APPENDIX E

Aquatic Invertebrates Interagency Monitoring Plan

Aquatic Invertebrate
Interagency Monitoring Plan

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Silver King Creek Macroinvertebrate Monitoring
August 2007-2015

Background

The US Fish and Wildlife Service proposes to treat Silver King Creek basin with rotenone during the late summer of 2010, 2011, and possibly 2012. The goal of this project is to restore Paiute cutthroat trout (*Oncorhynchus clarkii seleniris*), a federally listed threatened species, to its historic habitat**.**

While rotenone is intended to eradicate non-native trout, it is also toxic to some aquatic macroinvertebrates. Rotenone was first used in the Silver King Creek basin in 1964, and on various occasions and locations up to 1993. Macroinvertebrate sampling within the basin began in 1984 and has occurred periodically up to 2007.

This monitoring study differs from the June 15, 2003, Interagency Study Proposal in that it incorporates more sampling stations throughout the basin as well as additional "control" and "treatment" sites. The sampling methodology is also changed to allow for additional analyses such as the River Invertebrate Prediction and Classification System (RIVPACS) analysis model (Hawkins et al. 2000).

Objectives

The primary objectives of this study are to: 1) analyze changes in macroinvertebrate assemblages and taxa from the use of rotenone during Paiute cutthroat trout recovery activities, 2) collect and identify taxa from the Silver King Creek basin, and 3) reestablish historic collection sites in selected streams.

Study Design

Twenty-three quantitative and 5 qualitative sampling site locations were established during August 2007 (Table 1). This study design differs from the June 15, 2003, Interagency Study Proposal in that it incorporates more sampling stations throughout the basin as well as additional "control" and "treatment" sites (eight pairs) (Figures 1 and 2). Five qualitative sampling sites were established within the area to be treated to increase the likelihood of collecting taxa with low relative abundances, i.e. rare taxa (Figure 3). The sampling methodology is also changed to allow for additional analyses.

Past analyses to evaluate the effects of rotenone on aquatic biota are hampered by the lack of data on aquatic invertebrate assemblages prior to the use of rotenone (Vinson and Vinson 2007). This monitoring effort includes five quantitative sampling sites (SKC Site 1 & 2, Tamarack Sites 1-3) and 3 qualitative sampling sites (SKC Site 1, Tamarack Sites 1 & 2) in areas that have never been treated with rotenone which are expected to be treated in the future.

Pre-treatment sampling will be conducted at all sites during mid-August 2007, 2008, and 2009 (2007 and 2008 excerpts attached). Further pre-treatment sampling will also be conducted at all sites during

mid-August 2010, immediately prior to treatment. Post-treatment monitoring will be conducted during mid-August the first year after treatment, 3 years post-treatment, and 5 years post-treatment.

Table 1. Sample Type and Locations within the Silver King Creek Basin

Stream	Site Number	Sample Type	UTM North	UTM East	Elevation (m)
Bull Creek	Bull Site 1	Quantitative	4259066	273218	2457
Corral Creek	Corral Site 1	Quantitative	4263805	274123	2424
Corral Creek	Corral Site 2	Quantitative	4263251	275248	2510
Coyote Creek	Coyote Site 1	Quantitative	4262687	273342	2411
Coyote Creek	Coyote Site 2	Quantitative	4261839	273608	2481
Coyote Creek	Coyote Site 3	Quantitative	4260799	274522	2492
Fly Valley Creek	Fly Site 1	Quantitative	4256568	272140	2653
Four Mile Creek	Four Mile Site 1	Quantitative	4257098	274165	2560
Silver King Creek	SKC Site 1	Quantitative	4264901	272645	2333
Silver King Creek	SKC Site 2	Quantitative	4263842	272756	2345
Silver King Creek	SKC Site 3	Quantitative	4262456	272874	2376
Silver King Creek	SKC Site 4	Quantitative	4262005	272675	2383
Silver King Creek	SKC Site 5	Quantitative	4260832	272085	2416
Silver King Creek	SKC Site 6	Quantitative	4260099	272602	2426
Silver King Creek	SKC Site 7	Quantitative	4259608	273247	2456
Silver King Creek	SKC Site 8	Quantitative	4259289	273140	2460
Silver King Creek	SKC Site 9	Quantitative	4258963	273359	2462
Silver King Creek	SKC Site 10	Quantitative	4258354	273562	2473
Silver King Creek	SKC Site 11	Quantitative	4257651	273471	2503
Silver King Creek	SKC Site 12	Quantitative	4257022	273187	2506
Tamarack Creek	Tamarack Site 2	Quantitative	4261479	271383	2422
Tamarack Creek	Tamarack Site 1	Quantitative	4262448	271943	2400
Tamarack Creek	Tamarack Site 3	Quantitative	4261437	270915	2443
Silver King Creek	SKC Site 1	Qualitative	4264901	272645	2333
Silver King Creek	SKC Site 2	Qualitative	4260655	272242	2416
Silver King Creek	SKC Site 3	Qualitative	4259883	272755	2425
Tamarack Creek	Tamarack Site 1	Qualitative	4261873	271653	2411
Tamarack Creek	Tamarack Site 2	Qualitative	4261457	270972	2439

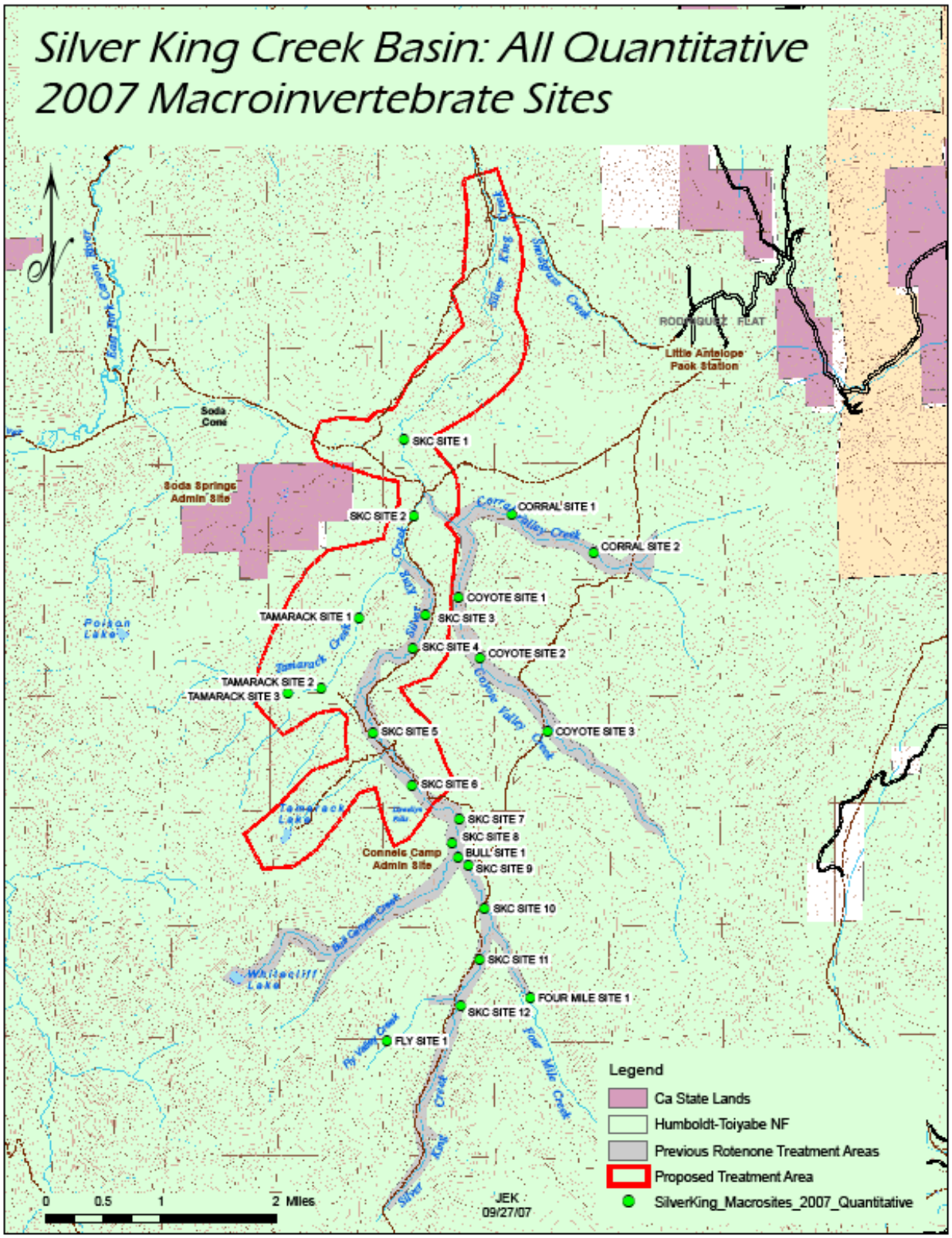

Figure 1. Quantitative Sampling Sites within the Silver King Creek Basin

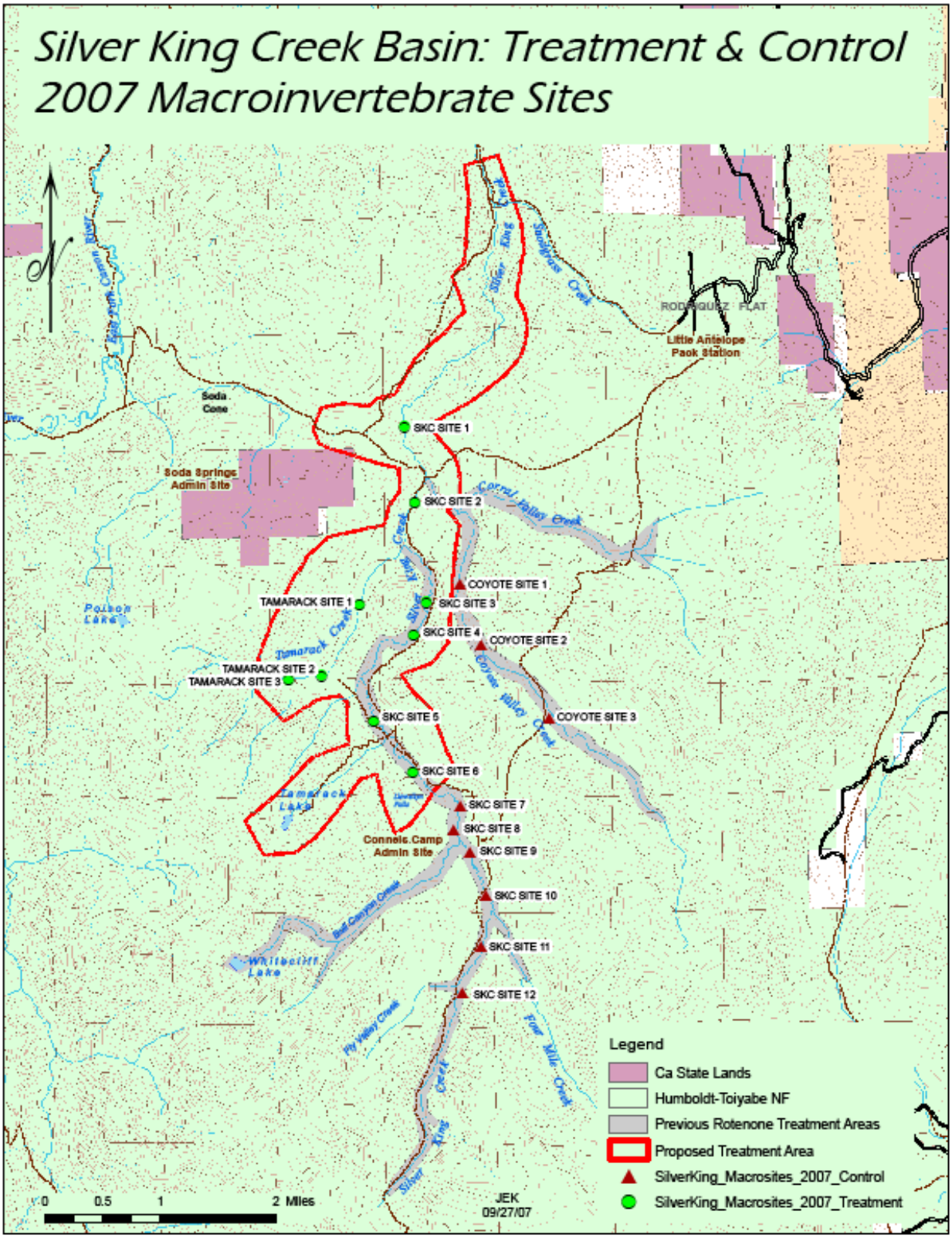

Figure 2. **Quantitative Sampling "Control" and "Treatment" Sites within the Silver King Creek Basin**

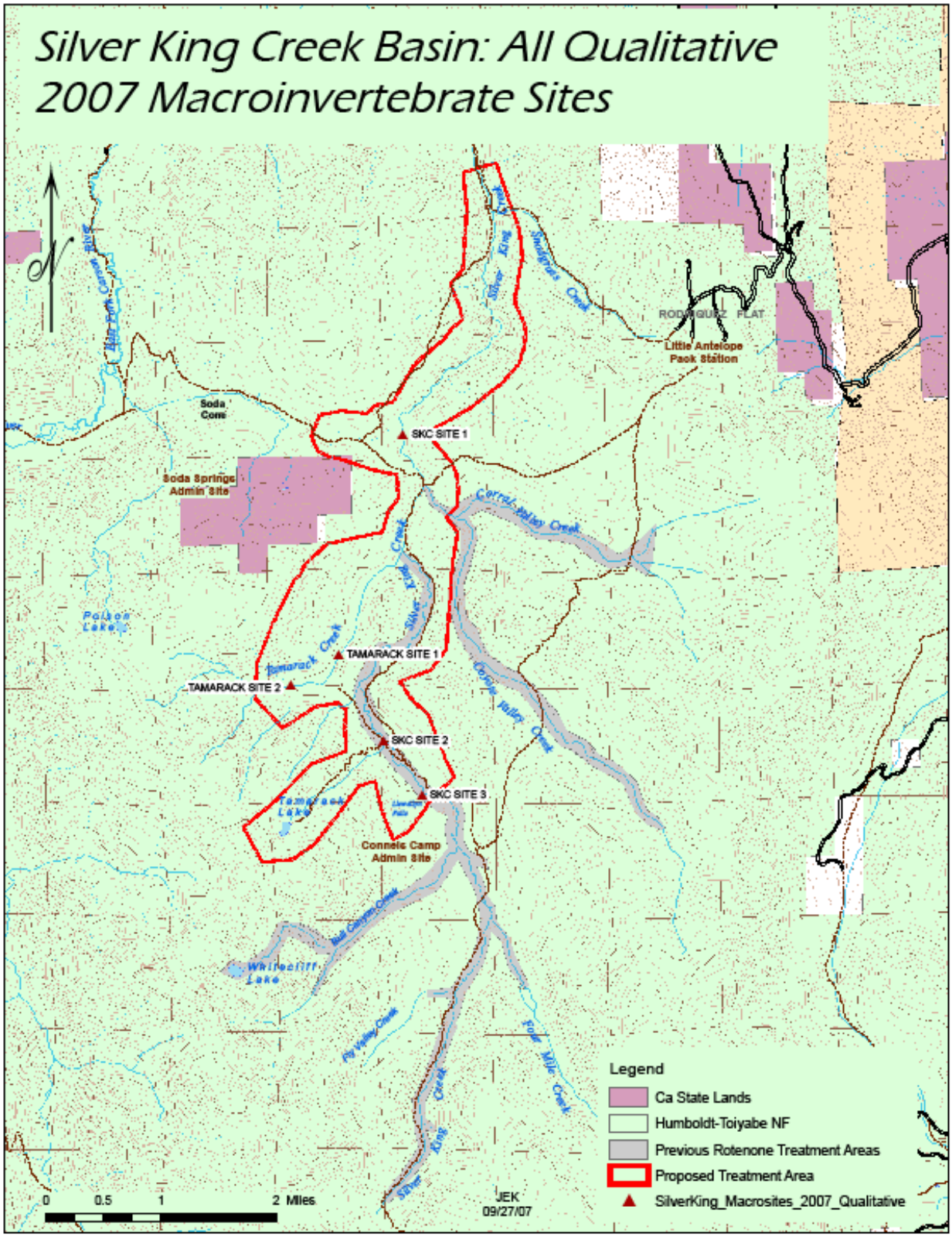

Figure 3. Qualitative Sampling Sites within the Silver King Creek Basin

Sampling Methods

Stream Invertebrate Collection Procedures as described by the National Aquatic Monitoring Center at Utah State University, Logan, Utah (www.usu.edu/buglab/) will be followed. Samples will be sent to the National Aquatic Monitoring Center at Utah State University, Logan, Utah for processing (see www.usu.edu/buglab/ for laboratory methods). Table 2 provides the normal taxonomic resolution of processed samples.

Fixed Area Quantitative Samples

The objective of quantitative invertebrate sampling is to collect the more common invertebrates at a site and estimate their relative abundances. Quantitative samples are collected using a Surber net (0.09 m^2) with a 500 micron mesh net. Eight samples are collected in 4 different riffles (2 samples from each riffle) and composited to make a single sample of approximately 0.74 m^2 for each location on each sampling date.

Qualitative Invertebrate Collections

The objective of qualitative invertebrate collections is to collect as many different kinds of invertebrates living at a site as possible. Samples are collected with a Surber net or a kicknet (457 x 229 mm) with a 500 micron mesh net and by hand picking invertebrates from woody debris and large boulders. All major habitat types (e.g., riffles, pools, back waters, macrophyte beds) are sampled and all samples are composited to form a single sample from each site.

Table 2. Normal Taxonomic Resolution Provided by the National Aquatic Monitoring Center

Taxon or Taxa group	BugLab's Current Standard Taxonomic Level	Northwest Bioassessment Work Group Minimum Standard Taxonomic Effort
Annelida		
Hirudinea	Genus/species	Genus
Oligochaeta	Order	Family
Arthropoda		
Hydracarina	Family/Genus/species	Order
Crustacea		
Anostraca	Genus/species	Genus/species
Cladocera	Genus/species	
Copepoda	Genus/species	
Decapoda	Genus/species	Genus
Ostracoda	Order/Family/Genus	
Crustacea		
Amphipoda	Genus/species	Genus
Isopoda	Genus	Genus
Collembola	Order	
Insecta		
Coleoptera	Genus/species	Genus
Except Curculionidae, Heteroceridae, Ptiliidae	Family	Family

Table 2. Continued

Taxon or Taxa group	BugLab's Current Standard Taxonomic Level	Northwest Bioassessment Work Group Minimum Standard Taxonomic Effort
Diptera		
Atherceridae	Genus/species	Genus
Blephariceridae	Genus/species	Genus
Ceratopogonidae	Genus	Subfamily
Chaoboridae	Genus	
Chironomidae	Subfamily	Genus
Culicidae	Genus	
Deuterophlebiidae	Genus/species	Genus
Dixidae	Genus	Genus
Dolichopodidae	Family	Family
Empididae	Genus	Genus
Ephydridae	Family	Family
Muscidae	Family	Family
Pelecorhynchidae	Genus	Genus
Psychodidae	Genus	Genus
Ptychopteridae	Genus	Genus
Sciomyzidae	Family	
Simuliidae	Genus	Genus
Stratiomyidae	Genus	Genus
Tabanidae	Genus	Family
Tanyderidae	Genus	Genus
Thaumaleidae	Genus	Genus
Tipulidae	Genus	Genus
Ephemeroptera	Genus/species	Genus
Ephemerellidae	species	species
Hemiptera	Genus/species	Genus
Arthropoda		
Lepidoptera	Genus	Genus
Megaloptera	Genus/species	Genus
Odonata	Genus/species	Genus
Plecoptera	Genus/species	Genus
Pteronarcyidae	species	species
Taeniopterygidae	Family/Genus	Family
Trichoptera	Genus/species	
Coelenterata	Class	Class/Order
Mollusca		
Gastropoda	Family/Genus/species	Genus
Pelecypoda	Order/Family/Genus	Genus
Sphaeriidae	Genus/species	Family/Genus
Nematoda	Phylum	Phylum
Nematophora	Phylum	Phylum
Porifera	Phylum	Phylum
Turbellaria	Class	Class

Data Summarization

As part of the National Aquatic Monitoring Center standard reporting, the following metrics or ecological summaries are provided for each sampling station:

Taxa richness	Abundance
EPT	Number of families
Percent taxon or family dominance	Shannon Diversity Index
Biotic indices - Hilsenhoff Biotic Index	Evenness
USFS Community tolerant quotient	Functional feeding group measures
Shredders	Scrapers
Collector-filterers	Collector-gatherers
Predators	Unknown feeding group
Clinger taxa	Long-live taxa

Additional information on the metrics and how they are calculated can be found at www.usu.edu/buglab/.

Statistical Analyses

An equal number (eight pairs) of control and treatment sites will sampled before and after the treatment with rotenone. Pre-treatment sampling will occur in 2007, 2008, and 2009; post-treatment monitoring will be conducted during mid-August the first year after treatment, 3 years post-treatment, and 5 years post-treatment. This will allow for a BACI (Before-After-Control-Impact) analysis to be used to detect treatment effects to biological metrics. Metrics to be used include aquatic invertebrate abundance and taxa richness (genera) which Vinson and Vinson 2007 suggest that differences would be detectable following a rotenone treatment. ANOVA may be also used to evaluate differences in aquatic invertebrate assemblage measures between pre-treatment and post-samples to detect treatment effects. Simple graphs of before and after comparisons will be used to evaluate differences in invertebrate assemblage measures and diversity indices between pre-treatment and post-treatment periods (Vinson and Dinger 2006).

RIVPAC analysis will also be conducted. This analysis allows for the prediction of what taxa should occur at a site in the absence of anthropogenic actions and factors in the probability of occurrences for all individual.

Accumulation curves will be used to provide information on the adequacy of sampling and on the relative number of taxa that may be present but are yet uncollected. These methods will be used following treatment to evaluate assemblage recovery. Rare taxa, (those whose individual abundances are less than 1% of the total sample abundance) will be identified in pre-treatment sampling and tracked post-treatment to detect treatment effects. Of particular interest will be sampling sites, Tamarack 1-3 and Silver King 1 & 2, which are areas that haven’t been treated with rotenone.

Historic Site Monitoring

Long-term sampling sites have been reestablished on Fly Valley Creek, Four-mile Creek, Bull Canyon, and at upstream historic sites in Silver King Creek. Although this monitoring study uses a different sampling design from those used historically, sampling these sites could provide additional information on historic assemblages. The Fly Valley and Four-mile creeks sites are in areas that were never chemically treated and will not be treated.

References

Hawkins, C.P., R.H. Norris, J.N. Hogue, and J.W. Feminella. 2000. Development and evaluation of predictive models for measuring the biological integrity of streams. Ecological Applications 10:1456-1477.

Vinson, M.R., and E. Dinger 2006. Rotenone effects on the aquatic macroinvertebrates of the Virgin River in the vicinity of the Webb Hill Barrier near St. George, Utah, 2003-2005. Final Report for Project Number: IV.A.1. Washington County Water Conservancy District. St. George, Utah. 33 pp.

Vinson, M.R., and D. K. Vinson. 2007. An Analysis of the Effects of Rotenone on Aquatic Invertebrate assemblages in the Silver King Creek Basin, California. Final Report prepared for U.S. Forest Service, Humboldt-Toiyabe National Forest Carson City, NV. 255 pp.

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Aquatic Invertebrate Report for Samples Collected in 2007 from the Silver King Creek Basin, Alpine County, California

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Sampling Locations

All sampling locations were located in Alpine County, California.

Station	Location	Latitude Degrees North	Longitude Degrees West
CORRAL:01	Corral Valley Creek, Lower Site, Site 1	38.494	119.590
CORRAL:02	Corral Valley Creek, Upper Site, Site 2, old site CVALL-10	38.489	119.577
COYOTE:01	Coyote Valley Creek, Lower Site, Site 1	38.484	119.599
COYOTE:02	Coyote Valley Creek, Middle Site, Site 2, old site COVAL-11	38.476	119.595
COYOTE:03	Coyote Valley Creek, Upper Site, Site 3, old site S3:500	38.467	119.584
S1:040	Bull Canyon Creek, Site S1:040	38.451	119.599
S1:250	Four Mile Canyon Creek, middle meadow, Station 1	38.434	119.587
S1:500	Fly Valley Creek, Station 1	38.428	119.610
SKC:01	Silver King Creek, new site 1	38.504	119.607
SKC:01Q	Silver King Creek, New Qualitative Site 1	38.504	119.607
SKC:02	Silver King Creek, new site 2	38.494	119.606
SKC:02Q	Silver King Creek, New Qualitative Site 2	38.465	119.611
SKC:03	Silver King Creek, new site 3 old site SKING-08	38.482	119.604
SKC:03Q	Silver King Creek, New Qualitative Site 3	38.458	119.604
SKC:04	Silver King Creek, new site 4 old site SKING-07	38.477	119.606
SKC:05	Silver King Creek, new site 5 old site SKING-06	38.467	119.612
SKC:06	Silver King Creek, new site 6 old site SKING-05	38.460	119.606
SKC:07	Silver King Creek, new site 7, old site S1:610	38.456	119.599
SKC:08	Silver King Creek, new site 8, old site SKING-04	38.453	119.600
SKC:09	Silver King Creek, new site 9, old sites S4:700 and SKING-01	38.450	119.597
SKC:10	Silver King Creek, new site 10, old site S6:738	38.445	119.595
SKC:11	Silver King Creek, new site 11, old site S7:775	38.438	119.596
SKC:12	Silver King Creek, new site 12, old site S8:813	38.433	119.599
TAMACK:01	Tamarack Creek, Lower Site, Site 1	38.476	119.618
TAMACK:01Q	Tamarack Creek, New Qualitative Site 1	38.476	119.618
TAMACK:02	Tamarack Creek, Middle Site, Site 2, old site TAMAC-14	38.472	119.625
TAMACK:02Q	Tamarack Creek, New Qualitative Site 2	38.472	119.625
TAMACK:03	Tamarack Creek, Upper Site, Site 3	38.472	119.626

Methods

Aquatic Invertebrate Sampling

Quantitative samples were collected at all sampling sites and qualitative samples were collected at a few of the sites (Table 2). The objective of qualitative invertebrate collections was to collect as many different kinds of invertebrates living at a site as possible. Qualitative collections of invertebrates were done at all sites. Samples were collected with a kick net with a 500 micron mesh net and by hand picking invertebrates from woody debris and large

boulders. All major habitat types (e.g., riffles, pools, back waters, macrophyte beds) were sampled and the invertebrates collected were composited to form a single qualitative sample from each site on each sampling date. The objective of quantitative invertebrate sampling was to collect the more common invertebrates at a site and estimate their relative abundances. Quantitative samples were collected using a Surber net (0.093 m2) with a 500 micron mesh net. Samples were collected by disturbing the area within the square sampling frame with our hands and scrubbing individual substrate particles within the sampling area and allowing the invertebrates and detritus to wash downstream into the net. Eight samples were collected in 4 different riffles and composited to make a sample of approximately 0.744 m^2 for each location on each sampling date.

Laboratory Methods

The general procedures followed for processing invertebrate samples were similar to those recommended by the United States Geological Survey (Cuffney et al. 1993) and are described in greater detail and rationalized in Vinson and Hawkins (1996). Methods for individual samples are presented in Table 3. Samples were sub-sampled if the sample appeared to contain more than 600 organisms. Sub-samples were obtained by pouring the sample into an appropriate diameter 250 micron sieve, floating this material by placing the sieve within an enamel pan partially filled with water and leveling the material within the sieve. The sieve was then removed from the water pan and the material within the sieve was divided into equal parts. One side of the sieve was then randomly chosen to be processed and the other side was set aside. The sieve was then placed back in the enamel pan and the material in the sieve again leveled and split in half. This process was repeated until approximately 600 organisms remained in one-half of the sieve. This material was then placed into a petri dish and all organisms were removed under a dissecting microscope at 10-30 power. Additional sub-samples were taken until at least 600 organisms were removed. All organisms within a sub-sample were removed. During the sorting process the organisms were separated into Orders. When the sorting of the sub-samples was completed, the entire sample was spread throughout a large white enamel pan and searched for 10 minutes to remove any taxa that might not have been picked up during the initial sample sorting process. The objective of this "big/rare" search was to provide a more complete taxa list by finding rarer taxa that may have

been excluded during the sub-sampling process. These rarer bugs were placed into a separate vial and tracked separately from the bugs removed during the sub-sampling process. All the organisms removed during the sorting process were then identified. Once the data had been entered into a computer and checked, the unsorted portion of the sample was discarded. The identified portion of the sample was placed in 70% ethanol, given a catalog number, and was retained.

Table 2. Field and Laboratory Processing Information Associated with Each Sample

Sample	Station	Sampling Date	Sampling Method	Habitat Sampled	Sampling Area (m^2)	% of Sample Processed	Number of Individuals Identified
130420	S1:040	8/3/2007	Surber net	Riffle	0.744	100	648
130421	CORRAL:01	8/3/2007	Surber net	Riffle	0.744	25	692
130422	CORRAL:02	8/3/2007	Surber net	Riffle	0.744	25	837
130423	COYOTE:01	8/2/2007	Surber net	Riffle	0.744	19	687
130424	COYOTE:02	8/2/2007	Surber net	Riffle	0.744	75	668
130425	COYOTE:03	8/2/2007	Surber net	Riffle	0.744	50	691
130426	S1:500	8/1/2007	Surber net	Riffle	0.744	50	613
130427	S1:250	8/1/2007	Surber net	Riffle	0.744	25	1083
130434	SKC:01	7/30/2007	Surber net	Riffle	0.744	38	637
130435	SKC:01Q-QL	7/30/2007	Kick net	Multiple	Qualitative	100	354
130436	SKC:02	7/30/2007	Surber net	Riffle	0.744	63	639
130437	SKC:03	7/30/2007	Surber net	Riffle	0.744	38	747
130438	SKC:04	7/30/2007	Surber net	Riffle	0.744	50	568
130439	SKC:05	7/31/2007	Surber net	Riffle	0.744	25	1026
130440	SKC:02Q-QL	7/31/2007	Kick net	Multiple	Qualitative	100	202
130441	SKC:06	7/31/2007	Surber net	Riffle	0.744	28	651
130442	SKC:03Q-QL	8/1/2007	Kick net	Multiple	Qualitative	100	324
130443	SKC:08	8/1/2007	Surber net	Riffle	0.744	38	817
130444	SKC:09	8/1/2007	Surber net	Riffle	0.744	25	908
130445	SKC:10	8/1/2007	Surber net	Riffle	0.744	25	676
130446	SKC:11	8/1/2007	Surber net	Riffle	0.744	38	706
130447	SKC:07	8/1/2007	Surber net	Riffle	0.744	28	809
130448	SKC:12	8/1/2007	Surber net	Riffle	0.744	25	887
130449	TAMACK:01	7/31/2007	Surber net	Riffle	0.744	25	728
130450	TAMACK:01 Q	7/31/2007	Kick net	Multiple	Qualitative	100	158
130451	TAMACK:02	7/31/2007	Surber net	Riffle	0.744	44	911
130452	TAMACK:02 Q	7/31/2007	Kick net	Multiple	Qualitative	100	167
130453	TAMACK:03	7/31/2007	Surber net	Riffle	0.744	38	649

Data Summarization

A number of metrics or ecological summaries were provided for each sampling station. These metrics were calculated as follows:

Taxa Richness - Richness is a component and estimate of community structure and stream health based on the number of distinct taxa. Taxa richness normally decreases with decreasing water quality. In some situations organic enrichment can cause an increase in the number of pollution tolerant taxa. Taxa richness was calculated for operational taxonomic units (OTUs) and the number of unique genera or families. The values for operational taxonomic units may be overestimates of the true taxa richness at a site if individuals were the same taxon as those identified to lower taxonomic levels or they may be underestimates of the true taxa richness if multiple taxa were present within a larger taxonomic grouping but were not identified. All individuals within all samples were generally identified similarly, so that comparisons in operational taxonomic richness among samples within this dataset are appropriate, but comparisons to other data sets may not. Comparisons to other datasets should be made at the genera or family level.

Abundance - The abundance, density, or number of aquatic macroinvertebrates per unit area is an indicator of habitat availability and fish food abundance. Abundance may be reduced or increased depending on the type of impact or pollutant. Increased organic enrichment typically causes large increases in abundance of pollution tolerant taxa. High flows, increases in fine sediment, or the presence of toxic substances normally cause a decrease in invertebrate abundance. Invertebrate abundance is presented as the number of individuals per square meter for quantitative samples and the number of individuals collected for qualitative samples.

EPT - A summary of the taxa richness and abundance among the insect Orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). These orders are commonly considered sensitive to pollution.

Number of Families - All families are separated and counted. The number of families normally decreases with decreasing water quality.

Percent Taxon or Family Dominance – An assemblage dominated by a single taxon or several taxa from the same family suggests environmental stress.

Shannon Diversity Index - Ecological diversity is a measure of community structure defined by the relationship between the number of distinct taxa and their relative abundances. The Shannon diversity index was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. The calculations were made following Ludwig and Reynolds (1988, equation 8.9, page 92).

Evenness - Evenness is a measure of the distribution of taxa within a community. The evenness index used in this report was calculated following Ludwig and Reynolds (1988, equation 8.15, page 94). Value ranges from 0-1 and approach zero as a single taxa becomes more dominant.

Biotic Indices - Biotic indices use the indicator taxa concept. Taxa are assigned water quality tolerance values based on their specific tolerances to pollution. Scores are typically weighted by taxa relative abundance. In the United States the most commonly used biotic index is the Hilsenhoff Biotic Index (Hilsenhoff 1987, Hilsenhoff 1988). The Hilsenhoff Biotic Index (HBI) summarizes the overall pollution tolerances of the taxa collected. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts. It is best at detecting organic pollution. Families were assigned an index value from 0- taxa normally found only in high quality unpolluted water, to 10- taxa found only in severely polluted waters. Family level values were taken from Hilsenhoff (1987, 1988) and a family level HBI was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. Sampling locations with HBI values of 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched, and 7-10 polluted. Rather than using mean HBI values for a sample, taxon HBI values can also be used to determine the number of pollution intolerant and tolerant taxa occurring at a site. In this report taxa with HBI values of 0-2 were considered intolerant clean water taxa and taxa with HBI values of 9-10 were considered pollution tolerant taxa. The number of tolerant and intolerant taxa and the abundances of tolerant and intolerant taxa were calculated for each sampling location.

USFS Community Tolerant Quotient - This index has been widely used by the USFS and BLM throughout the western United States. Taxa are assigned a tolerant quotient (TQ) from 2-taxa found only in high quality unpolluted water, to 108 - taxa found in severely polluted waters. TQ values were developed by Winget and Mangum (1979). The dominance weighted

community tolerance quotient (CTQd) was calculated. Values can vary from about 20 to 100, in general the lower the value the better the water quality.

Functional Feeding Group Measures – A common classification scheme for aquatic macroinvertebrates is to categorize them by feeding acquisition mechanisms. Categories are based on food particle size and food location, e.g., suspended in the water column, deposited in sediments, leaf litter, or live prey. This classification system reflects the major source of the resource, either within the stream itself or from riparian or upland areas and the primary location, either erosional or depositional habitats. The number of taxa and individuals of the following feeding groups were calculated for each sampling location.

Shredders - Shredders use both living vascular hydrophytes and decomposing vascular plant tissue - coarse particulate organic matter (CPOM). Shredders are sensitive to changes in riparian vegetation. Shredders can be good indicators of toxicants that adhere to organic matter.

Scrapers - Scrapers feed on periphyton - attached algae and associated material. Scraper populations increase with increasing abundance of diatoms and can decrease as filamentous algae, mosses, and vascular plants increase. Scrapers decrease in relative abundance in response to sedimentation and organic pollution.

Collector-Filterers - Collector-filterers feed on suspended fine particulate organic matter (FPOM). Collector-gatherers are sensitive to toxicants in the water column and deposited in sediments.

Collector-Gatherers - Collector-gatherers feed on deposited fine particulate organic matter. Collector-gatherers are sensitive to deposited toxicants.

Predators - Predators feed on living animal tissue.

Unknown Feeding Group - This category includes taxa that are highly variable, parasites, and those that for which the primary feeding mode is currently unknown.

Clinger Taxa - The number of Aclinger@ taxa have been found by Karr and Chu (1998) to respond negatively to human disturbance. Clinger taxa were determined using information in Merritt and Cummins (1996). These taxa typically cling to the tops of rocks and are thought to be reduced by sedimentation or abundant algal growths

Long-Live Taxa – The number of long-lived taxa was calculated the number of taxa collected that typically have 2-3 year life cycles. Disturbances and water quality and habitat

impairment typically reduces the number of long-lived taxa Karr and Chu (1998). Life-cycle length determinations were based on information in Merritt and Cummins (1996) and Dr. Mark Vinson's knowledge of the invertebrate fauna of Utah.

Results

Abundance data are reported as the estimated number of individuals per square meter. Taxa richness data are the number per sample. NC = Not calculated. * = unable to calculate. EPT = totals for the insect orders, Ephemeroptera, Plecoptera, Trichoptera. QL in station = qualitative sample.

General Assemblage Measures

Station	Sampling Date	Sample	Total Abundance	EPT Abundance	Number of Families	Dominant Family	% Contribution Dominant Family
S1:040	8/3/2007	130420	871	816	21	Baetidae	30.08
CORRAL:01	8/3/2007	130421	3583	2942	24	Peltoperlidae	36.20
CORRAL:02	8/3/2007	130422	4399	3399	26	Peltoperlidae	22.53
COYOTE:01	8/2/2007	130423	4791	4113	21	Ephemerellidae	29.35
COYOTE:02	8/2/2007	130424	1193	1009	21	Peltoperlidae	38.47
COYOTE:03	8/2/2007	130425	1824	837	16	Elmidae	49.23
S1:500	8/1/2007	130426	1630	1306	22	Ephemerellidae	22.52
S1:250	8/1/2007	130427	5677	3425	25	Baetidae	18.14
SKC:01	7/30/2007	130434	2223	1813	22	Heptageniidae	30.32
SKC:01Q-QL	7/30/2007	130435	354	273	19	Chloroperlidae	27.68
SKC:02	7/30/2007	130436	1348	1097	22	Ephemerellidae	19.96
SKC:03	7/30/2007	130437	2646	1950	23	Ephemerellidae	26.23
SKC:04	7/30/2007	130438	1509	1075	22	Baetidae	23.00
SKC:05	7/31/2007	130439	5395	3245	21	Chironomidae	27.93
SKC:02Q-QL	7/31/2007	130440	202	146	20	Chloroperlidae	25.74
SKC:06	7/31/2007	130441	3050	2427	21	Ephemerellidae	34.07
SKC:03Q-QL	8/1/2007	130442	324	259	26	Chloroperlidae	14.81
SKC:08	8/1/2007	130443	2870	2082	23	Ephemerellidae	28.78
SKC:09	8/1/2007	130444	4761	3243	25	Ephemerellidae	31.04
SKC:10	8/1/2007	130445	3425	2548	20	Peltoperlidae	18.60
SKC:11	8/1/2007	130446	2486	1973	27	Ephemerellidae	26.71
SKC:07	8/1/2007	130447	3753	2644	24	Ephemerellidae	30.00
SKC:12	8/1/2007	130448	4620	3133	25	Baetidae	27.14
TAMACK:01	7/31/2007	130449	3821	2944	20	Ephemerellidae	24.34
TAMACK:01Q	7/31/2007	130450	158	111	14	Peltoperlidae	36.08
TAMACK:02	7/31/2007	130451	2738	2077	22	Ephemerellidae	21.80
TAMACK:02Q	7/31/2007	130452	167	142	22	Heptageniidae	25.75
TAMACK:03	7/31/2007	130453	2281	1757	20	Ephemerellidae	27.53
Mean			2575	1885	22		27.29

Diversity Indices

Station	Sampling Date	Sample	Total Taxa Richness	EPT Taxa Richness	Shannon Diversity	Simpson Diversity	Evenness
S1:040	8/3/2007	130420	37	26	2.363	0.163	0.533
CORRAL:01	8/3/2007	130421	53	36	2.720	0.159	0.374
CORRAL:02	8/3/2007	130422	51	35	3.018	0.085	0.552
COYOTE:01	8/2/2007	130423	42	31	2.775	0.093	0.645
COYOTE:02	8/2/2007	130424	46	32	2.634	0.171	0.375
COYOTE:03	8/2/2007	130425	33	18	2.414	0.181	0.445
S1:500	8/1/2007	130426	46	34	3.091	0.062	0.715
S1:250	8/1/2007	130427	49	34	2.975	0.080	0.622
SKC:01	7/30/2007	130434	47	34	2.778	0.100	0.595
SKC:01Q-QL	7/30/2007	130435	33	24	2.698	0.110	0.583
SKC:02	7/30/2007	130436	49	37	3.102	0.070	0.626
SKC:03	7/30/2007	130437	49	34	2.934	0.079	0.654
SKC:04	7/30/2007	130438	44	31	2.855	0.091	0.607
SKC:05	7/31/2007	130439	59	40	2.96	0.088	0.566
SKC:02Q-QL	7/31/2007	130440	29	19	2.720	0.095	0.675
SKC:06	7/31/2007	130441	44	31	2.815	0.094	0.616
SKC:03Q-QL	8/1/2007	130442	42	27	3.020	0.070	0.684
SKC:08	8/1/2007	130443	55	39	3.185	0.064	0.635
SKC:09	8/1/2007	130444	49	31	2.840	0.097	0.580
SKC:10	8/1/2007	130445	39	26	2.853	0.086	0.651
SKC:11	8/1/2007	130446	54	40	2.902	0.116	0.444
SKC:07	8/1/2007	130447	53	37	3.213	0.062	0.637
SKC:12	8/1/2007	130448	51	34	2.772	0.114	0.518
TAMACK:01	7/31/2007	130449	45	34	2.908	0.086	0.616
TAMACK:01Q	7/31/2007	130450	23	18	2.317	0.167	0.546
TAMACK:02	7/31/2007	130451	39	27	2.969	0.080	0.627
TAMACK:02Q	7/31/2007	130452	39	29	3.011	0.079	0.607
TAMACK:03	7/31/2007	130453	38	31	2.849	0.090	0.621
Mean			44.2	31	2.846	0.101	0.584

Biotic Indices

Station	Sampling Date	Sample	Hilsenhoff Biotic Index		USFS Community Tolerance Quotient CTQd
			Index	Indication	
S1:040	8/3/2007	130420	2.27	Slight organic enrichment	44
CORRAL:01	8/3/2007	130421	1.40	Little organic enricment	53
CORRAL:02	8/3/2007	130422	1.86	Little organic enricment	56
COYOTE:01	8/2/2007	130423	2.04	Slight organic enrichment	51
COYOTE:02	8/2/2007	130424	1.55	Little organic enricment	53
COYOTE:03	8/2/2007	130425	2.87	Slight organic enrichment	60
S1:500	8/1/2007	130426	2.43	Slight organic enrichment	46
S1:250	8/1/2007	130427	2.86	Slight organic enrichment	53
SKC:01	7/30/2007	130434	3.09	Slight organic enrichment	46
SKC:01Q-QL	7/30/2007	130435	2.66	Slight organic enrichment	50
SKC:02	7/30/2007	130436	3.06	Slight organic enrichment	46
SKC:03	7/30/2007	130437	3.11	Slight organic enrichment	47
SKC:04	7/30/2007	130438	2.78	Slight organic enrichment	47
SKC:05	7/31/2007	130439	3.15	Slight organic enrichment	58
SKC:02Q-QL	7/31/2007	130440	2.53	Slight organic enrichment	60
SKC:06	7/31/2007	130441	2.37	Slight organic enrichment	47
SKC:03Q-QL	8/1/2007	130442	2.28	Slight organic enrichment	46
SKC:08	8/1/2007	130443	2.26	Slight organic enrichment	54
SKC:09	8/1/2007	130444	2.54	Slight organic enrichment	55
SKC:10	8/1/2007	130445	2.79	Slight organic enrichment	46
SKC:11	8/1/2007	130446	2.72	Slight organic enrichment	47
SKC:07	8/1/2007	130447	2.53	Slight organic enrichment	50
SKC:12	8/1/2007	130448	3.13	Slight organic enrichment	53
TAMACK:01	7/31/2007	130449	2.45	Slight organic enrichment	46
TAMACK:01Q	7/31/2007	130450	1.91	Little organic enricment	63
TAMACK:02	7/31/2007	130451	2.26	Slight organic enrichment	49
TAMACK:02Q	7/31/2007	130452	2.62	Slight organic enrichment	46
TAMACK:03	7/31/2007	130453	2.52	Slight organic enrichment	42
Mean			2.50		51

Taxa richness and relative abundance values with respect to tolerance or intolerance to pollution were based on the Hilsenhoff Biotic Index (HBI). Intolerant taxa are those taxa given a HBI score of 0, 1, or 2. Tolerant taxa are those taxa given a HBI score of 8, 9, or 10. Abundance data are presented as the estimated number per square meter for quantitative samples and the estimated number of individuals collected for qualitative samples. Taxa richness data are presented as the number of taxa per sample. Numbers in parentheses are percentages of the total. QL in station = qualitative sample.

Station	Sampling Date	Sample	Intolerant Taxa				Tolerant Taxa			
			Richness		Abundance		Richness		Abundance	
S1:040	8/3/2007	130420	19	(51)	242	(28)	0	0	0	0
CORRAL:01	8/3/2007	130421	25	(47)	1234	(34)	1	(2)	22	(1)
CORRAL:02	8/3/2007	130422	22	(43)	1690	(38)	1	(2)	38	(1)
COYOTE:01	8/2/2007	130423	22	(52)	2191	(46)	0	0	0	0
COYOTE:02	8/2/2007	130424	21	(46)	386	(32)	0	0	0	0
COYOTE:03	8/2/2007	130425	14	(42)	550	(30)	0	0	0	0
S1:500	8/1/2007	130426	23	(50)	715	(44)	1	(2)	3	0
S1:250	8/1/2007	130427	24	(49)	1457	(26)	1	(2)	387	(7)
SKC:01	7/30/2007	130434	24	(51)	805	(36)	1	(2)	7	0
SKC:01Q-QL	7/30/2007	130435	19	(58)	188	(53)	0	0	0	0
SKC:02	7/30/2007	130436	29	(59)	464	(34)	0	0	0	0
SKC:03	7/30/2007	130437	25	(51)	982	(37)	1	(2)	11	0
SKC:04	7/30/2007	130438	23	(52)	599	(40)	1	(2)	5	0
SKC:05	7/31/2007	130439	28	(47)	1505	(28)	1	(2)	113	(2)
SKC:02Q-QL	7/31/2007	130440	12	(41)	86	(43)	0	0	0	0
SKC:06	7/31/2007	130441	23	(52)	1312	(43)	1	(2)	38	(1)
SKC:03Q-QL	8/1/2007	130442	19	(45)	139	(43)	1	(2)	1	0
SKC:08	8/1/2007	130443	28	(51)	1269	(44)	1	(2)	50	(2)
SKC:09	8/1/2007	130444	23	(47)	2050	(43)	2	(4)	156	(3)
SKC:10	8/1/2007	130445	18	(46)	1044	(30)	1	(3)	145	(4)
SKC:11	8/1/2007	130446	28	(52)	995	(40)	1	(2)	50	(2)
SKC:07	8/1/2007	130447	24	(45)	1859	(50)	1	(2)	76	(2)
SKC:12	8/1/2007	130448	25	(49)	1313	(28)	1	(2)	290	(6)
TAMACK:01	7/31/2007	130449	22	(49)	1491	(39)	1	(2)	11	0
TAMACK:01Q	7/31/2007	130450	11	(48)	42	(27)	0	0	0	0
TAMACK:02	7/31/2007	130451	17	(44)	989	(36)	0	0	0	0
TAMACK:02Q	7/31/2007	130452	17	(44)	40	(24)	0	0	0	0
TAMACK:03	7/31/2007	130453	20	(53)	1142	(50)	0	0	0	0
Mean			22	(49)	956	(37)	1	(1)	50	(1)

Functional Feeding Groups

Taxa richness by functional feeding group. Data are presented as the number of taxa collected. Numbers in parentheses are percentages of the total. QL in station = qualitative sample.

Station	Sampling Date	Sample	Shredders		Scrapers		Collector-Filterers		Collector-Gatherers		Predators		Unknown	
S1:040	8/3/2007	130420	4	(11)	6	(16)	3	(8)	8	(22)	12	(32)	4	(11)
CORRAL:01	8/3/2007	130421	6	(11)	10	(19)	5	(9)	10	(19)	15	(28)	7	(13)
CORRAL:02	8/3/2007	130422	5	(10)	10	(20)	5	(10)	10	(20)	14	(27)	7	(14)
COYOTE:01	8/2/2007	130423	5	(12)	7	(17)	2	(5)	11	(26)	13	(31)	4	(10)
COYOTE:02	8/2/2007	130424	4	(9)	8	(17)	2	(4)	13	(28)	12	(26)	7	(15)
COYOTE:03	8/2/2007	130425	2	(6)	4	(12)	2	(6)	7	(21)	11	(33)	7	(21)
S1:500	8/1/2007	130426	8	(17)	8	(17)	4	(9)	9	(20)	13	(28)	4	(9)
S1:250	8/1/2007	130427	5	(10)	8	(16)	4	(8)	14	(29)	12	(24)	6	(12)
SKC:01	7/30/2007	130434	3	(6)	5	(11)	5	(11)	15	(32)	14	(30)	3	(6)
SKC:01Q-QL	7/30/2007	130435	4	(12)	4	(12)	3	(9)	11	(33)	7	(21)	3	(9)
SKC:02	7/30/2007	130436	5	(10)	6	(12)	7	(14)	11	(22)	15	(31)	4	(8)
SKC:03	7/30/2007	130437	4	(8)	6	(12)	5	(10)	16	(33)	11	(22)	5	(10)
SKC:04	7/30/2007	130438	4	(9)	6	(14)	6	(14)	13	(30)	10	(23)	4	(9)
SKC:05	7/31/2007	130439	6	(10)	4	(7)	7	(12)	18	(31)	17	(29)	6	(10)
SKC:02Q-QL	7/31/2007	130440	2	(7)	1	(3)	4	(14)	10	(34)	9	(31)	3	(10)
SKC:06	7/31/2007	130441	3	(7)	5	(11)	3	(7)	11	(25)	14	(32)	6	(14)
SKC:03Q-QL	8/1/2007	130442	7	(17)	3	(7)	3	(7)	13	(31)	12	(29)	3	(7)
SKC:08	8/1/2007	130443	7	(13)	6	(11)	5	(9)	17	(31)	14	(25)	6	(11)
SKC:09	8/1/2007	130444	5	(10)	6	(12)	4	(8)	15	(31)	12	(24)	7	(14)
SKC:10	8/1/2007	130445	3	(8)	6	(15)	1	(3)	11	(28)	14	(36)	4	(10)
SKC:11	8/1/2007	130446	6	(11)	8	(15)	5	(9)	13	(24)	18	(33)	4	(7)
SKC:07	8/1/2007	130447	4	(8)	7	(13)	8	(15)	13	(25)	14	(26)	6	(11)
SKC:12	8/1/2007	130448	5	(10)	8	(16)	4	(8)	14	(27)	15	(29)	5	(10)
TAMACK:01	7/31/2007	130449	6	(13)	5	(11)	6	(13)	10	(22)	15	(33)	2	(4)
TAMACK:01Q	7/31/2007	130450	3	(13)	5	(22)	1	(4)	6	(26)	6	(26)	2	(9)
TAMACK:02	7/31/2007	130451	4	(10)	7	(18)	2	(5)	12	(31)	10	(26)	4	(10)
TAMACK:02Q	7/31/2007	130452	4	(10)	9	(23)	3	(8)	8	(21)	14	(36)	1	(3)
TAMACK:03	7/31/2007	130453	7	(18)	7	(18)	3	(8)	9	(24)	10	(26)	2	(5)
Mean			5	(11)	6	(14)	4	(9)	12	(26)	13	(29)	5	(10)

Invertebrate abundance by functional feeding group. Data are presented as the estimated number of individuals per square meter. Numbers in parentheses are percentages of the total. QL in station = qualitative sample.

Station	Sampling Date	Sample	Shredders		Scrapers		Collector-Filterers		Collector-Gatherers		Predators		Unknown	
S1:040	8/3/2007	130420	198	(23)	187	(21)	26	(3)	341	(39)	103	(12)	16	(2)
CORRAL:01	8/3/2007	130421	1431	(40)	409	(11)	48	(1)	687	(19)	859	(24)	149	(4)
CORRAL:02	8/3/2007	130422	1153	(26)	700	(16)	90	(2)	1375	(31)	726	(17)	355	(8)
COYOTE:01	8/2/2007	130423	996	(21)	2026	(42)	216	(5)	784	(16)	583	(12)	186	(4)
COYOTE:02	8/2/2007	130424	566	(47)	91	(8)	32	(3)	233	(20)	201	(17)	69	(6)
COYOTE:03	8/2/2007	130425	137	(8)	177	(10)	11	(1)	169	(9)	409	(22)	921	(50)
S1:500	8/1/2007	130426	364	(22)	352	(22)	85	(5)	602	(37)	195	(12)	32	(2)
S1:250	8/1/2007	130427	790	(14)	656	(12)	108	(2)	2960	(52)	515	(9)	649	(11)
SKC:01	7/30/2007	130434	18	(1)	810	(36)	164	(7)	950	(43)	183	(8)	36	(2)
SKC:01Q-QL	7/30/2007	130435	21	(6)	22	(6)	8	(2)	157	(44)	119	(34)	17	(5)
SKC:02	7/30/2007	130436	47	(3)	316	(23)	226	(17)	543	(40)	154	(11)	23	(2)
SKC:03	7/30/2007	130437	95	(4)	427	(16)	155	(6)	1494	(56)	355	(13)	44	(2)
SKC:04	7/30/2007	130438	192	(13)	133	(9)	28	(2)	897	(59)	137	(9)	19	(1)
SKC:05	7/31/2007	130439	1165	(22)	75	(1)	223	(4)	2973	(55)	754	(14)	202	(4)
SKC:02Q-QL	7/31/2007	130440	21	(10)	1	0	31	(15)	60	(30)	77	(38)	12	(6)
SKC:06	7/31/2007	130441	508	(17)	422	(14)	73	(2)	1501	(49)	436	(14)	91	(3)
SKC:03Q-QL	8/1/2007	130442	60	(19)	10	(3)	42	(13)	92	(28)	80	(25)	37	(11)
SKC:08	8/1/2007	130443	423	(15)	499	(17)	86	(3)	1345	(47)	371	(13)	146	(5)
SKC:09	8/1/2007	130444	426	(9)	294	(6)	156	(3)	3101	(65)	417	(9)	367	(8)
SKC:10	8/1/2007	130445	653	(19)	621	(18)	71	(2)	1337	(39)	454	(13)	288	(8)
SKC:11	8/1/2007	130446	215	(9)	608	(24)	69	(3)	1183	(48)	350	(14)	61	(2)
SKC:07	8/1/2007	130447	215	(6)	613	(16)	413	(11)	1837	(49)	446	(12)	225	(6)
SKC:12	8/1/2007	130448	329	(7)	739	(16)	34	(1)	2884	(62)	534	(12)	99	(2)
TAMACK:01	7/31/2007	130449	774	(20)	694	(18)	208	(5)	1065	(28)	1005	(26)	70	(2)
TAMACK:01Q	7/31/2007	130450	59	(37)	10	(6)	13	(8)	51	(32)	19	(12)	6	(4)
TAMACK:02	7/31/2007	130451	624	(23)	536	(20)	135	(5)	847	(31)	529	(19)	68	(2)
TAMACK:02Q	7/31/2007	130452	33	(20)	22	(13)	8	(5)	74	(44)	28	(17)	2	(1)
TAMACK:03	7/31/2007	130453	311	(14)	564	(25)	23	(1)	984	(43)	388	(17)	12	(1)
Mean			422	(16)	429	(17)	99	(4)	1090	(42)	372	(14)	150	(6)

The 10 metrics thought to be most responsive to human-induced disturbance (Karr and Chu 1998). QL in station = qualitative sample.

Station	Sampling Date	Sample	Total Taxa	Ephemeroptera Taxa	Plecoptera Taxa	Trichoptera Taxa	Long-Lived Taxa	Intolerant Taxa	% Tolerant Individuals	Clinger Taxa	% Contribution Dominant Taxon	% Predators
S1:040	8/3/2007	130420	37	10	8	8	4	19	0.0	21	30.1	11.8
CORRAL:01	8/3/2007	130421	53	11	12	13	11	25	0.6	27	36.2	24.0
CORRAL:02	8/3/2007	130422	51	11	11	13	10	22	0.9	29	22.5	16.5
COYOTE:01	8/2/2007	130423	42	13	10	8	5	22	0.0	19	16.8	12.2
COYOTE:02	8/2/2007	130424	46	15	10	7	11	21	0.0	26	38.5	16.8
COYOTE:03	8/2/2007	130425	33	8	7	3	8	14	0.0	16	39.3	22.4
S1:500	8/1/2007	130426	46	11	11	12	6	23	0.2	26	15.2	12.0
S1:250	8/1/2007	130427	49	12	9	13	8	24	6.8	27	18.1	9.1
SKC:01	7/30/2007	130434	47	14	10	10	10	24	0.3	26	20.1	8.2
SKC:01Q-QL	7/30/2007	130435	33	11	9	4	8	19	0.0	17	21.2	33.6
SKC:02	7/30/2007	130436	49	13	13	11	9	29	0.0	29	14.5	11.4
SKC:03	7/30/2007	130437	49	15	10	9	10	25	0.4	25	18.7	13.4
SKC:04	7/30/2007	130438	44	14	9	8	9	23	0.3	25	23.0	9.1
SKC:05	7/31/2007	130439	59	16	11	13	9	28	2.1	29	15.7	14.0
SKC:02Q-QL	7/31/2007	130440	29	7	6	6	4	12	0.0	12	22.8	38.1
SKC:06	7/31/2007	130441	44	12	9	10	8	23	1.2	26	16.1	14.3
SKC:03Q-QL	8/1/2007	130442	42	8	9	10	7	19	0.3	16	12.7	24.7
SKC:08	8/1/2007	130443	55	15	13	11	6	28	1.7	25	13.2	12.9
SKC:09	8/1/2007	130444	49	11	9	11	7	23	3.3	27	21.5	8.8
SKC:10	8/1/2007	130445	39	12	8	6	6	18	4.2	19	18.6	13.3
SKC:11	8/1/2007	130446	54	14	12	14	7	28	2.0	30	25.5	14.1
SKC:07	8/1/2007	130447	53	13	8	16	9	24	2.0	30	14.8	11.9
SKC:12	8/1/2007	130448	51	13	11	10	5	25	6.3	23	27.1	11.6
TAMACK:01	7/31/2007	130449	45	13	11	10	4	22	0.3	21	19.1	26.3
TAMACK:01Q	7/31/2007	130450	23	9	8	1	2	11	0.0	9	36.1	12.0
TAMACK:02	7/31/2007	130451	39	13	10	4	5	17	0.0	16	20.7	19.3
TAMACK:02Q	7/31/2007	130452	39	11	9	9	5	17	0.0	19	18.0	16.8
TAMACK:03	7/31/2007	130453	38	12	10	9	4	20	0.0	18	20.7	17.0
Mean			44	12	10	9	7	22	1.9	23	21	14.5

List of taxa collected in 28 samples at the sites listed in Table 1. Samples were collected between 10 July 2007 and 3 August 2007. Count is the total number of individuals identified and retained.

Taxon	Count
Annelida	
Clitellata subclass oligochaeta	20
Arthropoda	
Arachnida	
Trombidiformes	316
Entognatha	
Collembola	1
Insecta	
Coleoptera	
Amphizoidae	
Amphizoa insolens	1
Dytiscidae	
Hydroporus	1
Sanfilippodytes	1
Elmidae	146
Cleptelmis addenda	34
Heterlimnius	582
Heterlimnius corpulentus	153
Lara	3
Narpus	1
Narpus concolor	3
Optioservus	53
Optioservus divergens/pecosensis	4
Optioservus quadrimaculatus	58
Hydraenidae	
Hydraena	6
Hydrophilidae	
Ametor	3
Staphylinidae	3
Diptera	
Athericidae	
Atherix pachypus	113
Ceratopogonidae	4
Bezzia	4
Probezzia	59
Chironomidae	54
Chironominae	1003
Orthocladiinae	959
Tanypodinae	52
Dixidae	
Dixa	1
Empididae	2

Taxonomic list, continued.

Taxon	Count
Chelifera	39
Clinocera	1
Pelecorhynchidae	
Glutops	112
Psychodidae	
Pericoma	276
Ptychopteridae	
Ptychoptera	1
Simuliidae	2
Helodon	4
Prosimulium	4
Simulium	252
Simulium tuberosum complex	2
Tipulidae	6
Antocha	42
Dicranota	9
Hexatoma	26
Limnophila	1
Pedicia	2
Tipula	2
Ephemeroptera	
Ameletidae	
Ameletus	87
Baetidae	19
Baetis	2453
Diphetor hageni	21
Ephemerellidae	471
Attenella delantala	107
Caudatella	754
Caudatella heterocaudata	1
Drunella	97
Drunella coloradensis/flavilinea	80
Drunella doddsii	1502
Drunella grandis/spinifera	569
Drunella spinifera	91
Serratella	9
Serratella tibialis	35
Timpanoga hecuba	10
Heptageniidae	385
Cinygma	9
Cinygmula	346
Epeorus	306
Ironodes	147
Rhithrogena	316

Taxonomic list, continued.

Taxon	Count
Leptophlebiidae	145
Paraleptophlebia	90
Heteroptera	
Saldidae	1
Megaloptera	
Sialidae	
Sialis	15
Odonata	
Coenagrionidae	
Argia	1
Plecoptera	
Capniidae	1
Capniidae/leuctridae	18
Chloroperlidae	275
Paraperla	2
Suwallia	213
Sweltsa	210
Leuctridae	25
Moselia infuscata	4
Nemouridae	13
Malenka	147
Visoka cataractae	24
Zapada	25
Zapada cinctipes	31
Zapada columbiana	151
Zapada frigida	1
Zapada oregonensis group	4
Peltoperlidae	
Yoraperla	2380
Perlidae	109
Doroneuria baumanni	99
Hesperoperla pacifica	18
Perlodidae	208
Isoperla	11
Megarcys	1
Oroperla barbara	14
Perlinodes aurea	8
Pteronarcyidae	
Pteronarcella	9
Pteronarcys	1
Pteronarcys princeps	6
Trichoptera	16
Apataniidae	
Apatania	3

Taxonomic list, continued.

Taxon	Count
Pedomoecus sierra	23
Brachycentridae	12
Brachycentrus	10
Brachycentrus americanus	212
Micrasema	300
Glossosomatidae	102
Glossosoma	52
Hydropsychidae	109
Arctopsyche	17
Arctopsyche californica	12
Arctopsyche grandis	86
Hydropsyche	27
Parapsyche	1
Parapsyche elsis	29
Lepidostomatidae	
Lepidostoma	3
Limnephilidae	11
Dicosmoecus	8
Psychoglypha	11
Philopotamidae	21
Dolophilodes	68
Rhyacophilidae	
Rhyacophila	100
Rhyacophila angelita group	13
Rhyacophila arnaudi	52
Rhyacophila betteni group	75
Rhyacophila brunnea/vemna groups	93
Rhyacophila hyalinata group	18
Rhyacophila sibirica group a	1
Rhyacophila verrula group	1
Rhyacophila vofixa group	102
Uenoidae	65
Neophylax	4
Neophylax splendens	2
Neothremma	26
Mollusca	
Bivalvia	
Veneroida	
Pisidiidae	
Pisidium	5
Platyhelminthes	
Turbellaria	297
Total 138 Taxa	**18483**

Literature Cited

Cuffney, T.F., Gurtz, M.E. and Meador, M.R.. 1993. Methods for collecting benthic invertebrate samples as part of the National Water-Quality Assessment Program: United States Geological Survey Open_File Report 93-406.

Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family level biotic index. The Journal of the North American Benthological Society. 7:65-68.

Hilsenhoff, W.L. 1987. An improved index of organic stream pollution. The Great Lakes Entomologist. 20:31-39.

Karr, J.R. and E.W. Chu. 1998. Restoring life in running waters: better biological monitoring. Island Press, Washington, D.C.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology: a primer on methods and computing. John Wiley and Sons. New York.

Merritt, R.W. and K.W. Cummins, editors, 1996. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa.

Vinson, M.R. and C.P. Hawkins. 1996. Effects of sampling area and subsampling procedures on comparisons of taxa richness among streams. Journal of the North American Benthological Society 15:393-400.

Wingett, R.N. and F. A. Mangum. 1979. Biotic condition index: integrated biological, physical, and chemical parameters for management. U.S. Forest Service Intermountain Region, U.S. Department of Agriculture, Ogden, Utah.

Major taxonomic identification resources used

Baumann, R.W., A.R. Gaufin, and R.F. Surdick. The stoneflies (Plecoptera) of the Rocky Mountains. Memoirs of the American Entomological Society Number 31. Academy of Natural Sciences, Philadelphia, Pennsylvania.

Brown, H. P. 1976. Aquatic Dryopoid Beetles (Coleoptera) of the United States. U. S. EPA. Cincinnati, Ohio.

Burch, J. B. 1973. Biota of Freshwater Ecosystems Identification Manual No. 11, Freshwater Unionacean Clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Project # 18050, Contract # 14-12-894.

Burch, J. B. 1973. Freshwater Unionacean Clams (Mollusca:gastropoda) of North America. U. S. Environmental Protection Agency, EPA-600\3-82-023. Contract # 68-03-1290.

Burch, J.B. 1980, 1982, 1988. North American freshwater snails. Walkerana, Volume 1, No. 3 and No. 4 and Volume 2, No. 6. Ann Arbor, Michigan.

Clarke, A.H. 1981. The freshwater molluscs of Canada. National Museum of Canada. Ottawa.

Edmunds, G. F., Jr., S. L. Jensen and L. Berner. 1976. The Mayflies of North and Central America. North Central Publishing Co., St. Paul, Minnesota.

Johannsen, O. A. 1977. Aquatic Diptera: Eggs, Larvae, and Pupae of Aquatic Flies. Published by the University, Ithaca, New York. 210 Pages.

Klemm, D. J. 1985. A Guide to the Freshwater Annelida (Polychaeta, Naidid and Tubificid Oligochaeta and Hirudinea) of North America. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous diving beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa, Ontario, Canada.

McCafferty, W. P. 1981. Aquatic Entomology. Jones and Bartlett Publishers, Inc., Boston.

Merritt, R. W. and K. W. Cummins (Editors). 1996. An Introduction to the Aquatic Insects of North America, Third Edition. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Needham, J.G., M.J. Westfall, Jr., M.L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville, Florida.

Pennak, R. W. 1989. Freshwater Invertebrates of the United States, Third Edition, John Wiley and Sons, Inc, New York.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). Second Edition. University of North Texas Press, Denton Texas.

Thorp J. H. and A. P. Covich (Editors). 1991. Ecology and Classification of Freshwater Inverebrates. Academic Press, Inc., San Diego, California.

Westfall, M.J. Jr., and M.L. 1996. Damselflies of North America. Scientific Publishers, Gainesville, Florida.

Wiederholm, T. (Editor) 1983. Chironomidae of the Holarctic Region. Entomologica Scandinavica.

Wiggins, G. B. 1996. Larvae of North American Caddisfly Genera (Tricoptera). Second Edition, University of Toronto Press. Toronto.

Aquatic Invertebrate Report for Samples Collected by USFS Toiyabe National Forest, USFS Carson Ranger District

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11 June 2009

Sampling Locations

Table 1. Sampling site locations

Station	Location	Latitude	Longitude	Elevation (meters)
CORRAL:01	Corral Valley Creek, Lower Site, Site 1, Alpine County, Nevada	38.494	119.590	0
CORRAL:02	Corral Valley Creek, Upper Site, Site 2, old site CVALL-10, Alpine County, Nevada	38.489	119.577	2505
COYOTE:01	Coyote Valley Creek, Lower Site, Site 1, Alpine County, Nevada	38.484	119.599	0
COYOTE:02	Coyote Valley Creek, Middle Site, Site 2, old site COVAL-11, Alpine County, Nevada	38.476	119.595	2481
COYOTE:03	Coyote Valley Creek, Upper Site, Site 3, old site S3:500, Alpine County, Nevada	38.467	119.584	0
S1:040	Bull Canyon Creek, Site S1:040, Alpine County, Nevada	38.451	119.599	0
S1:250	Four Mile Canyon Creek, middle meadow, Station 1, Alpine County, Nevada	38.434	119.587	0
S1:500	Fly Valley Creek, Station 1, Alpine County, Nevada	38.428	119.610	0
SKC:01	Silver King Creek, new site 1, Alpine County, Nevada	38.503	119.607	0
SKC:01Q	Silver King Creek, New Qualitative Site 1, Alpine County, Nevada	38.503	119.607	0
SKC:02	Silver King Creek, new site 2, Alpine County, Nevada	38.494	119.606	0
SKC:02Q	Silver King Creek, New Qualitative Site 2, Alpine County, Nevada	38.465	119.610	0
SKC:03	Silver King Creek, new site 3 old site SKING-08, Alpine County, Nevada	38.482	119.604	0
SKC:03Q	Silver King Creek, New Qualitative Site 3, Alpine County, Nevada	38.458	119.604	0
SKC:04	Silver King Creek, new site 4 old site SKING-07, Alpine County, Nevada	38.477	119.606	0
SKC:05	Silver King Creek, new site 5 old site SKING-06, Alpine County, Nevada	38.467	119.612	0
SKC:06	Silver King Creek, new site 6 old site SKING-05, Alpine County, Nevada	38.460	119.606	0
SKC:07	Silver King Creek, new site 7, old site S1:610, Alpine County, Nevada	38.456	119.599	0
SKC:08	Silver King Creek, new site 8, old site SKING-04, Alpine County, Nevada	38.453	119.600	0
SKC:09	Silver King Creek, new site 9, old sites S4:700 and SKING-01, Alpine County, Nevada	38.450	119.597	0
SKC:10	Silver King Creek, new site 10, old site S6:738, Alpine County, Nevada	38.445	119.595	0
SKC:11	Silver King Creek, new site 11, old site S7:775, Alpine County, Nevada	38.438	119.595	0
SKC:12	Silver King Creek, new site 12, old site S8:813, Alpine County, Nevada	38.433	119.599	0
TAMACK:01	Tamarack Creek, Lower Site, Site 1, Alpine County, Nevada	38.476	119.618	0
TAMACK:01Q	Tamarack Creek, New Qualitative Site 1, Alpine County, Nevada	38.476	119.618	0

TAMACK:02	Tamarack Creek, Middle Site, Site 2, old site TAMAC-14, Alpine County, Nevada	38.472	119.625	0
TAMACK:02Q	Tamarack Creek, New Qualitative Site 2, Alpine County, Nevada	38.472	119.625	0
TAMACK:03	Tamarack Creek, Upper Site, Site 3, Alpine County, Nevada	38.472	119.626	0

Methods

Field sampling

Samples were collected between August 11, 2008 and August 14, 2008 (Table 2). Aquatic invertebrates were collected qualitatively from all available habitats with a kick net fitted with a 500 micron net and quantitatively from riffle habitats with Surber net with a 500 micron mesh net.

Laboratory methods

General procedures for processing invertebrate samples were similar to those recommended by the United States Geological Survey (Cuffney et al. 1993) and are described in greater detail and rationalized in Vinson and Hawkins (1996). Samples were sub-sampled if the sample appeared to contain more than 600 organisms. Sub-samples were obtained by pouring the sample into an appropriate diameter 500 micron sieve, floating this material by placing the sieve within an enamel pan partially filled with water and leveling the material within the sieve. The sieve was then removed from the water pan and the material within the sieve was divided into two equal parts. One half of the sieve was then randomly chosen to be processed and the other half set aside. The sieve was then placed back in the enamel pan and the material in the sieve again leveled and split in half. This process was repeated until approximately 600 organisms remained in one-half of the sieve. This material was placed into a Petri dish and all organisms were removed under a dissecting microscope at 10-30 power. Additional sub-samples were taken until at least 600 organisms were removed, All organisms within a sub-sample were removed, and separated into taxonomic Orders. When the sorting of the sub-samples was completed, the entire sample was spread throughout a large white enamel pan and searched for 10 minutes to remove any taxa that might not have been picked up during the initial sample sorting process. The objective of this "big/rare" search was to provide a more complete taxa list by finding rarer taxa that may have been excluded during the sub-sampling process. These rarer bugs were placed into a separate vial and the data entered separately from the bugs removed during the sub-sampling process. All the organisms removed during the sorting process were then identified using appropriate identification keys (see literature cited list for list of taxonomic resources used). Once the data had been entered into a computer and checked, the unsorted portion of the sample was discarded. The identified portion of the sample was placed in a 20 ml glass scintillation vial with polypropylene lids in 70% ethanol, given a catalog number, and retained. In this report, metrics were calculated using data from the sub-sampled and big/rare portions of the sample. Abundance data are presented as the estimated number of individuals per square meter for quantitative samples and the estimated number per sample for qualitative samples.

Table 2. Field comments and laboratory processing information.

Sample	Station	Sampling Date	Habitat Sampled	Sampling Method	Sampling Area Sqmts	% of sample processed	Number of individuals identified	Field Comments
140380	SKC:01	08/14/2008	Riffle	Surber net	0.74	100	510	
140381	SKC:01Q	08/14/2008	Multiple	Kick net	1.00	13	647	
140382	SKC:02	08/14/2008	Riffle	Surber net	0.74	56	637	
140383	SKC:02Q	08/12/2008	Multiple	Kick net	1.00	15	618	
140384	SKC:03	08/12/2008	Riffle	Surber net	0.74	25	785	
140385	SKC:03Q	08/13/2008	Multiple	Kick net	1.00	13	625	
140386	SKC:04	08/12/2008	Riffle	Surber net	0.74	38	644	
140387	SKC:05	08/12/2008	Riffle	Surber net	0.74	75	683	
140388	SKC:06	08/12/2008	Riffle	Surber net	0.74	22	674	
140389	SKC:07	08/12/2008	Riffle	Surber net	0.74	25	613	
140390	SKC:08	08/13/2008	Riffle	Surber net	0.74	25	745	
140391	SKC:09	08/13/2008	Riffle	Surber net	0.74	38	936	
140392	SKC:10	08/13/2008	Riffle	Surber net	0.74	38	899	
140393	SKC:11	08/13/2008	Riffle	Surber net	0.74	50	628	
140394	SKC:12	08/13/2008	Riffle	Surber net	0.74	63	622	
140407	TAMACK:01	08/12/2008	Riffle	Surber net	0.74	28	713	
140408	TAMACK:01Q	08/12/2008	Multiple	Kick net	1.00	52	565	
140409	TAMACK:02	08/12/2008	Riffle	Surber net	0.74	25	611	
140410	TAMACK:02Q	08/12/2008	Multiple	Kick net	1.00	22	714	
140411	TAMACK:03	08/12/2008	Riffle	Surber net	0.74	50	620	
140412	COYOTE:01	08/11/2008	Riffle	Surber net	0.74	13	651	
140413	COYOTE:02	08/11/2008	Riffle	Surber net	0.74	19	638	
140414	COYOTE:03	08/11/2008	Riffle	Surber net	0.74	19	705	
140415	CORRAL:01	08/14/2008	Riffle	Surber net	0.74	13	722	
140416	CORRAL:02	08/11/2008	Riffle	Surber net	0.74	19	637	
140417	S1:500	08/13/2008	Riffle	Surber net	0.74	44	703	
140418	S1:250	08/13/2008	Riffle	Surber net	0.74	13	727	
140419	S1:040	08/12/2008	Riffle	Surber net	0.74	29	627	

Data summarization

A number of metrics or ecological summaries can be calculated from an aquatic invertebrate sample. A summary and description of commonly used metrics is available in Barbour et al. (1999, http://www.epa.gov/owow/monitoring/rbp/index.html#Table%20of%20Contents) and Karr and Chu (1998). Both of these publications suggest use of the following metrics for assessing the health of aquatic invertebrate assemblages: Total taxa richness, EPT taxa richness, Ephemeroptera taxa richness, Plecoptera taxa richness, Trichoptera taxa richness, % EPT abundance, % Ephemeroptera abundance, % Chironomidae abundance, Intolerant taxa richness, % tolerant organisms, Hilsenhoff Biotic Index, % contribution of the dominant taxon, clinger taxa richness, % clinger abundance, % collector-filterer abundance, and the % scraper abundance. Assessments are best made by comparing samples to samples collected similarly at reference sites or from samples collected prior to impacts or management actions at a location. In this report, the following metrics were calculated for each sample.

Taxa richness - Richness is a component and estimate of community structure and stream health based on the number of distinct taxa. Taxa richness normally decreases with decreasing water quality. In some situations organic enrichment can cause an increase in the number of pollution tolerant taxa. Taxa richness was calculated for operational taxonomic units (OTUs) and the number of unique genera, and families. The values for operational taxonomic units may be overestimates of the true taxa richness at a site if individuals were the same taxon as those identified to lower taxonomic levels or they may be underestimates of the true taxa richness if multiple taxa were present within a larger taxonomic grouping but were not identified. All individuals within all samples were generally identified similarly, so that comparisons in operational taxonomic richness among samples within this dataset are appropriate, but comparisons to other data sets may not. Comparisons to other datasets should be made at the genera or family level.

Abundance - The abundance, density, or number of aquatic macroinvertebrates per unit area is an indicator of habitat availability and fish food abundance. Abundance may be reduced or increased depending on the type of impact or pollutant. Increased organic enrichment typically causes large increases in abundance of pollution tolerant taxa. High flows, increases in fine sediment, or the presence of toxic substances normally cause a decrease in invertebrate abundance. Invertebrate abundance is presented as the number of individuals per square meter for quantitative samples and the number of individuals collected in each sample for qualitative samples.

EPT - A summary of the taxonomic richness and abundance within the insect Orders Ephemeroptera, Plecoptera, and Trichoptera (EPT). These orders are commonly considered sensitive to pollution (Karr and Chu 1998).

Percent contribution of the dominant family or taxon - An assemblage largely dominated (>50%) by a single taxon or several taxa from the same family suggests environmental stress. Habitat conditions likely limit the number of taxa that can occur at the site.

Shannon diversity index - Ecological diversity is a measure of community structure defined by the relationship between the number of distinct taxa and their relative abundances. The Shannon diversity index was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. The calculations were made following Ludwig and Reynolds (1988, equation 8.9, page 92).

Evenness - Evenness is a measure of the distribution of taxa within a community. The evenness index used in this report was calculated following Ludwig and Reynolds (1988, equation 8.15, page 94). Value ranges from 0-1 and approach zero as a single taxa becomes more dominant.

Clinger taxa - The number of clinger taxa have been found by Karr and Chu (1998) to respond negatively to human disturbance. Clinger taxa were determined using information in Merritt et al. (2008). These taxa typically cling to the tops of rocks and are thought to be reduced by sedimentation or abundant algal growths.

Long-live taxa - The number of long-lived taxa was calculated the number of taxa collected that typically have 2-3 year life cycles. Disturbances and water quality and habitat impairment typically reduces the number of long-lived taxa Karr and Chu (1998). Life-cycle length determinations were based on information in Merritt et al. (2008).

Biotic indices - Biotic indices use the indicator taxa concept. Taxa are assigned water quality tolerance values based on their tolerance to pollution. Scores are typically weighted by taxa relative abundance. In the United States the most commonly used biotic index is the Hilsenhoff Biotic Index (Hilsenhoff 1987, Hilsenhoff 1988). The USFS and BLM

throughout the western United States have also frequently used the USFS Community Tolerance Quotient.

Hilsenhoff biotic index - The Hilsenhoff Biotic Index (HBI) summarizes the overall pollution tolerances of the taxa collected. This index has been used to detect nutrient enrichment, high sediment loads, low dissolved oxygen, and thermal impacts. It is best at detecting organic pollution. Families were assigned an index value from 0- taxa normally found only in high quality unpolluted water, to 10- taxa found only in severely polluted waters. Family level values were taken from Hilsenhoff (1987, 1988) and a family level HBI was calculated for each sampling location for which there were a sufficient number of individuals and taxa collected to perform the calculations. Sampling locations with HBI values of 0-2 are considered clean, 2-4 slightly enriched, 4-7 enriched, and 7-10 polluted. Rather than using mean HBI values for a sample, taxon HBI values can also be used to determine the number of pollution intolerant and tolerant taxa occurring at a site. In this report, taxa with HBI values ≤ 1 were considered intolerant clean water taxa and taxa with HBI values ≥ 9 were considered pollution tolerant taxa. The number of tolerant and intolerant taxa and the abundances of tolerant and intolerant taxa were calculated for each sampling location.

USFS community tolerant quotient - Taxa are assigned a tolerant quotient (TQ) from 2 - taxa found only in high quality unpolluted water, to 108 - taxa found in severely polluted waters. TQ values were developed by Winget and Mangum (1979). The dominance weighted community tolerance quotient (CTQd) was calculated. Values can vary from about 20 to 100, in general the lower the value the better the water quality.

Functional feeding group measures - A common classification scheme for aquatic macroinvertebrates is to categorize them by feeding acquisition mechanisms. Categories are based on food particle size and food location, e.g., suspended in the water column, deposited in sediments, leaf litter, or live prey. This classification system reflects the major source of the resource, either within the stream itself or from riparian or upland areas and the primary location, either erosional or depositional habitats. The number of taxa and individuals of the following feeding groups were calculated for each sampling location. Functional feeding group designations were from Merritt et al. (2008).

Shredders - Shredders use both living vascular hydrophytes and decomposing vascular plant tissue - coarse particulate organic matter. Shredders are sensitive to changes in riparian vegetation. Shredders can be good indicators of toxicants that adhere to organic matter.

Scrapers - Scrapers feed on periphyton - attached algae and associated material. Scraper populations increase with increasing abundance of diatoms and can decrease as filamentous algae, mosses, and vascular plants increase, often in response to increases in nitrogen and phosphorus. Scrapers decrease in relative abundance in response to sedimentation and higher levels of organic pollution or nutrient enrichment.

Collector-filterers - Collector-filterers feed on suspended fine particulate organic matter. Collector-filterers are sensitive to toxicants in the water column and to pollutants that adhere to organic matter.

Collector-gatherers - Collector-gatherers feed on deposited fine particulate organic matter. Collector-gatherers are sensitive to deposited toxicants.

Predators - Predators feed on living animal tissue. Predators typically make up about 25% of the assemblage in stream environments and 50% of the assemblage in still-water environments.

Unknown feeding group - This category includes taxa that are highly variable, parasites, and those that for which the primary feeding mode is currently unknown.

Results

Abundance data and taxa richness are reported as the estimated number of individuals per square meter for quantitative samples and the number per sample for qualitative samples. NC = Not calculated. * = unable to calculate. EPT = totals for the insect orders, Ephemeroptera, Plecoptera, Trichoptera. QL = qualitative sample.

Sample	Sampling date	Station	Total abundance	EPT abundance	Dominant family	% contribution dominant family
140380	08/14/2008	SKC:01	689	269	Chironomidae	48.17
140381	08/14/2008	SKC:01Q	647	260	Chironomidae	44.98
140382	08/14/2008	SKC:02	1512	1259	Baetidae	19.58
140383	08/12/2008	SKC:02Q	618	177	Chironomidae	61.17
140384	08/12/2008	SKC:03	4077	2615	Baetidae	25.75
140385	08/13/2008	SKC:03Q	625	243	Chironomidae	39.84
140386	08/12/2008	SKC:04	2278	1420	Chironomidae	23.88
140387	08/12/2008	SKC:05	1226	727	Chironomidae	24.23
140388	08/12/2008	SKC:06	4038	2527	Peltoperlidae	33.21
140389	08/12/2008	SKC:07	3273	2001	Peltoperlidae	27.25
140390	08/13/2008	SKC:08	3869	2696	Peltoperlidae	20.11
140391	08/13/2008	SKC:09	3308	1623	Chironomidae	29.08
140392	08/13/2008	SKC:10	3197	2410	Peltoperlidae	33.00
140393	08/13/2008	SKC:11	1669	1426	Peltoperlidae	31.88
140394	08/13/2008	SKC:12	1333	946	Heptageniidae	18.53
140407	08/12/2008	TAMACK:01	3395	2277	Chironomidae	23.77
140408	08/12/2008	TAMACK:01Q	565	296	Chironomidae	33.10
140409	08/12/2008	TAMACK:02	3262	2503	Peltoperlidae	37.12
140410	08/12/2008	TAMACK:02Q	714	261	Chironomidae	45.52
140411	08/12/2008	TAMACK:03	1634	1293	Ephemerellidae	28.65
140412	08/11/2008	COYOTE:01	6574	4180	Peltoperlidae	34.04
140413	08/11/2008	COYOTE:02	4522	1880	Chironomidae	27.13
140414	08/11/2008	COYOTE:03	4765	1593	Elmidae	41.64
140415	08/14/2008	CORRAL:01	7304	5580	Peltoperlidae	33.05
140416	08/11/2008	CORRAL:02	4491	1740	Chironomidae	33.53
140417	08/13/2008	S1:500	2128	1436	Ephemerellidae	31.49
140418	08/13/2008	S1:250	7235	4285	Elmidae	26.07
140419	08/12/2008	S1:040	2906	1822	Chironomidae	29.08
Mean			2923.3	1776.6		32.32

Diversity indices

Sample	Sampling Date	Station	Total taxa richness	Total genera richness	Total family richness	EPT taxa richness	Shannon diversity index	Evenness
140380	08/14/2008	SKC:01	44	30	31	24	2.680	0.710
140381	08/14/2008	SKC:01Q	55	40	30	32	2.730	0.680
140382	08/14/2008	SKC:02	43	31	27	26	2.960	0.790
140383	08/12/2008	SKC:02Q	46	32	24	31	2.300	0.600
140384	08/12/2008	SKC:03	46	29	23	28	2.820	0.740
140385	08/13/2008	SKC:03Q	51	37	33	28	2.860	0.730
140386	08/12/2008	SKC:04	46	31	25	30	2.810	0.730
140387	08/12/2008	SKC:05	50	34	27	29	2.990	0.760
140388	08/12/2008	SKC:06	46	29	27	24	2.740	0.710
140389	08/12/2008	SKC:07	51	35	30	28	2.690	0.680
140390	08/13/2008	SKC:08	48	29	26	32	2.970	0.770
140391	08/13/2008	SKC:09	52	31	25	31	2.840	0.720
140392	08/13/2008	SKC:10	46	29	23	31	2.710	0.710
140393	08/13/2008	SKC:11	45	30	24	29	2.830	0.740
140394	08/13/2008	SKC:12	51	36	27	34	3.060	0.780
140407	08/12/2008	TAMACK:01	43	29	25	31	2.730	0.730
140408	08/12/2008	TAMACK:01Q	46	29	24	33	2.830	0.740
140409	08/12/2008	TAMACK:02	49	31	26	35	2.670	0.690
140410	08/12/2008	TAMACK:02Q	56	40	29	34	2.950	0.730
140411	08/12/2008	TAMACK:03	51	33	27	34	3.200	0.810
140412	08/11/2008	COYOTE:01	49	30	24	31	2.520	0.650
140413	08/11/2008	COYOTE:02	50	34	31	28	3.030	0.770
140414	08/11/2008	COYOTE:03	39	27	21	23	2.730	0.740
140415	08/14/2008	CORRAL:01	52	34	28	33	2.820	0.710
140416	08/11/2008	CORRAL:02	43	23	26	24	2.790	0.740
140417	08/13/2008	S1:500	57	33	27	38	3.010	0.740
140418	08/13/2008	S1:250	45	31	27	30	2.670	0.700
140419	08/12/2008	S1:040	44	31	26	28	2.630	0.690
Mean			48.0	31.7	26.5	30.0	2.800	0.730

Genera richness by major taxonomic group.

Sample	Sampling Date	Station	Coleoptera	Diptera	Ephemerotpera	Heteroptera	Megaloptera	Odonata	Plecoptera	Trichoptera	Annelida	Custacea	Mollusca
140380	08/14/2008	SKC:01	3	11	12	0	2	0	5	7	1	0	0
140381	08/14/2008	SKC:01Q	4	12	12	0	1	0	11	9	1	0	1
140382	08/14/2008	SKC:02	3	9	12	0	0	0	7	7	0	0	0
140383	08/12/2008	SKC:02Q	5	9	10	0	0	0	11	10	1	0	0
140384	08/12/2008	SKC:03	5	8	11	0	0	0	10	7	1	0	1
140385	08/13/2008	SKC:03Q	4	11	8	0	1	0	11	9	0	0	1
140386	08/12/2008	SKC:04	5	9	11	0	0	0	11	8	0	0	0
140387	08/12/2008	SKC:05	5	11	10	0	0	0	9	10	0	0	1
140388	08/12/2008	SKC:06	3	11	10	0	0	0	8	6	1	0	1
140389	08/12/2008	SKC:07	3	13	8	0	0	0	6	14	1	0	1
140390	08/13/2008	SKC:08	4	6	14	0	0	0	6	12	0	0	1
140391	08/13/2008	SKC:09	4	11	14	0	0	0	7	10	1	0	1
140392	08/13/2008	SKC:10	1	9	11	0	0	0	10	10	1	0	0
140393	08/13/2008	SKC:11	3	9	12	0	0	0	9	8	0	0	0
140394	08/13/2008	SKC:12	2	10	9	0	0	0	12	13	0	0	0
140407	08/12/2008	TAMACK:01	1	8	11	0	0	0	9	11	0	0	0
140408	08/12/2008	TAMACK:01Q	0	6	12	0	1	0	11	10	0	0	0
140409	08/12/2008	TAMACK:02	2	8	14	0	0	0	11	10	0	0	0
140410	08/12/2008	TAMACK:02Q	2	12	13	0	0	0	11	10	1	0	0
140411	08/12/2008	TAMACK:03	1	12	12	0	0	0	10	12	0	0	0
140412	08/11/2008	COYOTE:01	5	8	10	0	0	0	12	9	1	0	0
140413	08/11/2008	COYOTE:02	6	9	11	0	1	0	10	7	0	0	1
140414	08/11/2008	COYOTE:03	6	6	10	0	0	0	8	5	1	0	1
140415	08/14/2008	CORRAL:01	6	7	13	0	0	0	9	11	1	0	1
140416	08/11/2008	CORRAL:02	4	10	8	0	0	0	7	9	1	0	0
140417	08/13/2008	S1:500	2	9	12	0	0	0	10	16	1	0	0
140418	08/13/2008	S1:250	3	8	10	0	0	0	8	12	1	0	1
140419	08/12/2008	S1:040	3	10	12	0	0	0	7	9	0	0	1
Mean			**3.4**	**9.4**	**11.1**	**0.0**	**0.2**	0.0	**9.1**	**9.7**	0.5	**0.0**	**0.5**

Total abundance by major taxonomic group.

Sample	Sampling Date	Station	Coleoptera	Diptera	Ephemerotpera	Heteroptera	Megaloptera	Odonata	Plecoptera	Trichoptera	Annelida	Custacea	Mollusca
140380	08/14/2008	SKC:01	12	358	182	0	19	0	36	50	18	0	0
140381	08/14/2008	SKC:01Q	22	341	137	0	2	0	96	27	1	0	1
140382	08/14/2008	SKC:02	41	183	780	0	0	0	175	305	0	0	0
140383	08/12/2008	SKC:02Q	17	419	70	0	0	0	87	20	5	0	0
140384	08/12/2008	SKC:03	119	1257	2041	0	0	0	342	232	16	0	5
140385	08/13/2008	SKC:03Q	16	327	100	0	19	0	109	34	0	0	3
140386	08/12/2008	SKC:04	25	826	1037	0	0	0	192	191	0	0	0
140387	08/12/2008	SKC:05	93	350	259	0	0	0	232	236	0	0	2
140388	08/12/2008	SKC:06	120	964	701	0	0	0	1513	314	130	0	32
140389	08/12/2008	SKC:07	162	969	304	0	0	0	968	730	5	0	5
140390	08/13/2008	SKC:08	389	714	985	0	0	0	1136	574	0	0	5
140391	08/13/2008	SKC:09	428	1073	898	0	0	0	517	208	11	0	7
140392	08/13/2008	SKC:10	160	432	707	0	0	0	1314	389	25	0	0
140393	08/13/2008	SKC:11	68	130	480	0	0	0	645	301	0	0	0
140394	08/13/2008	SKC:12	58	283	591	0	0	0	250	105	0	0	0
140407	08/12/2008	TAMACK:01	5	1031	776	0	0	0	1397	104	0	0	0
140408	08/12/2008	TAMACK:01Q	0	228	85	0	3	0	162	49	0	0	0
140409	08/12/2008	TAMACK:02	43	668	868	0	0	0	1485	150	0	0	0
140410	08/12/2008	TAMACK:02Q	3	377	142	0	0	0	88	31	2	0	0
140411	08/12/2008	TAMACK:03	5	276	892	0	0	0	247	154	0	0	0
140412	08/11/2008	COYOTE:01	303	1930	857	0	0	0	2538	785	32	0	0
140413	08/11/2008	COYOTE:02	751	1696	795	0	7	0	895	190	0	0	14
140414	08/11/2008	COYOTE:03	2100	1036	1069	0	0	0	486	37	7	0	14
140415	08/14/2008	CORRAL:01	455	727	2147	0	0	0	2751	681	347	0	22
140416	08/11/2008	CORRAL:02	889	1704	448	0	0	0	959	332	7	0	0
140417	08/13/2008	S1:500	31	560	939	0	0	0	167	330	3	0	0
140418	08/13/2008	S1:250	1888	846	1792	0	0	0	1996	497	11	0	54
140419	08/12/2008	S1:040	45	1002	633	0	0	0	994	194	0	0	9
Mean			294.6	739.5	739.8	0.0	1.8	0.0	777.8	258.9	22.1	0.0	6.2

Biotic Indices

Sample	Sampling date	Station	Hilsenhoff Biotic Index		USFS Community CTQd
			Index	Indication	
140380	08/14/2008	SKC:01	4.02	Possible slight organic pollution	66
140381	08/14/2008	SKC:01Q	4.22	Possible slight organic pollution	64
140382	08/14/2008	SKC:02	3.23	No apparent organic pollution	56
140383	08/12/2008	SKC:02Q	4.62	Some organic pollution	66
140384	08/12/2008	SKC:03	3.42	No apparent organic pollution	58
140385	08/13/2008	SKC:03Q	3.78	Possible slight organic pollution	71
140386	08/12/2008	SKC:04	3.25	No apparent organic pollution	53
140387	08/12/2008	SKC:05	2.96	No apparent organic pollution	61
140388	08/12/2008	SKC:06	2.10	No apparent organic pollution	73
140389	08/12/2008	SKC:07	2.43	No apparent organic pollution	64
140390	08/13/2008	SKC:08	2.40	No apparent organic pollution	57
140391	08/13/2008	SKC:09	3.13	No apparent organic pollution	60
140392	08/13/2008	SKC:10	1.86	No apparent organic pollution	53
140393	08/13/2008	SKC:11	1.63	No apparent organic pollution	52
140394	08/13/2008	SKC:12	3.01	No apparent organic pollution	49
140407	08/12/2008	TAMACK:01	2.63	No apparent organic pollution	51
140408	08/12/2008	TAMACK:01Q	3.01	No apparent organic pollution	67
140409	08/12/2008	TAMACK:02	1.88	No apparent organic pollution	51
140410	08/12/2008	TAMACK:02Q	3.58	Possible slight organic pollution	60
140411	08/12/2008	TAMACK:03	2.25	No apparent organic pollution	47
140412	08/11/2008	COYOTE:01	2.29	No apparent organic pollution	60
140413	08/11/2008	COYOTE:02	3.73	Possible slight organic pollution	67
140414	08/11/2008	COYOTE:03	3.54	Possible slight organic pollution	66
140415	08/14/2008	CORRAL:01	1.63	No apparent organic pollution	60
140416	08/11/2008	CORRAL:02	3.39	No apparent organic pollution	70
140417	08/13/2008	S1:500	2.49	No apparent organic pollution	55
140418	08/13/2008	S1:250	2.67	No apparent organic pollution	51
140419	08/12/2008	S1:040	2.86	No apparent organic pollution	59
Mean			2.93		59.5

Taxa richness and relative abundance values with respect to tolerance or intolerance to pollution were based on the Hilsenhoff Biotic Index (HBI). Intolerant taxa have HBI score <= 1. Tolerant taxa have a HBI score >= 9. Data are presented as estimated count per square meter for quantitative samples and total number per sample for qualitative samples.

			Intolerant taxa				Tolerant Taxa			
Sample	Sampling date	Station	Richness		Abundance		Richness		Abundance	
140380	08/14/2008	SKC:01	11	(25)	81	(12)	1	(2)	5	(1)
140381	08/14/2008	SKC:01Q	11	(20)	45	(7)	1	(2)	21	(3)
140382	08/14/2008	SKC:02	11	(26)	244	(16)	1	(2)	5	(0)
140383	08/12/2008	SKC:02Q	14	(30)	45	(7)	1	(2)	1	(0)
140384	08/12/2008	SKC:03	12	(26)	861	(21)	1	(2)	16	(0)
140385	08/13/2008	SKC:03Q	14	(27)	58	(9)	1	(2)	17	(3)
140386	08/12/2008	SKC:04	16	(35)	591	(26)	1	(2)	14	(1)
140387	08/12/2008	SKC:05	15	(30)	306	(25)	1	(2)	13	(1)
140388	08/12/2008	SKC:06	13	(28)	531	(13)	1	(2)	74	(2)
140389	08/12/2008	SKC:07	12	(24)	707	(22)	1	(2)	32	(1)
140390	08/13/2008	SKC:08	19	(40)	1123	(29)	1	(2)	5	(0)
140391	08/13/2008	SKC:09	19	(37)	925	(28)	1	(2)	47	(1)
140392	08/13/2008	SKC:10	19	(41)	874	(27)	1	(2)	43	(1)
140393	08/13/2008	SKC:11	15	(33)	492	(29)	1	(2)	8	(0)
140394	08/13/2008	SKC:12	19	(37)	322	(24)	1	(2)	11	(1)
140407	08/12/2008	TAMACK:01	17	(40)	859	(25)	1	(2)	19	(1)
140408	08/12/2008	TAMACK:01Q	14	(30)	49	(9)	0	(0)	0	(0)
140409	08/12/2008	TAMACK:02	19	(39)	766	(23)	0	(0)	0	(0)
140410	08/12/2008	TAMACK:02Q	12	(21)	109	(15)	0	(0)	0	(0)
140411	08/12/2008	TAMACK:03	16	(31)	638	(39)	0	(0)	0	(0)
140412	08/11/2008	COYOTE:01	15	(31)	1569	(24)	1	(2)	65	(1)
140413	08/11/2008	COYOTE:02	14	(28)	967	(21)	1	(2)	267	(6)
140414	08/11/2008	COYOTE:03	13	(33)	782	(16)	1	(3)	65	(1)
140415	08/14/2008	CORRAL:01	16	(31)	2127	(29)	1	(2)	130	(2)
140416	08/11/2008	CORRAL:02	13	(30)	782	(17)	1	(2)	65	(1)
140417	08/13/2008	S1:500	19	(33)	867	(41)	0	(0)	0	(0)
140418	08/13/2008	S1:250	18	(40)	1058	(15)	1	(2)	281	(4)
140419	08/12/2008	S1:040	14	(32)	553	(19)	1	(2)	94	(3)
Mean			15.0	(31)	654.7	(21)	0.8	(2)	46.4	(1)

Functional feeding groups

Taxa richness by functional feeding group. The percent of the total is shown in parentheses.

Sample	Sampling date	Station	Shredders		Scrapers		Collector-filterers		Collector-gatherers		Predators		Unknown	
140380	08/14/2008	SKC:01	0	(0)	7	(16)	2	(5)	15	(34)	17	(39)	2	(5)
140381	08/14/2008	SKC:01Q	6	(11)	9	(16)	4	(7)	14	(25)	17	(31)	4	(7)
140382	08/14/2008	SKC:02	2	(5)	7	(16)	4	(9)	14	(33)	12	(28)	3	(7)
140383	08/12/2008	SKC:02Q	11	(24)	2	(4)	4	(9)	13	(28)	11	(24)	5	(11)
140384	08/12/2008	SKC:03	3	(7)	3	(7)	5	(11)	14	(30)	14	(30)	6	(13)
140385	08/13/2008	SKC:03Q	3	(6)	4	(8)	5	(10)	10	(20)	22	(43)	6	(12)
140386	08/12/2008	SKC:04	4	(9)	3	(7)	4	(9)	12	(26)	14	(30)	8	(17)
140387	08/12/2008	SKC:05	5	(10)	4	(8)	7	(14)	10	(20)	19	(38)	4	(8)
140388	08/12/2008	SKC:06	3	(7)	3	(7)	4	(9)	14	(30)	16	(35)	5	(11)
140389	08/12/2008	SKC:07	3	(6)	5	(10)	8	(16)	8	(16)	20	(39)	6	(12)
140390	08/13/2008	SKC:08	2	(4)	9	(19)	5	(10)	12	(25)	16	(33)	3	(6)
140391	08/13/2008	SKC:09	3	(6)	7	(13)	4	(8)	14	(27)	17	(33)	6	(12)
140392	08/13/2008	SKC:10	3	(7)	6	(13)	2	(4)	13	(28)	17	(37)	4	(9)
140393	08/13/2008	SKC:11	4	(9)	5	(11)	3	(7)	14	(31)	15	(33)	3	(7)
140394	08/13/2008	SKC:12	7	(14)	7	(14)	2	(4)	10	(20)	22	(43)	3	(6)
140407	08/12/2008	TAMACK:01	5	(12)	5	(12)	4	(9)	11	(26)	15	(35)	3	(7)
140408	08/12/2008	TAMACK:01Q	6	(13)	8	(17)	1	(2)	10	(22)	19	(41)	1	(2)
140409	08/12/2008	TAMACK:02	7	(14)	8	(16)	1	(2)	12	(24)	17	(35)	3	(6)
140410	08/12/2008	TAMACK:02Q	7	(13)	6	(11)	2	(4)	15	(27)	22	(39)	3	(5)
140411	08/12/2008	TAMACK:03	5	(10)	9	(18)	2	(4)	10	(20)	20	(39)	4	(8)
140412	08/11/2008	COYOTE:01	4	(8)	7	(14)	2	(4)	12	(24)	19	(39)	5	(10)
140413	08/11/2008	COYOTE:02	7	(14)	6	(12)	3	(6)	13	(26)	17	(34)	4	(8)
140414	08/11/2008	COYOTE:03	3	(8)	5	(13)	3	(8)	10	(26)	11	(28)	6	(15)
140415	08/14/2008	CORRAL:01	5	(10)	9	(17)	5	(10)	12	(23)	14	(27)	6	(12)
140416	08/11/2008	CORRAL:02	3	(7)	5	(12)	2	(5)	10	(23)	16	(37)	6	(14)
140417	08/13/2008	S1:500	6	(11)	11	(19)	3	(5)	13	(23)	21	(37)	3	(5)
140418	08/13/2008	S1:250	4	(9)	7	(16)	4	(9)	12	(27)	14	(31)	3	(7)
140419	08/12/2008	S1:040	3	(7)	5	(11)	5	(11)	11	(25)	13	(30)	6	(14)
Mean			4.4	(9)	6.1	(13)	3.6	(7)	12.1	(25)	16.7	(35)	4.3	(9)

Invertebrate abundance by functional feed group. The percent of the total is shown in parentheses.

Sample	Sampling date	Station	Shredders		Scrapers		Collector-filterers		Collector-gatherers		Predators		Unknown	
140380	08/14/2008	SKC:01	0	(0)	92	(13)	5	(1)	477	(69)	101	(15)	12	(2)
140381	08/14/2008	SKC:01Q	42	(6)	60	(9)	18	(3)	424	(66)	59	(9)	41	(6)
140382	08/14/2008	SKC:02	86	(6)	301	(20)	279	(18)	660	(44)	149	(10)	30	(2)
140383	08/12/2008	SKC:02Q	67	(11)	4	(1)	45	(7)	440	(71)	31	(5)	31	(5)
140384	08/12/2008	SKC:03	307	(8)	512	(13)	97	(2)	2580	(63)	503	(12)	55	(1)
140385	08/13/2008	SKC:03Q	86	(14)	6	(1)	30	(5)	362	(58)	113	(18)	25	(4)
140386	08/12/2008	SKC:04	251	(11)	145	(6)	75	(3)	1502	(66)	257	(11)	34	(1)
140387	08/12/2008	SKC:05	272	(22)	43	(4)	122	(10)	513	(42)	188	(15)	84	(7)
140388	08/12/2008	SKC:06	1642	(41)	34	(1)	128	(3)	1597	(40)	513	(13)	115	(3)
140389	08/12/2008	SKC:07	1341	(41)	46	(1)	193	(6)	1077	(33)	342	(10)	259	(8)
140390	08/13/2008	SKC:08	859	(22)	354	(9)	288	(7)	1280	(33)	618	(16)	389	(10)
140391	08/13/2008	SKC:09	375	(11)	173	(5)	96	(3)	1837	(56)	301	(9)	459	(14)
140392	08/13/2008	SKC:10	1077	(34)	375	(12)	307	(10)	897	(28)	300	(9)	228	(7)
140393	08/13/2008	SKC:11	705	(42)	218	(13)	69	(4)	395	(24)	195	(12)	64	(4)
140394	08/13/2008	SKC:12	115	(9)	270	(20)	8	(1)	573	(43)	302	(23)	65	(5)
140407	08/12/2008	TAMACK:01	826	(24)	249	(7)	106	(3)	1246	(37)	865	(25)	102	(3)
140408	08/12/2008	TAMACK:01Q	143	(25)	17	(3)	30	(5)	262	(46)	108	(19)	4	(1)
140409	08/12/2008	TAMACK:02	1303	(40)	257	(8)	180	(6)	941	(29)	542	(17)	30	(1)
140410	08/12/2008	TAMACK:02Q	57	(8)	48	(7)	26	(4)	445	(62)	129	(18)	8	(1)
140411	08/12/2008	TAMACK:03	196	(12)	276	(17)	23	(1)	636	(39)	480	(29)	15	(1)
140412	08/11/2008	COYOTE:01	2651	(40)	608	(9)	1173	(18)	1416	(22)	538	(8)	188	(3)
140413	08/11/2008	COYOTE:02	571	(13)	216	(5)	145	(3)	2620	(58)	700	(15)	269	(6)
140414	08/11/2008	COYOTE:03	223	(5)	314	(7)	108	(2)	1547	(32)	597	(13)	1974	(41)
140415	08/14/2008	CORRAL:01	2684	(37)	581	(8)	164	(2)	2455	(34)	886	(12)	499	(7)
140416	08/11/2008	CORRAL:02	686	(15)	332	(7)	50	(1)	1859	(41)	759	(17)	804	(18)
140417	08/13/2008	S1:500	210	(10)	266	(13)	45	(2)	1093	(51)	479	(23)	35	(2)
140418	08/13/2008	S1:250	1819	(25)	758	(10)	131	(2)	2153	(30)	374	(5)	1945	(27)
140419	08/12/2008	S1:040	846	(29)	204	(7)	70	(2)	1340	(46)	326	(11)	108	(4)
Mean			694.3	(20)	241.4	(8)	143.3	(5)	1165.3	(45)	384.1	(14)	281.1	(7)

The 10 metrics thought to be most responsive to human induced disturbance (Karr and Chu 1998).

Sample	Sampling Date	Station	Total taxa	Epheme-roptera taxa	Plecoptera taxa	Trichoptera taxa	Long-lived taxa	Intolerant taxa	Clinger taxa	% tolerant indi-viduals	% contribution dominant taxon	% predators
140380	08/14/2008	SKC:01	44	10	4	4	5	11	17	0.73	35.26	14.65
140381	08/14/2008	SKC:01Q	55	10	9	5	7	11	21	3.25	30.14	9.12
140382	08/14/2008	SKC:02	43	9	5	6	7	11	20	0.33	19.58	9.86
140383	08/12/2008	SKC:02Q	46	9	8	9	7	14	21	0.16	32.85	5.02
140384	08/12/2008	SKC:03	46	8	6	5	9	12	21	0.39	25.75	12.34
140385	08/13/2008	SKC:03Q	51	6	8	7	10	14	20	2.72	22.40	18.08
140386	08/12/2008	SKC:04	46	9	7	6	9	16	24	0.61	17.56	11.28
140387	08/12/2008	SKC:05	50	8	5	9	7	15	24	1.06	14.44	15.34
140388	08/12/2008	SKC:06	46	7	6	5	6	13	17	1.83	33.21	12.70
140389	08/12/2008	SKC:07	51	8	4	12	8	12	22	0.98	27.25	10.45
140390	08/13/2008	SKC:08	48	13	3	10	9	19	25	0.13	20.11	15.97
140391	08/13/2008	SKC:09	52	12	3	8	7	19	26	1.42	19.08	9.10
140392	08/13/2008	SKC:10	46	10	7	8	4	19	22	1.35	33.00	9.38
140393	08/13/2008	SKC:11	45	9	6	8	8	15	22	0.48	31.88	11.68
140394	08/13/2008	SKC:12	51	9	8	11	7	19	24	0.83	15.38	22.66
140407	08/12/2008	TAMACK:01	43	11	6	7	4	17	20	0.56	22.92	25.48
140408	08/12/2008	TAMACK:01Q	46	11	7	9	3	14	17	0.00	21.06	19.12
140409	08/12/2008	TAMACK:02	49	12	7	8	5	19	22	0.00	37.12	16.61
140410	08/12/2008	TAMACK:02Q	56	12	9	9	5	12	20	0.00	22.55	18.07
140411	08/12/2008	TAMACK:03	51	11	6	10	5	16	22	0.00	10.41	29.38
140412	08/11/2008	COYOTE:01	49	7	9	7	10	15	23	0.99	34.04	8.18
140413	08/11/2008	COYOTE:02	50	9	7	5	9	14	20	5.90	20.43	15.48
140414	08/11/2008	COYOTE:03	39	10	5	5	9	13	19	1.36	35.13	12.53
140415	08/14/2008	CORRAL:01	52	11	6	8	10	16	27	1.78	33.05	12.13
140416	08/11/2008	CORRAL:02	43	6	5	5	6	13	17	1.45	21.51	16.90
140417	08/13/2008	S1:500	57	9	6	13	8	19	27	0.00	16.54	22.51
140418	08/13/2008	S1:250	45	10	4	11	7	18	23	3.88	25.93	5.17
140419	08/12/2008	S1:040	44	10	4	7	6	14	19	3.23	27.84	11.22
Mean			48.0	9.5	6.1	7.8	7.0	15.0	21.5	1.27	25.23	14.30

Taxonomic list and counts for 28 samples collected between August 11, 2008 and August 14, 2008. Count is the total number of individuals identified and retained. Samples heading refers to the number of samples contain that taxon.

Order	Family	Subfamily/Genus/Species	Samples	Count
Phylum: Annelida				
Class: Clitellata	SubClass: Oligochaeta			
			15	96
Phylum: Arthropoda				
Class: Arachnida	SubClass: Acari			
Trombidiformes			13	48
Trombidiformes	Arrenuridae	Arrenurus	1	1
Trombidiformes	Hydryphantidae	Protzia	19	84
Trombidiformes	Hygrobatidae	Hygrobates	1	1
Trombidiformes	Lebertiidae	Lebertia	24	107
Trombidiformes	Oxidae	Oxus	4	5
Trombidiformes	Sperchonidae		2	6
Trombidiformes	Sperchonidae	Sperchon	17	128
Trombidiformes	Torrenticolidae	Testudacarus	4	9
Trombidiformes	Torrenticolidae	Torrenticola	14	38
Class: Insecta	SubClass: Pterygota			
Coleoptera	Dytiscidae		1	2
Coleoptera	Dytiscidae	Hydroporinae Hydroporini Oreodytes	2	2
Coleoptera	Dytiscidae	Hydroporinae Hygrotini Hygrotus	1	1
Coleoptera	Dytiscidae	Stictotarsus	1	1
Coleoptera	Elmidae		10	116
Coleoptera	Elmidae	Cleptelmis addenda	15	56
Coleoptera	Elmidae	Heterlimnius corpulentus	23	967
Coleoptera	Elmidae	Lara	3	6
Coleoptera	Elmidae	Narpus concolor	4	5
Coleoptera	Elmidae	Optioservus	12	100
Coleoptera	Elmidae	Optioservus divergens/pecosensis	1	1
Coleoptera	Elmidae	Optioservus quadrimaculatus	11	39
Coleoptera	Helophoridae	Helophorus	2	5
Coleoptera	Hydraenidae	Hydraena	7	25
Coleoptera	Hydraenidae	Ochthebius	1	1
Coleoptera	Hydrophilidae	Ametor	1	1
Diptera	Athericidae	Atherix pachypus	8	105
Diptera	Ceratopogonidae	Ceratopogoninae Sphaeromiini Probezzia	15	87
Diptera	Chironomidae		11	80
Diptera	Chironomidae	Chironominae	28	2040
Diptera	Chironomidae	Orthocladiinae	28	2104
Diptera	Chironomidae	Tanypodinae	22	128
Diptera	Dixidae	Dixa	2	3
Diptera	Dixidae	Dixella	1	1
Diptera	Dixidae	Meringodixa chalonensis	2	2
Diptera	Empididae	Clinocera	4	6
Diptera	Empididae	Hemerodromiinae Hemerodromiini Chelifera	13	45
Diptera	Empididae	Neoplasta	6	15
Diptera	Ephydridae		1	1
Diptera	Muscidae		1	1
Diptera	Pelecorhynchidae	Glutops	13	94

Diptera	Psychodidae	Pericoma	23	234
Diptera	Ptychopteridae	Ptychoptera	6	47
Diptera	Sciomyzidae	Sepedon	1	1
Diptera	Simuliidae	Helodon	2	3
Diptera	Simuliidae	Simuliinae Simuliini Simulium	27	434
Diptera	Tipulidae		3	3
Diptera	Tipulidae	Dicranota	6	11
Diptera	Tipulidae	Hexatoma	18	53
Diptera	Tipulidae	Limoniinae Antocha monticola	9	83
Diptera	Tipulidae	Limoniinae Eriopterini Rhabdomastix	4	4
Diptera	Tipulidae	Limoniinae Hexatomini Limnophila	6	10
Diptera	Tipulidae	Pedicia	1	1
Diptera	Tipulidae	Tipulinae Tipula	1	1
Ephemeroptera	Ameletidae	Ameletus	18	84
Ephemeroptera	Baetidae	Baetis	27	1390
Ephemeroptera	Baetidae	Diphetor hageni	8	16
Ephemeroptera	Ephemerellidae		20	352
Ephemeroptera	Ephemerellidae	Attenella	4	12
Ephemeroptera	Ephemerellidae	Attenella delantala	11	43
Ephemeroptera	Ephemerellidae	Caudatella	25	624
Ephemeroptera	Ephemerellidae	Drunella coloradensis/flavilinea	7	13
Ephemeroptera	Ephemerellidae	Drunella doddsii	25	599
Ephemeroptera	Ephemerellidae	Drunella grandis/spinifera	21	273
Ephemeroptera	Ephemerellidae	Drunella spinifera	10	131
Ephemeroptera	Ephemerellidae	Serratella tibialis	9	37
Ephemeroptera	Ephemerellidae	Timpanoga hecuba	1	3
Ephemeroptera	Heptageniidae		20	170
Ephemeroptera	Heptageniidae	Cinygma	2	4
Ephemeroptera	Heptageniidae	Cinygmula	21	334
Ephemeroptera	Heptageniidae	Epeorus	21	204
Ephemeroptera	Heptageniidae	Ironodes	6	23
Ephemeroptera	Heptageniidae	Rhithrogena	23	211
Ephemeroptera	Leptophlebiidae		6	84
Ephemeroptera	Leptophlebiidae	Paraleptophlebia	25	386
Ephemeroptera	Siphlonuridae	Siphlonurus	2	8
Hemiptera	Gerridae		1	1
Megaloptera	Corydalidae	Orohermes crepusculus	1	2
Megaloptera	Sialidae	Sialis	5	37
Plecoptera			2	7
Plecoptera	Capniidae	Capniinae	4	5
Plecoptera	Chloroperlidae		19	104
Plecoptera	Chloroperlidae	Chloroperlinae Suwallia	10	49
Plecoptera	Chloroperlidae	Paraperla	1	1
Plecoptera	Chloroperlidae	Sweltsa	28	371
Plecoptera	Leuctridae		10	36
Plecoptera	Leuctridae	Moselia infuscata	5	10
Plecoptera	Nemouridae		2	5
Plecoptera	Nemouridae	Malenka	20	144
Plecoptera	Nemouridae	Soyedina	1	2
Plecoptera	Nemouridae	Visoka cataractae	6	15
Plecoptera	Nemouridae	Zapada	3	18
Plecoptera	Nemouridae	Zapada cinctipes	7	52
Plecoptera	Nemouridae	Zapada columbiana	9	43
Plecoptera	Peltoperlidae	Yoraperla	27	3000
Plecoptera	Perlidae		22	96
Plecoptera	Perlidae	Doroneuria baumanni	21	86

Plecoptera	Perlidae	Hesperoperla	2	10
Plecoptera	Perlidae	Hesperoperla hoguei	4	8
Plecoptera	Perlodidae		27	238
Plecoptera	Perlodidae	Isoperlinae Isoperla	7	31
Plecoptera	Perlodidae	Kogotus	5	11
Plecoptera	Perlodidae	Oroperla barbara	7	10
Plecoptera	Perlodidae	Perlodinae Arcynopterygini Perlinodes aurea	1	1
Plecoptera	Perlodidae	Perlodinae Arcynopterygini Skwala	1	1
Plecoptera	Pteronarcyidae	Pteronarcyinae Pteronarcellini Pteronarcella	1	2
Plecoptera	Pteronarcyidae	Pteronarcyinae Pteronarcyini Pteronarcys	4	9
Trichoptera			11	39
Trichoptera	Apataniidae	Apatania	6	7
Trichoptera	Apataniidae	Pedomoecus sierra	13	49
Trichoptera	Brachycentridae	Brachycentrus	5	19
Trichoptera	Brachycentridae	Brachycentrus americanus	14	231
Trichoptera	Brachycentridae	Micrasema	24	471
Trichoptera	Glossosomatidae		10	39
Trichoptera	Glossosomatidae	Glossosomatinae Glossosomatini Glossosoma	12	82
Trichoptera	Hydropsychidae		16	147
Trichoptera	Hydropsychidae	Arctopsychinae Arctopsyche	2	31
Trichoptera	Hydropsychidae	Arctopsychinae Arctopsyche grandis	7	43
Trichoptera	Hydropsychidae	Arctopsychinae Parapsyche elsis	6	25
Trichoptera	Limnephilidae		11	30
Trichoptera	Limnephilidae	Cryptochia	4	4
Trichoptera	Limnephilidae	Desmona	1	2
Trichoptera	Limnephilidae	Dicosmoecinae Dicosmoecus	7	11
Trichoptera	Limnephilidae	Dicosmoecinae Ecclisomyia	1	1
Trichoptera	Limnephilidae	Homophylax	1	1
Trichoptera	Limnephilidae	Limnephilinae Chilostigmini Psychoglypha	5	10
Trichoptera	Philopotamidae		2	2
Trichoptera	Philopotamidae	Philopotaminae Dolophilodes	6	34
Trichoptera	Phryganeidae	Yphria californica	5	21
Trichoptera	Rhyacophilidae	Rhyacophila	22	67
Trichoptera	Rhyacophilidae	Rhyacophila angelita group	2	4
Trichoptera	Rhyacophilidae	Rhyacophila betteni group	13	82
Trichoptera	Rhyacophilidae	Rhyacophila brunnea/vemna group	18	98
Trichoptera	Rhyacophilidae	Rhyacophila lieftincki group	22	109
Trichoptera	Rhyacophilidae	Rhyacophila sibirica group A	2	6
Trichoptera	Rhyacophilidae	Rhyacophila vofixa group	15	87
Trichoptera	Uenoidae		4	42
Trichoptera	Uenoidae	Neothremma	3	50
Trichoptera	Uenoidae	Thremmatinae Neophylax	1	3
Class: Malacostraca	SubClass: Eumalacostraca			
Amphipoda	Hyalellidae	Hyalella	1	3
Phylum: Mollusca				
Class: Bivalvia	SubClass: Heterodonta			
Veneroida	Pisidiidae	Musculium	1	1
Veneroida	Pisidiidae	Pisidiinae Pisidium	12	28
Phylum: Platyhelminthes				
Class: Turbellaria				
			13	166

Total: OTU Taxa : **144** Genera : **114** Families : **53** Individuals : **18899**

Literature Cited

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Cuffney, T.F., Gurtz, M.E., and Meador, M.R. 1993. Methods for collecting benthic invertebrate samples as part of the National Water Quality Assessment Program: United States Geological Survey Open File Report 93-406.

Hilsenhoff, W.L. 1987. An improved index of organic stream pollution. The Great Lakes Entomologist. 20:31-39.

Hilsenhoff, W. L. 1988. Rapid field assessment of organic pollution with a family level biotic index. The Journal of the North American Benthological Society. 7:65-68.

Karr, J.R. and E.W. Chu. 1998. Restoring life in running waters: better biological monitoring. Island Press, Washington, D.C.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology: a primer on methods and computing. John Wiley and Sons. New York.

Merritt, R.W. K.W. Cummins, and M. B. Berg, editors. 2008. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa. 4th Edition.

Vinson, M.R. and C.P. Hawkins. 1996. Effects of sampling area and subsampling procedures on comparisons of taxa richness among streams. Journal of the North American Benthological Society 15:393-400.

Major taxonomic identification resources used. Numerous regional published papers and workshop proceedings are used as well. For a complete list contact the BugLab.

Adler, P.H., D.C. Currie, and D.M. Wood. 2004. The blackflies (Simuliidae) of North America. Cornell University Press.

Baumann, R.W., A.R. Gaufin, and R.F. Surdick. 1977. The stoneflies (Plecoptera) of the Rocky Mountains. Memoirs of the American Entomological Society Number 31.

Brown, H. P. 1976. Aquatic Dryopoid Beetles (Coleoptera) of the United States. U. S. EPA. Cincinnati, Ohio.

Burch, J. B. 1973. Biota of Freshwater Ecosystems Identification Manual No. 11, Freshwater Unionacean Clams (Mollusca: Pelecypoda) of North America. U. S. Environmental Protection Agency, Project # 18050, Contract # 14-12-894.

Burch, J. B. 1973. Freshwater Unionacean Clams (Mollusca:gastropoda) of North America. U. S. Environmental Protection Agency, EPA-600\3-82-023. Contract # 68-03-1290.

Burch, J. B. and J. L. Tottenham. 1980. North American Freshwater Snails: Species lists, ranges, and illustrations. Walkerana 1:1-215.

Burch, J. B. 1982. North American Freshwater Snails: Identification keys, generic synonymy, supplemental notes, glossary, reference, index. Walkerana 1:217-365.

Burch, J. B. 1988. North American Freshwater Snails: Introduction, systematics, nomenclature, identification, morphology, habitats, and distribution. Walkerana 2:1-80.

Clarke, A.H. 1981. The freshwater molluscs of Canada. National Museum of Canada. Ottawa.

Edmunds, G. F., Jr., S. L. Jensen and L. Berner. 1976. The Mayflies of North and Central America. North Central Publishing Co., St. Paul, Minnesota.

Johannsen, O. A. 1977. Aquatic Diptera: Eggs, Larvae, and Pupae of Aquatic Flies. Published by the University, Ithaca, New York.

Klemm, D. J. 1972. Biota of Freshwater Ecosystems Identification Manual No. 8, Freshwater Leeches (Annelida: Hirundinea) of North America. U.S. Environmental Protection Agency. Project # 18050, Contract # 14-12-894.

Klemm, D. J. 1985. A Guide to the Freshwater Annelida (Polychaeta, Naidid and Tubificid Oligochaeta and Hirudinea) of North America. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous diving beetles (Coleoptera: Dytiscidae) of the nearctic region, with emphasis on the fauna of Canada and Alaska. NRC-CNRC Press, Ottawa.

McCafferty, W. P. 1981. Aquatic Entomology. Jones and Bartlett Publishers, Inc., Boston.

Merritt, R.W. K.W. Cummins, and M. B. Berg, editors. 2007. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa. 4th Edition.

Needham, J. G., M. J. Westfall, and M. L. May. 2000. Dragonflies of North America. Scientific Publishers. Gainesville, Florida.

Pennak, R. W. 1989. Freshwater Invertebrates of the United States, Third Edition, John Wiley and Sons, Inc, New York.

Stewart, K. W. and B. P. Stark. 2002. Nymphs of North American Stonefly Genera (Plecoptera). University of North Texas Press, Denton Texas. 2nd Edition.

Thorp J. H. and A. P. Covich, editors. 1991. Ecology and Classification of Freshwater Inverebrates. Academic Press, Inc., San Diego, California.