The Distribution and Abundance of Lotic Macroinvertebrates during Spring 1997 in Seven Streams of the Santa Clara Valley area, California

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SANTA CLARA VALLEY
URBAN RUNOFF POLLUTION
PREVENTION PROGRAM

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The Distribution and Abundance of Lotic Macroinvertebrates during Spring 1997 in Seven Streams of the Santa Clara Valley area, California

***By* James L. Carter *and* Steven V. Fend**

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Menlo Park, California
2000

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The Distribution and Abundance of Lotic Macroinvertebrates during Spring 1997 in Seven Streams of the Santa Clara Valley area, California

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ABSTRACT

Benthic macroinvertebrates were collected during May 1997 from riffle habitats located in 7 streams within the Santa Clara Valley area. A total of 261 taxa were identified from 44 sites. In general, total taxon richness decreased from upstream to downstream sites. Sites located in most upland areas contained more taxa and higher percentage composition of the Orders Ephemeroptera, Plecoptera, and Trichoptera than sites from lowland areas. Sites located in lowland areas contained more taxa and higher percentage composition of taxa contained within the Chironomidae and Oligochaeta.

INTRODUCTION

Aquatic macroinvertebrates are the most numerous animals inhabiting streams and rivers. In addition to being numerically abundant, they also represent more species than any other group of animals found in lotic systems. Individual species and species assemblages have been used for about a century to assess the condition of many types of aquatic resources (Kolkwitz and Marsson, 1909; Helawell, 1986).
Macroinvertebrates have many characteristics that make them useful for monitoring the quality of lotic systems (Rosenberg and Resh, 1993). They are easily and inexpensively sampled using a variety of sampling devices. Depending on the species, their populations can respond both negatively and positively to anthropogenic (human induced) influences. Some macroinvertebrate species live for only weeks, while other species live for several years allowing the evaluation of both short- and long-term environmental influences. Most macroinvertebrates are relatively easy to identify once they have developed to their mature aquatic stage. Although some taxonomic groups are poorly known at the species-level and are time consuming to identify, many advances in aquatic invertebrate taxonomy have occurred during the last few decades and environmental criteria are often based on taxonomic levels higher than the species.

Macroinvertebrates are an integral and functional part of stream ecosystems. All trophic groups, such as grazers, detritivores, and predators are represented, and impacts on stream function have been evaluated by assessing changes in the trophic structure of the macroinvertebrate community. Macroinvertebrates are the primary link between plants and insectivorous fish in lotic systems and many stream fishes (e.g. trout and sculpins) depend on benthic invertebrates for their survival. Lastly, terrestrial predators including other insects, spiders, birds, bats, and raccoons prey upon stream invertebrates creating an energy pathway from the stream to the surrounding terrestrial ecosystem.

As a result of the above characteristics, benthic macroinvertebrates are the most frequently used group of organisms for monitoring the "health" of lotic systems (Rosenberg and Resh, 1993; Karr and Chu, 1999). However, the faunas of most geographic areas are poorly known and there tends to be little information on the occurrence and natural variability in macroinvertebrate communities over larger spatial areas and/or temporally. This is particularly true for urban areas. The development of biocriteria based on the macroinvertebrate community of streams found in the San Francisco Bay area is dependent on obtaining sufficient knowledge of the spatial and temporal variability in the composition of lotic macroinvertebrates inhabiting the areas streams.

The objective of this report is to provide baseline information on the occurrence and abundance of macroinvertebrates in selected streams within the Santa Clara Valley area. Our intent is to provide high-resolution taxonomic macroinvertebrate data for locations that represent physically, chemically, and biologically diverse conditions within this highly developed urban environment. The ultimate goal of this study is to develop biocriteria based on benthic macroinvertebrate community composition to evaluate the integrity of streams and rivers in the San Francisco Bay area.

Acknowledgements

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METHODS

Eighty-five sites located on 14 streams within the Santa Clara Valley area were sampled for macroinvertebrates (Figure 1). The streams were: 1) San Francisquito Ck., 2) Corte Madera Ck., 3) Los Trancos Ck., 4) Stevens Ck., 5) Saratoga Ck., 6) Guadalupe R., 7) Los Gatos Ck., 8) Ross Ck., 9) Guadalupe Ck., 10) Alamitos Ck., 11) Barret Ck., 12) Arroyo Calero, 13) Coyote Ck., and 14) Upper Penitencia Ck. This report details the macroinvertebrate composition of 44 sites located on 7 streams in the eastern portion of the basin: Guadalupe R., Guadalupe Ck., Alamitos Ck., Barret Ck., Arroyo Calero, Coyote Ck., and Upper Penitencia Ck.

Field

Sampling locations were chosen to be approximately equidistant, with sites set at 2 km intervals. The most downstream site within each sub-basin was either the point of observed or assumed intermittent flow or where there appeared to be a tidal influence to river flow and/or sediment type. In general, the most upstream site was at an altitude of approximately 300m.

At each site a semi-quantitative collection of macroinvertebrates was made from a single riffle. Each collection was a composite of 5-0.09 m^2 kick samples taken with a 0.3 m wide D-frame kicknet fitted with a 500 μm mesh. The five individual kick samples were

taken systematically in each riffle in a downstream to upstream direction, crossing the stream twice along two perpendicular diagonal lines (i.e. a V-shape across the riffle's breadth). Two of the five samples were obtained in the thalweg and the remaining three samples were taken between the thalweg and the margins. At sites containing extremely long riffles, sampling focused on the upstream portion of the riffle.

Large organic (leaves and twigs) and inorganic material was removed from each kick sample prior to field elutriating, compositing, and preserving. If the remaining material contained excessive amounts of fine inorganic material (e.g., sand and fine gravel) the organic material was elutriated from the inorganic material. The inorganic material remaining after elutriating was then searched for taxa with high specific gravities (e.g., cased Trichoptera) that may not have been removed while elutriating. The composited sample was preserved in the field with 10% buffered formalin.

Laboratory

All samples were subsampled in the laboratory. The subsampling device was a rectangular, acrylic frame with a bottom of 100 μm mesh nylon underlain by 2.5 cm^2 wire mesh for support and demarcating 5 cm^2 grids. Three sizes of the frame were constructed to accommodate different sample volumes. While the frame was partially submerged in water, the sample was added and uniformly distributed. The frame was then raised out of the water and allowed to drain, thereby fixing the position of the sample in the frame.

Five randomly chosen 5 cm x 5 cm grids were removed. The density of the organisms per grid was estimated to determine the number of grids needed to obtain at least 500 organisms. If the density of organisms contained in a minimum of 3 grids substantially exceeded 500, at least 3 of the 5 grids were uniformly distributed in another frame and the procedure repeated. The necessary grids were removed and combined to form the subsample. All organisms were sorted from the subsample at 8x magnification. After each subsample was sorted a second person searched the just-sorted material for a maximum of 30 min. to remove the organisms that may have been overlooked during the initial sorting. After the subsample was removed from the sample, visually obvious taxa that may not have been contained in the subsample were sorted from the remaining portion of the sample for a period of 15 min. All taxa were placed in vials and stored in 80% ethanol prior to identification.

All organisms were identified to the lowest practicable taxonomic level. Primary references included Merritt and Cummins (1996), Thorp and Covich (1991), and Pennak (1989). All data were entered into an electronic spreadsheet.

RESULTS AND DISCUSSION

Description of data tables

Site locations and site name abbreviations are detailed in Table 1. A common format is used for site names throughout the report. The first three characters represent

the stream name and the last two characters (numbers) represent the approximate distance from the site to the mouth of the stream in km.

Abbreviations used to qualify taxonomic designations used in Tables 4-10 are defined in Table 2. Table 3 summarizes sample characteristics including abundance m^{-2}, total taxon richness, and richness and proportional abundance of taxonomic groups generally considered pollution tolerant (Orders: Ephemeroptera, Plecoptera, and Trichoptera) and pollution intolerant (Chironomidae and Oligochaeta). Table 4 lists all the taxa identified from the 44 sites, the per taxon abundance m^{-2} summed across all 44 sites, and the constancy for each taxon. Constancy represents the number of sites in which the taxon was found.

Tables 5-10 contain the estimated number of individuals m^2/taxon/site grouped by stream. At the bottom of each site-column is the estimated number of individuals m^2/site and the total taxonomic richness per site (i.e. the number of taxa identified from the site). Although macroinvertebrate samples were collected semi-quantitatively, abundances are listed as densities (number of individuals m^{-2}) for comparative purposes.

Summarization of taxonomic richness and percentage composition

The total number of taxa (richness) identified from the 44 collections was 261. The mean richness per site was 52.7 ± 11.45 (standard deviation). The sites ranged in richness from 35 at COC35 and COC54 to 81 at BAC01 in the Alamitos Ck. drainage (Table 3). The combined richness of the Orders Ephemeroptera, Plecoptera, and Trichoptera (EPT), which are generally considered to be pollution intolerant, ranged from 3 at GUR07 and COC12 to 27 at ALC14 and BAC01. In general, richness decreased from upstream sites to downstream sites (Figure 2) with the exception of sites within the mid-portion of Coyote Ck.

The distribution of taxa among major taxonomic groups also varied from upstream to downstream and among streams. In general, the percentage of the total richness per site attributed to the richness of EPT decreased from upstream to downstream. Consequently, EPT richness was relatively high in streams that were contained in upland areas such as Guadalupe Ck. and lower in streams contained in lowland areas such as Guadalupe R. In Penitencia Ck., although EPT richness decreased from upstream to downstream sites (Table 3), the percentage of richness attributable to the EPT remained relatively high over the entire portion sampled (Figure 2).

In contrast to EPT richness, the percentage of total richness per site attributed to the richness of Chironomidae and Oligochaeta increased from upstream to downstream sites. Oligochaete richness was maximum (21) at COC12 and represented approximately 50% of the taxa present at that site (Table 3). Chironomid and oligochaete richness also was high at the upstream sites on Arroyo Calero and represented approximately 50% of the taxa identified (Figure 2).

The estimated mean density of macroinvertebrates among the 44 sites was 21,435 m^{-2} ± 10,725 (standard deviation). The estimated density of macroinvertebrates per site ranged from 2,971 m^{-2} at PEC00 to 46,753 m^{-2} at GUR11 (Table 3).

The pattern of density among sites differed from the pattern of total richness among sites (Figure 3). Macroinvertebrate densities were generally lower at the most upstream and downstream sites and higher at mid-elevation sites. Even though densities were similar at

upstream and downstream sites, the community composition differed dramatically. Upstream sites contained higher percentages of EPT and downstream sites contained higher percentages of oligochaetes; a pattern similar to the pattern found for richness among major taxonomic groups. Percentages of chironomids generally increased downstream. However, at the most upstream sites on Coyote Ck. (COC83 and COC89), chironomids represented approximately 50% of the individuals (Figure 3). The maximum percentage composition of oligochaetes (87.5%) occurred at the most downstream Coyote Ck. site (COC12) (Table 3).

LITERATURE CITED

Helawell, J.M. 1986. Biological indicators of freshwater pollution and environmental management. Elsevier Applied Science Publishers, London.

Karr, J.R., and Chu, E.W. 1999. Restoring life in running waters: better biological monitoring. Island Press, Washington, D.C., p. 206.

Kolkwitz, R. and Marsson. 1909. Ökologie der tierischen Saprobien. Beiträge zur Lehre von des biologischen Gewasserbeurteilung. Internationale Revue der Gesamten Hydrobiologie und Hydrographie 2: 126-52.

Merritt, R.W. and Cummins, K.W. (eds.) 1996. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Co., Dubuque, IA.

Pennak, R.W. 1989. Fresh-water invertebrates of the United States: Protozoa to Mollusca. John Wiley and Sons, Inc., New York, NY

Rosenberg, D.M, and Resh, V.H. (eds.) 1993. Freshwater biomonitoring and benthic macroinvertebrates. Chapman and Hall, New York, NY

Thorp, J.H. and Covich, A.P. (eds.) 1991. Ecology and classification of North American freshwater invertebrates. Academic Press, Inc., San Diego, CA.

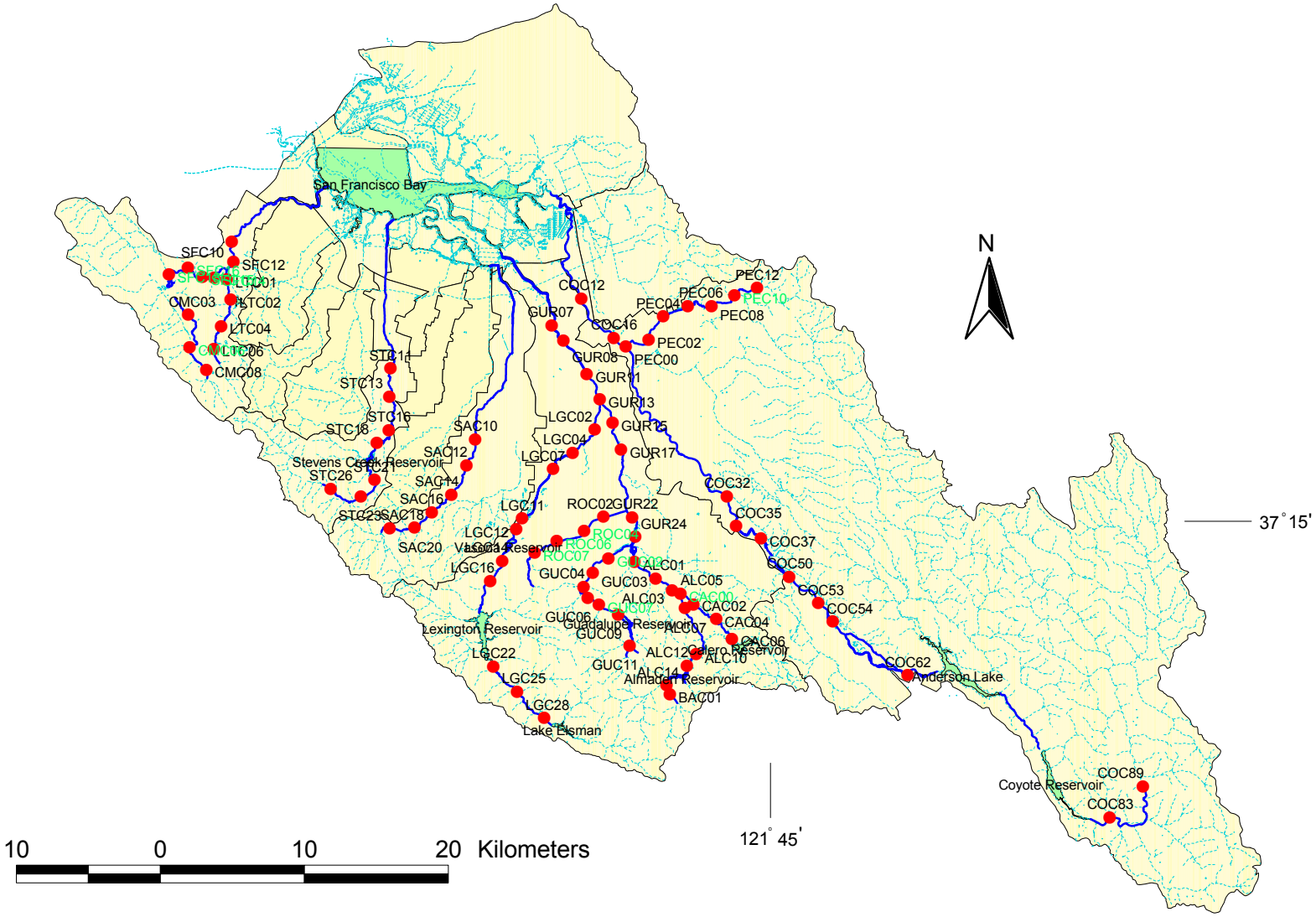

Figure 1. Location of the 85 sites on 14 streams in the Santa Clara Valley area, CA.

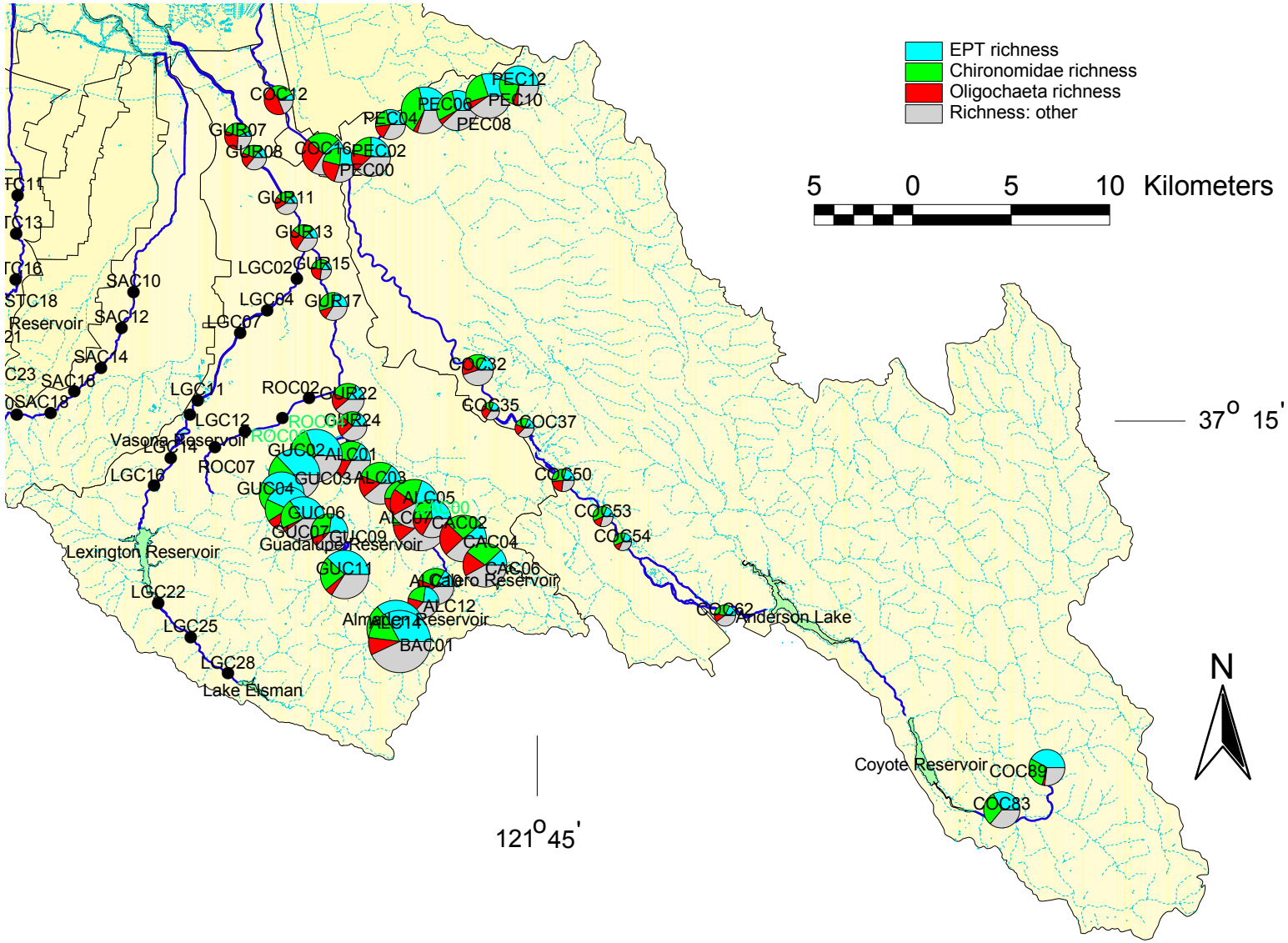

Figure 2. Percentage taxon richness of major taxonomic groups. The size of the circle is an indication of the total absolute taxon richness per site.

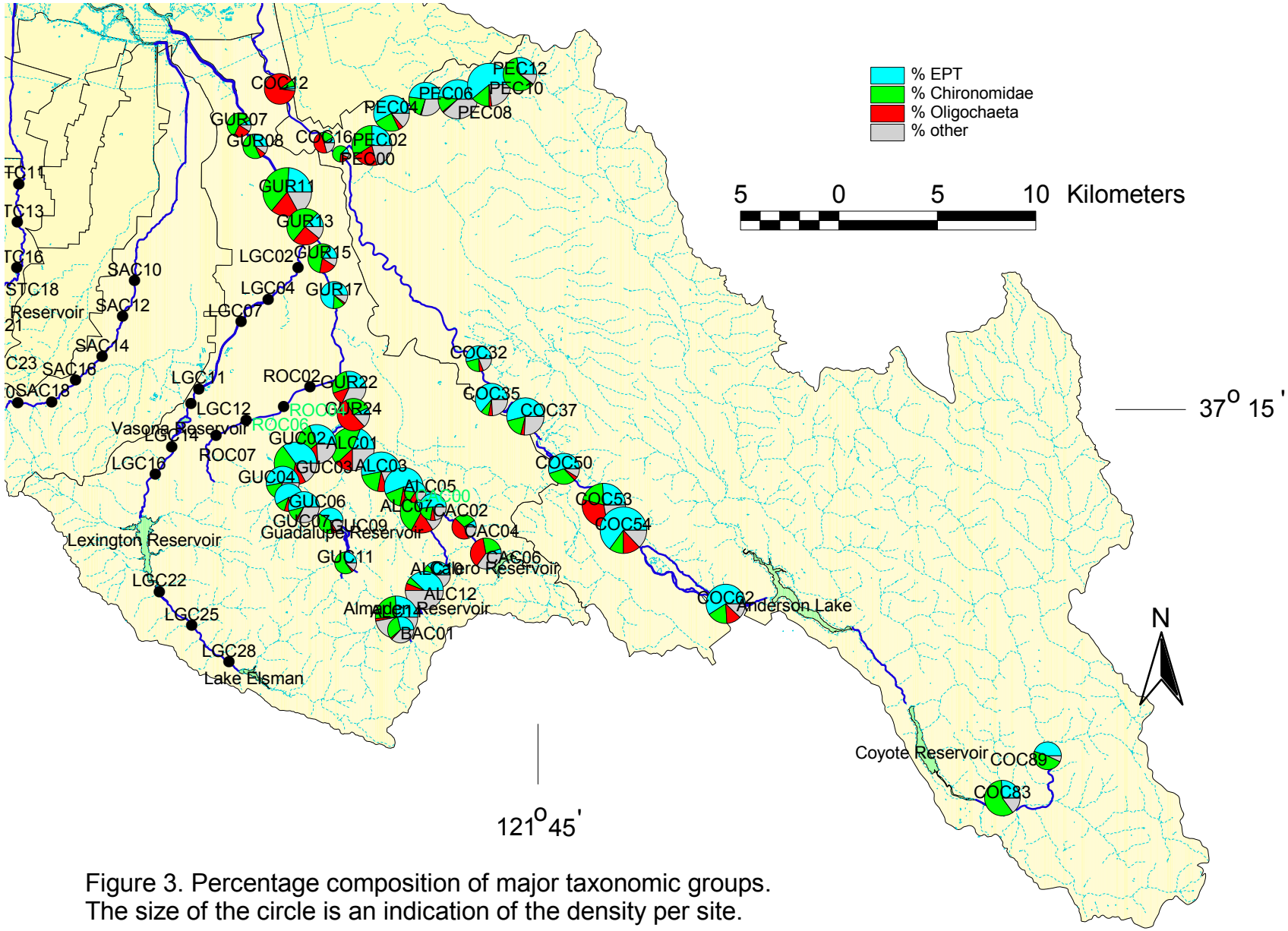

Figure 3. Percentage composition of major taxonomic groups.
The size of the circle is an indication of the density per site.

Table 1. Site code abbreviations, site name, latitude, and longitude.

Abbreviation	Site name	Latitude			Longitude		
GUR07	Guadalupe River at Trimble Rd.	37	22	51.11	121	56	17.26
GUR08	Guadalupe River at airport	37	22	16.50	121	55	43.33
GUR11	Guadalupe River at Hedding St.	37	21	1.95	121	54	35.82
GUR13	Guadalupe River at St. John St.	37	20	5.23	121	53	58.03
GUR15	Guadalupe River at Virginia St.	37	19	13.59	121	53	21.27
GUR17	Guadalupe River at Willow Glen Way	37	18	13.33	121	52	55.93
GUR22	Guadalupe River at Branham Rd.	37	15	40.69	121	52	22.17
GUR24	Guadalupe River at Water District	37	14	56.85	121	52	12.59
GUC02	Guadalupe Creek at Meander Dr.	37	14	7.33	121	53	27.42
GUC03	Guadalupe Creek at Camden Ave.	37	13	35.32	121	54	10.61
GUC04	Guadalupe Creek at gage	37	13	2.89	121	54	36.16
GUC06	Guadalupe Creek above Pheasant Hill Rd.	37	12	38.73	121	54	23.43
GUC07	Guadalupe Creek below Reynolds Rd.	37	12	23.23	121	53	52.00
GUC09	Guadalupe Creek below Reservoir	37	12	1.64	121	52	57.10
GUC11	Guadalupe Creek above Reservoir	37	10	52.47	121	52	24.21
ALC01	Alamitos Creek at Mazzone Dr.	37	14	0.46	121	52	13.69
ALC03	Alamitos Creek at Mt Forest Dr.	37	13	23.38	121	51	13.56
ALC05	Alamitos Creek at Camden Ave.	37	12	58.95	121	50	26.82
ALC07	Alamitos Creek at Hampswood St.	37	12	18.31	121	49	49.62
ALC10	Alamitos Creek at New Almaden	37	10	34.81	121	49	16.17
ALC12	Alamitos Creek above New Almaden	37	10	8.90	121	49	41.47
ALC14	Alamitos Creek above Reservoir	37	9	24.18	121	50	37.81
BAC01	Barret Creek	37	9	3.47	121	50	28.83
CAC00	Arroyo Calero at mouth	37	12	50.72	121	50	2.82
CAC02	Arroyo Calero at Harry St.	37	12	26.55	121	49	26.32
CAC04	Arroyo Calero above Fortini Rd.	37	11	54.50	121	48	21.42
CAC06	Arroyo Calero below dam	37	11	11.14	121	47	35.84
COC12	Coyote Creek at Montague Expr.	37	23	51.60	121	54	54.59
COC16	Coyote Creek at Oakland Rd.	37	22	24.14	121	53	21.23
COC32	Coyote Creek at Scarlet Way	37	16	32.04	121	47	56.04
COC35	Coyote Creek at Silver Creek Valley Rd.	37	15	24.92	121	47	28.49
COC37	Coyote Creek at Bernal Rd.	37	14	57.90	121	46	18.25
COC50	Coyote Creek at Metcalf Rd.	37	13	32.47	121	44	57.18
COC53	Coyote Creek above Malech Lane	37	12	33.69	121	43	34.24
COC54	Coyote Creek at Riverside Golf Course	37	11	52.74	121	42	53.15
COC62	Coyote Creek below dam	37	9	53.43	121	39	20.67
COC83	Coyote Creek at cableway	37	4	38.70	121	29	46.99
COC89	Coyote Creek below Gilroy Hot Springs	37	5	49.17	121	28	15.23
PEC00	Upper Penitencia Creek at Flea Market	37	22	6.14	121	52	46.93
PEC02	Upper Penitencia Creek at Mabury Rd.	37	22	20.62	121	51	42.62
PEC04	Upper Penitencia Creek at Summerdale St.	37	23	14.10	121	51	3.16
PEC06	Upper Penitencia Creek below Alum Rock	37	23	38.41	121	49	53.36
PEC08	Upper Penitencia Creek at Alum Rock -Downstream	37	23	38.81	121	48	46.77
PEC10	Upper Penitencia Creek at Alum Rock-Upstream	37	24	3.39	121	47	42.44
PEC12	Upper Penitencia Creek above Alum Rock	37	24	21.51	121	46	39.25

Table 2. Definitions of taxonomic abbreviations.

Abbreviation	Definition
sp.	The specimen most probably represents a single undetermined species.
spp.	The specimens represent a mixture of two or more undetermined species.
sp. 1	Represents a single distinctive species lacking a published description for the life-stage at which the specimen was collected.
cf	The specimen is probably the taxon indicated but there is uncertainty because of life-stage, condition of the specimen, and/or lack of adequate description.
nr	The specimen is probably not the taxon indicated but is morphologically closer to the indicated taxon than any other description available.
tp1	The specimen is a distinctive morphotype within the taxonomic level indicated.
L	The specimen is a larva.
P	The specimen is a pupa.
e.i.	The specimen is an early instar or immature, and therefore cannot be identified further.

Table 3. Total abundance m^{-2}, richness, and percentage composition of major taxonomic groups per site.

	Abundance m^{-2}	Total richness	EPT richness	Chironomidae richness	Oligochaeta richness	EPT percentage	Chironomidae percentage	Oligochaeta percentage
GUR07	9166	43	3	16	13	6.7	61	23.3
GUR08	9910	41	6	12	8	29.4	52.7	8.2
GUR11	46753	39	6	10	7	24.4	39.8	18.8
GUR13	25186	43	5	12	11	13	50.8	25.3
GUR15	14869	37	6	11	10	17.2	54.8	19.1
GUR17	12621	44	10	14	5	73.6	14.1	1.8
GUR22	20820	48	8	13	8	28.2	26.9	13.4
GUR24	19180	45	8	9	11	6.5	26.4	53.5
GUC02	29547	70	22	19	6	31.2	29.5	15.3
GUC03	35113	68	25	16	9	35.3	36.9	10.5
GUC04	20147	61	25	15	4	52.8	15.4	0.9
GUC06	13448	61	26	10	5	58.4	11.5	6.7
GUC07	17388	60	21	13	2	54.5	11.9	1.8
GUC09	11049	53	12	17	4	41.2	36.4	7.1
GUC11	7307	65	25	15	3	26.8	58	3
ALC01	36941	54	9	18	9	18.6	42.6	13.4
ALC03	30273	58	9	16	10	52.6	19	8.4
ALC05	28897	52	11	15	7	55.7	16	5.3
ALC07	35017	72	16	21	7	32.5	34	17
ALC10	12589	52	9	14	8	37	7.9	2.5
ALC12	27636	47	11	11	8	37.7	5.5	6.4
ALC14	34903	75	27	19	7	26.2	24.6	1.7
BAC01	11578	81	27	12	7	28.9	32.2	2.1
CAC00	6697	65	13	13	12	47.9	18.2	12.2
CAC02	12347	54	14	13	9	51.7	20.2	6.4
CAC04	9625	63	7	17	15	8.5	29.3	43.1
CAC06	17265	60	7	17	11	4.8	22.7	37
COC12	17047	45	3	12	21	2.9	6.5	87.5
COC16	6287	58	7	15	16	9.2	21.5	48.3
COC32	11106	47	8	9	9	54.3	22	5.3
COC35	19177	35	7	7	9	63.8	8.3	4.3
COC37	26463	36	7	9	7	54.2	17.2	2.7
COC50	17272	39	8	12	8	55.2	32	4.4
COC53	36764	37	7	14	5	25.7	20.3	32.3
COC54	42641	35	7	13	4	65.3	9.5	12.1
COC62	29554	38	7	11	5	58.7	16.6	11.9
COC83	23795	52	17	16	0	26.2	59.3	0
COC89	13347	52	22	15	1	45.1	48	0.2
PEC00	2971	50	12	11	12	12.2	62	19.5
PEC02	30868	55	14	12	8	24.8	33.9	19.6
PEC04	24146	46	14	10	7	58.4	23.6	4.4
PEC06	20592	63	18	24	2	47.5	22	0.6
PEC08	29535	56	16	16	2	47.9	13.3	0.5
PEC10	36103	61	18	15	3	61.1	14	1.5
PEC12	20652	55	25	14	2	27.6	60.9	0.8

Table 4. Total abundance and constancy per taxon across 44 sites. Constancy represents the number of sites in which the taxon was found.

		Total Abundance	Constancy
Coelenterata			
Hydra spp.		631	9
Platyhelminthes			
Dugesia spp.		9476	31
Polycelis sp.		17	1
Nemertea			
Prostoma sp.		2419	22
Nematoda		1083	16
Mermithidae		3092	26
Nematomorpha			
cf *Gordius* spp.		4	1
Ectoprocta			
Fredericella sultana	(Blumenbach, 1779)	88	2
Plumatella sp.		237	3
Annelida			
Polychaeta			
Nereis limnicola	Johnson, 1903	200	5
Aphanoneura			
Aeolosoma spp.		1284	14
Oligochaeta			
Haplotaxida			
Haplotaxidae			
Haplotaxis sp.		34	1
Tubificida			
Enchytraeidae			
Cernosvitoviella sp.		26	1
cf *Enchytraeus* spp.		1409	9
Naididae			
Bratislavia unidentata	(Harman, 1973)	80	2
Chaetogaster diaphanus	(Gruithuisen 1828)	443	5
Chaetogaster diastrophus	(Gruithuisen, 1828)	11	1
Dero digitata	(Muller, 1773)	106	2
Dero furcata	(Muller, 1773)	22	1
Dero nivea	Aiyer, 1930	71	2
Nais communis	(Piquet, 1906)	27648	38
Nais elinguis	Muller, 1773	2064	3
Nais pardalis	(Piquet, 1906)	12850	20
Nais simplex	(Piquet, 1906)	4930	15
Nais variabilis	(Piquet, 1906)	36907	34
Ophidonais serpentina	(Muller, 1773)	12469	25
Paranais frici	(Hrabe, 1941)	218	5
Pristina aequiseta	Bourne, 1891	1815	17
Pristina leidyi	(Smith, 1896)	764	8
Pristinella jenkinae	(Stephenson, 1931)	198	4
Pistinella osborni	(Walton, 1906)	585	11
Slavina appendiculata	(d'Udekem, 1855)	7666	23
Stylaria lacustris	(Linnaeus, 1767)	181	4
Tubificidae			

Aulodrilus pluriseta	(Piquet, 1906)	73	3
Bothrioneurum vejdovskyanum	Stolc, 1886	4468	18
Limnodrilus hoffmeisteri	Claparede, 1862	54	1
Limnodrilus udekemianus	Claparede, 1862	866	2
Potamothrix bavaricus	(Oschmann, 1913)	50	1
Rhyacodrilus coccineus/montana	(Vejdovsky, 1875)/(Brinkhurst, 1965)	434	3
Tubifex tubifex	(Muller, 1774)	2	1
Quistadrilus multisetosus	(Smith, 1900)	392	1
Tubificidae tp. 1		2162	7
Tubificidae tp. 2		4495	5
Lumbriculida			
Lumbriculidae			
cf *Kincaidiana* n. sp.		2	1
Lumbriculus cf *variegatus*	(Muller, 1774)	239	6
cf *Stylodrilus* n. sp.		2	1
Trichodrilus n. sp. 1		17	1
Lumbricina		8	2
Sparganophilidae			
Sparganophilus nr *eiseni*	Smith, 1895	282	7
Ocnerodrilidae			
Eukerria saltensis	(Beddard, 1892)	488	25
Lumbricidae			
Allolobophora chlorotica	(Savigny, 1826)	6	2
Eiseniella tetraedra	(Savigny, 1826)	469	18
cf *Dendrodrilus rubidus*	(Savigny, 1826)	2	1
Branchiobdellida		11	1
Hirudinoidea			
Glossiphoniidae			
Helobdella stagnalis	(Linnaeus, 1758)	64	1
Helobdella triserialis	(Blanchard, 1849)	30	1
Erpobdellidae		45	3
Arthropoda			
Mandibulata			
Crustacea			
Cladocera			
Chydoridae		90	1
Daphnidae			
Ostracoda		8238	23
Eucopepoda			
Cyclopoida		1028	15
Calanoida			
Harpacticoida		41	1
Mysidacea			
Isopoda			
Isopoda sp. 1		60	2
Asellidae			
Caecidotea sp. 1		185	5
Sphaeromatidae			
Amphipoda			
Corophiidae			
Corophium cf *spinicornae*	Stimpson, 1857	96	4
Crangonyctidae			

Crangonyx sp.		896	12
cf *Stygobromus* sp.		202	3
Talitridae			
Hyalella azteca	(Saussure)	2953	12
Decopoda			
Astacidae			
Pacifastacus leniusculus	(Dana, 1852)	10	4
Cambaridae			
Grapsidae			
Insecta			
Ephemeroptera			
Ameletidae			
Ameletus spp.		81	4
Siphlonuridae			
Siphlonurus sp.		10	2
Baetidae			
Acentrella turbida	(McDunnough) 1924	1275	2
Baetis tricaudatus	Dodds, 1923	162902	44
Baetis sp. 1		1188	4
Centroptilum spp.		369	2
Diphetor hageni	(Eaton, 1885)	9761	19
Fallceon quilleri	(Dodds, 1923)	27763	22
Heptageniidae			
Epeorus cf *albertae*	(McDunnough, 1924)	219	3
Epeorus longimanus	(Eaton, 1885)	32	4
Ironodes spp.		10	4
Nixe sp.		5764	20
Ephemerellidae			
Drunella cf *flavilinia*	(McDunnough, 1926)	1139	13
Ephemerella cf *infrequens*	McDunnough, 1924	2	1
Ephemerella maculata	Traver, 1934	1894	14
Serratella micheneri	(Traver, 1934)	7434	13
Serratella teresa	(Traver, 1934)	1668	8
Tricorythidae			
Tricorythodes cf *minutus*	Traver, 1935	10313	28
Caenidae			
Caenis sp.		205	3
Leptophlebiidae			
Paraleptophlebia cf *debilis*	(Walker, 1853)	2099	16
Paraleptophlebia cf *memorialis*	(Eaton, 1884)	2	1
Odonata			
Anisoptera			
Aeshnidae			
Cordulegastridae			
Cordulegaster dorsalis	Hagen, 1895	17	1
Gomphidae			
Libellulidae			
Zygoptera			
Calopterygidae			
Lestidae			
Coenagrionidae		43	3
Argia sp.		552	11

Plecoptera			
Pteronarcyidae			
Pteronarcys sp. e.i.		2	1
Peltoperlidae			
cf *Yoraperla* sp. e.i.		2	1
Nemouridae			
Malenka spp.		18753	23
Leuctridae		42	2
Capniidae		43	1
Perlidae			
Calineuria californica	(Banks, 1905)	1806	15
Hesperoperla pacifica	Banks, 1900	200	5
Perlodidae			
Isoperla sp. 1		312	3
Isoperla sp. 2		2	1
cf *Kogotus* sp.		8	2
cf *Skwala* sp. e.i.		62	1
Chloroperlidae			
Suwallia cf *pallidula*	Banks, 1904	464	5
Sweltsa spp.		45	5
Hemiptera			
Belostomatidae			
Abedus sp.		41	1
Corixidae			
Sigara sp.		480	9
Megaloptera			
Sialidae			
Sialis sp.		827	18
Corydalidae			
cf *Neohermes* sp.		48	5
Trichoptera			
Hydropsychoidea			
Philopotamidae			
Dolophilodes sp.		2	1
Wormaldia gabriella	(Banks, 1930)	758	10
Psychomyiidae			
Polycentropodidae			
Polycentropus sp.		34	5
Hydropsychidae			
Hydropsychidae spp. e.i.		46706	40
Parapsyche almota	Ross, 1938	76	4
Cheumatopsyche mickeli	Denning, 1942	18998	25
Hydropsyche californica	Banks, 1899	24660	37
Hydropsyche oslari	Banks, 1905	4745	15
Rhyacophilidae			
Rhyacophila angelita	Banks, 1911	6	1
Rhyacophila cf *arcella*	Denning, 1975	1985	16
Rhyacophila pellisa	Ross, 1938	15	1
Glossosomatidae			
Agapetus celatus P	McLachlan, 1871	231	8
Agapetus marlo P	Milne, 1936	53	3
Agapetus spp.		1572	15

Glossosoma pterna	Ross, 1947	253	8
Hydroptilidae		17	1
Hydroptila spp.		3420	29
Ithytrichia cf *clavata*	Morton, 1905	668	2
Metrichia sp.		882	10
Stactobiella sp.		125	1
Limnephiloidea			
Brachycentridae			
Amiocentrus aspilus	(Ross, 1938)	69	3
Micrasema sp.		334	8
Lepidostomatidae			
Lepidostoma tp.1		24	1
Lepidostoma tp. 2		314	2
Lepidostoma cf *cantha*	Ross, 1941	30	4
Lepidostoma spp.		2826	18
Limnephilidae			
Psychoglypha cf *bella*	(Banks, 1903)	6	1
Uenoidae			
Neophylax cf *rickeri*	Milne, 1935	252	8
Sericostomatidae			
Gumaga sp.		497	3
Odontoceridae			
Parthina sp.		730	3
Leptoceridae			
Oecetis sp.		172	3
Lepidoptera			
Pyralidae			
Petrophila sp.		256	7
Coleoptera			
Adephaga			
Gyrinidae			
Gyrinus sp.		121	1
Haliplidae			
Peltodytes sp.		67	1
Dytiscidae			
Agabus sp.		153	6
Nebrioporus/Stictotarsus spp.		53	4
Polyphaga			
Hydrophilidae			
Hydrophilidae L		23	6
Hydraenidae			
Hydraena sp.		127	3
Psephenidae			
Eubrianax sp.		455	11
Dryopidae			
Postelichus sp.		39	1
Scirtidae			
Elmidae			
Acneus sp.		2	1
Ampumixis dispar	(Fall, 1925)	134	2
Cleptelmis ornata	(Schaeffer, 1911)	73	2
Narpus concolor	(LeConte, 1881)	58	3

Optioservus cf *seriatus*	(LeConte, 1874)	4375	33
Optioservus spp.		12462	30
Ordobrevia nubifera	(Fall, 1901)	960	8
Zaitzevia cf *parvula*	(Horn, 1870)	2392	17
Diptera			
Nematocera			
Blephariceridae			
Tipulidae		105	5
Antocha sp.		1204	16
Dicranota sp.		1273	23
Hexatoma spp.		485	7
Limonia sp. 1		8	2
cf *Rhabdomastix* sp.		2	1
Tipula spp.		30	4
Psychodidae			
Maruina sp.		47	2
Pericoma/Telmatoscopus sp.		88	4
Ceratopogonidae			
cf *Culicoides* sp.		26	1
cf *Palpomyia* spp.		458	8
Simuliidae			
Simulium cf *argus/vittatum*	Williston, 1893/Zetterstedt, 1838	53939	30
Simulium aureum cplx	Fries, 1824	7820	26
Simulium canadense	Hearle, 1932	2077	5
Simulium piperi	Dyar and Shannon, 1927	9827	20
Simulium tuberosum cplx	(Lundstrom, 1911)	23098	16
Simulium cf *virgatum*	Coquillett, 1902	697	7
Chironomidae			
Tanypodinae			
Macropelopiini			
Alotanypus sp.		13	1
cf *Brundiniella* sp.		121	2
Procladiini			
Procladius (Holotanypus) sp.		4	2
Pentaneurini			
Ablabesmyia sp.		271	7
Conchapelopia sp.		1225	14
Nilotanypus sp.		342	4
Pentaneura sp.		4792	24
Rheopelopia sp.		4578	19
cf *Thienemannimyia* sp.		133	5
Zavrelimyia sp.		71	2
Diamesinae			
Pagastia sp.		2	1
Potthastia gaedii gr.		4729	3
Orthocladiinae			
Corynoneurini			
Corynoneura spp.		3048	19
Thienemanniella spp.		2627	19
Orthocladiini			
Brillia cf *retifinis*	Saether, 1969	4360	17
Cardiocladius sp.		693	10

Cricotopus bicinctus	(Meigen, 1918)	6081	24
Cricotopus sylvestris gr.		30	1
Cricotopus tremulus gr. spp.		26370	30
Cricotopus trifascia gr.		25221	29
Cricotopus sp. 1		1261	6
Eukiefferiella brehmi gr.		4949	16
Eukiefferiella claripennis gr.		2915	19
Eukiefferiella devonica gr.		2386	11
Euryhapsis sp.		34	1
Heleniella sp.		86	2
Heterotrissocladius marcidus gr.		80	2
Krenosmittia sp.		71	2
Limnophyes sp.		202	3
Nanocladius bicolor gr.		11	1
Nanocladius parvulus gr.		41	1
Orthocladius (*Euorthocladius*) tp. 2		277	2
Parakiefferiella sp.		30	1
Parametriocnemus sp.		9009	34
Paraphaenocladius sp.		43	1
Rheocricotopus sp.		30318	39
Synorthocladius sp.		1805	11
Tvetenia bavarica gr.		1266	9
Chironominae			
Chironomini			
cf *Chironomus* sp.		324	5
Cryptochironomus sp.		406	10
Demicryptochironomus sp.		32	1
Dicrotendipes californicus	(Johannsen, 1905)	592	8
Dicrotendipes modestus	(Say, 1823)	181	1
Microtendipes pedellus gr.		3547	10
Microtendipes rydalensis gr.		2379	14
Paratendipes sp.		144	3
Phaenopsectra sp.		1744	17
Polypedilum cf *illinoense*	(Malloch, 1915)	790	9
Polypedilum aviceps	Townes, 1945	44160	35
Polypedilum fallax	Johannsen, 1905	28	1
Pseudochironomini			
Pseudochironomus sp.		1115	6
Tanytarsini			
Micropsectra spp.		22789	39
Paratanytarsus sp.		660	6
Rheotanytarsus sp.		28638	39
Stempellinella sp.		981	6
Sublettea sp.		390	1
Tanytarsus tp. 1		7310	10
Tanytarsus tp. 2		4687	8
Dixidae			
Dixa spp.		456	6
Meringodixa sp.		17	1
Brachycera			
Stratiomyidae			
cf *Caloparyphus* sp.		1432	13

cf *Euparyphus* sp.		219	7
Odontomyia sp.		105	2
cf *Oxycera* sp.		9	1
Tabanidae			
Pelecorhynchidae			
Dolichopodidae		69	10
Empididae			
Chelifera sp.		527	13
Clinocera sp.		267	11
Hemerodromia sp.		729	13
Wiedemannia sp.		23	4
Empididae tp. 1 P		608	12
Empididae tp. 2 P		519	11
Cyclorrapha		127	4
Syrphidae			
Ephydridae		17	4
Sciomyzidae			
Muscidae			
cf *Limnophora* tp. 1		202	11
cf *Limnophora* tp. 2		2	1
Chelicerata			
Arachnoidea			
Eylaidae			
Hydryphantidae			
Protzia sp.		90	3
Wandesia sp.		22	1
Spherchontidae			
Sperchon spp.		34880	42
Lebertiidae			
Lebertia sp.		1293	16
Torrenticolidae		5214	14
Limnesiidae			
Hygrobatidae			
Atractides sp.		5005	26
Hygrobates sp.		84	2
Mideopsidae			
Oribatei		90	1
Mollusca			
Gastropoda			
Prosobranchia		278	3
Limnophila			
Physidae			
cf *Physella*		478	6
Lymnaeidae			
Planorbidae		678	8
Pelecypoda			
Corbiculidae			
Corbicula fluminea	(Muller)	1999	8
Sphaeriidae			

Table 5. Estimated abundance of benthic macroinvertebrates m^{-2} in riffles from the Guadalupe River, May 1997.

	GUR07	GUR08	GUR11	GUR13	GUR15	GUR17	GUR22	GUR24
Coelenterata								
Hydra spp.		17		86			90	
Platyhelminthes								
Dugesia spp.	11	39	54	349	84	24	887	366
Nemertea								
Prostoma sp.	155	108	325	43		24	271	304
Nematoda	11		164	86				60
Mermithidae	230	17	54			24	121	30
Nematomorpha								
Ectoprocta								
Plumatella sp.						24		151
Annelida								
Polychaeta								
Nereis limnicola	50	2	2	2				
Aphanoneura								
Aeolosoma spp.			54	304	84	24	181	30
Oligochaeta								
Haplotaxida								
Haplotaxidae								
Tubificida								
Enchytraeidae								
cf *Enchytraeus* spp.	11			174	394	45		
Naididae								
Bratislavia unidentata					56	24		
Chaetogaster diaphanus				86				60
Chaetogaster diastrophus	11							
Nais communis	207	17	1193	3126	730	24	362	
Nais pardalis	1457	37	3147	1042	168			181
Nais simplex					196		422	964
Nais variabilis	155	37	4069	956	1040	114	181	5937
Ophidonais serpentina	22	575	217	304			1175	2923
Paranais frici	52						60	
Pristina aequiseta	22		108	86			60	
Pristina leidyi				43				
Pistinella osborni	11				56			
Slavina appendiculata	125	108		521	112		512	90
Stylaria lacustris								60
Tubificidae								
Bothrioneurum vejdovskyanum	41				84	24		30
Lumbriculida								
Lumbriculidae								
Lumbriculus cf *variegatus*			54					
Lumbricina		4						
Sparganophilidae								
Sparganophilus nr *eiseni*			9					4
Ocnerodrilidae								
Eukerria saltensis	11	26		2	2		22	9
Lumbricidae								
Eiseniella tetraedra	11	4		43				2

Branchiobdellida								
Hirudinoidea								
Glossiphoniidae								
Helobdella triserialis							30	
Erpobdellidae								
Arthropoda								
Mandibulata								
Crustacea								
Cladocera								
Chydoridae								
Daphnidae								
Ostracoda		90					30	60
Eucopepoda								
Cyclopoida	62	17	54	174				
Calanoida								
Harpacticoida	41							
Mysidacea								
Isopoda								
Asellidae								
Sphaeromatidae								
Amphipoda								
Corophiidae								
Crangonyctidae								
Crangonyx sp.	2	2	592	47	4	114	2	4
Talitridae								
Hyalella azteca							293	2
Decopoda								
Astacidae								
Cambaridae								
Grapsidae								
Insecta								
Ephemeroptera								
Ameletidae								
Siphlonuridae								
Baetidae								
Baetis tricaudatus	202	2136	10314	2555	2095	7513	2631	2
Centroptilum spp.						93		
Diphetor hageni			2					
Fallceon quilleri	260	336	547	129	28	50	1630	
Heptageniidae								
Ephemerellidae								
Serratella micheneri								2
Tricorythidae								
Tricorythodes cf *minutus*	153	344			56	233	973	926
Caenidae								
Leptophlebiidae								
Paraleptophlebia cf *debilis*						24		
Odonata								
Anisoptera								
Aeshnidae								
Cordulegastridae								
Gomphidae								

Libellulidae							
Zygoptera							
Calopterygidae							
Lestidae							
Coenagrionidae	11						
Argia sp.						93	
Plecoptera							
Pteronarcyidae							
Peltoperlidae							
Nemouridae							
Malenka spp.					45	93	
Leuctridae							
Capniidae							
Perlidae							
Perlodidae							
Chloroperlidae							
Hemiptera							
Belostomatidae							
Corixidae							
Sigara sp.						32	
Megaloptera							
Sialidae							
Sialis sp.		2	2	43		47	
Corydalidae							
Trichoptera							
Hydropsychoidea							
Philopotamidae							
Psychomyiidae							
Polycentropodidae							
Hydropsychidae							
Hydropsychidae spp. e.i.		17		172	84	226	30	30
Cheumatopsyche mickeli		2					129	60
Hydropsyche californica		75	504	207	209	762	265	138
Rhyacophilidae							
Glossosomatidae							
Hydroptilidae							
Hydroptila spp.			54	217	84	316	123	95
Limnephiloidea							
Brachycentridae							
Lepidostomatidae							
Lepidostoma spp.						24	
Limnephilidae							
Uenoidae							
Sericostomatidae							
Odontoceridae							
Leptoceridae							
Lepidoptera							
Pyralidae							
Petrophila sp.			54				101
Coleoptera							
Adephaga							
Gyrinidae							

Haliplidae								
Dytiscidae								
Nebrioporus/Stictotarsus spp.								
Polyphaga								
Hydrophilidae								
Hydrophilidae L	11	2						
Hydraenidae								
Psephenidae								
Dryopidae								
Scirtidae								
Elmidae								
Optioservus cf *seriatus*		19			28	90	685	189
Optioservus spp.			108		28		424	431
Diptera								
Nematocera								
Blephariceridae								
Tipulidae								
Dicranota sp.			4					
Psychodidae								
Ceratopogonidae								
Simuliidae								
Simulium cf *argus/vittatum*		37	217	43	142	306	243	
Simulium aureum cplx				131		144		
Chironomidae								
Tanypodinae								
Macropelopiini								
Procladiini								
Procladius (Holotanypus) sp.						2		
Pentaneurini								
Ablabesmyia sp.					30	24		
Conchapelopia sp.		54					30	
Pentaneura sp.		17	220	43	252	159	121	
Rheopelopia sp.						24		
cf *Thienemannimyia* sp.	11							
Diamesinae								
Orthocladiinae								
Corynoneurini								
Thienemanniella spp.	155	54	54					
Orthocladiini								
Cardiocladius sp.							60	
Cricotopus bicinctus	105	431		174		24	663	663
Cricotopus tremulus gr. spp.	1582	1059	2984	2693	1079		1055	1662
Cricotopus trifascia gr.	52	1223	5371	2532	2973	45	1628	1675
Eukiefferiella brehmi gr.							90	
Eukiefferiella claripennis gr.			108	260	56			
Nanocladius bicolor gr.	11							
Parametriocnemus sp.			435	217		93		
Rheocricotopus sp.	288	538	5046	1520	2133	385	1266	482
Synorthocladius sp.						24		
Chironominae								
Chironomini								
cf *Chironomus* sp.	15	19		4				

Cryptochironomus sp.	2	17					30	
Dicrotendipes californicus	26						30	2
Phaenopsectra sp.	22				112	252	60	30
Polypedilum cf *illinoense*	30					45		
Polypedilum aviceps	84		379		56	45	241	90
Polypedilum fallax					28			
Pseudochironomini								
Pseudochironomus sp.								30
Tanytarsini								
Micropsectra spp.	30	54	379	521	308	226		
Paratanytarsus sp.		71						
Rheotanytarsus sp.	217	1690	3634	4211	1124	433	332	422
Sublettea sp.				390				
Tanytarsus tp. 1				217				
Tanytarsus tp. 2	2964							
Dixidae								
Brachycera								
Stratiomyidae								
cf *Caloparyphus* sp.						24		
Tabanidae								
Pelecorhynchidae								
Dolichopodidae		2						
Empididae								
Chelifera sp.			108					
Clinocera sp.				45				
Hemerodromia sp.					28			
Empididae tp. 1 P			4	43				
Cyclorrapha								
Syrphidae								
Ephydridae								
Sciomyzidae								
Muscidae								
Chelicerata								
Arachnoidea								
Eylaidae								
Hydryphantidae								
Spherchontidae								
Sperchon spp.	237	90	6075	1302	786	385	1838	603
Lebertiidae								
Lebertia sp.			54		28	24		
Torrenticolidae								
Limnesiidae								
Hygrobatidae								
Atractides sp.						45		30
Hygrobates sp.								30
Mideopsidae								
Oribatei								
Mollusca								
Gastropoda								
Prosobranchia							211	
Limnophila								
Physidae								

cf *Physella*					112		95	151
Lymnaeidae								
Planorbidae				43			90	30
Pelecypoda								
Corbiculidae								
Corbicula fluminea		521				24	930	39
Sphaeriidae								
Abundance	9166	9910	46753	25186	14869	12621	20820	19180
Taxon Richness	43	41	39	43	37	44	48	45

Table 6. Estimated abundance of benthic macroinvertebrates m^{-2} in riffles from Guadalupe Creek, May 1997.

	GUC02	GUC03	GUC04	GUC06	GUC07	GUC09	GUC11
Coelenterata							
Platyhelminthes							
Dugesia spp.	405	86			30	95	41
Nemertea							
Prostoma sp.	30				62		
Nematoda							
Mermithidae	185	43		155	62		
Nematomorpha							
Ectoprocta							
Annelida							
Polychaeta							
Aphanoneura							
Aeolosoma spp.						39	
Oligochaeta							
Haplotaxida							
Haplotaxidae							
Tubificida							
Enchytraeidae							
cf *Enchytraeus* spp.		86		34			
Naididae							
Nais communis	1798	1259	62	620	217		13
Nais simplex	280		30	52			
Nais variabilis		1042		155	93	607	
Ophidonais serpentina		129				133	
Paranais frici	30						
Pristina aequiseta		43					
Pristina leidyi	125						
Pristinella jenkinae		86					
Slavina appendiculata	1860	825	93				
Tubificidae							
Bothrioneurum vejdovskyanum	435					19	
Rhyacodrilus coccineus/montana							202
Tubificidae tp. 1				34			
Lumbriculida							
Lumbriculidae							
Lumbriculus cf *variegatus*						22	
Lumbricina							
Sparganophilidae							
Ocnerodrilidae							
Eukerria saltensis		11	2				
Lumbricidae							
Eiseniella tetraedra		200					2
Branchiobdellida							
Hirudinoidea							
Glossiphoniidae							
Erpobdellidae							
Arthropoda							
Mandibulata							
Crustacea							

Cladocera							
Chydoridae							
Daphnidae							
Ostracoda	67					2	
Eucopepoda							
Cyclopoida	30					95	
Calanoida							
Harpacticoida							
Mysidacea							
Isopoda							
Asellidae							
Caecidotea sp. 1				17			
Sphaeromatidae							
Amphipoda							
Corophiidae							
Crangonyctidae							
Talitridae							
Hyalella azteca						54	
Decopoda							
Astacidae							
Pacifastacus leniusculus			4		2		
Cambaridae							
Grapsidae							
Insecta							
Ephemeroptera							
Ameletidae							
Ameletus spp.			2	17			60
Siphlonuridae							
Baetidae							
Baetis tricaudatus	3449	7713	4441	4355	4585	1828	123
Baetis sp. 1							15
Diphetor hageni	1057	217	155	243	248		15
Heptageniidae							
Epeorus cf *albertae*			30				
Epeorus longimanus			2	26	2		
Ironodes spp.			2	2	2		
Nixe sp.	418	217	478	73	258		99
Ephemerellidae							
Drunella cf *flavilinia*	17	211	116	146	121		73
Ephemerella maculata	282	310	65	47	43		62
Serratella micheneri	534	86					
Serratella teresa	37	652	530	299	62		
Tricorythidae							
Tricorythodes cf *minutus*	1270	43				19	
Caenidae							
Leptophlebiidae							
Paraleptophlebia cf *debilis*	93			4	32	228	69
Odonata							
Anisoptera							
Aeshnidae							
Cordulegastridae							
Gomphidae							

Libellulidae							
Zygoptera							
Calopterygidae							
Lestidae							
Coenagrionidae							
Plecoptera							
Pteronarcyidae							
Pteronarcys sp. e.i.							2
Peltoperlidae							
cf *Yoraperla* sp. e.i.							2
Nemouridae							
Malenka spp.	902	1830	2738	1673	2530	964	304
Leuctridae				2			
Capniidae							
Perlidae							
Calineuria californica	30	9	233	131	198		448
Hesperoperla pacifica				19	30		13
Perlodidae							
cf *Kogotus* sp.		2					
cf *Skwala* sp. e.i.	62						
Chloroperlidae							
Suwallia cf *pallidula*							256
Sweltsa spp.		2	30	2	2		9
Hemiptera							
Belostomatidae							
Corixidae							
Sigara sp.	32						
Megaloptera							
Sialidae							
Sialis sp.	34					19	
Corydalidae							
cf *Neohermes* sp.				2			6
Trichoptera							
Hydropsychoidea							
Philopotamidae							
Dolophilodes sp.							2
Wormaldia gabriella			30	34			
Psychomyiidae							
Polycentropodidae							
Hydropsychidae							
Hydropsychidae spp. e.i.	805	346	340	120	125	75	
Parapsyche almota							2
Cheumatopsyche mickeli	62	11					
Hydropsyche californica	9	17	2	19		50	
Hydropsyche oslari	2	103	381	321	174		6
Rhyacophilidae							
Rhyacophila cf *arcella*	6	88	187	209	661	58	67
Rhyacophila pellisa		15					
Glossosomatidae							
Agapetus celatus P	34	2	62				24
Agapetus spp.	69	325	631	19	62		194
Glossosoma pterna	30		34	17	2		24

Hydroptilidae				17			
Hydroptila spp.	30	43				151	
Metrichia sp.						95	
Limnephiloidea							
Brachycentridae							
Amiocentrus aspilus		43				22	
Micrasema sp.		43	65		30		
Lepidostomatidae							
Lepidostoma tp.1						24	
Lepidostoma cf *cantha*		24	2	2			
Lepidostoma spp.	30	43	62	17	280	1042	56
Limnephilidae							
Uenoidae							
Neophylax cf *rickeri*			26	45	28		22
Sericostomatidae							
Odontoceridae							
Parthina sp.							13
Leptoceridae							
Lepidoptera							
Pyralidae							
Coleoptera							
Adephaga							
Gyrinidae							
Haliplidae							
Dytiscidae							
Agabus sp.						2	
Nebrioporus/Stictotarsus spp.							
Polyphaga							
Hydrophilidae							
Hydraenidae							
Psephenidae							
Eubrianax sp.			2	22			6
Dryopidae							
Scirtidae							
Elmidae							
Cleptelmis ornata		43	30				
Narpus concolor		2		4			
Optioservus cf *seriatus*	329	396	62		95	56	15
Optioservus spp.	3171	2995	967	710	157		13
Ordobrevia nubifera				34	30		43
Zaitzevia cf *parvula*	30	86	62	310	340		43
Diptera							
Nematocera							
Blephariceridae							
Tipulidae					30		13
Antocha sp.		129	30	34	32	56	15
Dicranota sp.	30	2		37	69	32	54
Hexatoma spp.							69
cf *Rhabdomastix* sp.							2
Tipula spp.				2			
Psychodidae							
Maruina sp.					30		

Pericoma/Telmatoscopus sp.						39	13
Ceratopogonidae							
cf *Palpomyia* spp.				17	30		54
Simuliidae							
Simulium cf *argus/vittatum*	1709			2	2		
Simulium aureum cplx	360	129	95				
Simulium canadense					409		
Simulium piperi	30	2	1808	252	880	463	30
Simulium tuberosum cplx		650	1901	1089	1914	482	
Simulium cf *virgatum*					2		
Chironomidae							
Tanypodinae							
Macropelopiini							
Procladiini							
Pentaneurini							
Conchapelopia sp.	217						54
Pentaneura sp.	62						
Rheopelopia sp.	984	394	164	69	99		41
Zavrelimyia sp.							28
Diamesinae							
Orthocladiinae							
Corynoneurini							
Corynoneura spp.		390		17		56	258
Thienemanniella spp.	125		62		62		
Orthocladiini							
Brillia cf *retifinis*		521	248	75	159	22	1292
Cardiocladius sp.	97				2	39	
Cricotopus bicinctus	217					39	
Cricotopus tremulus gr. spp.	1210	1389	30				
Cricotopus trifascia gr.	1115					284	28
Cricotopus sp. 1	217	868	30	17			
Eukiefferiella brehmi gr.	30	43	30				
Eukiefferiella claripennis gr.	62	738	185		93	19	
Eukiefferiella devonica gr.	30	174				360	
Heleniella sp.						39	
Heterotrissocladius marcidus gr.						39	
Krenosmittia sp.							28
Orthocladius (*Euorthocladius*) tp. 2		174					
Parakiefferiella sp.			30				
Parametriocnemus sp.		1783	125	121	95	151	69
Rheocricotopus sp.	217	435	62		62	1156	
Synorthocladius sp.	837	217					
Tvetenia bavarica gr.			185	155	125	39	463
Chironominae							
Chironomini							
Demicryptochironomus sp.			32				
Microtendipes pedellus gr.	775						
Microtendipes rydalensis gr.				52	62	56	136
Phaenopsectra sp.						133	
Polypedilum cf *illinoense*				52		19	136
Polypedilum aviceps	1365	5173	1119	794	682		756
Pseudochironomini							

Tanytarsini							
Micropsectra spp.	745	390	527	189	465	1270	885
Paratanytarsus sp.	280						
Rheotanytarsus sp.	125	174	280		125	304	
Stempellinella sp.							13
Tanytarsus tp. 1		86					54
Tanytarsus tp. 2					30		
Dixidae							
Dixa spp.							295
Brachycera							
Stratiomyidae							
cf *Caloparyphus* sp.			30		2		
Tabanidae							
Pelecorhynchidae							
Dolichopodidae				17			15
Empididae							
Chelifera sp.		43				19	54
Clinocera sp.	62					2	13
Hemerodromia sp.					30		
Wiedemannia sp.	2						
Empididae tp. 1 P	30	93	4	19			
Empididae tp. 2 P	71					2	
Cyclorrapha						2	
Syrphidae							
Ephydridae	2		2				
Sciomyzidae							
Muscidae							
cf *Limnophora* tp. 1	37						
Chelicerata							
Arachnoidea							
Eylaidae							
Hydryphantidae							
Protzia sp.							13
Spherchontidae							
Sperchon spp.	125	564	775	327	900	170	69
Lebertiidae							
Lebertia sp.		43	125	17	93		13
Torrenticolidae	30	347	30		248		
Limnesiidae							
Hygrobatidae							
Atractides sp.	280	435	280	86	93	39	
Mideopsidae							
Oribatei							
Mollusca							
Gastropoda							
Prosobranchia							
Limnophila							
Physidae							
Lymnaeidae							
Planorbidae							
Pelecypoda							
Corbiculidae							

Corbicula fluminea						19	
Sphaeriidae							
Abundance	29547	35113	20147	13448	17388	11049	7307
Total Richness	70	68	61	61	60	53	65

Table 7. Estimated abundance of benthic macroinvertebrates m^{-2} in riffles from Los Alamitos Creek, May 1997.

	ALC01	ALC03	ALC05	ALC07	ALC10	ALC12	ALC14	BAC01
Coelenterata								
Hydra spp.					17	82		
Platyhelminthes								
Dugesia spp.	661	1647	217	332				
Polycelis sp.								17
Nemertea								
Prostoma sp.	54	108				82		
Nematoda	108							17
Mermithidae	54	325	164	706	34	41	41	
Nematomorpha								
Ectoprocta								
Annelida								
Polychaeta								
Aphanoneura								
Oligochaeta								
Haplotaxida								
Haplotaxidae								
Haplotaxis sp.								34
Tubificida								
Enchytraeidae								
Naididae								
Chaetogaster diaphanus		54		217				
Dero nivea						41		
Nais communis	650	325	543	2713	34	166	372	52
Nais pardalis	108	54	217	271	69	786	82	17
Nais simplex		435	164	1410	17			
Nais variabilis	3744	1139	108	1193	52	82		17
Ophidonais serpentina	108	54	379		86			
Pristina aequiseta	108	271				41	41	
Pristinella jenkinae			54					
Pistinella osborni			54	54				
Slavina appendiculata	108	217		108	34	620		
Tubificidae								
Bothrioneurum vejdovskyanum	54					41		
Rhyacodrilus coccineus/montana								103
Lumbriculida								
Lumbriculidae								
cf *Kincaidiana* n. sp.							2	
Lumbriculus cf *variegatus*	2							
cf *Stylodrilus* n. sp.								2
Trichodrilus n. sp. 1								17
Lumbricina								
Sparganophilidae								
Sparganophilus nr *eiseni*							82	
Ocnerodrilidae								
Eukerria saltensis	78	2			4		2	
Lumbricidae								
Eiseniella tetraedra		4			19	2	2	
Branchiobdellida								

Hirudinoidea								
Glossiphoniidae								
Erpobdellidae								
Arthropoda								
Mandibulata								
Crustacea								
Cladocera								
Chydoridae								
Daphnidae								
Ostracoda	2988	276	222	601		166		
Eucopepoda								
Cyclopoida					17	248	41	
Calanoida								
Harpacticoida								
Mysidacea								
Isopoda								
Isopoda sp. 1					17			
Asellidae								
Caecidotea sp. 1	2				17		82	
Sphaeromatidae								
Amphipoda								
Corophiidae								
Crangonyctidae								
Crangonyx sp.	54	4						
cf *Stygobromus* sp.	112							88
Talitridae								
Hyalella azteca		114	2	9				
Decopoda								
Astacidae								
Pacifastacus leniusculus				2				
Cambaridae								
Grapsidae								
Insecta								
Ephemeroptera								
Ameletidae								
Ameletus spp.								2
Siphlonuridae								
Siphlonurus sp.						4		
Baetidae								
Baetis tricaudatus	868	3354	3989	3972	3643	8525	5507	618
Baetis sp. 1								17
Centroptilum spp.				276				
Diphetor hageni			271	825			82	34
Fallceon quilleri	271	553	1216	1920				
Heptageniidae								
Epeorus cf *albertae*							133	56
Epeorus longimanus								2
Nixe sp.				2		84	41	34
Ephemerellidae								
Drunella cf *flavilinia*							228	24
Ephemerella cf *infrequens*							2	
Serratella micheneri	1335	3128	456	607				

Serratella teresa							41	
Tricorythidae								
Tricorythodes cf *minutus*	508	2		108			41	
Caenidae								
Leptophlebiidae								
Paraleptophlebia cf *debilis*				108	17	41	43	17
Odonata								
Anisoptera								
Aeshnidae								
Cordulegastridae								
Cordulegaster dorsalis								17
Gomphidae								
Libellulidae								
Zygoptera								
Calopterygidae								
Lestidae								
Coenagrionidae								
Argia sp.					2	2		2
Plecoptera								
Pteronarcyidae								
Peltoperlidae								
Nemouridae								
Malenka spp.			168	388	82	166	872	519
Leuctridae								40
Capniidae								
Perlidae								
Calineuria californica							95	41
Hesperoperla pacifica							136	2
Perlodidae								
Isoperla sp. 1							2	
Isoperla sp. 2					2			
Chloroperlidae								
Suwallia cf *pallidula*								2
Hemiptera								
Belostomatidae								
Corixidae								
Sigara sp.	108	54		54				
Megaloptera								
Sialidae								
Sialis sp.			56	9	17	288		
Corydalidae								
Trichoptera								
Hydropsychoidea								
Philopotamidae								
Wormaldia gabriella			2					56
Psychomyiidae								
Polycentropodidae								
Polycentropus sp.							2	2
Hydropsychidae								
Hydropsychidae spp. e.i.	1085	3363	6022	2008	724	702	951	327
Parapsyche almota							43	22
Cheumatopsyche mickeli	1989	4486	2951	325				

Hydropsyche californica	771	859	1008	245	171	635		
Hydropsyche oslari					2		260	155
Rhyacophilidae								
Rhyacophila angelita							6	
Rhyacophila cf *arcella*					2		114	200
Glossosomatidae								
Agapetus celatus P							6	30
Agapetus marlo P						2		
Agapetus spp.		4		4			82	161
Glossosoma pterna								34
Hydroptilidae								
Hydroptila spp.	54	166	2	543	17		43	
Metrichia sp.				54		82	248	
Stactobiella sp.						125		
Limnephiloidea								
Brachycentridae								
Amiocentrus aspilus							4	
Micrasema sp.							41	69
Lepidostomatidae								
Lepidostoma tp. 2								17
Lepidostoma spp.						41	84	831
Limnephilidae								
Uenoidae								
Neophylax cf *rickeri*							52	34
Sericostomatidae								
Odontoceridae								
Leptoceridae								
Lepidoptera								
Pyralidae								
Petrophila sp.	56		2	2				
Coleoptera								
Adephaga								
Gyrinidae								
Haliplidae								
Dytiscidae								
Agabus sp.			56	9				17
Nebrioporus/Stictotarsus spp.					17			
Polyphaga								
Hydrophilidae								
Hydrophilidae L		4		2				
Hydraenidae								
Hydraena sp.					52		41	34
Psephenidae								
Eubrianax sp.							174	127
Dryopidae								
Scirtidae								
Elmidae								
Ampumixis dispar							82	52
Narpus concolor								52
Optioservus cf *seriatus*	129	549	228	168	56	319	86	39
Optioservus spp.	409	230	65	280			581	138
Ordobrevia nubifera							372	52

Zaitzevia cf *parvula*					2		332	56
Diptera								
Nematocera								
Blephariceridae								
Tipulidae							2	17
Antocha sp.		2		73		222	93	140
Dicranota sp.				2	170	183	127	54
Hexatoma spp.							4	39
Psychodidae								
Maruina sp.								17
Pericoma/Telmatoscopus sp.								34
Ceratopogonidae								
cf *Palpomyia* spp.								86
Simuliidae								
Simulium cf *argus/vittatum*	1574	1414	3003	2230	467	5266		
Simulium aureum cplx	222	56	723	56	394	1804		
Simulium canadense							553	69
Simulium piperi				54	1963	1053	1158	644
Simulium tuberosum cplx		4	383	54	3201	4036	8120	1122
Simulium cf *virgatum*		164	338					
Chironomidae								
Tanypodinae								
Macropelopiini								
Procladiini								
Pentaneurini								
Conchapelopia sp.		278		54		41		
Pentaneura sp.		54	4	164				
Rheopelopia sp.	2	54		465	34		207	
cf *Thienemannimyia* sp.	108							
Diamesinae								
Pagastia sp.							2	
Potthastia gaedii gr.	217							
Orthocladiinae								
Corynoneurini								
Corynoneura spp.			164	379			41	52
Thienemanniella spp.	379	54	108	650			82	103
Orthocladiini								
Brillia cf *retifinis*					103		168	461
Cardiocladius sp.	54	110			34		84	
Cricotopus bicinctus	1845	379		489				
Cricotopus tremulus gr. spp.	7433	1574	54	379	17	125		86
Cricotopus trifascia gr.	435	650	814	1085		166		
Eukiefferiella brehmi gr.	108		271	54	17		125	
Eukiefferiella claripennis gr.				54	69		82	
Eukiefferiella devonica gr.			108	650	121	166		
Heterotrissocladius marcidus gr.						41		
Limnophyes sp.					17			
Nanocladius parvulus gr.							41	
Parametriocnemus sp.		217	108	217	69		413	138
Rheocricotopus sp.	1031	596	543	543	52	82	41	
Synorthocladius sp.	108	108	164	164				86
Tvetenia bavarica gr.						41	82	

Chironominae								
Chironomini								
Dicrotendipes californicus	271			108				
Microtendipes pedellus gr.	222	108	164	921				
Microtendipes rydalensis gr.		54	108			41	1033	465
Phaenopsectra sp.	110						82	
Polypedilum cf *illinoense*								86
Polypedilum aviceps	2605	868	977	1735	86	84	1653	741
Pseudochironomini								
Pseudochironomus sp.				164				
Tanytarsini								
Micropsectra spp.	108	164	435	2334	293	288	1158	792
Paratanytarsus sp.	54							
Rheotanytarsus sp.	650	489	596	1031	52	454	2067	637
Stempellinella sp.							495	86
Tanytarsus tp. 1				271	34		745	
Dixidae								
Dixa spp.								17
Meringodixa sp.								17
Brachycera								
Stratiomyidae								
cf *Caloparyphus* sp.	222	2		108				17
cf *Euparyphus* sp.	54							2
Tabanidae								
Pelecorhynchidae								
Dolichopodidae				2				
Empididae								
Chelifera sp.		54			34	41	41	34
Clinocera sp.			4	4	34			
Hemerodromia sp.								34
Wiedemannia sp.		4	4					
Empididae tp. 2 P		2	174	4	19	6		
Cyclorrapha								
Syrphidae								
Ephydridae	2			11				
Sciomyzidae								
Muscidae								
cf *Limnophora* tp. 1		2	2	6				
cf *Limnophora* tp. 2				2				
Chelicerata								
Arachnoidea								
Eylaidae								
Hydryphantidae								
Protzia sp.								17
Spherchontidae								
Sperchon spp.	2387	760	489	217	52		1985	534
Lebertiidae								
Lebertia sp.			54	108			372	121
Torrenticolidae				54			1240	327
Limnesiidae								
Hygrobatidae								
Atractides sp.	164	217	489	596	34	82	1033	207

Mideopsidae								
Oribatei								
Mollusca								
Gastropoda								
Prosobranchia		54						
Limnophila								
Physidae								
Lymnaeidae								
Planorbidae								
Pelecypoda								
Corbiculidae								
Sphaeriidae								
Abundance	36941	30273	28897	35017	12589	27636	34903	11578
Taxa Richness	54	58	52	72	52	47	75	81

Table 8. Estimated abundance of benthic macroinvertebrates m^{-2} in riffles from Calero Creek, May 1997.

	CAC00	CAC02	CAC04	CAC06
Coelenterata				
Hydra spp.			164	121
Platyhelminthes				
Dugesia spp.	13	166		211
Nemertea				
Prostoma sp.	26	24	17	30
Nematoda			37	151
Mermithidae	39		17	181
Nematomorpha				
Ectoprocta				
Annelida				
Polychaeta				
Aphanoneura				
Aeolosoma spp.	65	24	37	
Oligochaeta				
Haplotaxida				
Haplotaxidae				
Tubificida				
Enchytraeidae				
Cernosvitoviella sp.	26			
Naididae				
Nais communis	26		254	90
Nais pardalis	375	448	127	
Nais simplex		24		
Nais variabilis	52		362	60
Ophidonais serpentina	26	164	2133	1537
Paranais frici	26			
Pristina aequiseta	13		37	
Pristina leidyi			108	
Pristinella jenkinae			54	
Pistinella osborni	13		73	
Slavina appendiculata		47	596	121
Stylaria lacustris		24	37	60
Tubificidae				
Aulodrilus pluriseta			17	
Bothrioneurum vejdovskyanum	116	47	235	2743
Quistadrilus multisetosus				392
Tubificidae tp. 1		24		1326
Tubificidae tp. 2	26			30
Lumbriculida				
Lumbriculidae				
Lumbriculus cf *variegatus*			71	30
Lumbricina				
Sparganophilidae				
Ocnerodrilidae				
Eukerria saltensis	118	6	2	
Lumbricidae				
Eiseniella tetraedra	2	4	41	6
Branchiobdellida				

Hirudinoidea				
Glossiphoniidae				
Helobdella stagnalis				64
Erpobdellidae				4
Arthropoda				
Mandibulata				
Crustacea				
Cladocera				
Chydoridae				90
Daphnidae				
Ostracoda	13	71	452	2213
Eucopepoda				
Cyclopoida		47	17	60
Calanoida				
Harpacticoida				
Mysidacea				
Isopoda				
Asellidae				
Sphaeromatidae				
Amphipoda				
Corophiidae				
Corophium cf *spinicornae*				60
Crangonyctidae				
cf *Stygobromus* sp.	2			
Talitridae				
Hyalella azteca		47	17	1935
Decopoda				
Astacidae				
Cambaridae				
Grapsidae				
Insecta				
Ephemeroptera				
Ameletidae				
Siphlonuridae				
Baetidae				
Baetis tricaudatus	129	97		185
Heptageniidae				
Ephemerellidae				
Serratella micheneri	196	192	22	
Tricorythidae				
Tricorythodes cf *minutus*	146	97	200	217
Caenidae				
Caenis sp.				123
Leptophlebiidae				
Paraleptophlebia cf *debilis*	13		245	
Odonata				
Anisoptera				
Aeshnidae				
Cordulegastridae				
Gomphidae				
Libellulidae				
Zygoptera				

Calopterygidae				
Lestidae				
Coenagrionidae				2
Argia sp.	177	11	9	2
Plecoptera				
Pteronarcyidae				
Peltoperlidae				
Nemouridae				
Malenka spp.	13			
Leuctridae				
Capniidae				
Perlidae				
Perlodidae				
Chloroperlidae				
Hemiptera				
Belostomatidae				
Corixidae				
Sigara sp.			9	170
Megaloptera				
Sialidae				
Sialis sp.	54		149	
Corydalidae				
Trichoptera				
Hydropsychoidea				
Philopotamidae				
Wormaldia gabriella	4	60		
Psychomyiidae				
Polycentropodidae				
Polycentropus sp.		24		
Hydropsychidae				
Hydropsychidae spp. e.i.	1305	2633	37	60
Cheumatopsyche mickeli	646	377	2	
Hydropsyche californica	665	2738	17	60
Rhyacophilidae				
Glossosomatidae				
Agapetus spp.		2		
Hydroptilidae				
Hydroptila spp.		47		123
Metrichia sp.	39	24		
Limnephiloidea				
Brachycentridae				
Micrasema sp.	13	71		
Lepidostomatidae				
Lepidostoma tp. 2			297	
Lepidostoma spp.	39	24		60
Limnephilidae				
Uenoidae				
Sericostomatidae				
Odontoceridae				
Leptoceridae				
Lepidoptera				
Pyralidae				

Petrophila sp.	39	2		
Coleoptera				
Adephaga				
Gyrinidae				
Gyrinus sp.				121
Haliplidae				
Dytiscidae				
Agabus sp.			2	67
Nebrioporus/Stictotarsus spp.				
Polyphaga				
Hydrophilidae				
Hydrophilidae L	2			
Hydraenidae				
Psephenidae				
Dryopidae				
Scirtidae				
Elmidae				
Optioservus cf *seriatus*	30			37
Optioservus spp.	105	166	146	
Diptera				
Nematocera				
Blephariceridae				
Tipulidae				
Antocha sp.	43	127		
Dicranota sp.	22	78		
Limonia sp. 1	4	4		
Tipula spp.	24	2		
Psychodidae				
Ceratopogonidae				
cf *Palpomyia* spp.			37	
Simuliidae				
Simulium cf *argus/vittatum*				151
Simulium aureum cplx	13	2		211
Simulium piperi	13	24		
Simulium tuberosum cplx	13			
Chironomidae				
Tanypodinae				
Macropelopiini				
Alotanypus sp.	13			
cf *Brundiniella* sp.			39	
Procladiini				
Pentaneurini				
Ablabesmyia sp.				90
Conchapelopia sp.			2	
Pentaneura sp.		71		
Diamesinae				
Orthocladiinae				
Corynoneurini				
Corynoneura spp.			144	
Thienemanniella spp.				121
Orthocladiini				
Brillia cf *retifinis*		166	54	

Cricotopus bicinctus				121
Cricotopus sylvestris gr.				30
Cricotopus tremulus gr. spp.			90	301
Cricotopus sp. 1		47		
Eukiefferiella brehmi gr.	13			
Eukiefferiella claripennis gr.				30
Heleniella sp.		47		
Parametriocnemus sp.	286	822	325	90
Rheocricotopus sp.	131	258	144	90
Synorthocladius sp.	13	47	37	
Chironominae				
Chironomini				
cf *Chironomus* sp.				241
Cryptochironomus sp.			17	60
Dicrotendipes modestus				181
Microtendipes pedellus gr.	26			
Microtendipes rydalensis gr.	245	24		
Paratendipes sp.		47	37	60
Phaenopsectra sp.	26	24	254	151
Polypedilum aviceps	26			
Pseudochironomini				
Tanytarsini				
Micropsectra spp.	336	846	1102	452
Paratanytarsus sp.			37	151
Rheotanytarsus sp.	26	47	108	482
Stempellinella sp.	52	47	288	
Tanytarsus tp. 1			108	
Tanytarsus tp. 2	26		37	1266
Dixidae				
Dixa spp.	13	26	17	
Brachycera				
Stratiomyidae				
Tabanidae				
Pelecorhynchidae				
Dolichopodidae			2	
Empididae				
Chelifera sp.	2	24		
Clinocera sp.			19	2
Hemerodromia sp.	26			
Wiedemannia sp.	13			
Empididae tp. 2 P	15		2	
Cyclorrapha				
Syrphidae				
Ephydridae				
Sciomyzidae				
Muscidae				
Chelicerata				
Arachnoidea				
Eylaidae				
Hydryphantidae				
Spherchontidae				
Sperchon spp.	478	1671	108	30

Lebertiidae				
Lebertia sp.			54	
Torrenticolidae				
Limnesiidae				
Hygrobatidae				
Atractides sp.	129	164		
Hygrobates sp.			54	
Mideopsidae				
Oribatei			90	
Mollusca				
Gastropoda				
Prosobranchia	13			
Limnophila				
Physidae				
cf *Physella*				90
Lymnaeidae				
Planorbidae	65		108	60
Pelecypoda				
Corbiculidae				
Corbicula fluminea			271	62
Sphaeriidae				
Abundance	6697	12347	9625	17265
Taxa Richness	65	54	63	60

Table 9. Estimated abundance of benthic macroinvertebrates m^{-2} in riffles from Coyote Creek, May 1997.

	COC12	COC16	COC32	COC35	COC37	COC50	COC53	COC54	COC62	COC83	COC89
Coelenterata											
Hydra spp.		11									
Platyhelminthes											
Dugesia spp.		67	523	1386	65			125		30	
Nemertea											
Prostoma sp.	26		39	108							
Nematoda		56	19	181	30			62			
Mermithidae		131			30			71			
Nematomorpha											
Ectoprocta											
Plumatella sp.								62			
Annelida											
Polychaeta											
Nereis limnicola	144										
Aphanoneura											
Aeolosoma spp.	26	22									
Oligochaeta											
Haplotaxida											
Haplotaxidae											
Tubificida											
Enchytraeidae											
cf *Enchytraeus* spp.	297	327									
Naididae											
Chaetogaster diaphanus	26										
Dero digitata	50	56									
Dero furcata		22									
Dero nivea						30					
Nais communis	297	1048	80	73	90	121	5425	3782	921		
Nais elinguis	1834	101									
Nais pardalis	4215	45									
Nais simplex	99						435	185			
Nais variabilis	2034	80			151	211	6004		2224		
Ophidonais serpentina		67	278	73	271	241		620	54		
Paranais frici	50										
Pristina aequiseta	26	700				30					22
Pristina leidyi	372	56	19		30						
Pistinella osborni		125	19								
Slavina appendiculata			60	73		60		558	325		
Tubificidae											
Bothrioneurum vejdovskyanum	99	101	39	144	151						
Limnodrilus hoffmeisteri	54										
Limnodrilus udekemianus	844	22									
Potamothrix bavaricus	50										
Tubificidae tp. 1	646										
Tubificidae tp. 2	3856	258		325							
Lumbriculida											
Lumbriculidae											
Lumbriculus cf *variegatus*						60					
Lumbricina							4				
Sparganophilidae											
Sparganophilus nr *eiseni*	13		17	129	28						
Ocnerodrilidae											
Eukerria saltensis	2	13	11	4	6	4	2		2		
Lumbricidae											
Allolobophora chlorotica				4							
Eiseniella tetraedra	50	13	62	2							

cf *Dendrodrilus rubidus*	2										
Branchiobdellida		11									
Hirudinoidea											
Glossiphoniidae											
Erpobdellidae		2		39							
Arthropoda											
Mandibulata											
Crustacea											
Cladocera											
Chydoridae											
Daphnidae											
Ostracoda				325	60	30	73				
Eucopepoda											
Cyclopoida	125	11								30	
Calanoida											
Harpacticoida											
Mysidacea											
Isopoda											
Asellidae											
Sphaeromatidae											
Amphipoda											
Corophiidae											
Corophium cf *spinicornae*					30	4			2		
Crangonyctidae											
Crangonyx sp.		11			60						
Talitridae											
Hyalella azteca			19	459					2		
Decopoda											
Astacidae											
Pacifastacus leniusculus									2		
Cambaridae											
Grapsidae											
Insecta											
Ephemeroptera											
Ameletidae											
Siphlonuridae											
Siphlonurus sp.										6	
Baetidae											
Acentrella turbida							1167		108		
Baetis tricaudatus	461	467	2913	329	9240	4512	4226	15866	13162	370	1862
Diphetor hageni										60	62
Fallceon quilleri	2	2	1602	9653	1311	1100	2616	4295	54		
Heptageniidae											
Nixe sp.		2								2941	676
Ephemerellidae											
Drunella cf *flavilinia*											45
Ephemerella maculata		2								840	144
Serratella micheneri								383	489		
Serratella teresa											45
Tricorythidae											
Tricorythodes cf *minutus*			118	1307	880	364	217	248			
Caenidae											
Caenis sp.			80			2					
Leptophlebiidae											
Paraleptophlebia cf *debilis*										155	995
Odonata											
Anisoptera											
Aeshnidae											
Cordulegastridae											

Gomphidae											
Libellulidae											
Zygoptera											
Calopterygidae											
Lestidae											
Coenagrionidae					30						
Argia sp.			207								
Plecoptera											
Pteronarcyidae											
Peltoperlidae											
Nemouridae											
Malenka spp.							2				
Leuctridae											
Capniidae											
Perlidae											
Perlodidae											
Isoperla sp. 1										99	211
cf *Kogotus* sp.											6
Chloroperlidae											
Suwallia cf *pallidula*										6	157
Hemiptera											
Belostomatidae											
Corixidae											
Sigara sp.			19					2			
Megaloptera											
Sialidae											
Sialis sp.		13		2		30			56		
Corydalidae											
cf *Neohermes* sp.										32	6
Trichoptera											
Hydropsychoidea											
Philopotamidae											
Wormaldia gabriella										6	164
Psychomyiidae											
Polycentropodidae											
Hydropsychidae											
Hydropsychidae spp. e.i.			19	362	1326	2139	867	3163	1410	452	476
Cheumatopsyche mickeli		2	125	37	2	4		6		517	125
Hydropsyche californica		24	1137	407	1535	1107	338	3877	2011	127	4
Hydropsyche oslari											297
Rhyacophilidae											
Rhyacophila cf *arcella*											2
Glossosomatidae											
Agapetus marlo P										45	6
Agapetus spp.											2
Glossosoma pterna										90	22
Hydroptilidae											
Hydroptila spp.	26	82	41	144	60	301			108	90	
Ithytrichia cf *clavata*										151	517
Metrichia sp.											22
Limnephiloidea											
Brachycentridae											
Lepidostomatidae											
Limnephilidae											
Uenoidae											
Sericostomatidae											
Gumaga sp.										271	185
Odontoceridae											
Leptoceridae											

Lepidoptera											
Pyralidae											
Coleoptera											
Adephaga											
Gyrinidae											
Haliplidae											
Dytiscidae											
Nebrioporus/Stictotarsus spp.										30	
Polyphaga											
Hydrophilidae											
Hydrophilidae L			2								
Hydraenidae											
Psephenidae											
Eubrianax sp.							2				
Dryopidae											
Postelichus sp.										39	
Scirtidae											
Elmidae											
Optioservus cf *seriatus*			19	73		32		62	56		
Optioservus spp.	2	11	19				144		108		
Ordobrevia nubifera										30	65
Zaitzevia cf *parvula*	26	11								97	
Diptera											
Nematocera											
Blephariceridae											
Tipulidae											
Antocha sp.										4	
Dicranota sp.			41		2	67	2		54		
Hexatoma spp.										220	30
Tipula spp.			2								
Psychodidae											
Pericoma/Telmatoscopus sp.		2									
Ceratopogonidae											
cf *Culicoides* sp.	26										
cf *Palpomyia* spp.										60	41
Simuliidae											
Simulium cf *argus/vittatum*	26	115	60		4770	773	6710	4582	2794	915	476
Simulium aureum cplx		93	19		60	2	454	185	515		
Simulium piperi		2									
Simulium tuberosum cplx						2			6		
Simulium cf *virgatum*					2			4	54		
Chironomidae											
Tanypodinae											
Macropelopiini											
Procladiini											
Procladius (Holotanypus) sp.									2		
Pentaneurini											
Ablabesmyia sp.		11				60	2		54		
Conchapelopia sp.							2			181	43
Nilotanypus sp.										60	
Pentaneura sp.	28	34	977	362	153	60	506	878		121	
Rheopelopia sp.										60	22
cf *Thienemannimyia* sp.		6						6			
Diamesinae											
Potthastia gaedii gr.										4469	43
Orthocladiinae											
Corynoneurini											
Corynoneura spp.					60			125	164		82
Thienemanniella spp.										151	103

Orthocladiini											
Brillia cf *retifinis*		4							114		
Cardiocladius sp.							151	62			
Cricotopus bicinctus	50	34	39	37	121	153			54	90	41
Cricotopus tremulus gr. spp.	174	124	179	110		151	217			93	373
Cricotopus trifascia gr.	52	73		506	1869	555	73		493	753	207
Eukiefferiella brehmi gr.							144			271	3348
Eukiefferiella claripennis gr.	127				60		579	62	54		103
Eukiefferiella devonica gr.					30	30			650		
Euryhapsis sp.		34									
Orthocladius (*Euorthocladius*) tp. 2											103
Parametriocnemus sp.		45	198			515	144	62	271	60	248
Rheocricotopus sp.	273	646	818	37	904	2865	868	930	489		41
Chironominae											
Chironomini											
cf *Chironomus* sp.		45									
Cryptochironomus sp.	26	58		108				2			
Dicrotendipes californicus	133	11									
Microtendipes pedellus gr.					30					1180	
Microtendipes rydalensis gr.			19					2			
Phaenopsectra sp.		22				121		2			
Polypedilum cf *illinoense*	52						288				
Polypedilum aviceps	125	202	19				506	62		723	1356
Pseudochironomini											
Tanytarsini											
Micropsectra spp.	50		99			181	1085	930	2553	90	
Rheotanytarsus sp.			99	435	1326	753	2893	930		392	
Tanytarsus tp. 1										5425	288
Tanytarsus tp. 2	26					90					
Dixidae											
Brachycera											
Stratiomyidae											
cf *Caloparyphus* sp.			19							211	2
cf *Euparyphus* sp.											24
Odontomyia sp.										2	103
Tabanidae											
Pelecorhynchidae											
Dolichopodidae			19	2							4
Empididae											
Chelifera sp.			19								
Clinocera sp.							73		9		
Hemerodromia sp.		11	80		273					2	41
Empididae tp. 1 P		34							54	90	
Empididae tp. 2 P								202	22		
Cyclorrapha							73			30	22
Syrphidae											
Ephydridae											
Sciomyzidae											
Muscidae											
cf *Limnophora* tp. 1			19			30	37				
Chelicerata											
Arachnoidea											
Eylaidae											
Hydryphantidae											
Protzia sp.										60	
Wandesia sp.											22
Spherchontidae											
Sperchon spp.	125	687	857	1735	1417	422	362	248			22
Lebertiidae											

Lebertia sp.									54		
Torrenticolidae										1447	
Limnesiidae											
Hygrobatidae											
Atractides sp.			19	73		60	73			121	41
Mideopsidae											
Oribatei											
Mollusca											
Gastropoda											
Prosobranchia											
Limnophila											
Physidae											
cf *Physella*			19								
Lymnaeidae											
Planorbidae		22									
Pelecypoda											
Corbiculidae											
Corbicula fluminea				133							
Sphaeriidae											
Abundance	17047	6287	11106	19177	26463	17272	36764	42641	29554	23795	13347
Taxon Richness	45	58	47	35	36	39	37	35	38	52	52

Table 10. Estimated abundance of benthic macroinvertebrates m^{-2} in riffles from Upper Penetencia Creek, May 1997.

	PEC00	PEC02	PEC04	PEC06	PEC08	PEC10	PEC12
Coelenterata							
Hydra spp.		43					
Platyhelminthes							
Dugesia spp.		1091	133	41	164	133	
Nemertea							
Prostoma sp.		260	269		54		
Nematoda	4	43			54		
Mermithidae	4		45	288			
Nematomorpha							
cf *Gordius* spp.							4
Ectoprocta							
Fredericella sultana		43	45				
Annelida							
Polychaeta							
Aphanoneura							
Aeolosoma spp.	4	390					
Oligochaeta							
Haplotaxida							
Haplotaxidae							
Tubificida							
Enchytraeidae							
cf *Enchytraeus* spp.				41			
Naididae							
Nais communis	22	260	224		54	398	
Nais elinguis		129					
Nais pardalis	4						
Nais simplex		217					
Nais variabilis	237	4469	45	82	108	67	
Ophidonais serpentina	32	868					
Pristina aequiseta	164	43					
Pristina leidyi	11						
Pristinella jenkinae	4						
Pistinella osborni	4	43	133				
Slavina appendiculata			493				
Tubificidae							
Aulodrilus pluriseta	11		45				
Bothrioneurum vejdovskyanum	65						
Rhyacodrilus coccineus/montana							129
Tubifex tubifex	2						
Tubificidae tp. 1	22					67	43
Lumbriculida							
Lumbriculidae							
Lumbricina							
Sparganophilidae							
Ocnerodrilidae							
Eukerria saltensis		24	123				
Lumbricidae							
Allolobophora chlorotica			2				
Branchiobdellida							

Hirudinoidea							
Glossiphoniidae							
Erpobdellidae							
Arthropoda							
Mandibulata							
Crustacea							
Cladocera							
Chydoridae							
Daphnidae							
Ostracoda	4	217	45	166		67	
Eucopepoda							
Cyclopoida							
Calanoida							
Harpacticoida							
Mysidacea							
Isopoda							
Isopoda sp. 1							43
Asellidae							
Caecidotea sp. 1						67	
Sphaeromatidae							
Amphipoda							
Corophiidae							
Crangonyctidae							
Talitridae							
Decopoda							
Astacidae							
Cambaridae							
Grapsidae							
Insecta							
Ephemeroptera							
Ameletidae							
Siphlonuridae							
Baetidae							
Baetis tricaudatus	235	2635	4349	3190	5111	8450	695
Baetis sp. 1						801	355
Diphetor hageni		86	357	2200	1793	1664	390
Fallceon quilleri	11	177					
Heptageniidae							
Ironodes spp.							4
Nixe sp.	17	47	54	41	60	136	86
Ephemerellidae							
Drunella cf *flavilinia*				4	67	22	65
Ephemerella maculata	15	4	13	13	54		
Serratella micheneri				4			
Serratella teresa							2
Tricorythidae							
Tricorythodes cf *minutus*	15	1617	4	43	164		
Caenidae							
Leptophlebiidae							
Paraleptophlebia cf *debilis*	15						
Paraleptophlebia cf *memorialis*							2
Odonata							

Anisoptera							
Aeshnidae							
Cordulegastridae							
Gomphidae							
Libellulidae							
Zygoptera							
Calopterygidae							
Lestidae							
Coenagrionidae							
Argia sp.			45	2			
Plecoptera							
Pteronarcyidae							
Peltoperlidae							
Nemouridae							
Malenka spp.	4	226	90	422		3333	1389
Leuctridae							
Capniidae							43
Perlidae							
Calineuria californica	11	45	22	4	11	323	205
Perlodidae							
Chloroperlidae							
Suwallia cf *pallidula*							43
Hemiptera							
Belostomatidae							
Abedus sp.				41			
Corixidae							
Megaloptera							
Sialidae							
Sialis sp.		4	2				
Corydalidae							
cf *Neohermes* sp.							2
Trichoptera							
Hydropsychoidea							
Philopotamidae							
Wormaldia gabriella						159	243
Psychomyiidae							
Polycentropodidae							
Polycentropus sp.						2	4
Hydropsychidae							
Hydropsychidae spp. e.i.	15	739	1610	2151	4450	4855	1085
Parapsyche almota						9	
Cheumatopsyche mickeli	4	1074	4590	876	596		
Hydropsyche californica	15	670	2837	598	547		
Hydropsyche oslari			45	108	807	1765	319
Rhyacophilidae							
Rhyacophila cf *arcella*		2		4	4	73	308
Glossosomatidae							
Agapetus celatus P						71	2
Agapetus spp.					2	6	9
Hydroptilidae							
Hydroptila spp.		260	45	45	110		
Metrichia sp.			45	2		271	

Limnephiloidea							
Brachycentridae							
Micrasema sp.							2
Lepidostomatidae							
Lepidostoma cf *cantha*							2
Lepidostoma spp.	4				54	133	2
Limnephilidae							
Psychoglypha cf *bella*							6
Uenoidae							
Neophylax cf *rickeri*						2	43
Sericostomatidae							
Gumaga sp.				41			
Odontoceridae							
Parthina sp.					325		392
Leptoceridae							
Oecetis sp.		86	45	41			
Lepidoptera							
Pyralidae							
Coleoptera							
Adephaga							
Gyrinidae							
Haliplidae							
Peltodytes sp.						67	
Dytiscidae							
Nebrioporus/Stictotarsus spp.				2	4		
Polyphaga							
Hydrophilidae							
Hydraenidae							
Psephenidae							
Eubrianax sp.	2			2	2	73	43
Dryopidae							
Scirtidae							
Elmidae							
Acneus sp.							2
Optioservus cf *seriatus*	52	263	2	47	54	67	43
Optioservus spp.	2	415	228	295	110	4	
Ordobrevia nubifera						334	
Zaitzevia cf *parvula*	4	177	95			200	521
Diptera							
Nematocera							
Blephariceridae							
Tipulidae							43
Antocha sp.					2	202	
Dicranota sp.		45		47	58	93	
Hexatoma spp.						26	97
Psychodidae							
Ceratopogonidae							
cf *Palpomyia* spp.						133	
Simuliidae							
Simulium cf *argus/vittatum*			179	4049	6823	4861	
Simulium aureum cplx	4	129		250	1636	133	
Simulium canadense					1044	2	

Simulium piperi	2			2	601	411	435
Simulium tuberosum cplx					121		
Simulium cf *virgatum*					133		
Chironomidae							
Tanypodinae							
Macropelopiini							
cf *Brundiniella* sp.				82			
Procladiini							
Pentaneurini							
Conchapelopia sp.		129	47	93			
Nilotanypus sp.				41	108	133	
Pentaneura sp.				125	271	67	43
Rheopelopia sp.			2	594	982	338	43
cf *Thienemannimyia* sp.		2					
Zavrelimyia sp.							43
Diamesinae							
Orthocladiinae							
Corynoneurini							
Corynoneura spp.	88	260	90	125	379		174
Thienemanniella spp.		86	45	166		67	
Orthocladiini							
Brillia cf *retifinis*	19			82	4		868
Cricotopus bicinctus				125	54	133	
Cricotopus tremulus gr. spp.	11			82	54		
Cricotopus trifascia gr.		217	45	248	54		
Cricotopus sp. 1				82			
Eukiefferiella brehmi gr.				41	164	200	
Eukiefferiella claripennis gr.							174
Eukiefferiella devonica gr.						67	
Krenosmittia sp.							43
Limnophyes sp.	11						174
Parametriocnemus sp.	82	129	90	125	435	267	564
Paraphaenocladius sp.							43
Rheocricotopus sp.	1111	3255	403	413	164		
Tvetenia bavarica gr.						133	43
Chironominae							
Chironomini							
Cryptochironomus sp.		86					
Dicrotendipes californicus	11						
Microtendipes pedellus gr.					54	67	
Microtendipes rydalensis gr.				82			
Phaenopsectra sp.	11			332			
Polypedilum cf *illinoense*				82			
Polypedilum aviceps	463	5690	4833	868	596	2127	7031
Pseudochironomini							
Pseudochironomus sp.		174		41	108	598	
Tanytarsini							
Micropsectra spp.	32	304	90	82	54	598	2344
Paratanytarsus sp.						67	
Rheotanytarsus sp.	4	129	45	288	435	200	999
Tanytarsus tp. 1				82			
Tanytarsus tp. 2				248			

Dixidae							
Dixa spp.							88
Brachycera							
Stratiomyidae							
cf *Caloparyphus* sp.				248	4	543	
cf *Euparyphus* sp.			4	6	56	73	
cf *Oxycera* sp.							9
Tabanidae							
Pelecorhynchidae							
Dolichopodidae		2				4	
Empididae							
Chelifera sp.					54		
Hemerodromia sp.	4	2	90		108		
Empididae tp. 1 P		129		41		67	
Cyclorrapha							
Syrphidae							
Ephydridae							
Sciomyzidae							
Muscidae							
cf *Limnophora* tp. 1		50		6	4	9	
Chelicerata							
Arachnoidea							
Eylaidae							
Hydryphantidae							
Spherchontidae							
Sperchon spp.	73	2908	2013	332	108	267	347
Lebertiidae							
Lebertia sp.	4	129					
Torrenticolidae		86	90	288	108	398	521
Limnesiidae							
Hygrobatidae							
Atractides sp.	15					200	
Mideopsidae							
Oribatei							
Mollusca							
Gastropoda							
Prosobranchia							
Limnophila							
Physidae							
cf *Physella*	11						
Lymnaeidae							
Planorbidae		260					
Pelecypoda							
Corbiculidae							
Sphaeriidae							
Abundance	2971	30868	24146	20592	29535	36103	20652
Taxa Richness	50	55	46	63	56	61	55