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WADEABLE STREAMS BIOASSESSMENT
REGION 8
Sites Sampled: May – July 2010

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Table of Contents

Executive Summary 4
Introduction 5
  Project Objective 6
Methods 7
  Sampling Site Selection 7
  Sampling Reach Determination 8
  Sample Collection 11
  Physical Habitat Quality Assessment and Water Quality Measurements 11
  Taxonomic Identification of BMIs 12
  Data Analysis 12
  Index of Biotic Integrity 13
  Quality Assurance and Quality Control (QA/QC) 13
Results 16
  BMI Community Structure 16
  Physical Habitat Quality 16
Conclusion 26
Literature Cited 28
Appendix A: Location Photos 30
Appendix B: Standard Operating Procedures 39
Appendix C: Water Chemistry Data 40
Appendix D: Benthic Macroinvertebrates Used for Calculating IBI Metrics 43

Tables and Figures

Tables

Table 1. Sites sampled during the 2010 index period (May - June 2010). 9

Table 2. Bioassessment metrics used to describe characteristics of the benthic macroinvertebrate (BMI) communities at assessed sites. 14

Table 3. Southern Coastal California Benthic Macroinvertebrate Index of Biotic Integrity parameters and scoring ranges (to adjust IBI score, multiply total IBI score by 10/7; from Ode et al. 2005). 15

Table 4. SCC-IBI metrics and overall rating for each location sampled during the 2010 biossessment survey. 18

Table 5 Physical habitat characterization and overall rating for each location sampled during the 2010 bioassessment survey 19

Figures

Figure 1. IBI scores for sites sampled during the 2010 bioassessment survey. 17

Figure 2. IBI scores as a function of elevation (IBI scores adjusted on a scale of 0 to 100). 20

Figure 3. IBI scores as a function of water temperature (IBI scores adjusted on a scale of 0 to 100). 20

Figure 4. IBI scores as a function of dissolved oxygen (IBI scores adjusted on a scale of 0 to 100). 21

Figure 5. IBI scores as a function of turbidity (IBI scores adjusted on a scale of 0 to 100). 21

Figure 6. IBI scores as a function of conductivity (IBI scores adjusted on a scale of 0 to 100). . 22

Figure 7. IBI scores as a function of alkalinity (IBI scores adjusted on a scale of 0 to 100). 22

Figure 8. IBI scores as a function of dissolved orthophosphate (IBI scores adjusted on a scale of 0 to 100). 23

Figure 9. IBI scores as a function of ammonia (IBI scores adjusted on a scale of 0 to 100)........ 23

Figure 10. IBI scores as a function of nitrate (IBI scores adjusted on a scale of 0 to 100). 24

Figure 11. IBI scores as a function of nitrite (IBI scores adjusted on a scale of 0 to 100). 24

Figure 12. IBI scores as a function of overall habitat characterization (IBI scores adjusted on a scale of 0 to 100). 25

Executive Summary

The Santa Ana Regional Water Quality Control Board contracted California State University Long Beach's Stream Ecology and Assessment Laboratory, through the Institute for Integrated Research in Materials Environments and Society, to conduct a six year study (2006-2011) of the waterways within the Santa Ana River watershed. This study is designed to address the federal Environmental Protection Agency-mandated requirement (EPA requirement 305(b)) for an assessment of the integrity of surface waters in the watersheds of the Santa Ana and San Jacinto Rivers by sampling the biological (benthic macroinvertebrates), physical (in-stream habitat, surrounding riparian habitats), and chemical (water quality measurements and water samples for further laboratory analysis) attributes at each sampling location. At the conclusion of the six year period, the data collected will be used to estimate the number of wadeable stream kilometers (perinnial and ephermeral) that are in one of five categories of health (very good, good, fair, poor, and very poor). Annual reports during these six years will provide information on the quality of the individual sites sampled.

During the 2010 bioassessment sampling events, a total of 242 distinct benthic macroinvertebrate taxa were identified from the 44 sampled locations. Taxa were identified to Level II of the Standard Taxonomic Effort compiled by the Southwestern Association of Freshwater Invertebrate Taxonomists. Sample locations were divided into three categories: low-elevation (0 meters to 350 meters), mid-elevation (350 meters to 700 meters), and high-elevation (700 meters and higher). Using the Southern California Coastal Index of Biotic Integrity (Ode et al. 2005) as a measure of biotic condition, stream sites were classified (very poor, poor, fair, good, and very good). Southern California Coastal Index of Biological Integrity scores (adjusted to a scale of 0 to 100) ranged from 10 to 43 (very poor to poor) for low-elevation sites, 16 to 60 (very poor to fair) for mid-elevation sites, and 22 to 80 (very poor to good) for high-elevation sites. The Southern California Coastal Index of Biological Integrity scores were positively correlated with elevation (R-square = 0.39) (low-elevation mean score = 20.3 ± 2.1, mid-elevation mean score = 29.1 ± 2.7, and high-elevation mean score = 50.7 ± 4.8). IBI scores were also positively correlated with overall habitat scores (R^2 = 0.37) and were negatively correlated with temperature (R^2 = 0.5), conductivity (R^2 = 0.29), and alkalinity (R^2 = 0.28). The physical habitat condition of the sampled sites ranged from poor to optimal (0 to 15 "poor," 16 to 30 "marginal," 31 to 45 "suboptimal," and 46 to 60 "optimal"). Predominantly natural high-elevation channels had the highest values (averaging 47.4 ± 2.1 and ranging from 28 to 59), followed by midelevation channels (averaging 33.1 ± 3.6 and ranging from 6 to 59), and finally the low-elevation channels had the lowest values (averaging 24.5 ± 4.5 and ranging from 1 to 56). The water quality characteristics were relatively consistent among sites with near neutral to alkaline mean pH values (5.22 to 11.01), more than adequate levels of mean dissolved oxygen (3.9 to 138.8 mg/L), and highly variable conductivity values (0.092 to 2000 µS/cm). Natural inland waters usually contain small amounts of dissolved mineral salts.

Although the data collected during the 2010 bioassessment sampling events are only a small subset of the proposed sites to be collected within the region over the six year experimental period, the results obtained during 2010 provide baseline information to begin assessing the health of the waters within the region.

Introduction

Freshwater is an important natural resource. Understanding the health of rivers, streams, and other water resources is essential for the development of management plans that protect the nation's vital water resources. One approach that has been advocated for determining water quality is the "Aquatic Life Use Assessment" (ALUA), which was adopted by the California Environmental Protection Agency (Cal/EPA) for determining water quality. These bioassessment tools utilize direct measurements of biological assemblages occupying various trophic levels and can include plants, macroinvertebrates, vertebrates (fish) and periphyton (diatoms and algae), as direct methods for assessing the biological health of a waterway's ecosystem. Direct measurements of biological communities, when used in conjunction to other relevant measurements of watershed health (e.g. watershed characteristics, land-use practices, in-stream habitat and water chemistry), are effective ways to monitor long-term trends of a watershed's condition (Davis and Simon 1995). Biological assessments, which integrate the effects of water quality over time, are sensitive to many aspects of both habitat and water chemistry and provide a more familiar representation of ecological health to those who are unfamiliar with interpreting the results of chemical or toxicity tests (Gibson 1996). When integrated with physical habitat assessments and chemical test results, biological assessments describe the health of a waterway and provide an *in vivo* means of evaluating the anthropogenic effects (e.g. sediments, temperature and habitat alteration) on a waterway. As defined by the 2006 EPA Wadeable Streams Assessment (WSA) document, *"biological integrity represents the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region."* Bioassessment is a proxy for determining stream water quality and habitat quality based on the types and numbers of organisms living there.

The monitoring of water quality using BMIs is the most utilized bioassessment method when compared with similar assessments that use vertebrates or periphyton. BMIs are not only ubiquitous, but are relatively stationary and highly diverse. These traits can provide a variety of predictable responses to a number of environmental stresses (Rosenberg and Resh 1993). Depending on the length of time an individual BMI taxon resides in an aquatic environment (a few months to several years), the sensitivity to physical and chemical alterations to its environment will vary. BMIs are an excellent indicator group in assessing the health of a waterway (Resh and Jackson 1993) and function as a significant food resource for both aquatic and terrestrial organisms. In addition, herbivorous BMIs aid in the control of periphyton populations and many BMI taxa contribute to the breakdown of detritus. Furthermore, the diversity of BMI taxa also plays an important role in the overall ecology and biogeography of a region (Erman 1996).

Biological assessments are often based on multimetric techniques. These techniques use a number of biologic measurements (metrics), each representing a particular aspect of the biological community, to assign a water quality value to the location under study. Locations can then be ranked by these values and classified into qualitative categories of "very good," "good," "fair," "poor," and "very poor." This system of ranking and categorizing biological conditions is referred to as an Index of Biotic Integrity (IBI), and is currently the recommended method for the development of biocriteria by the United States Environmental Protection Agency (USEPA;

Davis and Simon 1995). This method may also be used in the development of Tiered Aquatic Life Uses (TALU). The current IBI used for southern California is the Southern Coastal California Index of Biological Integrity (SCC-IBI; Ode et al. 2005), developed by the California Department of Fish and Game's Aquatic Bioassessment Laboratory (Cal/DFG-ABL).

Water quality information for the streams in the Santa Ana and San Jacinto watersheds (Region 8) is currently based mostly on discharger data from NPDES permits, and volunteer monitoring efforts of selected streams. This information focuses on problem areas within the region or areas where permits have been issued. Consequently, there are a large number of streams in the region that lack water quality information. Due to lack of available funding to implement a fully comprehensive "multiple biological assemblage model" to assess the biotic integrity, a decision was made by the Santa Ana Regional Water Quality Control Board (SARWQCB) to initially focus on using a macroinvertebrate bioassessment tool to assess the biotic integrity of the wadeable streams (perennial and ephermeral) in Region 8 of California.

The SARWQCB contracted California State University Long Beach (CSULB) Stream Ecology and Assessment Laboratory (SEAL), through the Institute for Integrated Research in Materials Environments and Society (IIRMES), to conduct a six-year study within Region 8 of California waterways utilizing a probabilistic sampling design. IIRMES, a multifaceted organization was designed to promote and enhance educational and research opportunities for faculty, graduate and undergraduate students, and the greater community at large by embracing and integrating all scientists who study historical and temporally changing phenomena from the solid earth to organisms, landscapes, and societies. By collaborating with interdisciplinary faculty, scientists within the organization are able to bring common research perspectives, techniques, and instrumentation to bear their research.

While IIRMES has the task of analyzing the water chemistry for sites from the probablisitic draw, E. S. Babcock & Sons Inc. is contracted by San Bernandino County Flood Control District to analyze the water chemistry for the sites that are under the SMC program.

Project Objective

The overall objective of the six-year bioassessment project described within this report is to address the federal Environmental Protection Agency (EPA) mandated requirement (EPA requirement 305(b)) for an assessment of the integrity of surface waters in Region 8 of California. Specifically, this project aims to meet this objective by collecting and subsequently analyzing macroinvertebrate data collected from random sites using the SCC-IBI. This method yields a single score of the biological integrity of a site. The SCC-IBI model provides a score based on the combination of seven biological metrics. This score can then be ranked, and compared to sites that are independently designated as high-quality "reference" sites.

The data collected using this analysis may be used to identify streams that may require improvement of water quality. They also may be used to refine and compare several methods of analysis and interpretation of bioassessment data. Although not comprehensive by nature, the design of the ongoing project will also provide a basis to estimate the percentage of wadeable stream kilometers in the region that meet the aquatic life beneficial use. The region's Basin Plan related to beneficial use is as follows: *"Inland surface water communities and populations including vertebrate, invertebrate and plant species shall not be degraded as a result of the discharge of waste. Degradation is damage to an aquatic community or population with the result that a balanced community no longer exists. A balanced community is one that is diverse, has the ability to sustain itself through cyclic seasonal changes, includes necessary food chain species, and is not dominated by pollution tolerant species, unless that domination is caused by physical habitat limitations. A balanced community also may include historically introduced non-native species but does not include species present because best available technology has not been implemented or because site-specific objectives have been adopted or because of thermal discharges* (SARWQCB 1995)*."*

Methods

In order to comply with standard sampling protocols, initially established by the Cal/DFG-ABL during the development of the SCC-IBI, benthic macroinvertebrate samples were collected between an index period between May 18 and June 29.

Sampling Site Selection

The SARWQCB worked with statistician Tony Olsen from EPA at Corvallis to design a cost effective, randomized sampling design based upon the Environmental Monitoring and Assessment Program (EMAP; USEPA 2006) criteria that could be used to representatively sub-sample the various streams in the region. Dr. Olsen provided a list of coordinates for 750 potential locations to select for sampling. Under the original sampling design, 50 sites would be randomly selected from these locations annually for a period of five years to provide a total of 250 sites that would be considered statistically representative of the 1302 linear stream kilometers covering the Santa Ana regional stream network. This sampling density provided a level of statistical precision of +/- 12% with at a spatial coverage resolution of approximately 1.6 linear kilometers. The original sampling study also did not include any stratification elements, and was designed for perennial and non-perennial streams that were 3rd and higher Strahler order. Given the nature of the terrain and the xeric conditions in southern California, not all sites were found to be viable for the study. Consequently prior to collecting any environmental measurements or infauna samples, the sites from within the list were prescreened by first undertaking reconnaissance of each of the sampling locations to determine accessibility and suitability for benthic macroinvertebrate sampling. Elements that were deemed essential for an accessible site to be considered suitable for sampling were based upon criteria that led to the development of the SCC-IBI. Subsequently, two approved modifications were made to the design in the sampling study outlined above:

First, due to the constraints in the available funds for the project, the number of sampling sites was set to 44 for the 2010 sampling year. Statistical analyses show that reduction in sampling effort increased the level of imprecision regarding the representation of the sub samples by 4% (Tony Olsen, personal communication). While not desirable, this difference was not considered to unduly compromise the objectives of the study. Furthermore it was concluded that additional sampling or an extension to the duration of the study could ultimately be undertaken to restore the original level of precision in the sampling design.

Second, the initial experimental design involved dividing Region 8 into three hydrological units (Santa Ana, San Gabriel, and the San Jacinto units). Because the portion of the San Gabriel hydrological unit included in Region 8 contained only seven sites, those sites were combined with those in the Santa Ana hydrological unit. The two hydrologic units (Santa Ana and San Jacinto, with the former including the San Gabriel) were subsequently divided into three elevation strata: 0 meters to 350 meters, 350 meters to 700 meters, and 700 meters and up. Randomly generated GPS coordinates were used to determine the location of sites (evenly distributed throughout defined categories). The purpose of dividing the region into three elevation categories was to ensure that sampling occurred throughout the entire region each year. It was determined that not dividing the region into these biologically relevant strata might have resulted in analytical bias due to intensive sampling in a small subset of the region one year and no sampling in this subset the following year.

Sampling took place between May 18 and June 29 in 2010, and the samples were transported to the laboratory within 48 hours of collection for water chemistry analyses, storage and subsequent processing. Table 1 provides site-specific information.

Sampling Reach Determination

The sampling procedures used during the 2010 bioassessment survey followed the FULL level of the *Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California* (Ode 2007), which is a modification of the California Stream Bioassessment Procedures (CSBP; DFG 2003) and Environmental Monitoring and Assessment Program (EMAP) procedures. At each sample location, a 150-meter reach was established (250-meters for streams with wetted-widths greater than 10 meters). Each reach was broken into 11 equidistant transects, spaced every 15 meters (25 meters for streams with widths greater than 10 meters), with each transect designated with a number representing its location along the reach (0 meters through 150/ 250 meters, downstream to upstream). BMI sample locations for each transect followed the reach-wide benthos procedure (RWB) for streams with gradients greater than 1%; the margin-center-margin (MCM) was used for streams with gradients less than 1%.

Table 1. Sites sampled during the 2010 index period (May 18 – June 29 2010).
Codes SMCXXXXX denote sites under the SMC program. Codes SMCR8_XXX denote sites from the original probablisitic draw with the three numbers corresponding to the SWAMP code and Master List site ID.

			Field Recorded			
Site Code	Stream name	County	Latitude	Longitude	Elevation (m)	Collection date
			NAD 83			
107	Bautista Canyon	Riverside	33.64736	-116.81468	827	24-May-10
167	Tributary of City Creek	San Bernardino	34.16605	-117.18051	641	16-Jun-10
201	Day Creek	San Bernardino	34.07375	-117.54105	308	20-May-10
236	Temescal Wash	Riverside	33.7424	-117.42849	352	18-May-10
240	Alder Creek	San Bernardino	34.17036	-117.08748	1217	23-Jun-10
274	City Creek	San Bernardino	34.17237	-117.18072	662	17-Jun-10
277	Coldwater Canyon	San Bernardino	34.18826	-117.25566	573	27-May-10
293	Temescal Wash	Riverside	33.78716	-117.48953	273	18-May-10
294	Santa Ana River	Riverside	33.96896	-117.48849	200	20-May-10
297	Mallot Creek	Riverside	33.80939	-116.81646	1115	25-May-10
304	Little Mill Creek	San Bernardino	34.18234	-117.14996	1043	16-Jun-10
309	Cajon Canyon	San Bernardino	34.27111	-117.45356	823	14-Jun-10
322	Dry Creek	Riverside	33.70977	-116.78127	764	24-May-10
356	Santa Ana River	Riverside	33.93057	-117.59215	166	10-Jun-10
380	Frog Creek	San Bernardino	34.16693	-116.883	2004	21-Jun-10
387	San Timoteo Canyon	San Bernardino	34.00549	-117.16881	458	19-May-10
395	Cucamonga Creek	Riverside	33.96633	-117.60172	184	10-Jun-10
396	Cajon Creek	San Bernardino	34.23503	-117.43389	686	27-May-10
400	Temescal Wash	Riverside	33.82915	-117.51021	233	29-Jun-10
403	Chino Creek	San Bernardino	33.96441	-117.68029	198	15-Jun-10
405	Stone Creek	Riverside	33.77521	-116.74025	1773	26-May-10
407	Cienaga Seca Creek	San Bernardino	34.16082	-116.79883	2025	21-Jun-10

436	Bear Creek	San Bernardino	34.17451	-117.01276	1142	23-Jun-10
441	Carbon Creek	Orange	33.85435	-117.90249	49	25-May-10
445	Forsee Creek	San Bernardino	34.16632	-116.93562	1632	24-Jun-10
448	Mile Creek	San Bernardino	34.18071	-116.9446	1555	22-Jun-10
450	Santa Ana River	Riverside	33.97123	-117.51147	192	29-Jun-10
478	Forsee Creek	San Bernardino	34.1799	-116.94904	1464	22-Jun-10
559	San Timoteo Wash	San Bernardino	34.03477	-117.21236	386	19-May-10
567	San Timoteo Creek	Riverside	33.97268	-117.08493	606	15-Jun-10
598	Day Creek	San Bernardino	34.11909	-117.54105	394	15-Jun-10
SMC-00135	Mill Creek Canyon	San Bernardino	34.07948	-116.88116	1920	7-Jun-10
SMC-00375	Plunge Creek	San Bernardino	34.10656	-117.15409	436	8-Jun-10
SMC-01383	Day Creek	San Bernardino	34.0654	-117.5416	299	1-Jun-10
SMC-02059	Santa Ana River	San Bernardino	34.06114	-117.30641	284	3-Jun-10
SMC-02167	Plunge Creek	San Bernardino	34.10485	-117.15669	432	7-Jun-10
SMC-02573	San Timoteo	San Bernardino	34.0143	-117.17895	466	9-Jun-10
SMC-03133	Cucamonga Creek	San Bernardino	33.99902	-117.59924	218	2-Jun-10
SMC-03533	San Timoteo	San Bernardino	34.02392	-117.1938	420	1-Jun-10
SMC-03687	Deer Creek	San Bernardino	34.08091	-117.58239	319	2-Jun-10
SMC-09591	Plunge Creek	San Bernardino	34.10424	-117.16682	413	3-Jun-10
SMC-09698	Strawberry Creek	Riverside	33.74398	-116.7086	1642	9-Jun-10
SMC-26909	San Jacinto River	Riverside	33.66446	-117.27666	398	31-May-10
SMC-27709	San Jacinto River	Riverside	33.66291	-117.2916	387	31-May-10

Sample Collection

BMI samples were collected starting with the downstream transect and then proceeding upstream. This technique was used in order to avoid habitat disruption to downstream transects during sample collection. Samples were collected at either 25% instream of the right bank (R), 50% instream of the right bank (C) or 75% instream of the right bank (L) at each transect following a R, C, L pattern starting with the right bank. This alternating pattern was followed along each 150-meter sampling reach until a single sample was collected from each reach (0 meters to 150 meters).

The BMIs were collected using a one foot wide, 0.5-milimeter mesh D-frame kick-net. A one-foot by one-foot sampling plot, directly in front of the net, was sampled by first checking for heavy organisms such as clams and/or snails. These organisms were removed from the substrate by hand and placed into the net. Stones larger than a golf ball were carefully picked-up and rubbed in front of the net to collect all attached animals. The remaining underlying substrate was sampled by digging through the material to a depth of four inches (10-centimeters) and thoroughly manipulating the substrate in each quadrat with a consistent sampling effort (approximately one to three minutes). For streams with insufficient current to bring the suspended BMIs into the net, sites were sampled using the standard figure-eight collecting procedure. This procedure was repeated at each of the 11 transects.

The resulting 11 samples from a site were composited into one 1-liter jar and preserved in the field using 95% ethanol. Larger samples (e.g. samples that contained more than 50% sediment or 66% organic material) were split into additional jars as needed. A label containing the project, sample date, site designation, longitude and latitude, sampler's initials, and jar number was placed in each jar. A chain of custody form was completed for each sample location. As soon as the samples were returned to the lab, the ethanol, having been diluted with variable amounts of water from the samples, was replaced with fresh 75% ethanol.

Physical Habitat Quality Assessment and Water Quality Measurements

The physical habitat quality was surveyed along the entire reach of each sampling location following the Full Standard Operating Procedures for Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California (Ode 2007). At every 15-meter intervals along the 150-meter reach (25-meter intervals along the 250-meter reach), starting at transect 0-meters, physical habitat quality was determined by observing substrate complexity, consolidation, embeddedness, sediment depth, identifying human influences, determining canopy cover, and identifying indications of trophic complexity. At each transect, a depth profile was obtained at five equidistant points starting at banks edge and ending on the opposite banks edge. Additional substrate measurements and depth profiles were measured midway between main transects throughout the entire reach. Each sampling reach was scored using the General Habitat Characterization Form. Stream velocity was measured using a 60% stream depth method at each transect using a Flowatch flow-meter that measures velocities directly (buoyant object method used when 60% depth method cannot be preformed due to obstructions or depth limitations).

Four water quality parameters were collected on site at each sample location using a YSI 556 environmental monitoring unit and these included pH, dissolved oxygen (mg/l), conductivity (µS/cm), and water temperature (°C). In addition to these on site measurements, a 1000 mL water sample was collected at each site for laboratory analysis to test for other parameters used to describe the general chemical status of the streams. These measurements were performed by IIRMES and include the quantification of ammonia as nitrogen, dissolved orthophosphate as P, nitrate-nitrogen, nitrite-nitrogen, alkalinity, turbidity, and total suspended solids. Measurements done under E. S. Babcock & Sons Inc. include the quantification of all analytes mentioned for IIRMES excluding turbidity, and including total nitrogen and phosphorus as P. Although this form of sampling only provides a snapshot of the potential water chemistry at the time of BMI collection, the water chemistry collected during BMI sampling can provide valuable insight as to potential exposure values at each site.

Taxonomic Identification of BMIs

The BMI samples were transported to and processed by CSULB-SEAL. At the laboratory, each sample was rinsed through a No. 35 standard testing sieve (0.5 mm brass mesh) and transferred into a tray marked with twenty, 25 cm^2 grids. All sample material was removed from one randomly selected grid at a time and placed into a Petri dish for inspection under a stereomicroscope. All invertebrates from the grid were separated from the surrounding detritus and transferred to vials containing 75% ethanol. This process was continued until 600 organisms were removed from each sample. The material left from the processed grids was transferred into a jar with 75% ethanol and labeled as “remnant” material. Any remaining unprocessed sample from the tray was transferred back to the original sample container with 75% ethanol and archived. BMIs were then identified to standard taxonomic levels established by the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT) using standard taxonomic keys, typically genus level for insects and order or class for non-insects (Brown 1972, Edmunds et al. 1976, Kathman and Brinkhurst 1998, Klemm 1985, Merritt and Cummins 1995, Pennak 1989, Stewart and Stark 1993, Surdick 1985, Thorp and Covich 1991, Usinger 1963, Wiederholm 1983, 1986, Wiggins 1996, Wold 1974).

Data Analysis

A taxonomic list of all aquatic macroinvertebrates identified from the samples was entered into a Microsoft Excel® spreadsheet program. Excel® was used to generate a standalone taxonomic list, and to calculate and summarize the benthic macroinvertebrate community-based metric values.

All biological metric scores reported in this document are based on 500 organisms (fewer than 500 organisms were used only if the total number of organisms in a sample was fewer than 500). Current SWAMP protocols require a sample of 600 BMIs; however, the So Cal IBI was built using counts of 500 BMIs. To generate the seven biological metrics (Table 2) used to calculate the So Cal IBI, all samples were statistically subsampled to 500 BMIs. Each of the seven metrics is included in one of the following major categories:

Richness Measures – These metrics reflect the diversity of the aquatic assemblage where increasing diversity correlates with increasing health of the assemblage and suggests that niche space, habitat, and food sources are adequate to support survival and propagation of a variety of species.

Tolerance/Intolerance Measures – These metrics reflect the relative sensitivity of the community to aquatic perturbations. The taxa used are usually pollution tolerant or intolerant, but are generally nonspecific to the type of stressors. The metric values usually increase as the effects of pollution in the form of organics and sedimentation increase.

Functional Feeding Groups – These metrics provide information on the balance of feeding strategies in the aquatic assemblage. The functional feeding group composition is a surrogate for complex processes of trophic interactions, production, and food source availability. An imbalance of the functional feeding groups reflects unstable food dynamics and indicates a stressed condition.

Index of Biotic Integrity

An Index of Biotic Integrity (IBI) uses biological metrics to describe the biological condition of a watershed or ecoregion. These metrics vary by biogeographical area and are based on reference sites. These reference sites are locations within the biogeographical area thought to be relatively pristine and minimally impacted by anthropogenic activities. Many different metrics were measured, but only those that showed responsiveness to watershed-scale and reach-scale disturbance variables and lacked correlation with other responsive metrics were used (Ode et al. 2005). The IBI used to evaluate the 44 sampled sites was developed from 2000 to 2003 and was based on data from the Southern California Coastal region (Ode et al. 2005; Table 3). It should be noted that the reference sites assessed during the development of the SCC-IBI did not include sites with physical alterations (i.e., concrete-lined or modified channels), and low gradient reference sites were largely underrepresented.

Quality Assurance and Quality Control (QA/QC)

All QA/QC requirements were followed by sampling personnel (CSULB 2010) during the 2010 sampling events. An auditor from the Southern California Coastal Water Research Project (SCCWRP) accompanied sampling personnel during the 2010 bioassessment to ensure that all sampling activities were completed using the approved methods. Only CSULB-SEAL personnel trained in the approved sampling methods participated in the collection of BMIs during the 2010 sampling events. All internal QA/QC procedures were followed and none of the limits described in the document were violated. Picking error also occurred in certain samples during sample processing leading to greater than 600 BMIs being picked, when this occurred 600 BMIs were randomly subsampled from the overall data set from that specific location. Sites SMCR8_294, SMCR8_387, SMCR8_450, SMCR8_478 Rep 1, SMCR8_559, SMCR8_567, SMCR8_00135, and SMCR8_03533 had fewer than 450 BMIs found in the benthic sample; although SCC-IBI scores were generated for these sites, scores generated using fewer than 450 BMIs have not been validated. All QA/QC documentation, including the chain of custody forms for each site, are on file with the appropriate contract laboratory and CSULB-SEAL.

Table 2. Bioassessment metrics used to describe characteristics of the benthic macroinvertebrate (BMI) communities at assessed sites.

BMI Metric	Description	Response to Impairment
Richness Measures		
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	Decrease
Number of Coleoptera Taxa	Number of taxa from the insect order Coleoptera (beetles)	Decrease
Number of Predator Taxa	Number of taxa from the predator functional feeding group	Decrease
Tolerance/Intolerance Measures		
Percent Tolerant Taxa	Percent of taxa in sample that are highly tolerant to impairment as indicated by a tolerance value 8, 9, 10	Increase
Percent Non-insect Taxa	Percent of organisms in sample that are not in the Class Insecta	Increase
Functional Feeding Groups (FFG)		
Percent Collector-Gatherers (CG)	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Collector-Filterers (CF)	Percent of macrobenthos that filter fine particulate matter	Increase
Percent Collector Gatherérers + Collector Filterers (CF)	Percent of macrobenthos that collect or gather fine particulate matter and/or percent of macrobenthos that filter fine particulate matter	Increase

Table 3. Southern Coastal California Benthic Macroinvertebrate Index of Biotic Integrity parameters and scoring ranges (to adjust IBI scores so that they range from 0 to 100, multiply the total IBI score by 10/7; from Ode et al. 2005).

	Metric Scoring Ranges for the Southern Coastal California B-IBI						
Metric Score	**# EPT Taxa**	**% Intolerant Individuals**	**# Predator Taxa**	**% Tolerant Taxa**	**% Non-Insect Taxa**	**% CF + CG**	**# Coleoptera Taxa**
10	> 17	25-100	> 12	0-4	0-8	0-59	> 5
9	16-17	23-24	12	5-8	9-12	60-63	
8	15	21-22	11	9-12	13-17	64-67	5
7	13-14	19-20	10	13-16	18-21	68-71	4
6	11-12	16-18	9	17-19	22-25	72-75	
5	9-10	13-15	8	20-22	26-29	76-80	3
4	7-8	10-12	7	23-25	30-34	81-84	2
3	5-6	7-9	6	26-29	35-38	85-88	
2	4	4-6	5	30-33	39-42	89-92	1
1	2-3	1-3	4	34-37	43-46	93-96	
0	0-1	0	0-3	38-100	47-100	97-100	0

Total IBI Scoring Range Adjusted Scale (0 - 100)	0-20 Very Poor	21-40 Poor	41-60 Fair	61-80 Good	81-100 Very Good

Results

BMI Community Structure

During the 2010 bioassessment sampling events, 242 distinct BMI taxa were identified from the 44 sampled locations (Appendix D). Low elevation sites were dominated by mayfly larvae *Baetis spp*. and *Tricorythodes spp*., caddisfly larvae *Hydropysche spp*. and immature Hydroptilidae, aquatic fly larvae from the family Chironomidae, aquatic crustacean *Hyalella sp*. and seed-shrimp from the order Ostracoda, aquatic worms from the class Oligochaeta, and aquatic snails *Physa sp*. Mid elevation sites were dominated by mayfly larvae *Baetis spp*., caddisfly larvae *Hydropsyche/Ceratopsyche sp*., aquatic fly larvae from the family Chironomidae, *Simulium sp*., *Caloparyphus/Euparyphus sp*., aquatic beetle larvae *Optioservus sp*., and seed-shrimp from the order Ostracoda. High elevation sites were dominated by mayfly larvae *Baetis sp*., stonefly larvae *Malenka sp*., *Yoraperla sp*., and *Zapada sp*., aquatic fly larvae from the family Chironomidae, *Simulium sp*., *Prosimulium sp*., and *Caloparyphus/Euparyphus sp*., seed shrimp from the order Ostracoda, bivalves *Pisidium sp*., and aquatic mites *Sperchon sp*.

Index of Biological Integrity – SCC-IBI scores are adjusted from a scale of 0 to 70 (seven summed metrics ranging from 0 to 10), to a scale of 0 to 100 for ease of interpretation. Adjusted SCC-IBI scores were obtained by multiplying the summed SCC-IBI score by 10 and dividing that score by 7. The adjusted SCC-IBI scores for the 2010 bioassessment sampling events ranged from 10 to 80 (Table 4, Figure 1). SCC-IBI scores were positively correlated with elevation ($R^2 = 0.39$, Figure 2) and overall habitat characterization scores ($R^2 = 0.37$, Figure 12), and negatively correlated with water temperature ($R^2 = 0.5$, Figure 3), conductivity ($R^2 = 0.29$, Figure 6), and alkalinity ($R^2 = 0.28$, Figure 7). SCC-IBI scores showed no correlation with dissolved oxygen (Figure 4), turbidity (Figure 5), dissolved orthophosphate (Figure 8), ammonia (Figure 9), nitrate (Figure 10), and nitrite (Figure 11).

Water Chemistry – Refer to Appendix C for water chemistry values.

Physical Habitat Quality

During the 2010 bioassessment sampling events, samples were collected from a wide array of landuse and channel types, which is presented in Table 5. Low elevation streams consisted of mix of streams surrounded by urban/suburb landcover with concrete-lined and natural channel types; mid elevation streams were predominantly urban/suburban landcover with man-made embankments and natural stream bottoms; and high elevation streams were all surrounded by forest landcover with natural channel types (Table 5). Landuse/landcover categories follow those used on the SWAMP field data sheets. Overall habitat characterization scores for the 2010 sampling year ranged from 1 to 59 (poor to optimal; Table 5) with low elevation streams averaging 24.5 ± 4.5 (marginal), mid elevation streams averaging 33.1 ± 3.6 (suboptimal), and high elevation streams averaging 47.4 ± 2.1 (optimal).

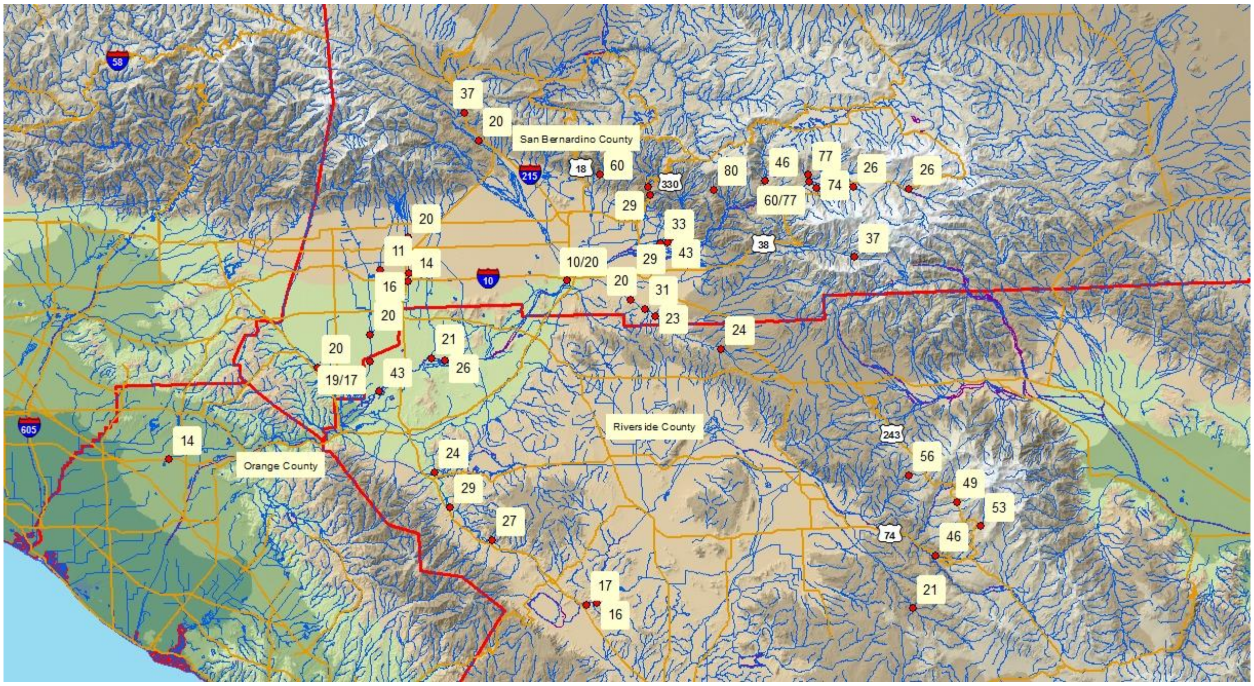

Figure 1. SCC-IBI scores for sites sampled during the 2010 bioassessment survey.

Table 4. SCC-IBI metrics and overall rating for each location sampled during the 2010 bioassessment survey. The eight sites reported in italics had fewer than 450 BMIs collected.

Site/Replicate	EPT Taxa	Predator Taxa	Coleoptera Taxa	Percent Non-Insect Taxa	Percent Intolerant Individuals	Percent Tolerant Taxa	Percent Collector Individuals	IBI Score (0 to 70)	IBI (Adjusted for 0 to100 Scale)	IBI Rating
SMCR8_107 (rep 1)	1	1	4	6	0	2	1	15	21	Poor
SMCR8_167 (rep 1)	3	4	2	8	4	6	1	28	40	Poor
SMCR8_167 (rep 2)	3	0	2	10	2	9	1	27	39	Poor
SMCR8_201 (rep 1)	0	0	0	10	0	0	1	11	16	Very Poor
SMCR8_236 (rep 1)	1	4	0	5	1	3	5	19	27	Poor
SMCR8_240 (rep 1)	9	10	2	8	10	7	10	56	80	Good
SMCR8_274 (rep 1)	2	1	2	8	1	4	2	20	29	Poor
SMCR8_277 (rep 1)	7	4	4	10	2	8	7	42	60	Fair
SMCR8_293 (rep 1)	1	3	0	6	0	2	8	20	29	Poor
SMCR8_294 (rep 1)	*1*	*0*	*2*	*9*	*0*	*5*	*1*	*18*	*26*	*Poor*
SMCR8_297 (rep 1)	3	10	2	8	5	7	4	39	56	Fair
SMCR8_304 (rep 1)	1	7	2	10	2	8	2	32	46	Fair
SMCR8_309 (rep 1)	1	4	2	8	1	6	4	26	37	Poor
SMCR8_322 (rep 1)	1	6	5	8	4	4	4	32	46	Fair
SMCR8_356 (rep 1)	2	8	0	9	0	1	10	30	43	Fair
SMCR8_380 (rep 1)	0	0	0	5	3	6	4	18	26	Poor
SMCR8_387 (rep 1)	*0*	*0*	*0*	*7*	*0*	*3*	*7*	*17*	*24*	*Poor*
SMCR8_395 (rep 1)	0	0	2	8	0	2	1	13	19	Very Poor
SMCR8_395 (rep 2)	0	0	0	8	0	4	0	12	17	Very Poor
SMCR8_396 (rep 1)	0	0	0	8	0	5	1	14	20	Very Poor
SMCR8_400 (rep 1)	3	1	0	5	0	1	7	17	24	Poor
SMCR8_403 (rep 1)	1	3	0	5	0	0	5	14	20	Very Poor
SMCR8_405 (rep 1)	5	1	2	10	3	8	5	34	49	Fair
SMCR8_407 (rep 1)	0	0	2	9	3	4	0	18	26	Poor
SMCR8_436 (rep 1)	5	4	5	7	3	7	1	32	46	Fair
SMCR8_441 (rep 1)	1	0	0	7	0	1	1	10	14	Very Poor
SMCR8_445 (rep 1)	9	8	4	7	10	6	8	52	74	Good
SMCR8_448 (rep 1)	10	10	5	8	5	8	8	54	77	Good
SMCR8_450 (rep 1)	*1*	*0*	*0*	*8*	*0*	*2*	*4*	*15*	*21*	*Poor*
SMCR8_478 (rep 1)	*6*	*1*	*4*	*9*	*10*	*8*	*4*	*42*	*60*	*Fair*
SMCR8_478 (rep 2)	10	6	4	10	10	9	5	54	77	Good
SMCR8_559 (rep 1)	*0*	*0*	*0*	*10*	*0*	*2*	*2*	*14*	*20*	*Very Poor*
SMCR8_567 (rep 1)	*0*	*1*	*0*	*9*	*0*	*6*	*1*	*17*	*24*	*Poor*
SMCR8_598 (rep 1)	0	0	0	10	0	4	0	14	20	Very Poor
SMC00135 (rep 1)	*2*	*0*	*0*	*10*	*2*	*9*	*3*	*26*	*37*	*Poor*
SMC00375 (rep 1)	1	5	2	6	1	2	3	20	29	Poor
SMC01383 (rep 1)	0	0	0	10	0	0	0	10	14	Very Poor
SMC02059 (rep 1)	1	0	0	6	0	0	0	7	10	Very Poor
SMC02059 (rep 2)	0	4	2	7	0	0	1	14	20	Very Poor
SMC02167 (rep 1)	3	5	2	8	1	7	4	30	43	Fair
SMC02573 (rep 1)	1	0	0	9	0	4	2	16	23	Poor
SMC03133 (rep 1)	2	0	0	7	0	2	3	14	20	Very Poor
SMC03533 (rep 1)	*0*	*1*	*0*	*9*	*0*	*5*	*7*	*22*	*31*	*Poor*
SMC03687 (rep 1)	0	0	0	8	0	0	0	8	11	Very Poor
SMC09591 (rep 1)	1	5	4	8	0	3	2	23	33	Poor
SMC09698 (rep 1)	6	7	2	8	3	7	4	37	53	Fair
SMC26909 (rep 1)	1	0	0	7	0	2	1	11	16	Very Poor
SMC27709 (rep 1)	1	0	0	6	0	5	0	12	17	Very Poor

Table 5. Physical habitat characterization and overall rating for each location sampled during the 2010 bioassessment survey

Site Code	Dominant landuse/ landcover	Epifaunal Substrate/Cover (0 to 20)	Sediment Deposition (0 to 20)	Channel Alteration (0 to 20)	Overall Habitat Characterization score (0 to 60)	Overall Habitat Characterization score Rating
107	Forest	7	5	16	28	Marginal
167	Forest	17	15	20	52	Optimal
201	Urban/Industrial	0	1	0	1	Poor
236	Suburb/Town	15	4	19	38	Suboptimal
240	Forest	18	12	20	50	Optimal
274	Forest	19	20	20	59	Optimal
277	Forest	18	13	20	51	Optimal
293	Suburb/Town	12	18	19	49	Optimal
294	Suburb/Town	3	1	17	21	Marginal
297	Forest	12	4	20	36	Suboptimal
304	Forest	20	19	20	59	Optimal
309	Forest	14	13	18	45	Suboptimal
322	Forest	17	15	20	52	Optimal
356	Suburb/Town	5	7	20	32	Marginal
380	Forest	20	18	20	58	Optimal
387	Agriculture	1	2	14	17	Marginal
395	Suburb/Town	1	19	0	20	Marginal
396	Forest	8	6	15	29	Marginal
400	Suburb/Town	16	18	20	54	Optimal
403	Suburb/Town	19	19	18	56	Optimal
405	Forest	14	8	20	42	Suboptimal
407	Forest	8	15	20	43	Suboptimal
436	Forest	19	19	20	58	Optimal
441	Urban/Industrial	9	15	1	25	Marginal
445	Forest	16	12	20	48	Optimal
448	Forest	17	10	20	47	Optimal
450	Suburb/Town	3	2	19	24	Marginal
478	Forest	18	16	19	53	Optimal
559	Agriculture	2	1	3	6	Poor
567	Agriculture	13	9	18	40	Suboptimal
598	Suburb/Town	2	1	20	23	Marginal
SMC-00135	Forest	13	10	20	43	Suboptimal
SMC-00375	Forest	11	9	19	39	Suboptimal
SMC-01383	Urban/Industrial	1	20	0	21	Marginal
SMC-02059	Urban/Industrial	1	1	0	2	Poor
SMC-02167	Forest	11	9	19	39	Suboptimal
SMC-02573	Agriculture	2	1	12	15	Poor
SMC-03133	Agriculture	0	20	0	20	Marginal
SMC-03533	Other	2	2	17	21	Marginal
SMC-03687	Urban/Industrial	0	20	0	20	Marginal
SMC-09591	Forest	8	5	18	31	Marginal
SMC-09698	Forest	17	14	13	44	Suboptimal
SMC-26909	Other	10	3	15	28	Marginal
SMC-27709	Suburb/Town	10	2	10	22	Marginal

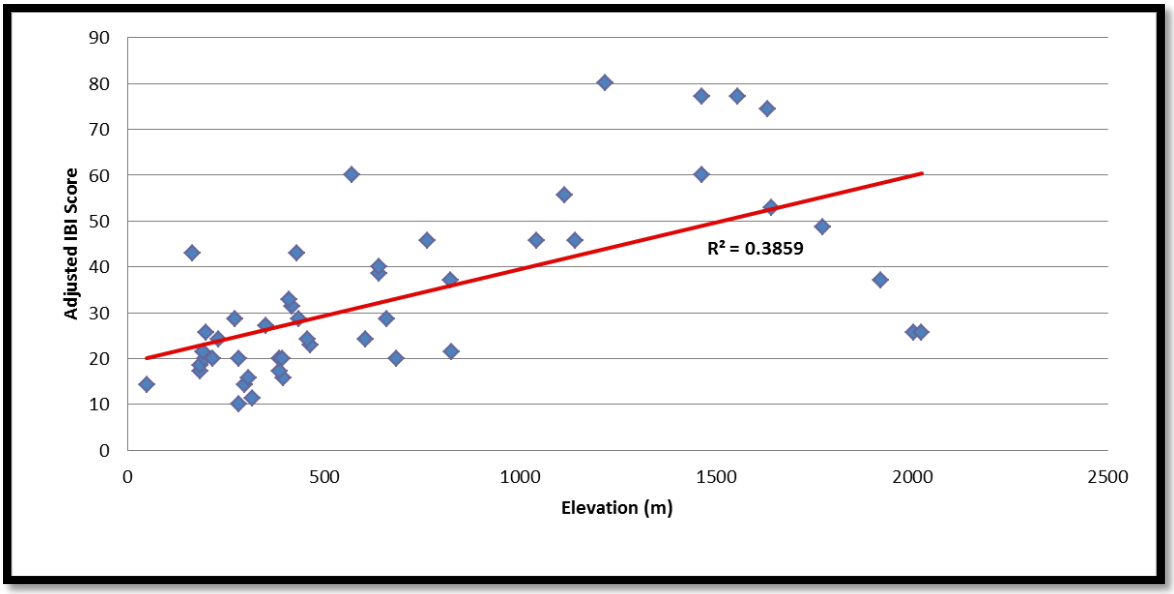

Figure 2. IBI scores as a function of elevation (IBI scores adjusted on a scale of 0 to 100).

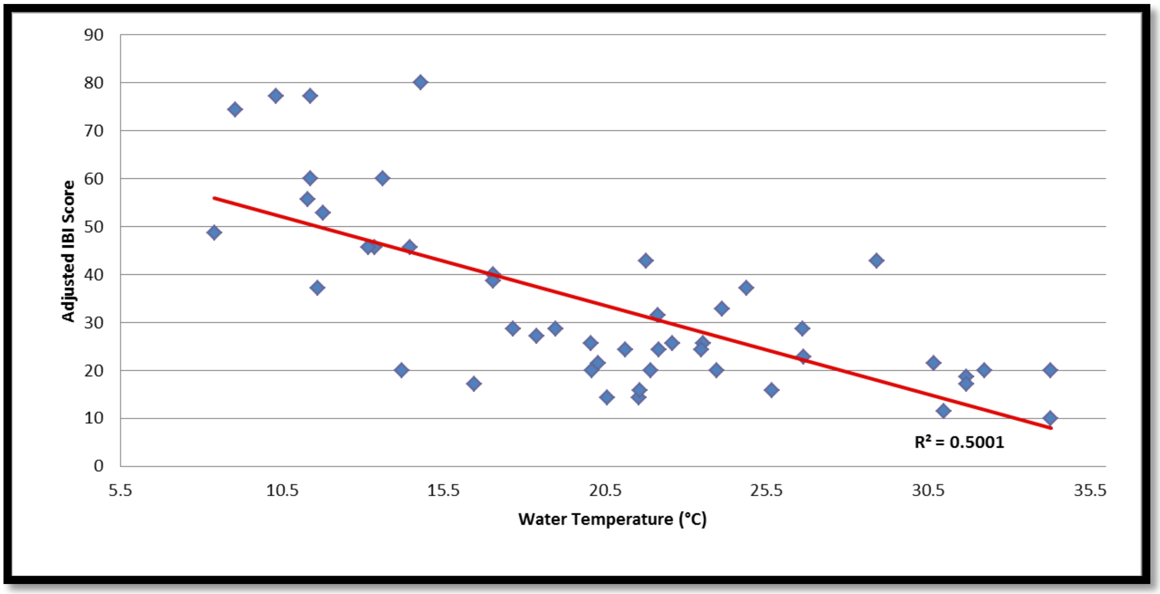

Figure 3. IBI scores as a function of water temperature (IBI scores adjusted on a scale of 0 to 100).

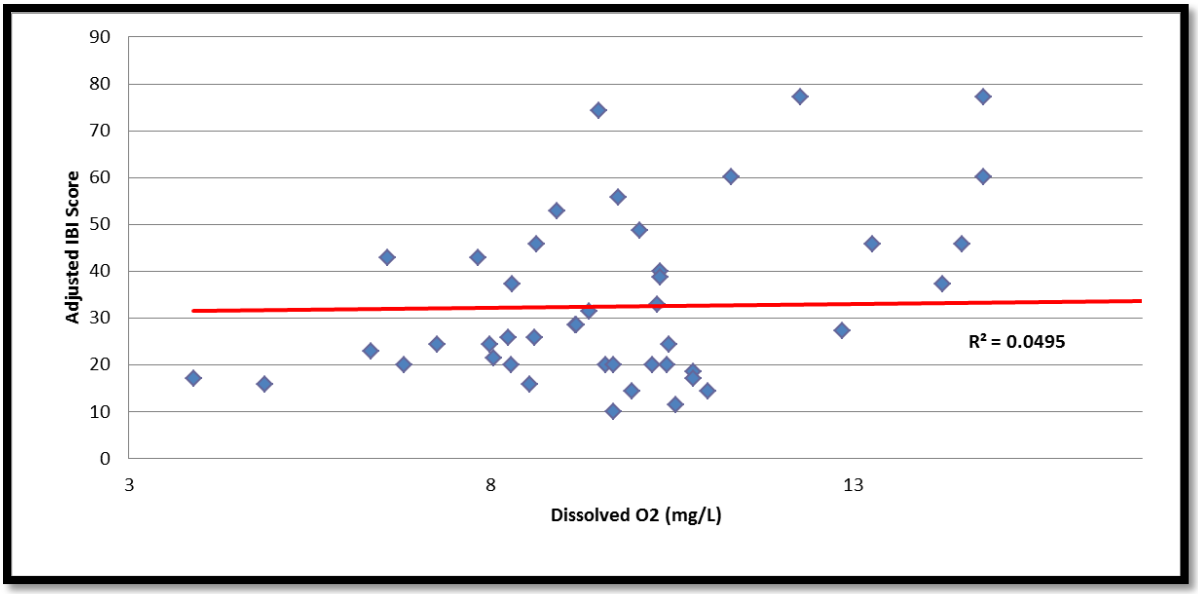

Figure 4. IBI scores as a function of dissolved oxygen (IBI scores adjusted on a scale of 0 to 100).

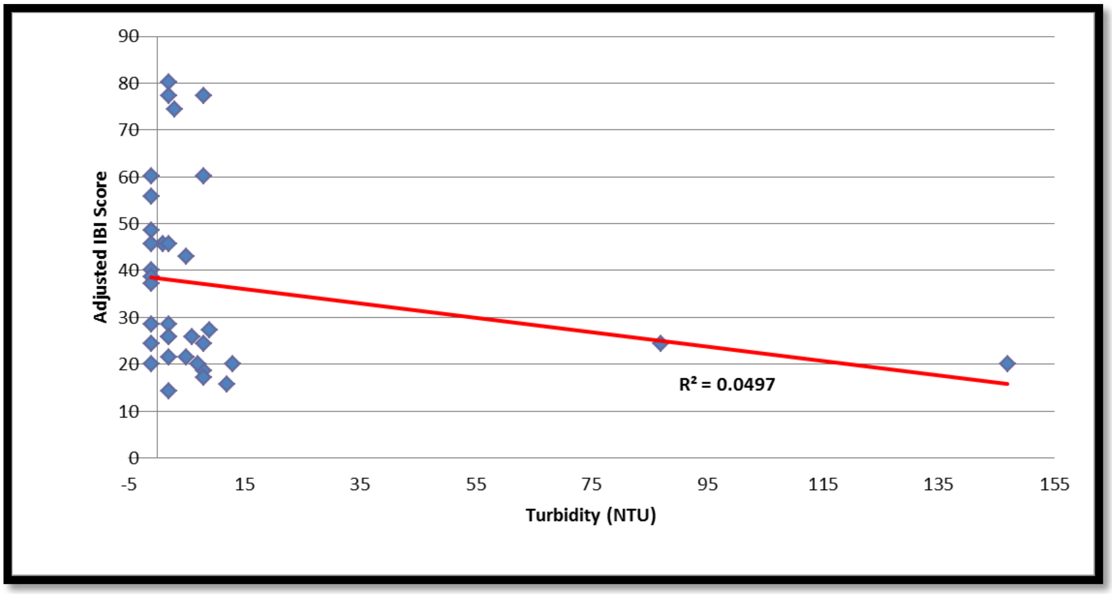

Figure 5. IBI scores as a function of turbidity (IBI scores adjusted on a scale of 0 to 100).

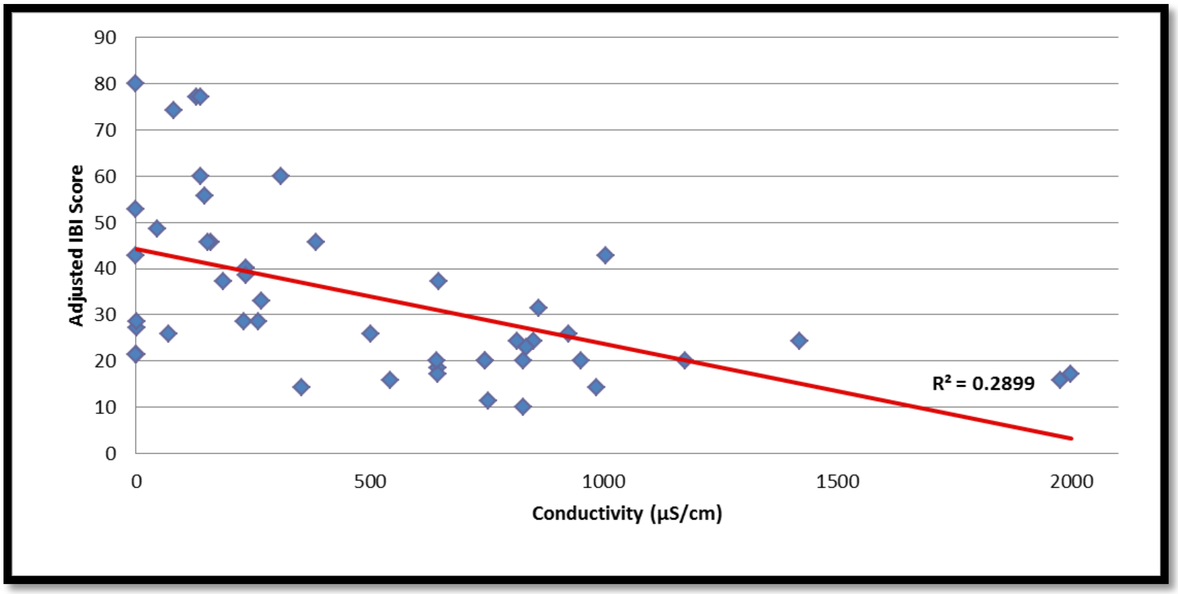

Figure 6. IBI scores as a function of conductivity (IBI scores adjusted on a scale of 0 to 100).

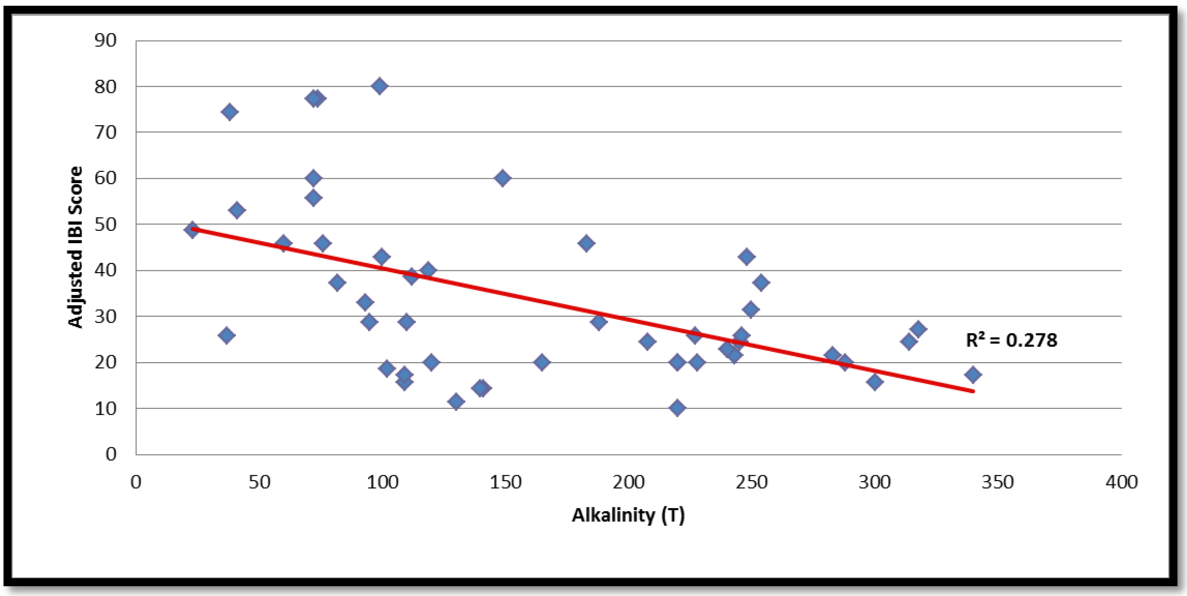

Figure 7. IBI scores as a function of alkalinity (IBI scores adjusted on a scale of 0 to 100).

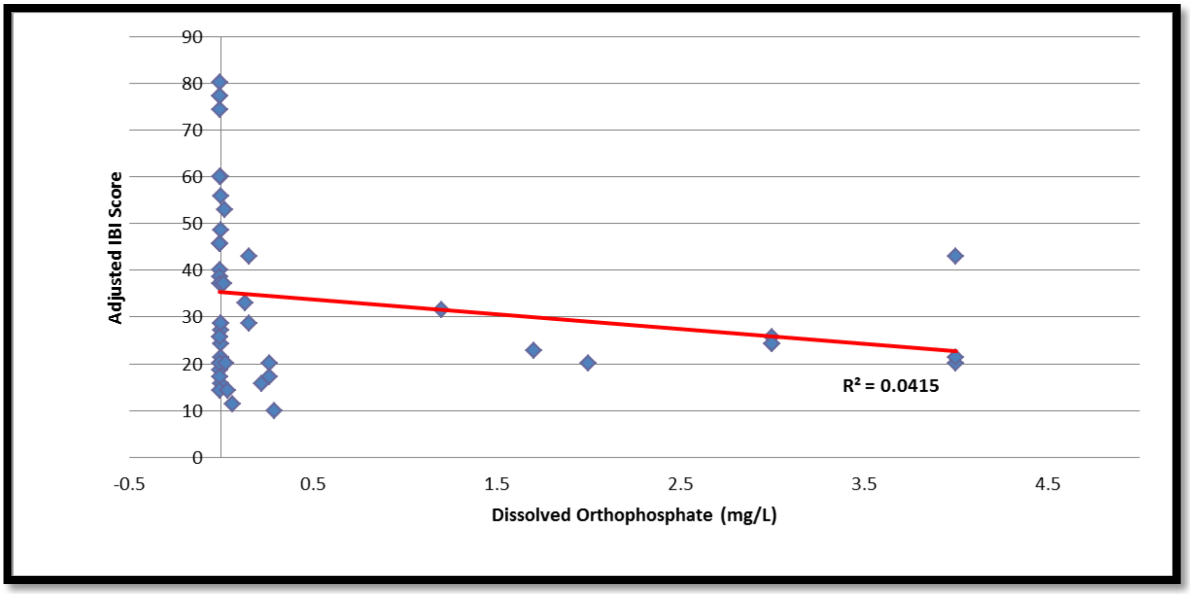

Figure 8. IBI scores as a function of dissolved orthophosphate (IBI scores adjusted on a scale of 0 to 100).

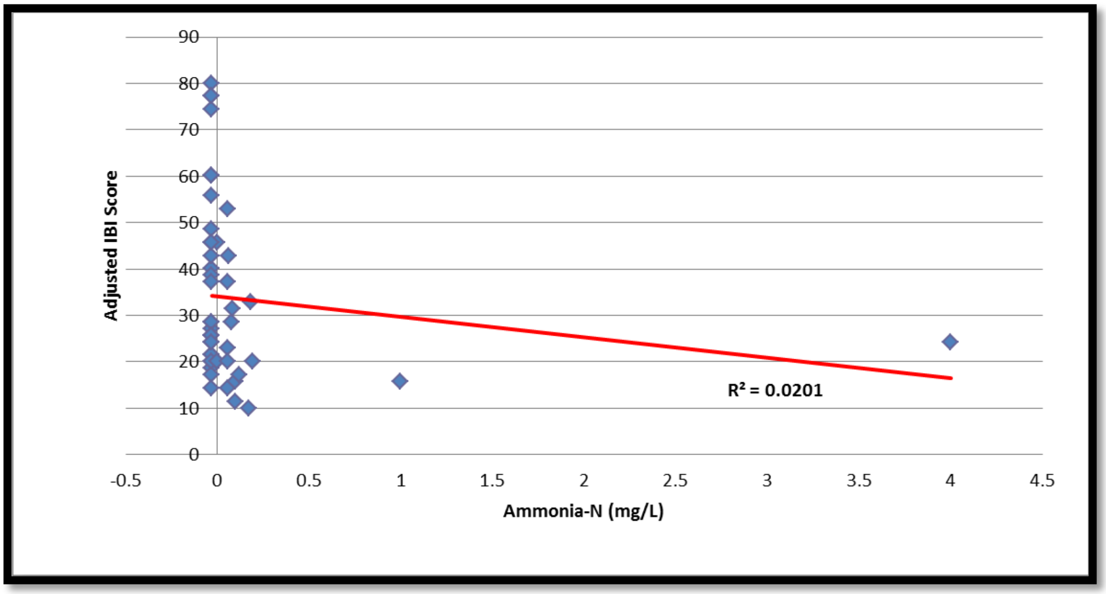

Figure 9. IBI scores as a function of ammonia (IBI scores adjusted on a scale of 0 to 100).

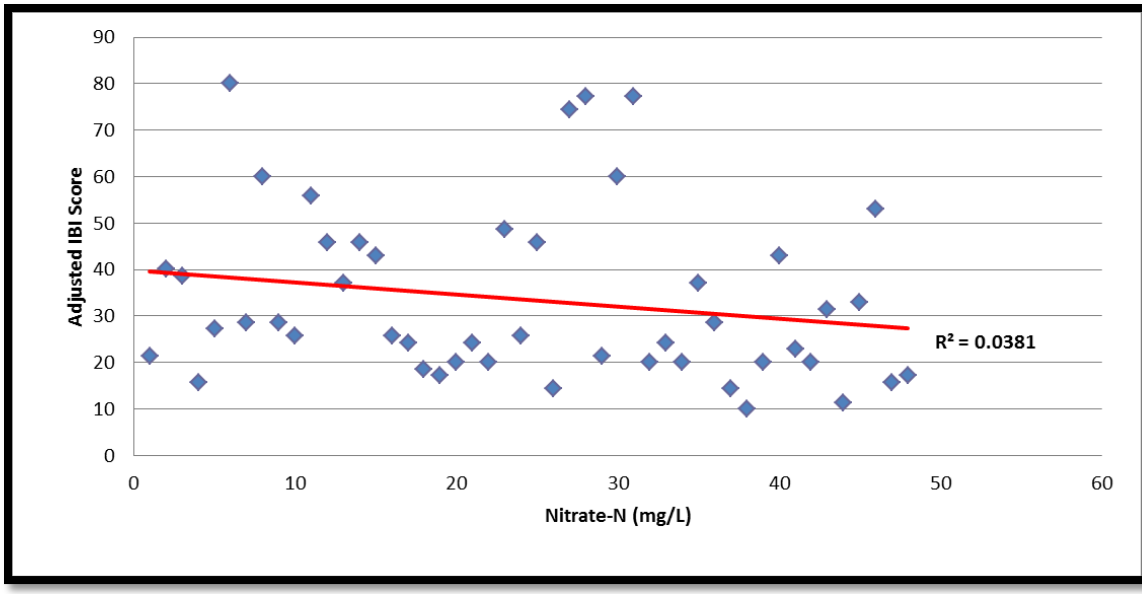

Figure 10. IBI scores as a function of nitrate (IBI scores adjusted on a scale of 0 to 100).

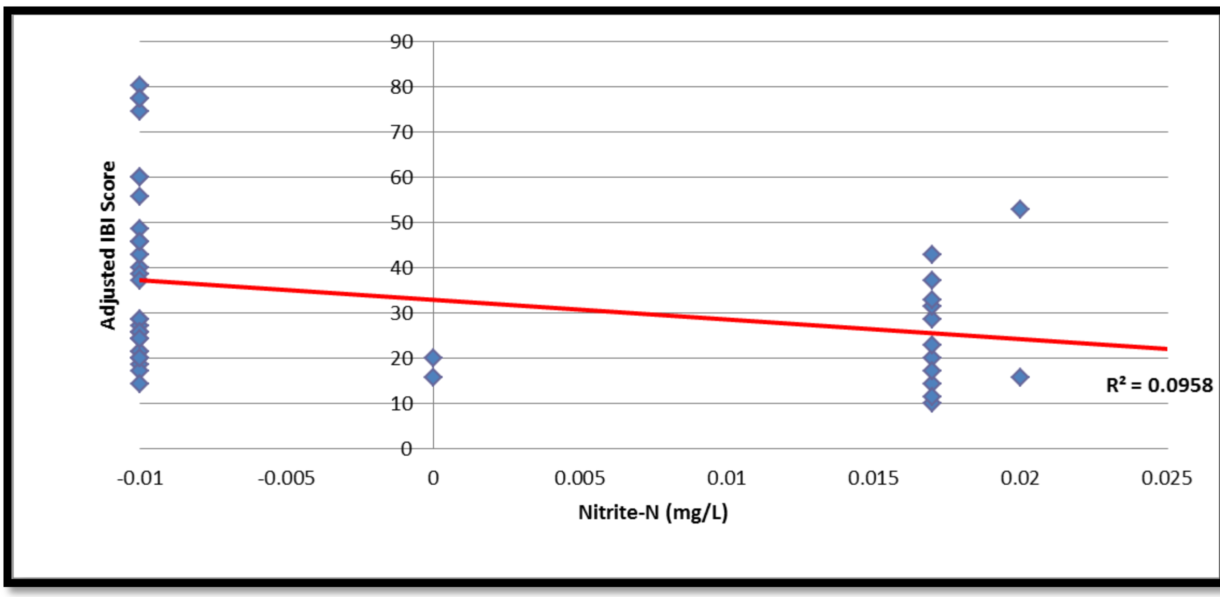

Figure 11. IBI scores as a function of nitrite (IBI scores adjusted on a scale of 0 to 100).

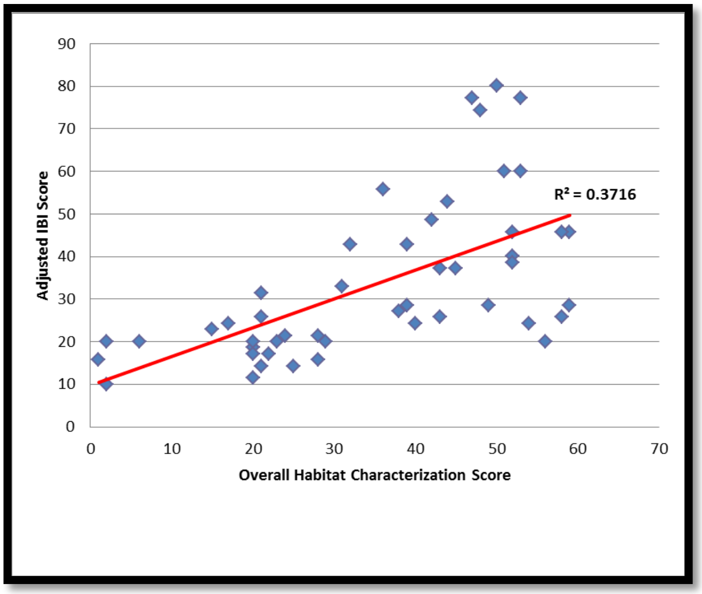

Figure 12. IBI scores as a function of overall habitat characterization (IBI scores adjusted on a scale of 0 to 100).

Conclusion

This report gives the results from the fourth year of an ongoing six-year monitoring project to assess the quality of the waterways within Region 8.

BMI Community Structure - The low and mid elevation sites were dominated by the facultative and tolerant insects and non-insects. These included midge larvae Chironomidae, crustaceans *Hyalella* sp. and Ostracoda, worms Oligochaeta, as well as mayflies *Baetis* sp. High-elevations sites were not only dominated by the aforementioned organisms (with the exception of Oligochaeta and *Hyalella* sp.), but were also dominated by semi-intolerant blackfly larvae *Simulium* sp., intolerant blackfly larvae *Prosimulium* sp., and intolerant stoneflies *Malenka* sp., *Yoraperla* sp., and *Zapada* sp.

Chironomidae larvae are highly tolerant of impaired conditions and are a documented signature of urbanization (Wang and Lyons 2002). Although Chironomidae larvae were present at all sites, their presence was not entirely determined by urbanization. Sites that were isolated from the influence of urbanization still exhibited similar levels of Chironomidae larvae when compared to sites surrounded by urbanization. Most Baetidae mayfly genera are moderately tolerant members of the EPT group of BMIs and have a preference for sediment-dominated streambeds, having no need for complex habitat with high volume of interstitial areas. They are, however, sensitive to contamination and low dissolved oxygen levels. The presence of stoneflies *Malenka* sp., *Yoraperla* sp., and *Zapada* sp. within high-elevation sites indicates relatively pristine habitat conditions for these sensitive organisms.

Physical/Habitat Quality and Chemical Characteristics – "Poor" scores for physical habitat condition of low elevation streams were primarily driven by the lack of epifaunal substrate cover coupled with channel alterations for flood control purposes; concrete-lined channels' physical habitat conditions scored higher than expected due to the lack of sediment within these systems, which is considered beneficial for inhabiting BMIs; on the contrary, concrete-lined channels lack micro-topography that many sensitive BMIs require to survive. "Marginal" scores for physical habitat condition of mid elevation streams were due to an increase in epifaunal substrate cover, when compared to low gradient streams. "Optimal" scores for physical habitat condition of high elevation streams were due to pristine habitat conditions, although a few locations were lacking in epifaunal substrate cover and had increased sedimentation.

The water quality characteristics were relatively consistent among sites with near neutral to moderately alkaline mean pH field values (5.22 to 11.01; Appendix C), more than adequate levels of mean dissolved oxygen (3.9 to 138.8; Appendix C), and highly variable conductivity values (0.092 to 2000 uS/cm; Appendix C). Natural inland waters usually contain small amounts of dissolved mineral salts; low and high levels of dissolved salts can be harmful to living organisms not able to osmoregulate causing the uptake of water into the organism's cells which can be lethal. Surveys of inland fresh waters indicate that a good mix of fish fauna is found where conductivity values range between 150 and 500 uS/cm and that the upper tolerance limit for freshwater organisms is 2000 uS/cm (McKee and Wolf 1971). Within this study, the highest levels of conductivity were found within our urban low elevation streams and are typical of systems with flows fed by urban influence.

SCC-IBI and Region 8 – While an IBI is an informative tool for assessing waterway condition, this multimetric technique is not without its limitations. When an IBI is developed, the individual metrics that comprise an IBI are generated for a specific region based on reference condition sites for that area. While Region 8 falls within the boundaries of the SCC-IBI, there were few sites from this area reflected in the developed SCC-IBI and this may partially explain the variability in IBI scores observed among the low gradient sites within Region 8. Moreover, the resultant IBI scores may not adequately reflect waterway condition or health. Many sites included in the developed SCC-IBI were located at high elevations and were also characterized as high gradient streams. However, many sites in Region 8 were low elevation, were characterized as low gradient, and many site reaches were located in channelized environments. Currently there is no developed IBI for low gradient, low elevation streams in this region, nor are channelized waterways included in the developed SCC-IBI.

Another important notation is that the SWAMP mandated sampling protocols include both a targeted riffle and multihabitat approach. The targeted riffle approach is used for high gradient streams, while the multihabitat approach is used at for low gradient streams. The multihabitat protocol may not be the best approach for these stream types, as many BMIs in this setting live on or near the bank margins. A 'margin-center-margin' protocol may better depict waterway condition for these site types.

Additionally, the SCC-IBI was developed by adjusting total counts of BMIs to 500 by means of Monte Carlo. This was necessary as the current SWAMP protocols require a sample of 600 BMIs, but the SCC-IBI was built using a 500 count. Several streams sampled during the 2010 bioassessment survey were whole-sorted and obtained fewer than 450 organisms; although IBI scores were generated for these locations, caution should be used when interpreting these scores being that they do not adhere to the statistical tools used to generate the SCC-IBI.

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Appendix A: Location Photos for Transect A

Photos from Transects F (upstream and downstream) and K (downstream) are available upon request.

Site 107: Transect A

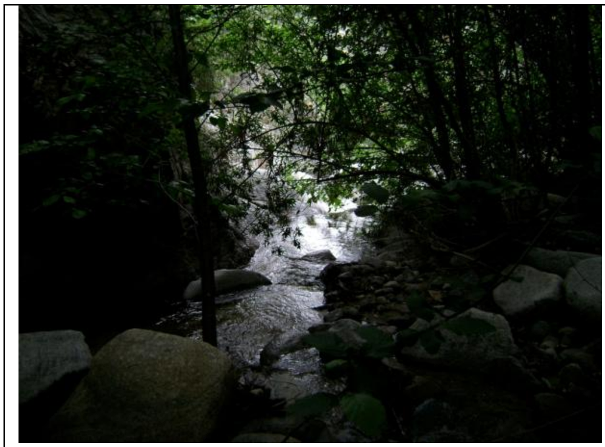
Site 167: Transect A

Site 201: Transect A

Site 236: Transect A

Site 240: Transect A

Site 274: Transect A



Site 277: Transect A

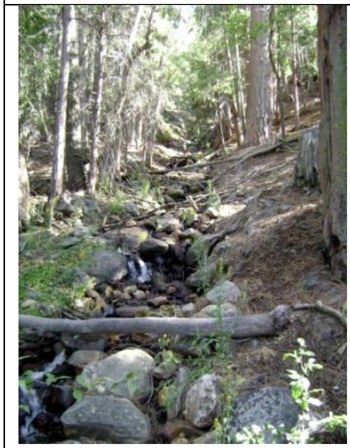
Site 293: Transect A

Site 294: Transect A

Site 297: Transect A

Site 304: Transect A

Site 309: Transect A

 Site 322: Transect A	 Site 356: Transect A
 Site 380: Transect A	 Site 387: Transect A
 Site 395: Transect A	 Site 396: Transect A

 Site 400: Transect A	 Site 403: Transect A
 Site 405: Transect A	 Site 407: Transect A
 Site 436: Transect A	 Site 441: Transect A

Site 445: Transect A

Site 448: Transect A

Site 450: Transect A

Site 478: Transect A

Site 559: Transect A

Site 567: Transect A

 Site 598: Transect A	 Site SMC-00135: Transect A
 Site SMC-00375: Transect A	 Site SMC-01383: Transect A
 Site SMC-02059: Transect A	 Site SMC-02167: Transect A

 Site SMC-02573: Transect A	 Site SMC-03133: Transect A
 Site SMC-03533: Transect A	 Site SMC-03687: Transect A
 Site SMC-09591: Transect A	 Site SMC-09698: Transect A

	
Site SMC-26909: Transect A	Site SMC-27709: Transect A

Appendix B: Standard Operating Procedures

STANDARD OPERATING PROCEDURES FOR COLLECTING BENTHIC MACROINVERTEBRATE SAMPLES AND ASSOCIATED PHYSICAL AND CHEMICAL DATA FOR AMBIENT BIOASSESSMENTS IN CALIFORNIA (UPDATED 02/01/07) CAN BE DOWNLOADED FROM:

http://swamp.mpsl.mlml.calstate.edu/wp-content/uploads/2009/04/swamp_sop_bioassessment_collection_020107.pdf

Appendix C: Water Chemistry Data

Appendix C1. Water chemistry data from IIRMES (including field and lab analyses). "DUP" denotes a field replicate; red values indicate a "Not Detectable" reading, and blue values indicate a"Detectable, but Not Quantifiable" reading.

Site	Lab Replicate	Field Replicate	Dissolved O2 (mg/L)	Field pH	Water Temp. (°C)	Conductivity (µS/cm)	Alkalinity (T)	Ammonia-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Dissolved Orthophosphate (mg/L)	Total Suspended Solids (mg/L)	Turbidity (NTU)
Reporting Limits						1	5	0.03	0.05	0.05	0.01	5	2
107	1	1	8.04	7.8	20.29	1.515	283	-0.03	-0.01	-0.01	0	8	2
167	1	1	10.35	7.95	17.04	236	119	-0.03	-0.01	-0.01	-0.01	1	-1
167 DUP	1	2	10.35	7.95	17.04	236	112	-0.03	-0.01	-0.01	-0.01	1	-1
201	1	1	8.54	9.33	25.65	545	109	1	-0.01	0	0	39	12
236	1	1	12.86	6.33	18.37	1.321	318	-0.03	N/A	-0.01	0	10	9
240	1	1	138.8	5.94	14.79	0.191	99	-0.03	-0.01	-0.01	-0.01	4	2
274	1	1	21.6	6.25	18.97	232	110	-0.03	0	-0.01	0	9	2
277	1	1	11.33	7.37	13.61	310	149	-0.03	0	-0.01	0	3	-1
293	1	1	9.17	7.17	17.66	1.283	188	-0.03	2	-0.01	0	1	-1
294	1	1	8.61	8.26	23.54	926	227	-0.03	4	-0.01	3	24	6
297	1	1	9.77	8.21	11.3	148	72	-0.03	-0.01	-0.01	0	-0.5	-1
304	1	1	13.27	6.2	14.47	161	60	-0.03	-0.01	-0.01	-0.01	3	1
309	1	1	8.3	7.27	24.88	648	254	-0.03	3	-0.01	-0.01	2	-1
322	1	1	8.63	7.7	13.36	386	183	0	-0.01	-0.01	-0.01	2	2
356	1	1	6.58	7.52	21.78	1005	248	-0.03	5	-0.01	4	27	5
380	1	1	8.25	8.64	20.07	71	37	-0.03	-0.01	-0.01	-0.01	3	2
387	1	1	7.27	7.74	23.48	851	245	4	2	-0.01	3	104	87
395	1	1	10.8	9.68	31.68	646	102	-0.03	-0.01	-0.01	-0.01	34	8
395 DUP	1	2	10.8	9.68	31.68	646	109	-0.03	-0.01	-0.01	-0.01	35	8
396	1	1	9.59	6.97	14.2	643	220	-0.03	1	-0.01	0	-0.5	-1
400	1	1	10.47	6.89	21.13	1419	208	-0.03	1	-0.01	0	1	-1
403	1	1	8.29	6.92	21.91	1174	228	0	3	0	4	11	7
405	1	1	10.06	8.48	8.41	47	23	-0.03	-0.01	-0.01	0	1	-1
407	1	1	74.5	7.76	22.57	503	246	-0.03	-0.01	-0.01	-0.01	9	2
436	1	1	14.52	5.22	13.18	154	76	-0.03	-0.01	-0.01	-0.01	2	-1
441	1	1	9.95	8.41	20.56	986	141	-0.03	0	-0.01	-0.01	3	2
445	1	1	9.5	5.39	9.05	82	38	-0.03	-0.01	-0.01	-0.01	18	3
448	1	1	12.28	7.23	10.31	130	74	-0.03	-0.01	-0.01	-0.01	4	2
450	1	1	117.4	7.6	30.68	0.918	243	-0.03	6	-0.01	4	22	5
478	1	1	14.81	7.23	11.37	138	72	-0.03	-0.01	-0.01	-0.01	29	8
478 DUP	1	2	14.81	7.23	11.37	138	72	-0.03	-0.01	-0.01	-0.01	29	8
559	1	1	6.81	8.27	32.24	953	288	-0.03	3	-0.01	2	348	147
567	1	1	7.99	7.6	22.15	815	314	-0.03	1	-0.01	3	24	8
598	1	1	10.23	8.34	20.08	748	165	0	-0.01	-0.01	-0.01	18	13

Appendix C2. Water chemistry data from E. S. Babcock & Sons, Inc. (including field and lab analyses). “DUP” denotes a field replicate; red values indicate a “Not Detectable” reading, and blue values indicate a”Detectable, but Not Quantifiable” reading.

Site	Lab Replicate	Field Replicate	Dissolved O2 (mg/L)	Field pH	Water Temp. (°C)	Conductivity (µS/cm)	Alkalinity (T)	Total Nitrogen (mg/L)	Ammonia-N (mg/L)	Nitrate-N (mg/L)	Nitrite-N (mg/L)	Dissolved Orthophosphate (mg/L)	Suspended Solids (mg/L)	Phosphorus as P (mg/L)
Reporting Limits						1	3	0.2	0.1	0.2	0.1	0.05	1	0.05
SMC-00135	1	1	14.25	6.98	11.6	187	82	0	0.059	0.11	0.017	0.011	8	0.04
SMC-00375	1	1	9.19	7.76	26.6	262	95	0.76	0.079	0.65	0.017	0.15	12	0.39
SMC-01383	1	1	11	7.9	21.55	354	140	1.8	0.059	1.5	0.017	0.036	4	0.04
SMC-02059	1	1	9.7	9.19	34.29	828	220	1.9	0.17	0.11	0.017	0.29	22	0.52
SMC-02059 DUP	1	2	9.7	9.19	34.29	828	220	2	0.19	0.11	0.017	0.26	25	0.52
SMC-02167	1	1	7.83	8.12	28.91	0.274	100	1.1	0.064	0.65	0.017	0.15	3	0.17
SMC-02573	1	1	6.35	7.09	26.63	836	240	3.2	0.059	2.6	0.017	1.7	59	2
SMC-03133	1	1	10.44	8	23.94	747	120	3	0.059	1.3	0.03	0.026	3	0.11
SMC-03533	1	1	9.36	7.27	22.14	861	250	3.2	0.081	2.4	0.017	1.2	150	2.1
SMC-03687	1	1	10.56	11.01	30.97	755	130	2.5	0.1	0.11	0.017	0.061	16	0.34
SMC-09591	1	1	10.31	7.56	24.13	268	93	1	0.18	0.63	0.017	0.13	3	0.14
SMC-09698	1	1	8.92	6.8	11.77	0.092	41	0.3	0.059	0.11	0.02	0.021	3	0.08
SMC-26909	1	1	4.89	7.43	21.56	1977	300	0.47	0.098	0.11	0.02	0.22	6	0.26
SMC-27709	1	1	3.9	6.83	16.46	2000	340	0.88	0.12	0.11	0.017	0.26	27	0.55

Appendix D: Benthic Macroinvertebrates Used for Calculating IBI Metrics

Table D1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_ 00135	SMCR8_ 00375	SMCR8_ 01383	SMCR8_ 02059 1	SMCR8_ 02059 2	SMCR8_ 02167	SMCR8_ 02573	SMCR8_ 03133	SMCR8_ 03533	SMCR8_ 03687
Insecta Taxa												
Ephemeroptera												
Ameletus	0	cg										
Baetidae	4	cg										
Baetis	5	cg	1	224				168	42	1	1	
Baetis adonis	5	cg	1									
Baetis tricaudatus	6	cg		100				184	9			
Caenis	7	cg										
Callibaetis	9	cg				1	1					
Camelobaetidius	4	cg						1				
Caudatella heterocaudata	1	cg										
Caudatella hystrix	1	cg										
Centroptilum	2	cg										
Cinygmula	4	sc										
Diphetor hageni	5	cg										
Drunella	0	cg										
Drunella doddsii	0	cg										
Drunella flavilinea	0	cg	2									
Drunella grandis	0	cg										
Epeorus	0	sc										
Ephemerella	1	cg										
Ephemerella dorothea	1	cg										
Ephemerellidae	1	cg						1				
Ephemeroptera												
Fallceon quilleri	4	cg				1		10	2	15		
Heptageniidae	4	sc										
Ironodes	3	sc	1									
Leptophlebiidae	2	cg										
Paraleptophlebia	4	cg										
Serratella	2	cg										
Serratella teresa	2	cg										
Odonata												
Anisoptera												
Argia	7	p										
Argia fumipennis	7	p						1				
Coenagrionidae	9	p										
Cordulegaster dorsalis	3	p										
Gomphidae	4	p										
Hetaerina americana	6	p										
Libellulidae	9	p										
Odonata				1				1				
Plecoptera												
Attaneuria	1	p										
Calineuria californica	2	p										
Chloroperlidae	1	p										
Diura	2	p										
Haploperla chilnualna	1	p										
Hesperoperla	2	p										
Hesperoperla pacifica	2	p										
Isoperla	2	p										
Malenka	2	sh	1									
Nemouridae	2	sh										
Osobenus yakimae	2	p										
Perlidae	1	p										
Perlodidae	2	p										
Plecoptera												
Sasquaperla hoopa	1	p										
Suwallia	1	p	3									
Sweltsa	1	p										
Taenionema	2	om										
Taeniopterygidae	2	om										
Tricorythodes minutus	4	cg				1						
Yoraperla nigrisoma	1	sh										
Zapada cinctipes	2	sh										
Hemiptera												
Belostomatidae	8	p										
Corisella decolor	8	p										
Corixidae	8	p				11	4					
Trichocorixa	8	p										
Trichocorixa calva	8	p										
Trichoptera												
Agapetus	0	sc										
Agapetus orosus	0	sc										
Brachycentridae	1			1				1				

Table D1 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_ 00135	SMCR8_ 00375	SMCR8_ 01383	SMCR8_ 02059 1	SMCR8_ 02059 2	SMCR8_ 02167	SMCR8_ 02573	SMCR8_ 03133	SMCR8_ 03533	SMCR8_ 03687
Trichoptera												
Glossosomatidae	0	sc										
Gumaga	3	sh										
Helicopsyche	3	sc										
Hydropsyche	4	cf		3				4				
Hydropsyche morosa	6	ph										
Hydropsychidae	4	cf								1		
Hydroptila	6	ph							6	17		
Hydroptilidae	4	ph								2		
Lepidostoma	1	sh										
Lepidostomatidae	1	sh										
Limnephilidae	4	sh	1									
Micrasema	1	mh		5				6				
Neophylax	3	sc										
Ochrotrichia	4	ph										
Parapsyche	0	p										
Psychoglypha	2	sh										
Rhyacophila	0	p	3									
Sericostomatidae	3	sh										
Tinodes	2	sc										
Trichoptera												
Wormaldia	3	cf										
Coleoptera												
Agabus	8	p										
Cleptelmis addenda	4	cg										
Coleoptera												
Crenitis	4	cg										
Dytiscinae	5	p										
Elmidae	4	cg		1								
Elodes		sc										
Helichus	5	sh										
Helophorus												
Hydrobius	8	p										
Hydrophilidae	5	p										
Hydroporinae	5	p										
Hydroporus	5	p										
Lara	4	sh										
Narpus	4	cg										
Optioservus	4	sc		9				7				
Ordobrevia nubifera	4	sc										
Peltodytes		mh										
Rhantus	5	p										
Sanfilippodytes	5	p					1					
Stictotarsus	5	p										
Zaitzevia	4	sc										
Diptera												
Ablabesmyia	8	cg										
Agathon	0	sc	2									
Alotanypus						1	1					
Anopheles	8	cg										
Apedilum	6	cg							3	2		
Atrichopogon	6	cg										
Atylotus/Tabanus	5	p										
Bezzia/Palpomyia	6	p										
Blepharicera	0	sc										
Blephariceridae	0	sc										
Boreoheptagyia	6	cg										
Brachycera											1	
Brillia	5	sh	22	1								
Caloparyphus/ Euparyphus	8	cg		1				2				
Cardiocladius	5	p										
Caudatella	1	cg										
Ceratopogonidae	6	p					1					
Chelifera/Metachela	6	p										
Chironomidae	6	cg										
Chironomus	10	cg			22	21	27		7	19		7
Clinocera	6	p										
Corynoneura	7	cg		4				6				
Cricotopus	7	cg		15	407	174	204	1	27	217	6	449
Cricotopus bicinctus group	7	cg										
Cricotopus trifascia group	7	cg							5			
Cryptochironomus	8	p		1					5	3		
Cryptolabis	3	sh										
Culicoides							1		2			
Dasyhelea	6	cg									1	
Demicryptochironomus	6	cg										

Table D1 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_00135	SMCR8_00375	SMCR8_01383	SMCR8_02059		SMCR8_02167	SMCR8_02573	SMCR8_03133	SMCR8_03533	SMCR8_03687
						1	2					
Diptera												
Dicranota	3	p									1	
Dicrotendipes	8	cg			20	71	63			40		35
Diptera					8						3	
Dixa	2	cg										
Dixidae	2	cg						1				
Dolichopodidae	4	p		5			1	2	6		2	
Empididae	6	p										
Endotribelos	6	cg										
Ephydridae	6					19	24		7		1	
Eukiefferiella	8	om	31	12	7			18	8		1	
Euparyphus	8	cg										
Forcipomyia	6	cg										
Glutops	3	p										
Heleniella	6	cg										
Hemerodromia	6	p										
Hesperoconopa	1	cg										
Hexatoma	2	p										
Labrundinia	6	p										
Limnophila	3	sh										
Limnophyes	8	cg							2		8	
Limonia	6	sh										
Maruina lanceolata	2	sc										
Micropsectra	7	cg					3		8		15	
Microtendipes	6	cf						2				
Muscidae	6	p	1	6				9				
Nemotelus	8	cg										
Neoplasta	6	p										
Nilotanypus	6	p										
Ormosia	3	cg				2	1					
Orthocladius	6	cg	14		27							
Orthocladius complex	6	cg										
Pagastia	1	cg	16					1				
Paracladopelma	7											
Parametriocnemus	5	cg		7	5			4			5	
Paraphaenocladius	4	cg									5	
Parasimulium	6	cf										
Paratanytarsus	6	cf										
Pentaneura	6	p					2	3	2		2	
Pericoma	4	cg									5	
Pericoma/Telmatoscopus	4	cg							3			
Phaenopsectra	7	sc										
Polypedilum	6	om		7			2	2	4	9	1	
Probezzia	6	p										
Procladius	9	p					10					1
Prodiamesa	3	cg										
Prosimulium	3	cf	11									
Pseudochironomus	5	cg								14		
Pseudodiamesa	6	cg	34									
Pseudosmittia		cg				3					4	
Psychodidae		cg									3	
Rheocricotopus	6	om							9		21	
Rheotanytarsus	6	cf		2				12	7		5	
Saetheria	6	cg										
Simuliidae	6	cf	1								2	
Simulium		cf	1					15	166	32	9	
Simulium canadensis	6	cf										
Stempellinella	4	cg										
Stilobezzia	6	p										
Stratiomyidae	8	cg										
Tanypodinae	7	p				1						
Tanytarsus	6	cf		3	4	67	83		1	6		7
Tanytarsus limneticus	6	cf				1	2					
Thienemanniella	6	cg										
Thienemannimyia group	6	p		3				6				
Tipulidae	3											
Tipulinae	3											
Tvetenia	5	cg										
Tvetenia bavarica group	5	cg										
Wiedemannia	6	p										
Lepidoptera												
Lepidoptera												
Petrophila	5	sc								26		

Table D1 continued part 3. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_00135	SMCR8_00375	SMCR8_01383	SMCR8_02059		SMCR8_02167	SMCR8_02573	SMCR8_03133	SMCR8_03533	SMCR8_03687
						1	2					
Megaloptera												
Corydalidae	0	p										
Neohermes	0	p										
Orohermes	0	p										
Non-Insecta Taxa												
Acari	5	p										
Oligochaeta	5	cg	1	61		116	65	4	168	87		
Ostracoda	8	cg				7	1		1	4		1
Turbellaria	4	p										
Amphipoda												
Amphipoda	4	cg										
Crangonyx	4	cg										
Hyalella	8	cg										
Basommatophora												
Gyraulus	8	sc										
Menetus opercularis												
Physa	8	sc		1						5	1	
Trombidiformes												
Atractides	8	p		1				1				
Estelloxus	8	p										
Lebertia	8	p		3								
Mesobates	8	p										
Mideopsis	5	p										
Pionidae						1	2					
Protzia	8	p										
Sperchon	8	p		21		2	1	24			1	
Sperchonopsis	8	p										
Testudacarus	5	p										
Torrenticola	5	p		1				3				
Trombidiformes				1								
Veneroida												
Pisidium	8	cf										
Sphaeriidae	8	cf										
Veneroida												
TOTAL			**310**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**104**	**500**

Table D2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_09591	SMCR8_09698	SMCR8_107	SMCR8_167 1	SMCR8_167 2	SMCR8_201	SMCR8_236	SMCR8_240	SMCR8_26909	SMCR8_274
Insecta Taxa												
Ephemeroptera												
Ameletus	0	cg		2								
Baetidae	4	cg										
Baetis	5	cg	274	21	70	32	141		1	14	31	73
Baetis adonis	5	cg								5		
Baetis tricaudatus	6	cg	100	3	4	5	4		1		1	22
Caenis	7	cg									1	
Callibaetis	9	cg	1									
Camelobaetidius	4	cg										
Caudatella heterocaudata	1	cg										
Caudatella hystrix	1	cg										
Centroptilum	2	cg										
Cinygmula	4	sc										
Diphetor hageni	5	cg								1		
Drunella	0	cg		3			4			3		
Drunella doddsii	0	cg							4			
Drunella flavilinea	0	cg										
Drunella grandis	0	cg										
Epeorus	0	sc		4						9		
Ephemerella	1	cg				1						
Ephemerella dorothea	1	cg										
Ephemerellidae	1	cg				2	2					6
Ephemeroptera												
Fallceon quilleri	4	cg	3				1		1		3	2
Heptageniidae	4	sc								2		
Ironodes	3	sc		6						14		
Leptophlebiidae	2	cg		1						5		
Paraleptophlebia	4	cg										
Serratella	2	cg										
Serratella teresa	2	cg								1		
Odonata												
Anisoptera												
Argia	7	p		2							2	
Argia fumipennis	7	p										
Coenagrionidae	9	p										
Cordulegaster dorsalis	3	p		1								
Gomphidae	4	p				1						
Hetaerina americana	6	p										
Libellulidae	9	p	1									
Odonata												
Plecoptera												
Attaneuria	1	p								40		
Calineuria californica	2	p										
Chloroperlidae	1	p		3								
Diura	2	p										
Haploperla chilnualna	1	p		1								
Hesperoperla	2	p										
Hesperoperla pacifica	2	p										
Isoperla	2	p										
Malenka	2	sh								45		
Nemouridae	2	sh		6						8		
Osobenus yakimae	2	p										
Perlidae	1	p										
Perlodidae	2	p										
Plecoptera				2								
Sasquaperla hoopa	1	p										
Suwallia	1	p										
Sweltsa	1	p										
Taenionema	2	om										
Taeniopterygidae	2	om										
Tricorythodes minutus	4	cg					1					2
Yoraperla nigrisoma	1	sh										
Zapada cinctipes	2	sh		2								
Hemiptera												
Belostomatidae	8	p										
Corisella decolor	8	p										
Corixidae	8	p							1		3	
Trichocorixa	8	p							1			
Trichocorixa calva	8	p										
Trichoptera												
Agapetus	0	sc		1		1	1			1		3
Agapetus orosus	0	sc										
Brachycentridae	1					1						

Table D2 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_09591	SMCR8_09698	SMCR8_107	SMCR8_167 1	SMCR8_167 2	SMCR8_201	SMCR8_236	SMCR8_240	SMCR8_26909	SMCR8_274
Trichoptera												
Ceratopsyche		cf										
Glossosomatidae	0	sc										
Gumaga	3	sh				1	1			38		4
Helicopsyche	3	sc										
Hydropsyche	4	cf				14	9					11
Hydropsyche morosa	6	ph		1						21		
Hydropsychidae	4	cf					7					4
Hydroptila	6	ph			6							
Hydroptilidae	4	ph					1					
Lepidostoma	1	sh		18						4		
Lepidostomatidae	1	sh								1		
Limnephilidae	4	sh		1								
Micrasema	1	mh				1				29		
Neophylax	3	sc								47		
Ochrotrichia	4	ph										
Parapsyche	0	p								43		
Psychoglypha	2	sh		10								
Rhyacophila	0	p				1	1			10		
Sericostomatidae	3	sh					1			1		
Tinodes	2	sc		9								1
Trichoptera										7		
Wormaldia	3	cf								7		
Coleoptera												
Agabus	8	p										
Cleptelmis addenda	4	cg										
Coleoptera										2		
Crenitis	4	cg			1							
Dytiscinae	5	p										
Elmidae	4	cg				1						
Elodes		sc										
Helichus	5	sh										
Helophorus												
Hydrobius	8	p			1							
Hydrophilidae	5	p										
Hydroporinae	5	p										
Hydroporus	5	p										
Lara	4	sh										
Narpus	4	cg										
Optioservus	4	sc	9	9		8						5
Ordobrevia nubifera	4	sc					2					
Peltodytes		mh										
Rhantus	5	p	1									
Sanfilippodytes	5	p										
Stictotarsus	5	p										
Zaitzevia	4	sc								1		
Diptera												
Ablabesmyia	8	cg										
Agathon	0	sc										
Alotanypus								2				
Anopheles	8	cg										
Apedilum	6	cg	3									
Atrichopogon	6	cg										
Atylotus/Tabanus	5	p		1								
Bezzia/Palpomyia	6	p		2	7	1			3	3		
Blepharicera	0	sc										1
Blephariceridae	0	sc					1					
Boreoheptagyia	6	cg										
Brachycera												
Brillia	5	sh		21	5				5	5	1	
Caloparyphus/ Euparyphus	8	cg	2		10							1
Cardiocladius	5	p					2					2
Caudatella	1	cg										
Ceratopogonidae	6	p		1						1		
Chelifera/Metachela	6	p										
Chironomidae	6	cg										
Chironomus	10	cg						19				
Clinocera	6	p										
Corynoneura	7	cg	1	6	22				15			
Cricotopus	7	cg	1	4	9	3	1	346	18			
Cricotopus bicinctus group	7	cg							21			
Cricotopus trifascia group	7	cg										
Cryptochironomus	8	p										
Cryptolabis	3	sh										

Table D2 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_09591	SMCR8_09698	SMCR8_107	SMCR8_167		SMCR8_201	SMCR8_236	SMCR8_240	SMCR8_26909	SMCR8_274
						1	2					
Diptera												
Culicoides					1						1	
Dasyhelea	6	cg										
Demicryptochironomus	6	cg					1					
Diamesa	5	cg										
Dicranota	3	p		1						11		
Dicrotendipes	8	cg						59	32		28	
Diptera					1			7	5		1	
Dixa	2	cg			1					1		
Dixidae	2	cg				3						
Dolichopodidae	4	p	6									
Empididae	6	p										
Endotribelos	6	cg										
Ephydridae	6		1								1	
Eukiefferiella	8	om		21	5	5	9	6		7		11
Euparyphus	8	cg				4						1
Forcipomyia	6	cg										
Glutops	3	p								1		
Heleniella	6	cg										
Hemerodromia	6	p										
Hesperoconopa	1	cg										
Hexatoma	2	p								11		
Labrundinia	6	p										
Limnophila	3	sh								2		
Limnophyes	8	cg								1	1	
Limonia	6	sh										
Maruina lanceolata	2	sc				7	7			5		
Micropsectra	7	cg		54	4				36	23	165	5
Microtendipes	6	cf										41
Muscidae	6	p	15						1			
Nemotelus	8	cg										
Neoplasta	6	p								1		
Nilotanypus	6	p				1						
Ormosia	3	cg										
Orthocladius	6	cg						20		1		
Orthocladius complex	6	cg		5								
Pagastia	1	cg		5								1
Paracladopelma	7											
Parametriocnemus	5	cg	14	9	44				21	12	11	
Paraphaenocladius	4	cg										
Parasimulium	6	cf										
Paratanytarsus	6	cf							1			
Pentaneura	6	p	5						11			
Pericoma	4	cg										
Pericoma/Telmatoscopus	4	cg								1		
Phaenopsectra	7	sc									1	
Polypedilum	6	om	1	11		3	2		13	7	27	35
Probezzia	6	p		1								
Procladius	9	p							9			
Prodiamesa	3	cg		4								
Prosimulium	3	cf										
Pseudochironomus	5	cg	2						3			
Pseudodiamesa	6	cg										
Pseudosmittia		cg										
Psychodidae		cg										
Rheocricotopus	6	om			3			12	27			
Rheotanytarsus	6	cf	17	3	30	2	6	24	15	4		9
Saetheria	6	cg										
Simuliidae	6	cf							4			2
Simulium		cf	31	5	202	387	295		43		9	246
Simulium canadensis	6	cf										
Stempellinella	4	cg			1							
Stilobezzia	6	p										
Stratiomyidae	8	cg										
Tanypodinae	7	p										
Tanytarsus	6	cf							10		9	
Tanytarsus limneticus	6	cf										
Thienemanniella	6	cg						5	8			
Thienemannimyia group	6	p	1			10						5
Tipulidae	3									2		
Tipulinae	3											
Tvetenia	5	cg										
Tvetenia bavarica group	5	cg		24						29		
Wiedemannia	6	p										

Table D2 continued part 3. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_09591	SMCR8_09698	SMCR8_107	SMCR8_167 1	SMCR8_167 2	SMCR8_201	SMCR8_236	SMCR8_240	SMCR8_26909	SMCR8_274
Lepidoptera												
Lepidoptera												
Petrophila	5	sc										
Megaloptera												
Corydalidae	0	p										
Neohermes	0	p										
Orohermes	0	p										
Non-Insecta Taxa												
Acari	5	p										1
Oligochaeta	5	cg	6	79	58				53	4	8	
Ostracoda	8	cg	1	52	7				89		166	2
Turbellaria	4	p										
Amphipoda												
Amphipoda	4	cg							2			
Crangonyx	4	cg							7			
Hyalella	8	cg							1		28	
Basommatophora												
Gyraulus	8	sc										
Menetus opercularis									1			
Physa	8	sc			2	2			34		2	3
Trombidiformes												
Atractides	8	p	2		2				1			
Estelloxus	8	p										
Lebertia	8	p		4						1		1
Mesobates	8	p								1		
Mideopsis	5	p								2		
Pionidae												
Protzia	8	p										
Sperchon	8	p	2		4	1			2	3		
Sperchonopsis	8	p		1						1		
Testudacarus	5	p								1		
Torrenticola	5	p		1		2						
Trombidiformes												
Veneroida												
Pisidium	8	cf		79								
Sphaeriidae	8	cf										
Veneroida												
TOTAL			**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**

Table D3. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_277	SMCR8_27709	SMCR8_293	SMCR8_294	SMCR8_297	SMCR8_304	SMCR8_309	SMCR8_322	SMCR8_356
Insecta Taxa											
Ephemeroptera											
Ameletus	0	cg									
Baetidae	4	cg	2						1		3
Baetis	5	cg	45	2	28	2	2	19	1	10	
Baetis adonis	5	cg	3	1						10	
Baetis tricaudatus	6	cg	20				1	9			
Caenis	7	cg									
Callibaetis	9	cg									
Camelobaetidius	4	cg									
Caudatella heterocaudata	1	cg									
Caudatella hystrix	1	cg									
Centroptilum	2	cg						3			
Cinygmula	4	sc									
Diphetor hageni	5	cg									
Drunella	0	cg	7								
Drunella doddsii	0	cg									
Drunella flavilinea	0	cg									
Drunella grandis	0	cg									
Epeorus	0	sc	1								
Ephemerella	1	cg									
Ephemerella dorothea	1	cg									
Ephemerellidae	1	cg									
Ephemeroptera											
Fallceon quilleri	4	cg	3	2		7			4	4	64
Heptageniidae	4	sc					1				
Ironodes	3	sc	1								
Leptophlebiidae	2	cg									
Paraleptophlebia	4	cg						1			
Serratella	2	cg									
Serratella teresa	2	cg					72				
Odonata											
Anisoptera									1		
Argia	7	p	2							2	
Argia fumipennis	7	p									
Coenagrionidae	9	p									4
Cordulegaster dorsalis	3	p									
Gomphidae	4	p									
Hetaerina americana	6	p									2
Libellulidae	9	p									
Odonata											
Plecoptera											
Attaneuria	1	p									
Calineuria californica	2	p									
Chloroperlidae	1	p									
Diura	2	p					8				
Haploperla chilnualna	1	p									
Hesperoperla	2	p									
Hesperoperla pacifica	2	p									
Isoperla	2	p									
Malenka	2	sh	1				2				
Nemouridae	2	sh									
Osobenus yakimae	2	p									
Perlidae	1	p									
Perlodidae	2	p					3				
Plecoptera							2				
Sasquaperla hoopa	1	p						1			
Suwallia	1	p									
Sweltsa	1	p									
Taenionema	2	om									
Taeniopterygidae	2	om									
Tricorythodes minutus	4	cg			2						66
Yoraperla nigrisoma	1	sh									
Zapada cinctipes	2	sh									
Hemiptera											
Belostomatidae	8	p									
Corisella decolor	8	p									1
Corixidae	8	p									
Trichocorixa	8	p									
Trichocorixa calva	8	p									1
Trichoptera											
Agapetus	0	sc	4								
Agapetus orosus	0	sc									
Brachycentridae	1						1				

Table D3 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_277	SMCR8_27709	SMCR8_293	SMCR8_294	SMCR8_297	SMCR8_304	SMCR8_309	SMCR8_322	SMCR8_356
Trichoptera											
Ceratopsyche		cf							1		
Glossosomatidae	0	sc	2								
Gumaga	3	sh	1				2				
Helicopsyche	3	sc	1								
Hydropsyche	4	cf									4
Hydropsyche morosa	6	ph	3						8		
Hydropsychidae	4	cf	1				1		4	4	2
Hydroptila	6	ph						1		12	76
Hydroptilidae	4	ph								2	13
Lepidostoma	1	sh	5				1			7	
Lepidostomatidae	1	sh									
Limnephilidae	4	sh									
Micrasema	1	mh	1						13	44	
Neophylax	3	sc									
Ochrotrichia	4	ph					1		5	3	
Parapsyche	0	p	2				2	2			
Psychoglypha	2	sh									
Rhyacophila	0	p									
Sericostomatidae	3	sh									
Tinodes	2	sc									
Trichoptera										2	
Wormaldia	3	cf	2								
Coleoptera											
Agabus	8	p					3				
Cleptelmis addenda	4	cg									
Coleoptera											
Crenitis	4	cg									
Dytiscinae	5	p						1			
Elmidae	4	cg									
Elodes		sc									
Helichus	5	sh	1								
Helophorus						1					
Hydrobius	8	p									
Hydrophilidae	5	p							1		
Hydroporinae	5	p						1			
Hydroporus	5	p						4			
Lara	4	sh									
Narpus	4	cg									
Optioservus	4	sc	2								
Ordobrevia nubifera	4	sc									
Peltodytes		mh								1	
Rhantus	5	p									
Sanfilippodytes	5	p								1	
Stictotarsus	5	p								2	
Zaitzevia	4	sc									
Diptera											
Ablabesmyia	8	cg								1	2
Agathon	0	sc									
Alotanypus											
Anopheles	8	cg									1
Apedilum	6	cg								13	
Atrichopogon	6	cg									
Atylotus/Tabanus	5	p									
Bezzia/Palpomyia	6	p		3			7	1		1	
Blepharicera	0	sc	5					3			
Blephariceridae	0	sc									
Boreoheptagyia	6	cg									
Brachycera											
Brillia	5	sh	57				14	18	1	3	
Caloparyphus/Euparyphus	8	cg	2						2	1	2
Cardiocladius	5	p						1			
Caudatella	1	cg									
Ceratopogonidae	6	p	3		1						3
Chelifera/Metachela	6	p									
Chironomidae	6	cg	1		1						
Chironomus	10	cg				1		8		1	
Clinocera	6	p					4				
Corynoneura	7	cg	16		3		1	1	1	10	
Cricotopus	7	cg	1	3			21	1	125	3	
Cricotopus bicinctus group	7	cg			1						
Cricotopus trifascia group	7	cg			17	1					
Cryptochironomus	8	p									1
Cryptolabis	3	sh									

Table D3 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_277	SMCR8_27709	SMCR8_293	SMCR8_294	SMCR8_297	SMCR8_304	SMCR8_309	SMCR8_322	SMCR8_356
Diptera											
Culicoides											
Dasyhelea	6	cg			11						4
Demicryptochironomus	6	cg									
Diamesa	5	cg									
Dicranota	3	p	2				1	4			
Dicrotendipes	8	cg			13	1					1
Diptera								2	6		
Dixa	2	cg	2							3	
Dixidae	2	cg									
Dolichopodidae	4	p					3		1		1
Empididae	6	p		1					1		1
Endotribelos	6	cg		1							1
Ephydridae	6			1						1	
Eukiefferiella	8	om	29				32	13	97		
Euparyphus	8	cg									
Forcipomyia	6	cg								1	
Glutops	3	p									
Heleniella	6	cg									
Hemerodromia	6	p							3		7
Hesperoconopa	1	cg									
Hexatoma	2	p						1			
Labrundinia	6	p			3						4
Limnophila	3	sh						1			
Limnophyes	8	cg		2	3						6
Limonia	6	sh					2				
Maruina lanceolata	2	sc	1							2	
Micropsectra	7	cg	27	40			33	79	22	20	
Microtendipes	6	cf								16	1
Muscidae	6	p			2		6				
Nemotelus	8	cg									
Neoplasta	6	p	3				1			2	
Nilotanypus	6	p							2		
Ormosia	3	cg									
Orthocladius	6	cg						1			
Orthocladius complex	6	cg									
Pagastia	1	cg	5					4			
Paracladopelma	7							1	3		
Parametriocnemus	5	cg	12	13	26		40	18	11	15	2
Paraphaenocladius	4	cg									1
Parasimulium	6	cf						1			
Paratanytarsus	6	cf									
Pentaneura	6	p				1			1	6	36
Pericoma	4	cg									
Pericoma/Telmatoscopus	4	cg									2
Phaenopsectra	7	sc									
Polypedilum	6	om	84	7	6		6	6			34
Probezzia	6	p									1
Procladius	9	p			7					3	19
Prodiamesa	3	cg									
Prosimulium	3	cf									
Pseudochironomus	5	cg									1
Pseudodiamesa	6	cg									
Pseudosmittia		cg									
Psychodidae		cg									1
Rheocricotopus	6	om			70	3					25
Rheotanytarsus	6	cf	19	17	51		6		47	68	7
Saetheria	6	cg				1		1			4
Simuliidae	6	cf						7			
Simulium		cf	88		42	35	6	275	2	151	5
Simulium canadensis	6	cf									
Stempellinella	4	cg									
Stilobezzia	6	p									
Stratiomyidae	8	cg									
Tanypodinae	7	p						2		4	
Tanytarsus	6	cf		1			2	1	11	7	
Tanytarsus limneticus	6	cf									
Thienemanniella	6	cg		1	22						
Thienemannimyia group	6	p			6		16			1	
Tipulidae	3										
Tipulinae	3								1		
Tvetenia	5	cg									
Tvetenia bavarica group	5	cg	10				174	3	12		
Wiedemannia	6	p									

Table D3 continued part 3. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_277	SMCR8_27709	SMCR8_293	SMCR8_294	SMCR8_297	SMCR8_304	SMCR8_309	SMCR8_322	SMCR8_356
Lepidoptera											
Lepidoptera											
Petrophila	5	sc									
Megaloptera											
Corydalidae	0	p					1				
Neohermes	0	p						1			
Orohermes	0	p					1				
Non-Insecta Taxa											
Acari	5	p					1				
Oligochaeta	5	cg	19	275	81	2	17	2	104	31	19
Ostracoda	8	cg		110	24		1		1	6	35
Turbellaria	4	p									
Amphipoda											
Amphipoda	4	cg									
Crangonyx	4	cg									
Hyalella	8	cg		16						1	11
Basommatophora											
Gyraulus	8	sc								3	
Menetus opercularis											
Physa	8	sc		4	74					21	26
Trombidiformes											
Atractides	8	p							5		
Estelloxus	8	p									
Lebertia	8	p	3		2						
Mesobates	8	p						2			
Mideopsis	5	p									
Pionidae											
Protzia	8	p									
Sperchon	8	p	1		4		1		2		
Sperchonopsis	8	p									
Testudacarus	5	p									
Torrenticola	5	p									
Trombidiformes											
Veneroida											
Pisidium	8	cf					1			1	
Sphaeriidae	8	cf									
Veneroida											
TOTAL			**500**	**500**	**500**	**55**	**500**	**500**	**500**	**500**	**500**

Table D4. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_380	SMCR8_387	SMCR8_395		SMCR8_396	SMCR8_400	SMCR8_403	SMCR8_405	SMCR8_407	SMCR8_436
					1	2						
Insecta Taxa												
Ephemeroptera												
Ameletus	0	cg								1		
Baetidae	4	cg							1			
Baetis	5	cg	19	7			14	13		5	58	107
Baetis adonis	5	cg	21	2			11	2				
Baetis tricaudatus	6	cg								21		249
Caenis	7	cg										
Callibaetis	9	cg										
Camelobaetidius	4	cg										
Caudatella heterocaudata	1	cg										
Caudatella hystrix	1	cg										
Centroptilum	2	cg										
Cinygmula	4	sc										
Diphetor hageni	5	cg										
Drunella	0	cg										19
Drunella doddsii	0	cg										
Drunella flavilinea	0	cg										
Drunella grandis	0	cg										
Epeorus	0	sc										
Ephemerella	1	cg										
Ephemerella dorothea	1	cg										
Ephemerellidae	1	cg										
Ephemeroptera								1				
Fallceon quilleri	4	cg			1			46	3			
Heptageniidae	4	sc										1
Ironodes	3	sc	3									
Leptophlebiidae	2	cg										
Paraleptophlebia	4	cg										
Serratella	2	cg								11		
Serratella teresa	2	cg										3
Odonata												
Anisoptera												
Argia	7	p										
Argia fumipennis	7	p										
Coenagrionidae	9	p										
Cordulegaster dorsalis	3	p										
Gomphidae	4	p										
Hetaerina americana	6	p										
Libellulidae	9	p										
Odonata												
Plecoptera												
Attaneuria	1	p										
Calineuria californica	2	p										
Chloroperlidae	1	p										
Diura	2	p										
Haploperla chilnualna	1	p										1
Hesperoperla	2	p										
Hesperoperla pacifica	2	p										
Isoperla	2	p										
Malenka	2	sh	51									
Nemouridae	2	sh	7									
Osobenus yakimae	2	p										
Perlidae	1	p										
Perlodidae	2	p										
Plecoptera												
Sasquaperla hoopa	1	p										
Suwallia	1	p										
Sweltsa	1	p								1		
Taenionema	2	om								9		
Taeniopterygidae	2	om								1		
Tricorythodes minutus	4	cg						11	71			
Yoraperla nigrisoma	1	sh										
Zapada cinctipes	2	sh										1
Hemiptera												
Belostomatidae	8	p										
Corisella decolor	8	p										
Corixidae	8	p										
Trichocorixa	8	p										
Trichocorixa calva	8	p										
Trichoptera												
Agapetus	0	sc										
Agapetus orosus	0	sc										1
Brachycentridae	1											

Table D4 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_380	SMCR8_387	SMCR8_395 1	SMCR8_395 2	SMCR8_396	SMCR8_400	SMCR8_403	SMCR8_405	SMCR8_407	SMCR8_436
Trichoptera												
Ceratopsyche		cf	2									
Glossosomatidae	0	sc										
Gumaga	3	sh								2		
Helicopsyche	3	sc										
Hydropsyche	4	cf					2	6				2
Hydropsyche morosa	6	ph										
Hydropsychidae	4	cf						12				
Hydroptila	6	ph				1		15				
Hydroptilidae	4	ph						3				
Lepidostoma	1	sh								1		1
Lepidostomatidae	1	sh										
Limnephilidae	4	sh								1		
Micrasema	1	mh								9		
Neophylax	3	sc								1		
Ochrotrichia	4	ph										
Parapsyche	0	p										
Psychoglypha	2	sh										
Rhyacophila	0	p								12		7
Sericostomatidae	3	sh										
Tinodes	2	sc								4		1
Trichoptera									1			
Wormaldia	3	cf										
Coleoptera												
Agabus	8	p									4	
Cleptelmis addenda	4	cg										
Coleoptera										1		
Crenitis	4	cg										
Dytiscinae	5	p										
Elmidae	4	cg										
Elodes		sc										
Helichus	5	sh										1
Helophorus												
Hydrobius	8	p										
Hydrophilidae	5	p										
Hydroporinae	5	p			1							
Hydroporus	5	p										
Lara	4	sh										
Narpus	4	cg										
Optioservus	4	sc										5
Ordobrevia nubifera	4	sc										
Peltodytes		mh										
Rhantus	5	p										
Sanfilippodytes	5	p										
Stictotarsus	5	p										
Zaitzevia	4	sc										2
Diptera												
Ablabesmyia	8	cg						1				
Agathon	0	sc								1		
Alotanypus												
Anopheles	8	cg										
Apedilum	6	cg		1				6				
Atrichopogon	6	cg										
Atylotus/Tabanus	5	p										
Bezzia/Palpomyia	6	p										
Blephariceras	0	sc										
Blephariceridae	0	sc								1		
Boreoheptagyia	6	cg										4
Brachycera												
Brillia	5	sh	12				3				7	5
Caloparyphus/Euparyphus	8	cg					1	2	1	1	2	
Cardiocladius	5	p	2				2					
Caudatella	1	cg										
Ceratopogonidae	6	p						2		1		
Chelifera/Metachela	6	p										
Chironomidae	6	cg			3	2	3	1		46		3
Chironomus	10	cg			7	5		2	32			
Clinocera	6	p								2		
Corynoneura	7	cg	10				7	1		3	1	
Cricotopus	7	cg		43	275	236	22	50	9	64	5	
Cricotopus bicinctus group	7	cg								7		
Cricotopus trifascia group	7	cg						1		3		
Cryptochironomus	8	p							5			
Cryptolabis	3	sh										

Table D4 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_380	SMCR8_387	SMCR8_395 1	SMCR8_395 2	SMCR8_396	SMCR8_400	SMCR8_403	SMCR8_405	SMCR8_407	SMCR8_436
Diptera												
Culicoides												
Dasyhelea	6	cg		1				1		1		
Demicryptochironomus	6	cg										
Diamesa	5	cg									4	
Dicranota	3	p										
Dicrotendipes	8	cg			96	50		17	138	1		
Diptera					11		2				1	
Dixa	2	cg									1	
Dixidae	2	cg										
Dolichopodidae	4	p								1		
Empididae	6	p						1				
Endotribelos	6	cg										
Ephydridae	6			25							1	
Eukiefferiella	8	om	34	38			40			57	6	3
Euparyphus	8	cg						1				
Forcipomyia	6	cg										
Glutops	3	p										
Heleniella	6	cg										
Hemerodromia	6	p							1			
Hesperoconopa	1	cg										1
Hexatoma	2	p										
Labrundinia	6	p										
Limnophila	3	sh										
Limnophyes	8	cg										
Limonia	6	sh								20		
Maruina lanceolata	2	sc										1
Micropsectra	7	cg	1	1						7	8	2
Microtendipes	6	cf										
Muscidae	6	p					1				6	
Nemotelus	8	cg		1								
Neoplasta	6	p										
Nilotanypus	6	p										
Ormosia	3	cg										
Orthocladius	6	cg	1									
Orthocladius complex	6	cg										1
Pagastia	1	cg									29	11
Paracladopelma	7											
Parametriocnemus	5	cg	6	6			19			4	99	
Paraphaenocladius	4	cg										
Parasimulium	6	cf										
Paratanytarsus	6	cf										
Pentaneura	6	p						3	6			
Pericoma	4	cg										
Pericoma/Telmatoscopus	4	cg		4								
Phaenopsectra	7	sc						1	1			
Polypedilum	6	om		1	17	4		12	85			
Probezzia	6	p										
Procladius	9	p						3	7			
Prodiamesa	3	cg										
Prosimulium	3	cf								40		
Pseudochironomus	5	cg			37	31		12				
Pseudodiamesa	6	cg										
Pseudosmittia		cg										
Psychodidae		cg		2	1							
Rheocricotopus	6	om		27		3	2	6		45		
Rheotanytarsus	6	cf		3			6	3		12		2
Saetheria	6	cg										
Simuliidae	6	cf	27							4		
Simulium		cf		86	2		361	23		2	198	39
Simulium canadensis	6	cf										1
Stempellinella	4	cg										
Stilobezzia	6	p										
Stratiomyidae	8	cg						1		1		
Tanypodinae	7	p										
Tanytarsus	6	cf		3					40	26		
Tanytarsus limneticus	6	cf										
Thienemanniella	6	cg								9		
Thienemannimyia group	6	p	2									
Tipulidae	3			1						1		1
Tipulinae	3											
Tvetenia	5	cg										
Tvetenia bavarica group	5	cg	3							10	65	6
Wiedemannia	6	p										

Table D4 continued part 3. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_380	SMCR8_387	SMCR8_395 1	SMCR8_395 2	SMCR8_396	SMCR8_400	SMCR8_403	SMCR8_405	SMCR8_407	SMCR8_436
Lepidoptera												
Lepidoptera					2							
Petrophila	5	sc										
Megaloptera												
Corydalidae	0	p										
Neohermes	0	p										
Orohermes	0	p										
Non-Insecta Taxa												
Acari	5	p						1				
Oligochaeta	5	cg	257	7	45	168	1	6	13	39	1	1
Ostracoda	8	cg			2			113	81			
Turbellaria	4	p							2			
Amphipoda												
Amphipoda	4	cg						4				
Crangonyx	4	cg						2				
Hyalella	8	cg		2				1	2			
Basommatophora												
Gyraulus	8	sc										
Menetus opercularis			24					3				
Physa	8	sc		1				107				8
Trombidiformes												
Atractides	8	p						1				
Estelloxus	8	p										
Lebertia	8	p										2
Mesobates	8	p										
Mideopsis	5	p										
Pionidae												
Protzia	8	p										2
Sperchon	8	p	2	1			3	3	1		4	2
Sperchonopsis	8	p										
Testudacarus	5	p										1
Torrenticola	5	p										2
Trombidiformes												1
Veneroida												
Pisidium	8	cf	13							11		
Sphaeriidae	8	cf										
Veneroida			3									
TOTAL			**500**	**263**	**500**	**500**	**500**	**500**	**500**	**500**	**500**	**500**

Table D5. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_441	SMCR8_445	SMCR8_448	SMCR8_450	SMCR8_478		SMCR8_559	SMCR8_567	SMCR8_598
							1	2			
Insecta Taxa											
Ephemeroptera											
Ameletus	0	cg									
Baetidae	4	cg			1						
Baetis	5	cg	4	3			57	15		37	
Baetis adonis	5	cg	1								
Baetis tricaudatus	6	cg		10	8		9	105		17	
Caenis	7	cg									
Callibaetis	9	cg									
Camelobaetidius	4	cg									
Caudatella heterocaudata	1	cg		77			85	35			
Caudatella hystrix	1	cg		3							
Centroptilum	2	cg									
Cinygmula	4	sc		1			1	5			
Diphetor hageni	5	cg						1			
Drunella	0	cg		1	12			8			
Drunella doddsii	0	cg		1							
Drunella flavilinea	0	cg					4				
Drunella grandis	0	cg						2			
Epeorus	0	sc		21	1		30	59			
Ephemerella	1	cg		3							
Ephemerella dorothea	1	cg			2		1	6			
Ephemerellidae	1	cg		3			2	7			
Ephemeroptera											
Fallceon quilleri	4	cg	9		6	4				2	
Heptageniidae	4	sc					4				
Ironodes	3	sc		20	7						
Leptophlebiidae	2	cg						1			
Paraleptophlebia	4	cg						2			
Serratella	2	cg		2							
Serratella teresa	2	cg			12		10	8			
Odonata											
Anisoptera											
Argia	7	p									
Argia fumipennis	7	p									
Coenagrionidae	9	p									
Cordulegaster dorsalis	3	p			4						
Gomphidae	4	p									
Hetaerina americana	6	p									
Libellulidae	9	p									
Odonata										1	
Plecoptera											
Attaneuria	1	p									
Calineuria californica	2	p			17						
Chloroperlidae	1	p					2	1			
Diura	2	p									
Haploperla chilnualna	1	p			4						
Hesperoperla	2	p						1			
Hesperoperla pacifica	2	p						2			
Isoperla	2	p			2			3			
Malenka	2	sh		3	7						
Nemouridae	2	sh		7	8						
Osobenus yakimae	2	p					1				
Perlidae	1	p			2						
Perlodidae	2	p									
Plecoptera											
Sasquaperla hoopa	1	p									
Suwallia	1	p						4			
Sweltsa	1	p									
Taenionema	2	om									
Taeniopterygidae	2	om									
Tricorythodes minutus	4	cg				1					
Yoraperla nigrisoma	1	sh		25							
Zapada cinctipes	2	sh		17							
Hemiptera											
Belostomatidae	8	p								1	
Corisella decolor	8	p									
Corixidae	8	p									
Trichocorixa	8	p									
Trichocorixa calva	8	p									
Trichoptera											
Agapetus	0	sc			2			3			
Agapetus orosus	0	sc									
Brachycentridae	1			4							

Table D5 continued part 1. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_441	SMCR8_445	SMCR8_448	SMCR8_450	SMCR8_478		SMCR8_559	SMCR8_567	SMCR8_598
							1	2			
Trichoptera											
Ceratopsyche		cf									
Glossosomatidae	0	sc			1						
Gumaga	3	sh			64						
Helicopsyche	3	sc									
Hydropsyche	4	cf		5	12			36			
Hydropsyche morosa	6	ph					24				
Hydropsychidae	4	cf			3			1			
Hydroptila	6	ph				9					
Hydroptilidae	4	ph				6					
Lepidostoma	1	sh		4	6		4	31			
Lepidostomatidae	1	sh									
Limnephilidae	4	sh						1			
Micrasema	1	mh		71	15		2	3			
Neophylax	3	sc		1				3			
Ochrotrichia	4	ph									
Parapsyche	0	p			14						
Psychoglypha	2	sh									
Rhyacophila	0	p		8	1		4	2			
Sericostomatidae	3	sh			2						
Tinodes	2	sc									
Trichoptera											
Wormaldia	3	cf									
Coleoptera											
Agabus	8	p									
Cleptelmis addenda	4	cg		1							
Coleoptera											
Crenitis	4	cg									
Dytiscinae	5	p									
Elmidae	4	cg									
Elodes		sc			1						
Helichus	5	sh									
Helophorus											
Hydrobius	8	p									
Hydrophilidae	5	p									
Hydroporinae	5	p									
Hydroporus	5	p									
Lara	4	sh		1							
Narpus	4	cg			1						
Optioservus	4	sc					1	5			
Ordobrevia nubifera	4	sc									
Peltodytes		mh									
Rhantus	5	p									
Sanfilippodytes	5	p									
Stictotarsus	5	p									
Zaitzevia	4	sc			15		1	2			
Diptera											
Ablabesmyia	8	cg									
Agathon	0	sc					3				
Alotanypus											
Anopheles	8	cg									
Apedilum	6	cg	2						5		3
Atrichopogon	6	cg			1						
Atylotus/Tabanus	5	p									
Bezzia/Palpomyia	6	p		1	6			2			
Blepharicera	0	sc						2			
Blephariceridae	0	sc									
Boreoheptagyia	6	cg									
Brachycera									1		
Brillia	5	sh		6	15		5	14			
Caloparyphus/Euparyphus	8	cg				2					
Cardiocladius	5	p									
Caudatella	1	cg						7			
Ceratopogonidae	6	p									
Chelifera/Metachela	6	p						1			
Chironomidae	6	cg		2							
Chironomus	10	cg							3		9
Clinocera	6	p									
Corynoneura	7	cg			2	2		1		1	
Cricotopus	7	cg	301		1		2	1	35	2	446
Cricotopus bicinctus group	7	cg							2		
Cricotopus trifascia group	7	cg	16						1		
Cryptochironomus	8	p	1								
Cryptolabis	3	sh			2						

Table D5 continued part 2. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_441	SMCR8_445	SMCR8_448	SMCR8_450	SMCR8_478		SMCR8_559	SMCR8_567	SMCR8_598
							1	2			
Diptera											
Culicoides											
Dasyhelea	6	cg				1					
Demicryptochironomus	6	cg									
Diamesa	5	cg									
Dicranota	3	p		3	7						
Dicrotendipes	8	cg	16						5		17
Diptera			5						3	1	
Dixa	2	cg			2						
Dixidae	2	cg									
Dolichopodidae	4	p									
Empididae	6	p			1						
Endotribelos	6	cg									
Ephydridae	6		1						22		
Eukiefferiella	8	om		20	4		1	6	9	1	
Euparyphus	8	cg				1					
Forcipomyia	6	cg									
Glutops	3	p			10						
Heleniella	6	cg			1						
Hemerodromia	6	p									
Hesperoconopa	1	cg									
Hexatoma	2	p									
Labrundinia	6	p									
Limnophila	3	sh		1	2						
Limnophyes	8	cg			3				1		
Limonia	6	sh									
Maruina lanceolata	2	sc					2	1			
Micropsectra	7	cg		30	1	3					1
Microtendipes	6	cf			1			3			
Muscidae	6	p									
Nemotelus	8	cg									
Neoplasta	6	p			1						
Nilotanypus	6	p									
Ormosia	3	cg			6						
Orthocladius	6	cg					2	3			5
Orthocladius complex	6	cg									
Pagastia	1	cg					1	1			
Paracladopelma	7									1	
Parametriocnemus	5	cg		1	17			3	4	1	
Paraphaenocladius	4	cg			4						
Parasimulium	6	cf									
Paratanytarsus	6	cf									
Pentaneura	6	p	4		1					2	
Pericoma	4	cg									
Pericoma/Telmatoscopus	4	cg		3	2				4		
Phaenopsectra	7	sc									
Polypedilum	6	om	3		4					2	6
Probezzia	6	p									
Procladius	9	p	6								
Prodiamesa	3	cg									
Prosimulium	3	cf									
Pseudochironomus	5	cg									
Pseudodiamesa	6	cg									
Pseudosmittia		cg							1		
Psychodidae		cg							3		
Rheocricotopus	6	om			1				4	2	
Rheotanytarsus	6	cf		1	18			1		1	
Saetheria	6	cg				65					
Simuliidae	6	cf	1						7		
Simulium		cf	9	6	7		39	29	55	25	
Simulium canadensis	6	cf									
Stempellinella	4	cg			7						
Stilobezzia	6	p		3							
Stratiomyidae	8	cg									
Tanypodinae	7	p									
Tanytarsus	6	cf	16		1				3		13
Tanytarsus limneticus	6	cf									
Thienemanniella	6	cg			1						
Thienemannimyia group	6	p				1					
Tipulidae	3									1	
Tipulinae	3										
Tvetenia	5	cg								1	
Tvetenia bavarica group	5	cg			46			6			

Table D5 continued part 3. BMI's collected, adjusted to counts of 500 via Monte Carlo method.

Identified Taxa	Tol Val (TV)	Func Feed Grp	SMCR8_441	SMCR8_445	SMCR8_448	SMCR8_450	SMCR8_478		SMCR8_559	SMCR8_567	SMCR8_598
							1	2			
Diptera											
Wiedemannia	6	p		1							
Lepidoptera											
Lepidoptera											
Petrophila	5	sc									
Megaloptera											
Corydalidae	0	p									
Neohermes	0	p									
Orohermes	0	p									
Non-Insecta Taxa											
Acari	5	p									
Oligochaeta	5	cg	95	70	12		3	41			
Ostracoda	8	cg	3	2	16	1		1			
Turbellaria	4	p								1	
Amphipoda											
Amphipoda	4	cg									
Crangonyx	4	cg									
Hyalella	8	cg									
Basommatophora											
Gyraulus	8	sc									
Menetus opercularis											
Physa	8	sc	7			1	1				
Trombidiformes											
Atractides	8	p		3							
Estelloxus	8	p		1							
Lebertia	8	p		9	13		1	1			
Mesobates	8	p									
Mideopsis	5	p			3						
Pionidae											
Protzia	8	p		2							
Sperchon	8	p		2						1	
Sperchonopsis	8	p			1						
Testudacarus	5	p		1	6						
Torrenticola	5	p			13						
Trombidiformes											
Veneroida											
Pisidium	8	cf									
Sphaeriidae	8	cf			31						
Veneroida											
TOTAL			**500**	**460**	**500**	**97**	**302**	**476**	**168**	**101**	**500**