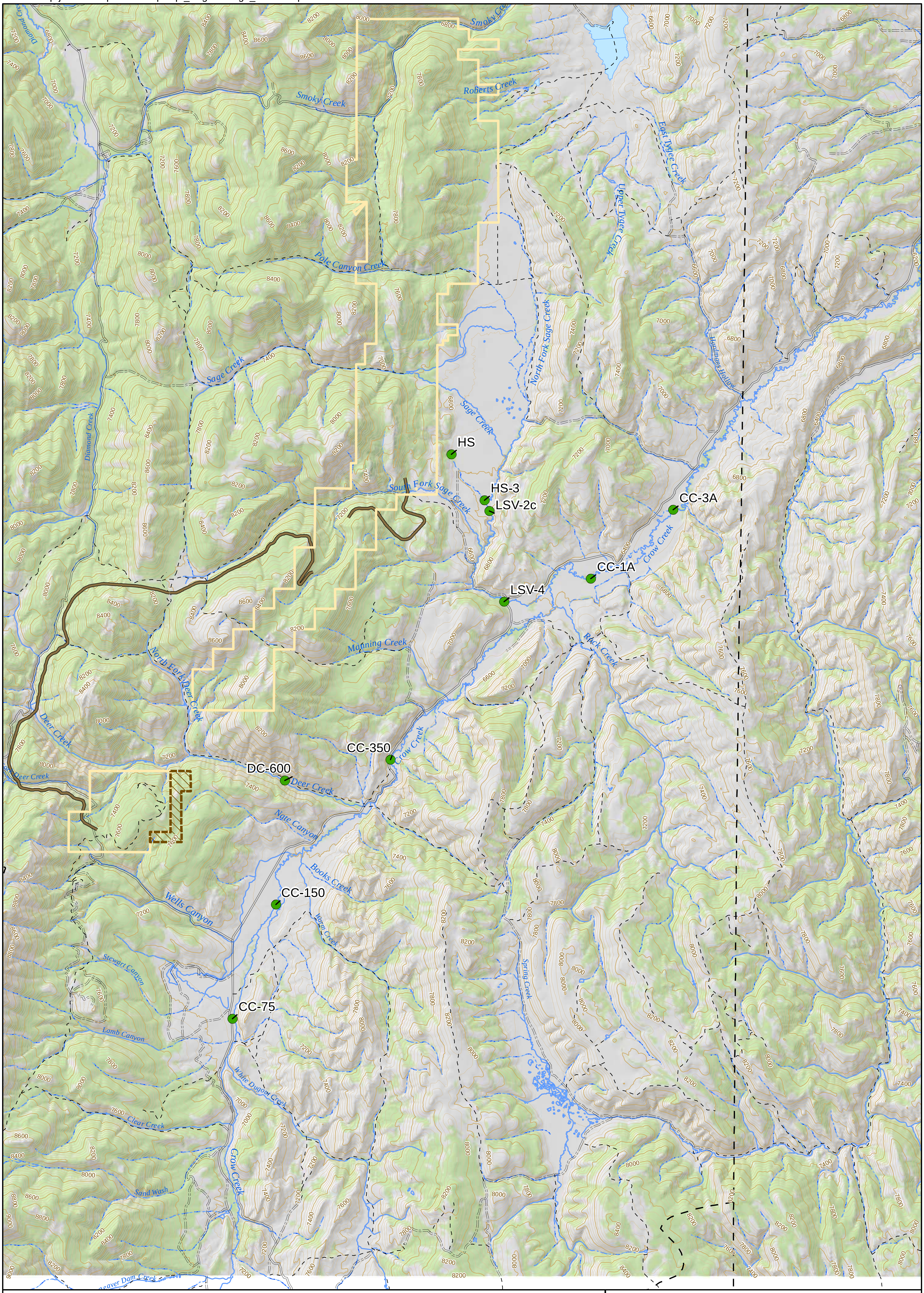


- SSSC Monitoring Locations
- Pending Lease Modification Area
- Lease Area/Active Mineral Extraction Area

N

Miles

0 1 2

J.R. SIMPLOT COMPANY

SMOKY CANYON MINE

FIGURE 3

SITE-SPECIFIC SELENIUM CRITERION STUDY MONITORING LOCATIONS

DATE: JUNE 29, 2011

BY: KSR | FOR: SMC

FORMATION ENVIRONMENTAL

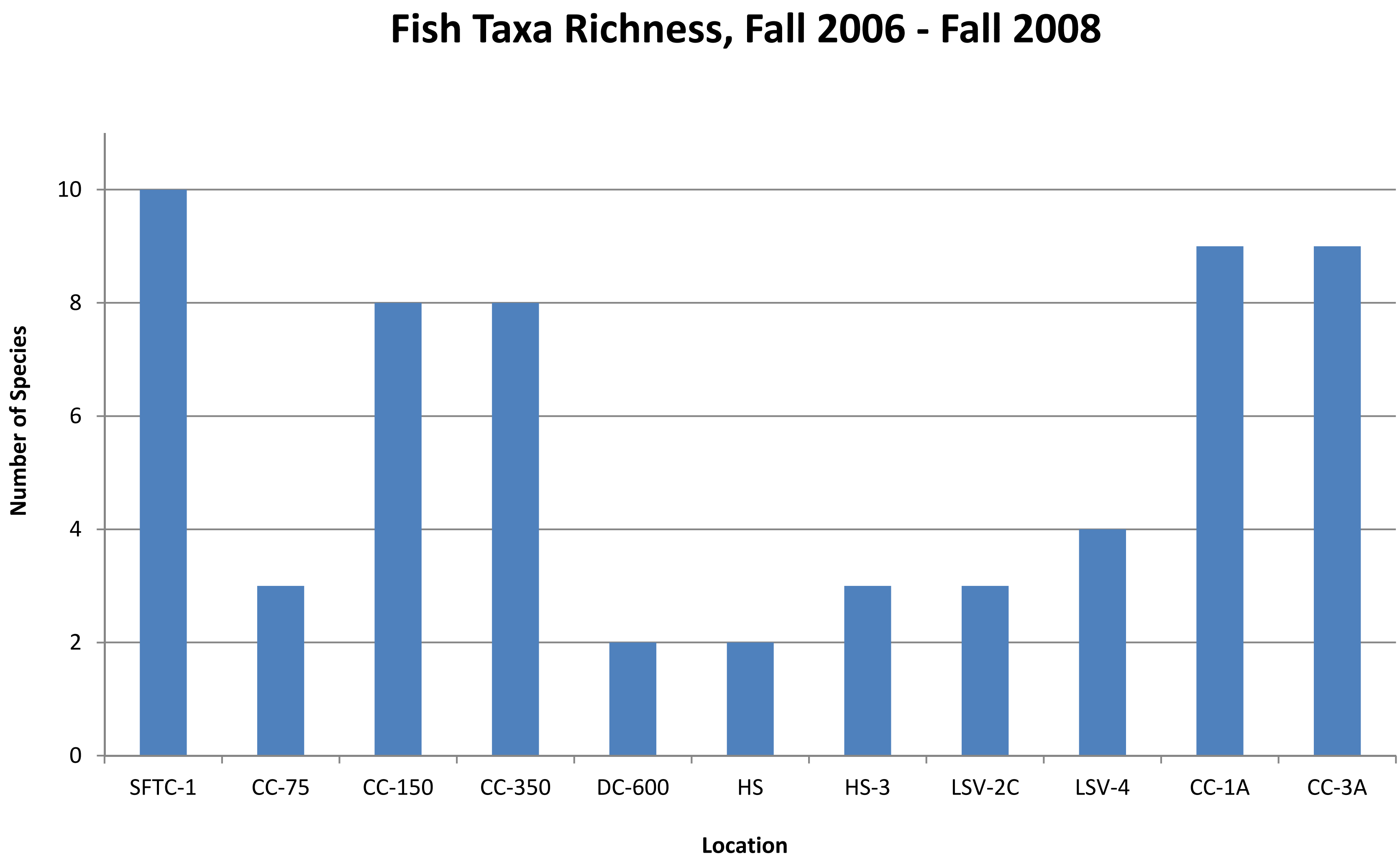


Figure 4
Fish Taxa Richness

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 1	BY: SMC / CHK: SMC

FORMATION ENVIRONMENTAL

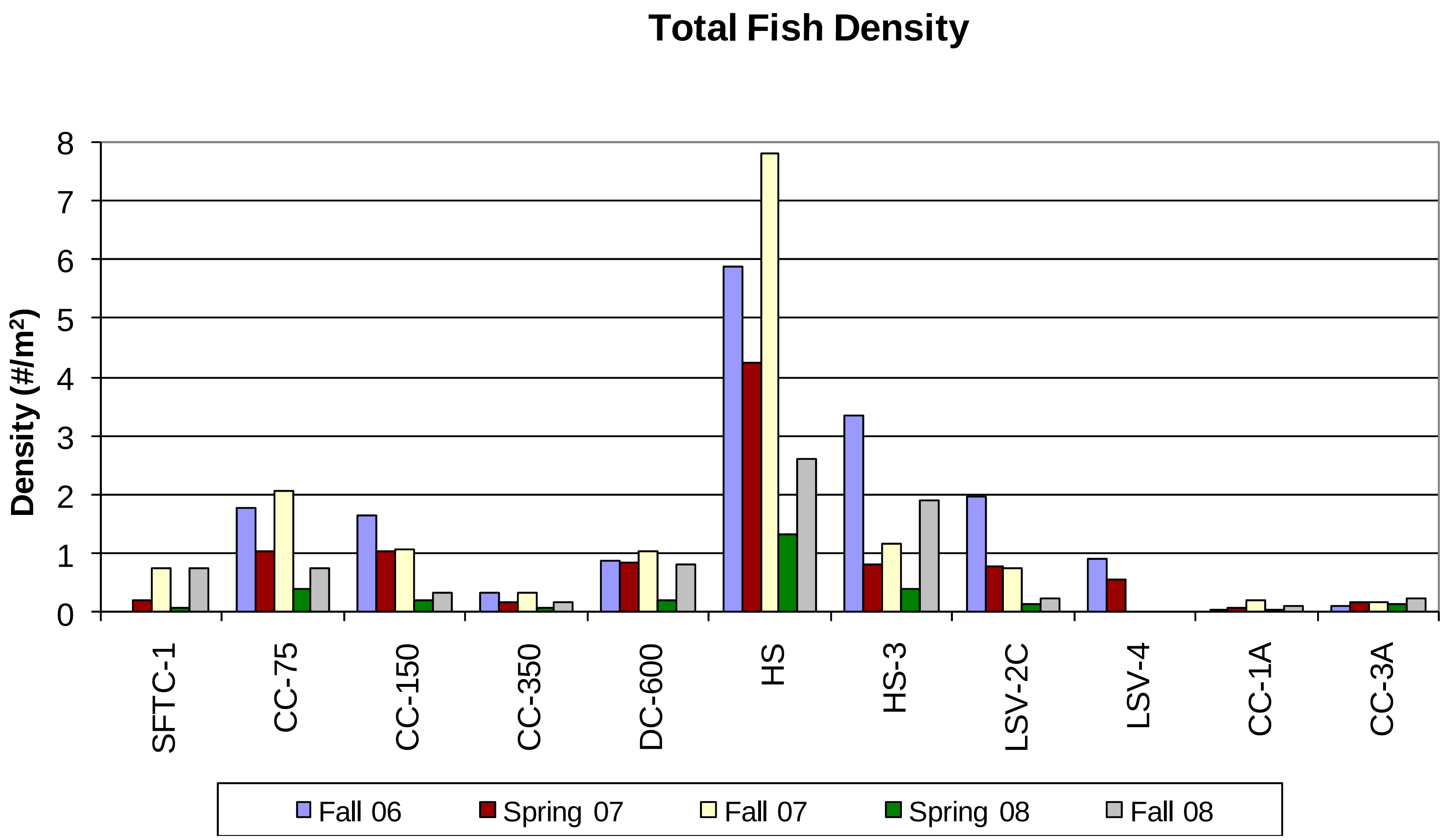
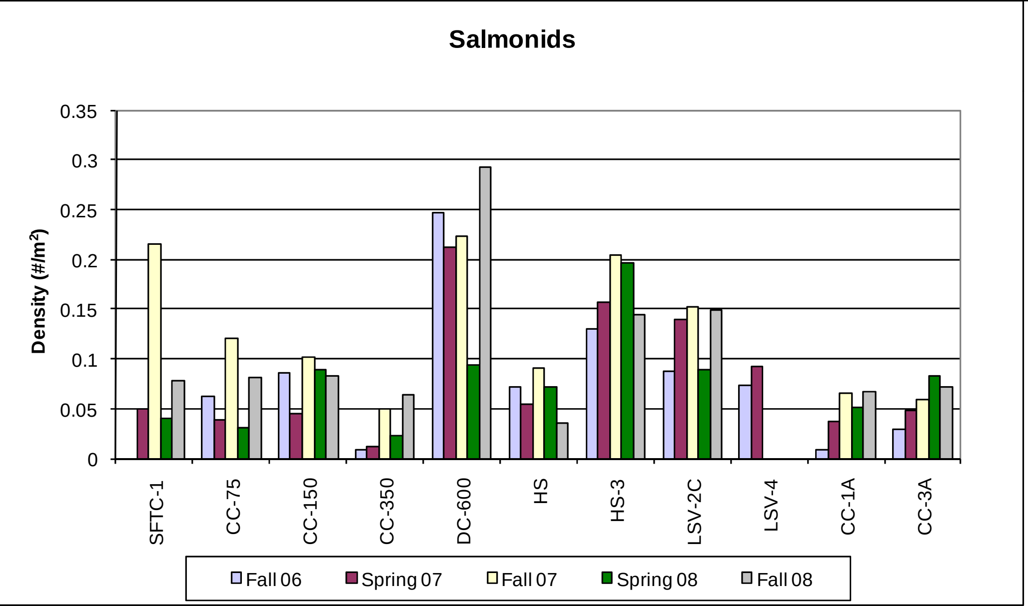


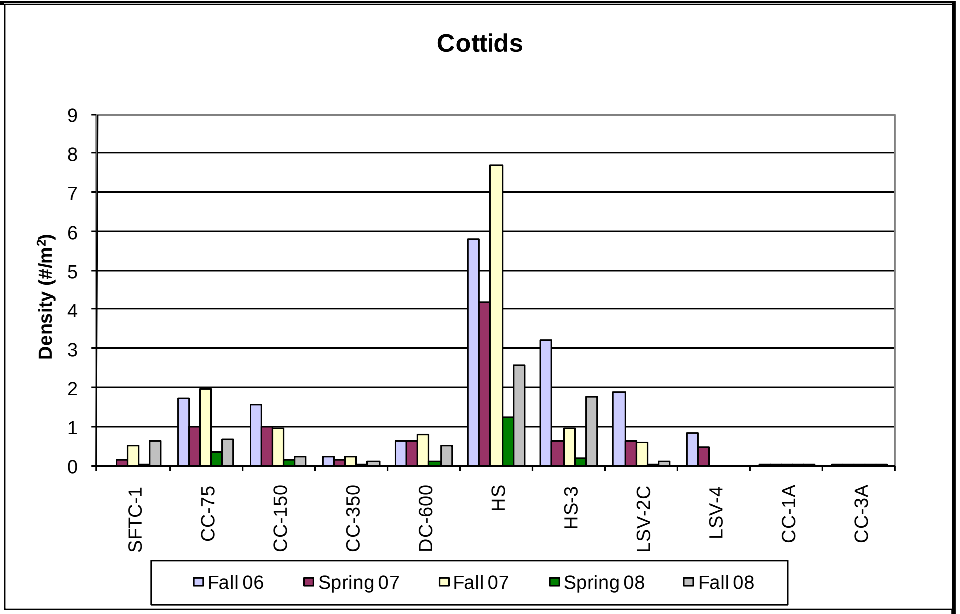
Figure 5
Total Fish Density

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL





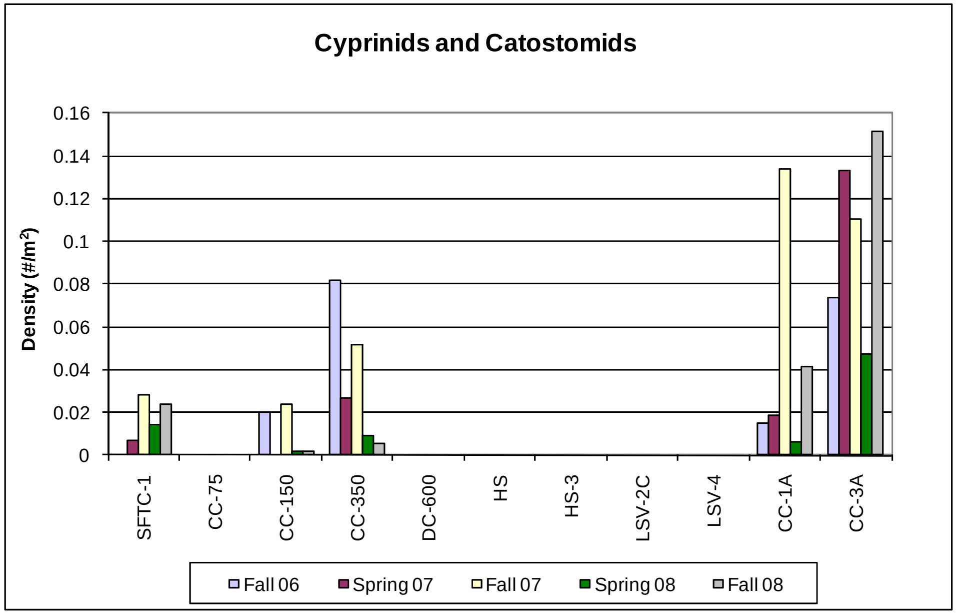


Figure 6
Salmonids, Cottids, Cyprinids and Catostomids Densities (#/m²) Based on Electrofishing Collections During 2006, 2007, 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 1	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

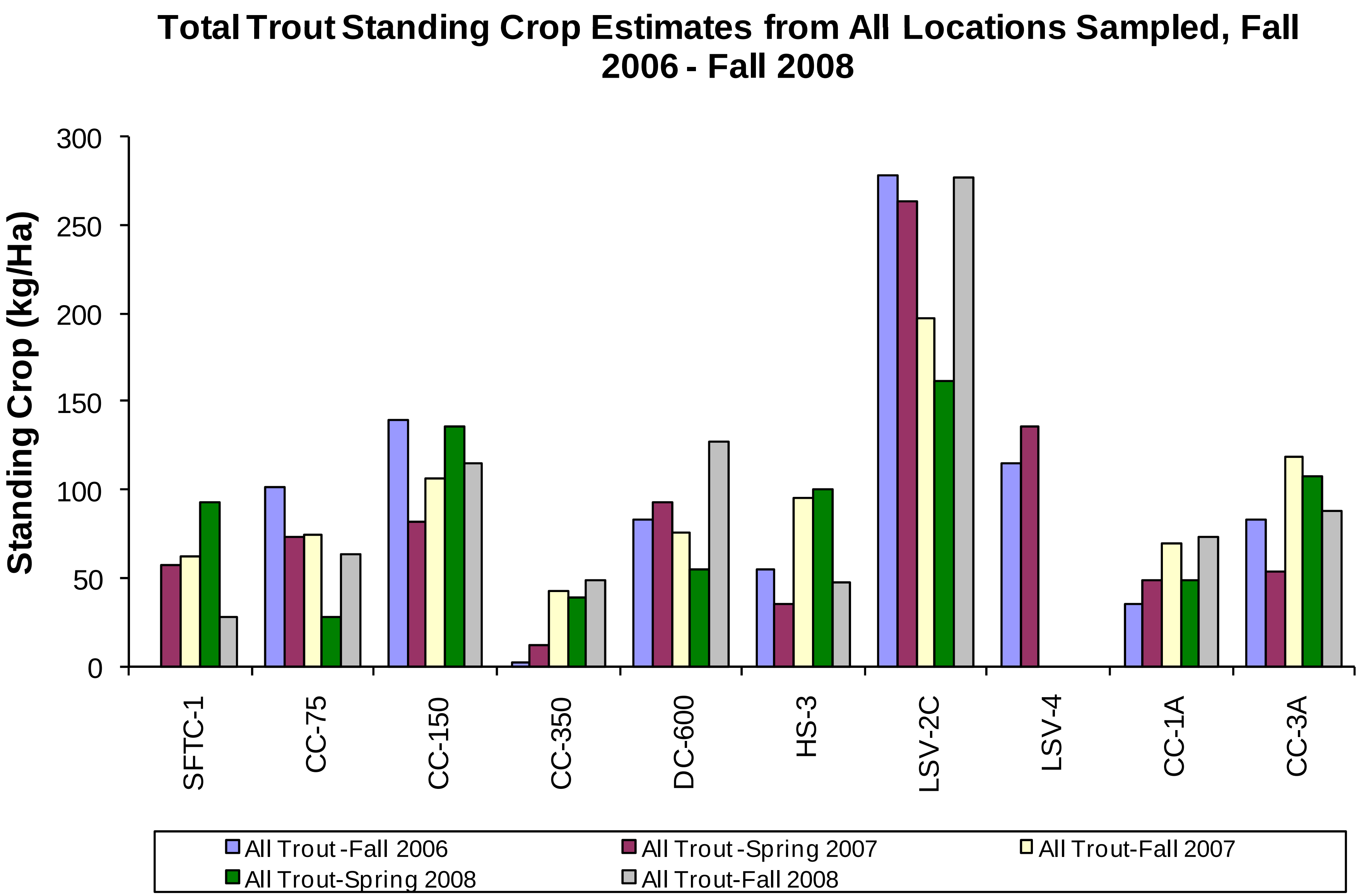
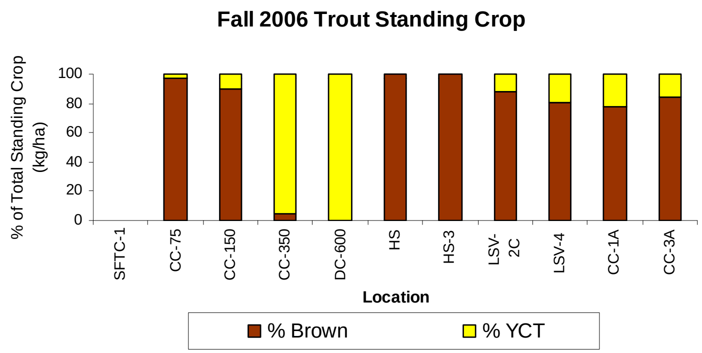


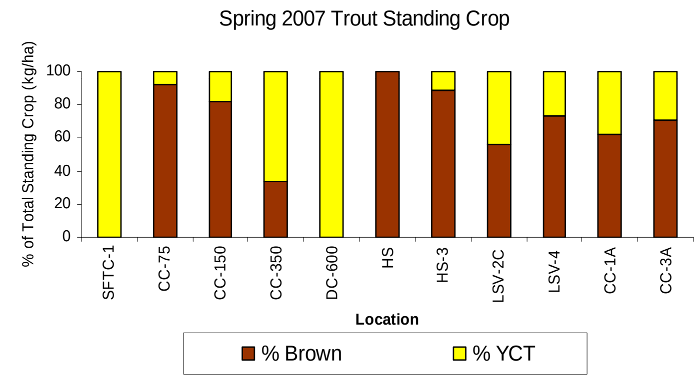
Figure 7
Total Trout Standing Crop Estimates (kg/Ha) from All Locations Sampled, Fall 2006 – Fall 2008

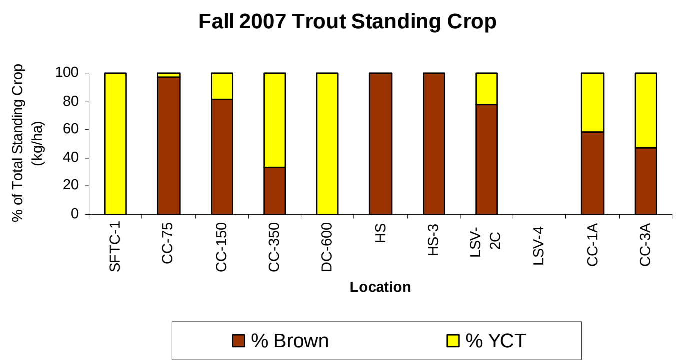
J.R. Simplot Company
Site-Specific Selenium Criterion

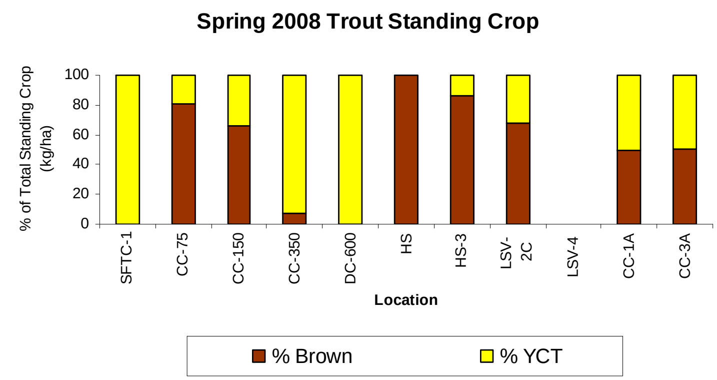
PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC CHK: SMC

FORMATION ENVIRONMENTAL









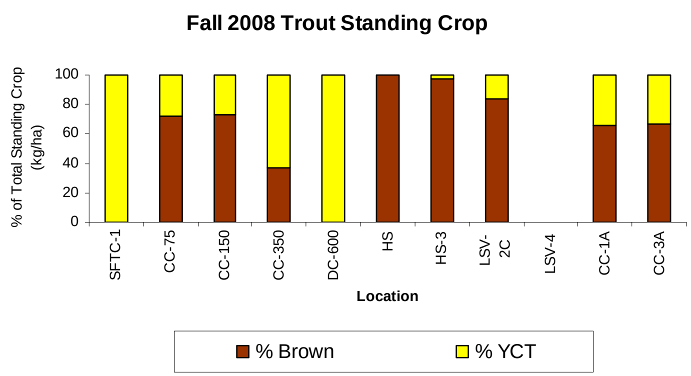


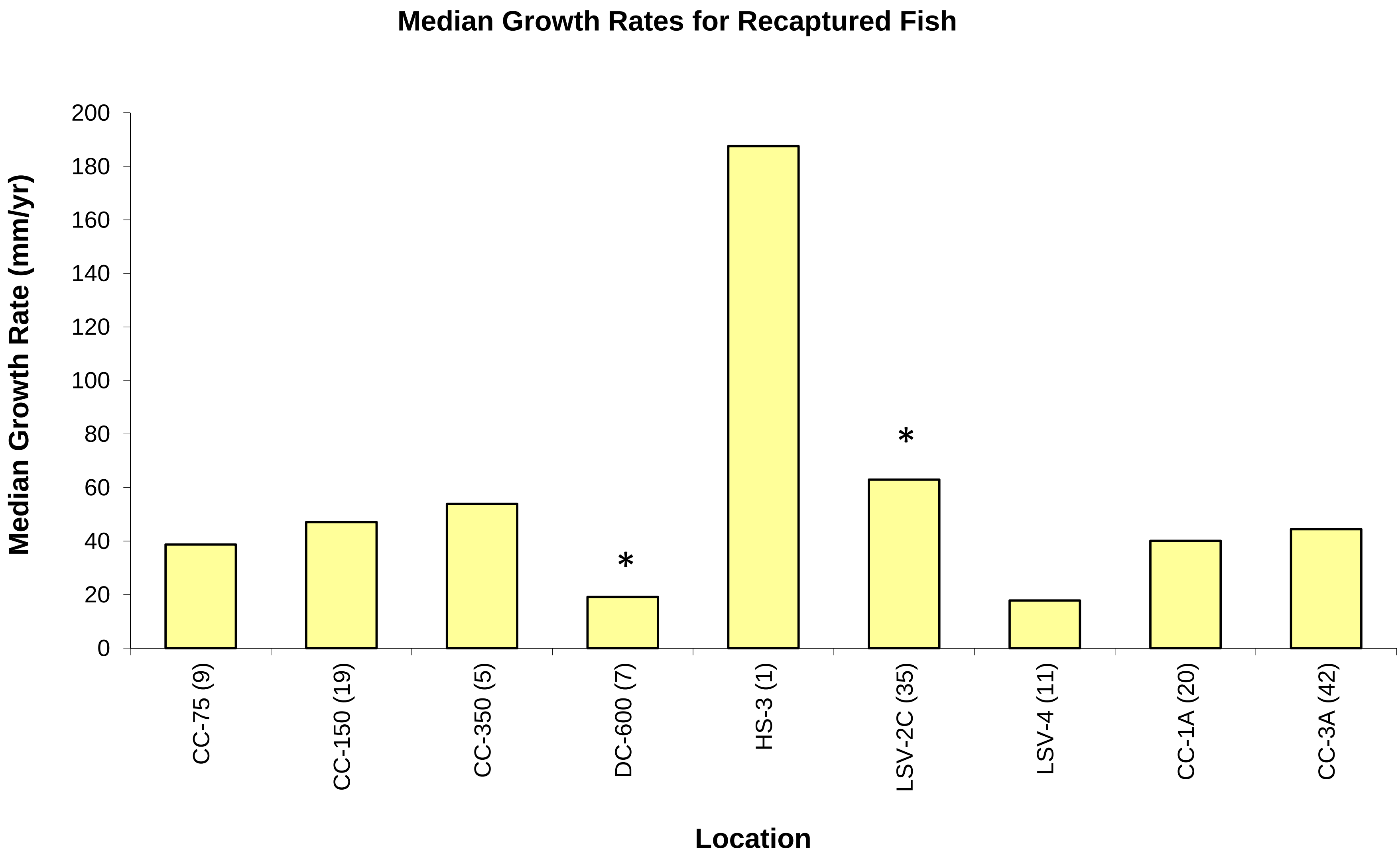
Figure 8

Total Trout Standing Crop Estimates (kg/Ha) from All Locations Sampled, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL



*Numbers in parentheses indicate sample size.

Figure 9
Median Growth Rates for Recaptured Fish (* denotes significantly different – Kruskal-Wallis One-Way ANOVA and Multiple Comparison Test, alpha = 0.05)

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

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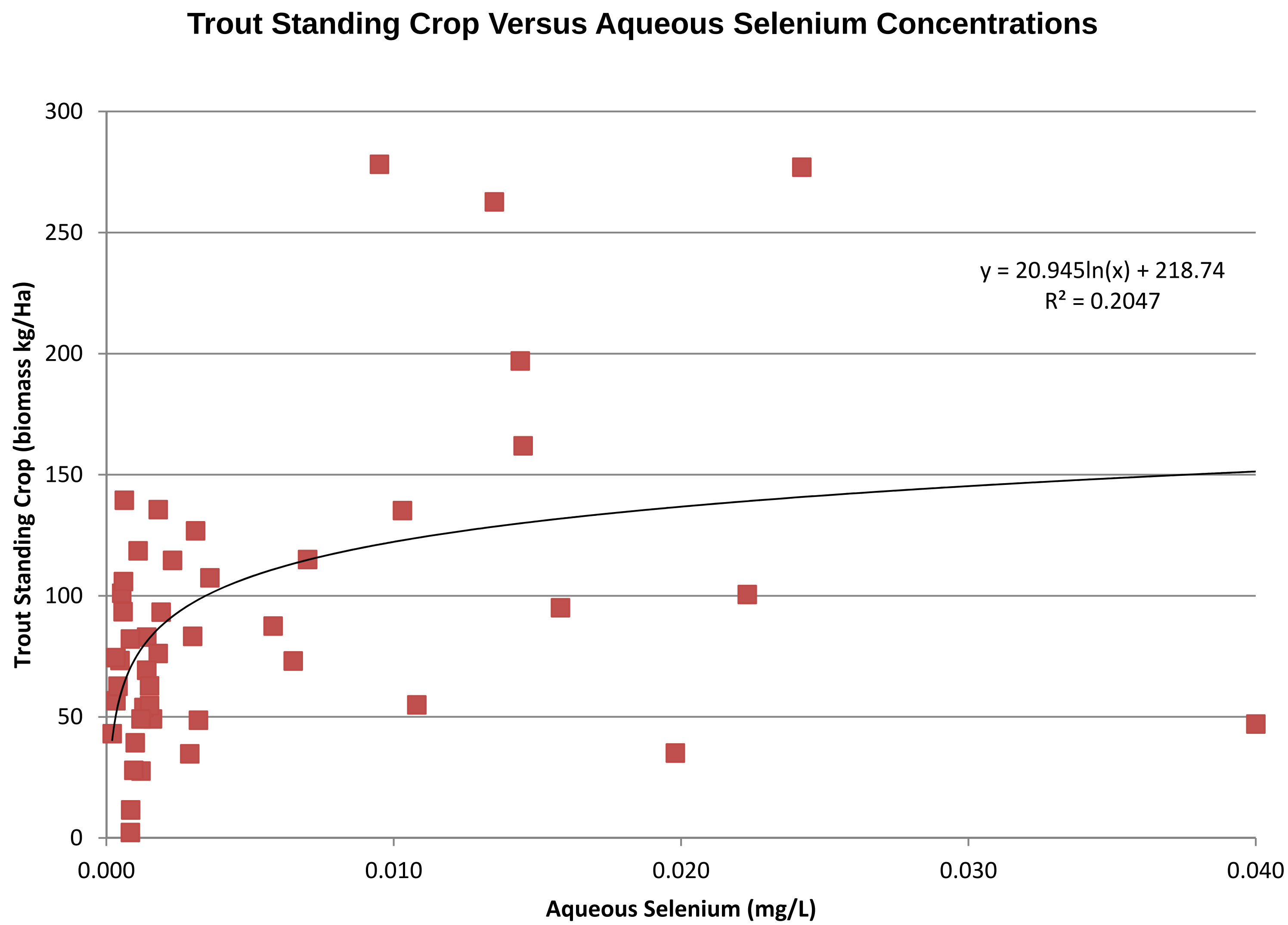

Figure 10
Trout Standing Crop Versus Aqueous Selenium Concentrations

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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Trout Standing Crop Versus Selenium Concentrations in Trout Tissue

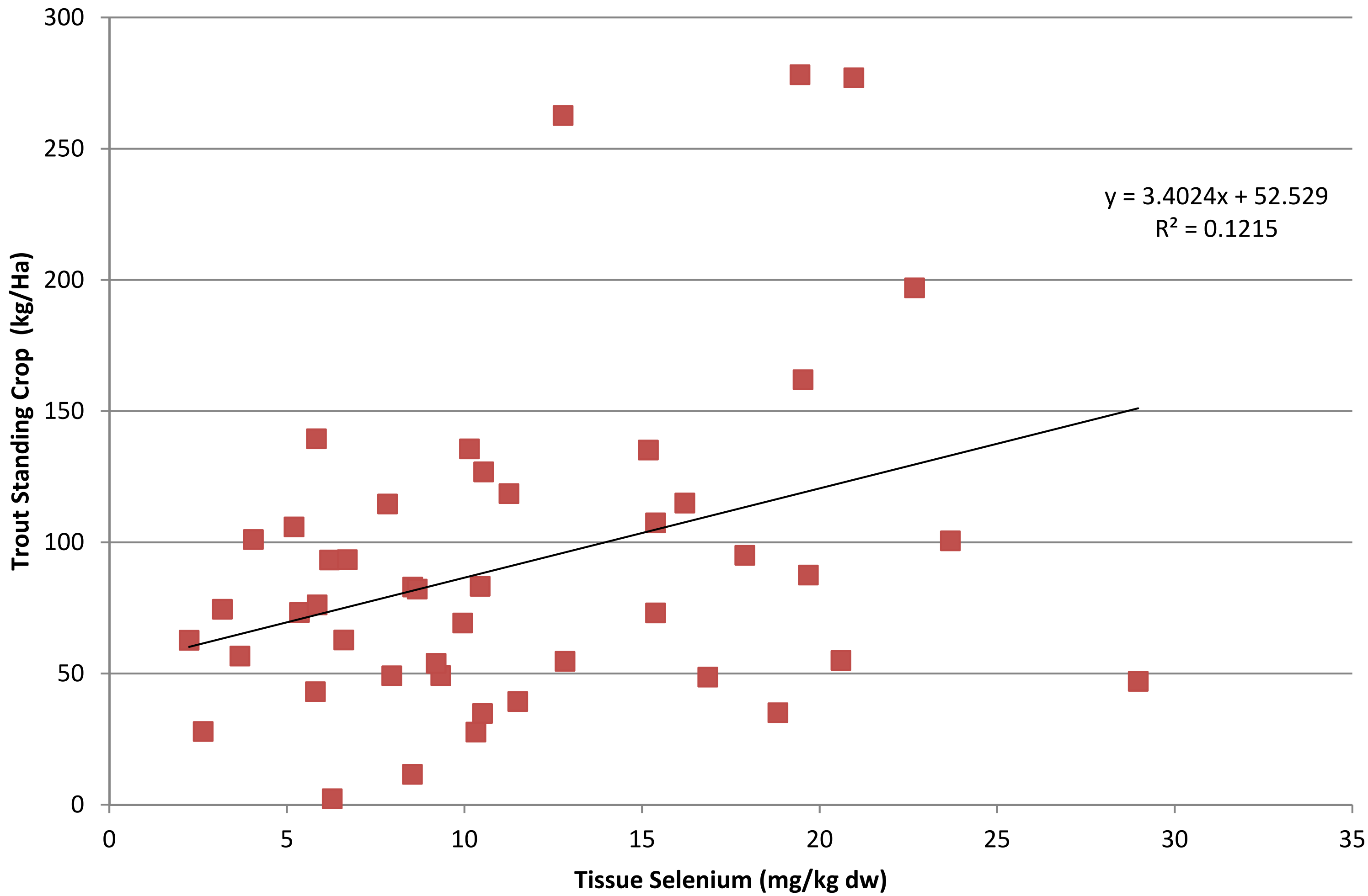

Figure 11
Trout Standing Crop Versus Selenium Concentrations in Trout Tissue

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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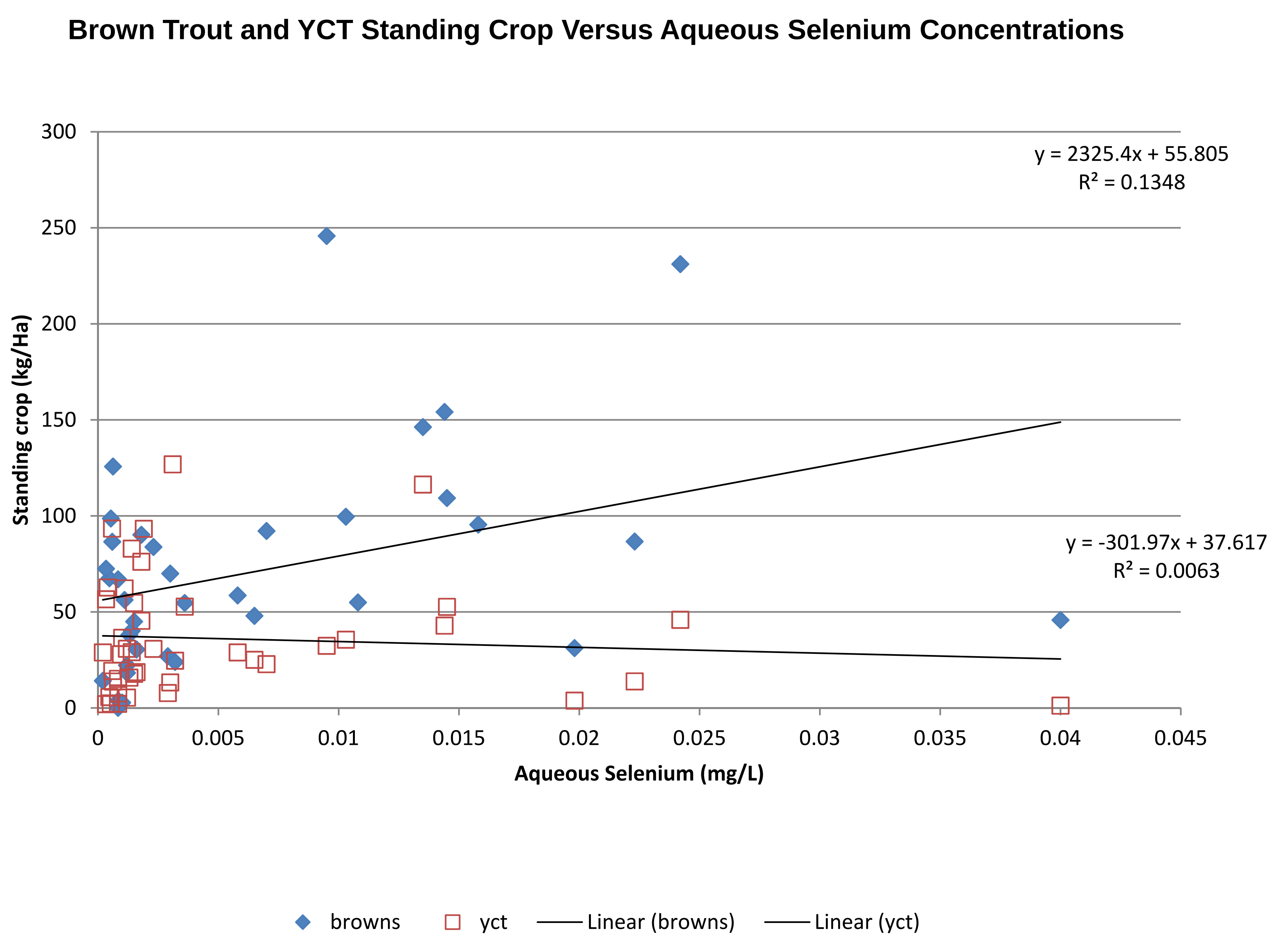

Figure 12
Brown Trout and Yellowstone Cutthroat Trout Standing Crop Versus Aqueous Selenium Concentrations

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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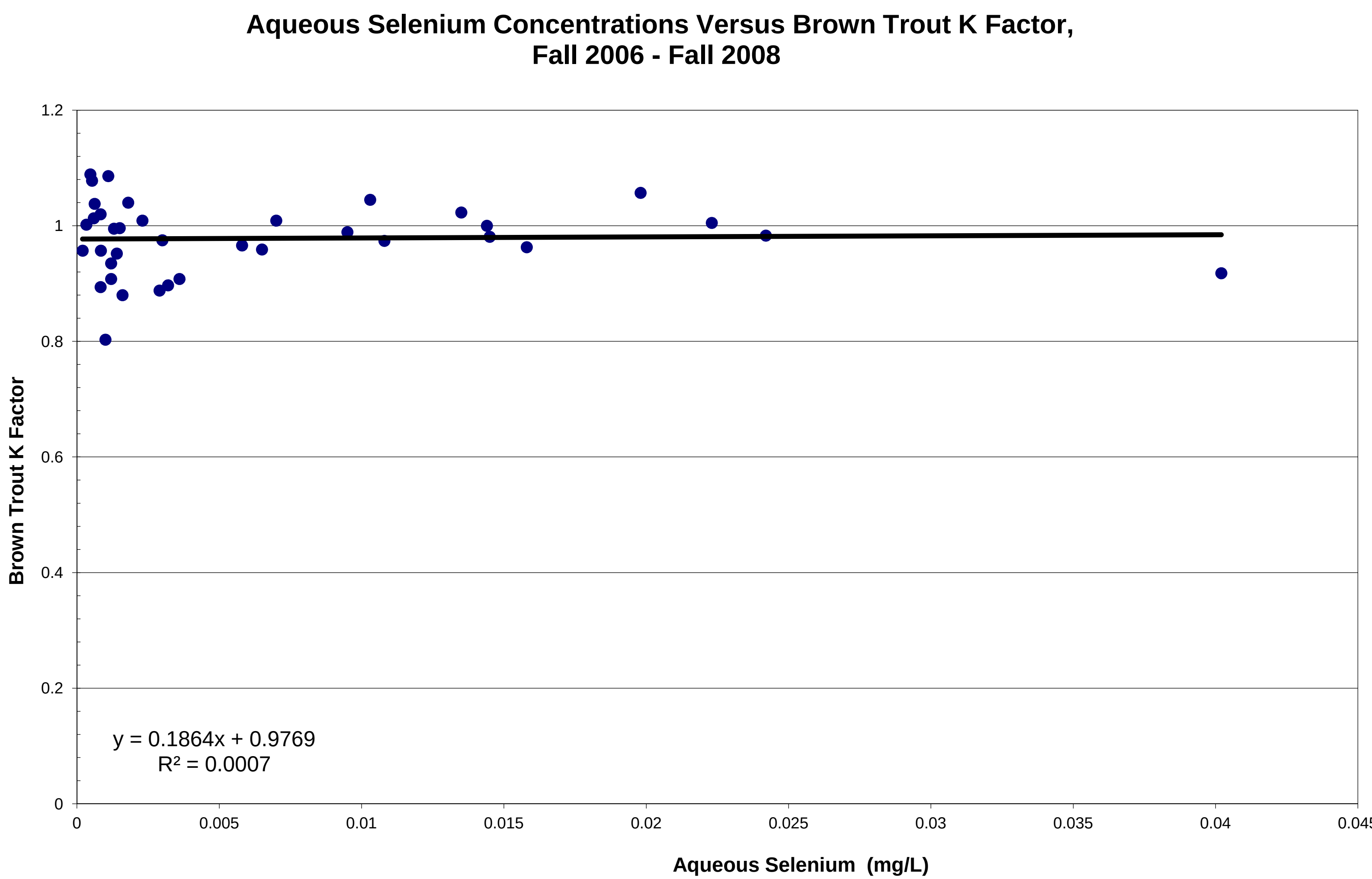

Figure 13
Aqueous Selenium Concentrations Versus Brown Trout K Factor, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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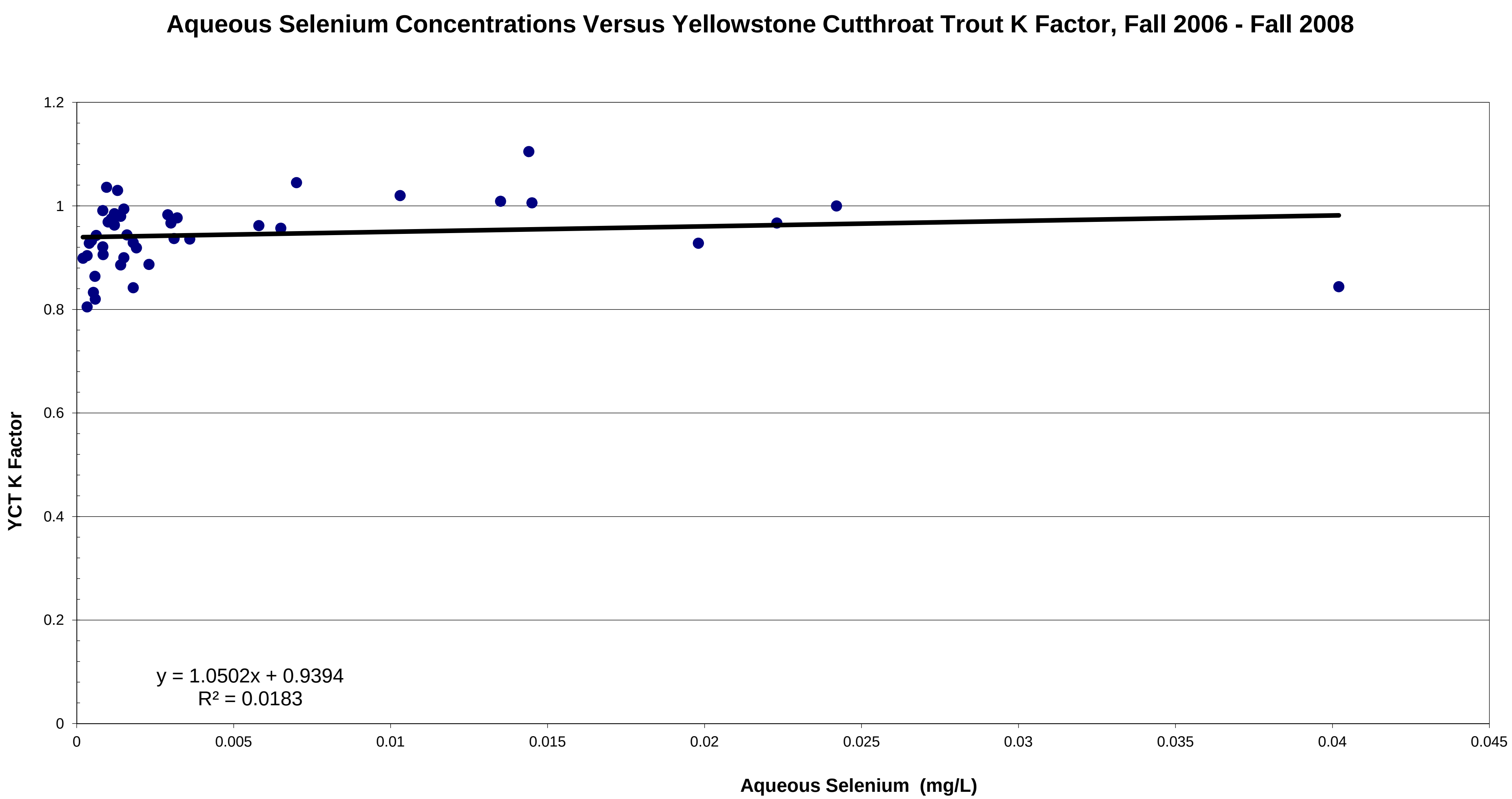

Figure 14
Aqueous Selenium Concentrations Versus Yellowstone Cutthroat Trout K Factor, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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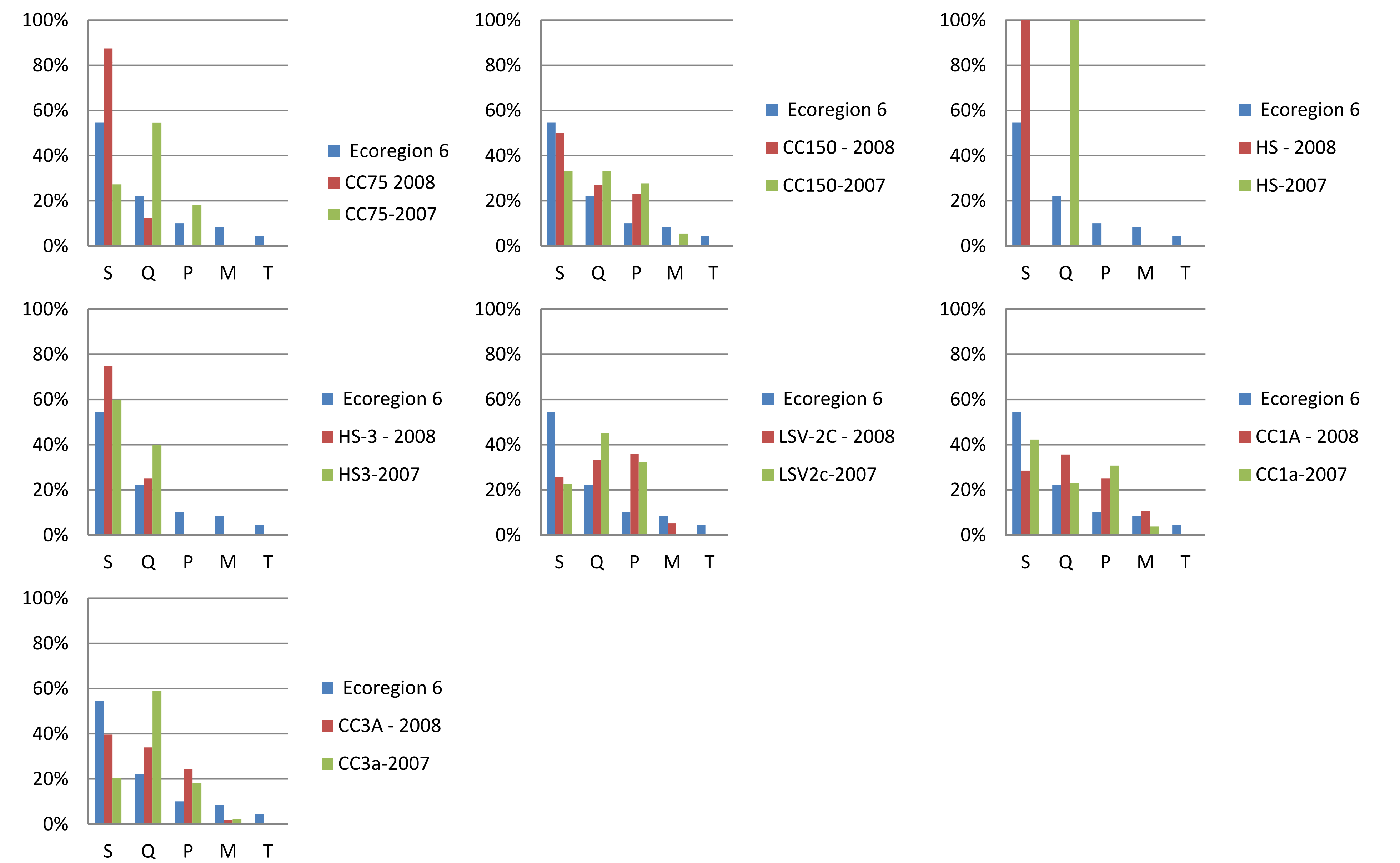

Figure 15
Comparison of Brown Trout Length Frequency by Size Class, Between the Simplot Sample Locations in Fall 2007 and Fall 2008 and that Reported for Ecoregion 6 by Brouder et al. 2009

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

FORMATION ENVIRONMENTAL

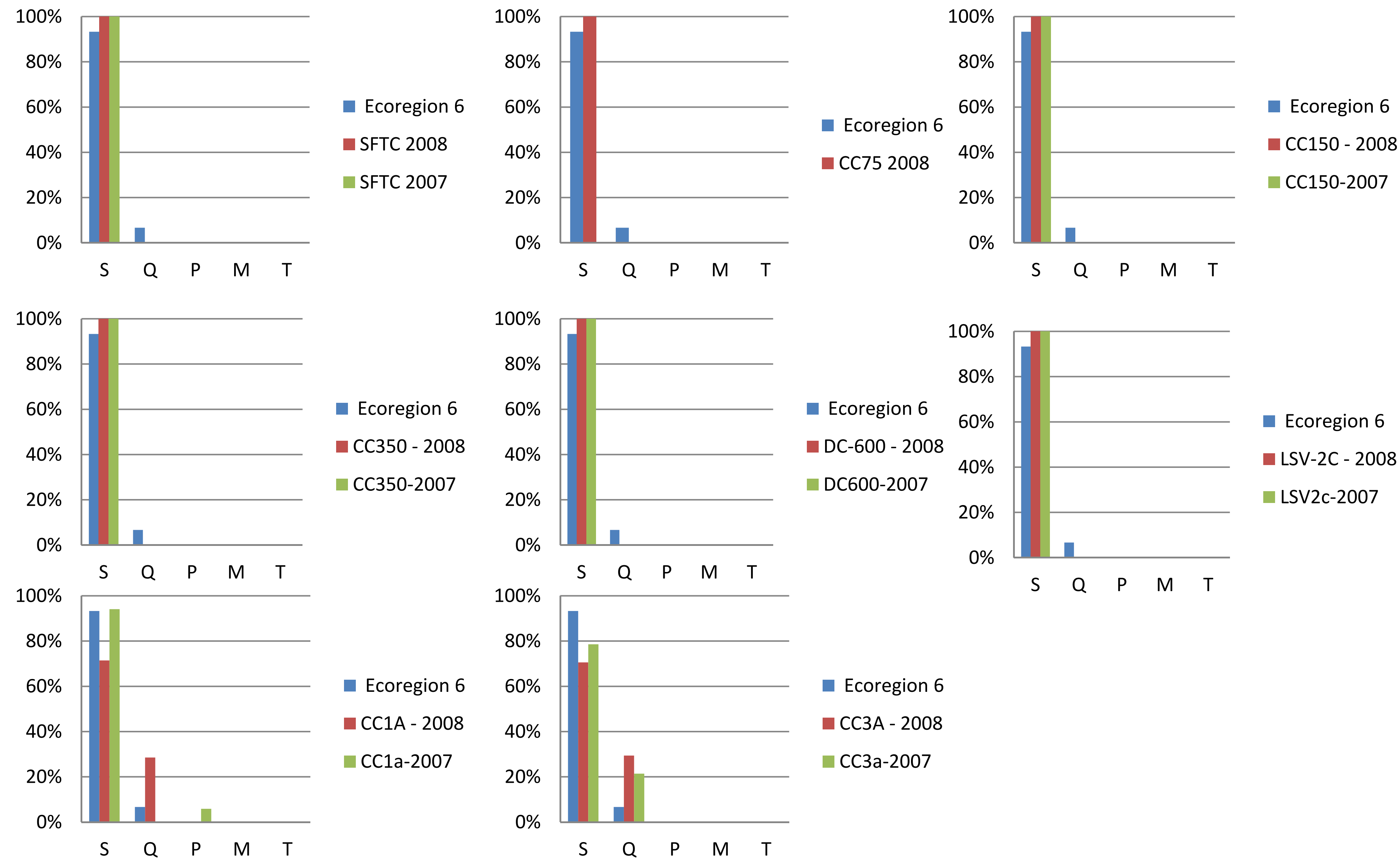

Figure 16
Comparison of Yellowstone Cutthroat Trout Length Frequency by Size Class, Between the Simplot Sample Locations in Fall 2007 and Fall 2008 and that Reported for Ecoregion 6 by Brouder et al. 2009

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

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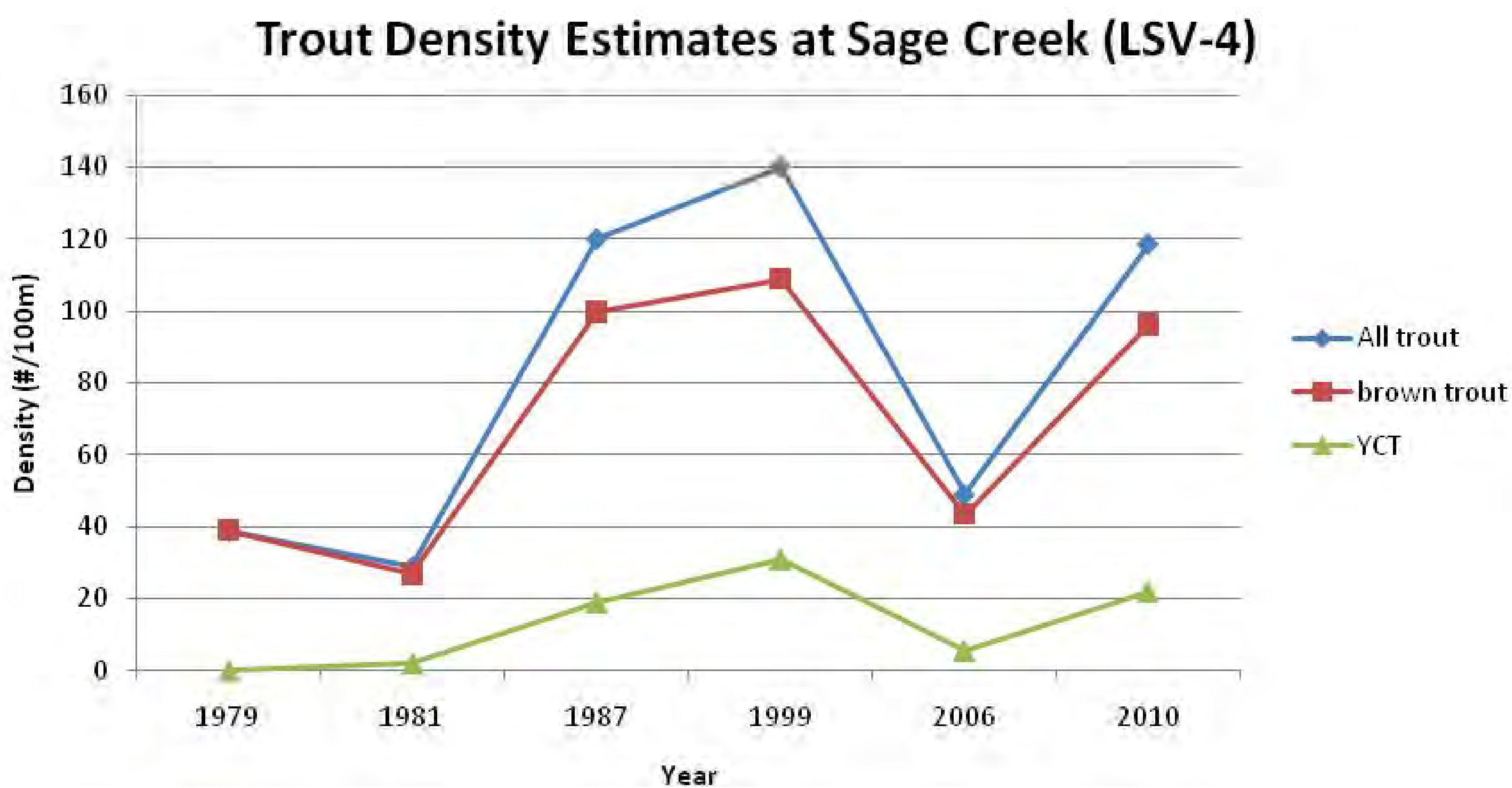

Figure 17
Trout Density Estimates at Sage Creek (LSV-4) Based on Historical Estimates, SSSC Monitoring Data (2006), and Panels F and G Monitoring (2010)

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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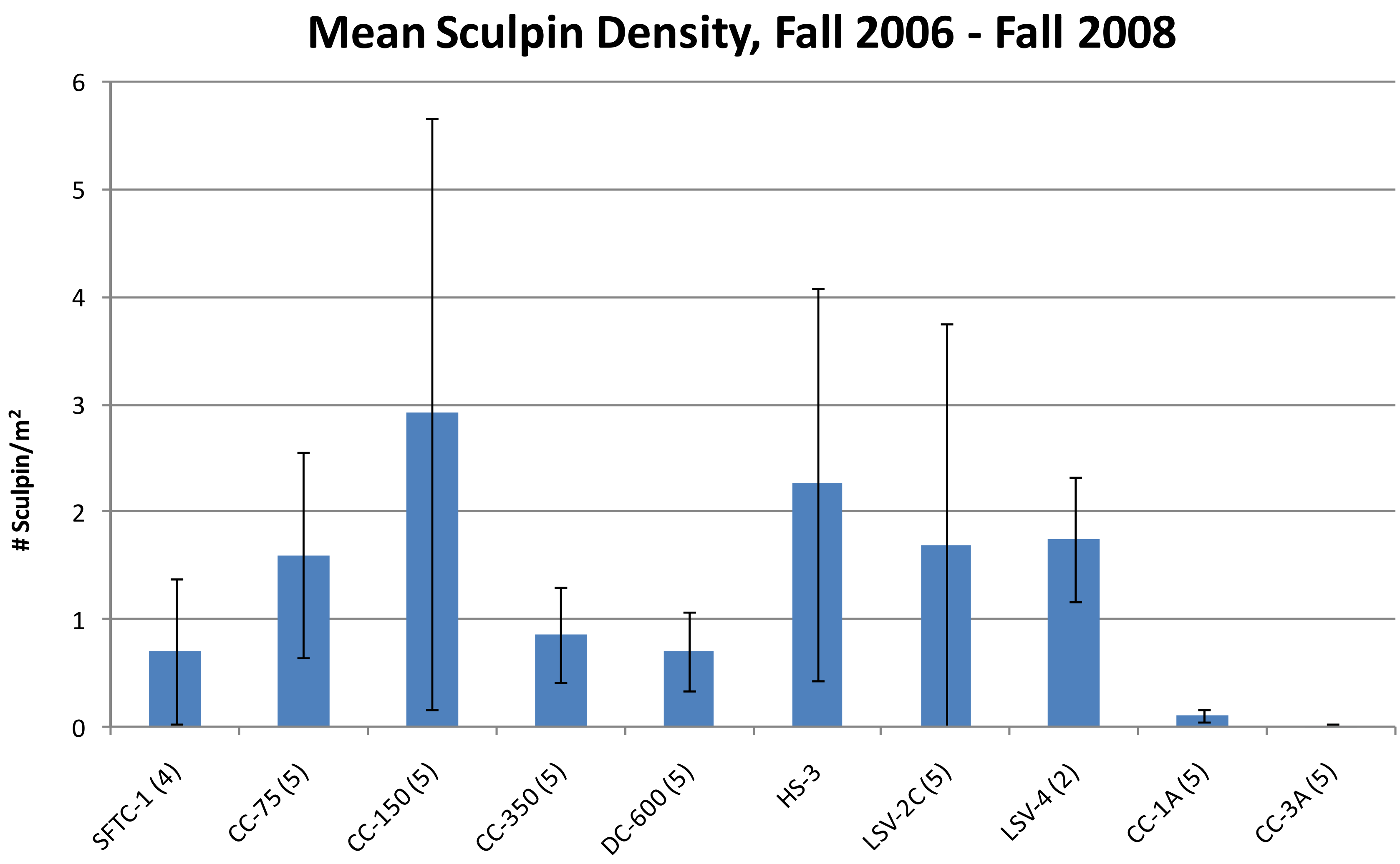

Notes: Density values based on statistically-derived population estimates. Error bars are one standard deviation. Parentheses indicate number of sampling seasons.

Figure 18
Mean Sculpin Density, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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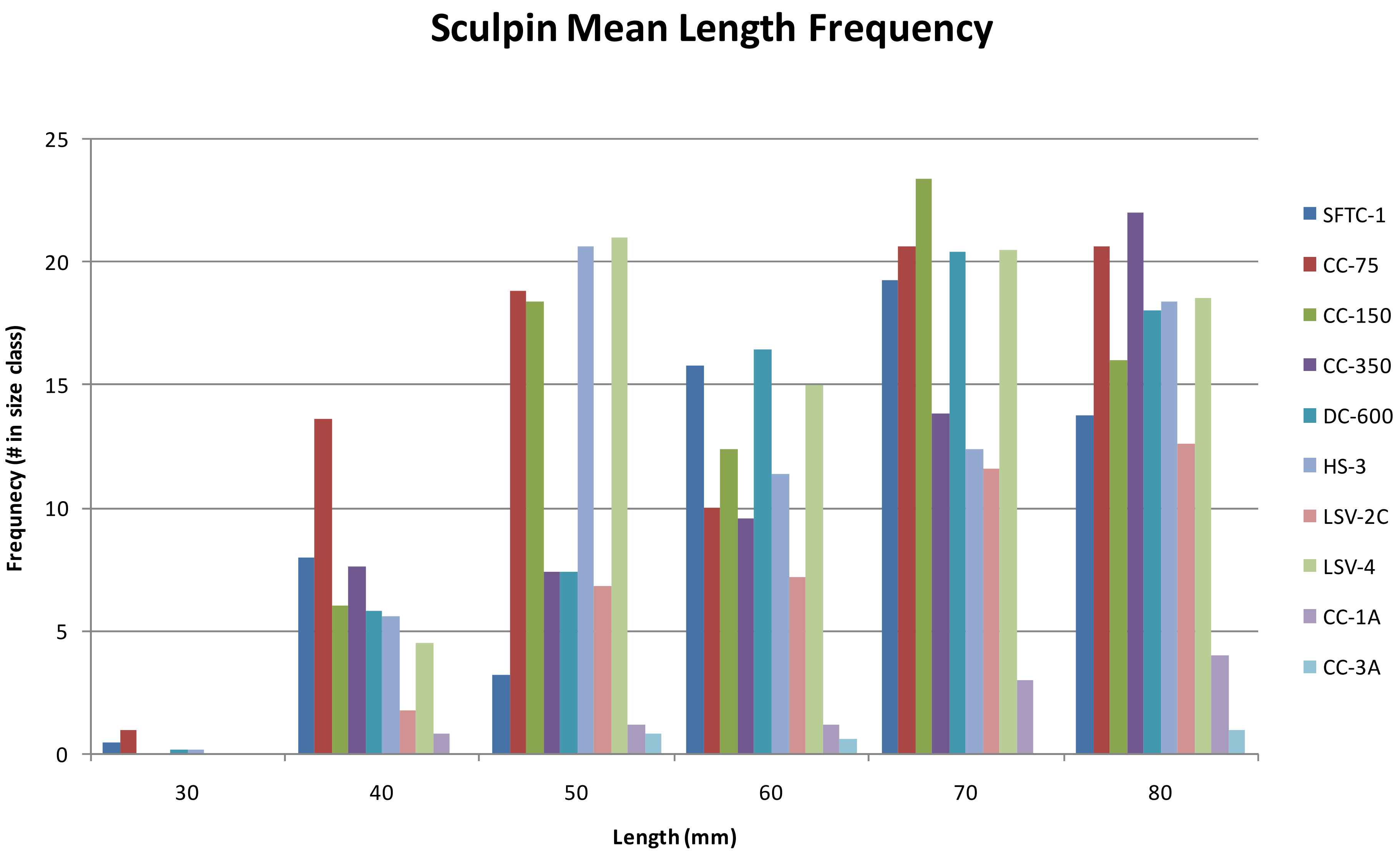

Figure 19
Sculpin Mean Length Frequency

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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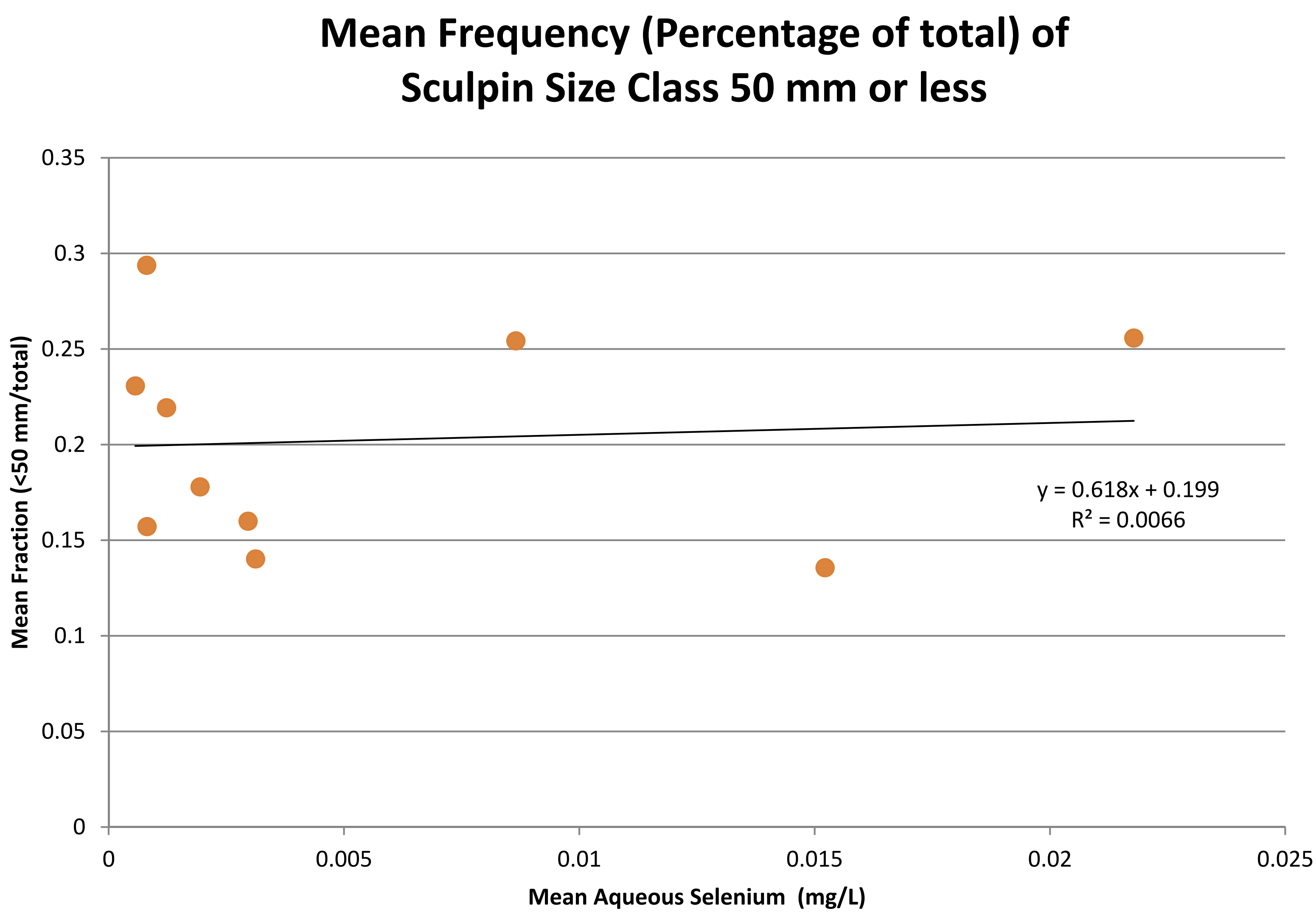

Figure 20
Mean Frequency (Percentage of Total) of Sculpin Size Class 50 mm or Less

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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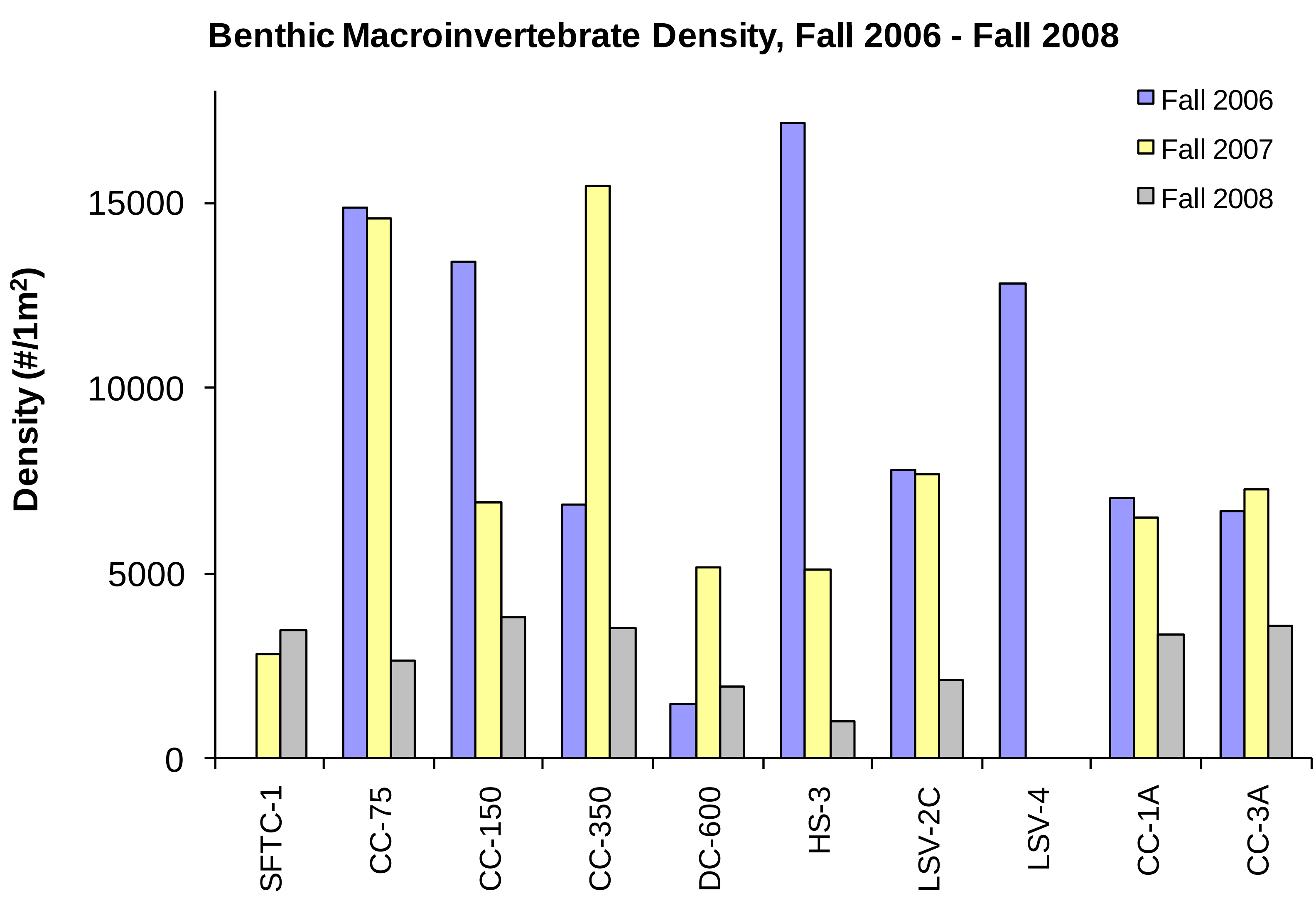

Figure 21
Benthic Macroinvertebrate Density, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC CHK: SMC

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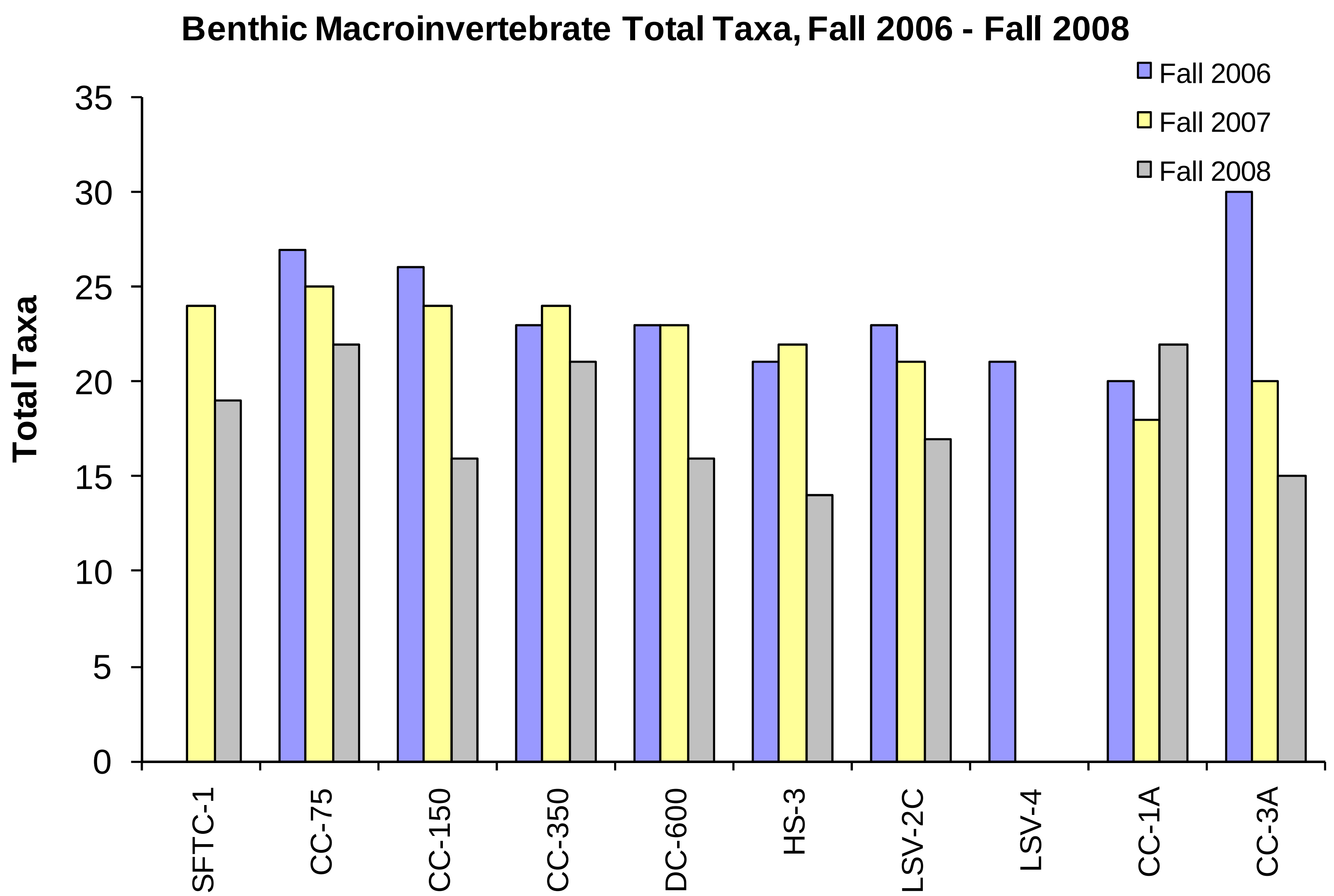

Figure 22
Benthic Macroinvertebrate Total Taxa, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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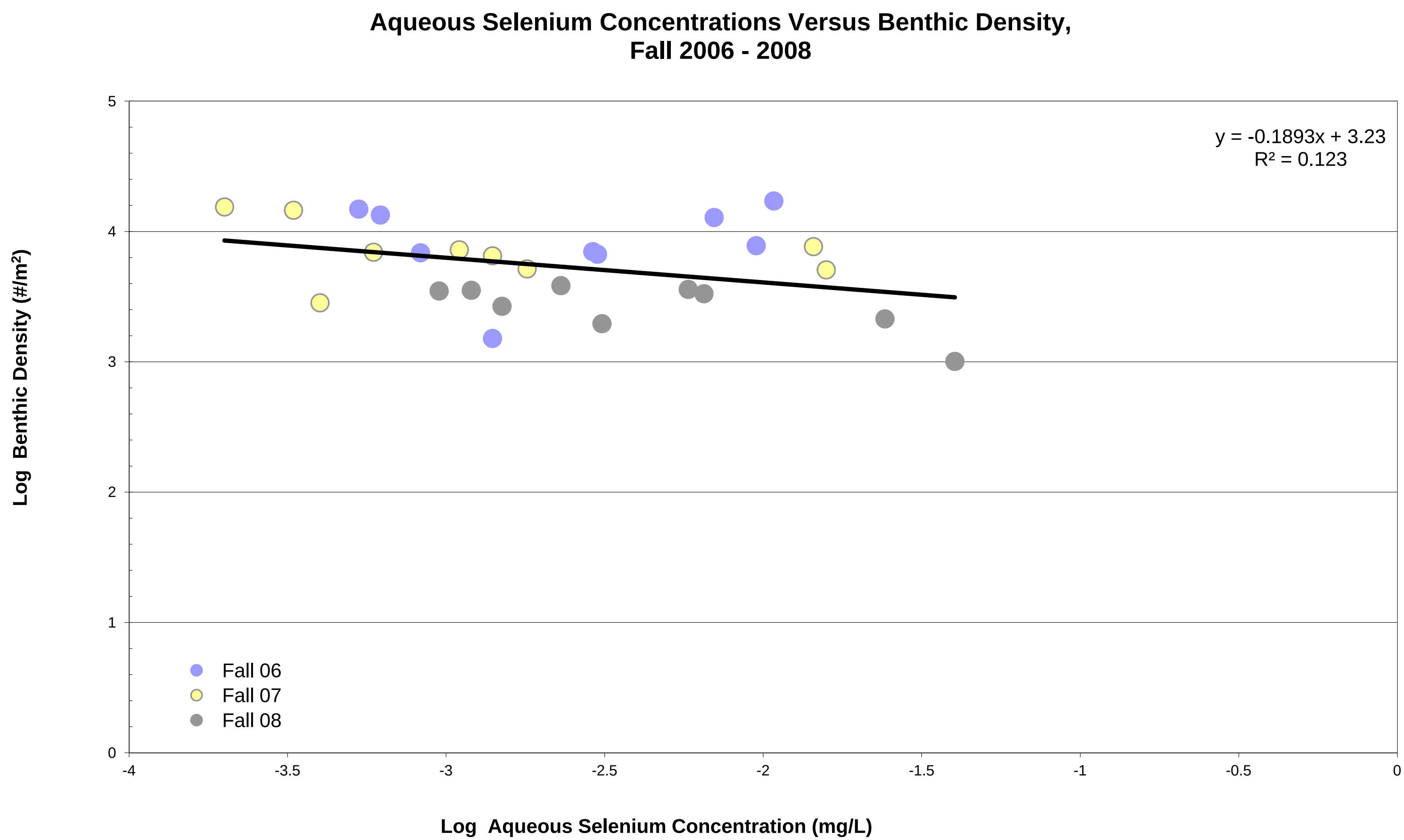

Figure 23
Aqueous Selenium Concentrations Versus Benthic Density, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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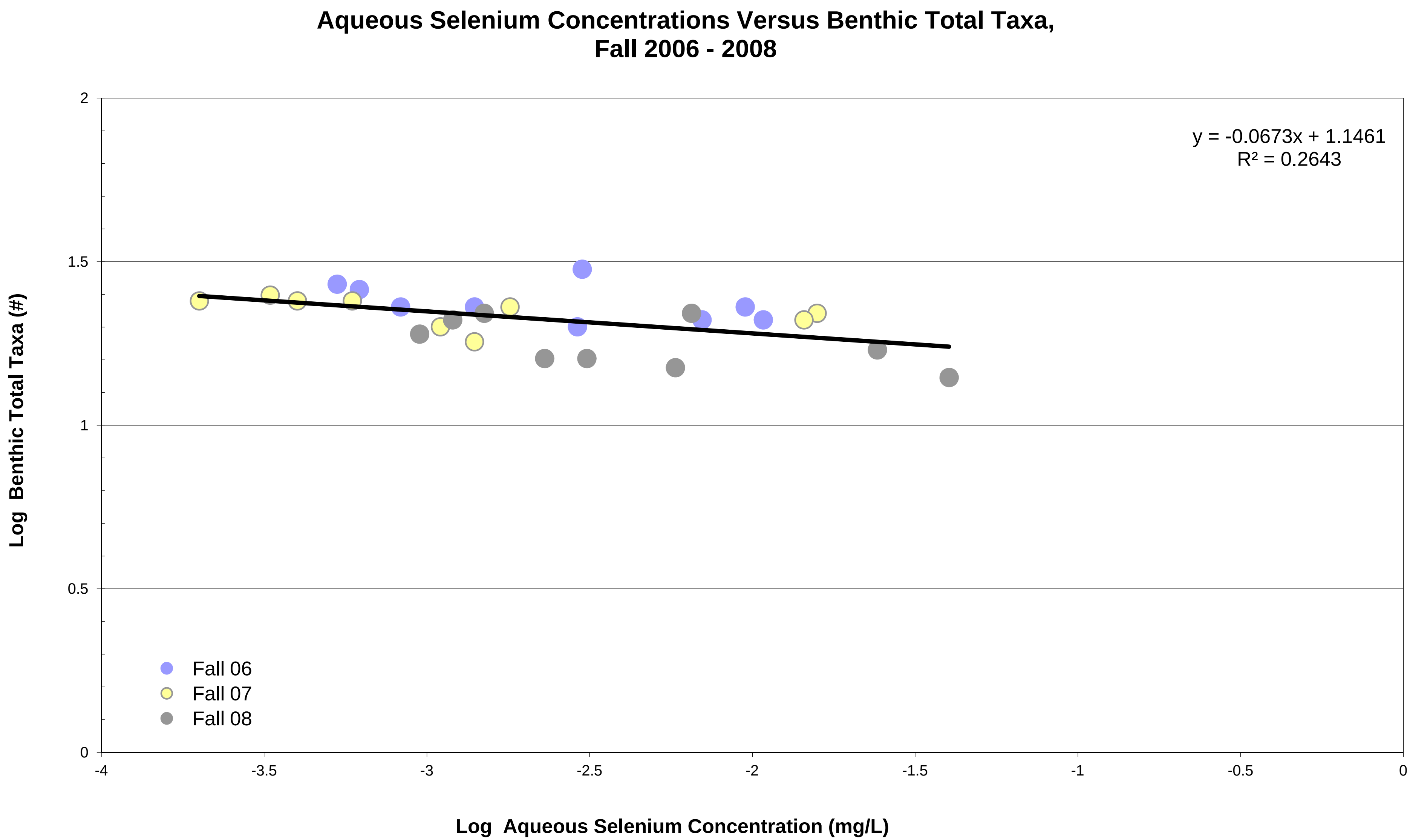

Figure 24
Aqueous Selenium Concentrations Versus Benthic Total Taxa, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

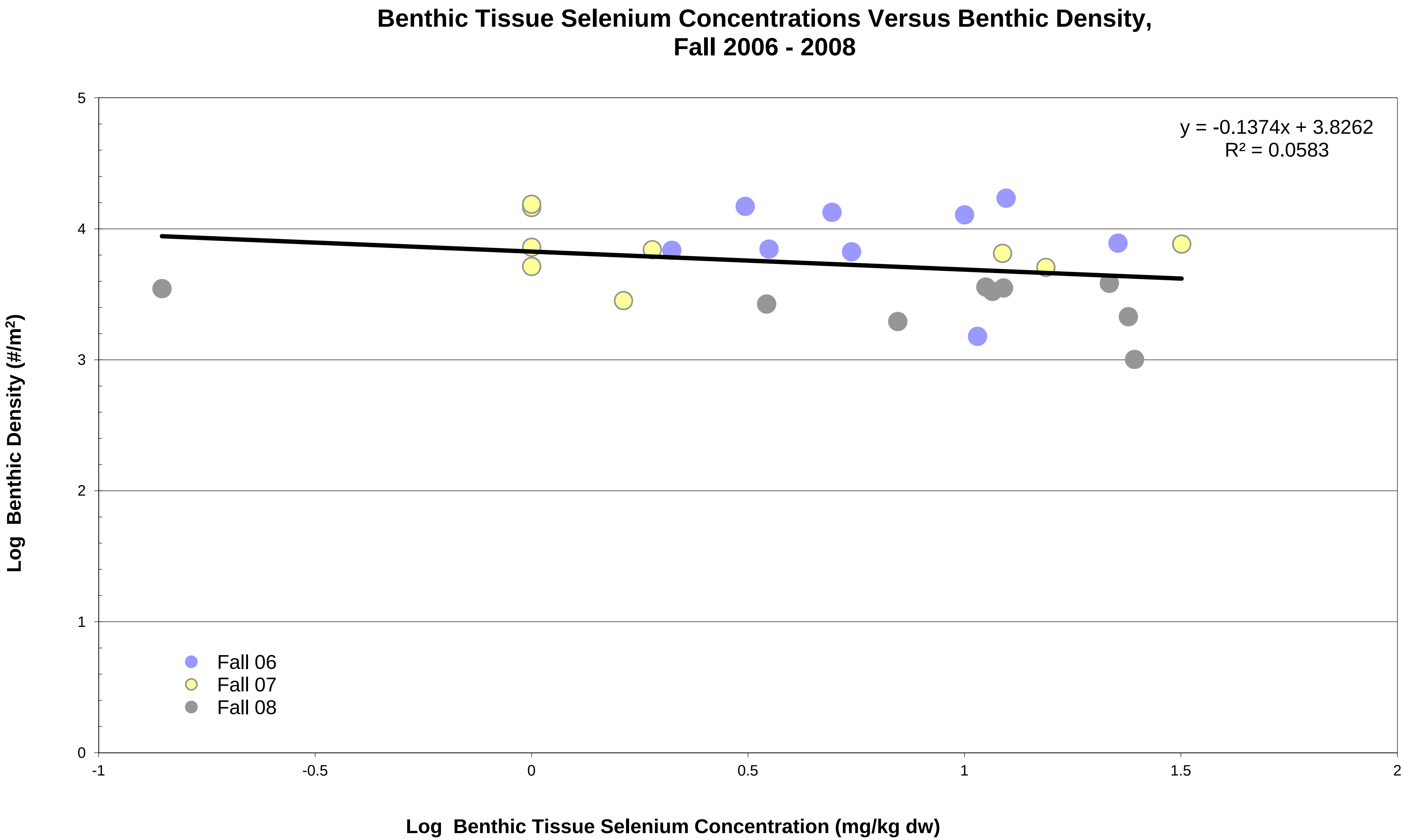

Figure 25
Benthic Tissue Selenium Concentrations Versus Benthic Density, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

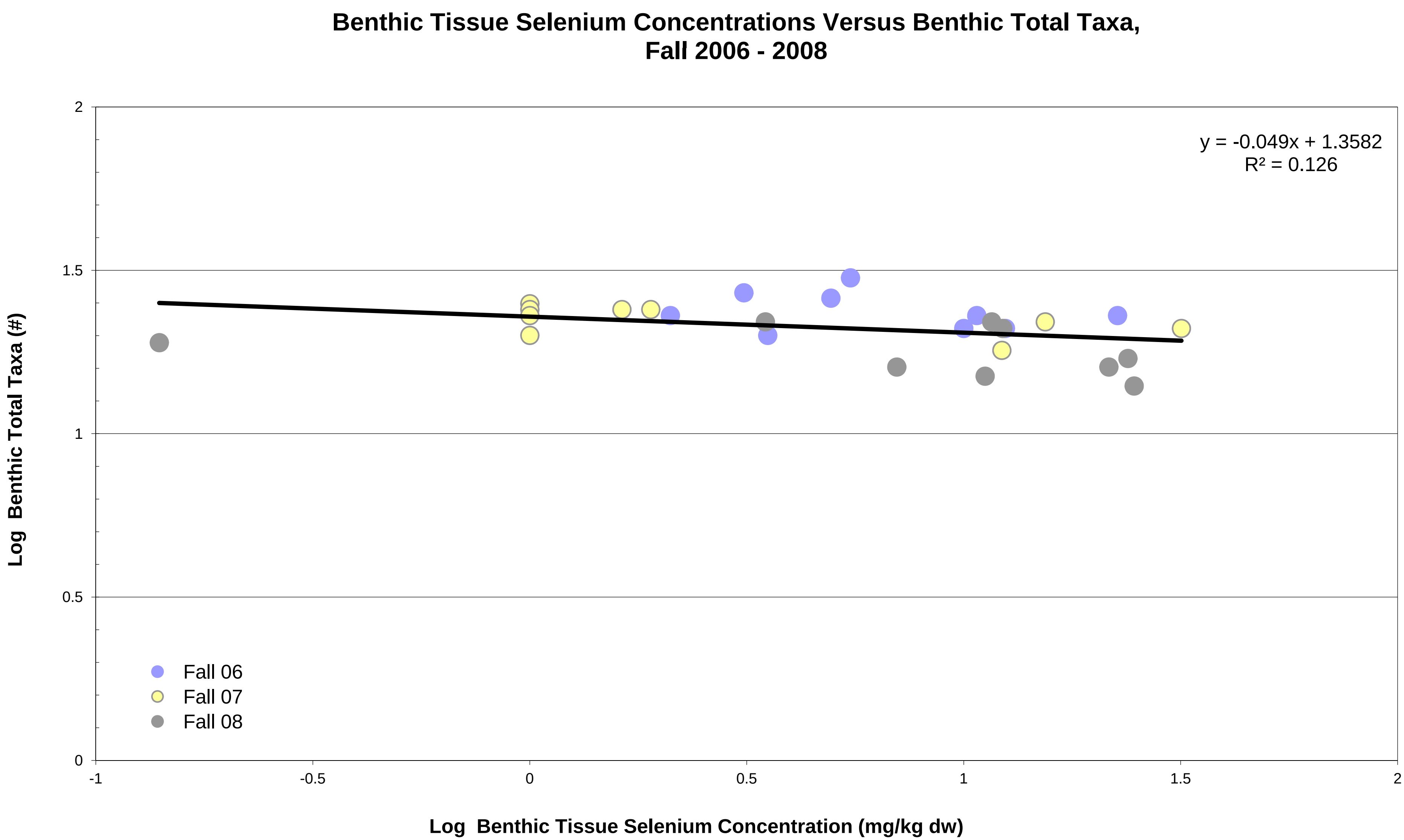

Figure 26
Benthic Tissue Selenium Concentrations Versus Benthic Total Taxa, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

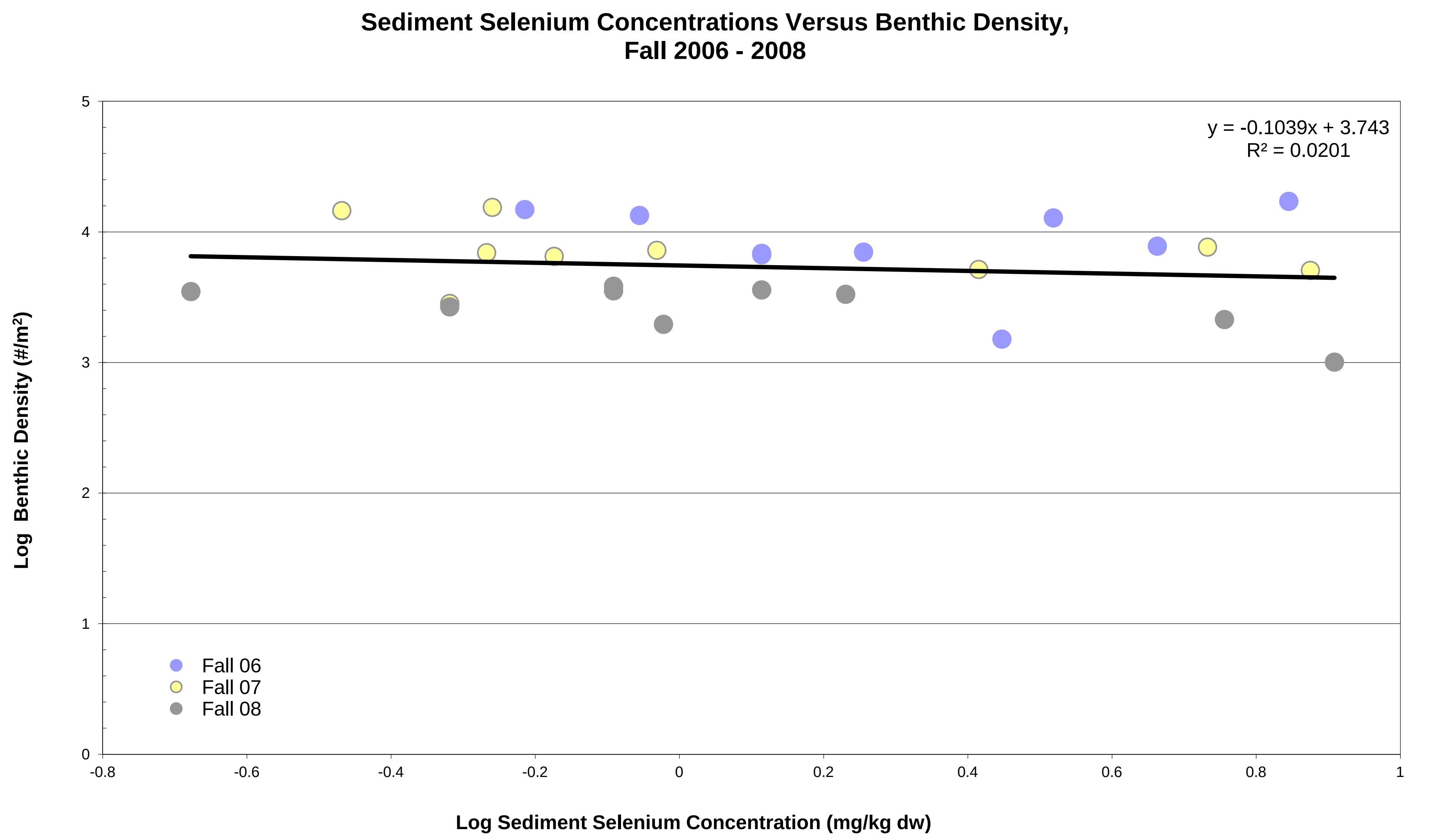

Figure 27
Sediment Selenium Concentrations Versus Benthic Density, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

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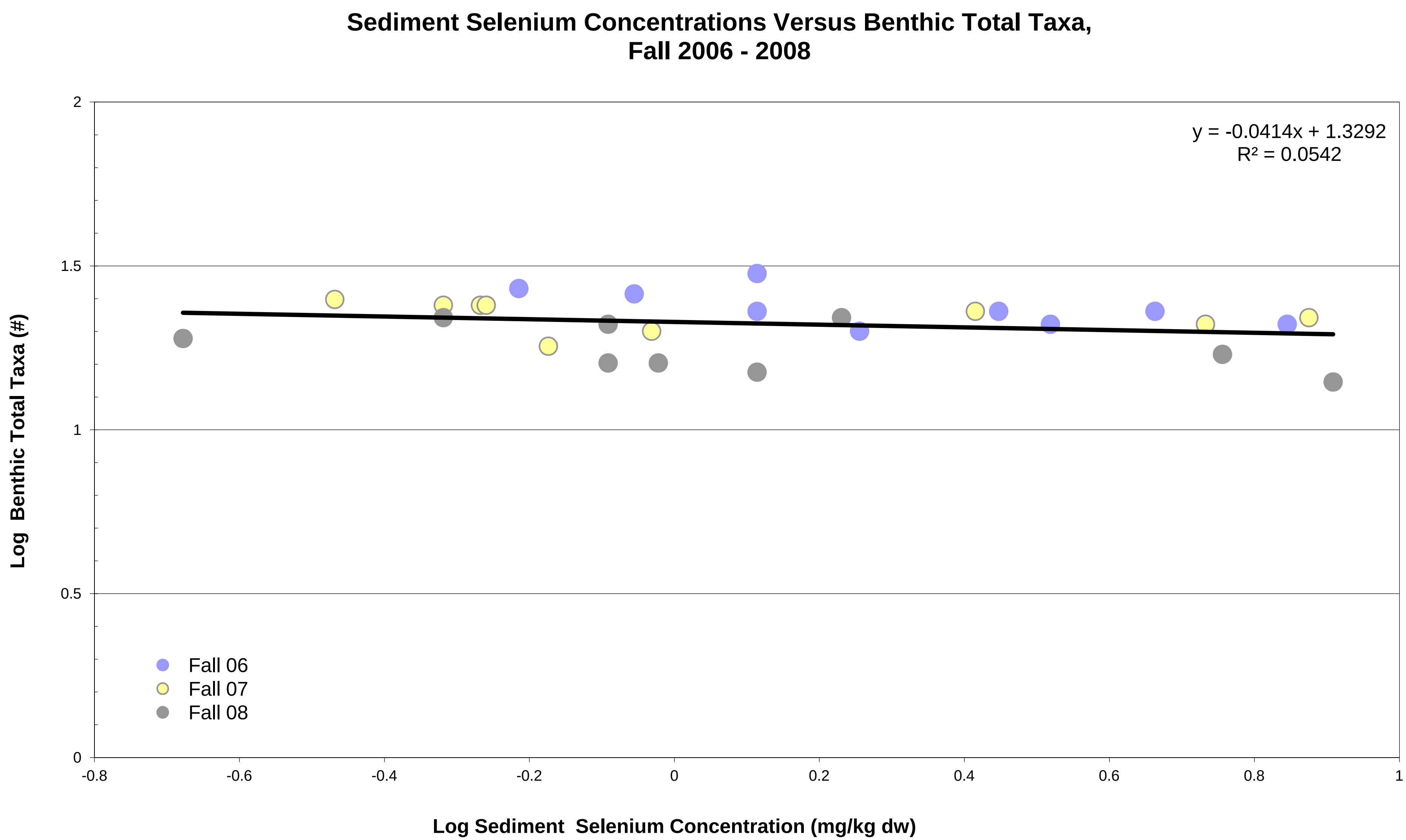

Figure 28
Sediment Selenium Concentrations Versus Benthic Total Taxa, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

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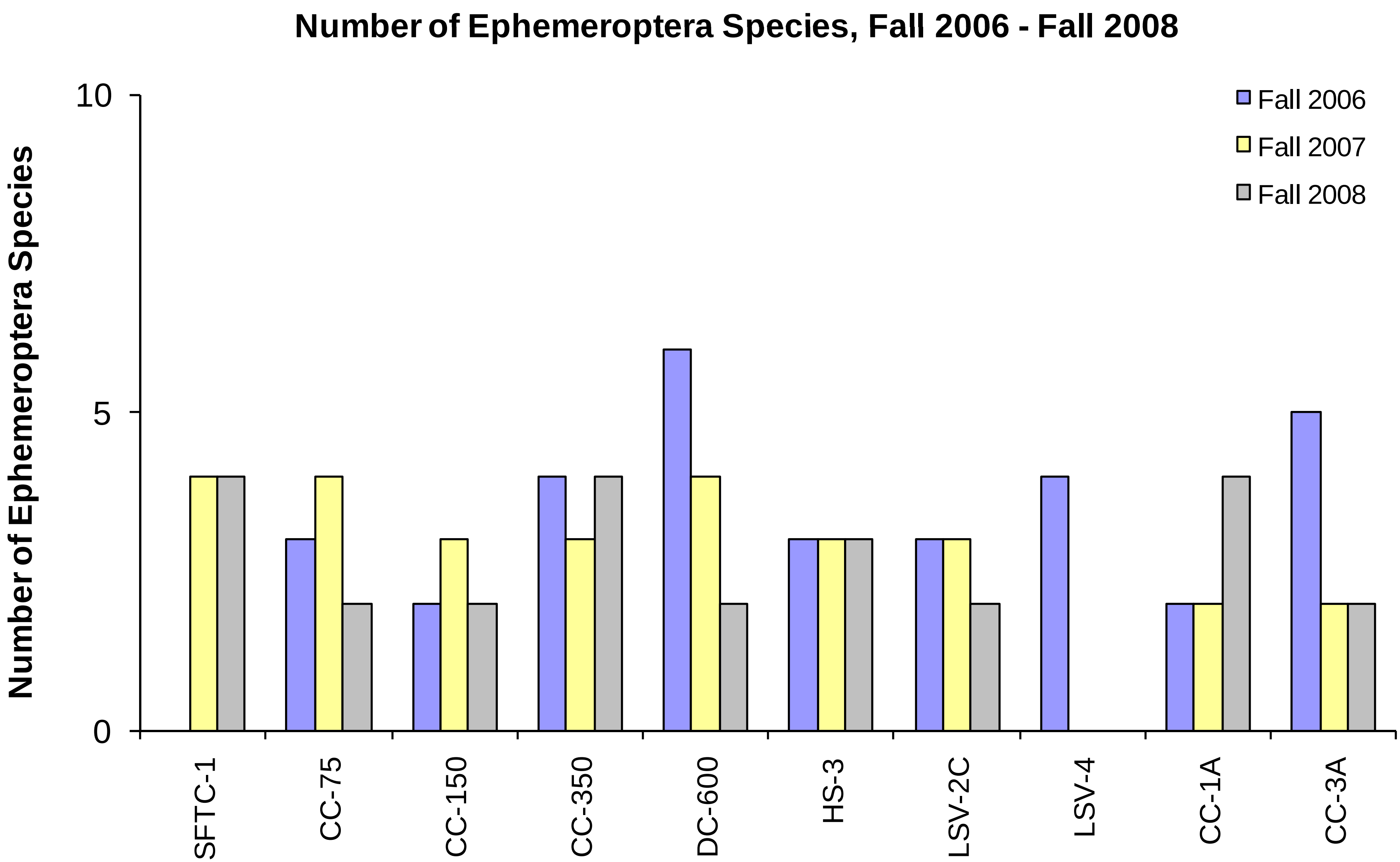

Figure 29
Number of Ephemeroptera Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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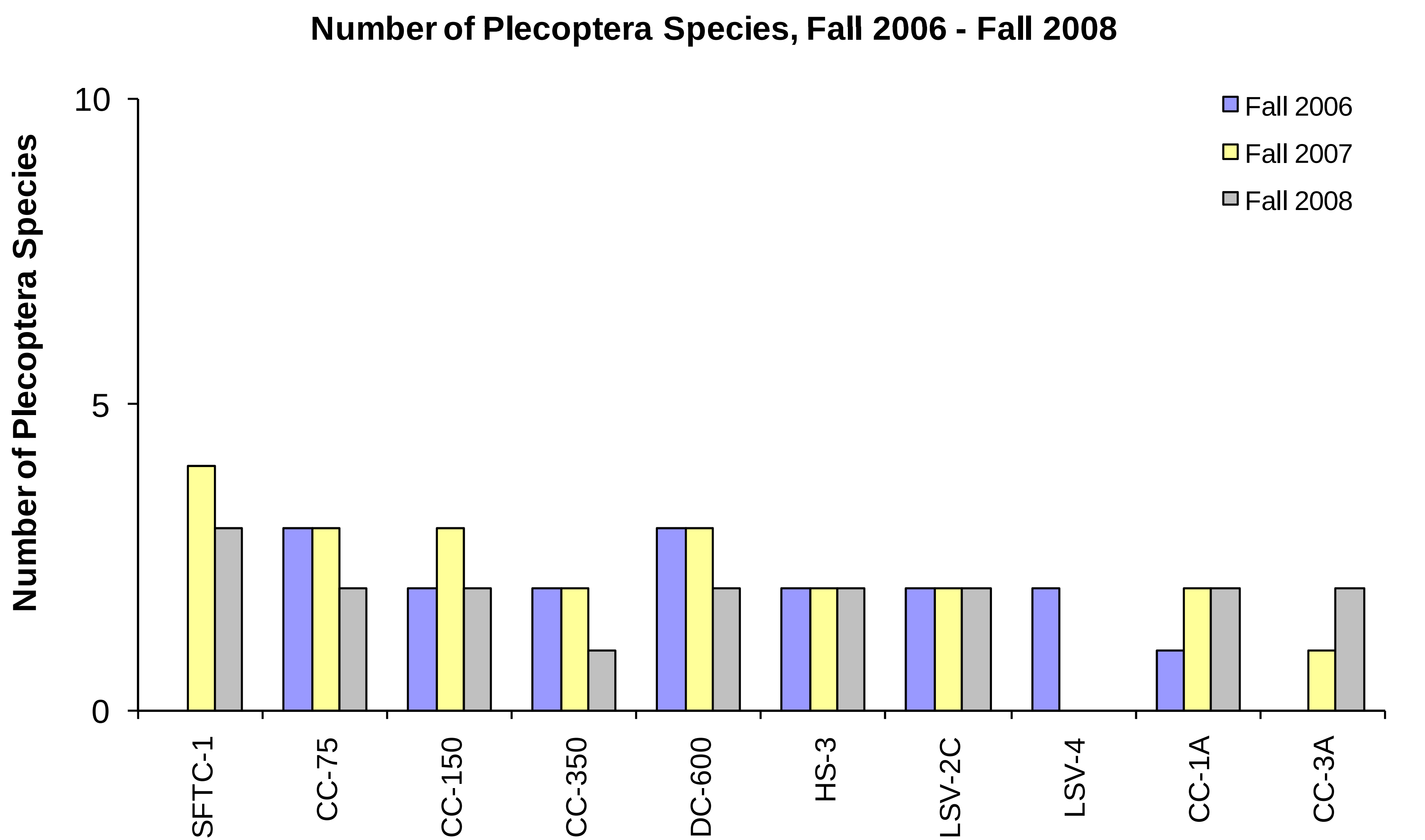

Figure 30
Number of Plecoptera Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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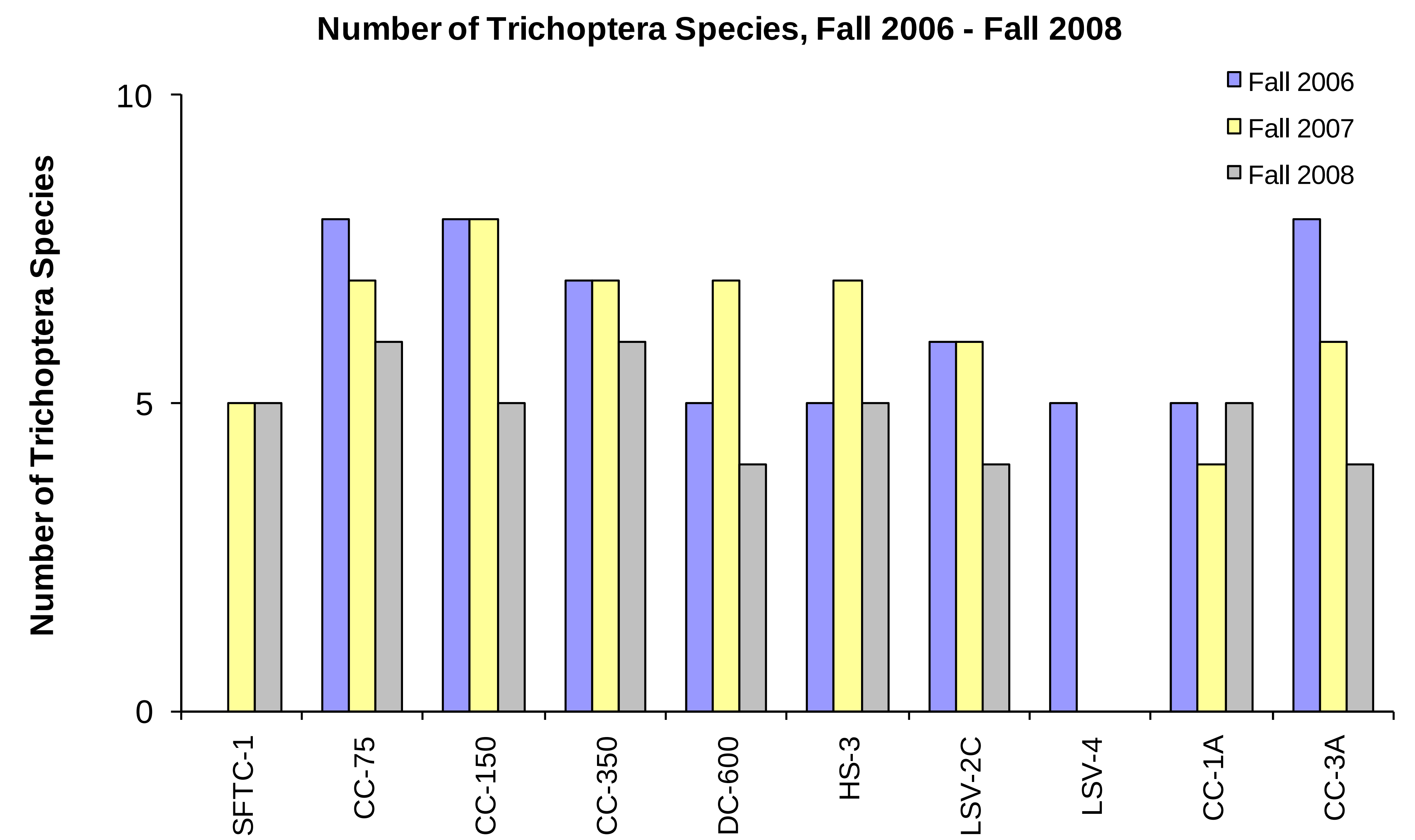

Figure 31
Number of Trichoptera Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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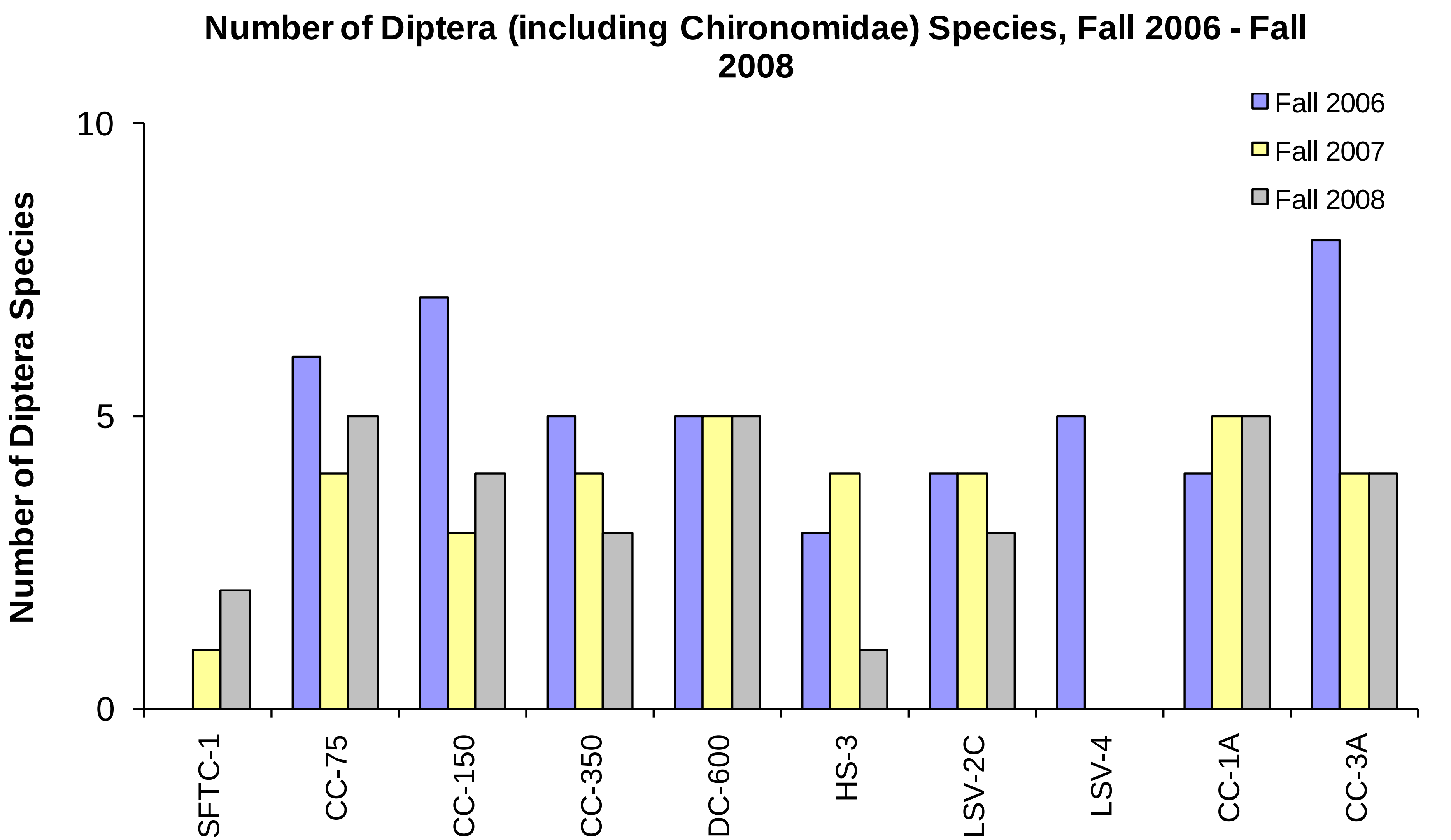

Figure 32
Number of Diptera (including Chironomidae) Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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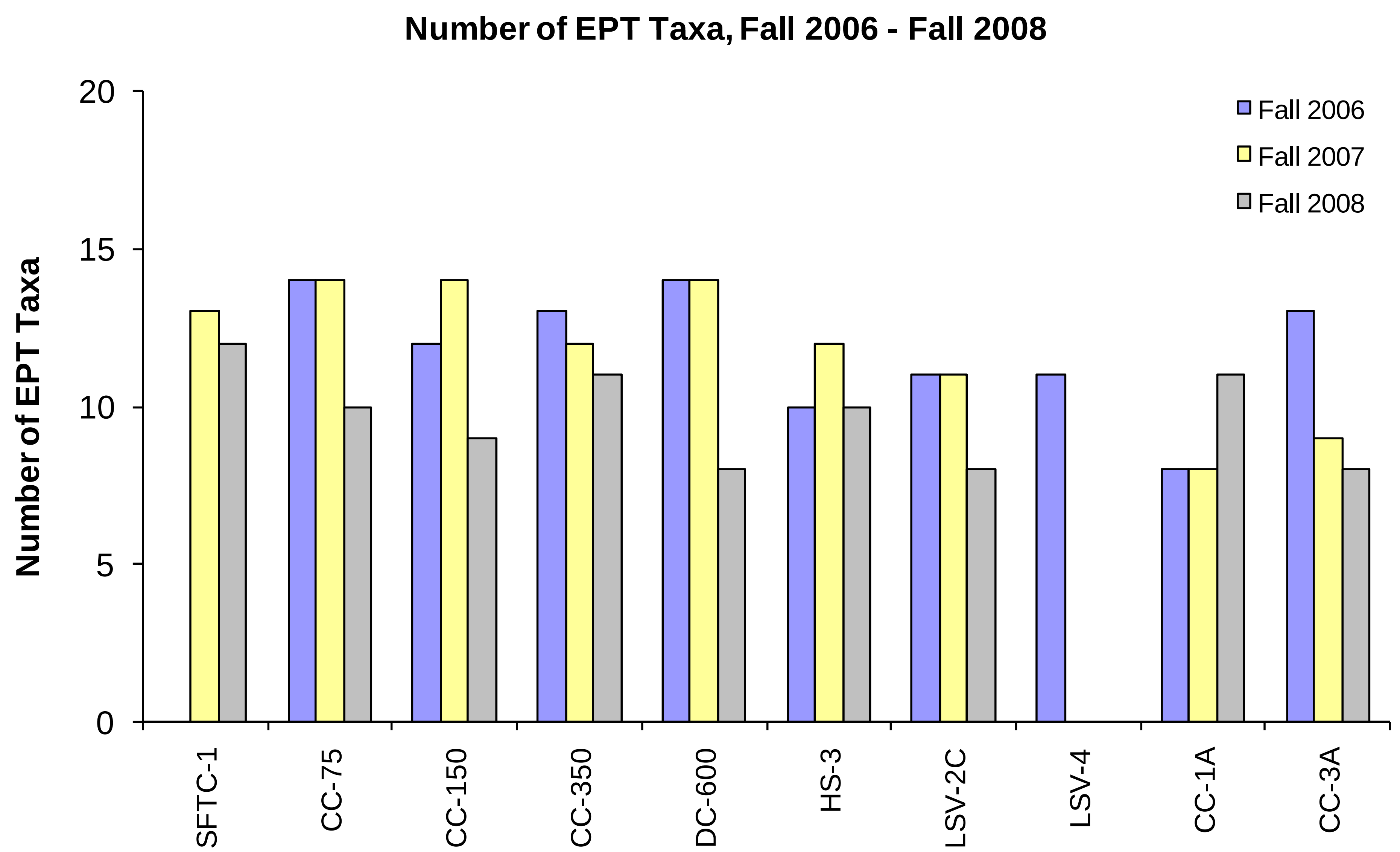

Figure 33
Number of EPT Taxa, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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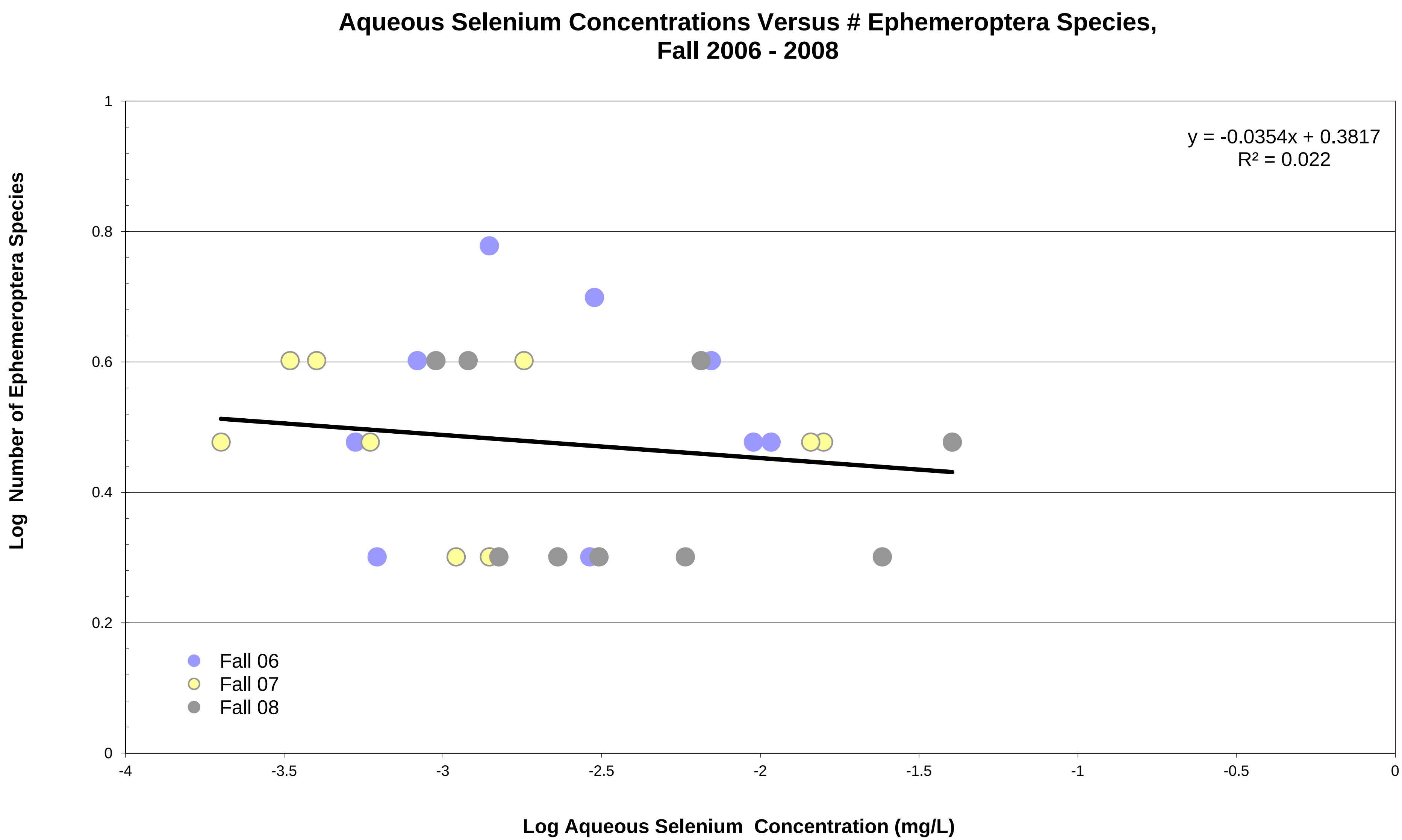

Figure 34
Aqueous Selenium Concentrations Versus Number of Ephemeroptera Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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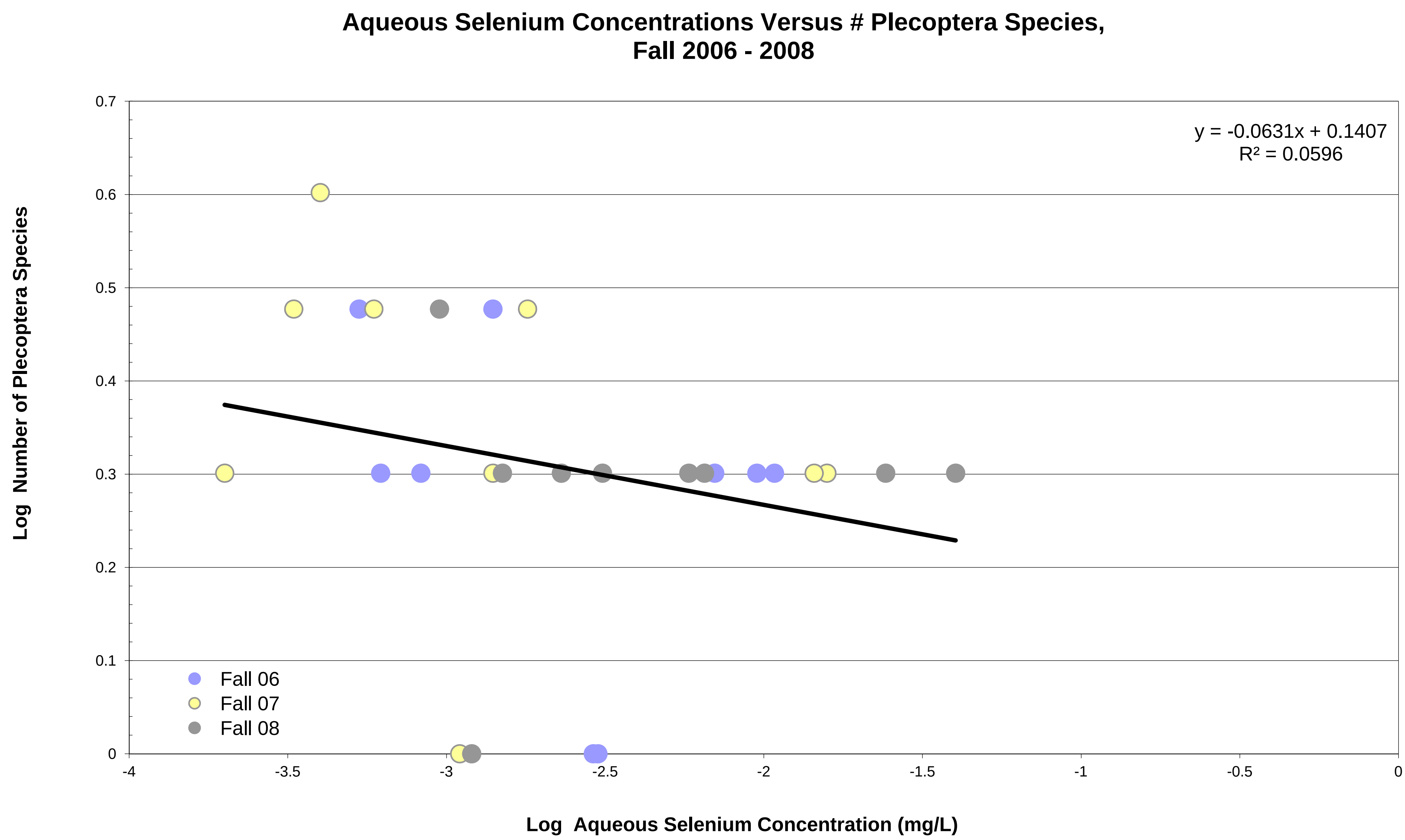

Figure 35
Aqueous Selenium Concentrations Versus Number of Plecoptera Species,
Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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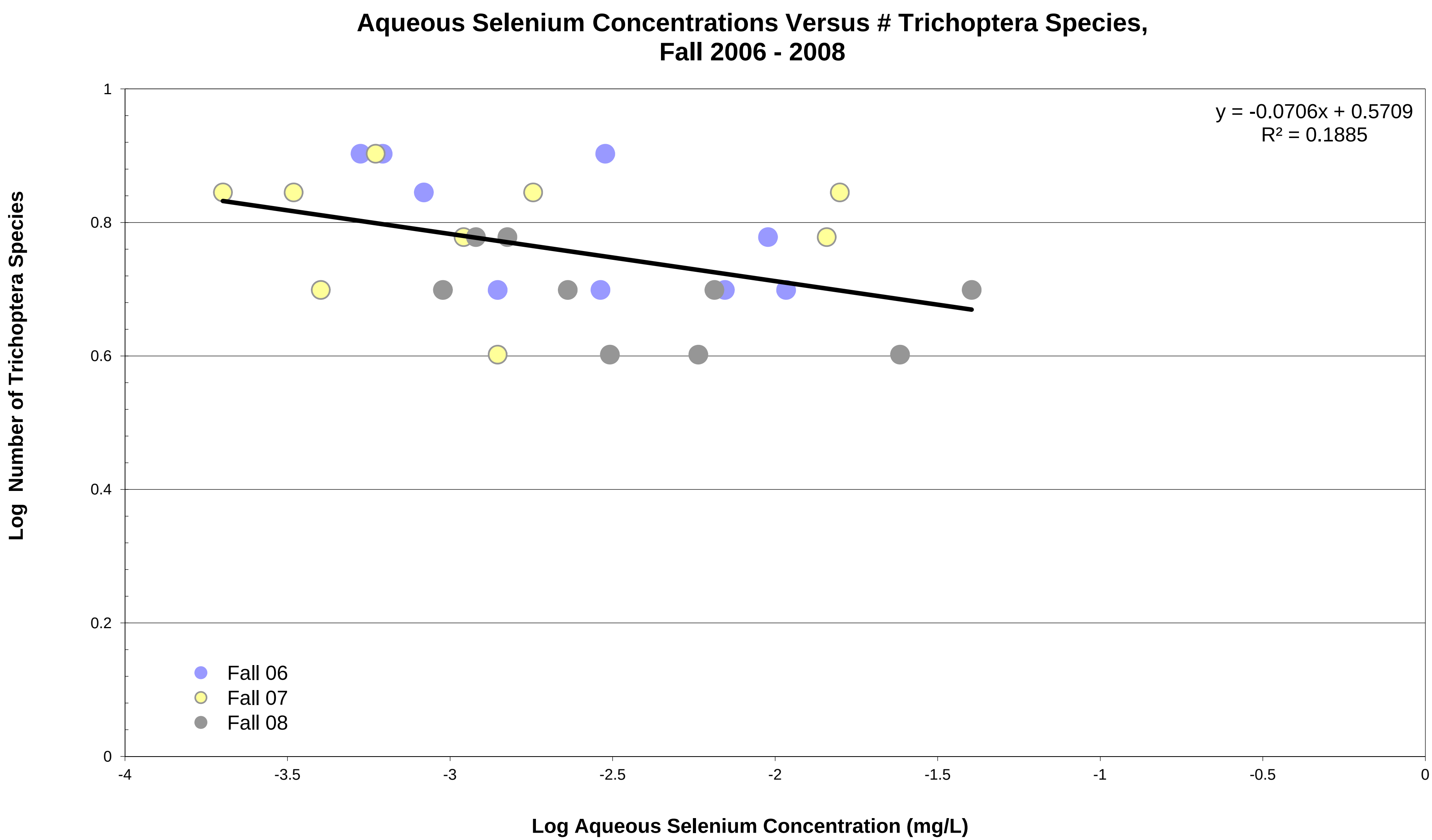

Figure 36
Aqueous Selenium Concentrations Versus Number of Trichoptera Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

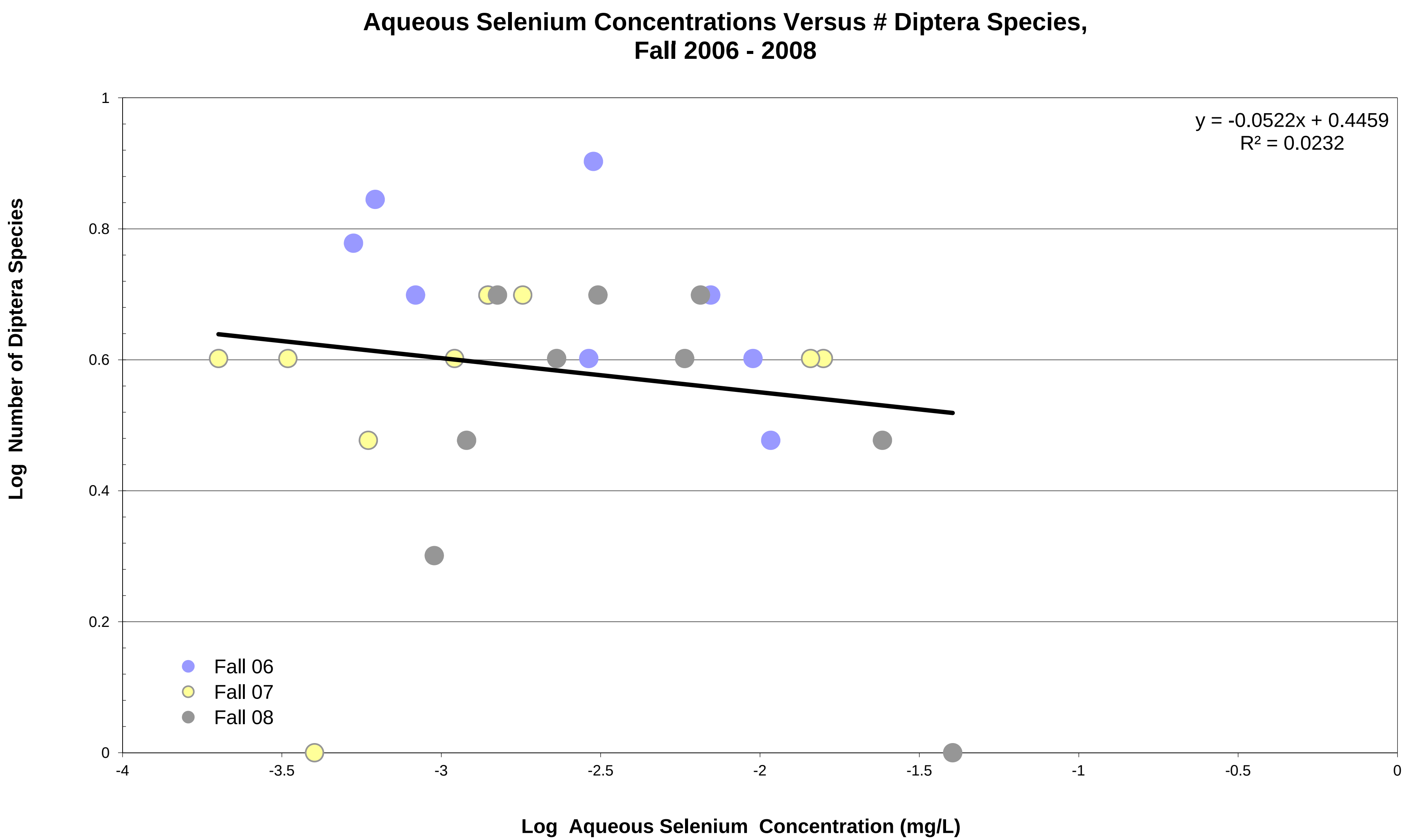

Figure 37
Aqueous Selenium Concentrations Versus Number of Diptera Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

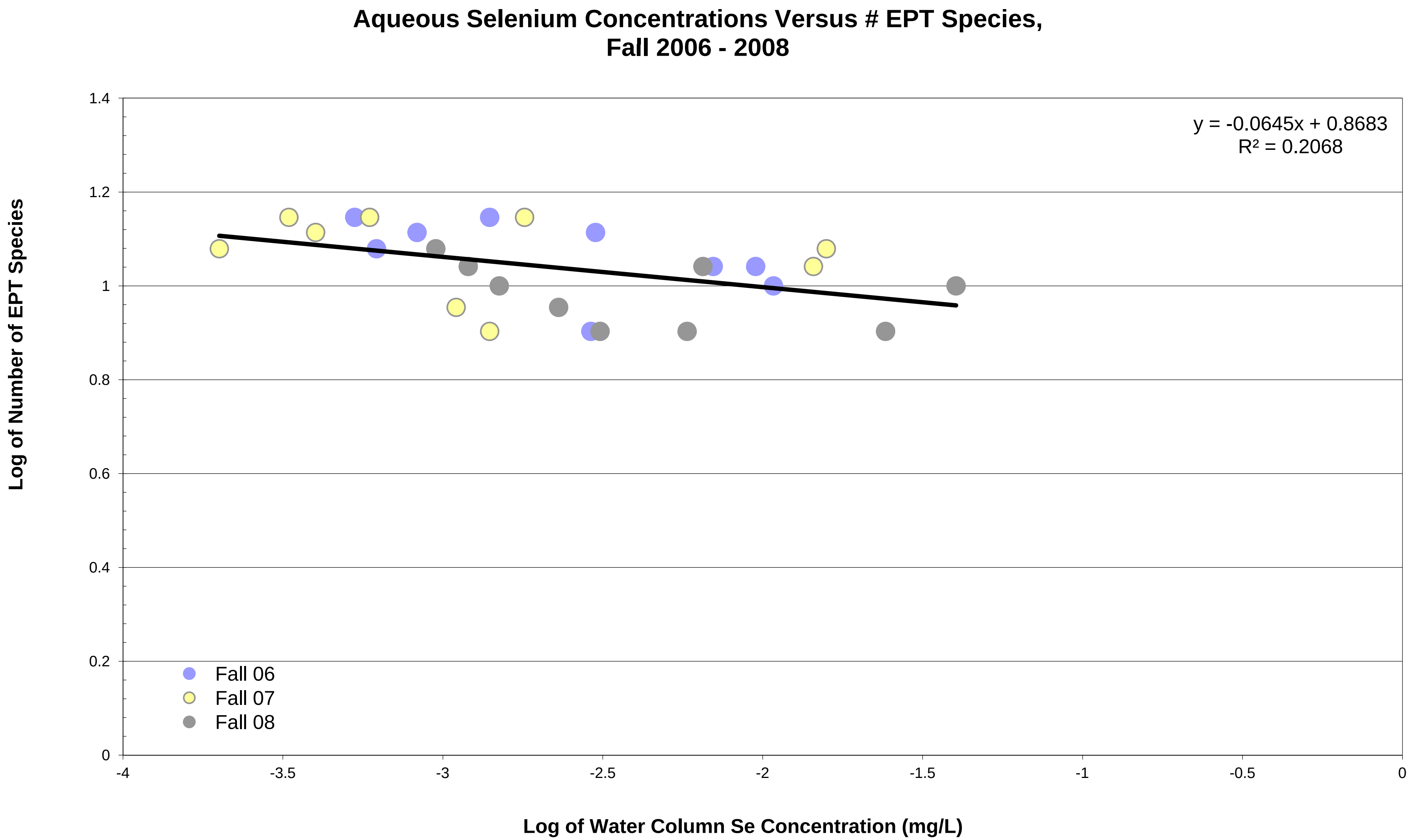

Figure 38
Aqueous Selenium Concentrations Versus Number of EPT Species,
Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

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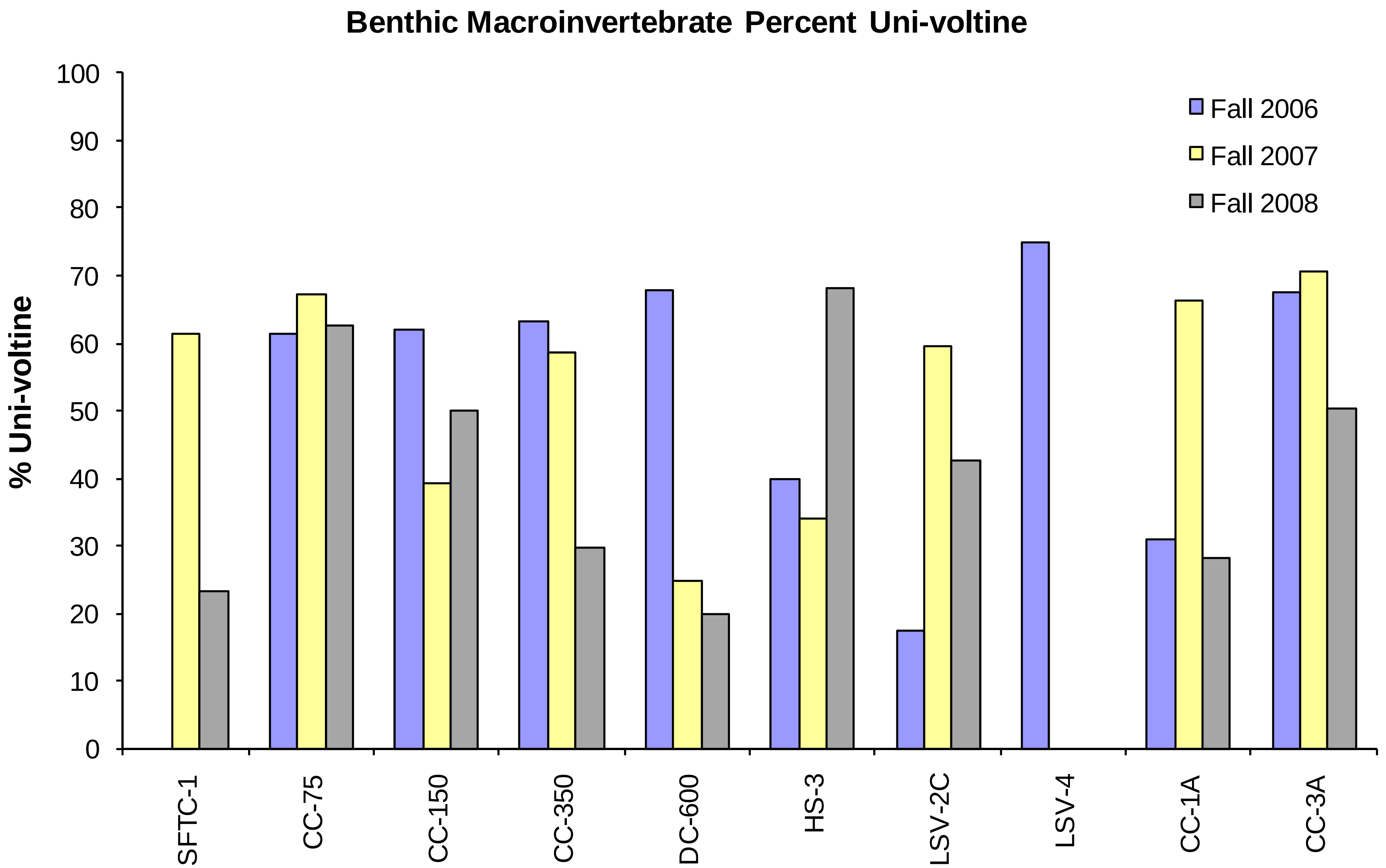

Figure 39
Benthic Macroinvertebrate Percent Uni-voltine,
Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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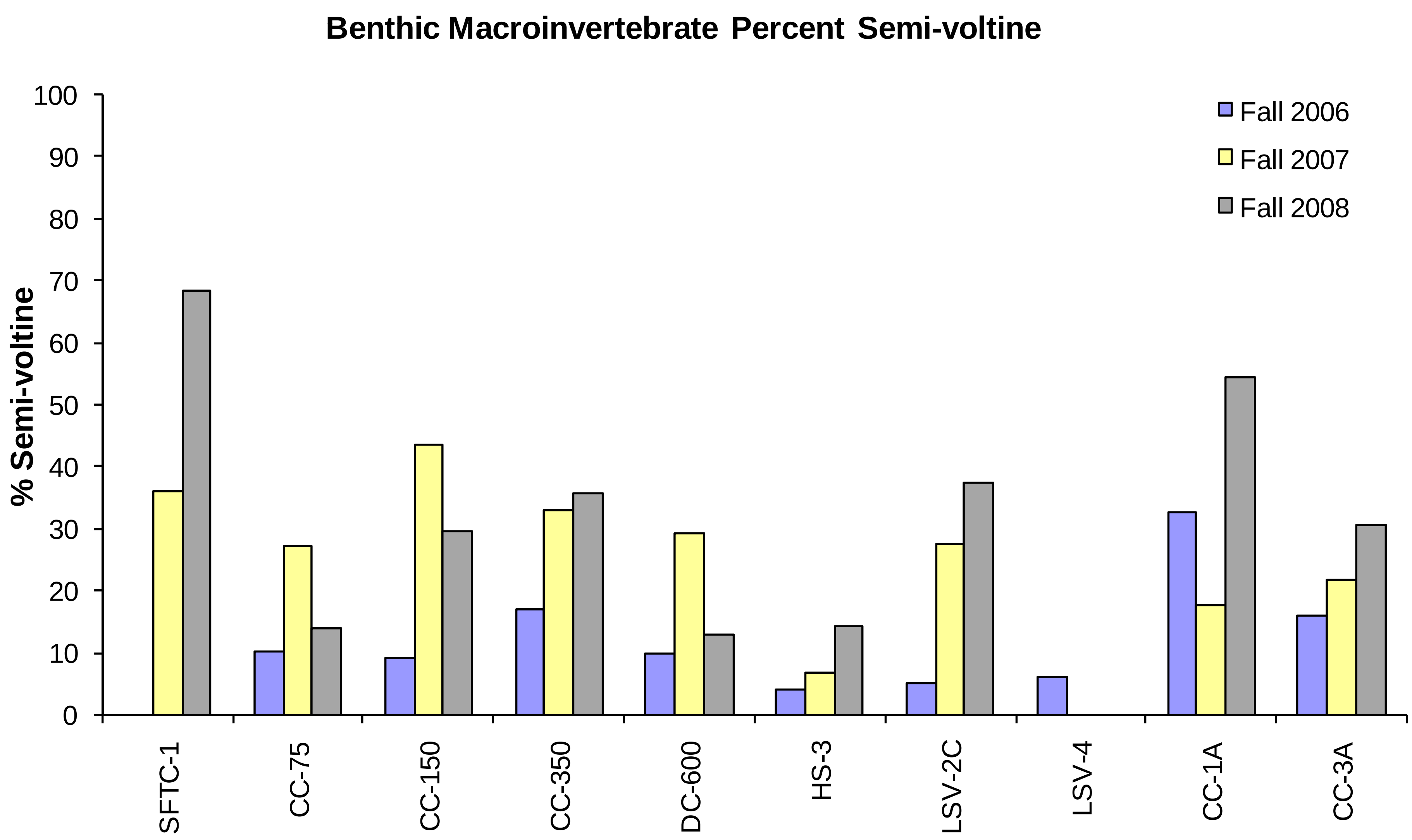

Figure 40
Benthic Macroinvertebrate Percent Semi-voltine,
Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

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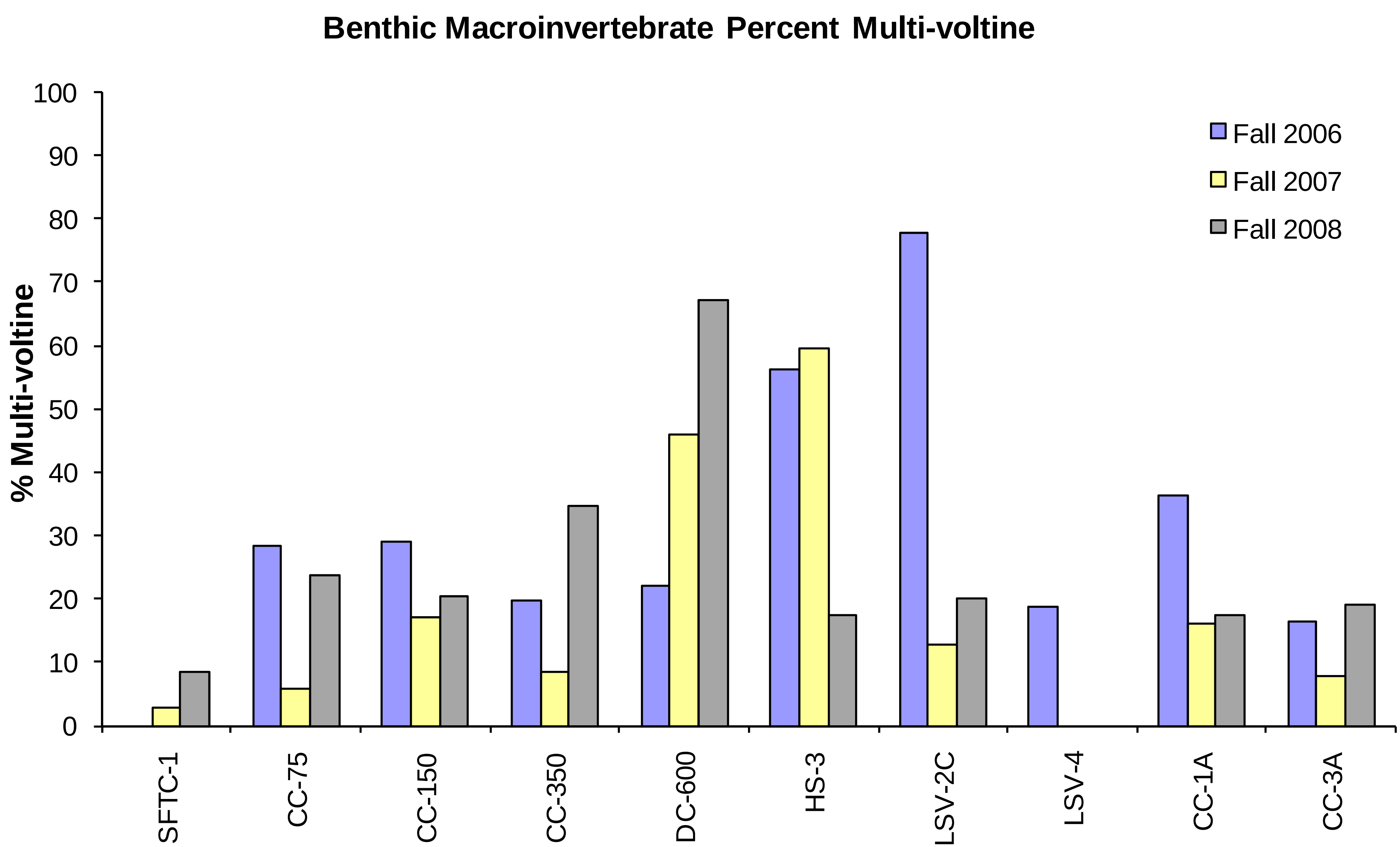

Figure 41
Benthic Macroinvertebrate Percent Multi-voltine,
Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

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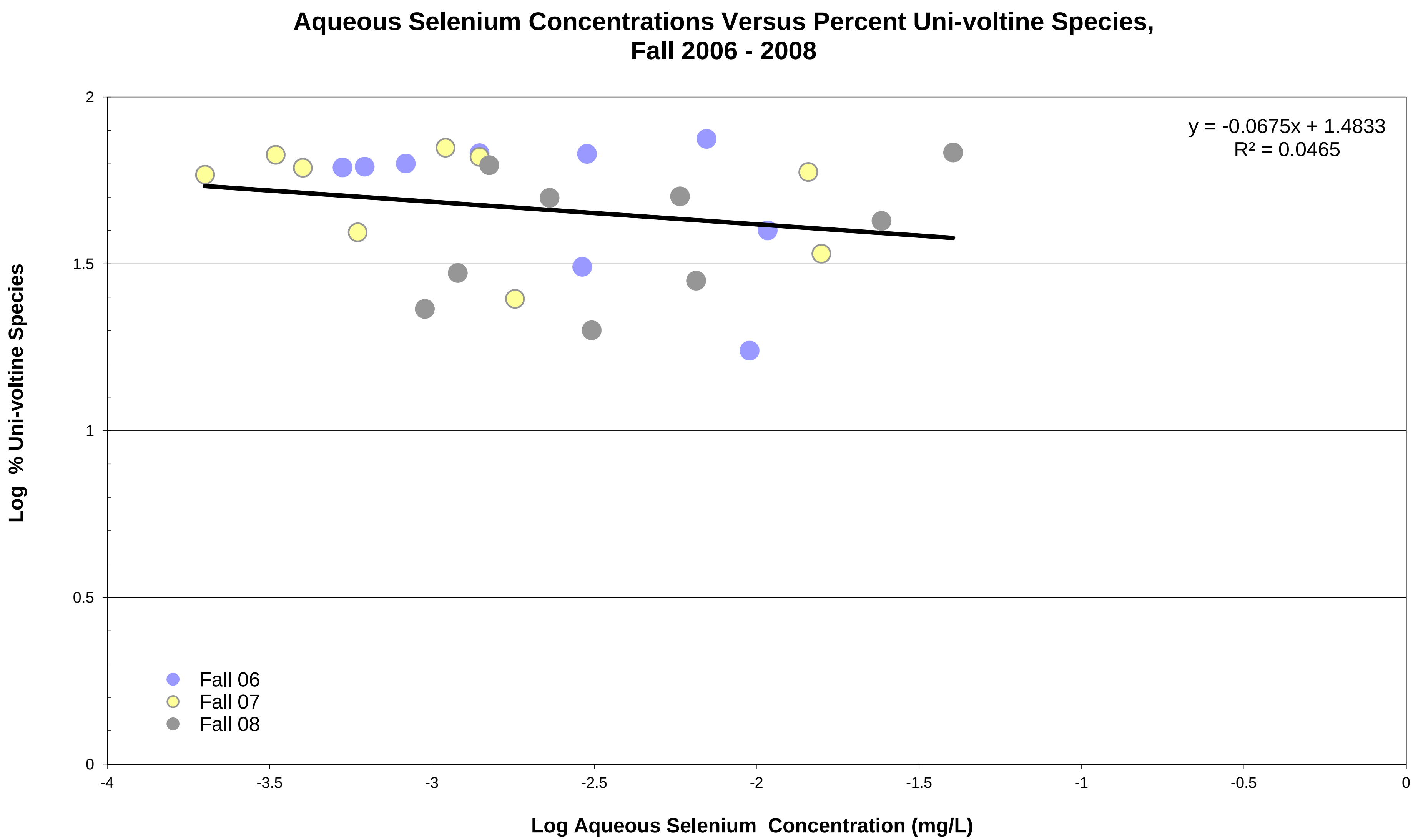

Figure 42
Aqueous Selenium Concentrations Versus Percent Uni-voltine Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC CHK: SMC

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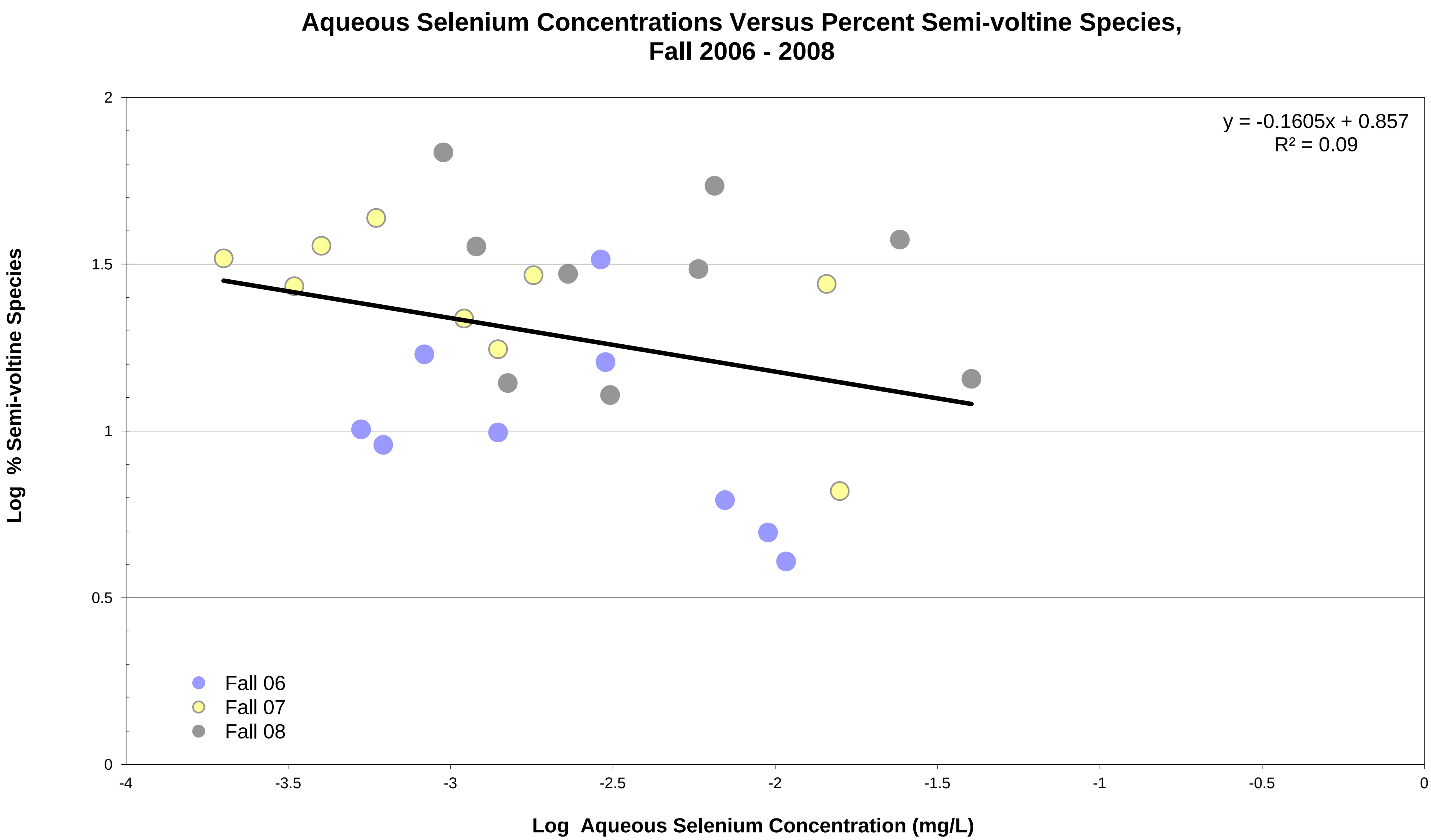


Figure 43
Aqueous Selenium Concentrations Versus Percent Semi-voltine Species, Fall 2006 – Fall 2008

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

Aqueous Selenium Concentrations Versus Percent Multi-voltine Species, Fall 2006 - 2008

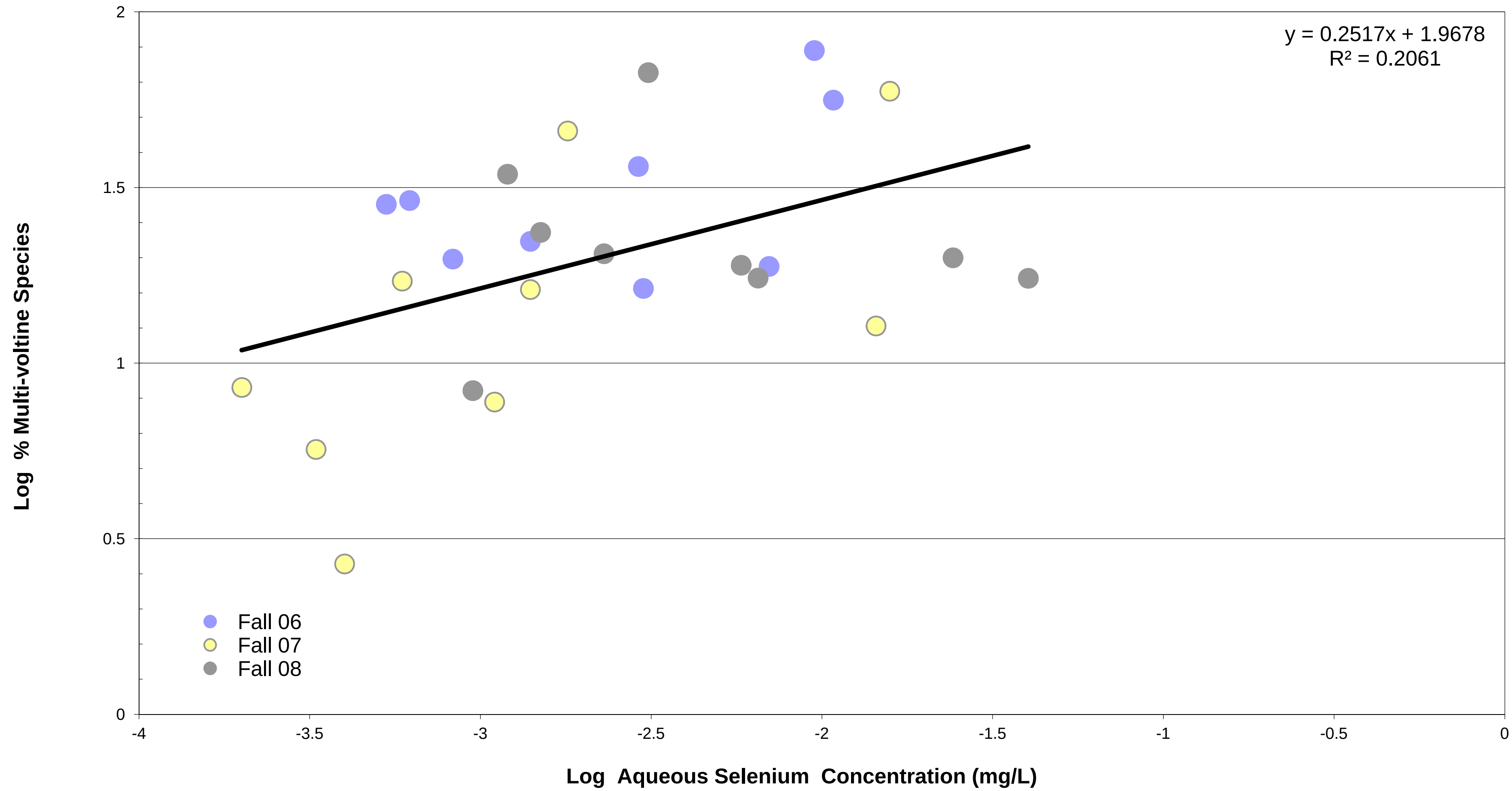


Figure 44
Aqueous Selenium Concentrations Versus Percent Multi-voltine Species, Fall 2006 – Fall 2008

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

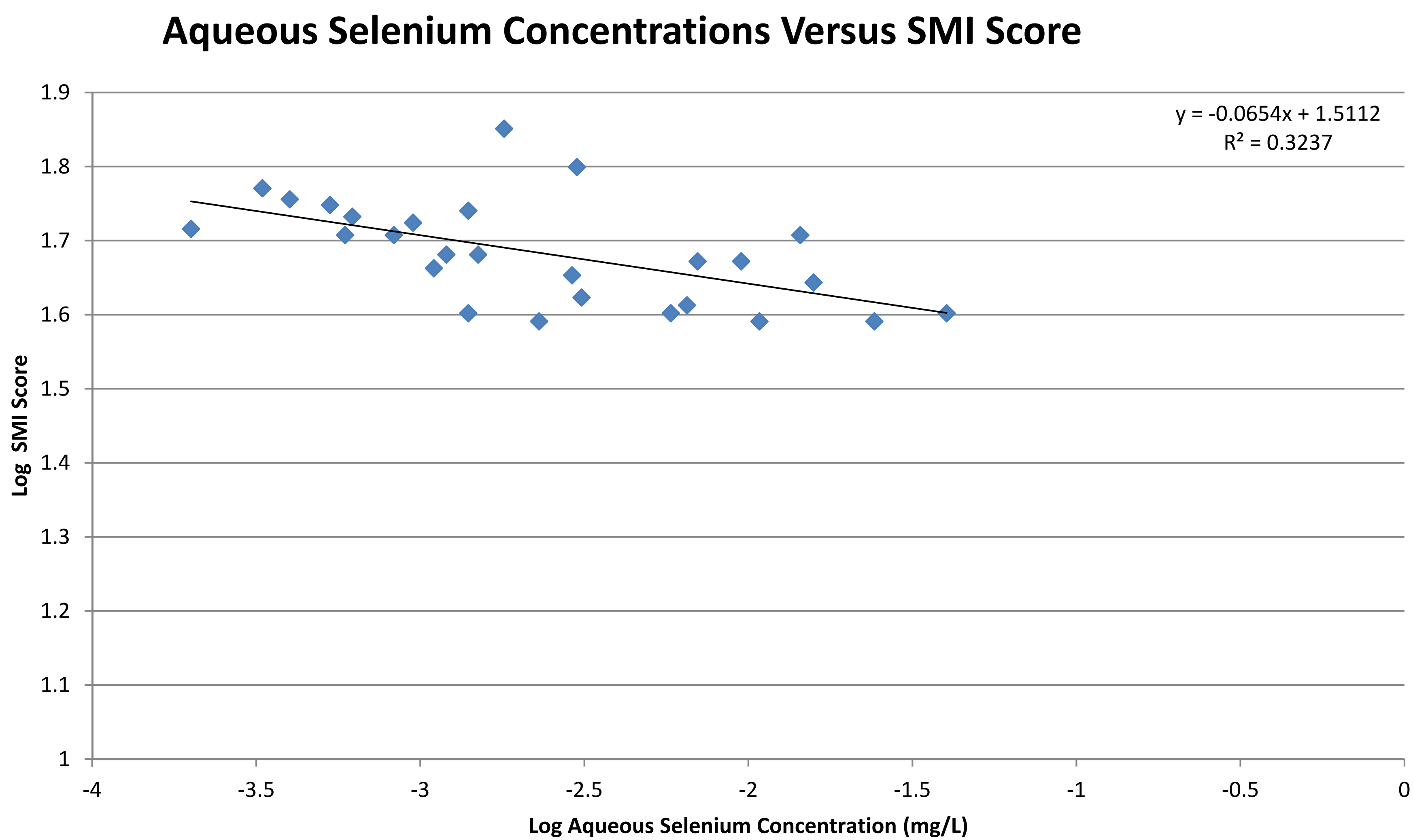


Figure 45
Aqueous Selenium Concentrations Versus SMI Score

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012	
REV: 0	BY: SMC	CHK: SMC

FORMATION ENVIRONMENTAL

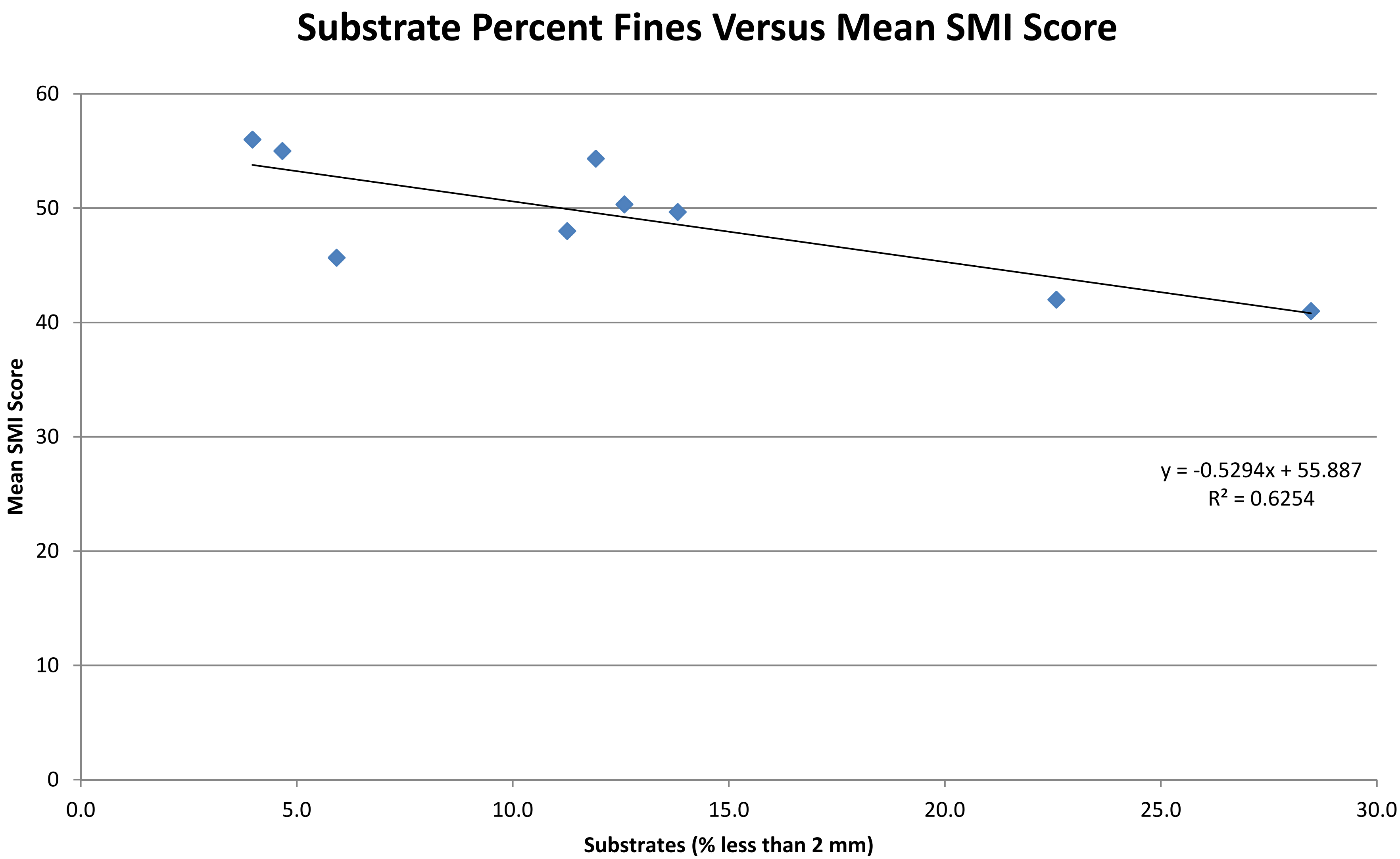


Figure 46
Substrate Percent Fines Versus Mean SMI Score

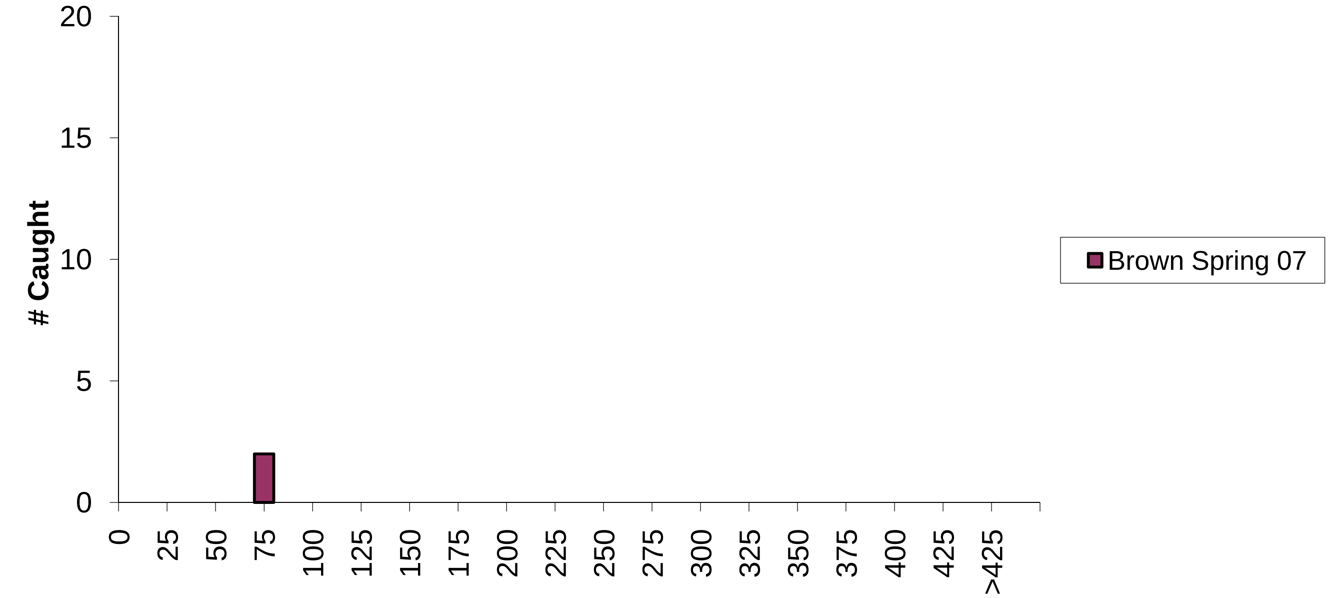
J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 0442-004-900.70	DATE: January 2012
REV: 0	BY: SMC / CHK: SMC

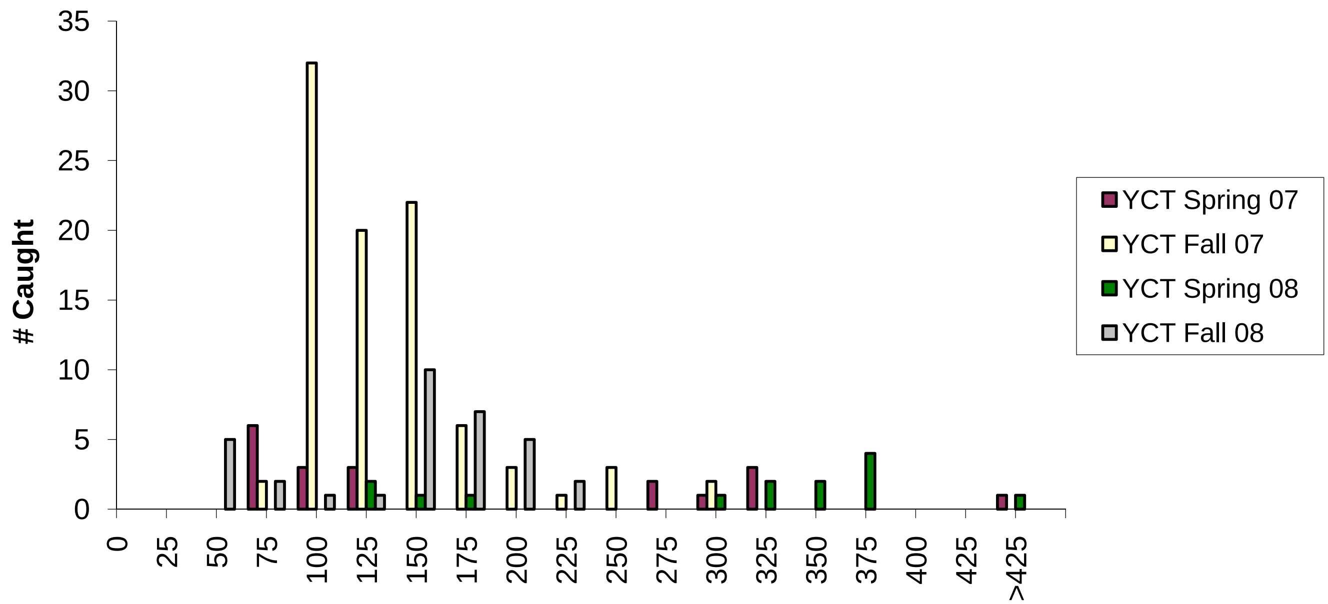
FORMATION ENVIRONMENTAL

ATTACHMENT 1
Length-Frequency Distribution for Trout

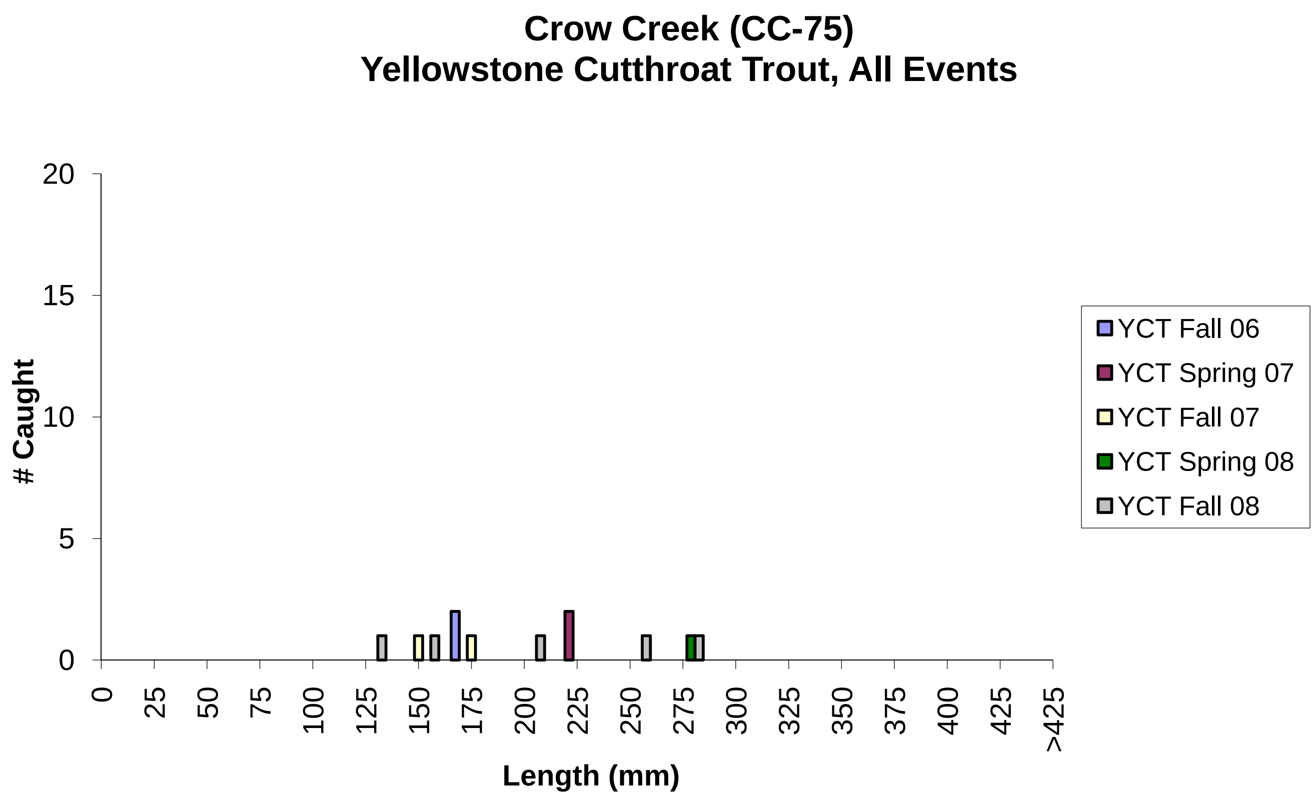
South Fork Tincup Creek (SFTC-1)
Brown Trout, All Events



South Fork Tincup Creek (SFTC-1)
Yellowstone Cutthroat Trout, All Events



Attachment 1 **Length-Frequency Distribution for Trout** **SFTC-1**	**J.R. Simplot Company** Site-Specific Selenium Criterion PRJ: 009-004.70 / DATE: June 2011 REV: 0 / CHK:SMC / BY:SMC FORMATION ENVIRONMENTAL

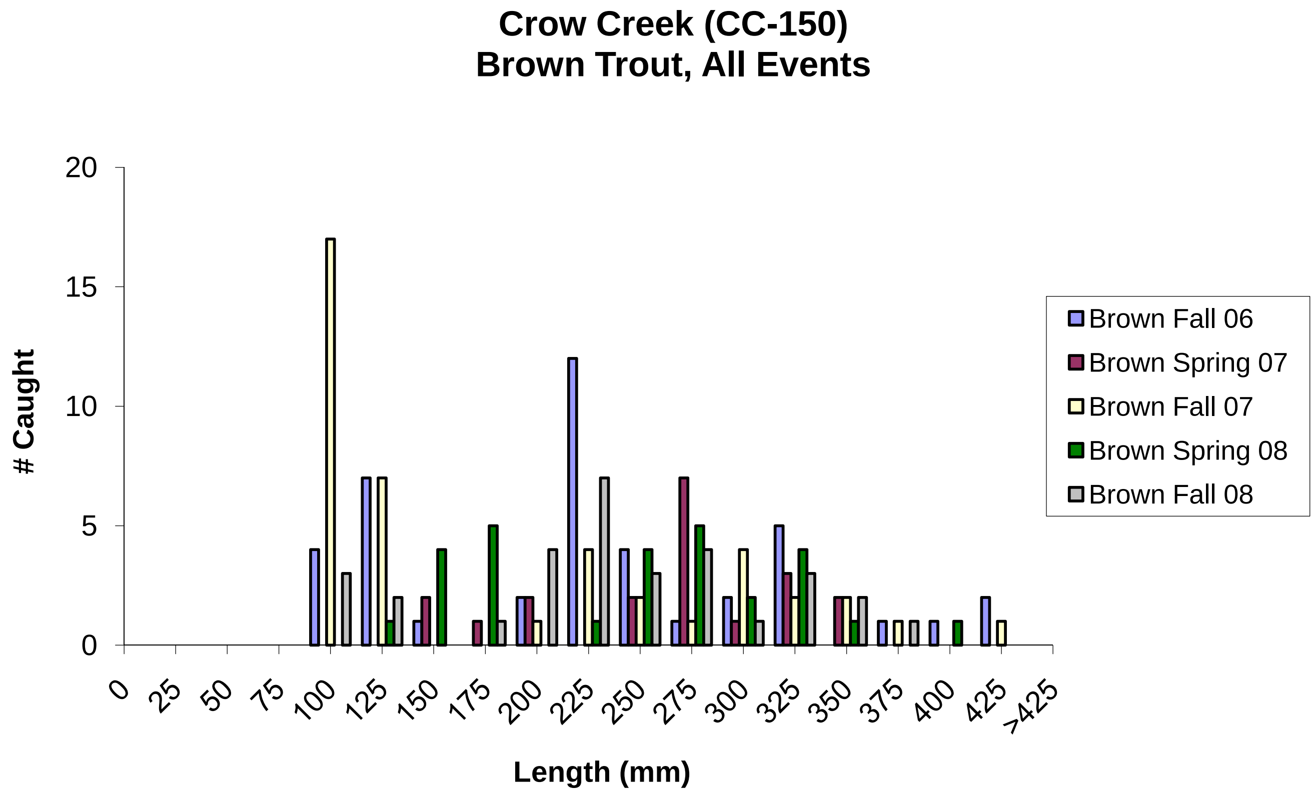


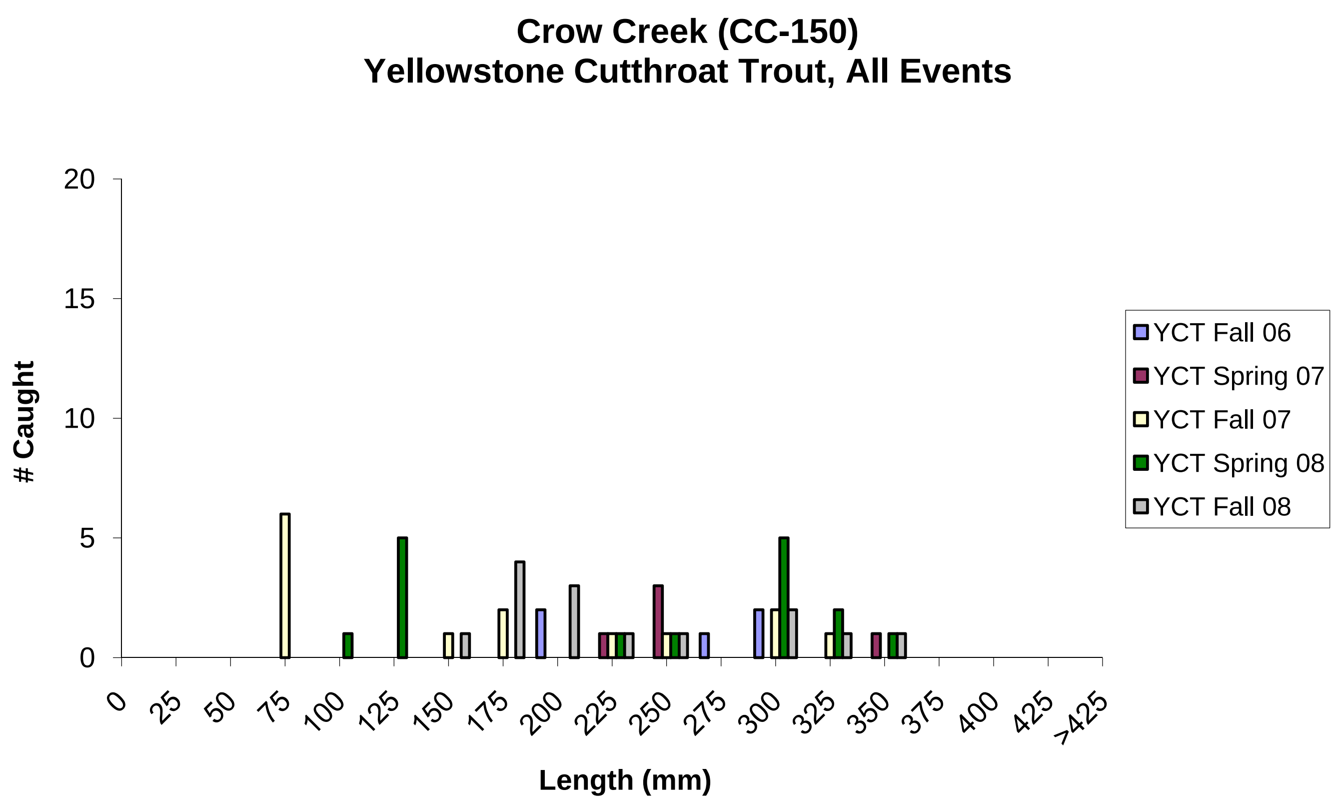
Attachment 1

Length-Frequency Distribution for Trout
CC-75

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL





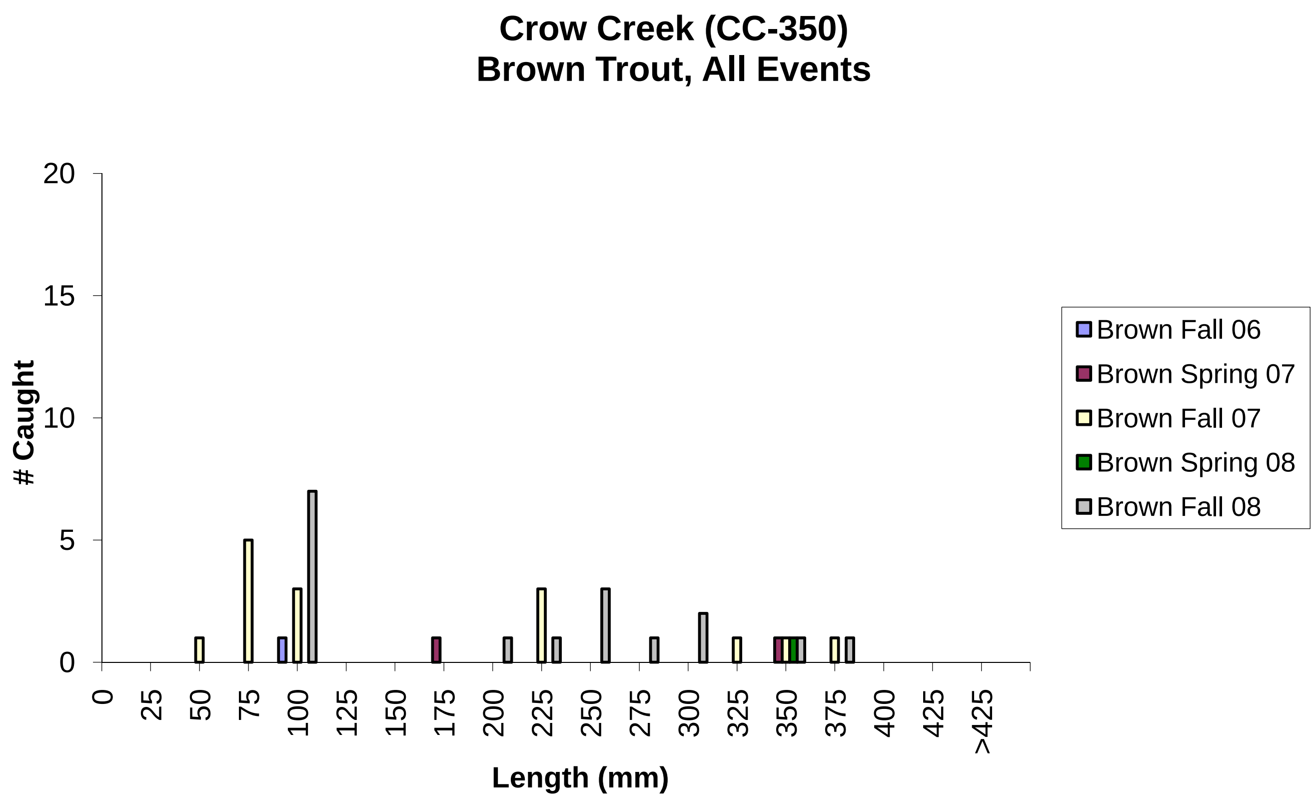
Attachment 1

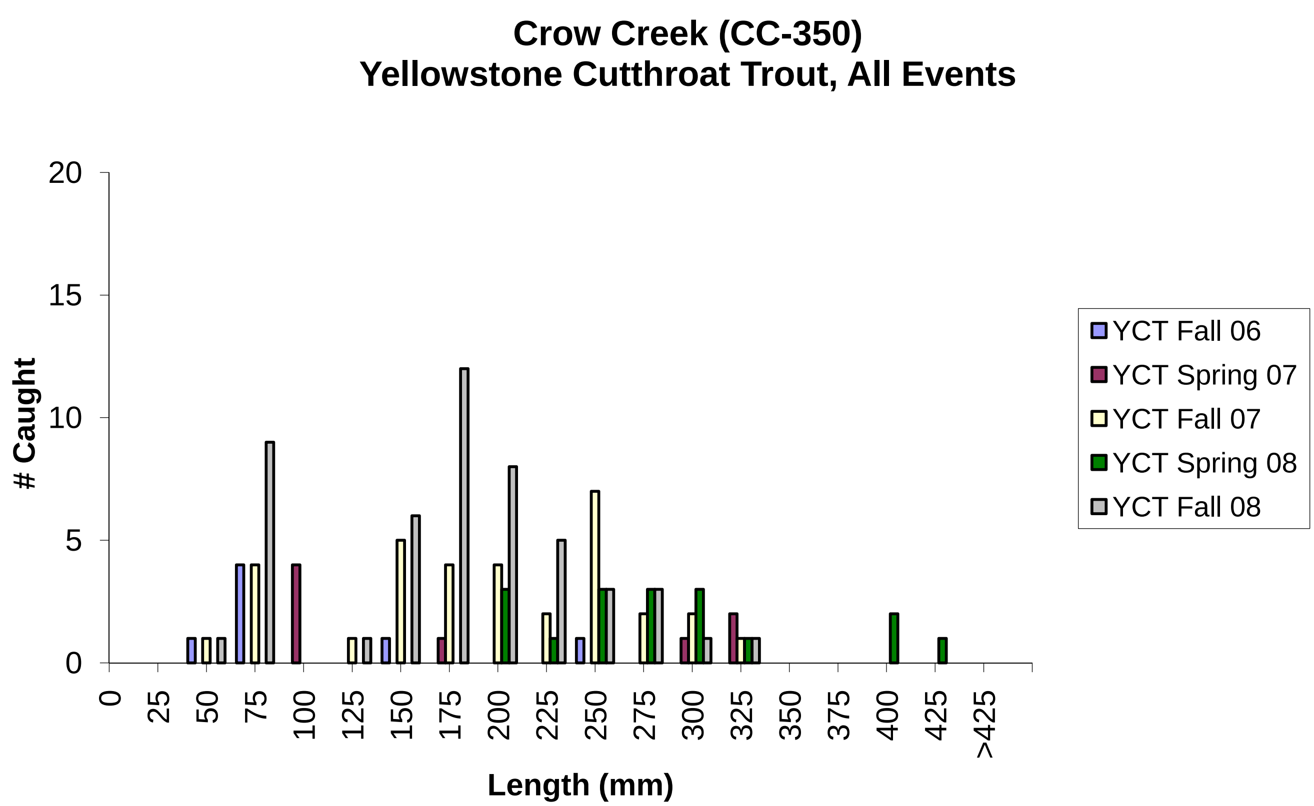
Length-Frequency Distribution for Trout CC-150

J.R. Simplot Company
Site-Specific Selenium Criterion

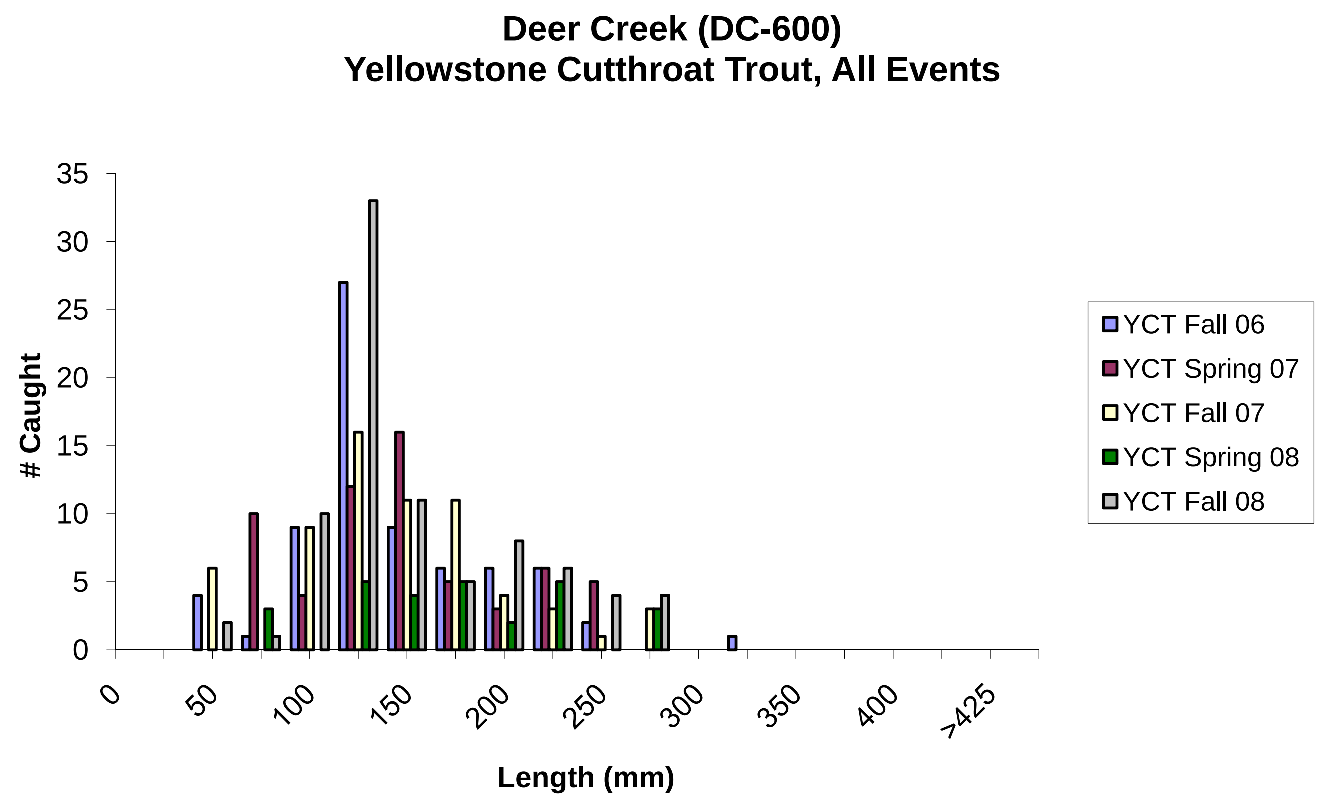
PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL

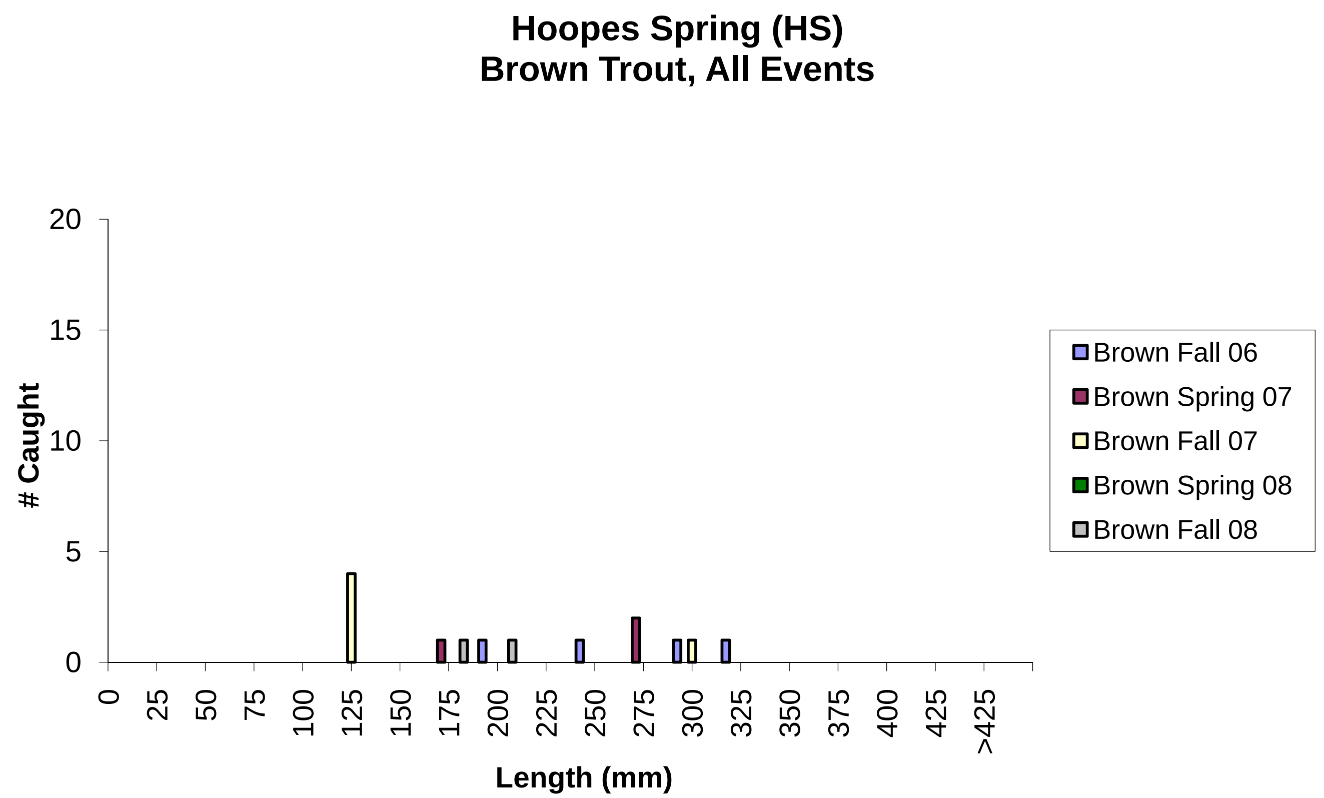




Attachment 1 **Length-Frequency Distribution for Trout** **CC-350**	**J.R. Simplot Company** Site-Specific Selenium Criterion		
	PRJ: 009-004.70	DATE: June 2011	
	REV: 0	CHK:SMC	BY:SMC
	FORMATION ENVIRONMENTAL		



Attachment 1	**J.R. Simplot Company** Site-Specific Selenium Criterion	
Length-Frequency Distribution for Trout **DC-600**	PRJ: 009-004.70	DATE: June 2011
	REV: 0	CHK:SMC BY:SMC
	FORMATION ENVIRONMENTAL	



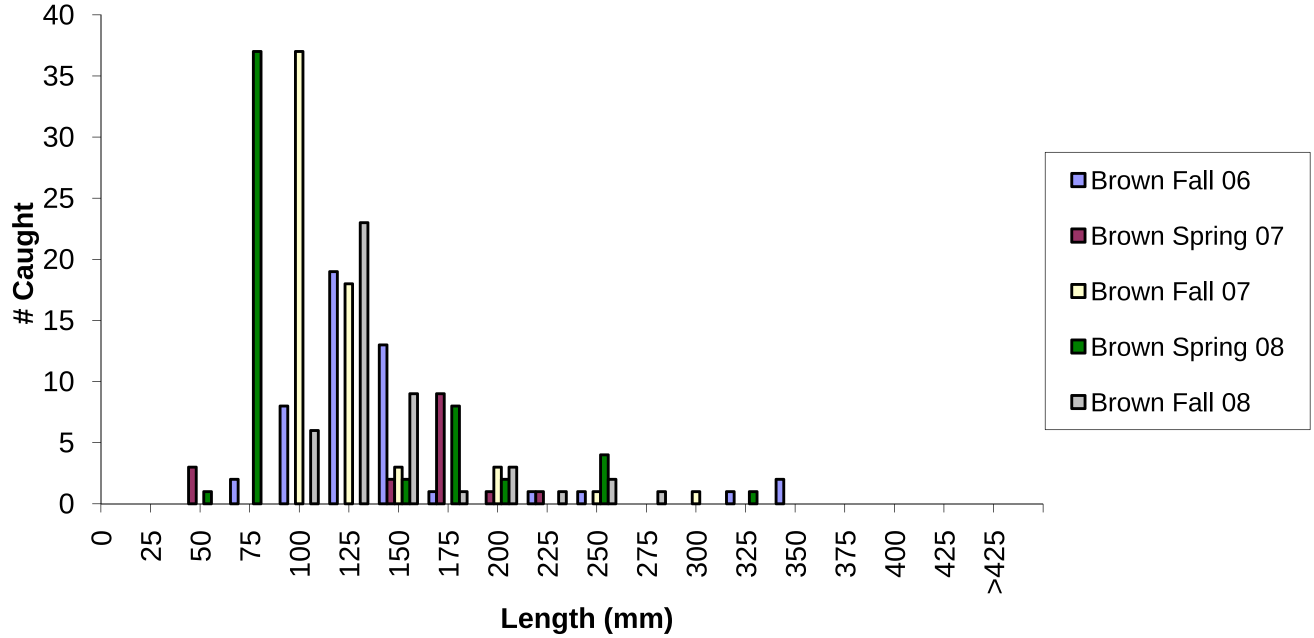
Attachment 1

Length-Frequency Distribution for Trout
HS

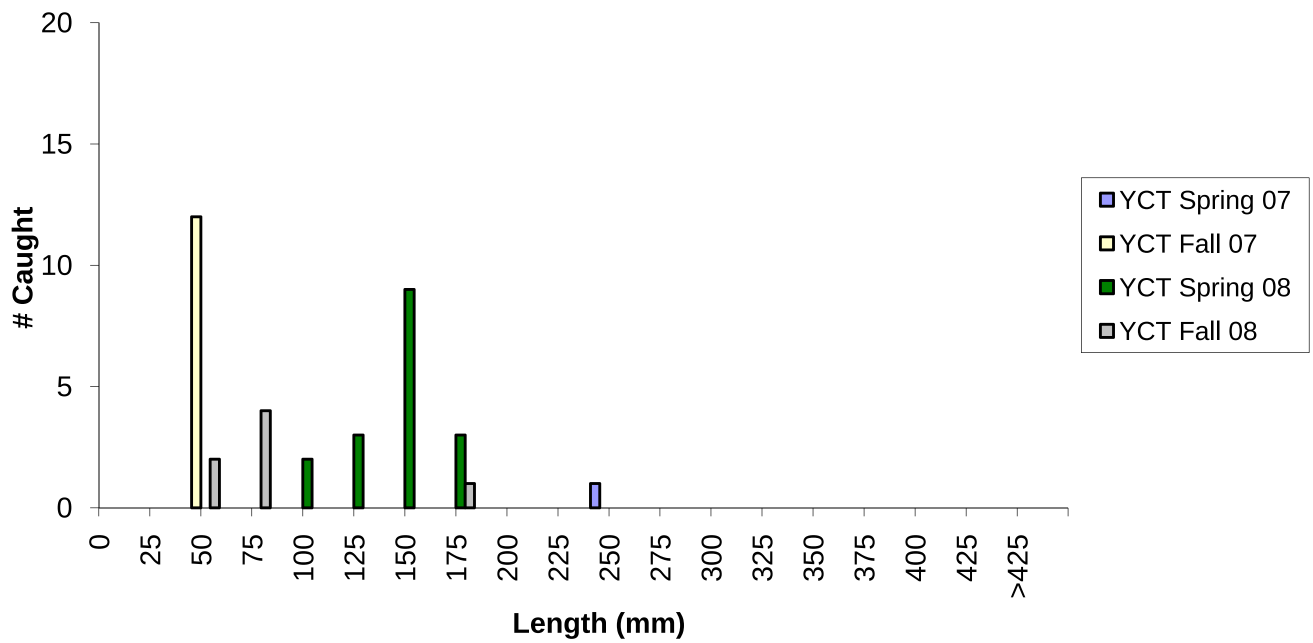
J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

Hoopes Spring (HS-3)
Brown Trout, All Events



Hoopes Spring (HS-3)
Yellowstone Cutthroat Trout, All Events



Attachment 1

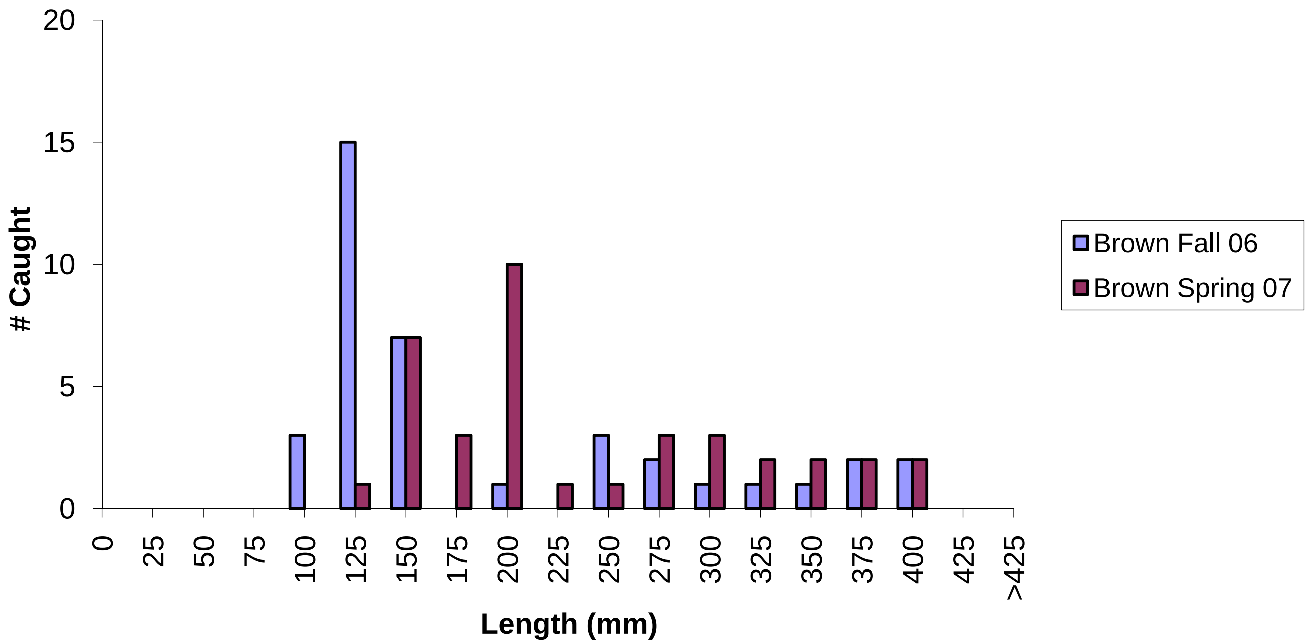
Length-Frequency Distribution for Trout
HS-3

J.R. Simplot Company
Site-Specific Selenium Criterion

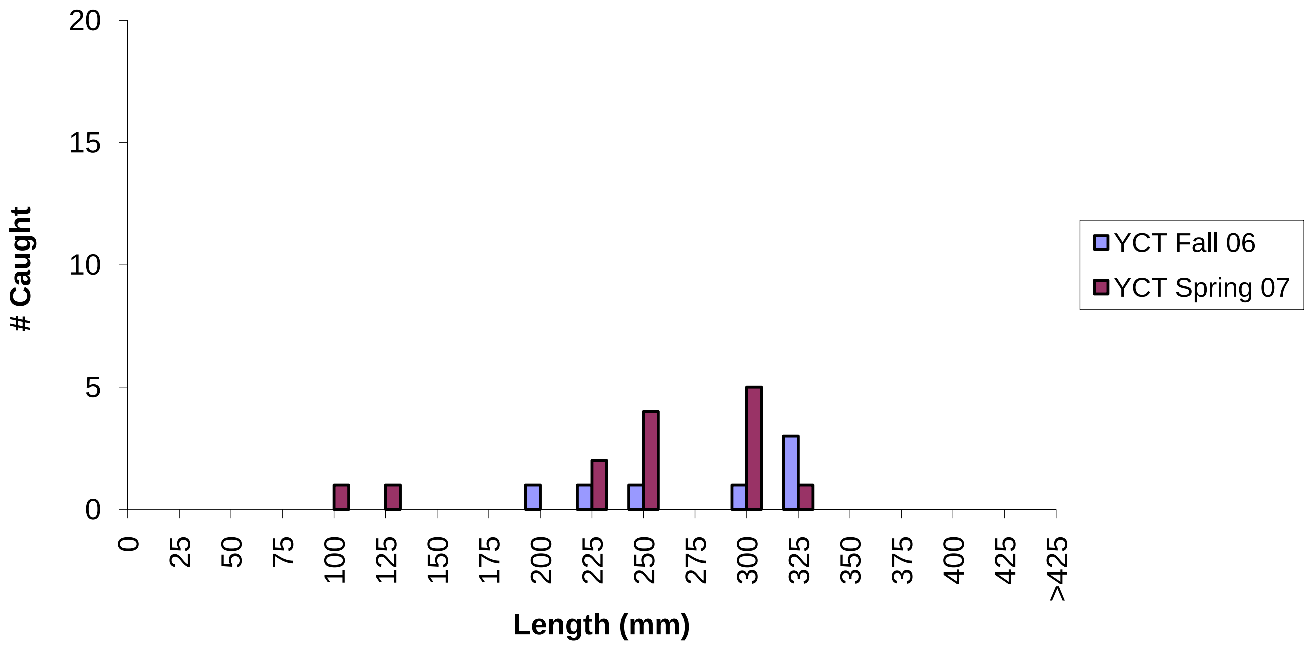
PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL

Lower Sage Valley (LSV-4)
Brown Trout, All Events



Lower Sage Valley (LSV-4)
Yellowstone Cutthroat Trout, All Events



Attachment 1

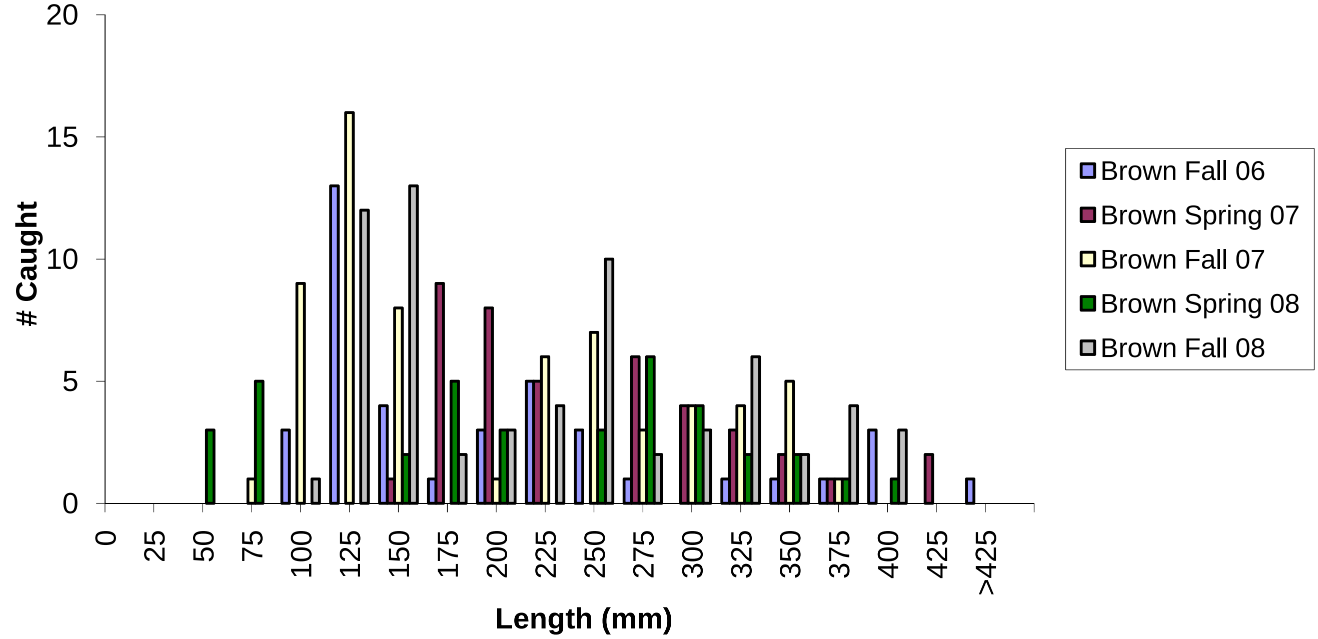
Length-Frequency Distribution for Trout
LSV-4

J.R. Simplot Company
Site-Specific Selenium Criterion

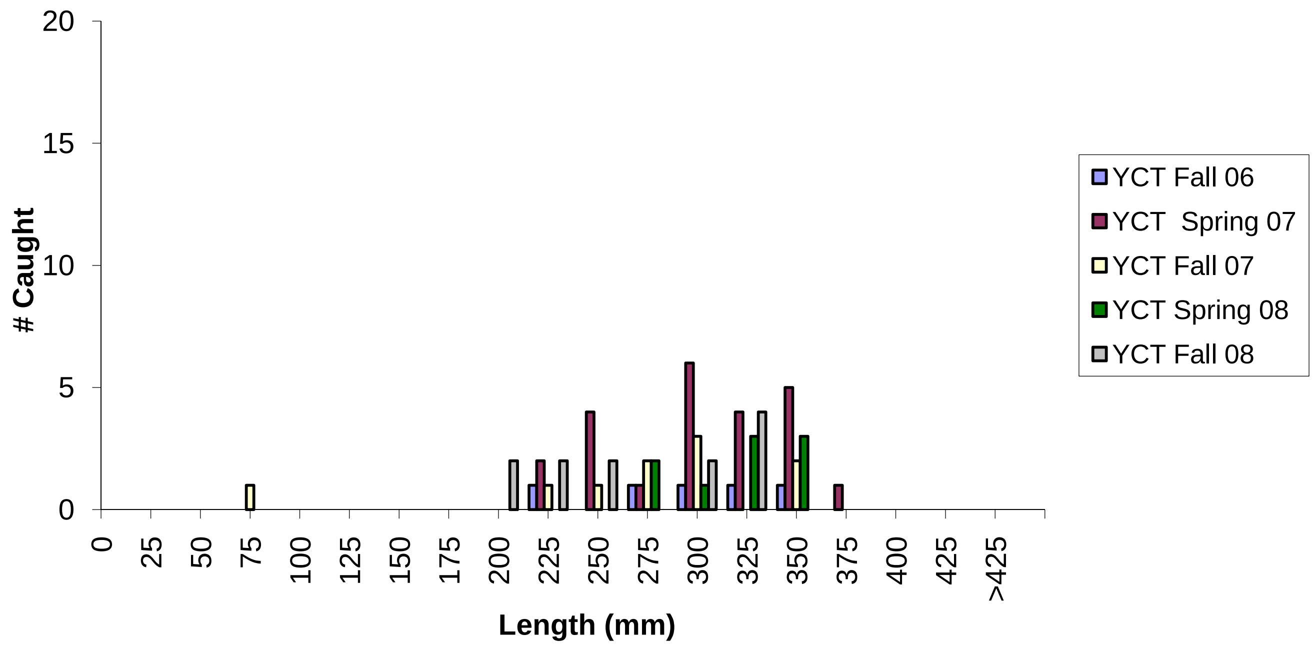
PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL

Lower Sage Valley (LSV-2C)
Brown Trout, All Events



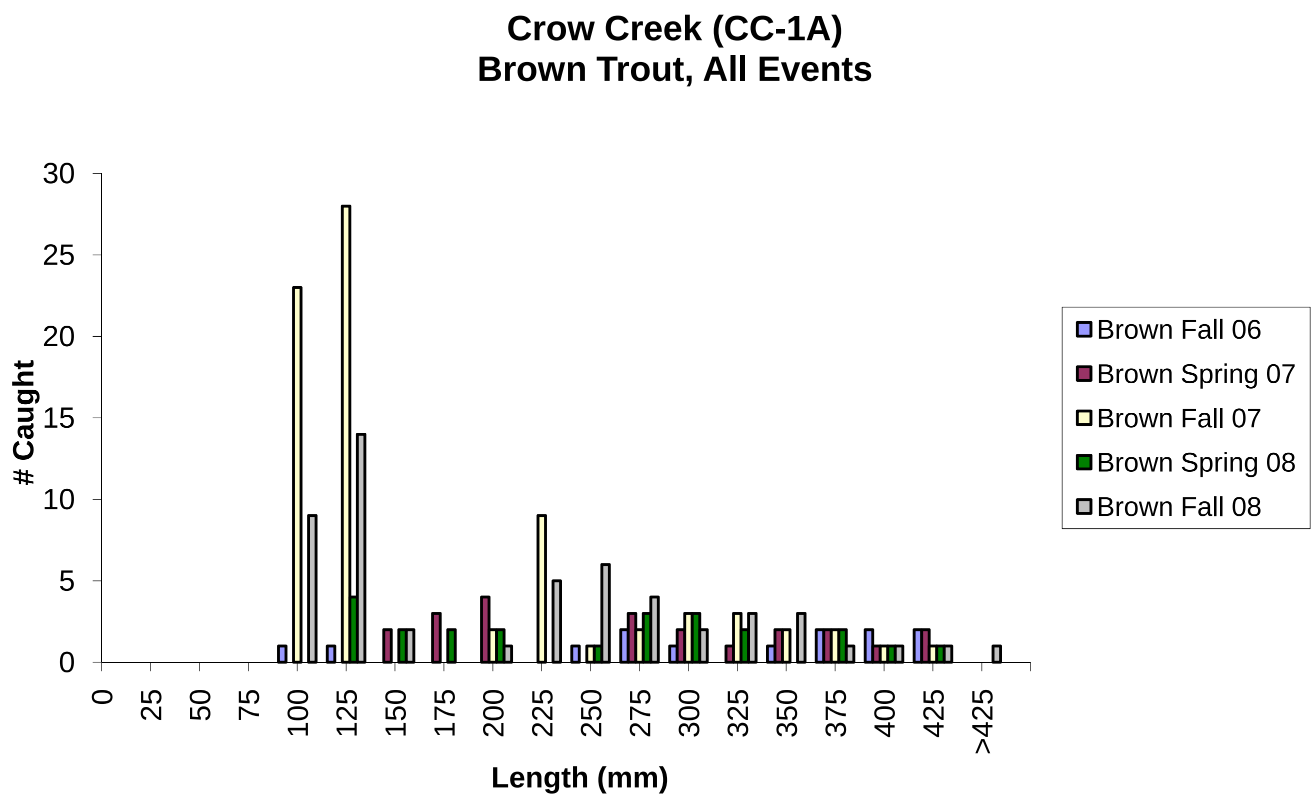
Lower Sage Valley (LSV-2C)
Yellowstone Cutthroat Trout, All Events

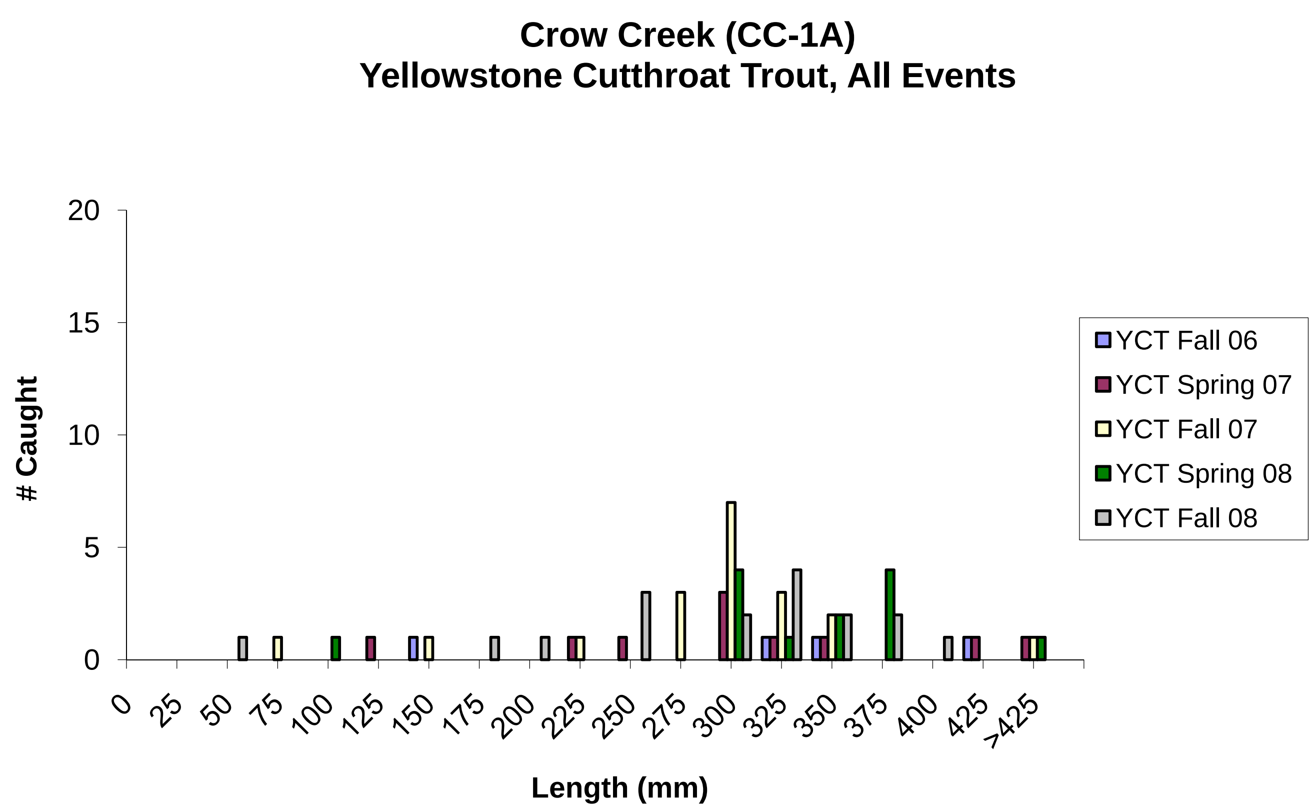


Attachment 1

Length-Frequency Distribution for Trout
LSV-2C

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC
FORMATION ENVIRONMENTAL		

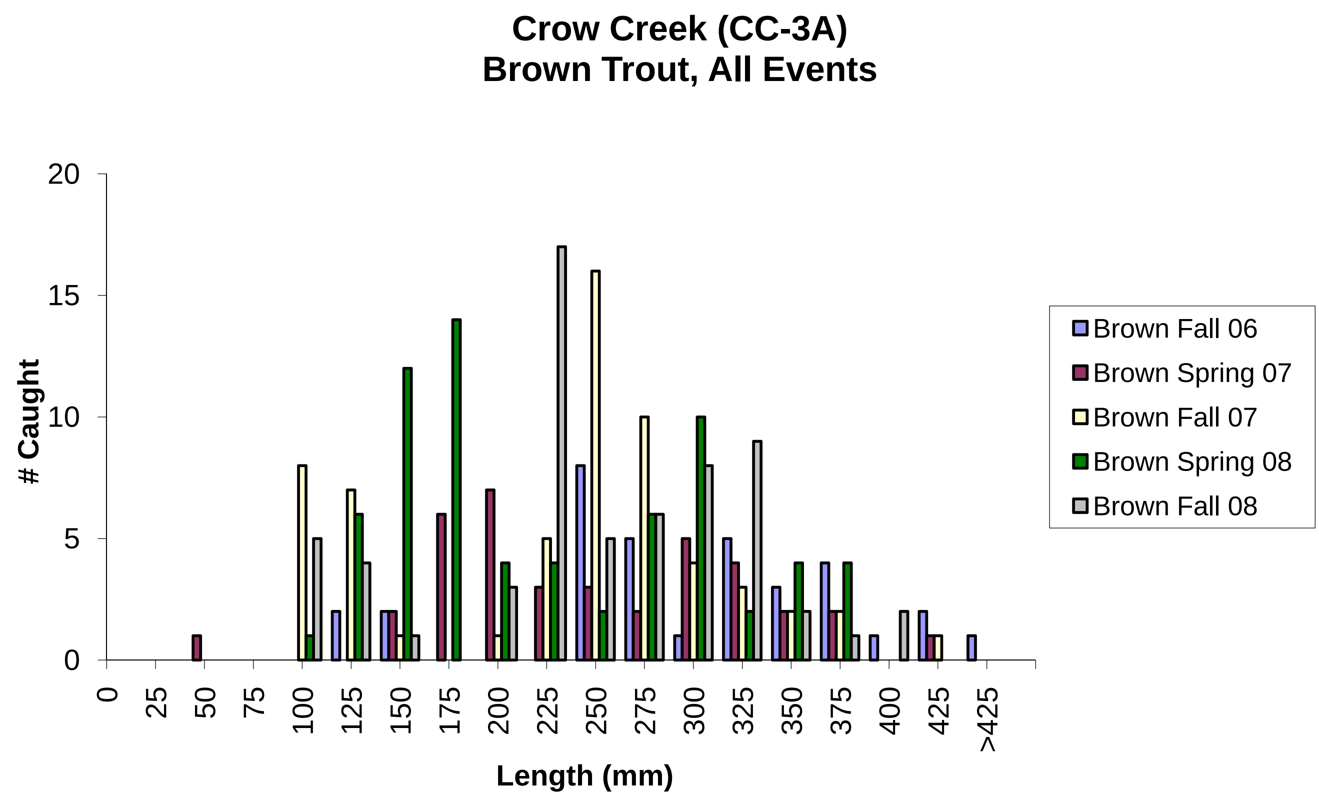


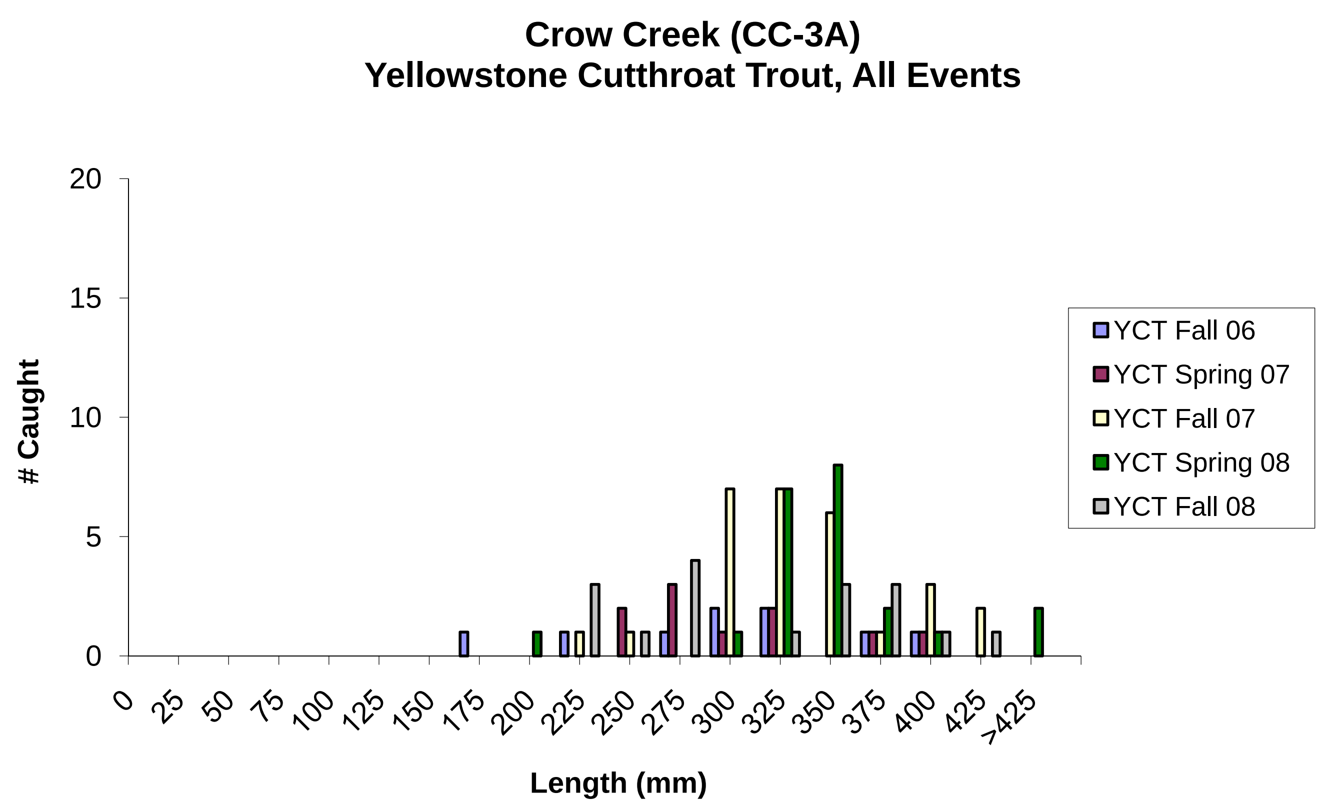


Attachment 1

Length-Frequency Distribution for Trout CC-1A

J.R. Simplot Company Site-Specific Selenium Criterion		
PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC
FORMATION ENVIRONMENTAL		





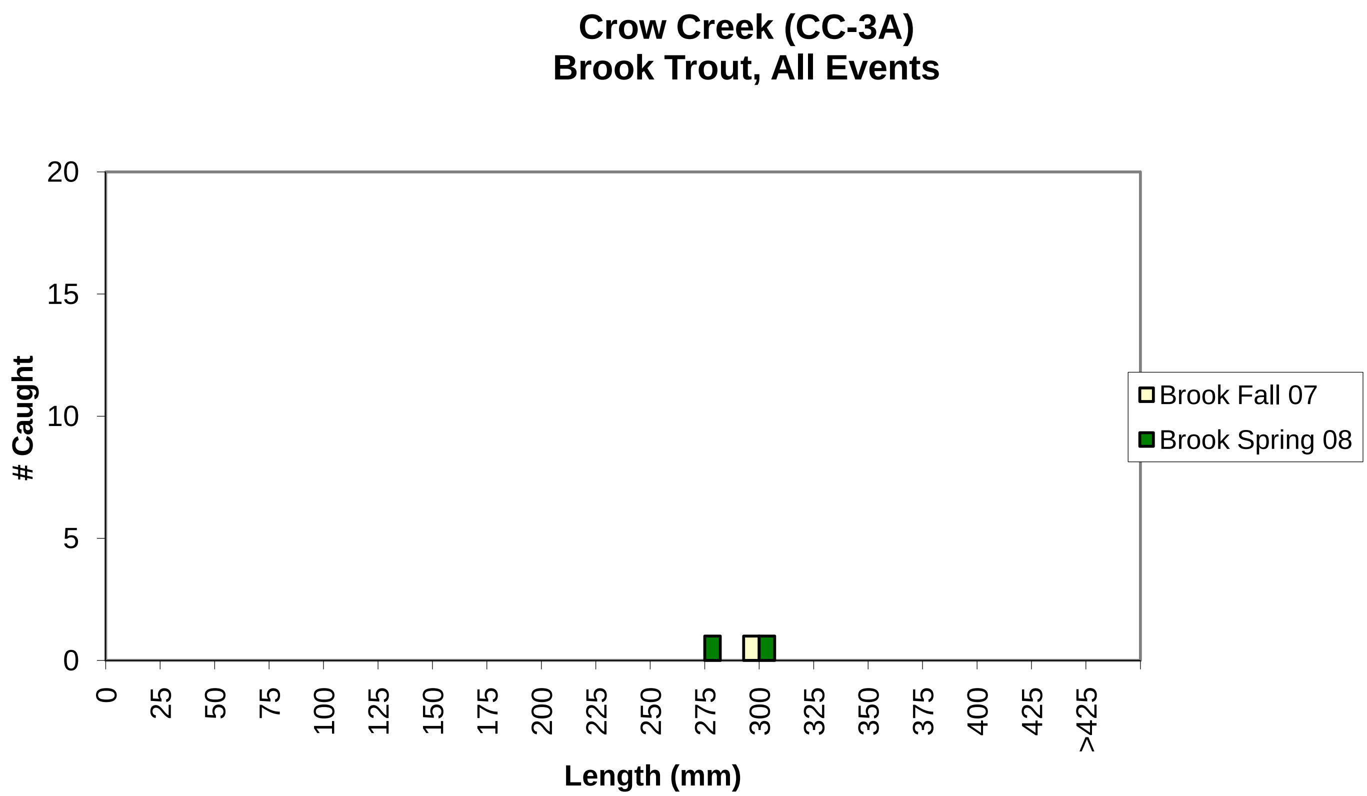
Attachment 1

Length-Frequency Distribution for Trout
CC-3A

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL



Attachment 1

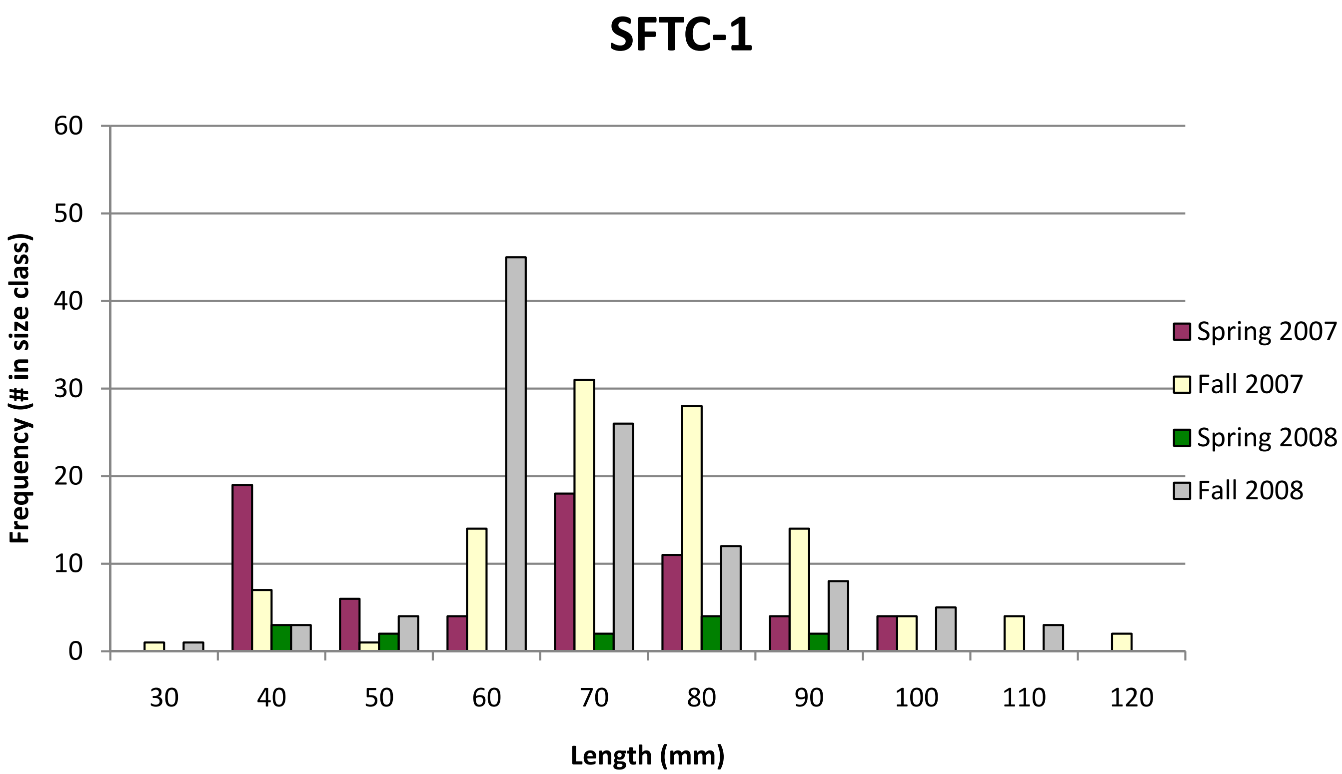
Length-Frequency Distribution for Trout
CC-3A

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL

ATTACHMENT 2
Length-Frequency Distribution for Sculpin



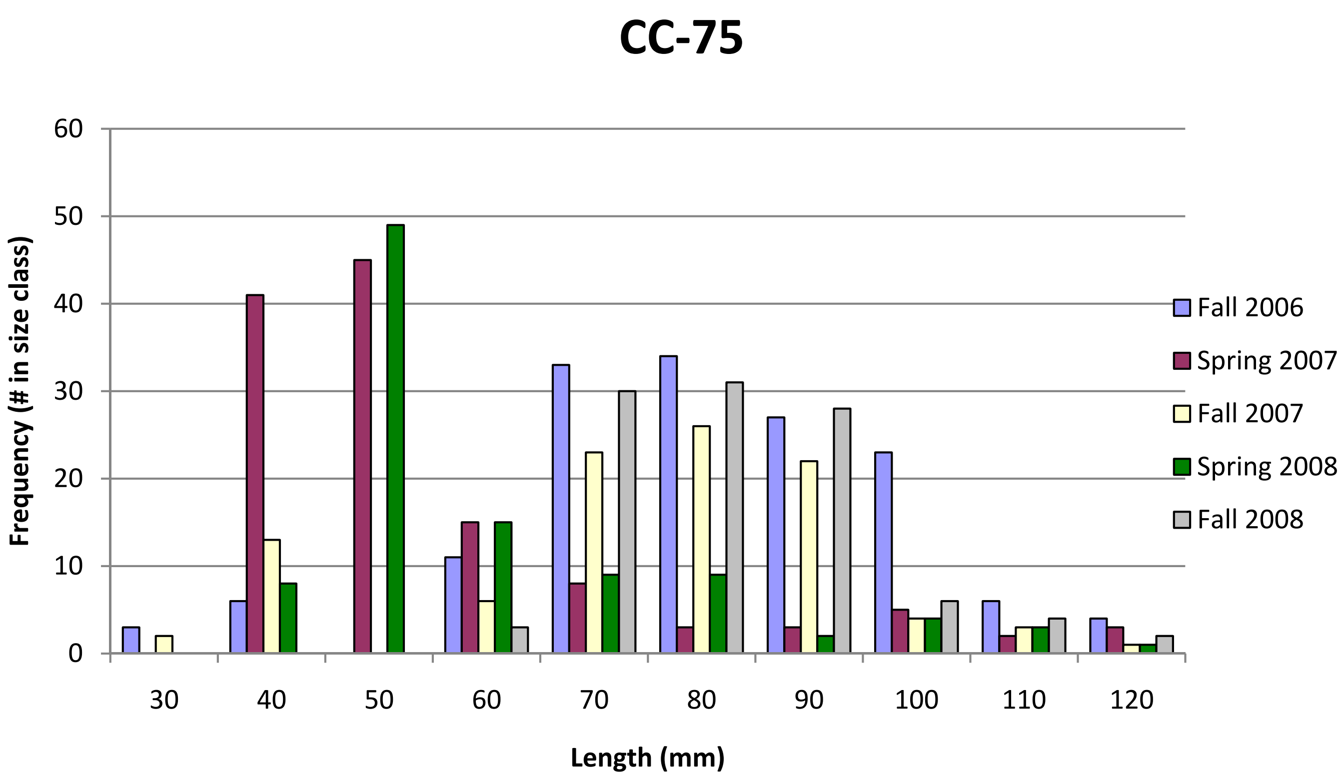
Attachment 2

Length-Frequency Distribution for Sculpin SFTC-1

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL



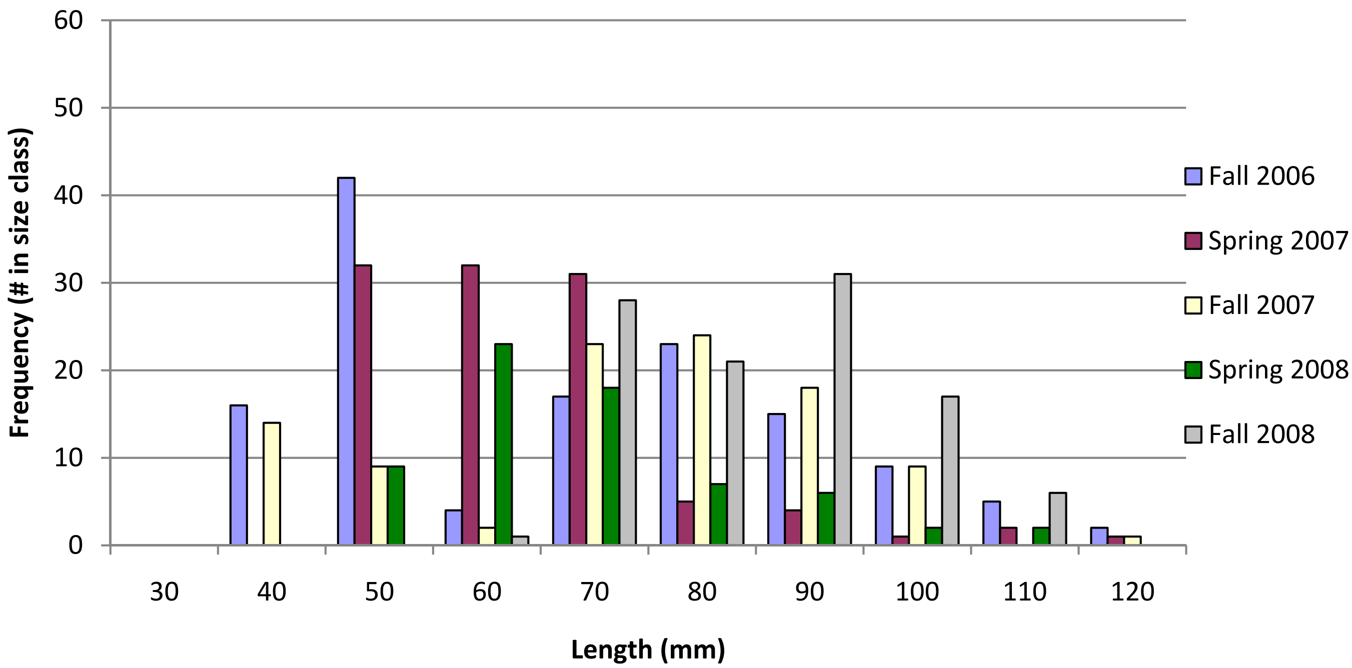
Attachment 2

Length-Frequency Distribution for Sculpin CC-75

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

CC-150

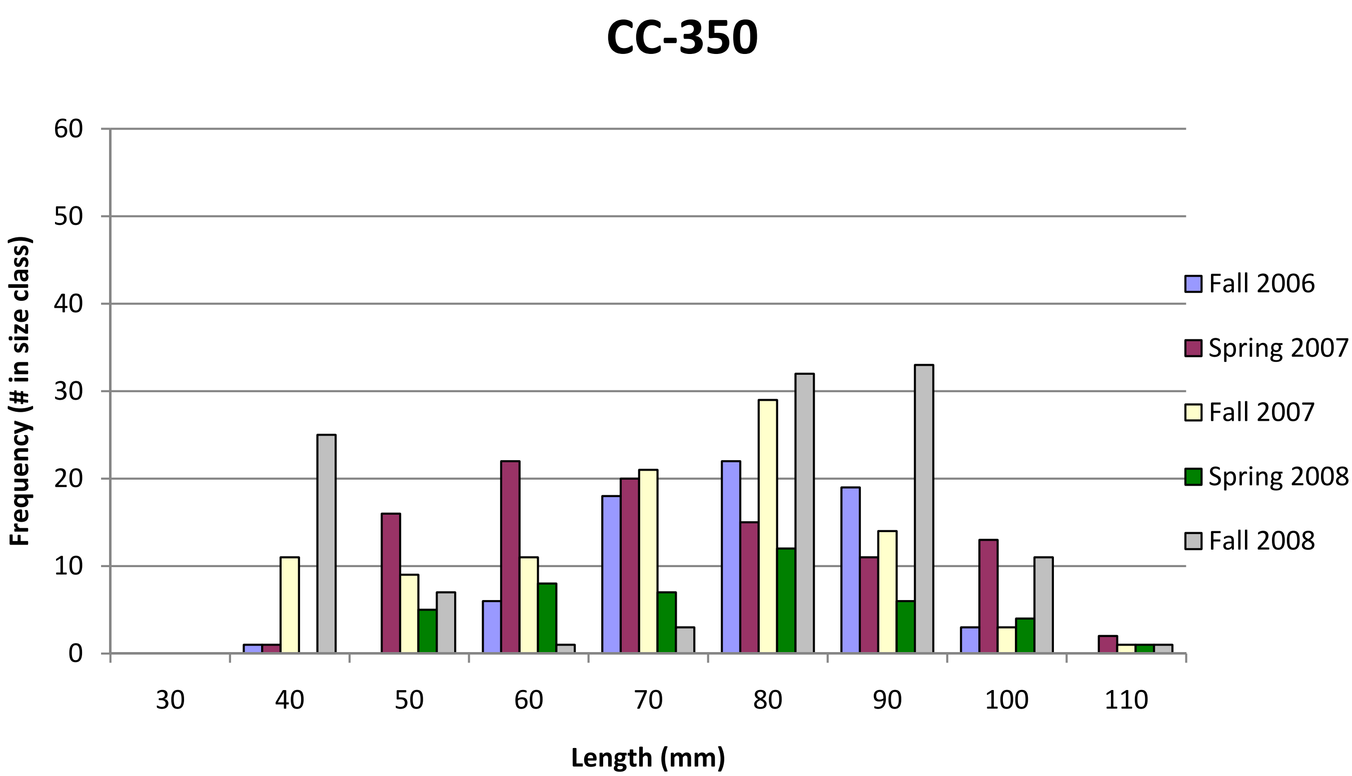


Attachment 2

Length-Frequency Distribution for Sculpin CC-150

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

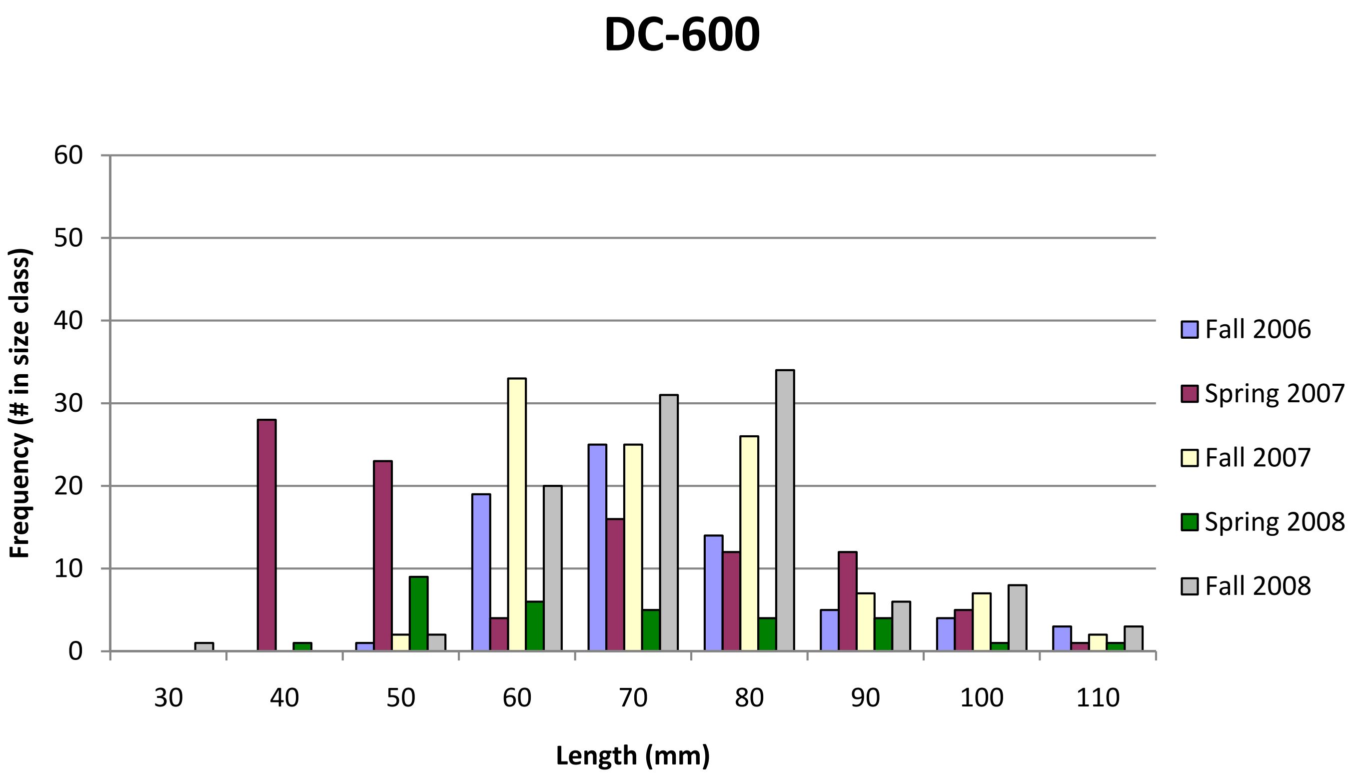


Attachment 2

Length-Frequency Distribution for Sculpin
CC-350

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL



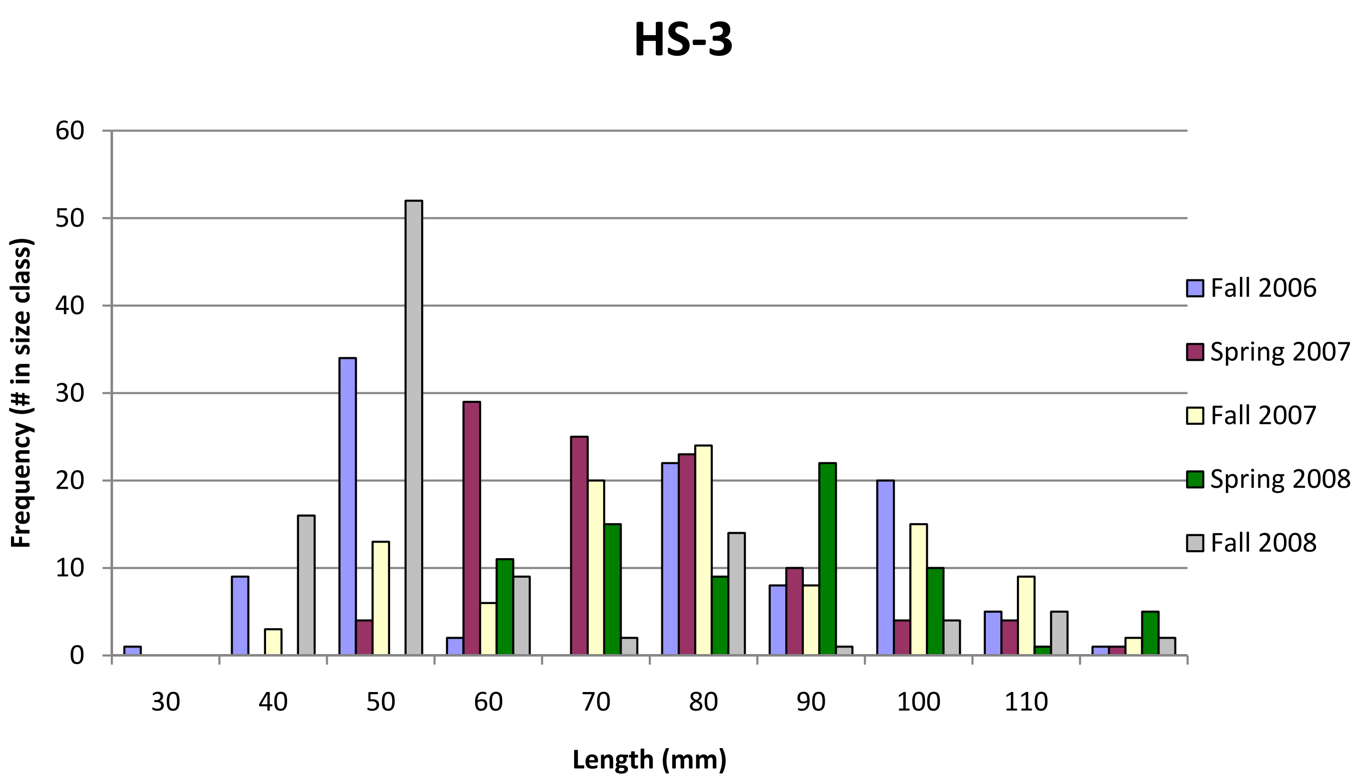
Attachment 2

Length-Frequency Distribution for Sculpin DC-600

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL



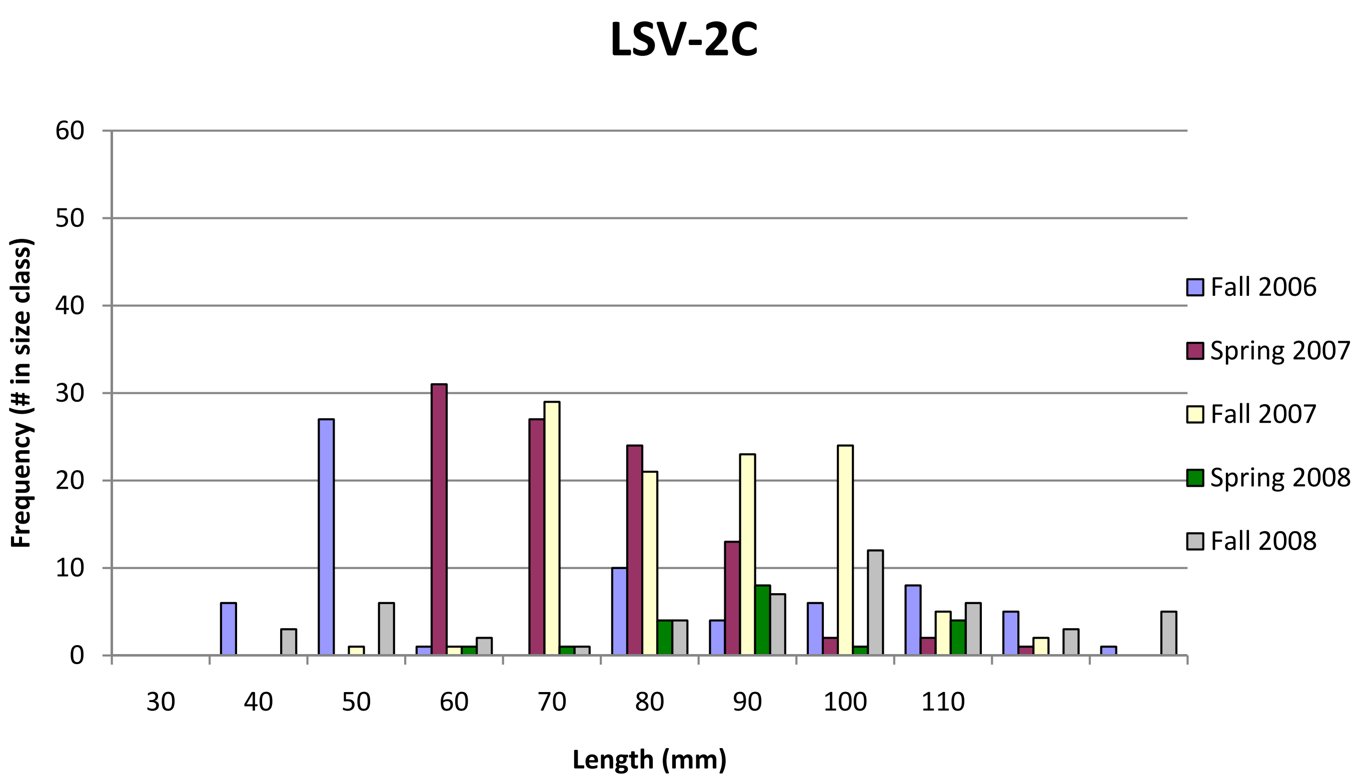
Attachment 2

Length-Frequency Distribution for Sculpin HS-3

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL



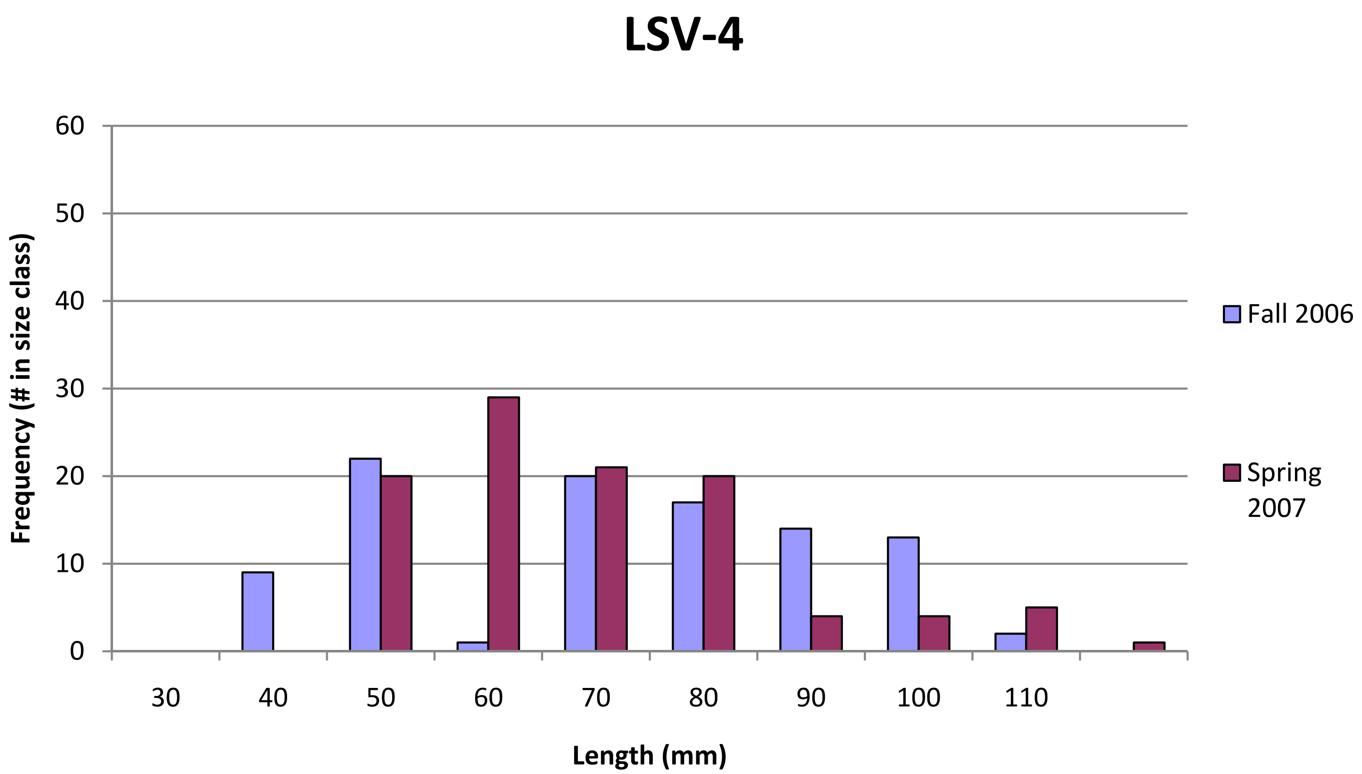
Attachment 2

Length-Frequency Distribution for Sculpin
LSV-2C

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL



Attachment 2

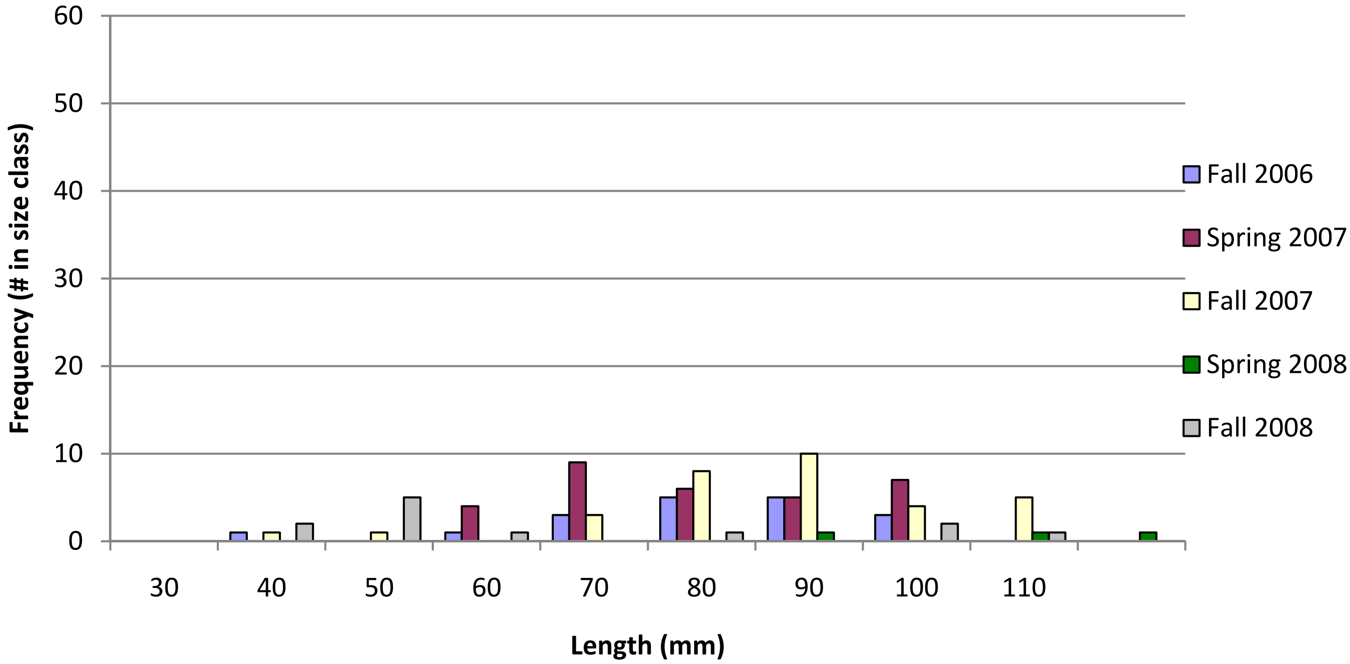
Length-Frequency Distribution for Sculpin LSV-4

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL

CC-1A



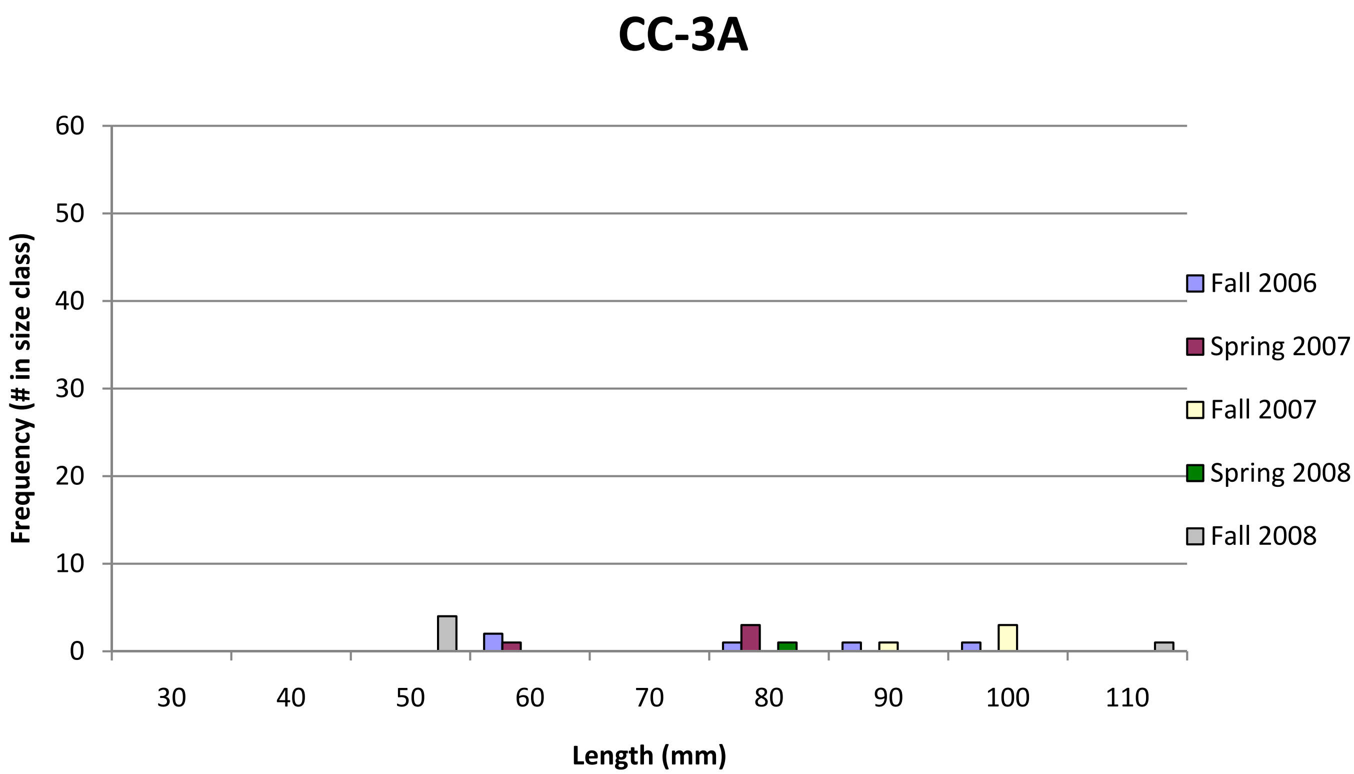
Attachment 2

Length-Frequency Distribution for Sculpin CC-1A

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL



Attachment 2

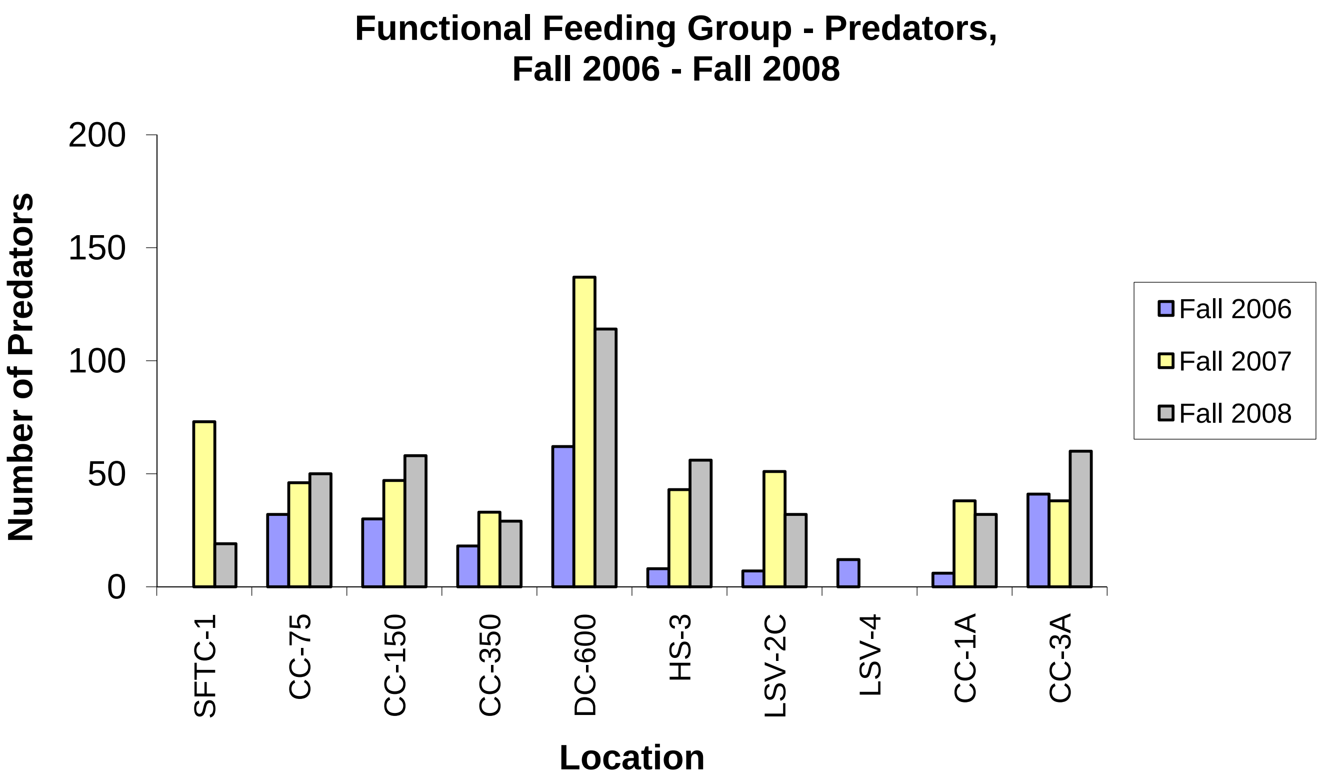
Length-Frequency Distribution for Sculpin
CC-3A

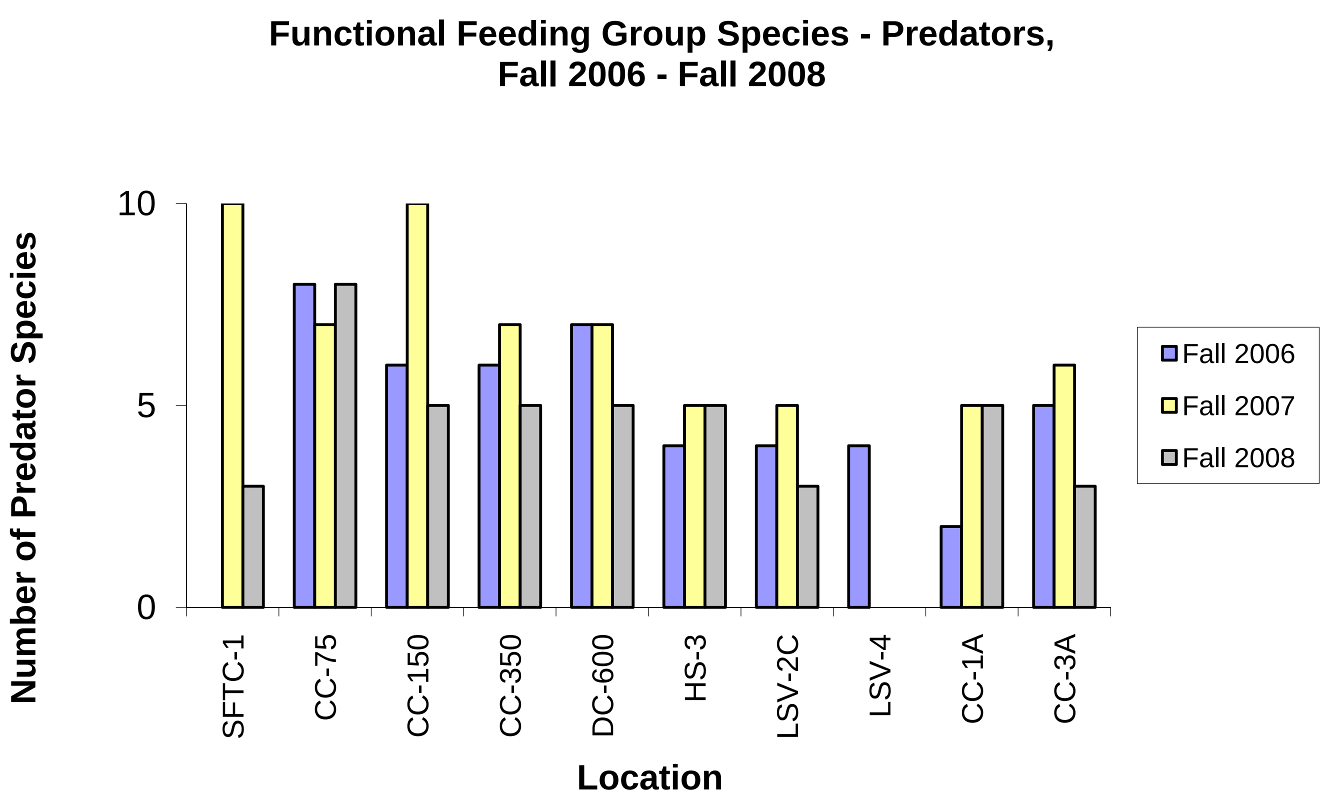
J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

ATTACHMENT 3
Functional Feeding Group Metrics





Attachment 3

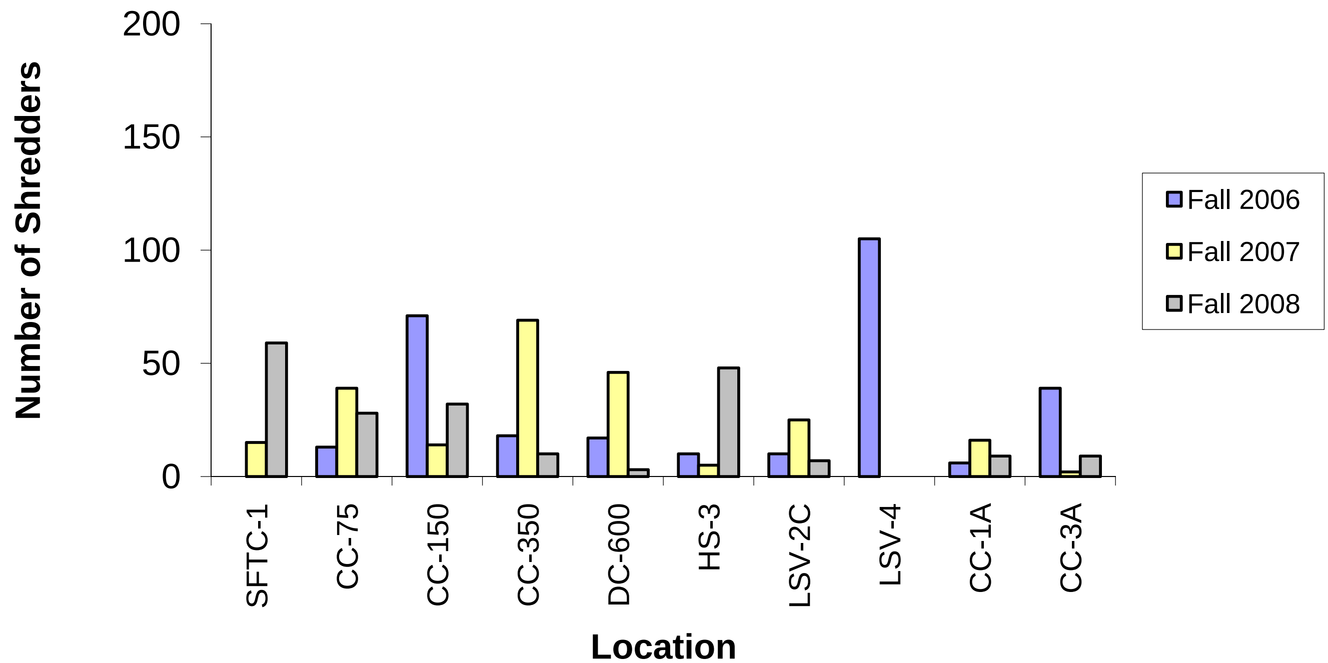
Functional Feeding Group Metrics
Predators

J.R. Simplot Company
Site-Specific Selenium Criterion

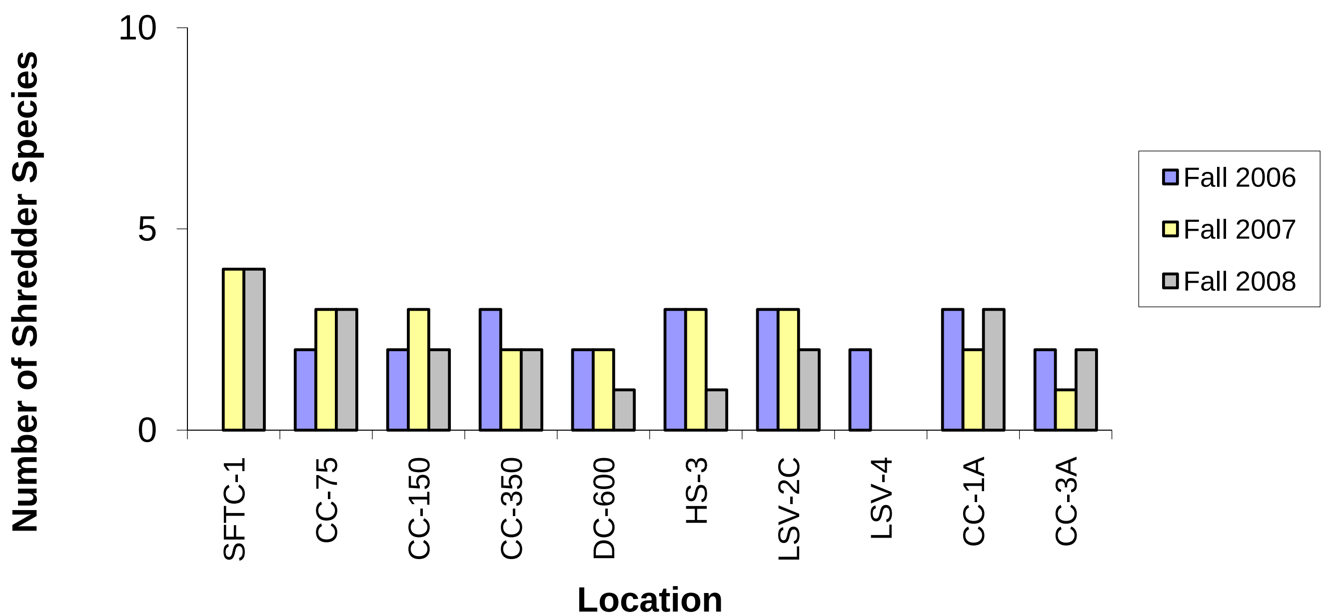
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

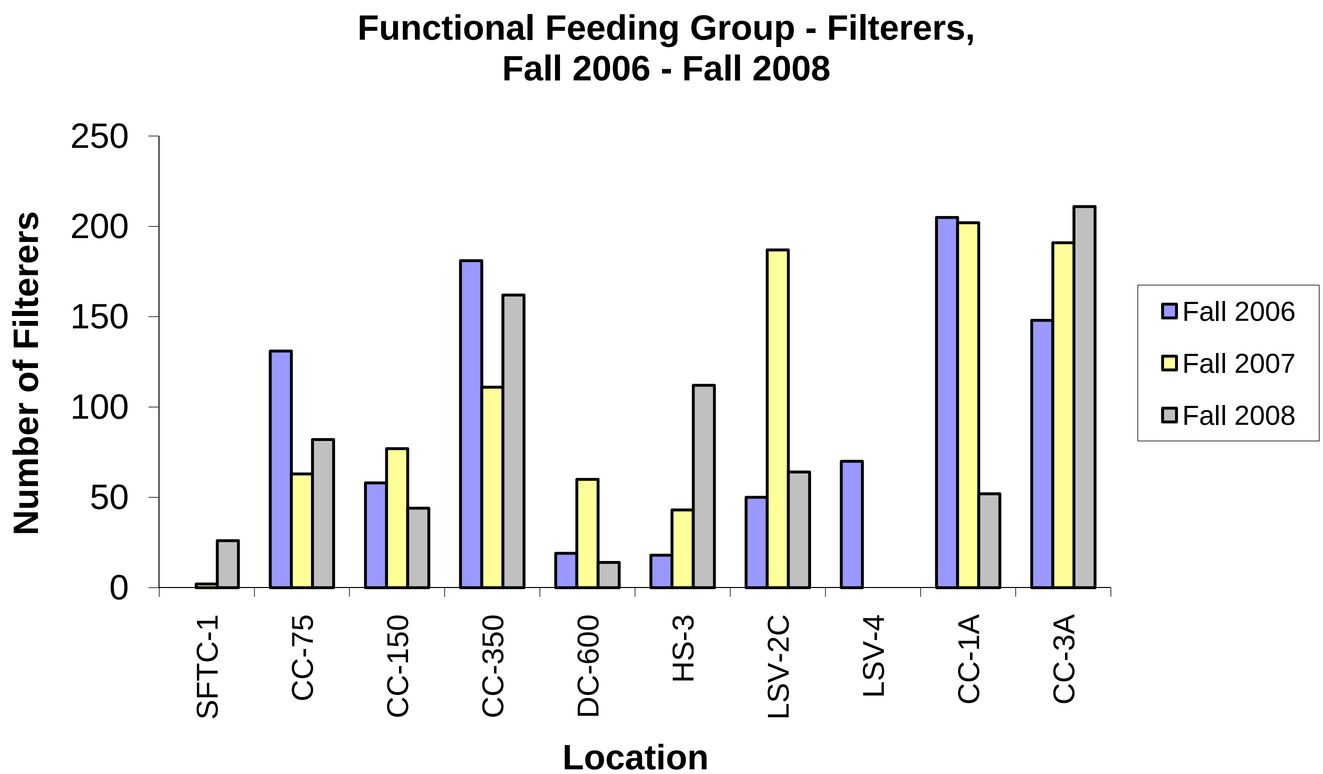
Functional Feeding Group - Shredders, Fall 2006 - Fall 2008

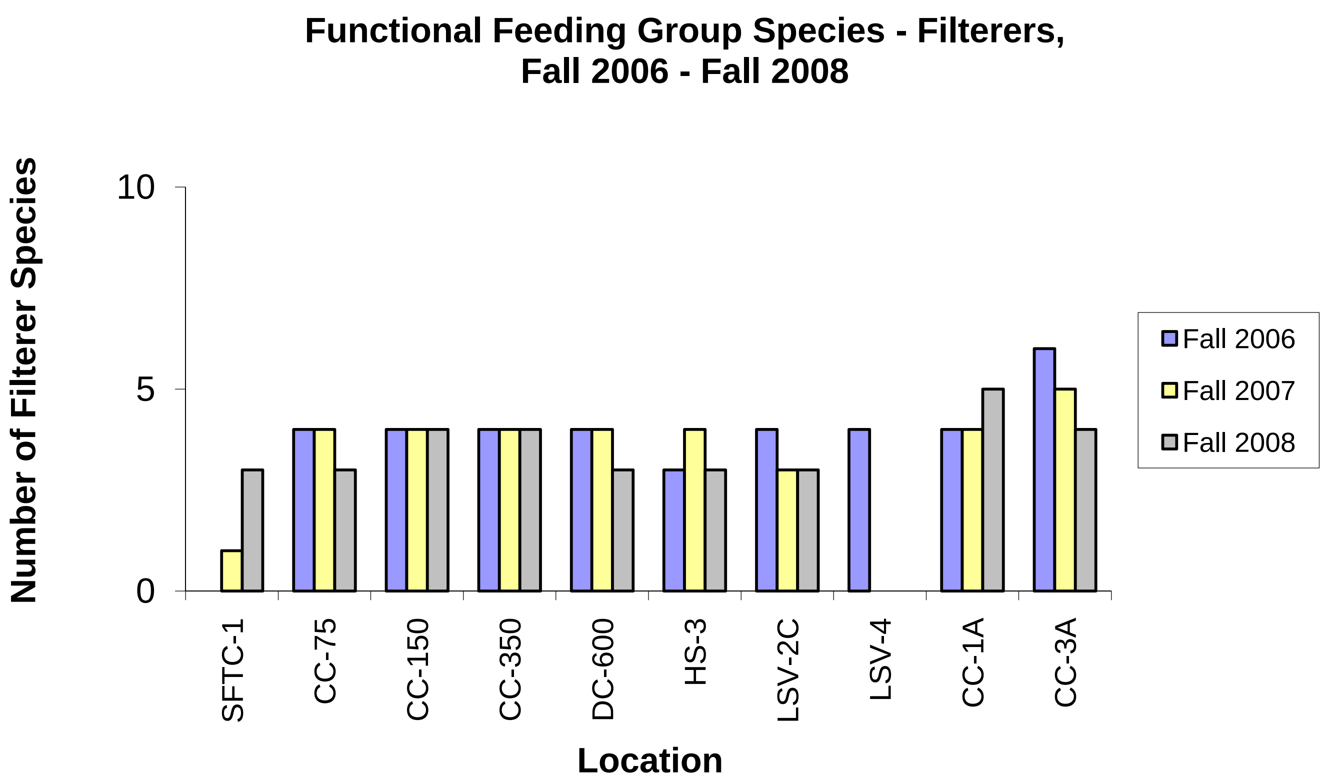


Functional Feeding Group Species - Shredders, Fall 2006 - Fall 2008



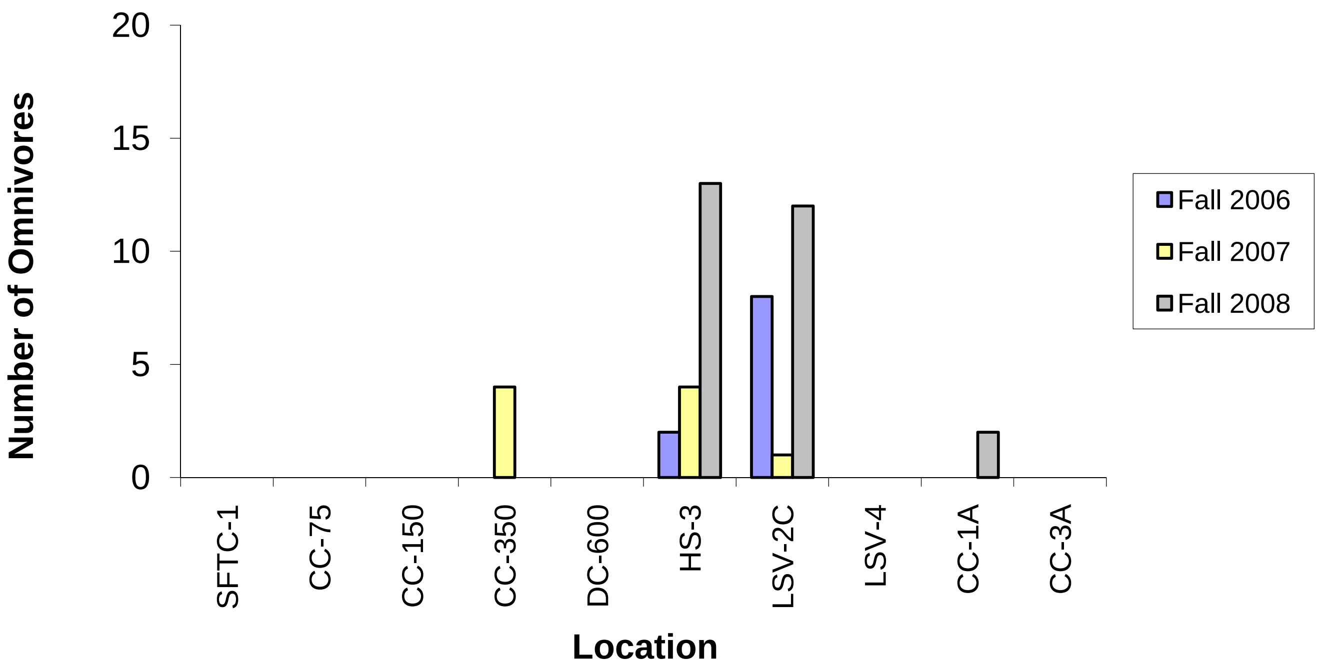
Attachment 3 **Functional Feeding Group Metrics Shredders**	**J.R. Simplot Company** Site-Specific Selenium Criterion		
	PRJ: 009-004.70	DATE: June 2011	
	REV: 0	CHK:SMC	BY:SMC
	FORMATION ENVIRONMENTAL		



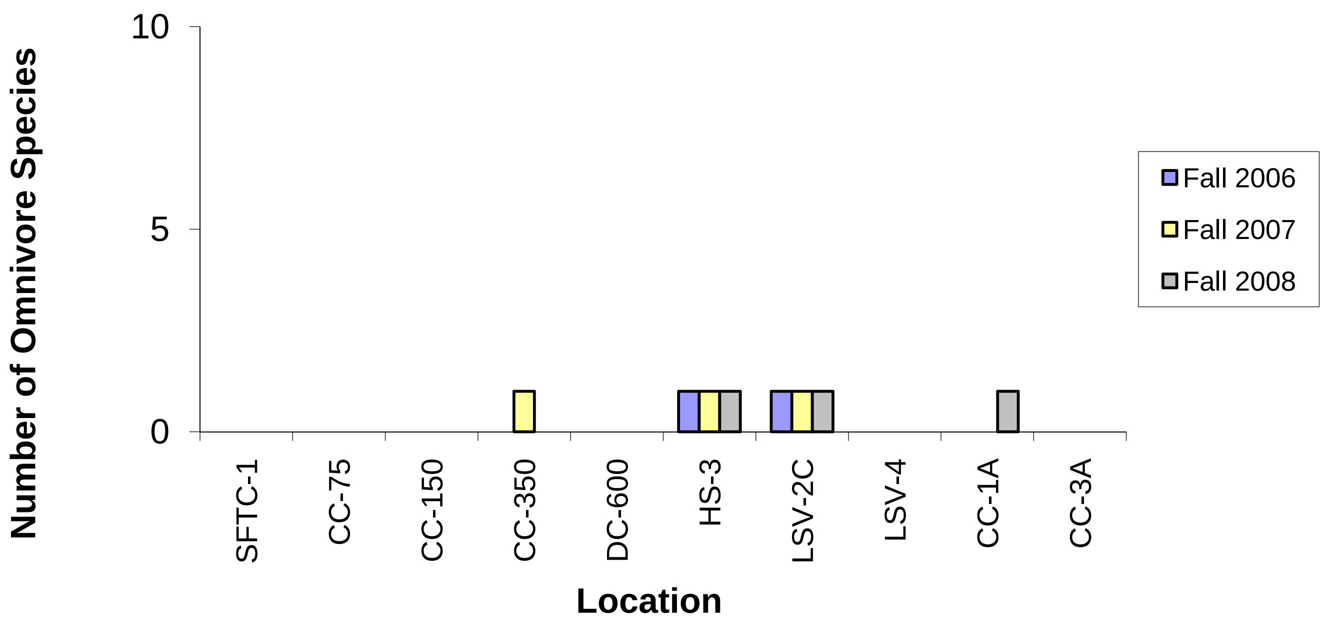


Attachment 3	**J.R. Simplot Company** Site-Specific Selenium Criterion	
Functional Feeding Group Metrics **Filterers**	PRJ: 009-004.70	DATE: June 2011
	REV: 0	CHK:SMC BY:SMC
	FORMATION ENVIRONMENTAL	

Functional Feeding Group - Omnivores, Fall 2006 - Fall 2008



Functional Feeding Group Species - Omnivores, Fall 2006 - Fall 2008

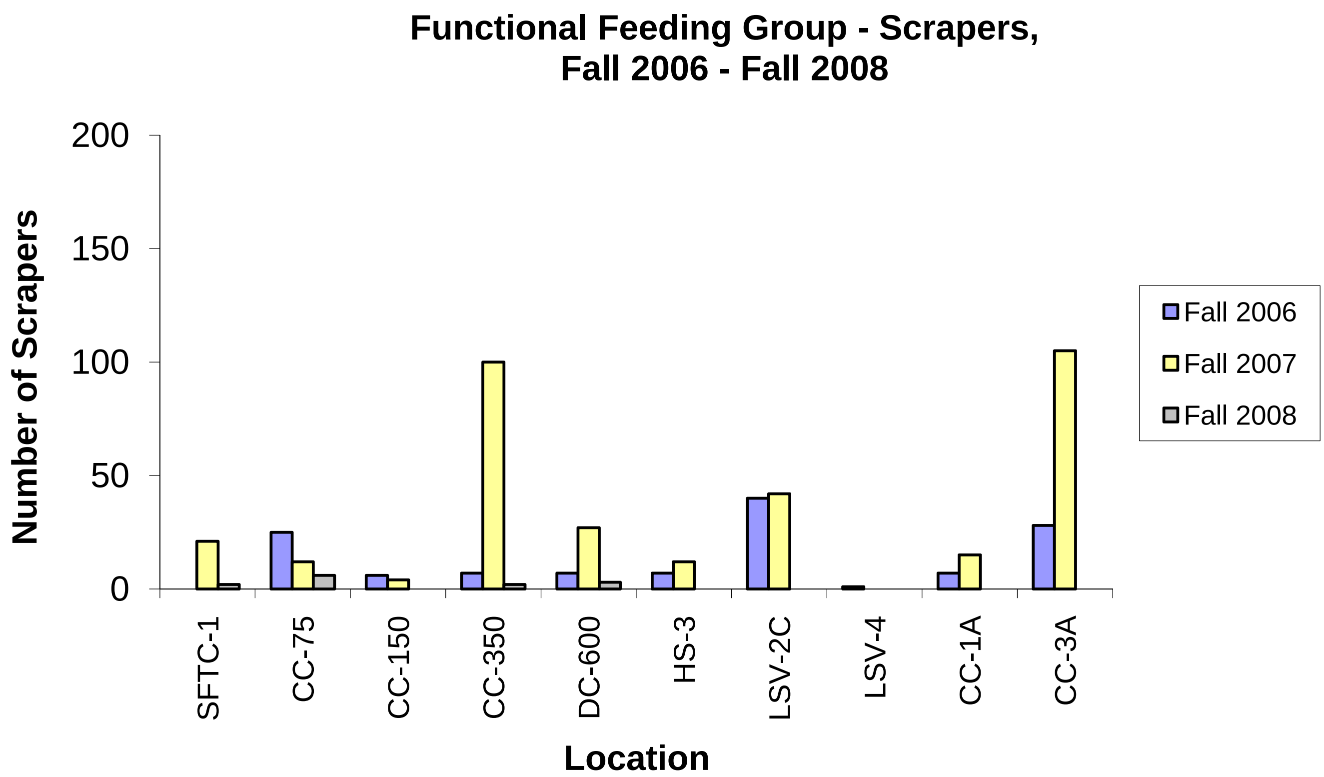


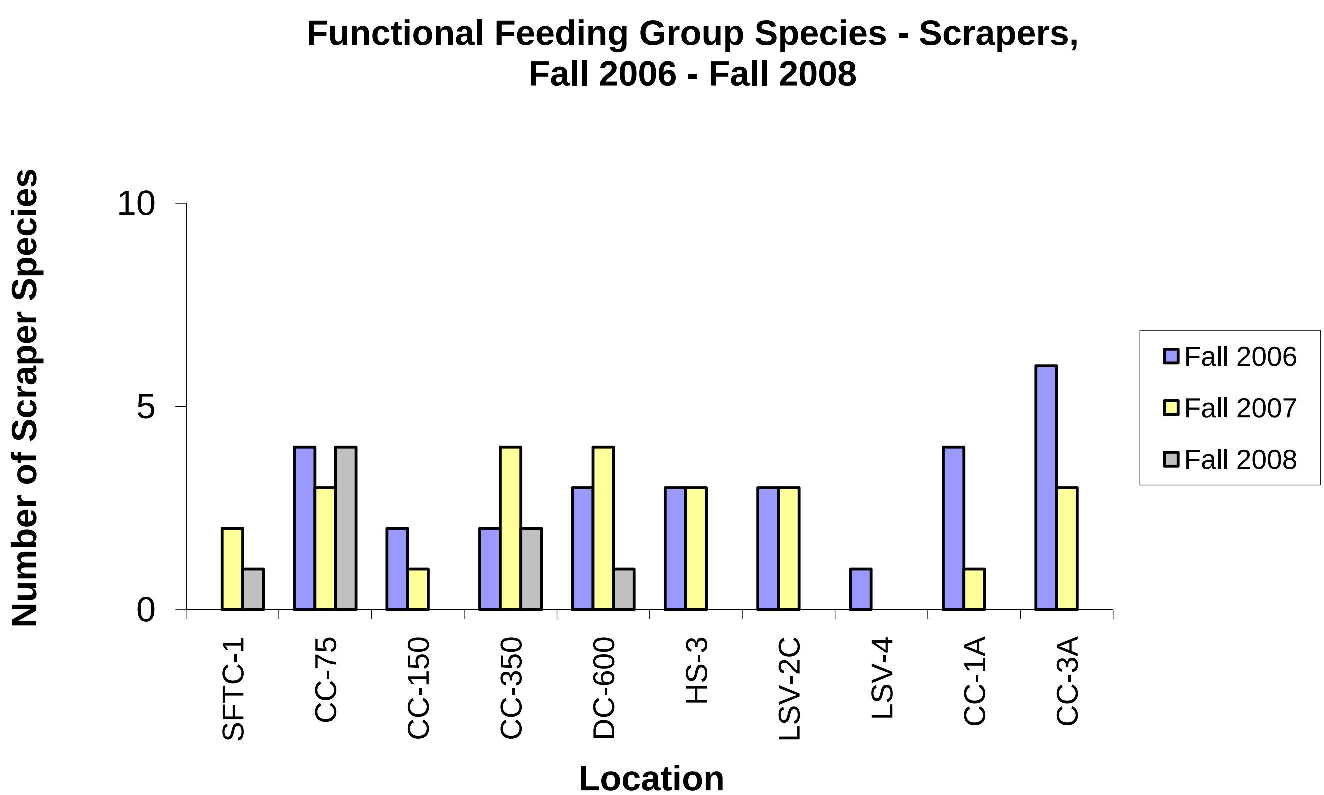
Attachment 3

Functional Feeding Group Metrics
Omnivores

J.R. Simplot Company Site-Specific Selenium Criterion	
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL





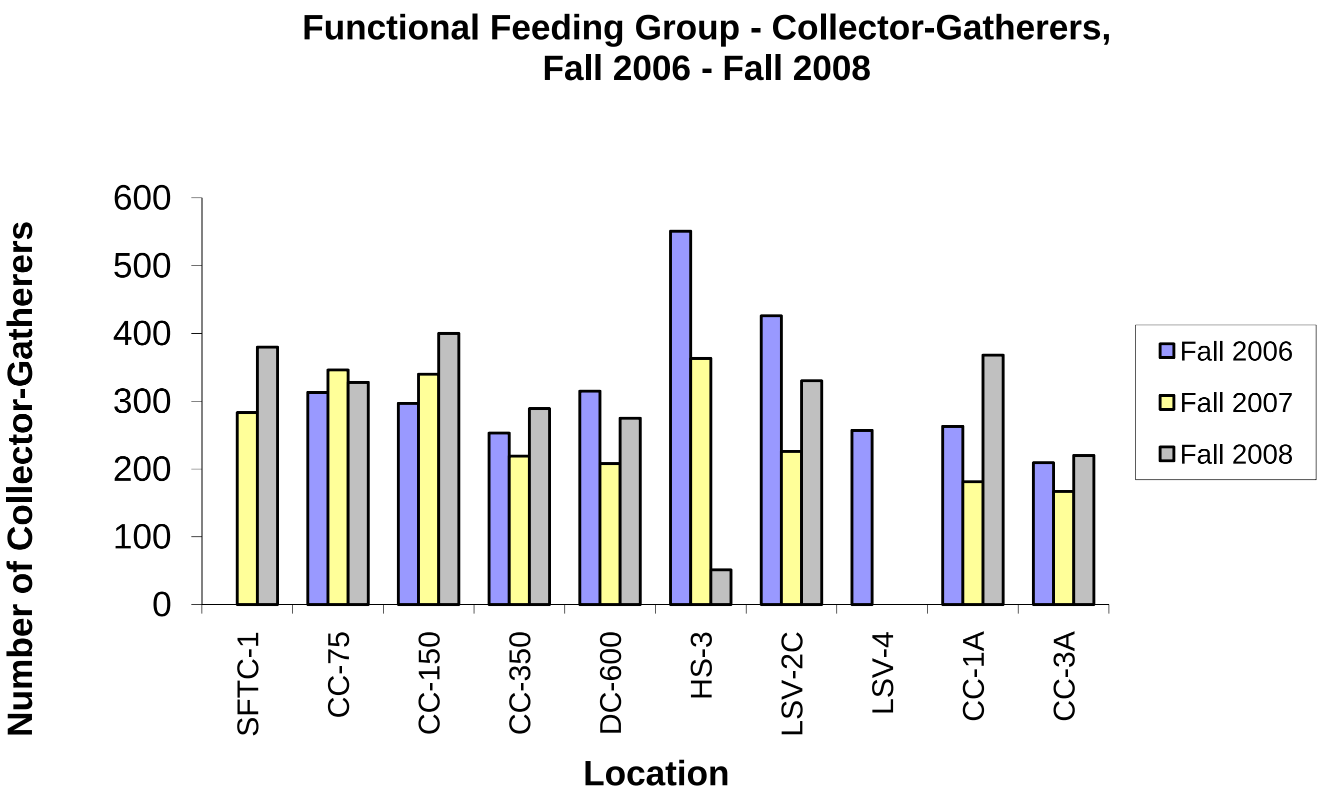
Attachment 3

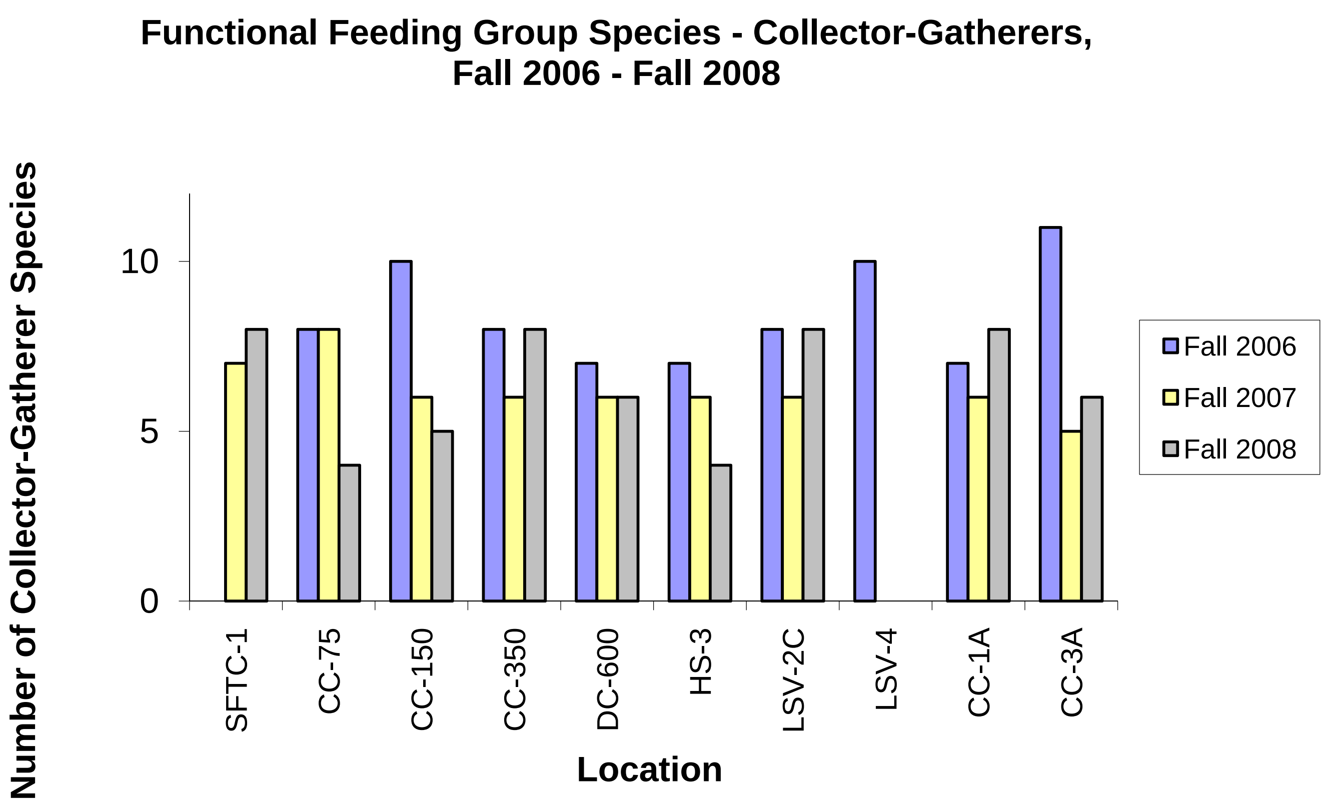
Functional Feeding Group Metrics
Scrapers

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL





Attachment 3

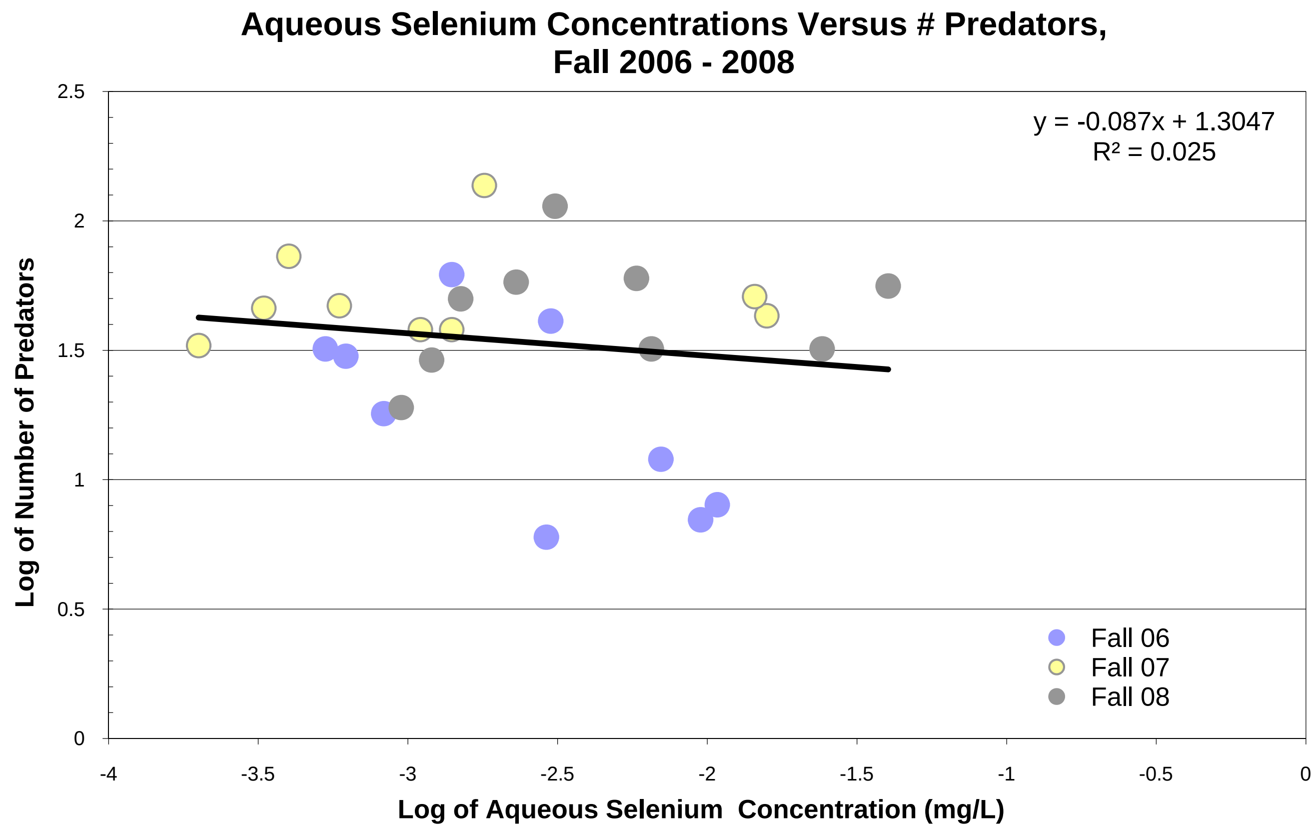
Functional Feeding Group Metrics
Collector-Gatherers

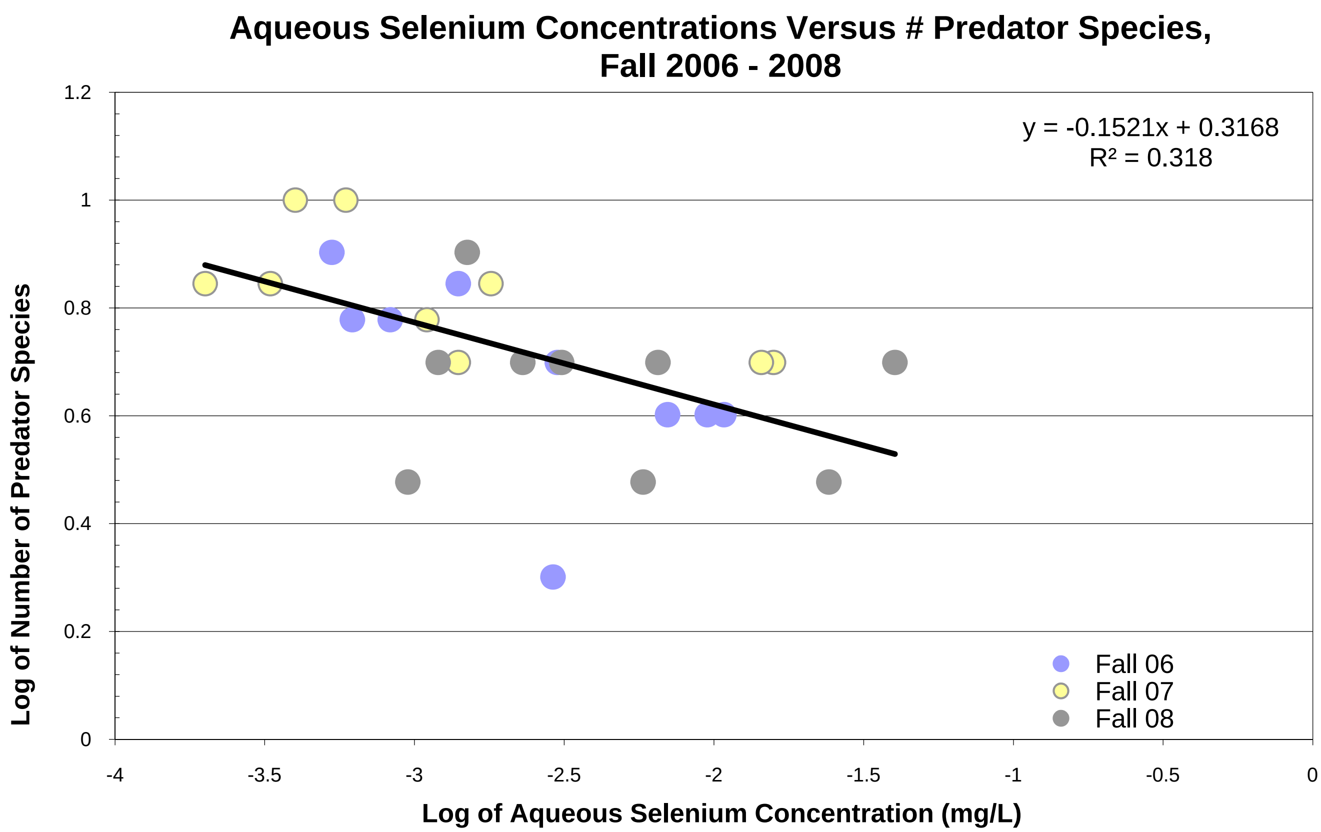
J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

ATTACHMENT 4
Functional Feeding Group Metrics Relative to Selenium Concentrations in Water





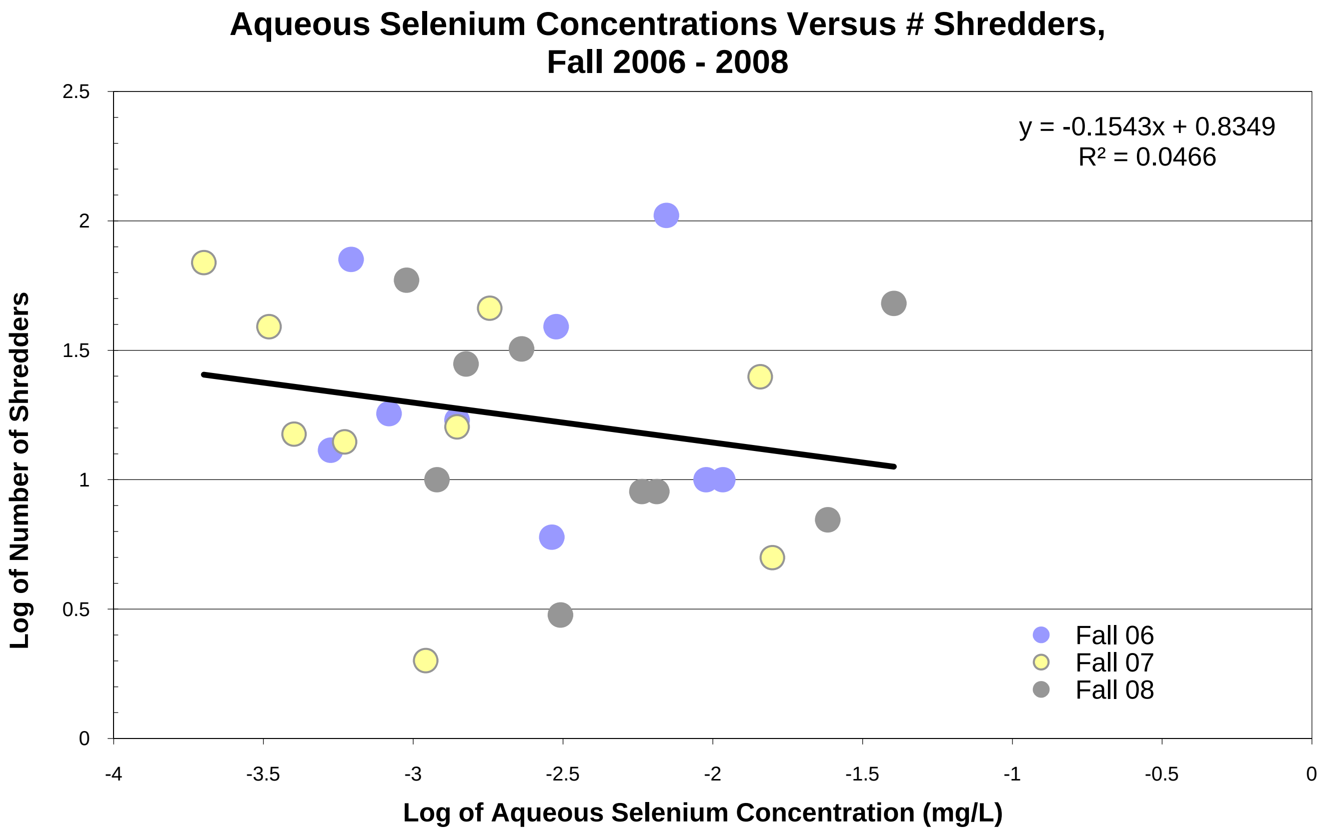
Attachment 4

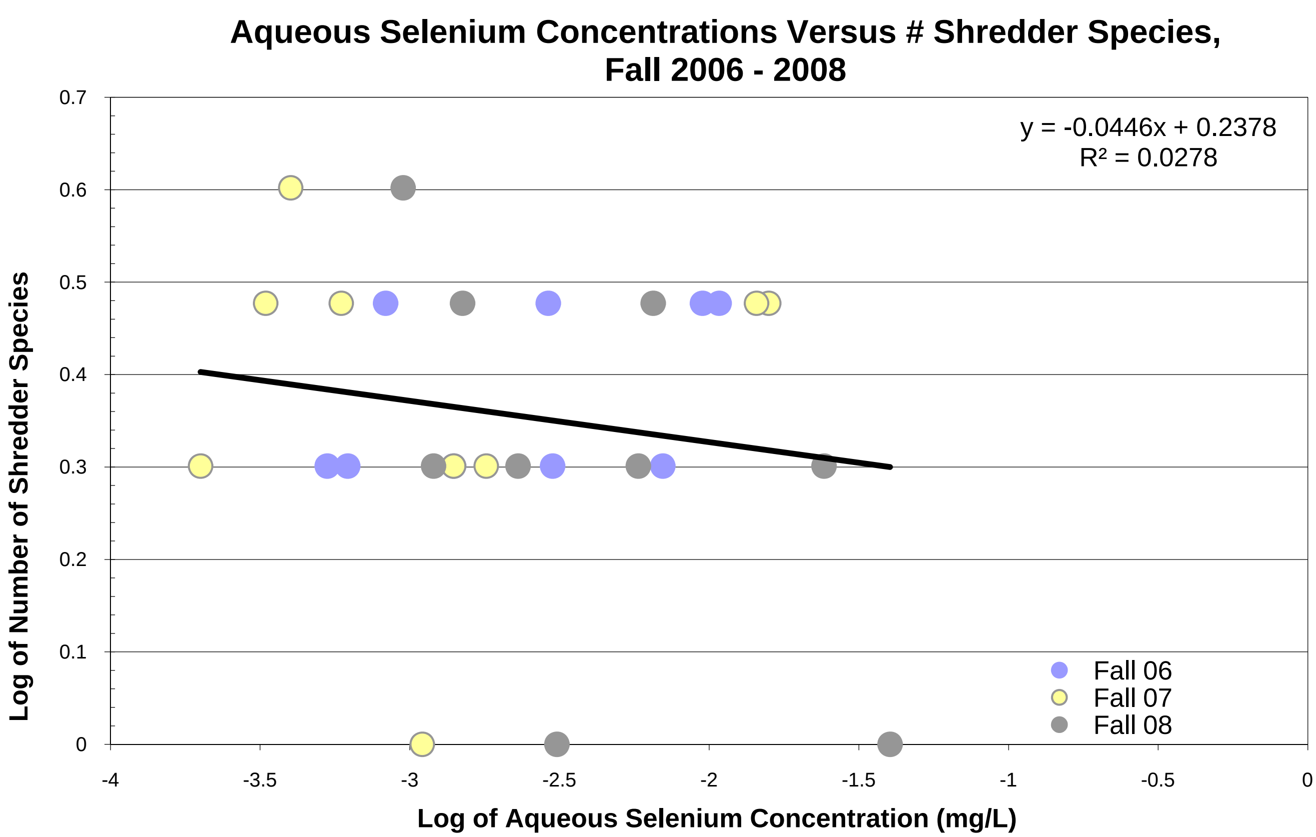
Functional Feeding Group Metrics
Relative to Aqueous Selenium Concentrations
Predators

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL





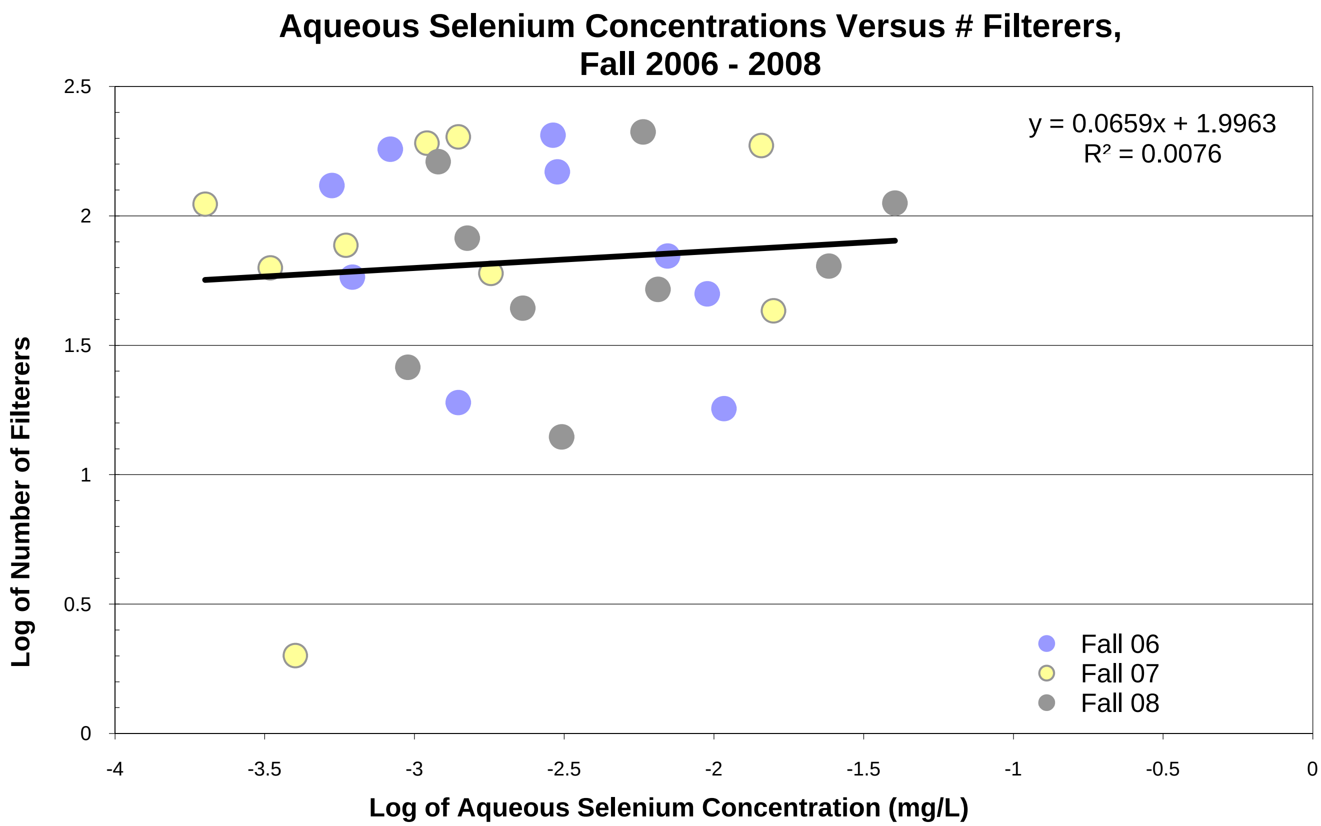
Attachment 4

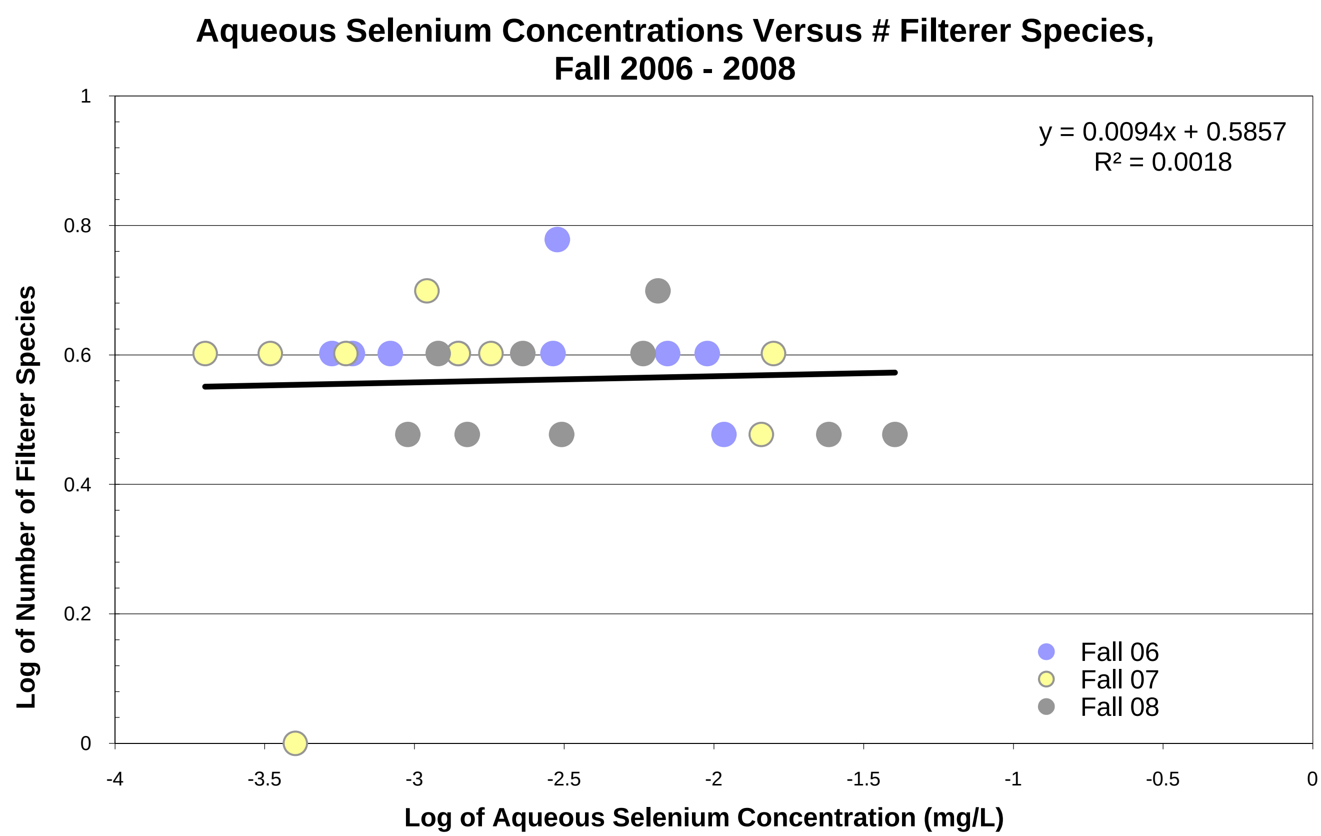
Functional Feeding Group Metrics
Relative to Aqueous Selenium Concentrations
Shredders

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL





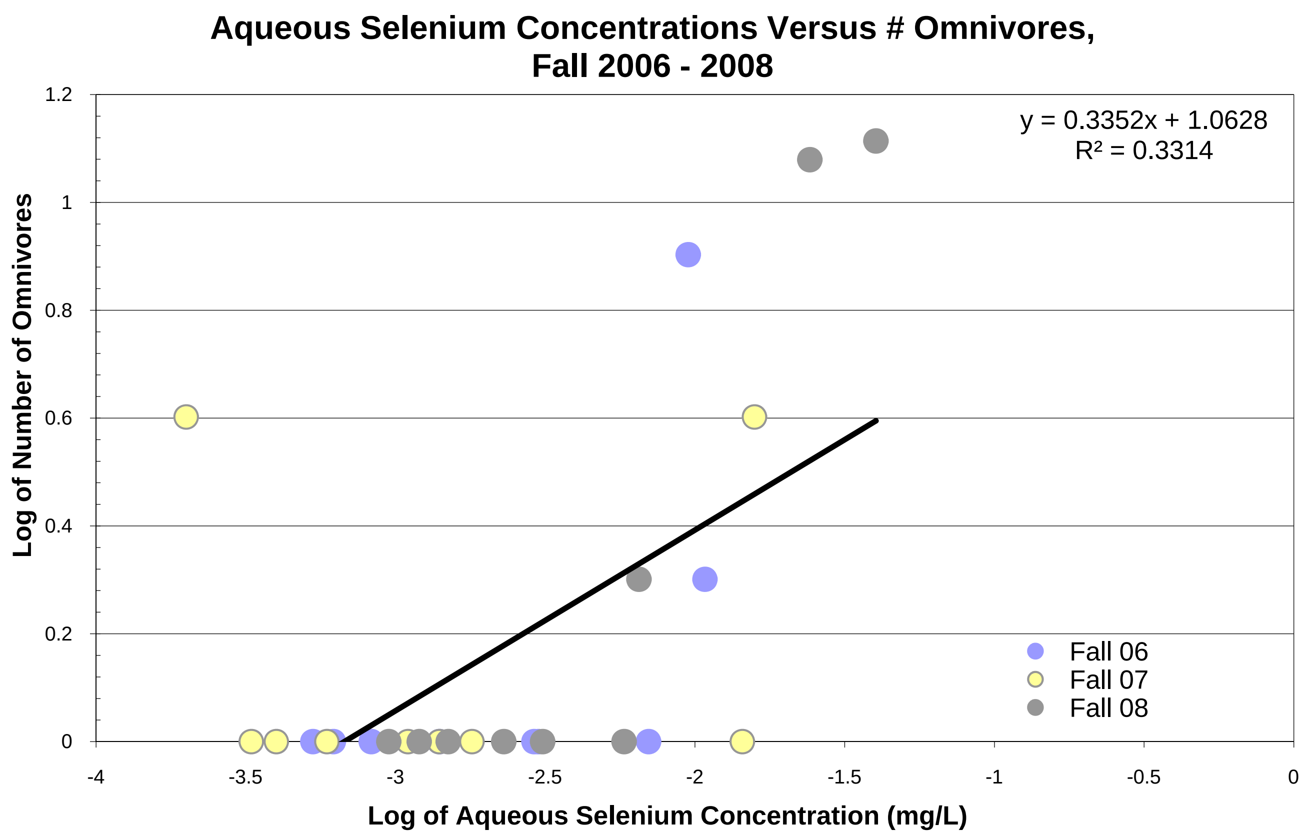
Attachment 4

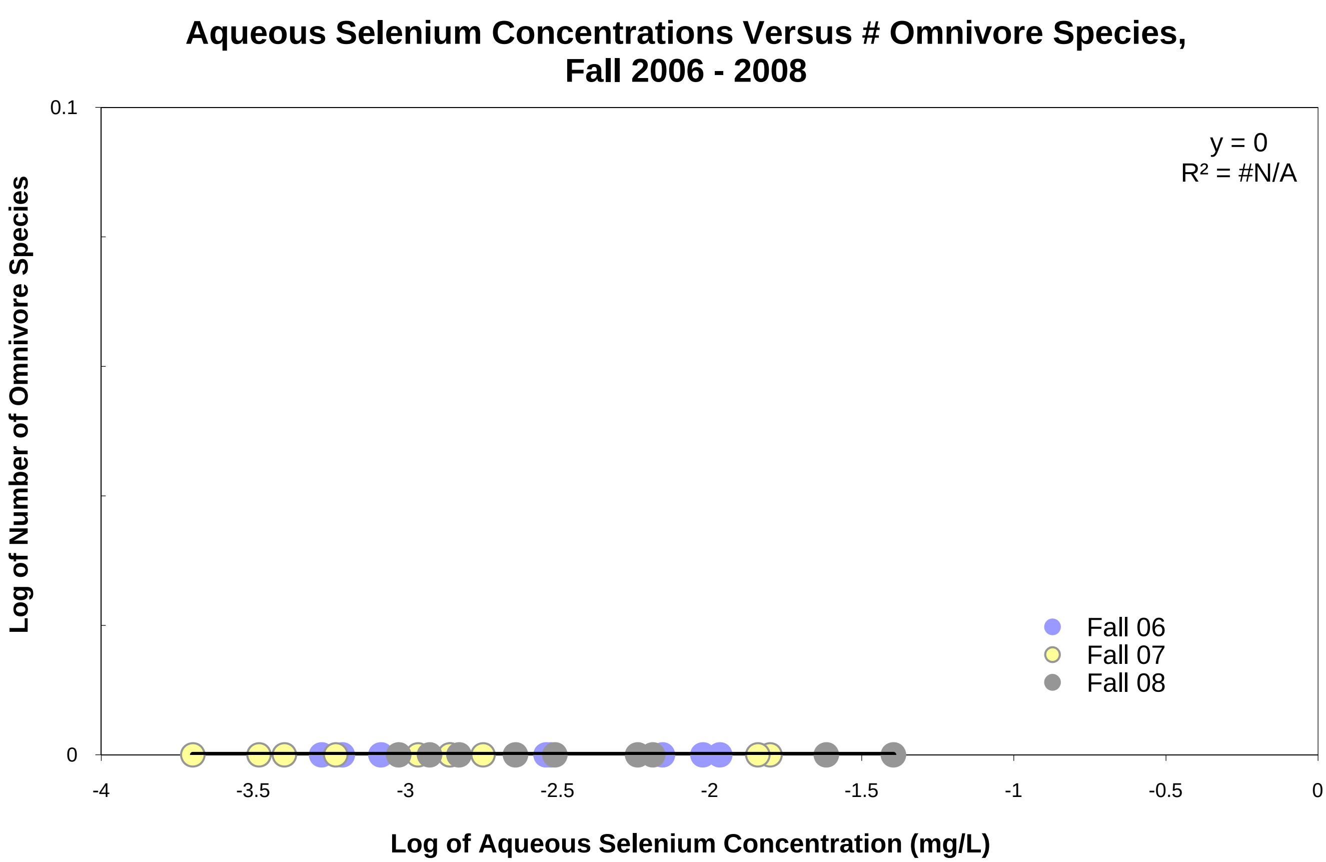
Functional Feeding Group Metrics
Relative to Aqueous Selenium Concentrations
Filterers

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL





Attachment 4

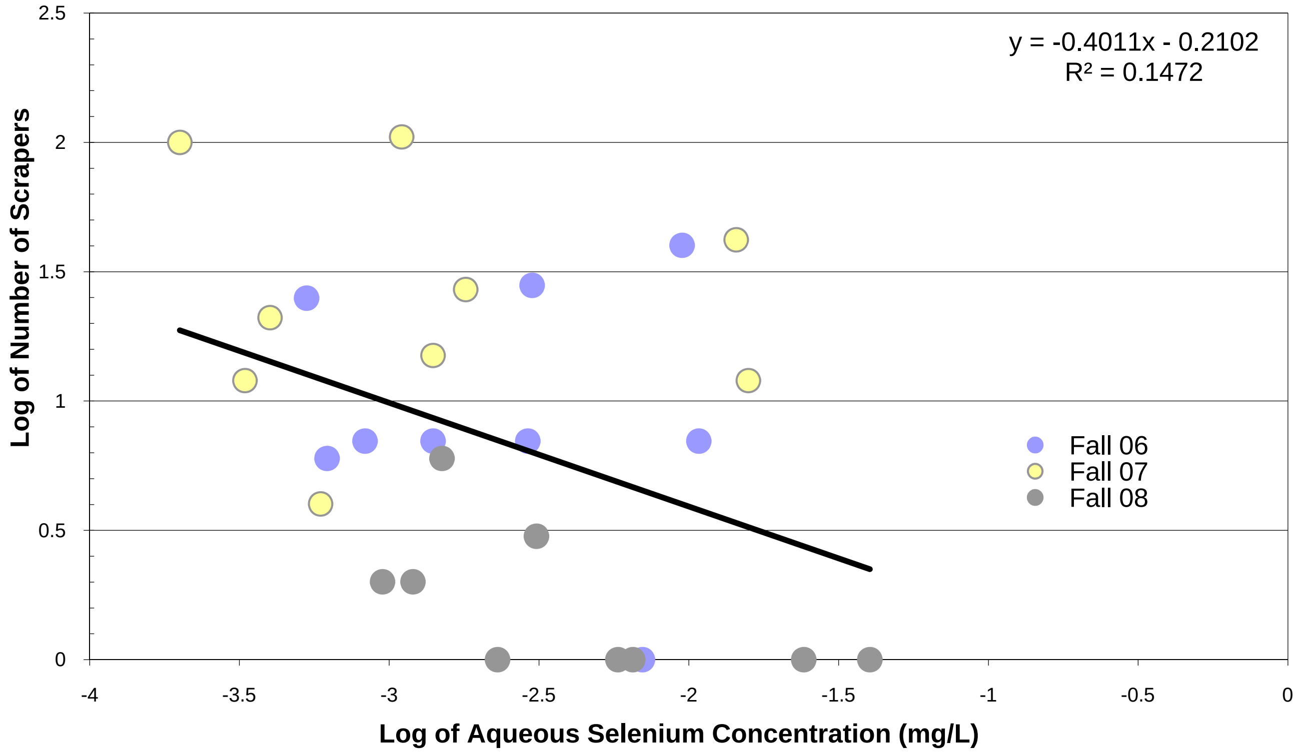
Functional Feeding Group Metrics
Relative to Aqueous Selenium Concentrations
Omnivores

J.R. Simplot Company
Site-Specific Selenium Criterion

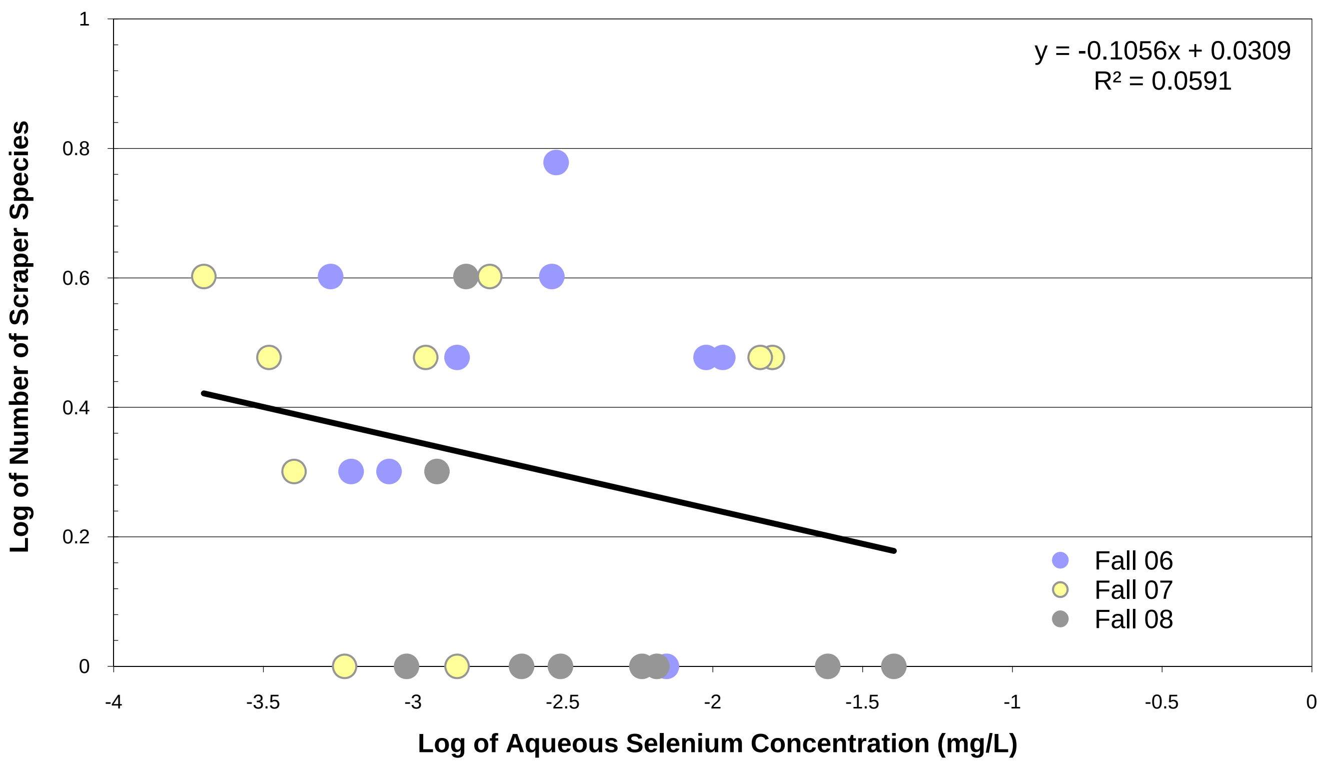
PRJ: 009-004.70	DATE: June 2011
REV: 0	CHK:SMC BY:SMC

FORMATION ENVIRONMENTAL

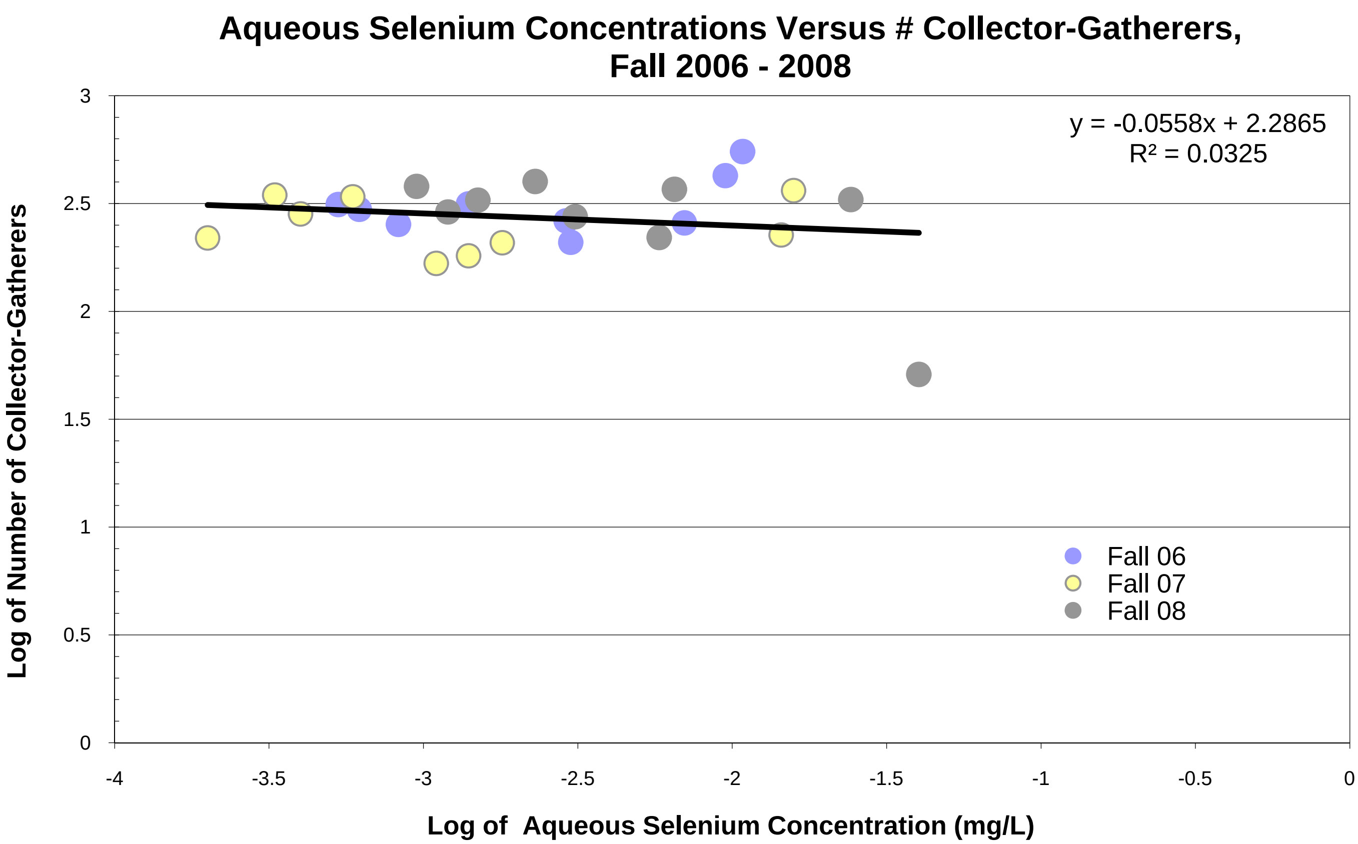
Aqueous Selenium Concentrations Versus # Scrapers, Fall 2006 - 2008

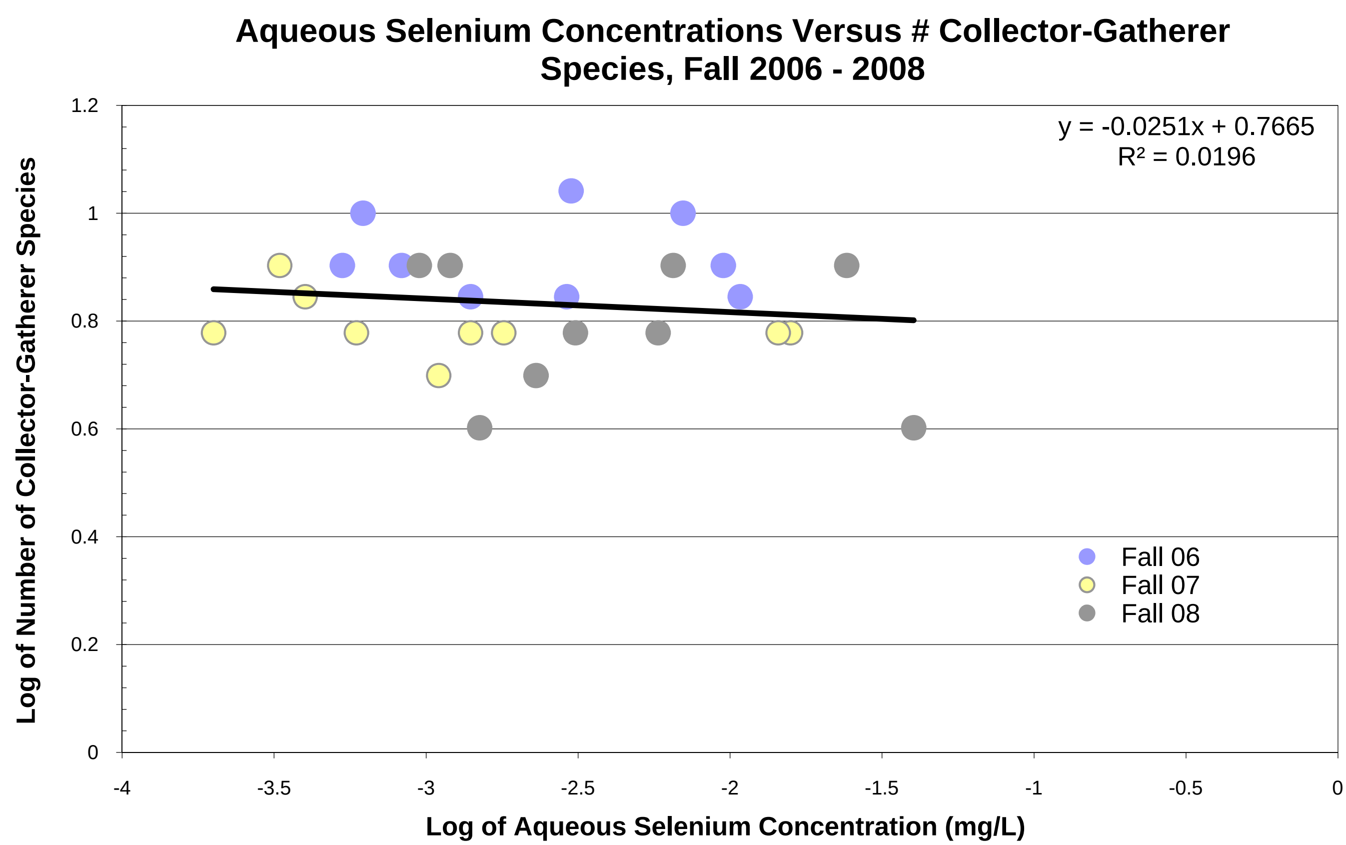


Aqueous Selenium Concentrations Versus # Scraper Species, Fall 2006 - 2008



Attachment 4 **Functional Feeding Group Metrics Relative to Aqueous Selenium Concentrations Scrapers**	**J.R. Simplot Company** Site-Specific Selenium Criterion PRJ: 009-004.70 — DATE: June 2011 REV: 0 — CHK:SMC — BY:SMC FORMATION ENVIRONMENTAL





Attachment 4

Functional Feeding Group Metrics
Relative to Aqueous Selenium Concentrations
Collector-Gatherers

J.R. Simplot Company
Site-Specific Selenium Criterion

PRJ: 009-004.70	DATE: June 2011	
REV: 0	CHK:SMC	BY:SMC

FORMATION ENVIRONMENTAL