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Characterization of Benthic Communities and Physical Habitat in Agricultural Streams in California's San Joaquin Valley in 2004

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ABSTRACT

This study was designed to characterize physical habitat and benthic communities (macroinvertebrates) in three agricultural streams in California's San Joaquin Valley in 2004. These streams have been listed as impaired water bodies (303 (d) list) by the State of California due to the presence of organophosphate insecticides (OP) chlorpyrifos and diazinon. A secondary goal of this study was to qualitatively compare the presence of OP-sensitive benthic species in these streams with available OP toxicity and exposure data to determine if these benthic species are present. Habitat requirements and to a lesser degree sampling gear limitations were considered in this comparison.

Based on 10 instream and riparian physical habitat metrics, total physical habitat scores in Del Puerto Creek ranged from 90 to 136 (maximum possible total score is 200). Most habitat metrics were highly variable among Del Puerto Creek sites and there appears to be no spatial trends. Orestimba Creek physical habitat scores ranged from 74 to 119. The lowest habitat score was reported at one of the most upstream sites. Salt Slough physical habitat scores ranged from 31 to 93 and the upstream site had the lowest habitat score. Salt Slough appears to have the strongest gradient of physical habitat metrics as bend/riffle frequency, channel alteration and riparian buffer declined significantly from downstream to upstream.

Abundance measures of macroinvertebrates were similar among the three streams considering that 10 sites were sampled in Orestimba Creek while five sites were sampled in both Del Puerto Creek and Salt Slough. Tolerant taxa were generally most dominant in all three streams. The most common dominant taxa in all three streams was the gastropod *Physa sp.* as this taxa was either the second or third most dominant taxa by stream. The

most dominant taxa found in Salt Slough was the amphipod species, *Americorophium spinicorne*, which comprised 24% of the taxa collected. Amphipods are generally considered sensitive to OP insecticides as well as other stressors

Channel flow and bend/riffle frequency were the most important physical habitat metrics influencing the various benthic metrics for these three streams. For the non-traditional habitat metrics, canopy and percent fines had the highest number of significant relationships with the various benthic metrics.

A qualitative comparison of OP-sensitives species in the three agricultural streams based on single species toxicity data was limited due to the lack of data. Species most sensitive to chlorpyrifos (*Chironomus sp.* and *Gammarus lacustris*) were generally found in all three streams except *G. lacustris* was absent for Del Puerto Creek. Species most sensitive to diazinon were the amphipod *Hyalella sp.* and the mayfly *Baetis sp. Hyalella* was more abundant in both Del Puerto Creek and Salt Slough than Orestimba Creek. *Baetis sp.* was only collected at one upstream site in Del Puerto Creek.

The presence of 69 taxa in Del Puerto Creek, 97 taxa in Orestimba Creek and 74 taxa in Salt Slough implies that the benthic communities in these streams are fairly diverse, considering their ephemeral environments, but without a clear definition of benthic community expectations it is unknown if these water bodies are actually impaired. Potential reference sites should be identified in agricultural streams in California's Central Valley in order to identify the range of benthic community taxa expected in non or minimally stressed environments. Extensive spatial and temporal assessments of benthic communities in concert with physical habitat assessments will be needed to accomplish this task.

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INTRODUCTION

California's San Joaquin Valley is one of the most productive agricultural areas in the United States due to abundant water and long growing seasons (Dubrovsky et al., 1998). Intense agricultural development in the San Joaquin Valley has modified many of the natural lotic systems in this area (May and Brown, 2000). The changing landscape coupled with various other anthropogenic factors has created stressful conditions for resident aquatic biological communities. Foe (1995) has reported that the following factors may have contributed to the decline of aquatic resources in California's Central Valley: water diversion, changes in basin hydrology, loss of habitat, introduction of exotic species and contaminants (e.g., organophosphate insecticides). Activities such as diking, dredging, filling of wetlands and significant diversion of freshwater flows for irrigated agriculture and urban use have also altered fish habitat and resulted in adverse impacts on fish populations (Moyle et al, 1992).

In recent years, assessments of benthic invertebrate assemblages and physical habitat (bioassessments) have been initiated in wadeable streams in California's Central Valley (Hall and Killen, 2001; Hall and Killen, 2002; Hall and Killen, 2003; Hall and Killen, in press; Brown and May, 2000; Jim Harrington, personal communication). Bioassessments provide a useful approach for integrating effects from physical, chemical, and biological stressors on aquatic organisms. Bioassessments are based upon the premise that the structure and function of an aquatic biological community can provide critical information about the quality of the surface water. These efforts are valuable for determining the status of aquatic biological communities across large spatial scales and landuse types (agricultural and urban). Information on the status of resident biological communities is particularly useful for determining impaired water bodies, developing Total Maximum Daily Loads (TMDLs), and measuring success of voluntary or regulatory actions. Bioassessments serve monitoring needs through three primary functions: (1) screening or initial assessment of conditions; (2) characterization of impairment and diagnosis; and (3) trend monitoring to evaluate improvements from mitigation practices or further degradation.

The primary goal of this study was to characterize physical habitat and benthic communities in three representative agricultural streams in California's San Joaquin Valley in 2004. All of these streams have been listed as impaired water bodies (303 d list) due to the presence of OP insecticides diazinon and chlorpyrifos (www.swrcb.ca.gov). The benthic community data was interpreted in the context of recent ecological risk assessments for the OP insecticides chlorpyrifos and diazinon which have identified OP-sensitive benthic species.

METHODS

Site Selection

The three second to fourth order wadeable streams sampled during this study were Del Puerto Creek (Figures 1 and 2), Orestimba Creek (Figures 1 and 3) and Salt Slough (Figures 1 and 4). The sites sampled covered approximately 8, 12 and 14 miles in Del Puerto Creek, Orestimba Creek and Salt Slough, respectively. The predominate land use type in all of these water bodies is agriculture. The upstream sites in Del Puerto Creek (DLP5) and Orestimba Creek (ORE10) were above agricultural activity but all the other sites were in areas dominated by agriculture. Downstream Salt Slough sites SSL1, SSL2 and SSL3 were located within the San Luis Wildlife Refuge and the Los Banos State Wildlife area; upstream sites SSL4 and SSL5 were in agricultural areas.

Five sample sites in both Del Puerto Creek and Salt Slough and ten sites in Orestimba Creek were selected for sampling using a stratified random design with approximate equal spacing among sample sites (Table 1; Figures 2-4). The Del Puerto Creek and Salt Slough sites were previously sampled in similar bioassessment studies in the late spring/early summer of 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003), and 2003 (Hall and Killen, 2004) The ten sites in Orestimba Creek were also previously sampled in similar bioassessment studies conducted in the late spring/early summer of 2000 (Hall and Killen, 2001), 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003) and 2003 (Hall and Killen, 2004). Initial site visits were conducted for all streams in April of 2004. Exact sample stations were determined in each stream and landowner contacts were made to access the sample sites for the late spring/early summer sampling.

Physical Habitat Assessments

Physical habitat was evaluated at each site concurrently with benthic collections and water quality evaluations. The physical habitat evaluation methods followed protocols described in Harrington and Born (2000). The physical habitat metrics used for this study are based on nationally standardized protocols described in Barbour et al. (1999). A total of 10 continuous metrics scored on a 0-20 scale were evaluated (Appendix A). Other non-continuous metrics including percent canopy, percent gradient, and substrate composition that were also measured are described in Appendix A.

Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates were collected in the late spring of 2004 from three replicate samples at sample sites in the three streams. The sample site selections and sampling procedures were conducted in accordance with methods described in Harrington and Born (2000). Sampling reaches were approximately equally spaced along the stream starting at the confluence. Within each of these sample reaches, a riffle was located (if possible) for the collection of benthic macroinvertebrates. A tape measure was placed along the riffle and potential sampling transects were located at each meter interval of the tape. Using a random numbers table, three transects were randomly selected for sampling from among those available within the riffle. Benthic samples were taken using a standard D-net with 0.5 mm mesh starting with the most downstream portion of the riffle. A 1x2 foot section of the riffle immediately upstream of the net was disturbed to a depth of 4-6 inches to dislodge and collect the benthic macroinvertebrates. Large rocks and woody debris were scrubbed and leaves were examined to dislodge organisms clinging to these substrates. Within each of the randomly chosen transects, three replicate samples were collected to reflect the structure and complexity of the habitat within the transect. If habitat complexity was lacking, samples were taken near the side margins and thalweg of the transect and the procedures described above were followed. All samples were preserved with 95% ethanol.

Due to the physical nature of these agricultural streams, it was often difficult to locate a substantial number of riffles to sample. In various cases, there was only a single section of riffle available within a selected reach to sample and in some instances there were no riffles present. In cases where riffles were lacking, alternative sampling methods for non-riffle areas were used as outlined in Harrington and Born (2000). This involved sampling the best available 1x2 foot sections of habitat throughout the reach using the same procedures described above. Nine 1x2 foot sections were randomly selected for sampling. Groups of three 1x2 foot sections were composited for each replicate for a total of three replicates per site.

Taxonomy of Benthic Macroinvertebrates

The goal of this study was to identify all benthic samples to the species level if possible. Species level identifications will be particularly useful if and when Indices of Biotic Integrity (IBIs) are developed for wadeable streams in California's Central Valley. For taxa such as oligochaetes and chironomids, family and genus level, respectively, were often the lowest level of identification possible.

The benthic macroinvertebrate subsampling (resulting in a maximum of 300 individuals) and identifications were supervised by Angie Montalvo of California's Department of Fish and Game (CDFG) in Rancho Cordova, California. The benthic macroinvertebrate samples were subsampled and sorted by personnel at the CDFG Laboratory located at Chico State University campus. Level 3 identifications (species level identifications) followed protocols outlined in Harrington and Born (2000). Mr. Dan Pickard of CDFG conducted the taxonomic identifications. Slide preparations and mounting for species such as midges and oligochaetes followed protocols from the United States Geological Survey National Quality Control Laboratory described in Moulton et al. 2000.

Water Quality Measurements

The following water quality parameters were measured at each stream site using procedures described in Kazyak (1997): temperature, pH, salinity, specific conductivity, dissolved oxygen, and turbidity.

Statistical Analysis

Principal components analysis (PCA) was used to determine the relationship among the various physical habitat and benthic metrics to identify groups of metrics that covary. Spatial trends (upstream to downstream) of both physical habitat and benthic metrics within each stream were examined using Spearmans Rank Correlation Coefficients and significance levels. The relationship among physical habitat and benthic metrics was also determined by using Spearmans Rank Correlation Analysis. The Wilcoxon Rank-Sum Test and Kruskal-Wallis test were used to compare habitat and benthic metrics among the three streams. The Wilcoxon signed rank test and the Friedman test were used to compare among years within a stream.

RESULTS

Physical Habitat

Del Puerto Creek

The total physical habitat scores in Del Puerto Creek ranged from 90 to 136 for the ten metrics that were scored on a 0 to 20 scale (Table 2). Most of the metrics were highly variable across the five stations within Del Puerto Creek indicating diverse physical habitat conditions in this waterbody. For example, embeddedness ranged from 5 to 13, channel flow status ranged from 8 to 15, and frequency of bend/riffles ranged from 7 to 13. The site with the lowest total physical habitat score (DLP5) had particularly low scores for embedddedness, velocity/depth/diversity and bank vegetation.

Other descriptive physical habitat metrics that were not scored on a 0-20 scale are presented in Table 3. These metrics are not scored on a 0-20 scale because some are bimodal (too much or too little canopy can be advantageous) and others are just descriptive. Mean flow by site ranged from 0.05 m/s upstream to 0.75 m/s downstream. The mean value across all five sites was 0.30 m/s. The percent canopy for the five Del Puerto Creek sites ranged from 0% at DLP4 and DLP5 to 54% at downstream site DLP1. Gradient was consistent at all sties (1%). The percent fines for substrate percentages ranged from 40% DLP5 and DLP1 to 90% at DLP4.

Orestimba Creek

Orestimba Creek total physical habitat scores for the 10 metrics that were scored on a 0 to 20 scale ranged from 74 to 119 (Table 2). The lowest total habitat score (74) was reported for upstream site ORE10 (Figure 3). This site had particularly low scores for epifaunal substrate, velocity/depth/diversity, and various riparian zone metrics. The highest total habitat score (119) was reported at three sites (ORE5, ORE6, and ORE7). The following metrics were reasonably high at this site: sediment deposition, channel flow status and channel alteration. Other descriptive habitat metrics for the 10 Orestimba Creek sties in Table 3 showed that mean site flow ranged from 0.01 to 0.48 m/s (mean stream value of 0.32 m/s), % canopy ranged from 0 to 65%, % gradient was consistently 1%, and % fines ranged from 20% to 90%.

Salt Slough

The total physical habitat scores in Salt Slough ranged from 31 to 93 for the 10 metrics that were scored on a 0 to 20 scale (Table 2). The lowest total physical habitat score (31) was reported at the most upstream site (SSL5). This site had particularly low scores for embeddedness, velocity/depth/diversity, sediment deposition, channel alteration, frequency of bends/riffles, bank stability, vegetative protection, and riparian vegetation. The highest total physical habitat score (93) was reported at the downstream sites SSL1 and SSL2. Channel flow status, and channel alteration were optimal (a high rating) at this site. The embeddedness metric, which is a rough measure of sediment loading, was particularly low at all sites in this stream when compared with either Del Puerto Creek or Orestimba Creek.

Other descriptive physical habitat metrics for the five Salt Slough sites in Table 3 showed that mean site flow ranged from 0 to 0.32 m/s (mean stream value was 0.19 m/s), 0% canopy at all sties, % gradient was consistently 1% and % fines were 100% at all sites. The low flow conditions, lack of canopy, and dominance of substrate by % fines clearly shows different physical features for this stream when compared with either Del Puerto Creek or Orestimba Creek.

Summary Statistical Analysis for All Creeks

Principal Components Analysis (PCA) was used to determine the relationship among habitat metrics and identify metrics that covary (i.e., increase or decrease together). The 10 habitat metrics that were scored on a 0 to 20 scale had three eigenvalues that were greater than 1 (Table 4). The significance of this finding is that 10 habitat metrics contain three important factors which explained 76% of the variance in the data set. The metrics important to each factor are presented in Table 5. Bend/riffle frequency, bank stability, and bank vegetation were heavily loaded on factor 1. These metrics include both instream as well as riparian metrics. Factor 2 is comprised of sediment deposition, riparian buffer, embeddedness, channel alteration, and velocity depth. Channel flow and epifaunal substrate comprise factor 3.

Correlations among raw physical habitat metrics grouped by factors identified by PCA showed only showed a significant correlation between bank vegetation and bank stability for factor 1 (Table 6). In factor 2, significant correlations were found between channel alteration and riparian buffer and channel alteration and velocity/depth. There was no significant correlation between channel flow and epifaunal substrate for factor 3.

The correlation matrix in Table 7 showed significant correlations among stream characteristics that were not scored on a 0 to 20 scale (i.e., width, depth) and some metrics that were scored on a 0 to 20 scale. The largest number of significant correlations occurred for depth, mean flow, fines, and gravel. Depth was negatively correlated with bend riffle frequency, sediment deposition, embeddedness and total score. Depth was positively correlated with channel flow. Mean flow was positively correlated bank vegetation, epifaunal substrate, riparian buffer, velocity depth, and total score. Fines were negatively correlated with bend riffle frequency, epifaunal substrate, sediment deposition, embeddedness and total score. Gravel was positively correlated with bend riffle frequency, epifaunal substrate, sediment deposition, embeddedness, and total score.

The Spearman rank test for trends was conducted for each physical habitat metric in each stream to examine trends that might be associated with changing morphology of the stream between upstream and downstream (Table 8). Salt Slough appears to have the strongest gradient from upstream to downstream in physical habitat metrics. Bend riffle frequency, channel alteration, and riparian buffer showed a negative correlation with site indicating a decrease in values moving upstream. In Orestimba Creek, there was a significant negative correlation for bank vegetation and velocity depth, i.e. decreasing values moving upstream. Channel flow was found to decrease moving upstream in Del Puerto Creek.

The following mean habitat metrics were significantly greater in both Del Puerto Creek and Orestimba Creek when compared with Salt Slough: bend/riffle frequency, sediment deposition, and embeddedness (Table 9). Pairwise regression also showed that mean channel flow status was significantly lower in both Del Puerto Creek and Orestimba Creek when compared with Salt Slough. The total physical habitat scores were not significantly different among the three streams using a p-value of < 0.05. However, if a slightly higher p-value of < 0.08 was used, the mean total habitat score at Salt Slough was lower when compared with the other two streams.

<u>Benthic Macroinvertebrates</u>

<u>Del Puerto Creek</u>

Approximately 4,000 individual macroinvertebrates were picked and identified from 69 taxa collected from five Del Puerto Creek sites (Table 10; Appendix B). The four most abundant taxa - *Simulium sp., Cyprididae, Physa sp.*, and *Tubificidae* comprised ~ 67% of the total individuals collected (Table 10). These four taxa are generally considered tolerant to moderately tolerant (i.e., *Simulium sp.*) of environmental stressors (Harrington and Born, 2000; Stribling et al., 1998). Pollution sensitive species such as Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies), i.e. EPT taxa, were generally found in very low numbers at most of the sites.

Total taxa richness ranged from 21 at upstream site (DLP5) to 39 at downstream site (DLP2) (Table 11). The most upstream site (DLP5) was above the agricultural activity in this stream. Taxa richness was reasonably consistent among the three transects at each site (Figure 5). The number of individuals collected at each site (total abundance) was higher at the upstream site (DLP5) by a factor of three when compared with the second highest site for abundance (DLP3) (Table 11). With the exception of DLP5, macroinvertebrate abundance values were fairly consistent among the three transects at each site (Figure 6).

Most of the other benthic metrics summarized in Table 11 were consistent among sites with only a few exceptions. The % dominant taxa were higher at upstream site DLP5 above agricultural activity. The % chironomidae were generally higher at the DLP3 when compared with the other four sites. Percent collectors/gatherers – a feeding guild typically dominant in a stressed environment (Harrington and Born, 2000) - were higher at upstream site DLP5 when compared with the other four downstream sites.

<u>Orestimba Creek</u>

Approximately 7,200 individual macroinvertebrates were picked and identified from 97 taxa collected from 10 sites in Orestimba Creek (Table 12; Appendix C). The following taxa comprised ~ 53% of the total number of individuals collected: *Eudistylia vancouveri*, *Dicrotendipes sp.*, *Physa sp.*, *Hydropsyche californica*, *Cricotopus bicinctus* group, *Cricotopus sp.*, and *Dugesia tigrina*. Most of these dominant taxa are generally considered tolerant of environmental stressors. The possible exception is the caddisfly (*H. californica*) which is generally considered sensitive to environmental stressors (Harrington and Born, 2000; Stribling et al., 1998).

Total taxa richness ranged from 23 at ORE9 to 45 at ORE6 (Table 13). Taxa richness was fairly consistent among the three transects at each site (Figure 7). The total number of individuals per site (total abundance) was much higher at upstream site ORE9 when compared with the other sites (Table 13). Macroinvertebrate abundance was fairly consistent among the three transects at each site with the exception of sites ORE6, ORE7, ORE8, and ORE10 (Figure 8).

Various benthic metrics for the Orestimba Creek sites summarized in Table 13 showed the following: (1) percent dominant taxa were higher at upstream site ORE10: (2) EPT index percent (taxa associated with non-stressed environments) was higher at ORE3 and ORE4; (3) percent Chironomidae were higher at the most upstream (ORE10) and most downstream sites (ORE1); (4) percent hydropsychidae (caddisflies) were higher at ORE3 and ORE4; and (5) percent collectors/gatherers – a feeding guild associated with stressed environments - were lower at upstream site ORE9.

Salt Slough

Approximately 3,700 individual macroinvertebrates were picked and identified from 74 taxa in five Salt Slough sites (Table 14, Appendix D). *Americorophium spinicorne*, *Physa sp.*, *Cricotopus bicinctus* group, *Cricotopus sp.*, and *Corbicula sp.* comprised ~52% of the individuals collected. The most dominant species (A.. *spinicorne*) is an amphipod. Amphipods are generally considered sensitive to OP insecticides (Giesy et al., 1999; Giddings et al., 2000) as well as other stressors (Harrington and Born, 2000). The second most dominant species (*Physa sp.*) is a gastropod – an assemblage of species generally considered to be fairly tolerant of pollutant stress (Harrington and Born, 2000). Chironomids - the third and fourth most dominant taxa collected in this stream – can be either tolerant or sensitive to environmental degradation depending upon the species (Stribling et al., 1998). *Corbicula sp.* (clams) are generally considered tolerant of most environmental stressors (Harrington and Born, 2000).

Total taxa richness ranged from 25 at SSL1 to 43 at SSL3 (Table 15). Richness was variable among the transects by site with the exception of the two upstream sites (Figure 9). Total abundance by site was generally higher at both the upstream and downstream sites (Table 15). Macroinvertebrate abundance was generally variable among the transects at each site (Figure 10).

The other benthic metrics in Table 15 were generally consistent among the five Salt Slough sites with the exception of percent collectors/filterers which were less abundant at the two upstream sites and percent scrapers which were more abundant at the upstream sites. Filterers generally increase in stressed environments while scrapers tend to have a variable response in stressed environments (Harrington and Born, 2000).

Spearman's Rank Correlation Analysis showed that channel flow and bend/riffle frequency were the most important physical habitat metrics influencing the various benthic metrics (Table 20). Channel flow status was positively correlated with percent collectors/filterers and Shannon Diversity Index and negatively correlated with percent dominant taxon and percent intolerant taxa. Bend/riffle frequency was positively correlated with EPT taxa and percent collectors/gatherers and negatively correlated with percent tolerant taxa. The total habitat score was positively correlated with EPT index, EPA taxa, number of Trichoptera taxa, and percent hydropsychidae and negatively correlated with percent tolerant taxa and tolerance value.

The correlation matrix in Table 21 for habitat metrics not scored on a 0-20 scale shows that canopy and % fines have the highest number of significant relationships with the various benthic metrics. Canopy was positively correlated with cumulative taxa, Shannon Diversity, and taxonomic richness and negatively correlated with percent dominant taxon. The percent fines was negatively correlated with EPT taxa and percent collectors/gatherers and positively correlated with percent tolerant taxa.

Water Quality

Del Puerto Creek

The only consistent water quality condition at all five sample sites in Del Puerto Creek in 2004 was pH (Table 1). Parameters such as temperature (20.6 to 25.6 C), conductivity (649 to 1,738 umhos/L), dissolved oxygen (7.43 to 10.06 mg/L) and turbidity (1.13 to 135 NTU) were variable across the various study sites. Spatial patterns showed that dissolved oxygen was higher at the two upstream sites. Both turbidity and temperature were lower at the most upstream sites (DLP5).

Summary Statistical Analysis for All Creeks

PCA was used to determine the relationship among the benthic metrics and identify metrics that covary (Table 16). Six eigenvalues exceeded 1 indicating that there were six important factors in these data. Number of Trichoptera taxa, EPT index (%), and percent Hydropsychidae were heavily loaded on factor 1 (Table 17). Factor 2 was composed of percent Chironomidae, percent collectors gatherers, and percent intolerant taxa. Percent tolerant taxa, Shannon Diversity, and percent dominant taxon were dominant metrics in Factor 3. Factor 4 was composed of percent predators, EPT taxa, and percent Baetidae. Percent scrapers and percent collectors/filterers were dominant in Factor 5. Factor 6 was composed of tolerance values, cumulative taxa, and taxonomic richness.

Spearmans Rank Correlation Analysis showed a significant ($p<0.05$) spatial trend for percent collectors/filterers and tolerance values in Del Puerto Creek, Shannon Diversity in Orestimba Creek and ETP Index and percent hydropsychidae in Salt Slough (Table 18). The percent collectors/filterers decreased from downstream to upstream in Del Puerto Creek while tolerance values increased from downstream to upstream. The Shannon Diversity index decreased from downstream to upstream in Orestimba Creek. In Salt Slough, the EPT index and percent hydropsychidae decreased from downstream to upstream.

A comparison among benthic metrics in Del Puerto Creek, Orestimba Creek and Salt Slough in Table 19 showed that the number of Trichoptera taxa were higher in Orestimba Creek when compared with Del Puerto Creek.

Relationship of Physical Habitat and Benthos

A comparison of water quality measurements in Table 22 for the five Del Puerto Creek sites sampled in 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003), 2003 (Hall and Killen, 2004) and 2004 showed the following: (1) temperature was greater at DLP4 in 2002 and 2003; (2) conductivity was higher at DLP5 in 2002 and 2004; (3) pH was fairly consistent at all sites among the four years; (4) dissolved oxygen was consistently lower at all five sites in 2001 and (5) turbidity was consistently lower at the most upstream site (DLP5) for all years.

Orestimba Creek

The pH was fairly consistent among all 10 sites in Orestimba Creek in 2004 (Table 1). Temperature ranged from 17.0 to 26.9 C with the lowest values at ORE1, OER2, and ORE5. Conductivity ranged from 689 to 937 umhos/L. Dissolved oxygen varied from 6.46 to 8.18 mg/L at all sites. There were no dissolved oxygen values below 5.0 mg/L in Orestimba Creek in 2004 - a concentration likely to be stressful to aquatic life (Lee and Jones-Lee, 2000). Turbidity was much lower at the upstream site (ORE10) when compared with the nine downstream sites. The lower turbidity at this upstream site likely occurs because there is no suspended sediment coming from eroded soil in irrigated agricultural fields (sites ORE 1-9).

A comparison of water quality data in Table 22 for the 10 Orestimba Creek sites sampled in 2000 (Hall and Killen, 2001), 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003), 2003 (Hall and Killen, 2004) and 2004 showed the following: (1) temperature was lower at seven of the sites in 2004; (2) specific conductance was higher for six of the sites in 2004; (3) pH was fairly consistent among all sites for the five years;

(4) dissolved oxygen was lower at most of the sites in 2001 except ORE1 and (5) turbidity was higher at seven of the ten sites in 2004.

Salt Slough

The following ranges of water quality conditions were reported in Salt Slough in 2004: temperature (15.9 to 24.6 mg/L), conductivity (951 to 2,148 umhos/L), pH (7.39 to 7.73), dissolved oxygen (6.81 to 7.88 mg/L), and turbidity (13.1 to 58.4 NTU) (Table 1). Temperature, pH and dissolved oxygen were generally lower at the upstream site (SSL5).

A comparison of water quality data in Table 22 for the five Salt Slough sites sampled in 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003), 2003 (Hall and Killen, 2004) and 2004 showed the following: (1) temperature was higher for all five sites in 2003; (2) conductivity was higher at four sites in 2003; (3) pH was consistent among sites for all four years; (4) dissolved oxygen was lower at all sites in 2001 and (5) turbidity was lower at four sites in 2002.

DISCUSSION

Physical Habitat

Three major stressors to aquatic life in California streams are water augmentation, sediment loading and impaired physical habitat (Jim Harrington, California Department of Fish and Game, personal communication). Altered physical habitat structure is also considered one of the major stressors of aquatic systems throughout the United States resulting in extinctions, local expirations and population reductions of aquatic fauna (Karr et al., 1986; Rankin, 1995). Identifying degraded physical habitat in streams is particularly critical for bioassessments as failure to do so can sometimes hinder investigations on the effects of toxic chemicals or other water quality related stressors. Rankin (1995) has reported that there is a small but still significant risk of reporting a water quality related impact when one does not exist (false positive) when habitat assessments are insufficient or absent. Physical habitat evaluations are not intended to replace biological assessments but rather to add an additional line of evidence about the status of lotic systems when conducted in concert with biological assessments. Evaluation of physical habitat in agricultural streams in California's Central Valley is particularly important due to the intensive development and landscape modifications in these areas.

Due to the limited number of sites sampled in the three agricultural streams in the present study, an extensive discussion or comparison of these physical habitat data across large spatial scales is problematic. Based on our limited sampling during 2004, the mean total physical habitat scores were not significantly different among the three streams using a p-value of < 0.05 (Table 9). However, a slightly higher p-value (<0.08) would result in a lower mean total habitat score in Salt Slough when compared with either Del Puerto Creek or Orestimba Creek. Various habitat metrics such as bend/riffle frequency, sediment deposition, and embeddedness were lower in Salt Slough when compared with the other two streams.

An exact extensive historical comparison of total physical habitat scores (maximum of 200) for Del Puerto Creek (90 to 136), Orestimba Creek (74 to 119) and Salt Slough (31 to 93) as presented in Table 2 is not possible because historical physical habitat data for California's Central Valley streams has not been summarized in a published format. However, based on best professional judgement from other physical habitat assessments in the area, the range of physical habitat scores reported for the three streams in our study is generally considered low (Peter Ode, California Department of Fish and Game, personal communication).

Physical habitat scores for the 10 Orestimba Creek sites sampled in 2004 can be cautiously compared with same type of assessments conducted in 2000 (Hall and Killen, 2001), 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003) and 2003 (Hall and Killen, 2004) with the caveat that these are only five temporally limited evaluations (Table 23). Total physical habitat scores across the five years were variable for all sites with somewhat less variability for sites ORE6, ORE7 and ORE8. The qualitative habitat metrics that showed the highest number of significant changes for year-to-year comparisons were embeddedness and channel alteration (Table 24a). Total physical habitat scores in Orestimba Creek were greater in 2000 than in 2003 and 2004 and greater in 2001 than 2002, 2003, and 2004.

A comparison of physical habitat metrics in Table 23, Table 24b and Table 24c among the five Del Puerto Creek and Salt Slough sites sampled in 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003), 2003 (Hall and Killen, 2004) and 2004 is also possible with the caveat that these are only four temporally limited evaluations. The final habitat scores among years in Del Puerto Creek site DLP2 were more consistent than the other four sites (Table 23). The only mean metric to show significant differences among years in Del Puerto Creek was epifaunal substrate (Table 24b). Epifaunal substrate was higher in 2003 than in 2001. The mean total physical habitat scores in Del Puerto Creek were consistent among the four years (Table 24b).

A comparison of total physical habitat scores among the five Salt Slough sites in 2001, 2002, 2003 and 2004 shows higher variability at SSL1 when compared with the other sites (Table 23). Mean channel flow, bend/riffle frequency, bank stability, and depth were significantly different among years in Salt Slough (Table 24c). The mean total physical habitat scores were higher in 2001 when compared to 2002 (Table 24c).

Presence of OP-Sensitive Species

A secondary goal of this study was to compare the presence of benthic macroinvertebrates in all three agricultural streams with available organophosphate (OP) single-species toxicity data. The intent of this qualitative comparison is to determine if OP-sensitive benthic species are present in these streams. In order to conduct a valid comparison, the following issues must be addressed: (1) Are the OP-sensitive benthic species determined from single species toxicity tests expected to be found in these systems based on their habitat requirements? and (2) Are the sampling techniques used in our study (D-net sampling with 0.5 mm mesh) appropriate for collecting all OP-sensitive benthic species? Ranges of chlorpyrifos and diazinon concentrations presented in Table 25 have been reported during high use periods for the various streams (Poletika et al., 2002; Poletika and Robb, 1998; Waterborne Environmental Inc., 2002). These exposure data are used in a comparative analysis with the OP toxicity data presented below.

Chlorpyrifos acute toxicity data were available for 12 different taxa collected in the three streams sampled during our study (Table 26). The most sensitive taxa to chlorpyrifos that could be affected at environmentally realistic concentrations in any stream (concentrations < 2,282 ng/L based on the highest concentration in any stream) were *Chironomus sp.* (LC50 = 70 ng/L), *Gammarus sp.* (LC50 = 110 ng/L), *Hyalella sp.,* (LC50 = 1,300 ng/L), *Tanypus sp.* (LC50 = 1,500 ng/L), *Paratanytarsus sp.* (LC50 < 1,600 ng/L), and *Dugesia tigrina* (LC50 = 2,000 – 4,300 ng/L). The species most sensitive to chlorpyrifos (*Chironomus sp.*) was found in all three streams. *Gammarus sp.* are also predicted to be sensitive to chlorpyrifos based on single species toxicity tests and the effect concentrations are environmentally realistic. This amphipod was found in Orestimba Creek and Salt Slough but was absent from Del Puerto Creek

The amphipod, *Hyalella sp.,* was collected in all three streams but was clearly less abundant in Orestimba Creek. The chironomid, *Tanypus sp.*, was only colleted in Salt Slough. The chironomid, *Paratanytarsus sp.*, was collected in all three streams but was clearly more dominant in Salt Slough. The flatworm, *Dugesia tigrina* was found at most sites in both Del Puerto and Orestimba Creeks but was only collected at one site in Salt Slough.

Diazinon acute toxicity data were available for five different taxa collected in either Del Puerto Creek, Orestimba Creek, or Salt Slough (Table 27). The most sensitive taxa to diazinon that could be affected at environmentally realistic concentrations in any stream (concentrations < 29,371 ng/L based on the highest value in any stream) were: *Hyalella sp.* (LC50 = 22,000 ng/L) and *Baetis adonis* (LC50 = 24,000 ng/L). The amphipod, *Hyalella sp.,* was more abundant in both Del Puerto Creek and Salt Slough than Orestimba Creek (only 2 specimens collected). The mayfly *Baetis adonis* - a species potentially sensitive to maximum reported environmental concentrations of diazinon - was collected at the most upstream site in Del Puerto Creek.

Historical Comparisons of Benthic Data

Historical comparisons of our data with other benthic data from these three streams were limited. In 1993, the U.S. Geological Survey collected benthic macroinvertebrates at one site in Orestimba Creek that was approximately half way between our stations ORE2 and ORE3 (Larry Brown, personal communication). Dominant taxa reported by these investigators were mayflies, oligochaetes and gastropods. The dominant taxa we generally reported in Orestimba Creek (particularly at ORE2 and ORE3) were oligochaetes, chironomids, polychaetes, and trichoptera (caddisflies). Mayflies were not collected during our 2004 sampling at these two sites and gastropods were collected in low numbers. Due to the ten year time period between the two sampling events, it is difficult to explain possible factors contributing to the differences in dominant taxa.

Benthic community assessments conducted during the present 2004 study at the 10 Orestimba Creek sties can be compared with similar studies conducted at the same sites in 2000 (Hall and Killen, 2001), 2001 (Hall and Killen, 2002), 2002 (Hall and Killen, 2003) and 2003 (Hall and Killen, 2004). A comparison of mean benthic metrics across all 10 sites for 2000, 2001, 2002, 2003, and 2004 showed that percent collectors, taxonomic richness, and percent shredders showed the highest number of significant differences for between year comparisons (Table 28a). Taxonomic richness – a common metric used in IBI development – was lower in 2000 than 2001, 2003 and 2004, lower in 2001 and 2002 than 2004, and lower in 2003 than 2004. In general, most of the metrics (~80%) did not show any significant differences over the five-year period thus suggesting that dramatic changes in benthic communities were not evident.

A comparison of mean benthic metrics reported for the five Del Puerto Creek sites in 2001, 2002, 2003 and 2004 showed significant differences ($p<0.05$) among years for percent grazers and percent shredders (Table 28b). The percent grazers were higher in 2002 than 2003 and 2004. Percent shredders were higher in 2001 and 2002 than 2003 and 2004. In general most of the 28 benthic metrics in Table 28b did not show significant annual differences in Del Puerto Creek.

A comparison of mean benthic metrics in Salt Slough for 2001, 2002, 2003, and 2004 showed significant differences among years for percent collectors, percent dominant taxa, percent predators, percent shredders, Shannon Diversity, and taxonomic richness. Table 28c shows the following: (1) percent collectors were higher in 2001 than 2002; (2) percent dominant taxa were higher in 2003 than 2001; (3) percent predators were higher in 2002 than 2003; (4) percent shredders were higher 2002 than 2003 and 2004; (5) Shannon Diversity was higher in 2004 than 2003 and (6) taxonomic richness was higher in 2004 than 2003. As reported above for both Orestimba Creek and Del

Puerto Creek, most of the benthic metrics in Salt Slough did not show significant annual differences between 2001 and 2004.

Regulatory and Ecological Implications

The state of California has classified Del Puerto Creek, Orestimba Creek and Salt Slough as impaired water bodies (303d list) due to the presence of chlorpyrifos and diazinon (www.swrcb.ca.gov). These water bodies were listed as impaired based on either OP concentrations exceeding a threshold (water quality criteria or target) or toxicity reported from single species toxicity tests (i.e. *Ceriodaphnia dubia* toxicity tests). Unfortunately, both the chemical monitoring and toxicity data used for these listings were based on data collected prior to 2001 and may not reflect the present use patterns of these OP insecticides. For example, in a recent analysis of diazinon and chlorpyrifos monitoring data (2001 to 2004) from the Sacramento and San Joaquin River watershed, target concentrations of these two OP insecticides were rarely exceeded (L. W. Hall, personnel communication).

Unfortunately, the status of resident biological communities was not considered when these water bodies were classified as impaired because these data were not available. The benthic community data generated form these three streams in 2004 as well as previous bioassessment efforts in these streams (Hall and Killen, 2001; Hall and Killen, 2002; Hall and Killen, 2003; Hall and Killen, 2004) is therefore useful for providing another line of evidence for determining the biological condition of these water bodies. A recent report by the NRC (National Research Council, 2001), addressing various issues associated with TMDLs and impaired water bodies, stated that biological criteria should be used in conjunction with physical and chemical criteria to determine whether a water body is meeting its designated use. This NRC report further supports the use of biological data for determining the status (or potential impairment) of water bodies by stating that biological criteria are more closely related to designated uses of a waterbody than are chemical or physical measurements. A recent EPA report entitled "*Consolidated Assessment and Listing Methodology*" (CALM document) clearly supports the use of bioassessments for determining attainment of aquatic life based water quality standards by stating that bioassessment data are core indicators (critical or essential indicators) (U.S. EPA, 2002). This CALM document also endorses the use of multiple lines of evidence (chemical, toxicity and bioassessment data) for making valid designations of impaired water bodies (U.S. EPA, 2002).

Benthic communities in all three agricultural streams were generally comprised of tolerant species with the exception of Salt Slough where amphipods (an OP sensitive species) were dominant. The dominant presence of the OP sensitive amphipod (i.e., *Americorophium spinicorne* comprised 24% of the taxa collected in 2004) suggests that the laboratory toxicity data used to generate the "effects benchmarks" for OPs may not accurately predict the status of resident biota in Salt Slough. Dominance by tolerant species is expected in these streams due to generally poor physical habitat conditions, fluctuating flow conditions and stressful water quality conditions such elevated temperature and low dissolved oxygen. For example, historical data from permanent gauging stations near ORE10 (USGS) and ORE8 (CA DWR) shows that in most years Orestimba Creek is ephemeral in the reach with no commercial agriculture but generally has continuous low flow (in non-drought years) in most of the lower reach which receives irrigation return water (Poletika and Robb, 1998).

Critical issues to address with the benthic community data from these streams are: (1) What are the biological (benthic) expectations for these agricultural streams? and (2) Do these streams meet these biological expectations and are they impaired based on the status of resident benthic communities? Unfortunately, an agricultural reference stream is not available for this watershed to compare benthic communities for each stream although progress is being made with the development of reference streams in the Central Valley of California (Jim Harrington, personal communication). Therefore, the traditional reference stream approach often used to interpret the status of benthic communities is not feasible. The presence of 69 taxa in Del Puerto Creek, 97 taxa in Orestimiba Creek, and 74 taxa in Salt Slough implies that the benthic communities in these streams are fairly diverse, considering their ephemeral environments, but without a clear definition of benthic community expectations it is unknown if these water bodies are actually impaired. We therefore recommend extensive spatial and temporal assessments of benthic communities in concert with physical habitat assessments in agricultural streams of California's Central Valley in order to identify the range of benthic community taxa assemblages by stream orders and identify potential reference sites.

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Table 1. Sample site names, coordinates and water quality parameters measured during late spring 2004 in Del Puerto Creek, Orestimba Creek and Salt Slough.

Site	Latitude	Longitude	Water Temperature (C)	Specific Conductivity µmhos/L	pH	Dissolved Oxygen mg/L	Salinity ppt	Turbidity NTU
DLP1	37 32 25	121 07 07	23.2	1179	8.44	8.28	0.6	81.3
DLP2	37 32 03	121 07 46	25.6	1165	8.53	7.93	0.6	135
DLP3	37 31 20	121 08 54	25.3	1254	8.53	7.43	0.6	64.5
DLP4	37 30 43	121 09 38	23.2	649	8.47	9.91	0.3	13.5
DLP5	37 28 59	121 12 41	20.6	1738	8.10	10.06	0.9	1.13
ORE1	37 25 10	121 00 09	17.0	761	7.86	7.33	0.4	213
ORE2	37 25 12	121 00 21	17.0	717	7.92	7.91	0.4	249
ORE3	37 24 47	121 00 59	21.9	824	7.93	6.97	0.4	215
ORE4	37 24 19	121 01 28	20.9	806	7.96	7.48	0.4	267
ORE5	37 23 54	121 02 02	17.0	712	7.81	7.48	0.4	254
ORE6	37 23 21	121 02 34	18.7	689	7.80	7.58	0.4	270
ORE7	37 22 59	121 03 00	18.2	892	7.62	7.24	0.5	384
ORE8	37 22 37	121 03 31	26.9	901	7.79	6.46	0.4	656
ORE9	37 21 53	121 03 45	20.1	937	8.22	8.18	0.5	18.6
ORE10	37 19 08	121 07 18	21.6	798	7.76	6.52	0.2	0.26
SSL1	37 14 54	120 51 12	24.6	1606	7.73	7.26	0.8	36.3
SSL2	37 11 59	120 49 33	21.9	1450	7.60	7.07	0.8	49.7
SSL3	37 09 33	120 48 44	23.2	1435	7.56	7.88	0.7	58.4
SSL4	37 08 21	120 46 04	18.9	951	7.59	6.81	0.5	56.1
SSL5	37 07 45	120 42 28	15.9	2148	7.39	6.08	1.3	13.1

Table 2. Scoring of individual physical habitat metrics (0-20 scale) and final habitat score (maximum of 200) for sites in Del Puerto Creek, Orestimba Creek and Salt Slough in 2004.

Site	Epi Subs	Embedd	Veloc Depth Divers	Sedim Depos	Chan Flow Status	Chan Alt	Freq Bends Riffles	Left Bank Stab	Right Bank Stab	L Bank Veget. Protect	R Bank Veget. Protect	L Bank Ripar Zone	R Bank Ripar Zone	Total
DPL1	15	13	11	14	15	15	13	6	7	8	8	5	6	136
DPL2	11	10	15	10	15	13	7	6	4	7	3	3	1	105
DPL3	10	9	10	10	15	11	10	6	6	5	5	2	2	101
DPL4	11	7	5	11	11	11	8	7	7	6	6	1	0	91
DPL5	6	5	5	11	8	16	11	6	4	3	3	7	5	90
ORE1	6	2	14	1	8	15	7	5	2	6	4	6	4	80
ORE2	11	4	13	3	16	13	10	5	5	6	6	6	3	101
ORE3	11	13	10	10	16	13	7	5	5	7	6	5	5	113
ORE4	12	13	10	14	10	13	9	6	4	6	6	6	5	114
ORE5	10	9	10	13	16	14	15	6	5	6	6	5	4	119
ORE6	12	12	10	13	13	12	11	7	7	6	6	5	5	119
ORE7	13	12	10	13	16	15	13	8	6	3	4	3	3	119
ORE8	11	9	10	12	15	15	11	2	5	5	5	2	3	105
ORE9	2	13	10	16	6	11	4	6	6	4	4	4	4	90
ORE10	6	8	4	11	7	12	8	4	4	2	2	3	3	74
SSL1	6	0	16	2	16	16	7	2	6	3	6	6	7	93
SSL2	6	1	6	2	18	16	4	7	7	8	4	8	6	93
SSL3	7	0	9	3	16	14	2	6	6	7	7	2	5	84
SSL4	7	1	6	1	16	12	2	1	6	3	4	1	4	64
SSL5	7	0	0	0	16	2	0	1	1	1	1	1	1	31

Table 3. Physical habitat characteristics for Del Puerto Creek, Orestimba Creek and Salt Slough that were not scored on a 0 - 20 scale.

Site	Mean Flow m/s	Ave. Width m	Ave. Depth cm	Canopy Cover %	Gradient %	Fines %	Gravel %	Cobble %	Boulder %	Bedrock %
DLP 1	0.75	4.7	15.9	54	1	40	50	10	0	0
DLP 2	0.3	3.7	34.8	18	1	70	10	10	10	0
DLP 3	0.37	1.8	41.9	1	1	80	20	0	0	0
DLP 4	0.05	2.8	13.2	0	1	90	10	0	0	0
DLP 5	0.05	1.7	3.75	0	1	40	40	20	0	0
ORE 1	0.46	2.82	31.0	14	1	90	10	0	0	0
ORE 2	0.3	6.56	20.1	45	1	50	50	0	0	0
ORE 3	0.35	6.4	18.3	38	1	30	70	0	0	0
ORE 4	0.49	3.4	13.3	65	1	20	60	10	0	0
ORE 5	0.26	7.5	12.6	60	1	40	60	0	0	0
ORE 6	0.48	4.7	14.4	22	1	40	40	10	0	0
ORE 7	0.19	3.3	19.9	18	1	45	50	5	0	0
ORE 8	0.4	3.8	12.6	0	1	55	40	5	0	0
ORE 9	0.29	0.6	7.2	0	1	95	5	0	0	0
ORE 10	0.01	5.0	4.8	0	1	65	15	20	0	0
SSL 1	0.31	22.2	36.3	0	1	100	0	0	0	0
SSL 2	0.27	26.9	32.1	0	1	100	0	0	0	0
SSL 3	0.32	22.6	26.5	0	1	100	0	0	0	0
SSL 4	0.05	6.93	63.9	9	1	100	0	0	0	0
SSL 5	0	6.5	50.0	0	1	100	0	0	0	0

Table 4. Eigenvalues and proportion of variance explained for the correlation matrix of the ten habitat metrics.

	Eigenvalue	Proportion	Cumulative
Factor 1 *	3.9796	0.3980	0.3980
Factor 2 *	2.0790	0.2079	0.6059
Factor 3 *	1.5192	0.1519	0.7578
Factor 4	0.7881	0.0788	0.8366
Factor 5	0.5986	0.0599	0.8964
Factor 6	0.4210	0.0421	0.9385
Factor 7	0.2960	0.0296	0.9681
Factor 8	0.1737	0.0174	0.9855
Factor 9	0.1194	0.0119	0.9975
Factor 10	0.0254	0.0025	1.0000

*eigenvalue > 1.0

Table 5. Eigenvectors for the three dominant factors of the correlation matrix of habitat metrics.

Metric	Factor 1	Factor 2	Factor 3
Factor 1			
BENRIFF	0.4052*	-0.1244	-0.0055
BANKSTAB	0.3648*	0.0181	-0.0166
BANKVEG	0.3553*	0.2772	0.1976
Factor 2			
SED DEP	0.3507+	-0.4489*	-0.1600
RIPBUFF	0.1867	0.4172*	-0.3912+
EMBEDDED	0.3640+	-0.4122*	-0.0337
CHAN ALT	0.3159+	0.3788*	-0.2834
VEL DPTH	0.2795	0.3203*	-0.0477
Factor 3			
CH FLOW	0.0158	0.3187+	0.6513*
EPI SUB	0.3287+	-0.1195	0.5235*

* largest coefficient for each factor
+ coefficient > 0.30 less than largest

Table 6. Correlation matrix for raw physical habitat metrics grouped by factors identified by the PCA. In the body of the table the correlation coefficients (top) are paired with the p-value (bottom) for the null hypothesis that the correlation is 0.0.

Metric	BANK STAB	BANK VEG	CHAN ALT	BEN RIFF	EPI SUB	RIP BUFF	SED DEP	VEL DPTH	CH FLOW	EMBEDD	TOTAL
BANKSTAB	1.0000*	0.6090*	0.4620*	0.4221	0.3355	0.2356	0.5009*	0.2111	0.0403	0.4503*	0.6959*
	–	0.0044	0.0403	0.0637	0.1481	0.3174	0.0245	0.3716	0.8661	0.0463	0.0007
BANKVEG	0.6090*	1.0000*	0.4865*	0.3239	0.5083*	0.3605	0.1976	0.5091*	0.2957	0.2769	0.7148*
	0.0044	–	0.0296	0.1635	0.0221	0.1184	0.4037	0.0219	0.2057	0.2372	0.0004
CHAN ALT	0.4620*	0.4865*	1.0000*	0.4835*	0.1162	0.6355*	0.1608	0.5609*	0.016	0.0925	0.6202*
	0.0403	0.0296	–	0.0308	0.6256	0.0026	0.4982	0.0101	0.9466	0.6982	0.0035
BENRIFF	0.4221	0.3239	0.4835*	1.0000*	0.6247*	0.2186	0.6442*	0.354	-0.0376	0.5907*	0.7918*
	0.0637	0.1635	0.0308	–	0.0032	0.3546	0.0022	0.1257	0.8751	0.0061	<0.0001
EPI SUB	0.3355	0.5083*	0.1162	0.6247*	1.0000*	-0.1118	0.3988	0.2366	0.4034	0.5359*	0.6757*
	0.1481	0.0221	0.6256	0.0032	–	0.6389	0.0816	0.3153	0.0777	0.0149	0.0011
RIPBUFF	0.2356	0.3605	0.6355*	0.2186	-0.1118	1.0000*	-0.0202	0.3587	-0.0261	-0.0082	0.3984
	0.3174	0.1184	0.0026	0.3546	0.6389	–	0.9326	0.1204	0.913	0.9725	0.0819
SED DEP	0.5009*	0.1976	0.1608	0.6442*	0.3988	-0.0202	1.0000*	0.0851	-0.3781	0.9208*	0.6639*
	0.0245	0.4037	0.4982	0.0022	0.0816	0.9326	–	0.7214	0.1002	<0.0001	0.0014
VEL DPTH	0.2111	0.5091*	0.5609*	0.354	0.2366	0.3587	0.0851	1.0000*	0.1173	0.2143	0.5815*
	0.3716	0.0219	0.0101	0.1257	0.3153	0.1204	0.7214	–	0.6223	0.3643	0.0072
CH FLOW	0.0403	0.2957	0.016	-0.0376	0.4034	-0.0261	-0.3781	0.1173	1.0000*	-0.248	0.1343
	0.8661	0.2057	0.9466	0.8751	0.0777	0.913	0.1002	0.6223	–	0.2918	0.5723
EMBEDDED	0.4503*	0.2769	0.0925	0.5907*	0.5359*	-0.0082	0.9208*	0.2143	-0.248	1.0000*	0.7127*
	0.0463	0.2372	0.6982	0.0061	0.0149	0.9725	<0.0001	0.3643	0.2918	–	0.0004
TOTAL	0.6959*	0.7148*	0.6202*	0.7918*	0.6757*	0.3984	0.6639*	0.5815*	0.1343	0.7127*	1.0000*
	0.0007	0.0004	0.0035	<0.0001	0.0011	0.0819	0.0014	0.0072	0.5723	0.0004	–

* p value < 0.05

Table 7. Correlation matrix for stream measurements against raw physical habitat metrics and the total habitat metric score. In the body of the table are the correlation coefficient (top) and the p-value (bottom) for the null hypothesis that the correlation is 0.0.

Metric	Width	Depth	Mean Flow	Canopy	Fines	Gravel	Cobble
BANKSTAB	0.089	-0.4207	0.3237	0.1715	-0.2374	0.2411	0.0317
	0.7089	0.0648	0.1639	0.4697	0.3135	0.3058	0.8944
BANKVEG	0.2316	-0.224	0.7448*	0.5262*	-0.2905	0.3728	-0.2438
	0.3259	0.3424	0.0002	0.0172	0.2141	0.1055	0.3004
CHAN ALT	0.2744	-0.3449	0.3944	0.1632	-0.2728	0.2667	0.1905
	0.2417	0.1364	0.0853	0.4919	0.2446	0.2556	0.4211
BENRIFF	-0.3917	-0.5795*	0.382	0.5193*	-0.7546*	0.7497*	0.3623
	0.0876	0.0074	0.0965	0.019	0.0001	0.0001	0.1165
EPI SUB	-0.2845	-0.149	0.4744*	0.6205*	-0.6643*	0.6751*	0.1222
	0.2241	0.5308	0.0346	0.0035	0.0014	0.0011	0.6077
RIPBUFF	0.4147	-0.2711	0.4546*	0.3338	-0.2902	0.2838	0.1483
	0.0691	0.2476	0.044	0.1503	0.2145	0.2253	0.5327
SED DEP	-0.5701*	-0.7279*	0.2782	0.3348	-0.6480*	0.5721*	0.4568*
	0.0087	0.0003	0.235	0.149	0.002	0.0084	0.0429
VEL DPTH	0.0485	-0.0458	0.6521*	0.3404	-0.1724	0.2054	-0.1768
	0.8392	0.848	0.0018	0.1419	0.4674	0.3849	0.4559
CH FLOW	0.5184*	0.5267*	0.1171	0.1496	0.0678	0.0684	-0.4839*
	0.0192	0.017	0.623	0.529	0.7765	0.7746	0.0306
EMBEDDED	-0.6111*	-0.5798*	0.4266	0.4863*	-0.7116*	0.6654*	0.333
	0.0042	0.0074	0.0607	0.0297	0.0004	0.0014	0.1514
TOTAL	-0.132	-0.5153*	0.6935*	0.6135*	-0.6998*	0.7110*	0.1668
	0.579	0.0201	0.0007	0.004	0.0006	0.0004	0.4823

Number of observations = 20
* p-value < 0.05

Table 8. Spearman rank correlation coefficients (top) and significance levels (bottom) for upstream-downstream trend in the physical habitat metrics and the total physical habitat index.

Physical Habitat metric	Del Puerto	Orestimba	Salt Slough
BANKSTAB	-0.1539 0.8048	0.2037 0.5724	-0.7 0.1881
BANKVEG	-0.6669 0.2189	-0.6712* 0.0336	-0.6 0.2848
BENRIFF	-0.1 0.8729	0.0793 0.8277	-0.9747* 0.0048
CHAN ALT	0.0513 0.9347	-0.3677 0.2958	-0.9747* 0.0048
CH FLOW	-0.8944* 0.0405	-0.4002 0.2518	-0.3536 0.5594
EMBEDDED	-1.0000* 0	0.2408 0.5028	0 1
EPI SUB	-0.8208 0.0886	-0.1605 0.6578	0.866 0.0577
RIPBUFF	0.0513 0.9347	-0.7100* 0.0214	-0.9000* 0.0374
SED DEP	-0.1054 0.866	0.5338 0.112	-0.6669 0.2189
VEL DPTH	-0.8721 0.0539	-0.8128* 0.0043	-0.8208 0.0886
TOTAL	-1.0000* 0	-0.092 0.8004	-0.9747* 0.0048
sample size	5	10	5

* P-value < 0.05

Table 9. Mean scores for each physical habitat metric and the total for each creek with the p-values for comparing the means among creeks based on the Kruskal-Wallis test. Pairwise comparisons between creeks are based on the Wilcoxon rank-sum test.

	Mean for each Creek				Pairwise Comparisons		
Physical Habitat Metric	Del Puerto	Orestimba	Salt Slough	Kruskal Wallace p-value	DO	DS	OS
VEL DPTH	9.2	10.1	7.4	0.4673			
EPI SUB	10.6	9.4	6.6	0.1891			
BENRIFF	9.8	9.5	3	0.0044*		*	*
CHAN ALT	13.2	13.3	12	0.9071			
BANKVEG	10.8	10	8.8	0.8471			
RIPBUFF	6.4	8.4	8.2	0.6991			
SED DEP	11.2	10.6	1.6	0.0065*		*	*
EMBEDDED	8.8	9.5	0.4	0.0009*		*	*
BANKSTAB	11.8	10.3	8.6	0.4188			
CH FLOW	12.8	12.3	16.4	0.0188*		*	*
TOTAL	104.6	103.4	73	0.0774			

DO – Del Puerto vs Orestimba
DS – Del Puerto vs Salt Slough
OS – Orestimba vs Salt Slough
* - p-value < 0.05

Table 10. Total and taxon abundance for benthic macroinvertebrates in Del Puerto Creek.

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Simulium sp.	Simuliidae/Diptera	1067	26.437	26.437
Cyprididae	Ostracoda	834	20.664	47.101
Physa sp.	Physidae/Gastropoda	495	12.265	59.366
Tubificidae unid. imm.	Tubificida/Oligochaeta	293	7.260	66.625
Gyraulus parvus	Planorbidae/Gastropoda	189	4.683	71.308
Dugesia tigrina	Planariidae/Turbellaria	166	4.113	75.421
Nais communis/ variabilis	Naididae/Oligochaeta	165	4.088	79.509
Orthocladius complex	Chironomidae/Diptera	109	2.701	82.210
Cricotopus sp.	Chironomidae/Diptera	92	2.279	84.490
Cricotopus bicinctus group	Chironomidae/Diptera	69	1.710	86.199
Corbicula sp.	Corbiculidae/Bivalvia	49	1.214	87.413
Dicrotendipes sp.	Chironomidae/Diptera	40	0.991	88.404
Lumbricina	Oligochaeta	40	0.991	89.395
Hyalella sp.	Hyalellidae/Malacostraca	40	0.991	90.387
Slavina appendiculata	Naididae/Oligochaeta	34	0.842	91.229
Parachironomus sp.	Chironomidae/Diptera	33	0.818	92.047
Fallceon quilleri	Baetidae/Ephemeroptera	32	0.793	92.839
Rheocricotopus sp.	Chironomidae/Diptera	31	0.768	93.608
Chironomus sp.	Chironomidae/Diptera	26	0.644	94.252
Prostoma sp.	Tertastemmatidae/Enopla	23	0.570	94.822
Fossaria sp.	Lymnaeidae/Gastropoda	22	0.545	95.367
Turbellaria	Platyhelminthes	18	0.446	95.813
Cladotanytarsus sp.	Chironomidae/Diptera	16	0.396	96.209
Pisidium sp.	Sphaeriidae/Bivalvia	16	0.396	96.606
Erpobdellidae	Hirudinea	12	0.297	96.903
Eukiefferiella sp.	Chironomidae/Diptera	10	0.248	97.151
Tubificidae w/hair cheatae	Tubificida/Oligochaeta	10	0.248	97.398
Enchytraeidae	Tubificida/Oligochaeta	8	0.198	97.597
Chironomini	Chironomidae/Diptera	7	0.173	97.770
Thienemannimyia group	Chironomidae/Diptera	7	0.173	97.944
Mooreobdella microstoma	Erpobdellidae/Hirudinea	6	0.149	98.092
Eudistylia vancouveri	Sabellidae/Polychaeta	6	0.149	98.241
Orthocladiinae	Chironomidae/Diptera	5	0.124	98.365
Procladius sp.	Chironomidae/Diptera	5	0.124	98.489
Corixidae	Hemiptera	4	0.099	98.588
Tricorythodes sp.	Leptohyphidae/Ephemeroptera	4	0.099	98.687
Planorbella sp.	Planorbidae/Gastropoda	4	0.099	98.786
Coenagrionidae	Odonata	3	0.074	98.860
Hydra sp.	Hydridae/Coelenterata	3	0.074	98.935
Lymnaeidae	Gastropoda	3	0.074	99.009
Chaetogaster diaphanus	Naididae/Oligochaeta	3	0.074	99.083
Ceratopogonidae	Diptera	2	0.050	99.133
Cryptochironomus sp.	Chironomidae/Diptera	2	0.050	99.182
Limnophyes sp.	Chironomidae/Diptera	2	0.050	99.232

Table 10. - continued.

Rheotanytarsus sp.	Chironomidae/Diptera	2	0.050	99.281
Helobdella stagnalis	Glossiphoniidae/Hirudinea	2	0.050	99.331
Peltodytes sp.	Haliplidae/Coleoptera	2	0.050	99.381
Dero digitata	Naididae/Oligochaeta	2	0.050	99.430
Pristina leidyi	Naididae/Oligochaeta	2	0.050	99.480
Ambrysus sp.	Naucoridae/Hemiptera	2	0.050	99.529
Arrenurus sp.	Arrenuridae/Arachnida	1	0.025	99.554
Baetis adonis	Baetidae/Ephemeroptera	1	0.025	99.579
Chironomidae	Chironomidae/Diptera	1	0.025	99.604
Nanocladius sp.	Chironomidae/Diptera	1	0.025	99.628
Parametriocnemus sp.	Chironomidae/Diptera	1	0.025	99.653
Paratanytarsus sp.	Chironomidae/Diptera	1	0.025	99.678
Pentaneura sp.	Chironomidae/Diptera	1	0.025	99.703
Polypedilum sp.	Chironomidae/Diptera	1	0.025	99.727
Tanypodinae	Chironomidae/Diptera	1	0.025	99.752
Stictotarsus examinus	Dytiscidae/Coleoptera	1	0.025	99.777
Ephydridae	Diptera	1	0.025	99.802
Hydrellia sp.	Ephydridae/Diptera	1	0.025	99.827
Hydrobiidae	Neotaenioglassa/Gastropoda	1	0.025	99.851
Brachycera	Diptera	1	0.025	99.876
Lumbriculidae	Oligochaeta	1	0.025	99.901
Sciomyzidae	Chironomidae/Diptera	1	0.025	99.926
Tipula sp.	Chironomidae/Diptera	1	0.025	99.950
Tipulidae	Chironomidae/Diptera	1	0.025	99.975
Quistadrilus multisetosus	Tubificida/Oligochaeta	1	0.025	100.000
	Total	4036		

Table 11. Benthic metrics by site for the 5 Del Puerto Creek sites.

	DLP1	**DLP2**	**DLP3**	**DLP4**	**DLP5**
Taxonomic Richness	26.00	39.00	32.00	24.00	21.00
Percent Dominant Taxon	53%	30%	44%	50%	88%
Number Plecoptera Taxa	0	0	0	0	0
Number Trichoptera Taxa	0	0	0	0	0
EPT Taxa	1.00	1.00	1.00	0.00	3.00
EPT Index (%)	1%	2%	0%	0%	1%
Sensitive EPT Index (%)	0%	0%	0%	0%	0%
Shannon Diversity	1.825	2.604	2.164	1.699	0.592
Tolerance Value	6.7	6.8	6.8	7.7	7.9
Percent Intolerant Taxa (0-2)	0%	0%	0%	0%	0%
Percent Tolerant Taxa (8-10)	45%	53%	46%	52%	32%
Percent Baetidae	1%	2%	0%	0%	1%
Percent Chironomidae	12%	16%	23%	5%	1%
Percent Hydropsychidae	0%	0%	0%	0%	0%
Percent Collector Gatherers	31%	35%	42%	16%	94%
Percent Collector-Filterers	55%	36%	45%	0%	0%
Percent Scrapers	2%	13%	7%	76%	4%
Percent Predators	8%	15%	5%	7%	1%
Percent Shredders	0%	0%	0%	0%	0%
Total Abundance (#/sample)	3039	1079	4699	668	12937

Table 12. Total and taxon abundance for benthic macroinvertebrates in Orestimba Creek.

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Eudistylia vancouveri	Sabellidae/Polychaeta	807	11.232	11.232
Dicrotendipes sp.	Chironomidae/Diptera	692	9.631	20.863
Physa sp.	Physidae/Gastropoda	668	9.297	30.160
Hydropsyche californica	Hydropsychidae/Trichoptera	602	8.379	38.539
Cricotopus bicinctus group	Chironomidae/Diptera	370	5.150	43.688
Cricotopus sp.	Chironomidae/Diptera	349	4.857	48.546
Dugesia tigrina	Planariidae/Turbellaria	316	4.398	52.944
Tubificidae unid. imm.	Tubificida/Oligochaeta	299	4.161	57.105
Ophidonais serpentina	Naididae/Oligochaeta	253	3.521	60.626
Prostoma sp.	Tertastemmatidae/Enopla	250	3.479	64.106
Slavina appendiculata	Naididae/Oligochaeta	248	3.452	67.557
Gammarus lacustris	Gammaridae/Malacostraca	184	2.561	70.118
Nais communis/ variabilis	Naididae/Oligochaeta	171	2.380	72.498
Simulium sp.	Simuliidae/Diptera	153	2.129	74.628
Sperchon sp.	Sperchontidae/Arachnida	148	2.060	76.688
Corbicula sp.	Corbiculidae/Bivalvia	129	1.795	78.483
Lumbricina	Oligochaeta	129	1.795	80.278
Hydra sp.	Hydridae/Coelenterata	127	1.768	82.046
Cyprididae	Ostracoda	124	1.726	83.772
Polypedilum sp.	Chironomidae/Diptera	114	1.587	85.358
Orthocladius complex	Chironomidae/Diptera	104	1.447	86.806
Rheocricotopus sp.	Chironomidae/Diptera	94	1.308	88.114
Nereis limnicola	Nereididae/Polychaeta	89	1.239	89.353
Fossaria sp.	LymnaeidaeGastropoda	69	0.960	90.313
Planorbella sp.	Planorbidae/Gastropoda	69	0.960	91.273
Paratanytarsus sp.	Chironomidae/Diptera	58	0.807	92.081
Gyraulus parvus	Planorbidae/Gastropoda	45	0.626	92.707
Ferrissia rivularis	Ancylidae/Gastropoda	42	0.585	93.292
Branchiura sowerbyi	Tubificida/Oligochaeta	30	0.418	93.709
Hydroptila sp.	Hydroptilidae/Trichoptera	29	0.404	94.113
Limnodrilus hoffmeisteri	Tubificidae/Oligochaeta	29	0.404	94.516
Enchytraeidae	Tubificidae/Oligochaeta	26	0.362	94.878
Anisogammarus sp.	Gammaridae/Malacostraca	23	0.320	95.198
Eukiefferiella sp.	Chironomidae/Diptera	20	0.278	95.477
Cladotanytarsus sp.	Chironomidae/Diptera	19	0.264	95.741
Microchironomus sp.	Chironomidae/Diptera	19	0.264	96.006
Tanypodinae	Chironomidae/Diptera	19	0.264	96.270
Erpobdellidae	Hirudinea	19	0.264	96.534
Fallceon quilleri	Baetidae/Ephemeroptera	16	0.223	96.757
Chironomus sp.	Chironomidae/Diptera	15	0.209	96.966
Chironomini	Chironomidae/Diptera	12	0.167	97.133
Corixidae	Hemiptera	12	0.167	97.300
Ablabesmyia sp.	Chironomidae/Diptera	11	0.153	97.453
Harnischia sp.	Chironomidae/Diptera	10	0.139	97.592
Phaenopsectra sp.	Chironomidae/Diptera	10	0.139	97.731
Tanytarsus sp.	Chironomidae/Diptera	10	0.139	97.871
Mooreobdella tetragon	Erpobdellidae/Hirudinea	10	0.139	98.010
Nanocladius sp.	Chironomidae/Diptera	9	0.125	98.135

Table 12. – continued

Orthocladiinae	Chironomidae/Diptera	9	0.125	98.260
Coenagrionidae	Odonata	9	0.125	98.386
Thienemanniella sp.	Chironomidae/Diptera	7	0.097	98.483
Cambaridae	Decapoda/Malacostraca	5	0.070	98.553
Limnophyes sp.	Chironomidae/Diptera	5	0.070	98.622
Thienemannimyia group	Chironomidae/Diptera	5	0.070	98.692
Menetus opercularis	Planorbidae/Gastropoda	5	0.070	98.761
Bezzia/ Palpomyia	Ceratopogonidae/Diptera	4	0.056	98.817
Cricotopus trifascia group	Chironomidae/Diptera	4	0.056	98.873
Parachironomus sp.	Chironomidae/Diptera	4	0.056	98.928
Paraphaenocladius sp.	Chironomidae/Diptera	4	0.056	98.984
Procladius sp.	Chironomidae/Diptera	4	0.056	99.040
Rheotanytarsus sp.	Chironomidae/Diptera	4	0.056	99.095
Argia sp.	Coenagrionidae/Odonata	4	0.056	99.151
Berosus sp.	Hydrophilidae/Coleoptera	4	0.056	99.207
Hexatoma sp.	Tipulidae/Diptera	4	0.056	99.262
Ormosia sp.	Chironomidae/Diptera	4	0.056	99.318
Chironomidae	Chironomidae/Diptera	3	0.042	99.360
Corynoneura sp.	Chironomidae/Diptera	3	0.042	99.402
Cryptochironomus sp.	Chironomidae/Diptera	3	0.042	99.443
Micropsectra sp.	Chironomidae/Diptera	3	0.042	99.485
Hydropsychidae	Trichoptera	3	0.042	99.527
Callibaetis sp.	Baetidae/Ephemeroptera	2	0.028	99.555
Psectrocladius sp.	Chironomidae/Diptera	2	0.028	99.582
Neoclypeodytes plicipennis	Dytiscidae/Coleoptera	2	0.028	99.610
Hydrellia sp.	Ephydridae/Diptera	2	0.028	99.638
Hyalella sp.	Hyalellidae/Malacostraca	2	0.028	99.666
Hydropsyche sp.	Hydropsychidae/Trichoptera	2	0.028	99.694
Chaetogaster diaphanus	Naididae//Oligochaeta	2	0.028	99.722
Stilobezzia sp.	Ceratopogonidae/Diptera	1	0.014	99.736
Apedilum sp.	Chironomidae/Diptera	1	0.014	99.749
Endochironomus sp.	Chironomidae/Diptera	1	0.014	99.763
Paracladopelma sp.	Chironomidae/Diptera	1	0.014	99.777
Pseudochironomus sp.	Chironomidae/Diptera	1	0.014	99.791
Tanytarsini	Chironomidae/Diptera	1	0.014	99.805
Enallagma sp.	Coenagrionidae/Odonata	1	0.014	99.819
Corisella inscripta	Corixidae/Hemiptera	1	0.014	99.833
Americorophium spinicorne	Corophiidae/Malacostraca	1	0.014	99.847
Stictotarsus striatellus	Dytiscidae/Coleoptera	1	0.014	99.861
Cryptochia sp.	Limnephilidae/Trichoptera	1	0.014	99.875
Limnesia sp.	Limnesiidae/Arachnida	1	0.014	99.889
Muscidae	Chironomidae/Diptera	1	0.014	99.903
Neomysis mercedis	Mysidacea/Malacostraca	1	0.014	99.916
Pristina leidyi	Naididae/Oligochaeta	1	0.014	99.930
Psychoda sp.	Chironomidae/Diptera	1	0.014	99.944
Manayunkia speciosa	Sabellidae/Polychaeta	1	0.014	99.958
Turbellaria	Platyhelminthes	1	0.014	99.972
Limonia sp.	Tipulidae/Diptera	1	0.014	99.986
Tubificidae w/hair cheatae	Tubificidae/Oligochaeta	1	0.014	100.000
	Total	7185		

Table 13. Benthic metrics by site for the 10 Orestimba Creek sites.

	ORE1	**ORE2**	**ORE3**	**ORE4**	**ORE5**	**ORE6**	**ORE7**	**ORE8**	**ORE9**	**ORE10**
Taxonomic Richness	36.00	33.00	44.00	34.00	44.00	45.00	32.00	34.00	23.00	27.00
Percent Dominant Taxon	22%	15%	25%	31%	22%	27%	19%	14%	62%	65%
Number Plecoptera Taxa	0	0	0	0	0	0	0	0	0	0
Number Trichoptera Taxa	1	0	1	2	2	3	2	2	0	0
EPT Taxa	1.00	0.00	2.00	3.00	3.00	4.00	3.00	2.00	0.00	1.00
EPT Index (%)	0%	0%	25%	32%	4%	10%	12%	0%	0%	0%
Sensitive EPT Index (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Shannon Diversity	2.949	2.965	2.921	2.467	2.961	2.899	2.572	2.879	1.507	1.423
Tolerance Value	7.3	7.4	6.3	5.2	7.7	6.2	5.5	6.2	7.5	7.9
Percent Intolerant Taxa (0-2)	3%	0%	0%	0%	0%	0%	0%	0%	0%	4%
Percent Tolerant Taxa (8-10)	48%	42%	42%	37%	36%	43%	30%	50%	47%	42%
Percent Baetidae	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Percent Chironomidae	60%	43%	26%	13%	23%	20%	19%	21%	14%	72%
Percent Hydropsychidae	0%	0%	25%	31%	4%	7%	11%	0%	0%	0%
Percent Collectors Gatherers	82%	73%	52%	31%	68%	40%	47%	46%	18%	84%
Percent Collector-Filterers	7%	14%	38%	56%	12%	15%	15%	5%	8%	1%
Percent Scrapers	5%	10%	4%	1%	5%	7%	2%	9%	71%	10%
Percent Predators	5%	2%	3%	9%	11%	30%	35%	39%	2%	5%
Percent Shredders	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total Abundance (#/sample)	385	297	573	949	1271	1793	4027	3696	20442	2807

Table 14. Total and taxon abundance for benthic macroinvertebrates in Salt Slough.

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Americorophium spinicorne	Corophiidae/Malacostraca	900	24.377	24.377
Physa sp.	Physidae/Gastropda	435	11.782	36.159
Cricotopus bicinctus group	Chironomidae/Diptera	211	5.715	41.874
Cricotopus sp.	Chironomidae/Diptera	190	5.146	47.021
Corbicula sp.	Corbiculidae/Bivalvia	171	4.632	51.652
Tubificidae unid. imm.	Tubificida/Oligochaeta	164	4.442	56.094
Trichocorixa calva	Corixidae/Hemiptera	159	4.307	60.401
Eudistylia vancouveri	Sabellidae/Polychaeta	150	4.063	64.464
Hydropsyche californica	Hydropsychidae/Trichoptera	141	3.819	68.283
Corixidae	Hemiptera	133	3.602	71.885
Ferrissia rivularis	Ancylidae/Gastropoda	121	3.277	75.163
Paratanytarsus sp.	Chironomidae/Diptera	119	3.223	78.386
Hyalella sp.	Hyalellidae/Malacostraca	90	2.438	80.823
Coenagrionidae	Odonata	82	2.221	83.044
Gammarus lacustris	Gammaridae/Malacostraca	65	1.761	84.805
Tanypus sp.	Chironomidae/Diptera	61	1.652	86.457
Nais communis/ variabilis	Naididae/Oligochaeta	54	1.463	87.920
Trichocorixa sp.	Corixidae/Hemiptera	36	0.975	88.895
Prostoma sp.	Tertastemmatidae/Enopla	31	0.840	89.735
Limnodrilus hoffmeisteri	Tubificida/Oligocheta	30	0.813	90.547
Chironomus sp.	Chironomidae/Diptera	28	0.758	91.306
Ophidonais serpentina	Naididae/Oligochaeta	28	0.758	92.064
Enallagma sp.	Coenagrionidae/Odonata	26	0.704	92.768
Branchiura sowerbyi	Tubificida/Oligochaeta	26	0.704	93.472
Slavina appendiculata	Naididae/Oligochaeta	24	0.650	94.122
Harnischia sp.	Chironomidae/Diptera	21	0.569	94.691
Dicrotendipes sp.	Chironomidae/Diptera	20	0.542	95.233
Callibaetis sp.	Baetidae/Ephemeroptera	17	0.460	95.693
Nanocladius sp.	Chironomidae/Diptera	17	0.460	96.154
Cladotanytarsus sp.	Chironomidae/Diptera	10	0.271	96.425
Menetus opercularis	Planorbidae/Gastropoda	10	0.271	96.696
Simulium sp.	Simuliidae/Diptera	10	0.271	96.966
Parachironomus sp.	Chironomidae/Diptera	8	0.217	97.183
Fossaria sp.	Lymnaeidae/Gastropoda	8	0.217	97.400
Apedilum sp.	Chironomidae/Diptera	7	0.190	97.589
Goeldichironomus sp.	Chironomidae/Diptera	7	0.190	97.779
Polypedilum sp.	Chironomidae/Diptera	7	0.190	97.969
Cyprididae	Ostracoda	7	0.190	98.158
Cryptochironomus sp.	Chironomidae/Diptera	6	0.163	98.321
Microchironomus sp.	Chironomidae/Diptera	6	0.163	98.483
Procladius sp.	Chironomidae/Diptera	5	0.135	98.619
Aeshnidae	Odonata	4	0.108	98.727
Liodessus obscurellus	Dytiscidae/Coleoptera	3	0.081	98.808
Palaemon macrodactylus	PalaemonidaeDecapoda	3	0.081	98.889
Dugesia tigrina	Planariidae/Turbellaria	3	0.081	98.971
Tubificidae w/hair cheatae	Tubificida/Oligochaeta	3	0.081	99.052
Chironomidae	Chironomidae/Diptera	2	0.054	99.106

Table 14. – continued.

Chironomini	Chironomidae/Diptera	2	0.054	99.160
Endotribelos sp.	Chironomidae/Diptera	2	0.054	99.215
Limnophyes sp.	Chironomidae/Diptera	2	0.054	99.269
Orthocladius complex	Chironomidae/Diptera	2	0.054	99.323
Rheocricotopus sp.	Chironomidae/Diptera	2	0.054	99.377
Chaetogaster diaphanus	Naididae/Oligochaeta	2	0.054	99.431
Anax sp.	Aeshnidae/Odonata	1	0.027	99.458
Cambaridae	Cambaridae/Malacostraca	1	0.027	99.485
Procambarus acutus	Cambaridae/Malacostraca	1	0.027	99.512
Cladopelma sp.	Chironomidae/Diptera	1	0.027	99.540
Corynoneura sp.	Chironomidae/Diptera	1	0.027	99.567
Phaenopsectra sp.	Chironomidae/Diptera	1	0.027	99.594
Tanypodinae	Chironomidae/Diptera	1	0.027	99.621
Tanytarsini	Chironomidae/Diptera	1	0.027	99.648
Corisella inscripta	Corixidae/Hemiptera	1	0.027	99.675
Corisella sp.	Corixidae/Hemiptera	1	0.027	99.702
Palmacorixa sp.	Corixidae/Hemiptera	1	0.027	99.729
Dolichopodidae	Chironomidae/Diptera	1	0.027	99.756
Laccophilus sp.	Dytiscidae/Coleoptera	1	0.027	99.783
Sanfilippodytes sp.	Dytiscidae/Coleoptera	1	0.027	99.810
Thermonectus intermedius	Dytiscidae/Coleoptera	1	0.027	99.837
Hydrobiidae	Neotaenioglasa/Gastropoda	1	0.027	99.865
Hydroptila sp.	Hydroptilidae/Trichoptera	1	0.027	99.892
Manayunkia speciosa	Sabellidae/Polychaeta	1	0.027	99.919
Limonia sp.	Chironomidae/Diptera	1	0.027	99.946
Tipulidae	Chironomidae/Diptera	1	0.027	99.973
Quistadrilus multisetosus	Tubificida/Oligochaeta	1	0.027	100.000
	Total	3692		

Table 15. Benthic metrics by site for the 5 Salt Slough sites.

	SSL1	**SSL2**	**SSL3**	**SSL4**	**SSL5**
Taxonomic Richness	25.00	28.00	43.00	40.00	26.00
Percent Dominant Taxon	31%	39%	44%	20%	38%
Number Plecoptera Taxa	0	0	0	0	0
Number Trichoptera Taxa	1	2	1	0	0
EPT Taxa	1.00	2.00	1.00	0.00	1.00
EPT Index (%)	7%	7%	4%	0%	2%
Sensitive EPT Index (%)	0%	0%	0%	0%	0%
Shannon Diversity	2.268	2.202	2.400	2.997	2.264
Tolerance Value	6.3	5.2	5.5	7.6	8.0
Percent Intolerant Taxa (0-2)	0%	0%	0%	0%	0%
Percent Tolerant Taxa (8-10)	55%	40%	47%	55%	61%
Percent Baetidae	0%	0%	0%	0%	2%
Percent Chironomidae	8%	25%	29%	17%	22%
Percent Hydropsychidae	7%	7%	4%	0%	0%
Percent Collector Gatherers	29%	32%	31%	39%	18%
Percent Collector-Filterers	47%	65%	57%	6%	12%
Percent Scrapers	0%	1%	3%	38%	43%
Percent Predators	24%	2%	9%	16%	26%
Percent Shredders	0%	0%	0%	0%	0%
Total Abundance (#/sample)	4825	867	1242	633	6915

Table 16. Eigenvalues and proportion of variance explained for the correlation matrix of the benthic metrics.

Factor	Eigenvalue	Proportion	Cumulative
Factor 1	5.6578	0.3328	0.3328
Factor 2	2.9756	0.1750	0.5078
Factor 3	2.7543	0.1620	0.6699
Factor 4	1.6410	0.0965	0.7664
Factor 5	1.1166	0.0657	0.8321
Factor 6	1.0246	0.0603	0.8923
Factor 7	0.8097	0.0476	0.9400
Factor 8	0.4792	0.0282	0.9682
Factor 9	0.2295	0.0135	0.9817
Factor 10	0.1746	0.0103	0.9919
Factor 11	0.0701	0.0041	0.9961
Factor 12	0.0540	0.0032	0.9992
Factor 13	0.0090	0.0005	0.9998
Factor 14	0.0031	0.0002	0.9999
Factor 15	0.0007	0.0000	1.0000
Factor 16	0.0002	0.0000	1.0000
Factor 17	0.0000	0.0000	1.0000

Table 17. Eigenvectors for the six dominant factors of the correlation matrix of benthic metrics.

Metric	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Factor 1						
Number Trichoptera Taxa	0.3494	0.0160	-0.0469	0.2304	-0.2029	-0.2211
EPT Index (%)	0.3094	-0.1273	-0.2141	-0.1444	-0.1497	0.1830
Percent Hydropsychidae	0.3055	-0.1128	-0.2214	-0.1933	-0.1903	0.1771
Factor 2						
Percent Chironomidae	-0.0168	0.4982	0.0393	-0.2258	0.0564	-0.2494
Percent Collectors Gatherers	-0.0205	0.4861	-0.2096	0.1799	0.0826	0.1317
Percent Intolerant Taxa	-0.1108	0.4501	-0.0798	-0.1175	-0.0096	-0.2972
Factor 3						
Percent Tolerant Taxa (8-10)	-0.1520	-0.1533	0.4484	-0.1580	0.1404	-0.1619
Shannon Diversity	0.2880	0.1245	0.3918	-0.0895	-0.0321	0.0202
Percent Dominant Taxon	-0.2755	-0.0813	-0.3780	0.0471	0.1420	0.1082
Factor 4						
Percent Predators	0.1481	-0.1134	0.2653	0.4650	-0.1260	-0.4351
EPT Taxa	0.2760	0.0198	-0.2583	0.4559	0.0323	0.0409
Percent Baetidae	-0.0867	-0.1672	0.1056	0.3632	0.6121	0.1274
Factor 5						
Percent Scrapers	-0.2563	-0.1891	0.2112	-0.0431	-0.4589	0.2494
Percent Collector-Filterers	0.1881	-0.2473	-0.1405	-0.4116	0.4449	-0.1904
Factor 6						
Tolerance Value	-0.3227	0.1855	0.1262	0.1648	-0.0480	0.3602
Cumulative Taxa	0.3026	0.1811	0.2501	-0.0310	0.1529	0.3497
Taxonomic Richness	0.3026	0.1811	0.2501	-0.0310	0.1529	0.3497

Table 18. Spearman rank correlation coefficients (top) and p-values (bottom) for upstream-downstream trend in the benthic metrics.

Benthic Habitat Metric	Del Puerto	Orestimba	Salt Slough
Cumulative Taxa	-0.7 0.1881	-0.53 0.1147	0.3 0.6238
EPT Index (%)	-0.37 0.5411	-0.23 0.5296	-0.87 0.0539
EPT Taxa	0.22 0.7177	0.01 0.9729	-0.45 0.4502
Number Trichoptera Taxa	. .	-0.03 0.9305	-0.79 0.1114
Percent Baetidae	-0.37 0.5411	0.06 0.8735	0.71 0.1817
Percent Chironomidae	-0.6 0.2848	-0.24 0.5109	0.2 0.7471
Percent Collector-Filterers	-0.87 0.0539	-0.44 0.2058	-0.6 0.2848
Percent Collectors Gatherers	0.4 0.5046	-0.27 0.4458	-0.1 0.8729
Percent Dominant Taxon	0.4 0.5046	0.37 0.2915	-0.1 0.8729
Percent Hydropsychidae	. .	-0.23 0.5296	-0.95 0.0138
Percent Intolerant Taxa (0-2)	. .	0.08 0.8307	. .
Percent Predators	-0.8 0.1041	0.27 0.4429	0.4 0.5046
Percent Scrapers	0.3 0.6238	0.43 0.2114	1 0
Percent Tolerant Taxa (8-10)	-0.3 0.6238	0.06 0.8796	0.56 0.3217

Table 18. - continued

Benthic Habitat Metric	Del Puerto	Orestimba	Salt Slough
Shannon Diversity	-0.7 0.1881	-0.78 0.0075	0.2 0.7471
Taxonomic Richness	-0.7 0.1881	-0.53 0.1147	0.3 0.6238
Tolerance Value	0.97 0.0048	0.2 0.5784	0.7 0.1881

Table 19. Mean scores for each benthic metric for each creek with the p-values for comparing the means among creeks based on the Kruskal-Wallis test. Pairwise comparisons between creeks are based on the Wilcoxon rank-sum test.

Benthic Metric	Mean for each Creek			Kruskal-Wallace p-value	Pairwise Comparisons		
	Del Puerto	Orestimba	Salt Slough		DO	DS	OS
Number Trichoptera Taxa	0	1.3	0.8	0.0409*	*		
EPT Index (%)	0.8	8.3	4	0.4921			
Percent Hydropsychidae	0	7.8	3.6	0.1826			
Percent Chironomidae	11.4	31.1	20.2	0.0745			
Percent Collector Gatherers	43.6	54.1	29.8	0.0821			
Percent Intolerant Taxa (0-2)	0	0.7	0	0.4737			
Percent Tolerant Taxa (8-10)	45.6	41.7	51.6	0.0910			
Shannon Diversity	1.7768	2.5543	2.4262	0.1022			
Percent Dominant Taxon	53	30.2	34.4	0.0704			
Percent Predators	7.2	14.1	15.4	0.5294			
EPT Taxa	1.2	1.9	1	0.4032			
Percent Baetidae	0.8	0.1	0.4	0.1299			
Percent Scrapers	20.4	12.4	17	0.7362			
Percent Collector Filterers	27.2	17.1	37.4	0.3921			
Tolerance Value	7.18	6.72	6.52	0.5697			
Cumulative Taxa	28.4	35.2	32.4	0.2093			
Taxonomic Richness	28.4	35.2	32.4	0.2093			

DO – Del Puerto vs Orestimba
DS – Del Puerto vs Salt Slough
OS – Orestimba vs Salt Slough
* - p-value < 0.05

Table 20. Spearman rank correlation coefficients (top) and p-values (bottom) for benthic metrics versus habitat metrics.

	BANK STAB	BANK VEG	CHAN ALT	BEN RIFF	EPI SUB	RIP BUFF	SED DEP	VEL DPTH	CHAN FLOW	EMBE DDED	TOTAL
Cumulative Taxa	-0.048	0.431	-0.034	0.045	0.359	-0.04	-0.081	0.243	0.309	0.133	0.318
	0.841	0.058	0.886	0.851	0.12	0.867	0.734	0.302	0.185	0.577	0.172
EPT Index ()	0.291	0.308	0.312	0.08	0.345	0.468*	0.152	0.11	0.401	0.22	0.505*
	0.214	0.187	0.18	0.738	0.136	0.038	0.522	0.644	0.079	0.352	0.023
EPT Taxa	0.207	0.111	0.43	0.522*	0.31	0.428	0.366	-0.023	0.058	0.32	0.558*
	0.381	0.643	0.059	0.018	0.183	0.06	0.113	0.924	0.809	0.168	0.011
Number Trichoptera Taxa	0.232	0.325	0.429	0.284	0.267	0.403	0.218	0.176	0.261	0.153	0.503*
	0.326	0.162	0.059	0.224	0.255	0.078	0.356	0.458	0.266	0.521	0.024
Percent Baetidae	-0.037	-0.135	-0.08	0.054	0.205	-0.05	0.017	-0.033	-0.118	0.074	0.084
	0.876	0.571	0.738	0.82	0.386	0.833	0.943	0.891	0.619	0.757	0.725
Percent Chironomidae	-0.193	0.115	-0.083	-0.181	-0.181	-0.085	-0.381	-0.04	0.236	-0.227	-0.201
	0.415	0.63	0.727	0.444	0.446	0.721	0.097	0.866	0.317	0.337	0.395
Percent Collector-Filterers	0.356	0.558*	0.254	-0.118	0.252	0.412	-0.032	0.369	0.489*	0.092	0.412
	0.124	0.011	0.28	0.622	0.284	0.071	0.894	0.11	0.029	0.7	0.071
Percent Collectors	-0.223	-0.153	0.311	0.451*	-0.048	0.177	-0.023	0.061	-0.107	0.058	0.082
Gatherers	0.344	0.519	0.182	0.046	0.842	0.456	0.924	0.798	0.652	0.808	0.731
Percent Dominant Taxon	0.265	-0.089	-0.158	-0.162	-0.383	0.101	0.189	-0.423	-0.460*	0.009	-0.303
	0.259	0.709	0.506	0.494	0.095	0.672	0.424	0.063	0.041	0.968	0.194

* p-value < 0.05

Table 20. - continued

	BANK STAB	BANK VEG	CHAN ALT	BEN RIFF	EPI SUB	RIP BUFF	SED DEP	VEL DPTH	CHAN FLOW	EMBE DDED	TOTAL
Percent Hydropsychidae	0.332	0.362	0.307	0.089	0.28	0.497*	0.173	0.127	0.389	0.216	0.483*
	0.152	0.117	0.188	0.709	0.232	0.026	0.465	0.593	0.09	0.359	0.031
Percent Intolerant Taxa	-0.363	-0.29	0.001	-0.083	-0.382	0.005	-0.175	-0.054	-0.467*	-0.14	-0.407
(0-2)	0.116	0.215	0.998	0.728	0.097	0.983	0.461	0.822	0.038	0.557	0.075
Percent Predators	-0.155	-0.138	-0.028	0.124	0.435	-0.343	0.034	0.114	0.257	-0.027	0.242
	0.513	0.562	0.906	0.602	0.055	0.138	0.886	0.631	0.274	0.91	0.304
Percent Scrapers	-0.217	-0.347	-0.766*	-0.252	-0.127	-0.766*	-0.081	-0.297	-0.31	-0.036	-0.429
	0.358	0.133	0	0.284	0.593	0	0.735	0.204	0.184	0.879	0.059
Percent Tolerant Taxa	-0.452*	-0.199	-0.349	-0.597*	-0.21	-0.478*	-0.499*	0.08	0.025	-0.415	-0.485*
(8-10)	0.045	0.4	0.131	0.005	0.374	0.033	0.025	0.737	0.915	0.069	0.03
Shannon Diversity	-0.272	0.246	0.063	0.034	0.314	-0.024	-0.262	0.422	0.446*	-0.04	0.234
	0.245	0.295	0.791	0.887	0.178	0.92	0.265	0.064	0.049	0.867	0.321
Taxonomic Richness	-0.048	0.431	-0.034	0.045	0.359	-0.04	-0.081	0.243	0.309	0.133	0.318
	0.841	0.058	0.886	0.851	0.12	0.867	0.734	0.302	0.185	0.577	0.172
Tolerance Value	-0.386	-0.514*	-0.43	-0.079	-0.394	-0.39	-0.17	-0.371	-0.304	-0.237	-0.519*
	0.093	0.02	0.058	0.742	0.086	0.089	0.474	0.107	0.193	0.315	0.019

** p-value < 0.05

Table 21. Spearman Rank Correlation coefficients (top) and p-values (bottom) for benthic metrics vs. physical habitat measurements (not scored on a 0-20 scale).

Benthic Metric	Width	Depth	Mean Flow	Canopy	Fines	Gravel
Cumulative Taxa	0.371	0.2	0.38	0.550*	-0.257	0.281
	0.1073	0.3988	0.0982	0.012	0.2745	0.2308
EPT Index (%)	0.323	0.072	0.225	0.363	-0.344	0.279
	0.1643	0.7617	0.3413	0.116	0.1379	0.2344
EPT Taxa	0.006	-0.314	0.244	0.304	-0.608*	0.514*
	0.9804	0.1772	0.3006	0.1919	0.0045	0.0204
Number Trichoptera	0.27	-0.119	0.403	0.26	-0.28	0.28
Taxa	0.2498	0.6177	0.0782	0.2684	0.2318	0.2314
Percent Baetidae	-0.129	0.078	-0.029	0.062	-0.14	-0.041
	0.588	0.7427	0.9024	0.7955	0.5548	0.8632
Percent Chironomidae	0.388	0.163	0.02	0.059	0.105	0.019
	0.0907	0.4926	0.9321	0.8043	0.6606	0.9352
Percent Collector-	0.423	0.435	0.527*	0.315	0.005	0.013
Filterers	0.0633	0.0553	0.0169	0.1767	0.9847	0.9555
Percent Collectors	-0.072	-0.28	-0.035	0.249	-0.463*	0.486*
Gatherers	0.7618	0.2326	0.8845	0.29	0.04	0.0298
Percent Dominant	-0.268	-0.299	-0.202	-0.444*	0.134	-0.269
Taxon	0.2531	0.201	0.3928	0.0496	0.5731	0.2513
Percent	0.338	0.014	0.275	0.34	-0.308	0.301
Hydropsychidae	0.1446	0.9517	0.2401	0.142	0.1869	0.1971
Percent Intolerant	-0.105	-0.162	-0.08	-0.132	0.068	-0.085
Taxa (0-2)	0.6583	0.4958	0.7389	0.58	0.7761	0.7224
Percent Predators	0.199	0.254	0.088	0.087	0.056	-0.061
	0.3997	0.2792	0.7108	0.7152	0.8155	0.7967
Percent Scrapers	-0.294	-0.047	-0.444	-0.244	0.257	-0.241
	0.2083	0.8436	0.0501	0.3002	0.2733	0.3057

* p-value < 0.05

Table 21. - continued.

Benthic Metric	Width	Depth	Mean Flow	Canopy	Fines	Gravel
Percent Scrapers	-0.294	-0.047	-0.444	-0.244	0.257	-0.241
	0.2083	0.8436	0.0501	0.3002	0.2733	0.3057
Percent Tolerant Taxa	0.091	0.525*	-0.045	-0.403	0.673*	-0.678*
(8-10)	0.7021	0.0173	0.8496	0.078	0.0011	0.001
Shannon Diversity	0.384	0.351	0.253	0.572*	-0.135	0.237
	0.095	0.1297	0.2816	0.0084	0.5692	0.3148
Taxonomic Richness	0.371	0.2	0.38	0.550*	-0.257	0.281
	0.1073	0.3988	0.0982	0.012	0.2745	0.2308
Tolerance Value	-0.2	-0.157	-0.648*	-0.23	0.135	-0.14
	0.3973	0.509	0.002	0.3291	0.5703	0.5569

* p-value < 0.05

Table 22. Comparison of individual water quality measurements for sites sampled over the last four (Del Puerto Creek and Salt Slough) and five (Orestimba Creek) years.

	Temperature (C)					Specific Conductance (µmhos/L)					pH				
Site	2004	2003	2002	2001	2000	2004	2003	2002	2001	2000	2004	2003	2002	2001	2000
DLP1	23.2	22.9	15.6	20.2	n/a	1179	1199	704	910	n/a	8.44	8.62	8.06	8.17	n/a
DLP2	25.6	25.6	20.6	23.7	n/a	1165	1336	709	900	n/a	8.53	8.82	8.58	-	n/a
DLP3	25.3	24.1	22.2	30.5	n/a	1254	1143	742	1086	n/a	8.53	8.12	8.34	8.51	n/a
DLP4	23.2	31.4	28.3	18.2	n/a	649	564	520	628	n/a	8.47	8.50	7.55	8.05	n/a
DLP5	20.6	18.7	22.7	22.1	n/a	1738	1287	1689	992	n/a	8.10	8.30	8.51	8.32	n/a
ORE1	17.0	18.7	18.1	18.8	21.5	761	659	663	648	754	7.86	7.28	7.80	7.96	8.01
ORE2	17.0	20.3	19.9	20.3	22.5	717	644	605	662	744	7.92	8.01	8.01	8.12	8.23
ORE3	21.9	22.7	21.1	20.3	23.0	824	672	653	675	739	7.93	8.10	8.12	7.86	8.18
ORE4	20.9	22.1	21.0	21.4	21.4	806	653	640	334	683	7.96	7.98	8.09	8.17	8.01
ORE5	17.0	20.4	18.8	22.8	22.0	712	596	656	636	654	7.81	7.15	8.06	8.08	8.1
ORE6	18.7	21.8	18.7	24.7	22.9	689	681	696	584	644	7.80	7.01	8.21	7.8	8.25
ORE7	18.2	24.4	20.1	19.5	29.5	892	745	711	663	620	7.62	7.73	8.14	8.04	8.48
ORE8	26.9	25.0	22.6	21.6	22.9	901	755	763	695	840	7.79	7.89	8.08	7.87	8.21
ORE9	20.1	28.5	23.1	30.3	27.7	937	933	697	1000	857	8.22	7.91	8.13	8.59	8.4
ORE10	21.6	21.9	18.1	27.1	27.4	798	780	825	1044	878	7.76	7.88	8.25	8.37	8.37
SSL1	24.6	28.6	18.5	22.1	n/a	1606	1957	1885	989	n/a	7.73	7.68	7.69	7.62	n/a
SSL2	21.9	26.1	19.3	22.1	n/a	1450	1844	1339	1011	n/a	7.60	7.37	7.43	7.73	n/a
SSL3	23.2	27.4	20.8	24.5	n/a	1435	1616	1256	495	n/a	7.56	7.51	7.56	7.74	n/a
SSL4	18.9	24.6	23.5	20.6	n/a	951	1139	1073	542	n/a	7.59	7.35	7.75	7.30	n/a
SSL5	15.9	22.6	18.0	23.2	n/a	2148	956	1473	552	n/a	7.39	6.96	7.37	7.37	n/a

Table 22. - continued.

	Dissolved Oxygen (mg/L)					Salinity (ppt)					Turbidity (NTU)				
Site	2004	2003	2002	2001	2000	2004	2003	2002	2001	2000	2004	2003	2002	2001	2000
DLP1	8.28	9.19	9.5	9	n/a	0.6	-	0.4	0.4	-	81.3	3.33	84	103	n/a
DLP2	7.93	9.19	8.8	5.9	n/a	0.6	-	0.4	0.5	-	135	1.70	130	59	n/a
DLP3	7.43	8.06	9.1	4.7	n/a	0.6	-	0.4	0.5	-	64.5	1.93	112	25	n/a
DLP4	9.91	6.35	5.4	4.5	n/a	0.3	-	0.2	0.4	-	13.5	6.5	20	56	n/a
DLP5	10.06	8.24	12.2	4.0	n/a	0.9	-	0.9	0.5	-	1.13	1.53	1.1	0.64	n/a
ORE1	7.33	6.92	7.6	8.4	6.7	0.4	-	0.4	0.4	-	213	109.7	376	142	115
ORE2	7.91	7.90	7.8	5.0	8.2	0.4	-	0.3	0.4	-	249	102.8	207	126	158
ORE3	6.97	7.70	8.1	4.9	7.5	0.4	-	0.3	0.4	-	215	119	153	142	156
ORE4	7.48	7.72	8.3	4.2	7.8	0.4	-	0.3	0.2	-	267	135.6	226	104	107
ORE5	7.48	6.86	7.6	4.3	8.1	0.4	-	0.4	0.3	-	254	130	201	110	107
ORE6	7.58	7.14	8.1	4.0	8.9	0.4	-	0.4	0.3	-	270	99.7	178	128	131
ORE7	7.24	7.99	8.4	4.2	8.9	0.5	-	0.4	0.4	-	384	71.2	166	136	153
ORE8	6.46	7.07	7.9	3.3	8.2	0.4	-	0.4	0.4	-	656	116	150	92	80
ORE9	8.18	5.78	8.0	4.0	7.8	0.5	-	0.4	0.4	-	18.6	144	236	108	213
ORE10	6.52	7.18	3.2	4.8	13.0	0.2	-	0.1	0.5	-	0.26	0.07	0.88	0.82	0.51
SSL1	7.26	5.37	6.4	2.8	n/a	0.8	-	0.9	0.5	-	36.3	43.1	46	61	n/a
SSL2	7.07	5.12	6.0	3.2	n/a	0.8	-	0.8	0.5	-	49.7	80.1	41	78	n/a
SSL3	7.88	5.25	6.7	2.8	n/a	0.7	-	0.7	0.3	-	58.4	66.4	52	68	n/a
SSL4	6.81	5.44	7.4	2.9	n/a	0.5	-	0.6	0.3	-	56.1	60.3	52	65	n/a
SSL5	6.08	4.06	4.8	2.7	n/a	1.3	-	0.7	0.3	-	13.1	78.6	37	80	n/a

Table 23. Comparison of individual physical habitat metrics (0-20 scale) and total scores for sites sampled over the last four (Del Puerto Creek and Salt Slough) or five (Orestimba Creek) years.

Site & Date	Epifaunal Substrate					Embeddedness					Velocity Depth/Divers.					Sediment Deposition					Channel Flow Status				
	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
DLP1	n/a	9	10	13	15	n/a	7	8	12	13	n/a	16	17	16	11	n/a	14	12	15	14	n/a	19	14	16	15
DLP2	n/a	7	11	13	11	n/a	7	7	12	10	n/a	14	10	15	15	n/a	16	12	14	10	n/a	16	15	16	15
DLP3	n/a	6	10	12	10	n/a	5	4	6	9	n/a	7	10	9	10	n/a	7	12	11	10	n/a	15	16	14	15
DLP4	n/a	2	9	10	11	n/a	10	4	8	7	n/a	5	10	10	5	n/a	6	6	10	11	n/a	8	8	6	11
DLP5	n/a	10	3	13	6	n/a	11	16	13	5	n/a	13	3	9	5	n/a	11	13	11	11	n/a	9	7	14	8
ORE1	6	13	9	15	6	4	6	0	1	2	7	13	6	6	14	4	6	1	5	1	16	17	14	14	8
ORE2	10	14	10	7	11	13	11	13	10	4	10	16	9	10	13	5	10	14	9	3	15	20	16	14	16
ORE3	14	15	11	10	11	14	16	15	13	13	10	18	10	9	10	15	16	10	10	10	19	20	14	16	16
ORE4	15	12	8	11	12	14	16	14	8	13	17	19	10	10	10	16	15	16	13	14	15	20	10	16	10
ORE5	17	16	10	10	10	13	15	7	8	9	19	19	17	8	10	15	9	14	12	13	15	15	15	16	16
ORE6	10	13	7	6	12	11	16	9	8	12	13	16	5	9	10	10	13	16	11	13	15	15	19	16	13
ORE7	8	10	8	12	13	13	16	10	8	12	12	18	10	10	10	14	16	17	15	13	11	20	18	16	16
ORE8	13	11	9	9	11	11	15	7	7	9	10	15	16	14	10	14	15	16	12	12	10	20	19	13	15
ORE9	14	10	11	10	2	14	12	9	6	13	10	14	10	6	10	14	5	16	8	16	15	20	9	9	6
ORE10	10	7	8	10	6	7	6	14	10	8	13	7	3	10	4	12	5	8	13	11	9	6	6	14	7
SSL1	n/a	8	2	5	6	n/a	1	0	0	0	n/a	11	11	9	16	n/a	4	2	1	2	n/a	20	13	14	16
SSL2	n/a	5	1	6	6	n/a	1	0	0	1	n/a	12	13	6	6	n/a	5	2	6	2	n/a	19	14	19	18
SSL3	n/a	2	1	6	7	n/a	1	0	0	0	n/a	11	9	9	9	n/a	4	2	4	3	n/a	19	11	15	16
SSL4	n/a	6	6	8	7	n/a	0	0	0	1	n/a	12	6	7	6	n/a	2	3	5	1	n/a	20	13	19	16
SSL5	n/a	2	6	2	7	n/a	0	0	0	0	n/a	2	0	1	0	n/a	1	3	1	0	n/a	18	9	15	16

Table 23. - continued.

Site & Date	Channel Alteration					Frequency Bends/Riffles					Left Bank Stability					Right Bank Stability					Left Bank Veget. Protect.				
	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
DLP1	n/a	15	14	15	15	n/a	18	15	15	13	n/a	7	5	5	6	n/a	8	5	6	7	n/a	7	3	5	8
DLP2	n/a	12	8	10	13	n/a	7	12	10	7	n/a	2	3	4	6	n/a	2	3	2	4	n/a	2	3	4	7
DLP3	n/a	13	14	14	11	n/a	7	14	11	10	n/a	6	7	8	6	n/a	4	7	6	6	n/a	6	7	5	5
DLP4	n/a	2	11	6	11	n/a	2	8	6	8	n/a	5	6	5	7	n/a	3	7	4	7	n/a	5	4	3	6
DLP5	n/a	17	16	17	16	n/a	15	9	11	11	n/a	7	7	8	6	n/a	9	7	8	4	n/a	7	5	5	3
ORE1	18	16	14	16	15	5	15	4	5	7	1	8	6	5	5	1	2	3	4	2	2	9	6	6	6
ORE2	18	15	15	13	13	17	12	11	8	10	1	5	6	6	5	1	6	6	6	5	2	9	6	6	6
ORE3	15	15	8	7	13	18	15	7	6	7	7	3	3	3	5	7	6	7	3	5	6	6	4	3	7
ORE4	15	14	14	16	13	10	11	6	10	9	5	4	4	6	6	5	2	2	3	4	4	5	3	4	6
ORE5	15	15	14	14	14	18	16	16	11	15	7	6	7	6	6	6	5	7	6	5	9	8	7	6	6
ORE6	14	14	13	11	12	8	15	15	9	11	8	8	8	8	7	8	8	8	7	7	9	6	6	6	6
ORE7	15	15	14	15	15	10	16	7	12	13	4	8	7	7	8	5	6	6	6	6	6	6	7	6	3
ORE8	13	13	14	13	15	15	10	11	13	11	7	8	4	5	2	9	8	6	7	5	7	6	7	5	5
ORE9	15	15	15	13	11	10	15	9	10	4	9	8	7	3	6	9	8	8	3	6	8	7	7	3	4
ORE10	19	15	13	12	12	16	13	11	12	8	7	5	4	3	4	7	6	4	2	4	3	4	4	1	2
SSL1	n/a	15	14	16	16	n/a	15	7	4	7	n/a	7	5	3	2	n/a	6	3	3	6	n/a	8	6	3	3
SSL2	n/a	16	15	16	16	n/a	7	1	5	4	n/a	9	8	10	7	n/a	9	8	6	7	n/a	7	7	8	8
SSL3	n/a	14	14	15	14	n/a	8	2	5	2	n/a	8	6	6	6	n/a	8	6	7	6	n/a	6	7	6	7
SSL4	n/a	15	13	13	12	n/a	11	5	6	2	n/a	5	2	0	1	n/a	6	7	6	6	n/a	4	4	3	3
SSL5	n/a	6	0	2	2	n/a	6	0	0	0	n/a	1	0	0	1	n/a	1	0	0	1	n/a	1	0	0	1

Table 23. - continued.

Site & Date	Right Bank Veget. Protect.					Left Bank Ripar. Zone					Right Bank Ripar. Zone					Total Score				
	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04	00	01	02	03	04
DLP1	n/a	8	4	5	8	n/a	5	1	2	5	n/a	7	3	3	6	n/a	140	111	128	136
DLP2	n/a	2	3	1	3	n/a	1	1	3	3	n/a	1	1	3	1	n/a	89	89	107	105
DLP3	n/a	6	7	3	5	n/a	3	4	3	2	n/a	4	4	4	2	n/a	89	116	106	101
DLP4	n/a	3	4	3	6	n/a	4	1	2	1	n/a	4	1	2	0	n/a	59	79	75	91
DLP5	n/a	7	5	4	3	n/a	8	6	6	7	n/a	8	6	5	5	n/a	132	103	124	90
ORE1	2	7	6	6	4	5	8	4	6	6	3	8	4	3	4	74	128	77	92	80
ORE2	2	9	6	6	6	5	8	5	5	6	5	6	3	3	3	104	141	120	103	101
ORE3	6	4	7	6	6	3	3	1	2	5	3	3	4	4	5	137	140	101	92	113
ORE4	4	3	3	4	6	4	3	2	3	6	5	3	2	5	5	129	127	94	109	114
ORE5	8	8	7	6	6	8	5	4	6	5	8	5	3	5	4	158	142	128	114	119
ORE6	8	5	6	6	6	6	3	5	5	5	4	2	4	3	5	124	134	121	105	119
ORE7	9	9	7	8	4	3	3	4	4	3	6	6	4	5	3	116	149	119	124	119
ORE8	7	6	7	6	5	6	3	4	2	2	6	3	5	4	3	128	133	125	110	105
ORE9	8	7	7	3	4	7	5	3	3	4	8	5	5	3	4	141	131	116	80	90
ORE10	3	3	4	1	2	3	3	6	3	3	3	3	6	3	3	112	83	91	94	74
SSL1	n/a	6	6	3	6	n/a	9	8	6	6	n/a	9	8	3	7	n/a	119	85	70	93
SSL2	n/a	7	7	6	4	n/a	9	8	10	8	n/a	9	8	8	6	n/a	115	92	106	93
SSL3	n/a	6	7	6	7	n/a	8	4	3	2	n/a	5	5	5	5	n/a	100	74	87	84
SSL4	n/a	4	6	7	4	n/a	3	4	1	1	n/a	3	4	6	4	n/a	91	73	81	64
SSL5	n/a	1	0	0	1	n/a	0	0	1	1	n/a	0	0	1	1	n/a	39	18	23	31

Table 24a. Mean Scores for each physical habitat metric, total score, and stream measurement for years 2000 through 2004 for Orestimba creek. The p-value is based on Friedman's test and the pairwise comparisons are based on the Wilcoxon signed rank test.

Habitat Metric	2000	2001	2002	2003	2004	Friedman p-value	00 vs 01	00 vs 02	00 vs 03	00 vs 04	01 vs 02	01 vs 03	01 vs 04	02 vs 03	02 vs 04	03 vs 04
EPI SUB	11.7	12.1	9.1	10	9.4	0.0893	-	-	-	-	-	-	-	-	-	-
EMBEDDED	11.4	12.9	9.8	7.9	9.5	0.0037	-	-	*	*	-	*	*	*	-	-
VEL DPTH	12.1	15.5	9.6	9.2	10.1	0.0009	-	-	-	-	*	*	*	-	-	-
SED DEP	11.9	11	12.8	10.8	10.6	0.1907	-	-	-	-	-	-	-	-	-	-
CH FLOW	14	17.3	14	14.4	12.3	0.1104	-	-	-	-	-	-	-	-	-	-
CHAN ALT	15.7	14.7	13.4	13	13.3	0.0059	-	*	*	*	-	-	*	-	-	-
BENRIFF	12.7	13.8	9.7	9.6	9.5	0.0165	-	-	-	-	*	*	*	-	-	-
BANKSTAB	11.4	12	11.3	9.9	10.3	0.3381	-	-	-	-	-	-	-	-	-	-
BANKVEG	11.3	12.7	11.7	9.8	10	0.1400	-	-	-	-	-	-	-	-	-	-
RIPBUFF	10.1	8.8	7.8	7.7	8.4	0.1614	-	-	-	-	-	-	-	-	-	-
TOTAL	122.3	130.8	109.2	102.3	103.4	0.0024	-	-	*	*	*	*	*	-	-	-
WIDTH	3.86	6.17	4.58	4.54	4.408	0.0258	*	-	-	-	*	-	-	-	-	-
DEPTH	0.22	0.479	0.2	0.184	0.1542	0.009	*	-	-	-	*	*	*	-	-	-
CANOPY	32.9	28.9	50.1	31.2	26.2	0.3049	-	-	-	-	-	-	-	-	-	-

Table 24b. Mean Scores for each physical habitat metric, total score, and stream measurement for years 2001, 2002, 2003 and 2004 for Del Puerto creek. The p-value is based on Friedman's test and the pairwise comparisons are based on the Wilcoxon signed rank test.

Habitat Metric	2001	2002	2003	2004	Friedman p-value	01 vs 02	01 vs 03	01 vs 04	02 vs 03	02 vs 04	03 vs 04
EPI SUB	6.8	8.6	12.2	10.6	0.0277	-	-	-	-	-	-
EMBEDDED	8	7.8	10.2	8.8	0.3384	-	-	-	-	-	-
VEL DPTH	11	10	11.8	9.2	0.8013	-	-	-	-	-	-
SED DEP	10.8	11	12.2	11.2	0.7302	-	-	-	-	-	-
CH FLOW	13.4	12	13.2	12.8	0.5679	-	-	-	-	-	-
CHAN ALT	11.8	12.6	12.4	13.2	0.8185	-	-	-	-	-	-
BENRIFF	9.8	11.6	10.6	9.8	0.6823	-	-	-	-	-	-
BANKSTAB	10.6	11.4	11.2	11.8	0.8115	-	-	-	-	-	-
BANKVEG	10.6	9	7.6	10.8	0.3221	-	-	-	-	-	-
RIPBUFF	9	5.6	6.6	6.4	0.5008	-	-	-	-	-	-
TOTAL	101.8	99.6	108	104.6	0.9075	-	-	-	-	-	-
WIDTH	2.18	2.92	2.28	2.94	0.5595	-	-	-	-	-	-
DEPTH	0.382	0.138	0.156	0.2191	0.1629	-	-	-	-	-	-
CANOPY	15.2	24.8	26.4	14.6	0.4476	-	-	-	-	-	-

Table 24c. Mean Scores for each physical habitat metric, total score, and stream measurement for years 2001, 2002, 2003 and 2004 for Salt Slough. The p-value is based on Friedman's test and the pairwise comparisons are based on the Wilcoxon signed rank test.

Habitat Metric	2001	2002	2003	2004	Friedman p-value	01 vs 02	01 vs 03	01 vs 04	02 vs 03	02 vs 04	03 vs 04
EPI SUB	4.6	3.2	5.4	6.6	0.0733	-	-	-	-	-	-
EMBEDDED	0.6	0	0	0.4	0.1009	-	-	-	-	-	-
VEL DPTH	9.6	7.8	6.4	7.4	0.1826	-	-	-	-	-	-
SED DEP	3.2	2.4	3.4	1.6	0.2304	-	-	-	-	-	-
CH FLOW	19.2	12	16.4	16.4	0.0048	-	-	-	-	-	-
CHAN ALT	13.2	11.2	12.4	12	0.1009	-	-	-	-	-	-
BENRIFF	9.4	3	4	3	0.0115	-	-	-	-	-	-
BANKSTAB	12	9	8.2	8.6	0.0293	-	-	-	-	-	-
BANKVEG	10	10	8.4	8.8	0.6086	-	-	-	-	-	-
RIPBUFF	11	9.8	8.8	8.2	0.3916	-	-	-	-	-	-
TOTAL	92.8	68.4	73.4	73	0.0136	-	-	-	-	-	-
WIDTH	20.8	18.96	17.92	17.026	0.0669	-	-	-	-	-	-
DEPTH	0.79	0.586	0.452	0.4176	0.0406	-	-	-	-	-	-
CANOPY	0.2	0	0	1.8	0.5724	-	-	-	-	-	-

Table 25. Range of chlorpyrifos and diazinon concentrations measured historically in Del Puerto Creek, Orestimba Creek and Salt Slough.

OP Pesticide	Location	Range Conc (ng/L)	Years	Reference
Chlorpyrifos	Del Puerto Creek	0 - 120	1991/93	Poletika et al. 2002
Chlorpyrifos	Orestimba Creek	0 - 2,282	1996/97	Poletika and Robb, 1998
Chlorpyrifos	Salt Slough	0 - 120	1991/93	Poletika et al. 2002
Diazinon	Del Puerto Creek	0 - 2,600	1991/93	Poletika et al. 2002
Diazinon	Orestimba Creek	0 - 29,371	1996/97	Poletika and Robb, 1998
Diazinon	Salt Slough	0 - 330	1991/93	Poletika et al. 2002

Table 26. Comparison of resident benthic species by site in Del Puerto Creek, Orestimba Creek and Salt Slough with acute chlorpyrifos toxicity data from Giesy et al.,1999 and Barron and Woodburn, 1995.

Species	Collection Site	Abundance	EC or LC50 Values (µg/L)
Hydropsyche californica	ORE 3	140	30.6[A]
Hydropsyche californica	ORE 4	274	30.6[A]
Hydropsyche californica	ORE 5	34	30.6[A]
Hydropsyche californica	ORE 6	59	30.6[A]
Hydropsyche californica	ORE 7	93	30.6[A]
Hydropsyche californica	ORE 8	2	30.6[A]
Hydropsyche californica	SSL 1	62	30.6[A]
Hydropsyche californica	SSL 2	51	30.6[A]
Hydropsyche californica	SSL 3	28	30.6[A]
Chironomus sp.	DLP 1	2	0.07[B]
Chironomus sp.	DLP 2	18	0.07[B]
Chironomus sp.	DLP 3	5	0.07[B]
Chironomus sp.	DLP 4	1	0.07[B]
Chironomus sp.	ORE 1	2	0.07[B]
Chironomus sp.	ORE 2	8	0.07[B]
Chironomus sp.	ORE 3	1	0.07[B]
Chironomus sp.	ORE 5	3	0.07[B]
Chironomus sp.	ORE 10	1	0.07[B]
Chironomus sp.	SSL 1	1	0.07[B]
Chironomus sp.	SSL 2	1	0.07[B]
Chironomus sp.	SSL 3	2	0.07[B]
Chironomus sp.	SSL 4	17	0.07[B]
Chironomus sp.	SSL 5	7	0.07[B]
Cricotopus sp.	DLP 1	25	3.5-90
Cricotopus sp.	DLP 2	22	3.5-90
Cricotopus sp.	DLP 3	96	3.5-90

Table 26. - continued.

Cricotopus sp.	DLP 4	18	3.5-90
Cricotopus sp.	ORE 1	45	3.5-90
Cricotopus sp.	ORE 2	66	3.5-90
Cricotopus sp.	ORE 3	65	3.5-90
Cricotopus sp.	ORE 4	34	3.5-90
Cricotopus sp.	ORE 5	37	3.5-90
Cricotopus sp.	ORE 6	66	3.5-90
Cricotopus sp.	ORE 7	136	3.5-90
Cricotopus sp.	ORE 8	140	3.5-90
Cricotopus sp.	ORE 9	117	3.5-90
Cricotopus sp.	ORE 10	17	3.5-90
Cricotopus sp.	SSL 1	49	3.5-90
Cricotopus sp.	SSL 2	138	3.5-90
Cricotopus sp.	SSL 3	144	3.5-90
Cricotopus sp.	SSL 4	39	3.5-90
Cricotopus sp.	SSL 5	31	3.5-90
Dicrotendipes sp.	DLP 2	31	7-40[C]
Dicrotendipes sp.	DLP 3	7	7-40[C]
Dicrotendipes sp.	DLP 4	2	7-40[C]
Dicrotendipes sp.	ORE 1	78	7-40[C]
Dicrotendipes sp.	ORE 2	12	7-40[C]
Dicrotendipes sp.	ORE 3	20	7-40[C]
Dicrotendipes sp.	ORE 4	20	7-40[C]
Dicrotendipes sp.	ORE 5	19	7-40[C]
Dicrotendipes sp.	ORE 6	15	7-40[C]
Dicrotendipes sp.	ORE 7	3	7-40[C]
Dicrotendipes sp.	ORE 8	7	7-40[C]

Table 26. - continued.

Dicrotendipes sp.	ORE 10	518	7-40[C]
Dicrotendipes sp.	SSL 1	1	7-40[C]
Dicrotendipes sp.	SSL 2	8	7-40[C]
Dicrotendipes sp.	SSL 3	4	7-40[C]
Dicrotendipes sp.	SSL 4	7	7-40[C]
Dugesia tigrina	DLP 1	48	2.0-4.3[D]
Dugesia tigrina	DLP 2	91	2.0-4.3[D]
Dugesia tigrina	DLP 3	8	2.0-4.3[D]
Dugesia tigrina	DLP 4	17	2.0-4.3[D]
Dugesia tigrina	DLP 5	2	2.0-4.3[D]
Dugesia tigrina	ORE 3	2	2.0-4.3[D]
Dugesia tigrina	ORE 4	24	2.0-4.3[D]
Dugesia tigrina	ORE 5	6	2.0-4.3[D]
Dugesia tigrina	ORE 6	55	2.0-4.3[D]
Dugesia tigrina	ORE 7	166	2.0-4.3[D]
Dugesia tigrina	ORE 8	63	2.0-4.3[D]
Dugesia tigrina	SSL 4	3	2.0-4.3[D]
Gammarus sp.	ORE 1	2	0.11[E]
Gammarus sp.	ORE 2	1	0.11[E]
Gammarus sp.	ORE 5	8	0.11[E]
Gammarus sp.	ORE 6	33	0.11[E]
Gammarus sp.	ORE 7	70	0.11[E]
Gammarus sp.	ORE 8	70	0.11[E]
Gammarus sp.	SSL 1	26	0.11[E]
Gammarus sp.	SSL 2	29	0.11[E]
Gammarus sp.	SSL 3	10	0.11[E]
Hyalella sp.	DLP 2	2	1.3
Hyalella sp.	DLP 5	38	1.3

Table 26. - continued.

Hyalella sp.	ORE 8	2	1.3
Hyalella sp.	SSL 2	13	1.3
Hyalella sp.	SSL 3	8	1.3
Hyalella sp.	SSL 4	60	1.3
Hyalella sp.	SSL 5	9	1.3
Enallagma sp.	ORE 1	1	11.4^{F}
Enallagma sp.	SSL 4	2	11.4^{F}
Enallagma sp.	SSL 5	24	11.4^{F}
Limnodrilus hoffmeisteri	ORE 1	5	>36
Limnodrilus hoffmeisteri	ORE 2	15	>36
Limnodrilus hoffmeisteri	ORE 3	1	>36
Limnodrilus hoffmeisteri	ORE 5	8	>36
Limnodrilus hoffmeisteri	SSL 3	3	>36
Limnodrilus hoffmeisteri	SSL 4	5	>36
Paratanytarsus sp.	DLP 3	1	<1.6
Paratanytarsus sp.	ORE 1	3	<1.6
Paratanytarsus sp.	ORE 2	4	<1.6
Paratanytarsus sp.	ORE 3	4	<1.6
Paratanytarsus sp.	ORE 4	12	<1.6
Paratanytarsus sp.	ORE 5	11	<1.6
Paratanytarsus sp.	ORE 6	1	<1.6
Paratanytarsus sp.	ORE 7	1	<1.6
Paratanytarsus sp.	ORE 8	5	<1.6
Paratanytarsus sp.	ORE 10	1	<1.6
Paratanytarsus sp.	SSL 1	2	<1.6
Paratanytarsus sp.	SSL 2	8	<1.6
Paratanytarsus sp.	SSL 3	10	<1.6
Paratanytarsus sp.	SSL 4	1	<1.6

Table 26. - continued.

Paratanytarsus sp.	SSL 5	90	<1.6
Simulium sp.	DLP 1	447	27[G]
Simulium sp.	DLP 2	248	27[G]
Simulium sp.	DLP 3	370	27[G]
Simulium sp.	DLP 4	1	27[G]
Simulium sp.	DLP 5	1	27[G]
Simulium sp.	ORE 2	10	27[G]
Simulium sp.	ORE 3	34	27[G]
Simulium sp.	ORE 4	2	27[G]
Simulium sp.	ORE 5	1	27[G]
Simulium sp.	ORE 6	21	27[G]
Simulium sp.	ORE 7	2	27[G]
Simulium sp.	ORE 8	14	27[G]
Simulium sp.	ORE 9	2	27[G]
Simulium sp.	SSL 2	4	27[G]
Simulium sp.	SSL 3	6	27[G]
Tanypus sp.	SSL 1	1	1.5[H]
Tanypus sp.	SSL 2	1	1.5[H]
Tanypus sp.	SSL 3	22	1.5[H]
Tanypus sp.	SSL 4	10	1.5[H]
Tanypus sp.	SSL 5	27	1.5[H]

[A] Listed toxicity value was for *Hydropsyche/Cheumatopsyche sp.*
[B] Listed toxicity value was for *Chironomus tentans.*
[C] Listed toxicity value was for *Dicrotendipes californicus.*
[D] Listed toxicity value was for *Dugesia dorotocephala.*
[E] Listed toxicity value was for *Gammarus lacustris*. Two values listed for this species. Used conservative value, other value = 0.76 µg/L.
[F] Listed toxicity value was for *Enallagma/Ischnura sp.*
[G] Listed toxicity value was for *Simulium vitattum.*
[H] Listed toxicity value was for *Tanypus grodhaus*

Table 27. Comparison of resident benthic species by site in Del Puerto Creek, Orestimba Creek and Salt Slough with acute diazinon toxicity data from Giddings et al. 2000.

Species	Collection Site	Abundance	EC or LC50 Values (μg/L)
Baetis adonis	DLP 5	1	24[A]
Gammarus sp.	ORE 1	2	184[B]
Gammarus sp.	ORE 2	1	184[B]
Gammarus sp.	ORE 5	8	184[B]
Gammarus sp.	ORE 6	33	184[B]
Gammarus sp.	ORE 7	70	184[B]
Gammarus sp.	ORE 8	70	184[B]
Gammarus sp.	SSL 1	26	184[B]
Gammarus sp.	SSL 2	29	184[B]
Gammarus sp.	SSL 3	10	184[B]
Hyalella sp.	DLP 2	2	22[C]
Hyalella sp.	DLP 5	38	22[C]
Hyalella sp.	ORE 8	2	22[C]
Hyalella sp.	SSL 2	13	22[C]
Hyalella sp.	SSL 3	8	22[C]
Hyalella sp.	SSL 4	60	22[C]
Hyalella sp.	SSL 5	9	22[C]
Physa sp.	DLP 1	3	48[D]
Physa sp.	DLP 2	86	48[D]
Physa sp.	DLP 3	51	48[D]
Physa sp.	DLP 4	326	48[D]
Physa sp.	DLP 5	29	48[D]
Physa sp.	ORE 1	9	48[D]
Physa sp.	ORE 2	7	48[D]
Physa sp.	ORE 3	9	48[D]
Physa sp.	ORE 4	2	48[D]
Physa sp.	ORE 5	17	48[D]
Physa sp.	ORE 6	7	48[D]

Table 27. - continued.

Physa sp.	ORE 7	7	48[D]
Physa sp.	ORE 8	56	48[D]
Physa sp.	ORE 9	538	48[D]
Physa sp.	ORE 10	16	48[D]
Physa sp.	SSL 1	1	48[D]
Physa sp.	SSL 2	2	48[D]
Physa sp.	SSL 3	14	48[D]
Physa sp.	SSL 4	113	48[D]
Physa sp.	SSL 5	305	4800[E]
Undetermined Tubificidae	DLP 1	138	3160[F]
Undetermined Tubificidae	DLP 2	93	3160[F]
Undetermined Tubificidae	DLP 3	69	3160[F]
Undetermined Tubificidae	DLP 4	3	3160[F]
Undetermined Tubificidae	ORE 1	15	3160[F]
Undetermined Tubificidae	ORE 2	28	3160[F]
Undetermined Tubificidae	ORE 3	33	3160[F]
Undetermined Tubificidae	ORE 4	21	3160[F]
Undetermined Tubificidae	ORE 5	188	3160[F]
Undetermined Tubificidae	ORE 6	6	3160[F]
Undetermined Tubificidae	ORE 7	5	3160[F]
Undetermined Tubificidae	ORE 8	4	3160[F]
Undetermined Tubificidae	SSL 1	99	3160[F]
Undetermined Tubificidae	SSL 2	4	3160[F]
Undetermined Tubificidae	SSL 3	11	3160[F]
Undetermined Tubificidae	SSL 4	39	3160[F]
Undetermined Tubificidae	SSL 5	14	3160[F]

[A] Listed toxicity value was for *Baetis intermedius.*
[B] Listed toxicity value was for *Gammarus lacustris.*
[C] Listed toxicity value was for *Hyalella azteca.*
[D] Listed toxicity value was for *Physa gyrina.*
[E] Listed toxicity value was for *Physa acuta.*
[F] Listed toxicity value was for *Tubifex* species.

Table 28a. Mean scores for each benthic metric by year for Orestimba Creek with p-values for among years means comparison and pairwise comparisons between years.

Benthic Metric	2000	2001	2002	2003	2004	Friedman p-value	00 vs 01	00 vs 02	00 vs 03	00 vs 04	01 vs 02
Abundance (#/ sample)	1012	588.033	1456.917	1365.967	.	0.1604	-	-	-	-	-
Cumulative EPT Taxa	.	1.9	1.3	.	.	0.4795	-	-	-	-	-
Cumulative Taxa	.	35.3	33.2	.	35.2	0.5179	-	-	-	-	-
Dipteran Taxa	.	1.533	.	.	.	.	-	-	-	-	-
EPT Index (%)	2.033	4.233	1.367	2.8	8.3	0.5292	-	-	-	-	-
EPT Taxa	0.933	1	0.933	1.3	1.9	0.0609	-	-	-	-	-
Ephemeroptera Taxa	0.6	0.567	0.4	.	.	0.5045	-	-	-	-	-
Non-Insect Taxa	.	11.633	.	.	.	.	-	-	-	-	-
Percent Baetidae	.	2.333	0.233	0.6	0.1	0.5668	-	-	-	-	-
Percent Chironomidae	.	18.367	34.4	40.6	31.1	0.0173	-	-	-	-	-
Percent Collectors	75.833	56.567	35.433	69.6	54.1	0.0002	*	*	-	*	*
Percent Diptera	.	9.067	.	.	.	.	-	-	-	-	-
Percent Dominant Taxon	44.2	32.133	35.1	24.8	30.2	0.0096	-	-	*	-	-
Percent Filterers	7.067	16.433	30.9	10.533	17.1	0.0039	*	*	-	-	-
Percent Grazers	3.733	3.367	8.1	.	.	0.4516	-	-	-	-	-
Percent Hydropsychidae	.	0.133	0.533	0.9	7.8	0.0812	-	-	-	-	-
Percent Intolerant Taxa (0-2)	0.3	0.233	0.033	0.267	0.7	0.1546	-	-	-	-	-
Percent Non-Insect Taxa	.	64.6	.	.	.	.	-	-	-	-	-
Percent Predators	7.1	10.4	13.767	4.333	14.1	0.7081	-	-	-	-	-
Percent Scrapers	.	.	.	11.1	12.4	1	-	-	-	-	-
Percent Shredders	6.067	6.733	11.767	0	0	0	-	-	*	*	-
Percent Tolerant Taxa (8-10)	52.567	52.667	30.867	35.933	41.7	0.0279	-	-	-	-	-
Plecoptera Taxa	0	0	0	0	0	.	-	-	-	-	-
Sensitive EPT Index (%)	0.433	0	0.167	0.867	0	0.406	-	-	-	-	-
Shannon Diversity	1.837	2.25	2.17	2.403	2.554	0.0057	-	-	*	-	-
Taxonomic Richness	17.333	22.367	21.9	23.067	35.2	0.0021	*	-	*	*	-
Tolerance Value	6.817	6.8	6.723	7.147	6.72	0.3142	-	-	-	-	-
Trichoptera Taxa	0.333	0.433	0.533	0.633	1.3	0.0246	-	-	-	*	-

*$p < 0.05$

Table 28a - continued

Benthic Metric	2000	2001	2002	2003	2004	Friedman p-value	01 vs 03	01 vs 04	02 vs 03	02 vs 04	03 vs 04
Abundance (#/ sample)	1012	588.033	1456.917	1365.967	.	0.1604	-	-	-	-	-
Cumulative EPT Taxa	.	1.9	1.3	.	.	0.4795	-	-	-	-	-
Cumulative Taxa	.	35.3	33.2	.	35.2	0.5179	-	-	-	-	-
Dipteran Taxa	.	1.533	.	.	.	.	-	-	-	-	-
EPT Index (%)	2.033	4.233	1.367	2.8	8.3	0.5292	-	-	-	-	-
EPT Taxa	0.933	1	0.933	1.3	1.9	0.0609	-	-	-	-	-
Ephemeroptera Taxa	0.6	0.567	0.4	.	.	0.5045	-	-	-	-	-
Non-Insect Taxa	.	11.633	.	.	.	.	-	-	-	-	-
Percent Baetidae	.	2.333	0.233	0.6	0.1	0.5668	-	-	-	-	-
Percent Chironomidae	.	18.367	34.4	40.6	31.1	0.0173	*	-	-	-	-
Percent Collectors	75.833	56.567	35.433	69.6	54.1	0.0002	-	-	*	*	-
Percent Diptera	.	9.067	.	.	.	.	-	-	-	-	-
Percent Dominant Taxon	44.2	32.133	35.1	24.8	30.2	0.0096	-	-	*	-	-
Percent Filterers	7.067	16.433	30.9	10.533	17.1	0.0039	-	-	*	*	-
Percent Grazers	3.733	3.367	8.1	.	.	0.4516	-	-	-	-	-
Percent Hydropsychidae	.	0.133	0.533	0.9	7.8	0.0812	-	-	-	-	-
Percent Intolerant Taxa (0-2)	0.3	0.233	0.033	0.267	0.7	0.1546	-	-	-	-	-
Percent Non-Insect Taxa	.	64.6	.	.	.	.	-	-	-	-	-
Percent Predators	7.1	10.4	13.767	4.333	14.1	0.7081	-	-	-	-	-
Percent Scrapers	.	.	.	11.1	12.4	1	-	-	-	-	-
Percent Shredders	6.067	6.733	11.767	0	0	0	*	*	*	*	-
Percent Tolerant Taxa (8-10)	52.567	52.667	30.867	35.933	41.7	0.0279	*	-	-	-	-
Plecoptera Taxa	0	0	0	0	0	.	-	-	-	-	-
Sensitive EPT Index (%)	0.433	0	0.167	0.867	0	0.406	-	-	-	-	-
Shannon Diversity	1.837	2.25	2.17	2.403	2.554	0.0057	-	-	*	-	-
Taxonomic Richness	17.333	22.367	21.9	23.067	35.2	0.0021	-	*	-	*	*
Tolerance Value	6.817	6.8	6.723	7.147	6.72	0.3142	-	-	-	-	-
Trichoptera Taxa	0.333	0.433	0.533	0.633	1.3	0.0246	-	*	-	-	-

*p <0.05

Table 28b. Mean scores for each benthic metric by year for Del Puerto Creek with p-values for among years means comparison.

Benthic Metric	2001	2002	2003	2004	Friedman p-value	01 vs 02	01 vs 03	01 vs 04	02 vs 03	02 vs 04	03 vs 04
Abundance (#/ sample)	864.867	1361.267	2691.933	.	0.2466	-	-	-	-	-	-
Cumulative EPT Taxa	1.4	1.8	.	.	1	-	-	-	-	-	-
Cumulative Taxa	34.6	35	.	28.4	0.8187	-	-	-	-	-	-
Dipteran Taxa	1.267	.	.	.	.	-	-	-	-	-	-
EPT Index (%)	6.267	1.067	1.867	0.8	0.5308	-	-	-	-	-	-
EPT Taxa	1.067	0.8	1.4	1.2	0.2584	-	-	-	-	-	-
Ephemeroptera Taxa	0.8	0.533	.	.	0.1573	-	-	-	-	-	-
Non-Insect Taxa	9.933	.	.	.	.	-	-	-	-	-	-
Percent Baetidae	5	0.6	1.467	0.8	0.5308	-	-	-	-	-	-
Percent Chironomidae	36.267	25.133	30.2	11.4	0.1777	-	-	-	-	-	-
Percent Collectors	38.533	38.667	50.733	43.6	0.7819	-	-	-	-	-	-
Percent Diptera	12.6	.	.	.	.	-	-	-	-	-	-
Percent Dominant Taxon	29.867	38.133	43.667	53	0.1176	-	-	-	-	-	-
Percent Filterers	16.6	7.6	30.667	27.2	0.3916	-	-	-	-	-	-
Percent Grazers	3.667	15.933	.	.	0.0253	-	-	-	-	-	-
Percent Hydropsychidae	1.067	0	0	0	0.3916	-	-	-	-	-	-
Percent Intolerant Taxa (0-2)	0	0.067	0.067	0	0.3916	-	-	-	-	-	-
Percent Non-Insect Taxa	42.133	.	.	.	.	-	-	-	-	-	-
Percent Predators	14.8	22.467	4.533	7.2	0.0954	-	-	-	-	-	-
Percent Scrapers	.	.	6.867	20.4	0.6547	-	-	-	-	-	-
Percent Shredders	16.067	15.133	0.067	0	0.0034	-	-	-	-	-	-
Percent Tolerant Taxa (8-10)	41.667	45.2	32.133	45.6	0.6685	-	-	-	-	-	-
Plecoptera Taxa	0	0	0	0	.	-	-	-	-	-	-
Sensitive EPT Index (%)	0	0.4	0.2	0	0.3916	-	-	-	-	-	-
Shannon Diversity	2.193	2.047	1.82	1.777	0.4309	-	-	-	-	-	-
Taxonomic Richness	21.8	21.533	18.8	28.4	0.1777	-	-	-	-	-	-
Tolerance Value	6.473	7.173	6.887	7.18	0.1748	-	-	-	-	-	-
Trichoptera Taxa	0.267	0.267	0.467	0	0.3916	-	-	-	-	-	-

* $p < 0.05$

Table 28c. Mean scores for each benthic metric by year for Salt Slough with p-values for among years means comparison.

Benthic Metric	2001	2002	2003	2004	Friedman p-value	01 vs 02	01 vs 03	01 vs 04	02 vs 03	02 vs 04	03 vs 04
Abundance (#/ sample)	399.533	1228.067	763.667	.	0.0743	-	-	-	-	-	-
Cumulative EPT Taxa	2	1	.	.	0.0833	-	-	-	-	-	-
Cumulative Taxa	35.6	40.2	.	32.4	0.0759	-	-	-	-	-	-
Dipteran Taxa	0.8	.	.	.	.	-	-	-	-	-	-
EPT Index (%)	2.867	2.467	3.4	4	0.5186	-	-	-	-	-	-
EPT Taxa	1	0.667	0.933	1	0.769	-	-	-	-	-	-
Ephemeroptera Taxa	0.067	0.2	.	.	0.5637	-	-	-	-	-	-
Non-Insect Taxa	8.333	.	.	.	.	-	-	-	-	-	-
Percent Baetidae	0	0	0	0.4	0.3916	-	-	-	-	-	-
Percent Chironomidae	35.133	33.333	20.4	20.2	0.3234	-	-	-	-	-	-
Percent Collectors	48.4	17.267	28.733	29.8	0.0503	-	-	-	-	-	-
Percent Diptera	1.133	.	.	.	.	-	-	-	-	-	-
Percent Dominant Taxon	33.4	42.267	53.133	34.4	0.0126	-	-	-	-	-	-
Percent Filterers	12.067	25.667	46.8	37.4	0.1344	-	-	-	-	-	-
Percent Grazers	8.8	14.6	.	.	0.1797	-	-	-	-	-	-
Percent Hydropsychidae	2.733	2.467	3.133	3.6	0.6922	-	-	-	-	-	-
Percent Intolerant Taxa (0-2)	0	0	0	0	.	-	-	-	-	-	-
Percent Non-Insect Taxa	46.267	.	.	.	.	-	-	-	-	-	-
Percent Predators	17.133	17.8	4.533	15.4	0.0386	-	-	-	-	-	-
Percent Scrapers	.	.	19.533	17	0.6547	-	-	-	-	-	-
Percent Shredders	10.8	24.667	0	0	0.0018	-	-	-	-	-	-
Percent Tolerant Taxa (8-10)	71.867	43.733	32.2	51.6	0.0694	-	-	-	-	-	-
Plecoptera Taxa	0	0	0	0	.	-	-	-	-	-	-
Sensitive EPT Index (%)	0	0	0	0	.	-	-	-	-	-	-
Shannon Diversity	2.173	1.94	1.567	2.426	0.0061	-	-	-	-	-	-
Taxonomic Richness	22.133	21.533	16.667	32.4	0.0048	-	-	-	-	-	-
Tolerance Value	7.833	7.38	6.1	6.52	0.3916	-	-	-	-	-	-
Trichoptera Taxa	0.933	0.467	0.933	0.8	0.1371	-	-	-	-	-	-

* p <0.05

Figure 1. San Joaquin River Basin showing relative locations of Del Puerto Creek, Orestimba Creek and Salt Slough.

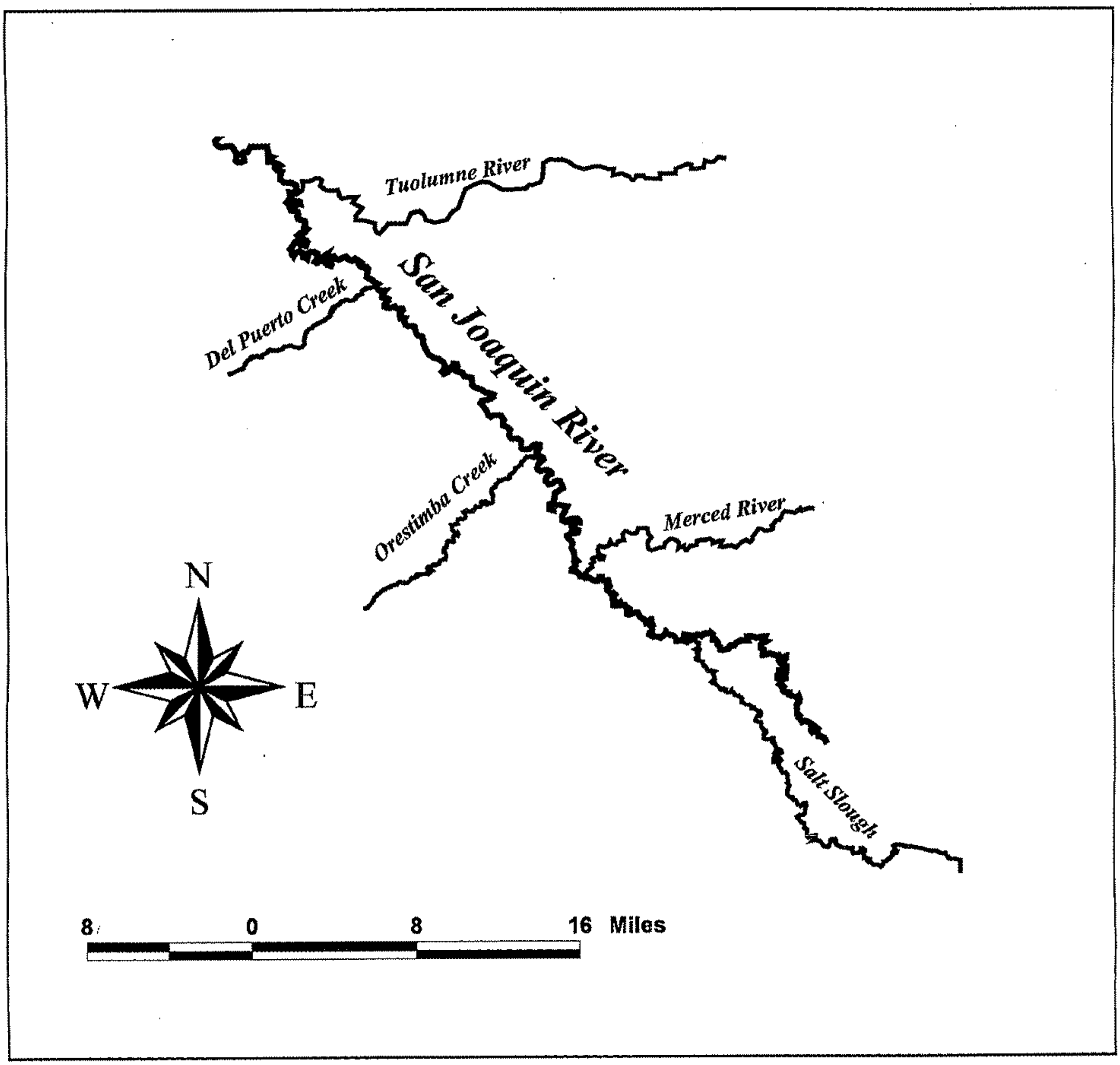
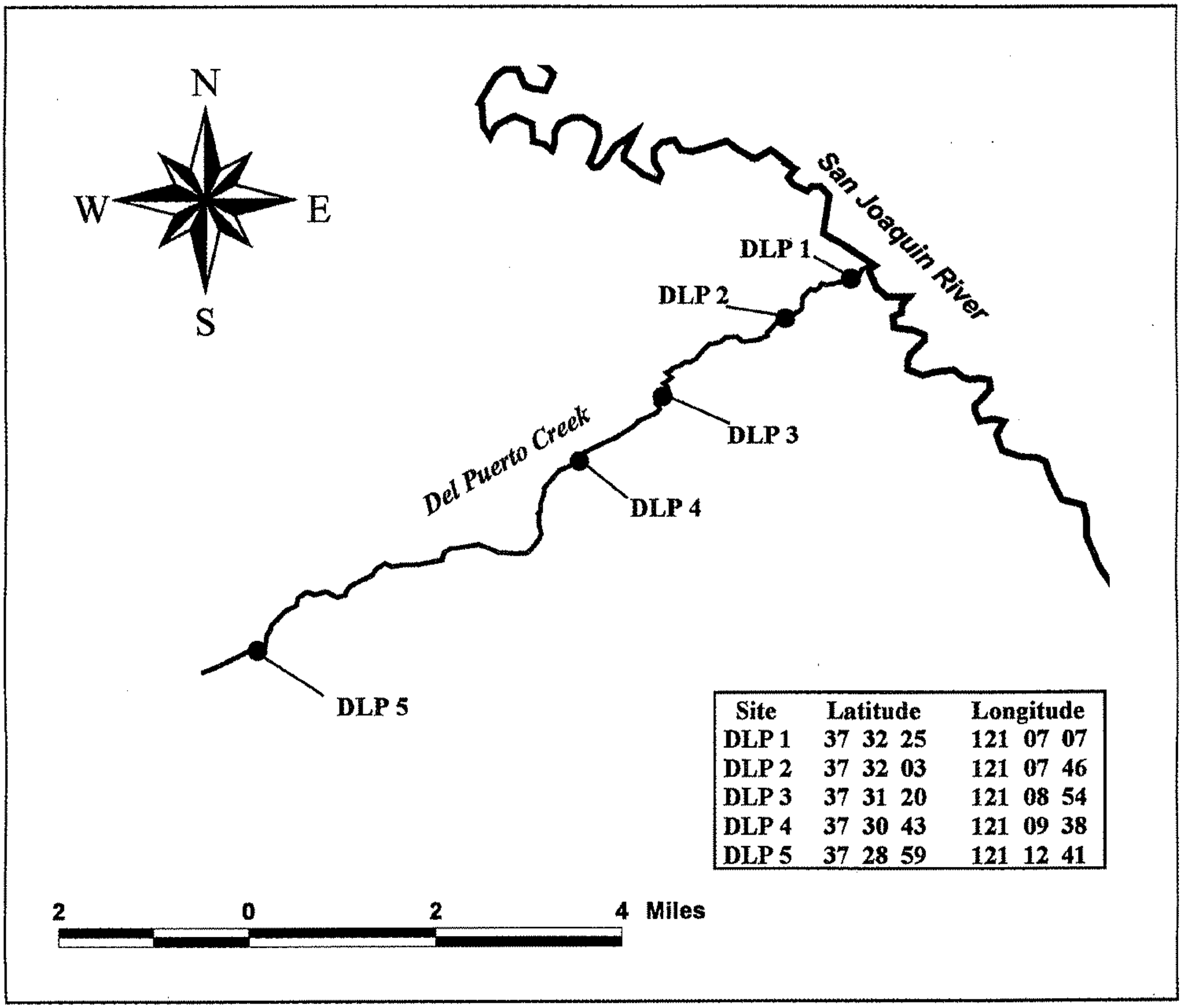
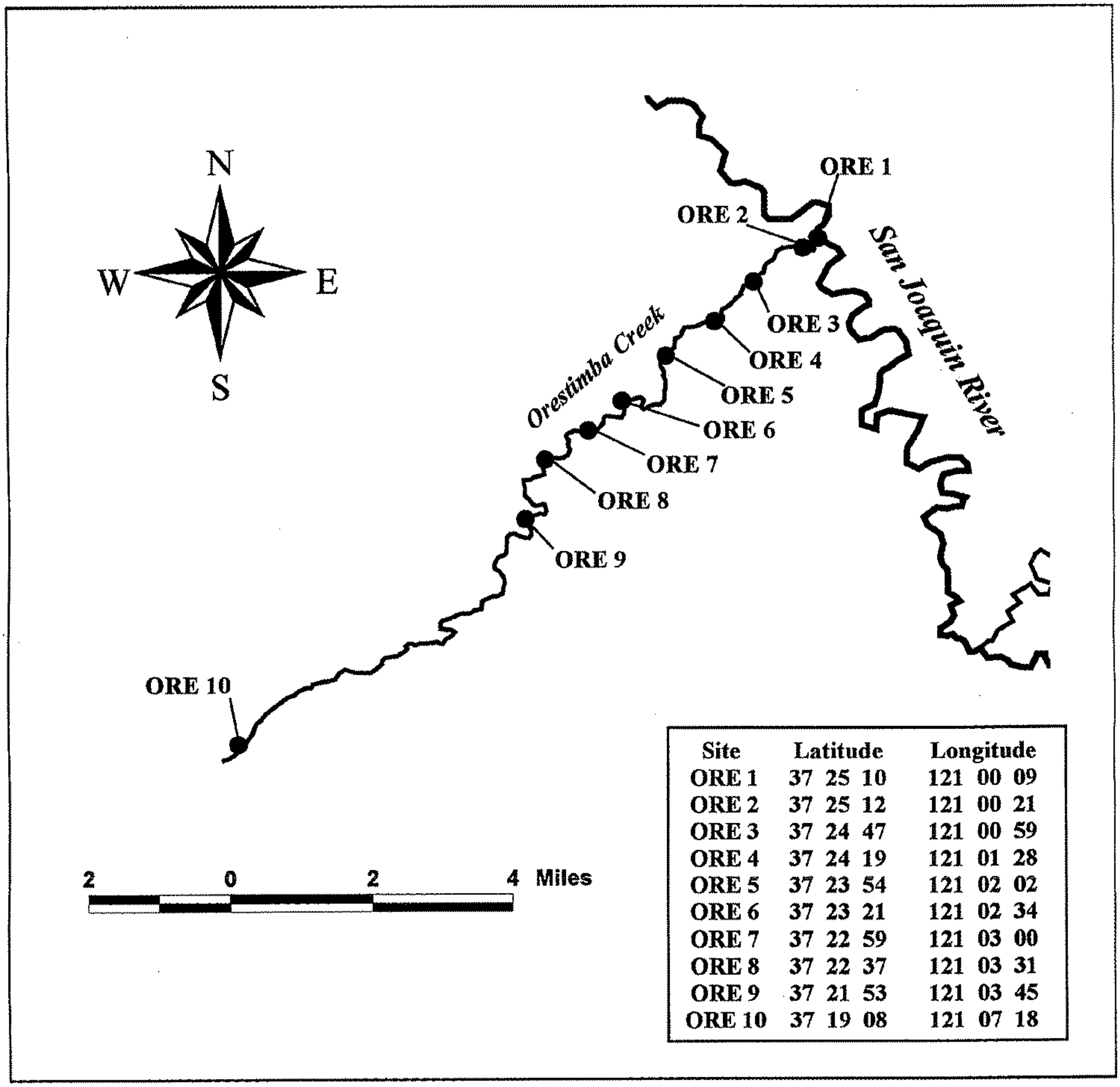


Figure 2. Del Puerto Creek sample sites.



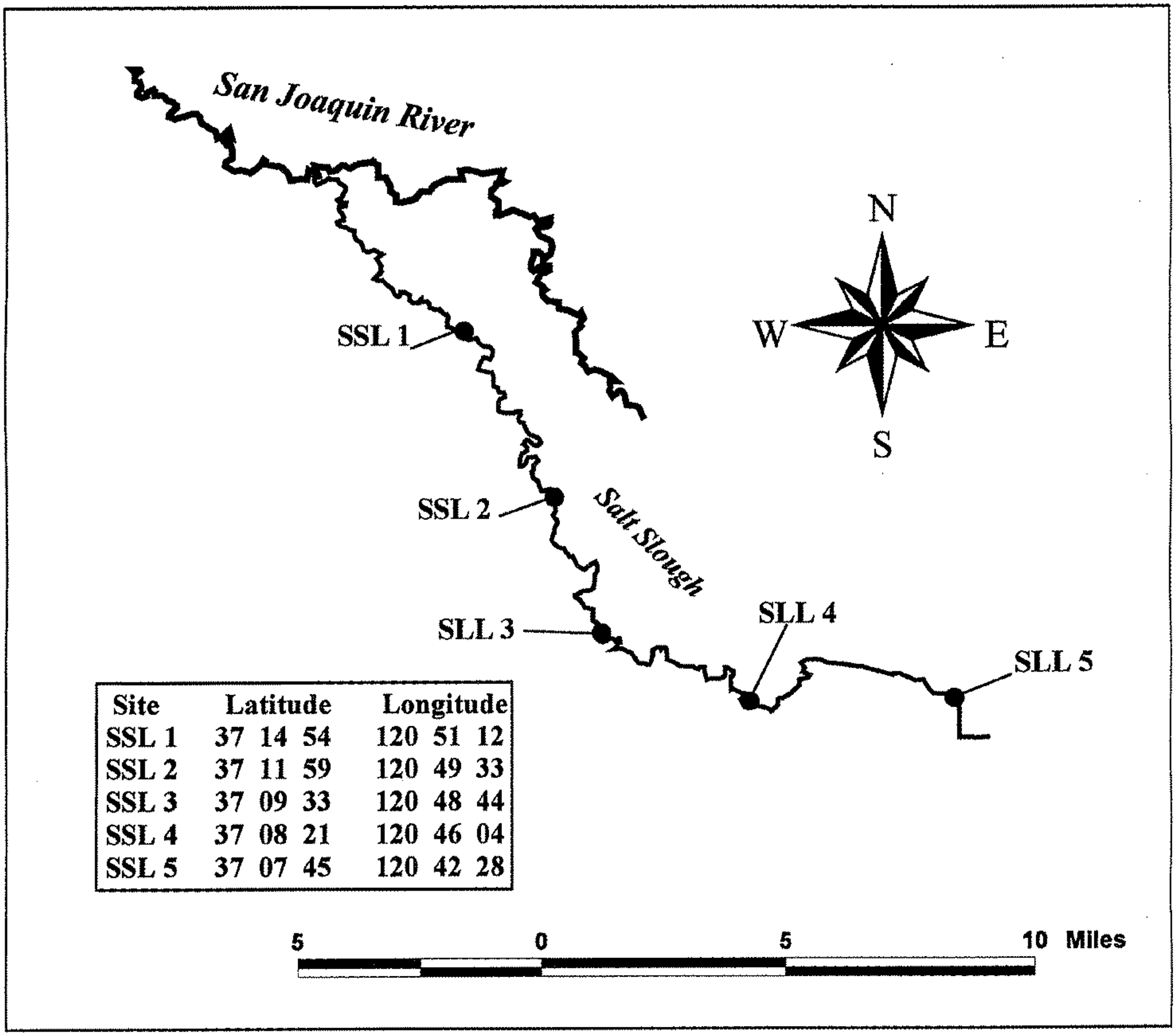
Site	Latitude	Longitude
DLP 1	37 32 25	121 07 07
DLP 2	37 32 03	121 07 46
DLP 3	37 31 20	121 08 54
DLP 4	37 30 43	121 09 38
DLP 5	37 28 59	121 12 41

Figure 3. Orestimba Creek sample sites.



Site	Latitude	Longitude
ORE 1	37 25 10	121 00 09
ORE 2	37 25 12	121 00 21
ORE 3	37 24 47	121 00 59
ORE 4	37 24 19	121 01 28
ORE 5	37 23 54	121 02 02
ORE 6	37 23 21	121 02 34
ORE 7	37 22 59	121 03 00
ORE 8	37 22 37	121 03 31
ORE 9	37 21 53	121 03 45
ORE 10	37 19 08	121 07 18

Figure 4. Salt Slough sample sites.



Site	Latitude	Longitude
SSL 1	37 14 54	120 51 12
SSL 2	37 11 59	120 49 33
SSL 3	37 09 33	120 48 44
SSL 4	37 08 21	120 46 04
SSL 5	37 07 45	120 42 28

Figure 5. Macroinvertebrate richness for each transect and site total for the 5 Del Puerto Creek sites.

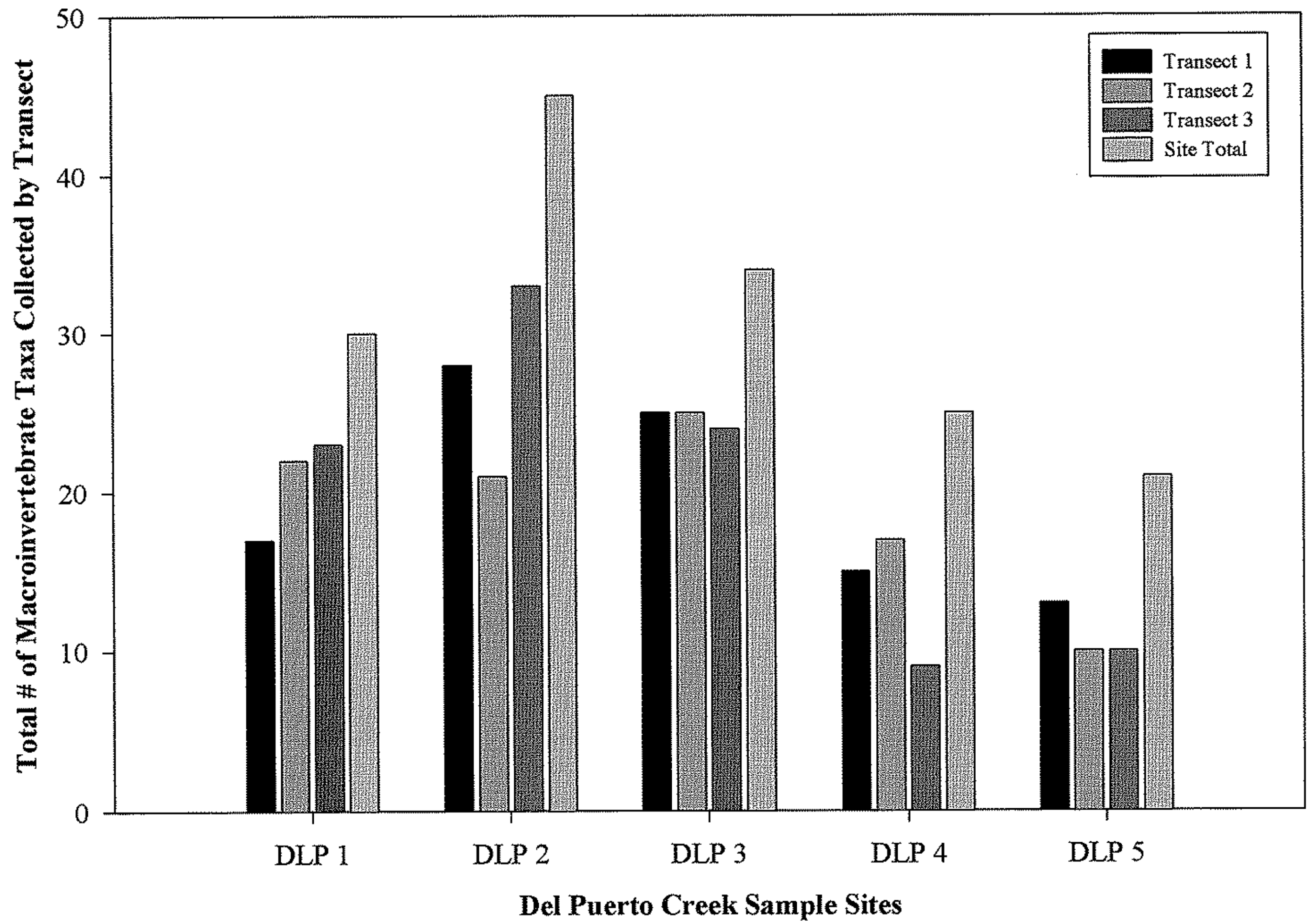


Figure 6. Macroinvertebrate abundance for each transect and site total for the 5 Del Puerto Creek sites.

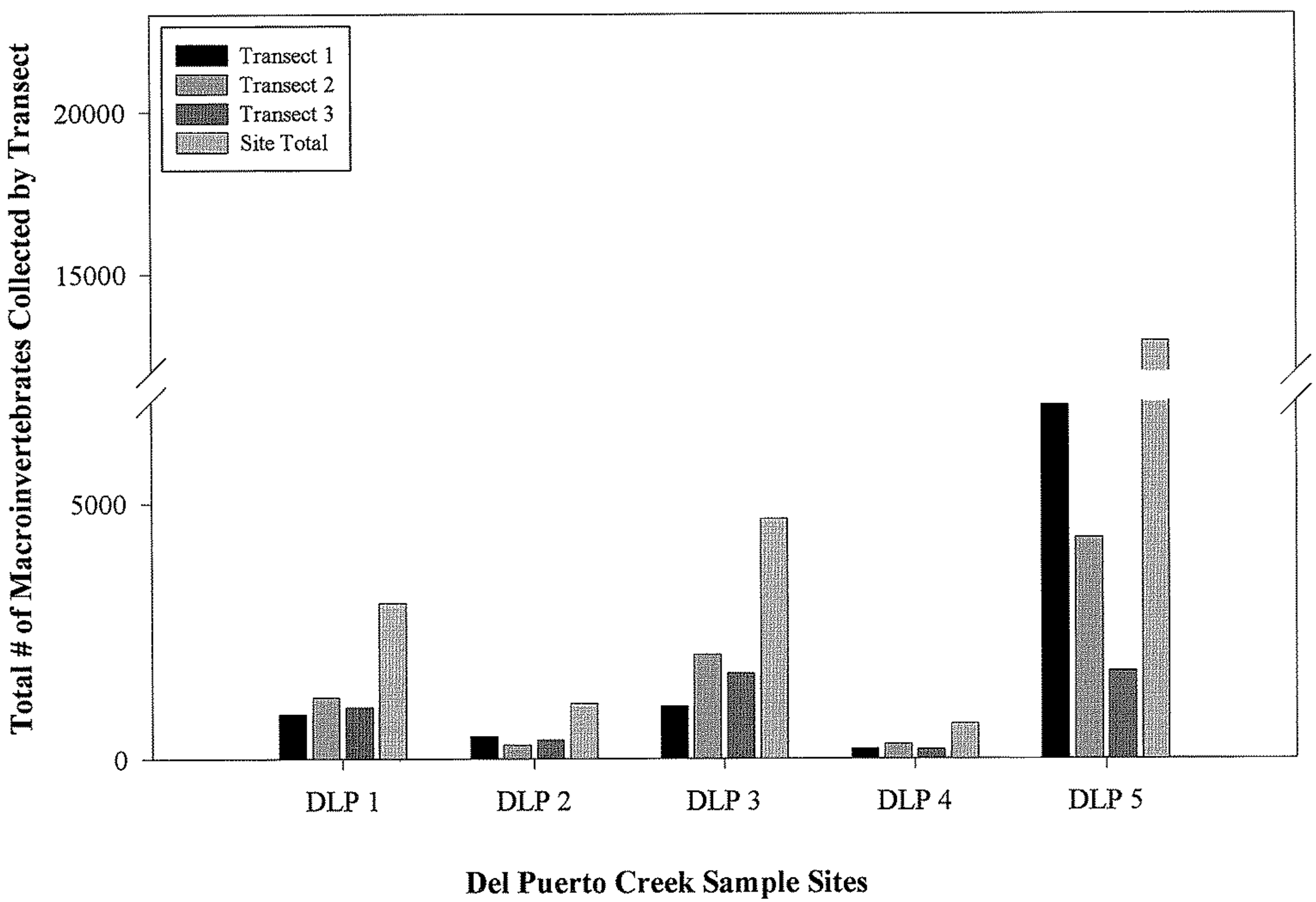


Figure 7. Macroinvertebrate richness for each transect and site total for the 10 Orestimba Creek sites.

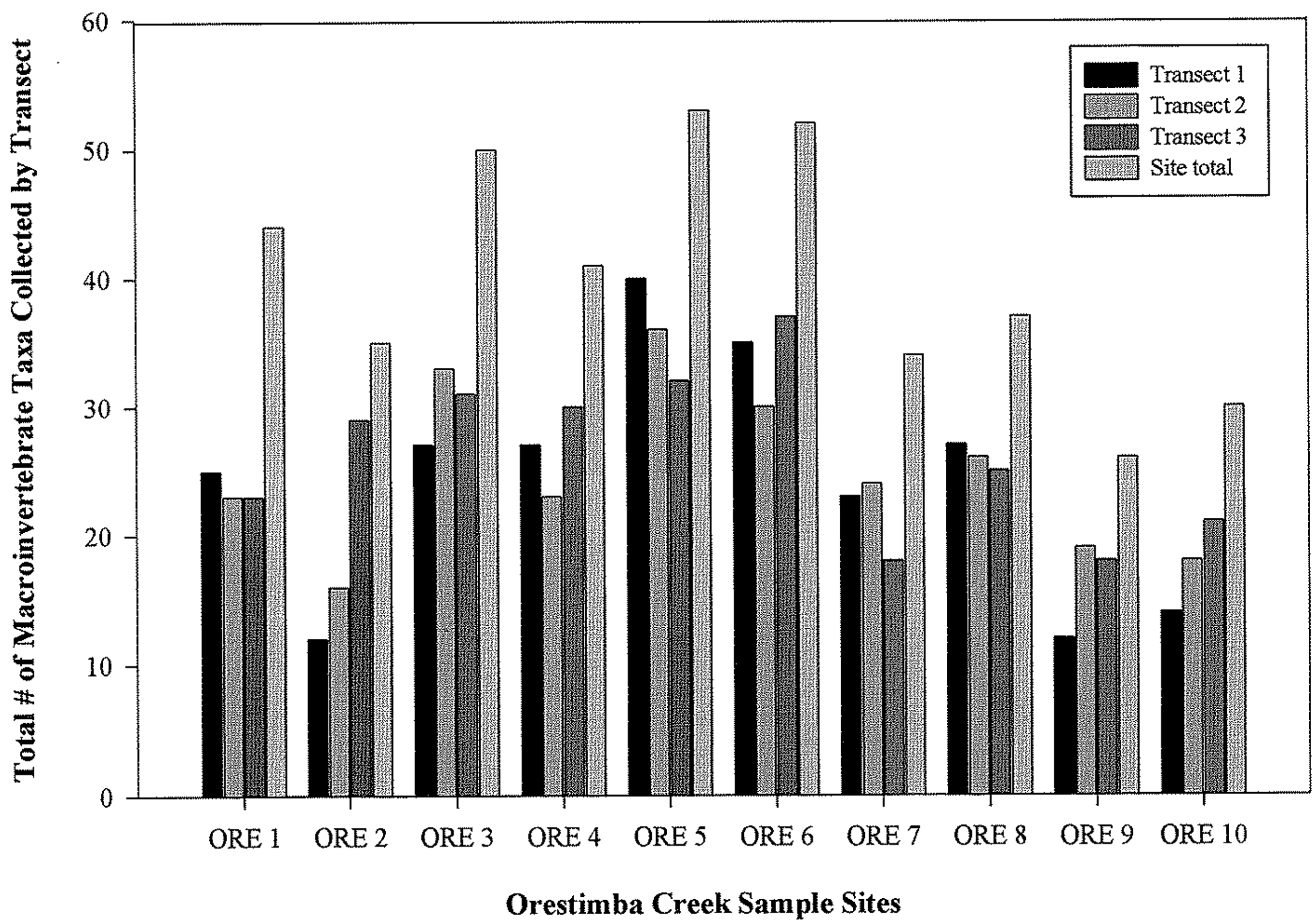


Figure 8. Macroinvertebrate abundance for each transect and site total for the 10 Orestimba Creek sites.

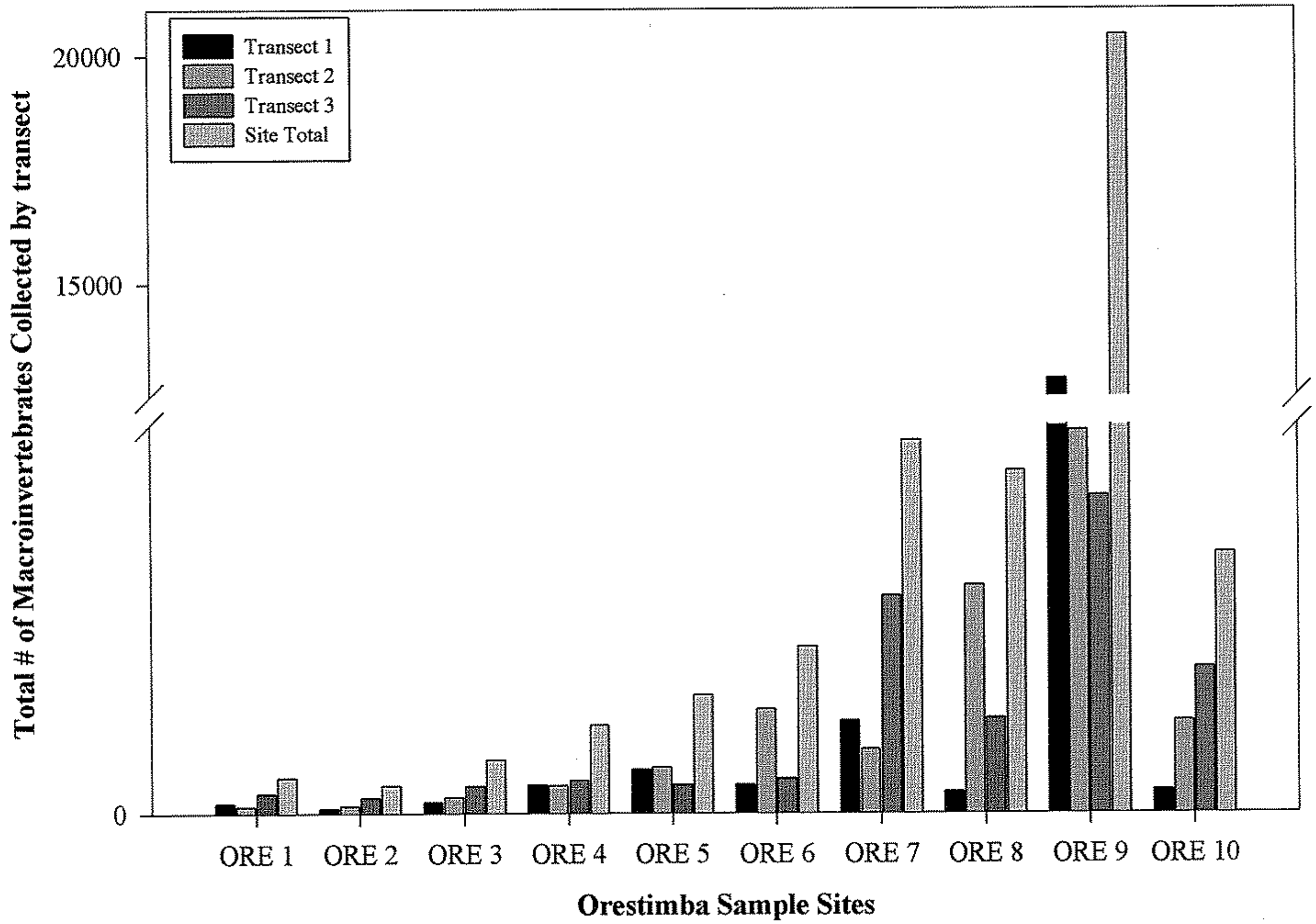


Figure 9. Macroinvertebrate richness for each transect and site total for the 5 Salt Slough sites

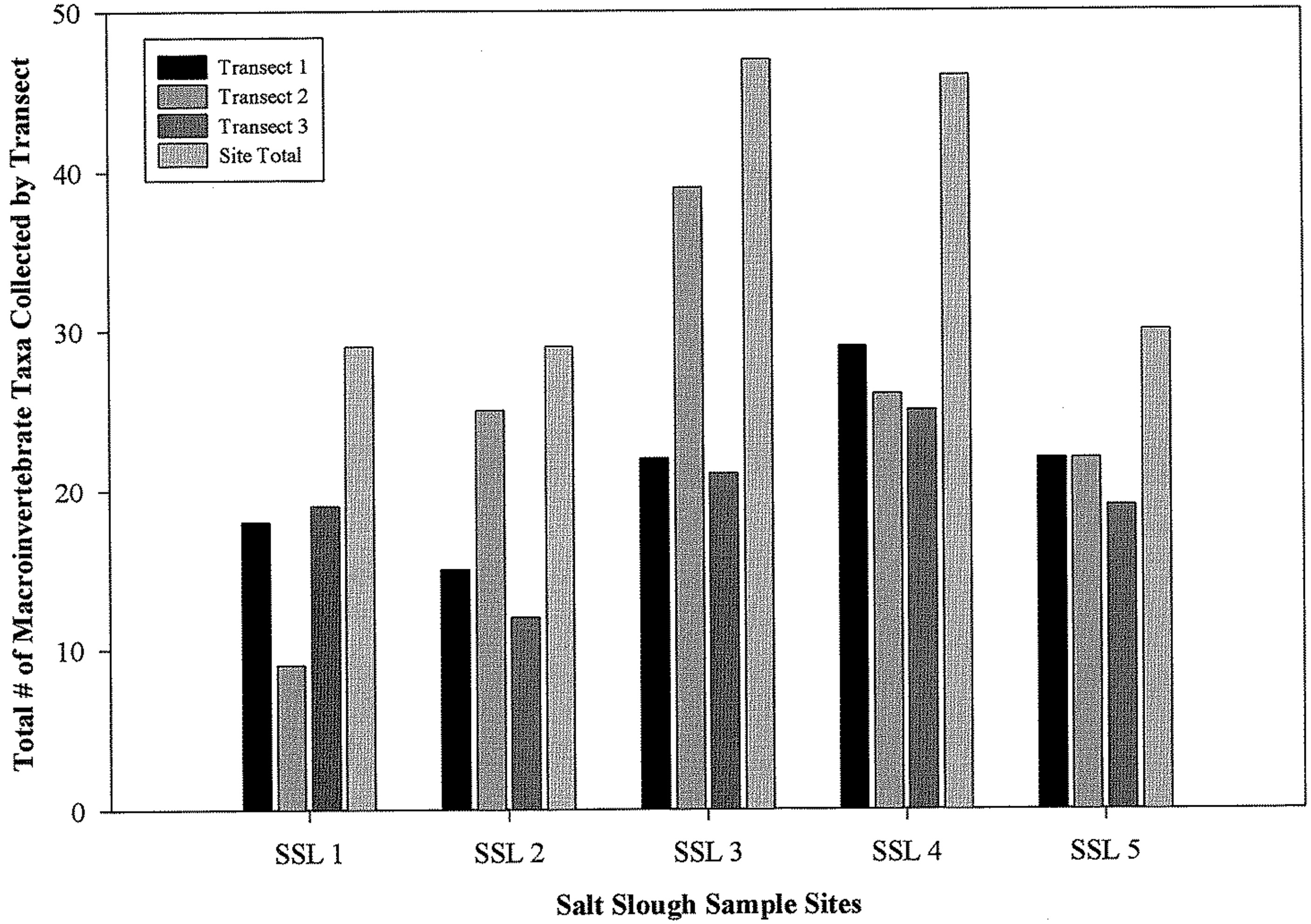
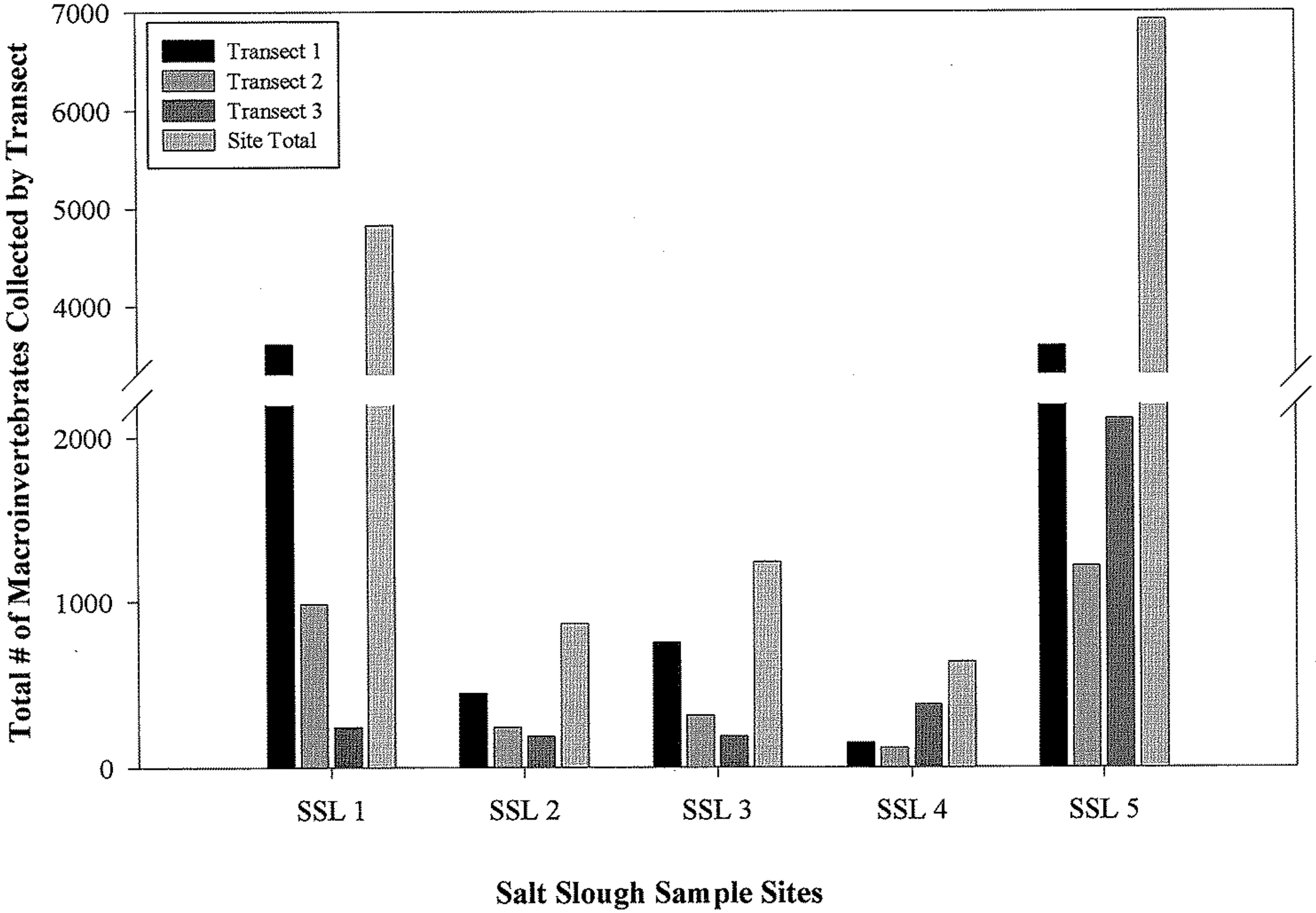


Figure 10. Macroinvertebrate abundance for each transect and site total for the 5 Salt Slough sites.



Appendix A

California bioassessment worksheets including specific descriptions of the various physical habitat metrics.

CALIFORNIA BIOASSESSMENT WORKSHEET

WATERSHED/ STREAM: ______________________ DATE/ TIME: ______________________

COMPANY/ AGENCY: ______________________ SAMPLE ID #: ______________________

SITE DESCRIPTION: ____

SAMPLING CREW

____
____
____

SITE INFORMATION

GPS Coordinates

Latitude: ______________
Longitude: ______________
Elevation: ______________
Ecoregion: ______________

COMMENTS:

____
____
____
____
____

CHEMICAL CHARACTERISTICS

Water Temperature: __________
Specific Conductance: __________
pH: __________
Dissolved Oxygen: __________

Bioassessment Laboratory Information:

____
____
____
____
____

SEND A COPY OF THIS FORM TO:
DFG/ WPCL
2005 Nimbus Road
Rancho Cordova, CA 95670
(916) 358-2858
website: www.dfg.ca.gov/cabw/cabwhome.html

RIFFLE/ REACH CHARACTERISTICS

Point Source Sampling Design

Riffle Length: ______
Transect 1: ______
Transect 2: ______
Transect 3: ______

(record Physical/ Habitat Characteristics in Riffle 1 column)

Non-Point Source Sampling Design

Reach Length: ______
Physical Habitat Quality Score: ______

Physical/ Habitat Characteristics

	Riffle 1	Riffle 2	Riffle 3
Riffle Length:			
Transect Location:			
Avg. Riffle Width:			
Avg. Riffle Depth:			
Riffle Velocity:			
% Canopy Cover:			
Substrate Complexity:			
Embeddedness:			
Substrate Composition:			
Fines (<0.1"):			
Gravel (0.1-2"):			
Cobble (2-10"):			
Boulder (>10"):			
Bedrock (solid):			
Substrate Consolidation:			
Percent Gradient:			

CALIFORNIA STREAM BIOASSESSMENT PROCEDURE
CHAIN OF CUSTODY (COC) RECORD

Project Name: ______________________ Date/ Time: ______________________

Watershed Name: ______________________ Boiassessment Lab: ______________________

Sample Number	Lab Number	Sample Date	Sample Description

Sampled by: (sign and date)	Relinquished by: (sign and date)	Received by: (sign and date)
Received by: (sign and date)	Received by: (sign and date)	Received by: (sign and date)

Address of Sampler: ______________________

Address of Project Advisor: ______________________

BIOLOGICAL METRICS USED TO DESCRIBE BENTHIC MACROINVERTEBRATE (BMI) SAMPLES COLLECTED FOLLOWING THE CALIFORNIA STREAM BIOASSESSMENT PROCEDURE (CSBP)

Biological Metrics	Description	Response to Impairment
Richness Measures		
Taxa Richness	Total number of individual taxa	decrease
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	decrease
Ephemeroptera Taxa	Number of mayfly taxa (genus or species)	decrease
Plecoptera Taxa	Number of stonefly taxa (genus or species)	decrease
Trichoptera Taxa	Number of caddisfly taxa (genus or species)	decrease
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly and caddisfly larvae	decrease
Sensitive EPT Index	Percent composition of mayfly, stonefly and caddisfly larvae with Tolerance Values of 0 through 3	decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	decrease
Tolerance/Intolerance Measures		
Tolerance Value	Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) and intolerant (lower values)	increase
Percent Intolerant Organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2	decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10	increase
Percent Hydropsychidae	Percent of organisms in the caddisfly family Hydropsychidae	increase
Percent Baetidae	Percent of organisms in the mayfly family Baetidae	increase
Percent Dominant Taxa	Percent composition of the single most abundant taxon	increase
Functional Feeding Groups		
Percent Collectors	Percent of macrobenthos that collect or gather fine particulate matter	increase
Percent Filterers	Percent of macrobenthos that filter fine particulate matter	increase
Percent Scrapers (Grazers)	Percent of macrobenthos that graze upon periphyton	variable
Percent Predators	Percent of macrobenthos that feed on other organisms	variable
Percent Shredders	Percent of macrobenthos that shreds coarse particulate matter	decrease

PHYSICAL HABITAT QUALITY
(California Stream Bioassessment Procedure)

WATERSHED/ STREAM: ____________________ DATE/ TIME: ____________________

COMPANY/ AGENCY: ____________________ SAMPLE ID NUMBER: ____________________

SITE DESCRIPTION: ____________________

Circle the appropriate score for all 20 habitat parameters. Record the total score on the front page of the CBW.

Parameters to be evaluated within the sampling reach

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
1. Epifaunal Substrate/ Available Cover	Greater than 70% (50% for low gradient streams) of substrate favorable for epifaunal colonization and fish cover; most favorable is a mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% (30-50% for low gradient streams) mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% (10-30% for low gradient streams) mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% (10% for low gradient streams) stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/ Depth Regimes *(deep<0.5 m, slow<0.3 m/s)*	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% (<20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Parameters to be evaluated in an area longer than the sampling reach

HABITAT PARAMETER	CONDITION CATEGORY			
	OPTIMAL	**SUBOPTIMAL**	**MARGINAL**	**POOR**
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left of right side by facing downstream	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zones covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities haveimpacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
	Left Bank 10 9	8 7 6	5 4 3	2 1 0
	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Appendix B

Number of lowest identified taxa by transect and combined transects including tolerance values (TV) and feeding guilds (FFG) for Del Puerto Creek sites. Tolerance values for taxa range from 1 to 10 with 10 being the most tolerant value. Feeding guilds are defined as follows: CG = collector-gatherer; CF = collector-filterer; SC = scraper; SH = shredder; P = predator; MH = macrophyte herbivore; OM = omnivore; PA = parasite; XY = Xylophage.

Del Puerto 1

Lowest Taxa	T1
Simulium sp.	166
Tubificidae unid. imm.	42
Dugesia tigrina	18
Slavina appendiculata	10
Gyraulus parvus	7
Rheocricotopus sp.	5
Nais communis/ variabilis	5
Cricotopus bicinctus group	3
Fallceon quilleri	3
Eukiefferiella sp.	2
Lumbricina	2
Prostoma sp.	2
Cladotanytarsus sp.	1
Orthocladius complex	1
Cricotopus sp.	1
Rheocricotopus sp.	1
Corbicula sp.	1
	270

Lowest Taxa	T2
Simulium sp.	134
Tubificidae unid. imm.	41
Dugesia tigrina	20
Nais communis/ variabilis	19
Rheocricotopus sp.	14
Slavina appendiculata	11
Cricotopus bicinctus group	6
Orthocladius complex	4
Parachironomus sp.	3
Prostoma sp.	3
Eukiefferiella sp.	2
Rheocricotopus sp.	2
Fallceon quilleri	2
Eudistylia vancouveri	2
Pristina leidyi	2
Gyraulus parvus	2
Chironomus sp.	1
Cladotanytarsus sp.	1
Cricotopus sp.	1
Limnophyes sp.	1
Thienemannimyia group	1
Corbicula sp.	1
	273

Lowest Taxa	T3
Simulium sp.	147
Tubificidae unid. imm.	55
Orthocladius complex	15
Corbicula sp.	10
Dugesia tigrina	10
Cricotopus sp.	9
Gyraulus parvus	6
Cricotopus bicinctus group	5
Nais communis/ variabilis	5
Parachironomus sp.	4
Eukiefferiella sp.	4
Rheocricotopus sp.	4
Rheocricotopus sp.	3
Fallceon quilleri	3
Lumbricina	3
Physa sp.	3
Prostoma sp.	3
Chironomus sp.	1
Rheotanytarsus sp.	1
Orthocladius complex	1
Tanypodinae	1
Corixidae	1
Slavina appendiculata	1
	295

Lowest Taxa	TV	FFG	TOTAL
Simulium sp.	6	CF	447
Tubificidae unid. imm.	10	CG	138
Dugesia tigrina	4	P	48
Nais communis/ variabilis		CG	29
Rheocricotopus sp.	6	OM	23
Slavina appendiculata		CG	22
Orthocladius complex	6	CG	20
Gyraulus parvus		SC	15
Cricotopus bicinctus group	7	CG	14
Corbicula sp.	6	CF	12
Cricotopus sp.			10
Prostoma sp.	8	P	8
Fallceon quilleri	4	CG	8
Eukiefferiella sp.	8	OM	8
Parachironomus sp.	10	P	7
Rheocricotopus sp.			6
Lumbricina		CG	5
Physa sp.	8	SC	3
Pristina leidyi		CG	2
Eudistylia vancouveri			2
Cladotanytarsus sp.	7	CG	2
Thienemannimyia group	6	P	1
Tanypodinae	7	P	1
Rheotanytarsus sp.	6	CF	1
Orthocladius complex			1
Limnophyes sp.	8	CG	1
Cricotopus sp.	7	CG	1
Corixidae	10	P	1
Chironomus sp.			1
Chironomus sp.	10	CG	1
			838

Del Puerto 2

Lowest Taxa	T1
Simulium sp.	76
Physa sp.	45
Dugesia tigrina	38
Nais communis/ variabilis	25
Corbicula sp.	14
Orthocladius complex	9
Gyraulus parvus	9
Dicrotendipes sp.	7
Tubificidae unid. imm.	7
Cricotopus sp.	6
Dicrotendipes sp.	4
Chironomus sp.	3
Cricotopus bicinctus group	3
Thienemannimyia group	3
Pisidium sp.	3
Parachironomus sp.	2
Cricotopus sp.	2
Hyalella sp.	2
Eudistylia vancouveri	2
Chaetogaster diaphanus	2
Dero digitata	2
Ceratopogonidae	1
Chironomidae	1
Rheocricotopus sp.	1
Fallceon quilleri	1
Enchytraeidae	1
Planorbella sp.	1
Prostoma sp.	1
	271

Lowest Taxa	T2
Tubificidae unid. imm.	85
Dugesia tigrina	45
Simulium sp.	41
Physa sp.	26
Corbicula sp.	16
Fallceon quilleri	13
Gyraulus parvus	9
Erpobdellidae	6
Pisidium sp.	5
Lumbricina	3
Nais communis/ variabilis	3
Chironomus sp.	2
Dicrotendipes sp.	2
Cladotanytarsus sp.	2
Helobdella stagnalis	2
Prostoma sp.	2
Dicrotendipes sp.	1
Thienemannimyia group	1
Corixidae	1
Eudistylia vancouveri	1
Quistadrilus multisetosus	1
	267

Lowest Taxa	T3
Simulium sp.	131
Orthocladius complex	18
Physa sp.	15
Chironomus sp.	13
Slavina appendiculata	12
Dicrotendipes sp.	10
Nais communis/ variabilis	10
Dugesia tigrina	8
Dicrotendipes sp.	7
Chironomini	7
Cricotopus sp.	7
Gyraulus parvus	4
Cricotopus sp.	3
Orthocladiinae	3
Hydra sp.	3
Pisidium sp.	3
Parachironomus sp.	2
Cladotanytarsus sp.	2
Corixidae	2
Cyprididae	2
Enchytraeidae	2
Ceratopogonidae	1
Cryptochironomus sp.	1
Orthocladiinae	1
Nanocladius sp.	1
Cricotopus bicinctus group	1
Thienemannimyia group	1
Procladius sp.	1
Tipulidae	1
Fallceon quilleri	1
Eudistylia vancouveri	1
Mooreobdella microstoma	1
Tubificidae unid. imm.	1
	276

Lowest Taxa	TV	FFG	TOTAL
Simulium sp.	6	CF	248
Tubificidae unid. imm.	10	CG	93
Dugesia tigrina	4	P	91
Physa sp.	8	SC	86
Nais communis/ variabilis		CG	38
Corbicula sp.	6	CF	30
Orthocladius complex	6	CG	27
Gyraulus parvus		SC	22
Chironomus sp.	10	CG	18
Dicrotendipes sp.			16
Fallceon quilleri	4	CG	15
Dicrotendipes sp.	8	CG	15
Slavina appendiculata		CG	12
Pisidium sp.	8	CF	11
Cricotopus sp.	7	CG	9
Cricotopus sp.			9
Chironomini			7
Erpobdellidae	8	P	6
Thienemannimyia group	6	P	5
Parachironomus sp.	10	P	4
Eudistylia vancouveri			4
Cricotopus bicinctus group	7	CG	4
Cladotanytarsus sp.	7	CG	4
Prostoma sp.	8	P	3
Orthocladiinae			3
Lumbricina		CG	3
Hydra sp.	5	P	3
Enchytraeidae	10	CG	3
Corixidae	10	P	3
Hyalella sp.	8	CG	2
Helobdella stagnalis	6	PA	2
Dero digitata		CG	2
Cyprididae	8	CG	2
Chaetogaster diaphanus			2
Ceratopogonidae			2
Tipulidae			1
Rheocricotopus sp.	6	OM	1
Quistadrilus multisetosus	10	CG	1
Procladius sp.	9	P	1
Planorbella sp.	6	SC	1
Orthocladiinae	5	CG	1
Nanocladius sp.	3	CG	1
Mooreobdella microstoma	8	P	1
Cryptochironomus sp.			1
Chironomidae	6	CG	1
			814

Del Puerto 3

Lowest Taxa	T1
Simulium sp.	127
Tubificidae unid. imm.	32
Physa sp.	26
Orthocladius complex	20
Nais communis/ variabilis	15
Cricotopus sp.	10
Cricotopus bicinctus group	9
Cricotopus sp.	7
Lumbricina	6
Corbicula sp.	6
Parachironomus sp.	4
Enchytraeidae	4
Mooreobdella microstoma	3
Tubificidae w/hair cheatae	3
Pisidium sp.	2
Dugesia tigrina	2
Chironomus sp.	1
Eukiefferiella sp.	1
Fallceon quilleri	1
Erpobdellidae	1
Lumbriculidae	1
Chaetogaster diaphanus	1
Planorbella sp.	1
Gyraulus parvus	1
Prostoma sp.	1
	285

Lowest Taxa	T2
Simulium sp.	98
Nais communis/ variabilis	70
Orthocladius complex	23
Cricotopus bicinctus group	23
Physa sp.	13
Tubificidae unid. imm.	12
Cricotopus sp.	9
Cricotopus sp.	6
Parachironomus sp.	5
Tubificidae w/hair cheatae	4
Dugesia tigrina	3
Dicrotendipes sp.	2
Cyprididae	2
Mooreobdella microstoma	2
Pisidium sp.	2
Cladotanytarsus sp.	1
Paratanytarsus sp.	1
Orthocladiinae	1
Fallceon quilleri	1
Erpobdellidae	1
Enchytraeidae	1
Corbicula sp.	1
Planorbella sp.	1
Prostoma sp.	1
Turbellaria	1
	284

Lowest Taxa	T3
Simulium sp.	145
Cricotopus bicinctus group	18
Orthocladius complex	15
Tubificidae unid. imm.	15
Parachironomus sp.	13
Cricotopus sp.	13
Nais communis/ variabilis	13
Physa sp.	12
Dicrotendipes sp.	5
Chironomus sp.	4
Lumbricina	4
Erpobdellidae	3
Tubificidae w/hair cheatae	3
Dugesia tigrina	3
Polypedilum sp.	1
Cladotanytarsus sp.	1
Cricotopus sp.	1
Eukiefferiella sp.	1
Rheocricotopus sp.	1
Thienemannimyia group	1
Fallceon quilleri	1
Pisidium sp.	1
Planorbella sp.	1
Prostoma sp.	1
	276

Lowest Taxa	TV	FFG	TOTAL
Simulium sp.	6	CF	370
Nais communis/ variabilis		CG	98
Tubificidae unid. imm.	10	CG	59
Orthocladius complex	6	CG	58
Physa sp.	8	SC	51
Cricotopus bicinctus group	7	CG	50
Cricotopus sp.			32
Parachironomus sp.	10	P	22
Cricotopus sp.	7	CG	14
Tubificidae w/hair cheatae	10	CG	10
Lumbricina		CG	10
Dugesia tigrina	4	P	8
Dicrotendipes sp.	8	CG	7
Corbicula sp.	6	CF	7
Pisidium sp.	8	CF	5
Mooreobdella microstoma	8	P	5
Erpobdellidae	8	P	5
Enchytraeidae	10	CG	5
Chironomus sp.			5
Prostoma sp.	8	P	3
Planorbella sp.	6	SC	3
Fallceon quilleri	4	CG	3
Eukiefferiella sp.	8	OM	2
Cyprididae	8	CG	2
Cladotanytarsus sp.	7	CG	2
Turbellaria	4	P	1
Thienemannimyia group	6	P	1
Rheocricotopus sp.	6	OM	1
Polypedilum sp.	6	CG	1
Paratanytarsus sp.	6	CF	1
Orthocladiinae	5	CG	1
Lumbriculidae	8	CG	1
Gyraulus parvus		SC	1
Chaetogaster diaphanus			1
			845

Del Puerto 4

Lowest Taxa	T1
Physa sp.	86
Gyraulus parvus	47
Turbellaria	17
Fossaria sp.	14
Cyprididae	12
Cricotopus sp.	4
Lymnaeidae	3
Lumbricina	2
Brachycera	1
Cricotopus bicinctus group	1
Cricotopus sp.	1
Procladius sp.	1
Ephydridae	1
Sciomyzidae	1
Tipula sp.	1
	192

Lowest Taxa	T2
Physa sp.	163
Gyraulus parvus	34
Cyprididae	29
Dugesia tigrina	13
Lumbricina	10
Cricotopus sp.	8
Fossaria sp.	8
Prostoma sp.	7
Cladotanytarsus sp.	4
Dicrotendipes sp.	2
Procladius sp.	2
Tubificidae unid. imm.	2
Cryptochironomus sp.	1
Chironomus sp.	1
Limnophyes sp.	1
Hydrellia sp.	1
Simulium sp.	1
	287

Lowest Taxa	T3
Physa sp.	77
Gyraulus parvus	68
Lumbricina	10
Cyprididae	9
Cladotanytarsus sp.	4
Cricotopus sp.	4
Dugesia tigrina	4
Procladius sp.	1
Tubificidae unid. imm.	1
	178

Lowest Taxa	TV	FFG	TOTAL
Physa sp.	8	SC	326
Gyraulus parvus		SC	149
Cyprididae	8	CG	50
Lumbricina		CG	22
Fossaria sp.	8	SC	22
Turbellaria	4	P	17
Dugesia tigrina	4	P	17
Cricotopus sp.	7	CG	16
Cladotanytarsus sp.	7	CG	8
Prostoma sp.	8	P	7
Procladius sp.	9	P	4
Tubificidae unid. imm.	10	CG	3
Lymnaeidae	6	SC	3
Dicrotendipes sp.	8	CG	2
Tipula sp.	4	OM	1
Simulium sp.	6	CF	1
Sciomyzidae	6	P	1
Limnophyes sp.	8	CG	1
Hydrellia sp.			1
Ephydridae			1
Cryptochironomus sp.	8	P	1
Cricotopus sp.			1
Cricotopus bicinctus group	7	CG	1
Chironomus sp.			1
Brachycera			1
			657

Del Puerto 5

Lowest Taxa	T1
Cyprididae	257
Hyalella sp.	18
Physa sp.	11
Orthocladius complex	3
Fallceon quilleri	2
Tricorythodes sp.	2
Dugesia tigrina	2
Rheotanytarsus sp.	1
Parametriocnemus sp.	1
Pentaneura sp.	1
Simulium sp.	1
Coenagrionidae	1
Hydrobiidae	1
	301

Lowest Taxa	T2
Cyprididae	266
Hyalella sp.	10
Physa sp.	10
Fallceon quilleri	2
Coenagrionidae	2
Gyraulus parvus	2
Baetis adonis	1
Ambrysus sp.	1
Erpobdellidae	1
Prostoma sp.	1
	296

Lowest Taxa	T3
Cyprididae	257
Hyalella sp.	10
Physa sp.	8
Peltodytes sp.	2
Fallceon quilleri	2
Tricorythodes sp.	2
Stictotarsus examinus	1
Ambrysus sp.	1
Arrenurus sp.	1
Prostoma sp.	1
	285

Lowest Taxa	TV	FFG	TOTAL
Cyprididae	8	CG	780
Hyalella sp.	8	CG	38
Physa sp.	8	SC	29
Fallceon quilleri	4	CG	6
Tricorythodes sp.	4	CG	4
Orthocladius complex	6	CG	3
Coenagrionidae		P	3
Prostoma sp.	8	P	2
Peltodytes sp.	5	MH	2
Gyraulus parvus		SC	2
Dugesia tigrina	4	P	2
Ambrysus sp.	5	P	2
Stictotarsus examinus	5	P	1
Simulium sp.	6	CF	1
Rheotanytarsus sp.	6	CF	1
Pentaneura sp.	6	P	1
Parametriocnemus sp.	5	CG	1
Hydrobiidae	8	SC	1
Erpobdellidae	8	P	1
Baetis adonis	5	CG	1
Arrenurus sp.	5	P	1
			882

Appendix C

Number of lowest identified taxa by transect and combined transects including tolerance values (TV) and feeding guilds (FFG) for Orestimba Creek sites. Tolerance values for taxa range from 1 to 10 with 10 being the most tolerant value. Feeding guilds are defined as follows: CG = collector-gatherer; CF = collector-filterer; SC = scraper; SH = shredder; P = predator; MH = macrophyte herbivore; OM = omnivore; PA = parasite; XY = Xylophage.

Orestimba 1

Lowest Taxa	T1
Dicrotendipes sp.	22
Eudistylia vancouveri	14
Cricotopus bicinctus group	9
Microchironomus sp.	8
Physa sp.	8
Polypedilum sp.	5
Orthocladius complex	5
Coenagrionidae	4
Nais communis/ variabilis	4
Paratanytarsus sp.	3
Paratanytarsus sp.	2
Cricotopus sp.	2
Tubificidae unid. imm.	2
Bezzia/ Palpomyia	1
Chironomini	1
Cryptochironomus sp.	1
Dicrotendipes sp.	1
Pseudochironomus sp.	1
Cladotanytarsus sp.	1
Procladius sp.	1
Gammarus lacustris	1
Ophidonais serpentina	1
Tubificidae w/hair cheatae	1
Corbicula sp.	1
Prostoma sp.	1
	100

Lowest Taxa	T2
Polypedilum sp.	11
Eudistylia vancouveri	9
Dicrotendipes sp.	8
Phaenopsectra sp.	7
Tubificidae unid. imm.	5
Limnodrilus hoffmeisteri	5
Nais communis/ variabilis	3
Corbicula sp.	3
Chironomini	2
Cricotopus bicinctus group	2
Branchiura sowerbyi	2
Chironomus sp.	1
Chironomus sp.	1
Polypedilum sp.	1
Cladotanytarsus sp.	1
Tanytarsini	1
Paratanytarsus sp.	1
Cricotopus sp.	1
Cryptochia sp.	1
Gammarus lacustris	1
Enchytraeidae	1
Pristina leidyi	1
Physa sp.	1
	69

Lowest Taxa	T3
Dicrotendipes sp.	45
Ophidonais serpentina	27
Cricotopus bicinctus group	24
Slavina appendiculata	14
Nais communis/ variabilis	13
Paratanytarsus sp.	8
Tubificidae unid. imm.	7
Polypedilum sp.	6
Microchironomus sp.	5
Orthocladius complex	5
Cricotopus sp.	5
Eudistylia vancouveri	4
Tanypodinae	3
Dicrotendipes sp.	2
Bezzia/ Palpomyia	1
Cryptochironomus sp.	1
Parachironomus sp.	1
Cricotopus trifascia group	1
Cricotopus sp.	1
Ablabesmyia sp.	1
Muscidae	1
Enallagma sp.	1
Corbicula sp.	1
	177

Lowest Taxa	TV	FFG	TOTAL
Dicrotendipes sp.	8	CG	75
Cricotopus bicinctus group	7	CG	35
Ophidonais serpentina			28
Eudistylia vancouveri			27
Polypedilum sp.	6	CG	22
Nais communis/ variabilis		CG	20
Tubificidae unid. imm.	10	CG	14
Slavina appendiculata		CG	14
Microchironomus sp.	6	CG	13
Paratanytarsus sp.	6	CF	11
Orthocladius complex	6	CG	10
Physa sp.	8	SC	9
Phaenopsectra sp.	7	SC	7
Cricotopus sp.	7	CG	6
Limnodrilus hoffmeisteri		CG	5
Corbicula sp.	6	CF	5
Coenagrionidae		P	4
Tanypodinae			3
Paratanytarsus sp.			3
Dicrotendipes sp.			3
Cricotopus sp.			3
Gammarus lacustris	4	CG	2
Cryptochironomus sp.	8	P	2
Cladotanytarsus sp.	7	CG	2
Chironomini			2
Branchiura sowerbyi	10	CG	2
Bezzia/ Palpomyia	6	P	2
Tubificidae w/hair cheatae	10	CG	1
Tanytarsini			1
Pseudochironomus sp.			1
Prostoma sp.	8	P	1
Procladius sp.	9	P	1
Pristina leidyi		CG	1
Polypedilum sp.			1
Parachironomus sp.			1
Muscidae	6	P	1
Enchytraeidae	10	CG	1
Enallagma sp.	9	P	1
Cryptochia sp.	0	SH	1
Cricotopus trifascia group	7	CG	1
Chironomus sp.	10	CG	1
Chironomus sp.			1
Chironomini	6	CG	1
Ablabesmyia sp.	8	CG	1
			346

Orestimba 2

Lowest Taxa	T1
Eudistylia vancouveri	20
Tubificidae unid. imm.	9
Limnodrilus hoffmeisteri	5
Dicrotendipes sp.	3
Corbicula sp.	3
Polypedilum sp.	1
Cladotanytarsus sp.	1
Gammarus lacustris	1
Nereis limnicola	1
Branchiura sowerbyi	1
Physa sp.	1
Prostoma sp.	1
	47

Lowest Taxa	T2
Fossaria sp.	15
Corbicula sp.	13
Chironomus sp.	8
Cladotanytarsus sp.	7
Tubificidae unid. imm.	7
Cricotopus bicinctus group	6
Nais communis/ variabilis	5
Eudistylia vancouveri	3
Limnodrilus hoffmeisteri	3
Physa sp.	3
Microchironomus sp.	2
Dicrotendipes sp.	1
Orthocladius complex	1
Nanocladius sp.	1
Tanypodinae	1
Nereis limnicola	1
	77

Lowest Taxa	T3
Cricotopus bicinctus group	36
Cricotopus sp.	19
Eudistylia vancouveri	16
Tubificidae unid. imm.	12
Simulium sp.	10
Nais communis/ variabilis	10
Dicrotendipes sp.	8
Limnodrilus hoffmeisteri	7
Polypedilum sp.	5
Cricotopus sp.	5
Paratanytarsus sp.	4
Cladotanytarsus sp.	3
Slavina appendiculata	3
Corbicula sp.	3
Physa sp.	3
Rheocricotopus sp.	2
Ophidonais serpentina	2
Phaenopsectra sp.	1
Chironomini	1
Orthocladius complex	1
Eukiefferiella sp.	1
Nanocladius sp.	1
Paraphaenocladius sp.	1
Tanypodinae	1
Procladius sp.	1
Sperchon sp.	1
Nereis limnicola	1
Lumbricina	1
Fossaria sp.	1
	160

Lowest Taxa	TV	FFG	TOTAL
Cricotopus bicinctus group	7	CG	42
Eudistylia vancouveri			39
Tubificidae unid. imm.	10	CG	28
Cricotopus sp.	7	CG	19
Corbicula sp.	6	CF	19
Fossaria sp.	8	SC	16
Nais communis/ variabilis		CG	15
Limnodrilus hoffmeisteri		CG	15
Dicrotendipes sp.	8	CG	12
Cladotanytarsus sp.	7	CG	11
Simulium sp.	6	CF	10
Chironomus sp.	10	CG	8
Physa sp.	8	SC	7
Polypedilum sp.	6	CG	6
Cricotopus sp.			5
Paratanytarsus sp.	6	CF	4
Slavina appendiculata		CG	3
Nereis limnicola			3
Rheocricotopus sp.	6	OM	2
Orthocladius complex	6	CG	2
Ophidonais serpentina			2
Nanocladius sp.	3	CG	2
Microchironomus sp.	6	CG	2
Tanypodinae	7	P	1
Tanypodinae			1
Sperchon sp.	8	P	1
Prostoma sp.	8	P	1
Procladius sp.	9	P	1
Phaenopsectra sp.	7	SC	1
Paraphaenocladius sp.	4	CG	1
Lumbricina		CG	1
Gammarus lacustris	4	CG	1
Eukiefferiella sp.	8	OM	1
Chironomini			1
Branchiura sowerbyi	10	CG	1
			284

Orestimba 3

Lowest Taxa	T1
Enchytraeidae	16
Cricotopus sp.	14
Eudistylia vancouveri	10
Tubificidae unid. imm.	10
Simulium sp.	8
Hydropsyche californica	7
Cricotopus bicinctus group	5
Corbicula sp.	5
Lumbricina	4
Fossaria sp.	4
Cricotopus sp.	3
Physa sp.	3
Slavina appendiculata	2
Branchiura sowerbyi	2
Apedilum sp.	1
Dicrotendipes sp.	1
Polypedilum sp.	1
Cladotanytarsus sp.	1
Rheotanytarsus sp.	1
Eukiefferiella sp.	1
Nanocladius sp.	1
Nanocladius sp.	1
Ormosia sp.	1
Fallceon quilleri	1
Sperchon sp.	1
Nais communis/ variabilis	1
Prostoma sp.	1
	106

Lowest Taxa	T2
Nais communis/ variabilis	31
Simulium sp.	20
Hydropsyche californica	17
Tubificidae unid. imm.	12
Eudistylia vancouveri	9
Orthocladius complex	8
Slavina appendiculata	7
Prostoma sp.	5
Dicrotendipes sp.	4
Cricotopus sp.	4
Cricotopus bicinctus group	4
Cricotopus sp.	4
Enchytraeidae	4
Branchiura sowerbyi	4
Fossaria sp.	4
Physa sp.	4
Eukiefferiella sp.	3
Paraphaenocladius sp.	3
Rheocricotopus sp.	2
Ophidonais serpentina	2
Menetus opercularis	2
Dugesia tigrina	2
Chironomus sp.	1
Microchironomus sp.	1
Paracladopelma sp.	1
Polypedilum sp.	1
Micropsectra sp.	1
Limnophyes sp.	1
Nanocladius sp.	1
Eukiefferiella sp.	1
Hydrellia sp.	1
Erpobdellidae	1
Limnodrilus hoffmeisteri	1
	166

Lowest Taxa	T3
Hydropsyche californica	116
Eudistylia vancouveri	27
Nais communis/ variabilis	20
Cricotopus sp.	19
Dicrotendipes sp.	14
Tubificidae unid. imm.	11
Cricotopus bicinctus group	9
Lumbricina	9
Simulium sp.	6
Ophidonais serpentina	6
Paratanytarsus sp.	4
Eukiefferiella sp.	4
Slavina appendiculata	4
Corbicula sp.	4
Polypedilum sp.	3
Orthocladius complex	3
Cricotopus sp.	3
Microchironomus sp.	2
Rheocricotopus sp.	2
Rheocricotopus sp.	2
Ormosia sp.	2
Fossaria sp.	2
Physa sp.	2
Cryptochironomus sp.	1
Dicrotendipes sp.	1
Rheotanytarsus sp.	1
Tanytarsus sp.	1
Nanocladius sp.	1
Orthocladiinae	1
Thienemannimyia group	1
Procladius sp.	1
	282

Lowest Taxa	TV	FFG	TOTAL
Hydropsyche californica	4	CF	140
Nais communis/ variabilis		CG	52
Eudistylia vancouveri			46
Cricotopus sp.	7	CG	37
Simulium sp.	6	CF	34
Tubificidae unid. imm.	10	CG	33
Enchytraeidae	10	CG	20
Dicrotendipes sp.	8	CG	19
Cricotopus bicinctus group	7	CG	18
Slavina appendiculata		CG	13
Lumbricina		CG	13
Orthocladius complex	6	CG	11
Fossaria sp.	8	SC	10
Cricotopus sp.			10
Physa sp.	8	SC	9
Corbicula sp.	6	CF	9
Ophidonais serpentina			8
Eukiefferiella sp.	8	OM	8
Prostoma sp.	8	P	6
Branchiura sowerbyi	10	CG	6
Polypedilum sp.	6	CG	5
Rheocricotopus sp.			4
Paratanytarsus sp.	6	CF	4
Paraphaenocladius sp.	4	CG	3
Ormosia sp.	3	CG	3
Nanocladius sp.	3	CG	3
Microchironomus sp.	6	CG	3
Rheotanytarsus sp.	6	CF	2
Rheocricotopus sp.	6	OM	2
Menetus opercularis	6	SC	2
Dugesia tigrina	4	P	2
Thienemannimyia group	6	P	1
Tanytarsus sp.	6	CF	1
Sperchon sp.	8	P	1
Procladius sp.	9	P	1
Paracladopelma sp.	7		1
Orthocladiinae			1
Nanocladius sp.			1
Micropsectra sp.	7	CG	1
Limnophyes sp.	8	CG	1
Limnodrilus hoffmeisteri		CG	1
Hydrellia sp.	6	SH	1
Fallceon quilleri	4	CG	1
Eukiefferiella sp.			1
Erpobdellidae	8	P	1
Dicrotendipes sp.			1
Cryptochironomus sp.	8	P	1
Cladotanytarsus sp.	7	CG	1
Chironomus sp.	10	CG	1
Apedilum sp.	6	CG	1
			554

Orestimba 4

Lowest Taxa	T1
Hydropsyche californica	123
Slavina appendiculata	40
Eudistylia vancouveri	39
Cricotopus sp.	14
Cricotopus bicinctus group	11
Corbicula sp.	11
Dugesia tigrina	11
Tubificidae unid. imm.	8
Rheocricotopus sp.	6
Prostoma sp.	5
Orthocladius complex	4
Nais communis/ variabilis	4
Dicrotendipes sp.	3
Rheocricotopus sp.	3
Hydropsychidae	3
Sperchon sp.	3
Lumbricina	3
Paratanytarsus sp.	2
Ophidonais serpentina	2
Polypedilum sp.	1
Dicrotendipes sp.	1
Cladotanytarsus sp.	1
Simulium sp.	1
Fallceon quilleri	1
Erpobdellidae	1
Fossaria sp.	1
Physa sp.	1
	303

Lowest Taxa	T2
Ophidonais serpentina	119
Hydropsyche californica	47
Eudistylia vancouveri	22
Lumbricina	16
Slavina appendiculata	10
Paratanytarsus sp.	9
Tubificidae unid. imm.	8
Dicrotendipes sp.	6
Corbicula sp.	6
Sperchon sp.	5
Orthocladius complex	4
Dugesia tigrina	4
Rheocricotopus sp.	3
Ablabesmyia sp.	3
Nais communis/ variabilis	3
Orthocladiinae	2
Rheocricotopus sp.	2
Prostoma sp.	2
Cladotanytarsus sp.	1
Paratanytarsus sp.	1
Tanypodinae	1
Coenagrionidae	1
Nereis limnicola	1
	276

Lowest Taxa	T3
Hydropsyche californica	104
Eudistylia vancouveri	78
Nereis limnicola	35
Corbicula sp.	12
Dicrotendipes sp.	10
Dugesia tigrina	9
Rheocricotopus sp.	7
Sperchon sp.	7
Cricotopus sp.	5
Tubificidae unid. imm.	5
Cricotopus bicinctus group	3
Lumbricina	3
Ophidonais serpentina	3
Prostoma sp.	3
Polypedilum sp.	2
Chironomini	2
Cladotanytarsus sp.	1
Paratanytarsus sp.	1
Rheotanytarsus sp.	1
Tanytarsus sp.	1
Paratanytarsus sp.	1
Rheotanytarsus sp.	1
Limnophyes sp.	1
Cricotopus sp.	1
Rheocricotopus sp.	1
Thienemanniella sp.	1
Tanypodinae	1
Simulium sp.	1
Fallceon quilleri	1
Physa sp.	1
	302

Lowest Taxa	TV	FFG	TOTAL
Hydropsyche californica	4	CF	274
Eudistylia vancouveri			139
Ophidonais serpentina			124
Slavina appendiculata		CG	50
Nereis limnicola			36
Corbicula sp.	6	CF	29
Dugesia tigrina	4	P	24
Lumbricina		CG	22
Tubificidae unid. imm.	10	CG	21
Dicrotendipes sp.	8	CG	19
Cricotopus sp.	7	CG	19
Sperchon sp.	8	P	15
Cricotopus bicinctus group	7	CG	14
Rheocricotopus sp.	6	OM	13
Paratanytarsus sp.	6	CF	12
Prostoma sp.	8	P	10
Rheocricotopus sp.			9
Orthocladius complex	6	CG	8
Nais communis/ variabilis		CG	7
Hydropsychidae			3
Cladotanytarsus sp.	7	CG	3
Ablabesmyia sp.	8	CG	3
Tanypodinae			2
Simulium sp.	6	CF	2
Polypedilum sp.	6	CG	2
Physa sp.	8	SC	2
Paratanytarsus sp.			2
Orthocladiinae			2
Fallceon quilleri	4	CG	2
Chironomini			2
Thienemanniella sp.	6	CG	1
Tanytarsus sp.	6	CF	1
Rheotanytarsus sp.	6	CF	1
Rheotanytarsus sp.			1
Polypedilum sp.	6	CG	1
Limnophyes sp.	8	CG	1
Fossaria sp.	8	SC	1
Erpobdellidae	8	P	1
Dicrotendipes sp.			1
Cricotopus sp.			1
Coenagrionidae		P	1
			881

Orestimba 5

Lowest Taxa	T1
Tubificidae unid. imm.	51
Eudistylia vancouveri	48
Polypedilum sp.	32
Nereis limnicola	28
Cricotopus bicinctus group	14
Nais communis/ variabilis	14
Corbicula sp.	13
Sperchon sp.	9
Dicrotendipes sp.	8
Rheocricotopus sp.	8
Hydropsyche californica	8
Ophidonais serpentina	8
Fossaria sp.	7
Slavina appendiculata	5
Physa sp.	5
Prostoma sp.	5
Cricotopus sp.	4
Orthocladius complex	3
Thienemanniella sp.	3
Chironomus sp.	2
Phaenopsectra sp.	2
Branchiura sowerbyi	2
Dugesia tigrina	2
Chironomini	1
Harnischia sp.	1
Microchironomus sp.	1
Harnischia sp.	1
Polypedilum sp.	1
Cladotanytarsus sp.	1
Micropsectra sp.	1
Nanocladius sp.	1
Cricotopus sp.	1
Thienemannimyia group	1
Ablabesmyia sp.	1
Simulium sp.	1
Gammarus lacustris	1
Cambaridae	1
Lumbricina	1
Limnodrilus hoffmeisteri	1
Ferrissia rivularis	1
	298

Lowest Taxa	T2
Tubificidae unid. imm.	77
Eudistylia vancouveri	32
Polypedilum sp.	18
Nais communis/ variabilis	14
Rheocricotopus sp.	13
Sperchon sp.	13
Lumbricina	13
Branchiura sowerbyi	10
Corbicula sp.	10
Cricotopus sp.	9
Hydropsyche californica	9
Prostoma sp.	9
Physa sp.	8
Harnischia sp.	7
Ophidonais serpentina	7
Slavina appendiculata	6
Cricotopus bicinctus group	5
Nereis limnicola	5
Fallceon quilleri	4
Gammarus lacustris	4
Dicrotendipes sp.	3
Paratanytarsus sp.	3
Ablabesmyia sp.	2
Limnodrilus hoffmeisteri	2
Fossaria sp.	2
Dugesia tigrina	2
Chironomus sp.	1
Cricotopus sp.	1
Rheocricotopus sp.	1
Thienemanniella sp.	1
Thienemanniella sp.	1
Thienemannimyia group	1
Limonia sp.	1
Ormosia sp.	1
Hydroptila sp.	1
Anisogammarus sp.	1
	297

Lowest Taxa	T3
Tubificidae unid. imm.	60
Eudistylia vancouveri	53
Sperchon sp.	21
Hydropsyche californica	17
Nereis limnicola	16
Polypedilum sp.	11
Paratanytarsus sp.	8
Corbicula sp.	8
Dicrotendipes sp.	7
Ophidonais serpentina	7
Slavina appendiculata	7
Lumbricina	6
Branchiura sowerbyi	6
Prostoma sp.	6
Rheocricotopus sp.	5
Limnodrilus hoffmeisteri	5
Fossaria sp.	4
Physa sp.	4
Gammarus lacustris	3
Nais communis/ variabilis	3
Chironomini	2
Cricotopus sp.	2
Eukiefferiella sp.	2
Dugesia tigrina	2
Dicrotendipes sp.	1
Micropsectra sp.	1
Orthocladiinae	1
Nanocladius sp.	1
Cricotopus bicinctus group	1
Thienemanniella sp.	1
Procladius sp.	1
Cambaridae	1
	273

Lowest Taxa	TV	FFG	TOTAL
Tubificidae unid. imm.	10	CG	188
Eudistylia vancouveri			133
Polypedilum sp.	6	CG	61
Nereis limnicola			49
Sperchon sp.	8	P	43
Hydropsyche californica	4	CF	34
Nais communis/ variabilis		CG	31
Corbicula sp.	6	CF	31
Rheocricotopus sp.	6	OM	26
Ophidonais serpentina			22
Prostoma sp.	8	P	20
Lumbricina		CG	20
Cricotopus bicinctus group	7	CG	20
Slavina appendiculata		CG	18
Dicrotendipes sp.	8	CG	18
Branchiura sowerbyi	10	CG	18
Physa sp.	8	SC	17
Cricotopus sp.	7	CG	15
Fossaria sp.	8	SC	13
Paratanytarsus sp.	6	CF	11
Limnodrilus hoffmeisteri		CG	8
Harnischia sp.	6	CG	8
Gammarus lacustris	4	CG	8
Dugesia tigrina	4	P	6
Thienemanniella sp.	6	CG	5
Fallceon quilleri	4	CG	4
Orthocladius complex	6	CG	3
Chironomus sp.	10	CG	3
Ablabesmyia sp.	8	CG	3
Thienemannimyia group	6	P	2
Phaenopsectra sp.	7	SC	2
Nanocladius sp.	3	CG	2
Micropsectra sp.	7	CG	2
Eukiefferiella sp.	8	OM	2
Cricotopus sp.			2
Chironomini			2
Cambaridae	8	CG	2
Thienemanniella sp.			1
Simulium sp.	6	CF	1
Rheocricotopus sp.			1
Procladius sp.	9	P	1
Polypedilum sp.			1
Orthocladiinae	5	CG	1
Ormosia sp.	3	CG	1
Microchironomus sp.	6	CG	1
Limonia sp.	6	SH	1
Hydroptila sp.	6	PH	1
Harnischia sp.			1
Ferrissia rivularis	6	SC	1
Dicrotendipes sp.			1
Cladotanytarsus sp.	7	CG	1
Chironomini	6	CG	1
Anisogammarus sp.		CG	1
			868

Orestimba 6

Lowest Taxa	T1
Sperchon sp.	50
Dugesia tigrina	41
Hydropsyche californica	28
Eudistylia vancouveri	24
Prostoma sp.	19
Slavina appendiculata	17
Cricotopus sp.	13
Orthocladius complex	12
Hydroptila sp.	11
Simulium sp.	10
Fallceon quilleri	8
Gammarus lacustris	8
Cricotopus bicinctus group	7
Nais communis/ variabilis	7
Lumbricina	6
Ferrissia rivularis	6
Mooreobdella tetragon	4
Corbicula sp.	4
Rheocricotopus sp.	3
Cricotopus trifascia group	3
Rheocricotopus sp.	3
Eukiefferiella sp.	2
Cricotopus sp.	2
Hydropsyche sp.	2
Ophidonais serpentina	2
Tubificidae unid. imm.	2
Physa sp.	2
Polypedilum sp.	1
Chironomini	1
Dicrotendipes sp.	1
Polypedilum sp.	1
Tanytarsus sp.	1
Orthocladiinae	1
Cyprididae	1
Branchiura sowerbyi	1
	304

Lowest Taxa	T2
Eudistylia vancouveri	173
Cricotopus bicinctus group	15
Hydropsyche californica	15
Sperchon sp.	15
Rheocricotopus sp.	14
Orthocladius complex	13
Prostoma sp.	13
Lumbricina	10
Dicrotendipes sp.	8
Ferrissia rivularis	7
Dugesia tigrina	7
Cricotopus sp.	4
Gammarus lacustris	4
Polypedilum sp.	3
Eukiefferiella sp.	3
Simulium sp.	3
Hydroptila sp.	3
Nais communis/ variabilis	3
Cricotopus sp.	2
Rheocricotopus sp.	2
Slavina appendiculata	2
Tanytarsus sp.	1
Orthocladiinae	1
Limnophyes sp.	1
Thienemannimyia group	1
Hydrellia sp.	1
Nereis limnicola	1
Erpobdellidae	1
Tubificidae unid. imm.	1
Physa sp.	1
	328

Lowest Taxa	T3
Eudistylia vancouveri	56
Ferrissia rivularis	23
Gammarus lacustris	21
Sperchon sp.	18
Prostoma sp.	17
Hydropsyche californica	16
Orthocladius complex	13
Rheocricotopus sp.	12
Cricotopus sp.	11
Lumbricina	11
Slavina appendiculata	11
Simulium sp.	8
Nais communis/ variabilis	8
Polypedilum sp.	7
Cricotopus bicinctus group	7
Dugesia tigrina	7
Dicrotendipes sp.	6
Hydroptila sp.	5
Hydra sp.	5
Corbicula sp.	4
Physa sp.	4
Paratanytarsus sp.	3
Tubificidae unid. imm.	3
Cricotopus sp.	2
Ophidonais serpentina	2
Menetus opercularis	2
Harnischia sp.	1
Paratanytarsus sp.	1
Limnophyes sp.	1
Thienemannimyia group	1
Ablabesmyia sp.	1
Psychoda sp.	1
Coenagrionidae	1
Neomysis mercedis	1
Erpobdellidae	1
Enchytraeidae	1
Fossaria sp.	1
	293

Lowest Taxa	TV	FFG	TOTAL
Eudistylia vancouveri			253
Sperchon sp.	8	P	83
Hydropsyche californica	4	CF	59
Dugesia tigrina	4	P	55
Prostoma sp.	8	P	49
Orthocladius complex	6	CG	38
Ferrissia rivularis	6	SC	36
Gammarus lacustris	4	CG	33
Slavina appendiculata		CG	30
Rheocricotopus sp.	6	OM	29
Cricotopus bicinctus group	7	CG	29
Cricotopus sp.	7	CG	28
Lumbricina		CG	27
Simulium sp.	6	CF	21
Hydroptila sp.	6	PH	19
Nais communis/ variabilis		CG	18
Dicrotendipes sp.	8	CG	14
Polypedilum sp.	6	CG	11
Fallceon quilleri	4	CG	8
Corbicula sp.	6	CF	8
Physa sp.	8	SC	7
Tubificidae unid. imm.		CG	6
Cricotopus sp.			6
Rheocricotopus sp.			5
Hydra sp.	5	P	5
Eukiefferiella sp.	8	OM	5
Ophidonais serpentina			4
Mooreobdella tetragon	8	P	4
Paratanytarsus sp.	6	CF	3
Cricotopus trifascia group	7	CG	3
Thienemannimyia group	6	P	2
Tanytarsus sp.	6	CF	2
Orthocladiinae	5	CG	2
Menetus opercularis	6	SC	2
Limnophyes sp.	8	CG	2
Hydropsyche sp.			2
Erpobdellidae	8	P	2
Psychoda sp.	10	CG	1
Polypedilum sp.			1
Paratanytarsus sp.			1
Nereis limnicola			1
Neomysis mercedis		CF	1
Hydrellia sp.	6	SH	1
Harnischia sp.	6	CG	1
Fossaria sp.	8	SC	1
Enchytraeidae	10	CG	1
Dicrotendipes sp.			1
Cyprididae	8	CG	1
Coenagrionidae		P	1
Chironomini			1
Branchiura sowerbyi	10	CG	1
Ablabesmyia sp.	8	CG	1
			925

Orestimba 7

Lowest Taxa	T1
Dugesia tigrina	52
Gammarus lacustris	51
Cricotopus sp.	33
Hydropsyche californica	31
Prostoma sp.	25
Cricotopus bicinctus group	20
Slavina appendiculata	16
Eudistylia vancouveri	9
Corbicula sp.	9
Lumbricina	7
Cricotopus sp.	6
Hydroptila sp.	5
Anisogammarus sp.	5
Orthocladius complex	4
Sperchon sp.	3
Physa sp.	3
Mooreobdella tetragon	2
Tubificidae unid. imm.	2
Branchiura sowerbyi	2
Dicrotendipes sp.	1
Paratanytarsus sp.	1
Nanocladius sp.	1
Manayunkia speciosa	1
	289

Lowest Taxa	T2
Dugesia tigrina	91
Eudistylia vancouveri	59
Prostoma sp.	20
Cricotopus bicinctus group	19
Gammarus lacustris	19
Cricotopus sp.	17
Hydropsyche californica	15
Orthocladius complex	10
Cricotopus sp.	9
Slavina appendiculata	7
Lumbricina	3
Tubificidae unid. imm.	3
Rheocricotopus sp.	2
Simulium sp.	2
Sperchon sp.	2
Hydra sp.	2
Corbicula sp.	2
Dicrotendipes sp.	1
Orthocladiinae	1
Coenagrionidae	1
Chaetogaster diaphanus	1
Ophidonais serpentina	1
Ferrissia rivularis	1
Physa sp.	1
	289

Lowest Taxa	T3
Eudistylia vancouveri	61
Hydropsyche californica	47
Slavina appendiculata	44
Prostoma sp.	30
Dugesia tigrina	23
Cricotopus sp.	21
Anisogammarus sp.	17
Cricotopus bicinctus group	11
Nais communis/ variabilis	4
Ferrissia rivularis	4
Hydroptila sp.	3
Lumbricina	3
Physa sp.	3
Dicrotendipes sp.	1
Polypedilum sp.	1
Fallceon quilleri	1
Ophidonais serpentina	1
Corbicula sp.	1
	276

Lowest Taxa	TV	FFG	TOTAL
Dugesia tigrina	4	P	166
Eudistylia vancouveri			129
Hydropsyche californica	4	CF	93
Prostoma sp.	8	P	75
Gammarus lacustris	4	CG	70
Slavina appendiculata		CG	67
Cricotopus sp.	7	CG	63
Cricotopus bicinctus group	7	CG	50
Cricotopus sp.			23
Anisogammarus sp.		CG	22
Orthocladius complex	6	CG	14
Lumbricina		CG	13
Corbicula sp.	6	CF	12
Hydroptila sp.	6	PH	8
Physa sp.	8	SC	7
Tubificidae unid. imm.	10	CG	5
Sperchon sp.	8	P	5
Ferrissia rivularis	6	SC	5
Nais communis/ variabilis		CG	4
Dicrotendipes sp.	8	CG	3
Simulium sp.	6	CF	2
Rheocricotopus sp.	6	OM	2
Ophidonais serpentina			2
Mooreobdella tetragon	8	P	2
Hydra sp.	5	P	2
Branchiura sowerbyi	10	CG	2
Polypedilum sp.	6	CG	1
Paratanytarsus sp.	6	CF	1
Orthocladiinae	5	CG	1
Nanocladius sp.	3	CG	1
Manayunkia speciosa		CF	1
Fallceon quilleri	4	CG	1
Coenagrionidae		P	1
Chaetogaster diaphanus			1
			854

Orestimba 8

Lowest Taxa	T1
Physa sp.	42
Gammarus lacustris	36
Lumbricina	23
Slavina appendiculata	14
Hydra sp.	13
Eudistylia vancouveri	12
Dugesia tigrina	11
Cricotopus bicinctus group	10
Prostoma sp.	10
Cricotopus sp.	6
Cricotopus sp.	6
Ophidonais serpentina	5
Fossaria sp.	5
Paratanytarsus sp.	4
Argia sp.	4
Tubificidae unid. imm.	4
Dicrotendipes sp.	3
Nais communis/ variabilis	2
Corbicula sp.	2
Cladotanytarsus sp.	1
Simulium sp.	1
Hydropsyche californica	1
Americorophium spinicorne	1
Hyalella sp.	1
Erpobdellidae	1
Chaetogaster diaphanus	1
Menetus opercularis	1
	220

Lowest Taxa	T2
Cricotopus bicinctus group	35
Hydra sp.	33
Cricotopus sp.	28
Prostoma sp.	28
Gammarus lacustris	25
Ophidonais serpentina	24
Slavina appendiculata	17
Cricotopus sp.	16
Dugesia tigrina	16
Eudistylia vancouveri	12
Simulium sp.	8
Nais communis/ variabilis	8
Orthocladius complex	6
Corbicula sp.	6
Erpobdellidae	5
Lumbricina	5
Physa sp.	5
Cambaridae	3
Dicrotendipes sp.	2
Parachironomus sp.	2
Mooreobdella tetragon	2
Dicrotendipes sp.	1
Paratanytarsus sp.	1
Eukiefferiella sp.	1
Hydropsyche californica	1
Fossaria sp.	1
	291

Lowest Taxa	T3
Hydra sp.	64
Prostoma sp.	46
Dugesia tigrina	36
Cricotopus bicinctus group	28
Ophidonais serpentina	25
Eudistylia vancouveri	17
Slavina appendiculata	13
Gammarus lacustris	9
Erpobdellidae	9
Physa sp.	9
Corbicula sp.	8
Orthocladius complex	7
Cricotopus sp.	6
Cricotopus sp.	5
Simulium sp.	5
Lumbricina	2
Fossaria sp.	2
Dicrotendipes sp.	1
Endochironomus sp.	1
Polypedilum sp.	1
Eukiefferiella sp.	1
Eukiefferiella sp.	1
Hydroptila sp.	1
Hyalella sp.	1
Mooreobdella tetragon	1
	299

Lowest Taxa	TV	FFG	TOTAL
Hydra sp.	5	P	110
Prostoma sp.	8	P	84
Cricotopus bicinctus group	7	CG	73
Gammarus lacustris	4	CG	70
Dugesia tigrina	4	P	63
Physa sp.	8	SC	56
Ophidonais serpentina			54
Slavina appendiculata		CG	44
Eudistylia vancouveri			41
Cricotopus sp.	7	CG	40
Lumbricina		CG	30
Cricotopus sp.			27
Corbicula sp.	6	CF	16
Erpobdellidae	8	P	15
Simulium sp.	6	CF	14
Orthocladius complex	6	CG	13
Nais communis/ variabilis		CG	10
Fossaria sp.	8	SC	8
Dicrotendipes sp.	8	CG	6
Paratanytarsus sp.	6	CF	5
Tubificidae unid. imm.	10	CG	4
Argia sp.	7	P	4
Mooreobdella tetragon	8	P	3
Cambaridae	8	CG	3
Parachironomus sp.	10	P	2
Hydropsyche californica	4	CF	2
Hyalella sp.	8	CG	2
Eukiefferiella sp.	8	OM	2
Polypedilum sp.	6	CG	1
Menetus opercularis	6	SC	1
Hydroptila sp.	6	PH	1
Eukiefferiella sp.			1
Endochironomus sp.	10	CG	1
Dicrotendipes sp.			1
Cladotanytarsus sp.	7	CG	1
Chaetogaster diaphanus			1
Americorophium spinicorne	4	CF	1
			810

Orestimba 9

Lowest Taxa	T1
Physa sp.	223
Planorbella sp.	31
Cricotopus bicinctus group	17
Simulium sp.	3
Nais communis/ variabilis	3
Ophidonais serpentina	3
Hydra sp.	3
Simulium sp.	2
Prostoma sp.	2
Cricotopus sp.	1
Rheocricotopus sp.	1
Gyraulus parvus	1
	290

Lowest Taxa	T2
Physa sp.	153
Cricotopus bicinctus group	35
Simulium sp.	32
Planorbella sp.	13
Cricotopus sp.	7
Cricotopus sp.	6
Nais communis/ variabilis	5
Hydra sp.	5
Ophidonais serpentina	4
Orthocladius complex	3
Slavina appendiculata	3
Orthocladiinae	2
Lumbricina	2
Parachironomus sp.	1
Chironomini	1
Corisella inscripta	1
Coenagrionidae	1
Mooreobdella tetragon	1
Prostoma sp.	1
	276

Lowest Taxa	T3
Physa sp.	162
Cricotopus bicinctus group	37
Simulium sp.	32
Planorbella sp.	23
Cricotopus sp.	8
Cricotopus sp.	6
Nais communis/ variabilis	6
Slavina appendiculata	6
Cyprididae	5
Enchytraeidae	3
Gyraulus parvus	3
Ophidonais serpentina	2
Hydra sp.	2
Coenagrionidae	1
Lumbricina	1
Fossaria sp.	1
Prostoma sp.	1
Turbellaria	1
	300

Lowest Taxa	TV	FFG	TOTAL
Physa sp.	8	SC	538
Cricotopus bicinctus group	7	CG	89
Simulium sp.	6	CF	67
Planorbella sp.	6	SC	67
Cricotopus sp.	7	CG	15
Nais communis/ variabilis		CG	14
Cricotopus sp.			13
Hydra sp.	5	P	10
Slavina appendiculata		CG	9
Ophidonais serpentina			9
Cyprididae	8	CG	5
Prostoma sp.	8	P	4
Gyraulus parvus		SC	4
Orthocladius complex	6	CG	3
Lumbricina		CG	3
Enchytraeidae	10	CG	3
Simulium sp.			2
Orthocladiinae			2
Coenagrionidae		P	2
Turbellaria	4	P	1
Rheocricotopus sp.	6	OM	1
Parachironomus sp.	10	P	1
Mooreobdella tetragon	8	P	1
Fossaria sp.	8	SC	1
Corisella inscripta	10	P	1
Chironomini			1
			866

Orestimba 10

Lowest Taxa	T1
Dicrotendipes sp.	148
Cyprididae	42
Gyraulus parvus	17
Fossaria sp.	14
Physa sp.	8
Corixidae	6
Ablabesmyia sp.	2
Berosus sp.	1
Stilobezzia sp.	1
Tanytarsus sp.	1
Cricotopus sp.	1
Hexatoma sp.	1
Enchytraeidae	1
Planorbella sp.	1
	244

Lowest Taxa	T2
Dicrotendipes sp.	192
Cyprididae	39
Cricotopus sp.	7
Tanypodinae	7
Gyraulus parvus	6
Tanytarsus sp.	5
Chironomidae	3
Corixidae	3
Berosus sp.	2
Orthocladius complex	2
Hexatoma sp.	2
Callibaetis sp.	2
Physa sp.	2
Chironomini	1
Chironomus sp.	1
Paratanytarsus sp.	1
Psectrocladius sp.	1
Corynoneura sp.	1
	277

Lowest Taxa	T3
Dicrotendipes sp.	178
Cyprididae	37
Gyraulus parvus	18
Cricotopus sp.	9
Physa sp.	6
Fossaria sp.	5
Tanypodinae	4
Corixidae	3
Neoclypeodytes plicipennis	2
Bezzia/ Palpomyia	2
Corynoneura sp.	2
Stictotarsus striatellus	1
Berosus sp.	1
Polypedilum sp.	1
Limnophyes sp.	1
Psectrocladius sp.	1
Tanypodinae	1
Ablabesmyia sp.	1
Hexatoma sp.	1
Limnesia sp.	1
Planorbella sp.	1
	276

Lowest Taxa	TV	FFG	TOTAL
Dicrotendipes sp.	8	CG	518
Cyprididae	8	CG	118
Gyraulus parvus		SC	41
Fossaria sp.	8	SC	19
Cricotopus sp.	7	CG	17
Physa sp.	8	SC	16
Corixidae	10	P	12
Tanypodinae	7	P	11
Tanytarsus sp.	6	CF	6
Hexatoma sp.	2	P	4
Berosus sp.	5	P	4
Corynoneura sp.	7	CG	3
Chironomidae	6	CG	3
Ablabesmyia sp.	8	CG	3
Psectrocladius sp.	8	CG	2
Planorbella sp.	6	SC	2
Orthocladius complex	6	CG	2
Neoclypeodytes plicipennis	5	P	2
Callibaetis sp.	9	CG	2
Bezzia/ Palpomyia	6	P	2
Tanypodinae			1
Stilobezzia sp.	6	P	1
Stictotarsus striatellus	5	P	1
Polypedilum sp.	6	CG	1
Paratanytarsus sp.	6	CF	1
Limnophyes sp.	8	CG	1
Limnesia sp.	5	P	1
Enchytraeidae	10	CG	1
Chironomus sp.	10	CG	1
Chironomini	6	CG	1
			797

Appendix D

Number of lowest identified taxa by transect and combined transects including tolerance values (TV) and feeding guilds (FFG) for Salt Slough sites. Tolerance values for taxa range from 1 to 10 with 10 being the most tolerant value. Feeding guilds are defined as follows:
CG = collector-gatherer; CF = collector-filterer; SC = scraper; SH = shredder; P = predator; MH = macrophyte herbivore; OM = omnivore; PA = parasite; XY = Xylophage.

Salt Slough 1

Lowest Taxa	T1
Trichocorixa calva	151
Americorophium spinicorne	66
Trichocorixa sp.	20
Gammarus lacustris	15
Corixidae	14
Cricotopus bicinctus group	7
Cricotopus sp.	7
Eudistylia vancouveri	7
Tubificidae unid. imm.	3
Paratanytarsus sp.	2
Hydropsyche californica	2
Corbicula sp.	2
Tanytarsini	1
Cricotopus sp.	1
Cambaridae	1
Procambarus acutus	1
Nais communis/ variabilis	1
Physa sp.	1
	302

Lowest Taxa	T2
Americorophium spinicorne	191
Hydropsyche californica	57
Cricotopus bicinctus group	26
Corbicula sp.	12
Gammarus lacustris	10
Cricotopus bicinctus group	4
Cricotopus sp.	2
Dicrotendipes sp.	1
Prostoma sp.	1
	304

Lowest Taxa	T3
Tubificidae unid. imm.	96
Eudistylia vancouveri	40
Corbicula sp.	31
Limnodrilus hoffmeisteri	22
Branchiura sowerbyi	14
Americorophium spinicorne	8
Harnischia sp.	4
Harnischia sp.	3
Cladotanytarsus sp.	3
Trichocorixa calva	3
Hydropsyche californica	3
Chironomidae	2
Chironomus sp.	1
Cricotopus sp.	1
Cricotopus sp.	1
Procladius sp.	1
Tanypus sp.	1
Gammarus lacustris	1
Hydrobiidae	1
	236

Lowest Taxa	TV	FFG	TOTAL
Americorophium spinicorne	4	CF	265
Trichocorixa calva	8	P	154
Tubificidae unid. imm.	10	CG	99
Hydropsyche californica	4	CF	62
Eudistylia vancouveri			47
Corbicula sp.	6	CF	45
Cricotopus bicinctus group	7	CG	37
Gammarus lacustris	4	CG	26
Limnodrilus hoffmeisteri		CG	22
Trichocorixa sp.	8	P	20
Corixidae	10	P	14
Branchiura sowerbyi	10	CG	14
Cricotopus sp.			8
Harnischia sp.			7
Cricotopus sp.	7	CG	4
Cladotanytarsus sp.	7	CG	3
Paratanytarsus sp.	6	CF	2
Chironomidae			2
Tanytarsini			1
Tanypus sp.	10	P	1
Prostoma sp.	8	P	1
Procladius sp.	9	P	1
Procambarus acutus	8	SH	1
Physa sp.	8	SC	1
Nais communis/ variabilis		CG	1
Hydrobiidae	8	SC	1
Dicrotendipes sp.	8	CG	1
Chironomus sp.	10	CG	1
Cambaridae	8	CG	1
			842

Salt Slough 2

Lowest Taxa	T1
Americorophium spinicorne	132
Cricotopus bicinctus group	44
Hydropsyche californica	38
Cricotopus sp.	30
Gammarus lacustris	20
Cricotopus sp.	12
Corbicula sp.	11
Dicrotendipes sp.	4
Simulium sp.	3
Polypedilum sp.	2
Paratanytarsus sp.	2
Ophidonais serpentina	2
Eudistylia vancouveri	1
Tubificidae unid. imm.	1
Prostoma sp.	1
	303

Lowest Taxa	T2
Americorophium spinicorne	96
Eudistylia vancouveri	30
Cricotopus bicinctus group	18
Cricotopus sp.	16
Hyalella sp.	13
Hydropsyche californica	8
Paratanytarsus sp.	6
Coenagrionidae	6
Polypedilum sp.	5
Nanocladius sp.	5
Ophidonais serpentina	5
Dicrotendipes sp.	4
Cricotopus sp.	4
Parachironomus sp.	3
Gammarus lacustris	3
Prostoma sp.	3
Cladotanytarsus sp.	2
Fossaria sp.	2
Physa sp.	2
Sanfilippodytes sp.	1
Chironomus sp.	1
Endotribelos sp.	1
Phaenopsectra sp.	1
Tanypus sp.	1
Tubificidae unid. imm.	1
	237

Lowest Taxa	T3
Corbicula sp.	69
Americorophium spinicorne	50
Eudistylia vancouveri	19
Cricotopus bicinctus group	7
Gammarus lacustris	6
Cricotopus sp.	5
Hydropsyche californica	5
Cricotopus sp.	2
Tubificidae unid. imm.	2
Simulium sp.	1
Hydroptila sp.	1
Branchiura sowerbyi	1
	168

Lowest Taxa	TV	FFG	T1
Americorophium spinicorne	4	CF	278
Corbicula sp.	6	CF	80
Cricotopus bicinctus group	7	CG	69
Hydropsyche californica	4	CF	51
Eudistylia vancouveri			50
Cricotopus sp.	7	CG	48
Gammarus lacustris	4	CG	29
Cricotopus sp.			21
Hyalella sp.	8	CG	13
Paratanytarsus sp.	6	CF	8
Dicrotendipes sp.	8	CG	8
Polypedilum sp.	6	CG	7
Ophidonais serpentina			7
Coenagrionidae		P	6
Nanocladius sp.	3	CG	5
Tubificidae unid. imm.	10	CG	4
Simulium sp.	6	CF	4
Prostoma sp.	8	P	4
Parachironomus sp.	10	P	3
Physa sp.	8	SC	2
Fossaria sp.	8	SC	2
Cladotanytarsus sp.	7	CG	2
Tanypus sp.	10	P	1
Sanfilippodytes sp.	5	P	1
Phaenopsectra sp.	7	SC	1
Hydroptila sp.	6	PH	1
Endotribelos sp.	6	CG	1
Chironomus sp.	10	CG	1
Branchiura sowerbyi	10	CG	1
			708

Salt Slough 3

Lowest Taxa	T1
Americorophium spinicorne	196
Cricotopus bicinctus group	33
Corbicula sp.	10
Nanocladius sp.	8
Paratanytarsus sp.	7
Gammarus lacustris	7
Cricotopus sp.	4
Cricotopus sp.	4
Coenagrionidae	4
Hydropsyche californica	4
Nais communis/ variabilis	3
Simulium sp.	2
Hyalella sp.	2
Eudistylia vancouveri	2
Ferrissia rivularis	2
Cryptochironomus sp.	1
Rheocricotopus sp.	1
Corixidae	1
Trichocorixa calva	1
Slavina appendiculata	1
Tubificidae unid. imm.	1
Prostoma sp.	1
	295

Lowest Taxa	T2
Cricotopus bicinctus group	58
Americorophium spinicorne	45
Eudistylia vancouveri	33
Tanypus sp.	22
Cricotopus sp.	16
Cricotopus sp.	15
Hydropsyche californica	13
Corixidae	12
Tubificidae unid. imm.	9
Harnischia sp.	7
Slavina appendiculata	7
Hyalella sp.	6
Corbicula sp.	6
Cladotanytarsus sp.	5
Physa sp.	5
Trichocorixa sp.	4
Harnischia sp.	3
Paratanytarsus sp.	3
Trichocorixa calva	3
Palaemon macrodactylus	3
Limnodrilus hoffmeisteri	3
Chironomus sp.	2
Microchironomus sp.	2
Orthocladius complex	2
Nanocladius sp.	2
Procladius sp.	2
Coenagrionidae	2
Ophidonais serpentina	2
Ferrissia rivularis	2
Prostoma sp.	2
Thermonectus intermedius	1
Cladopelma sp.	1
Dicrotendipes sp.	1
Microchironomus sp.	1
Rheocricotopus sp.	1
Simulium sp.	1
Corisella sp.	1
Branchiura sowerbyi	1
Quistadrilus multisetosus	1
	305

Lowest Taxa	T3
Americorophium spinicorne	105
Corbicula sp.	16
Hydropsyche californica	11
Cricotopus sp.	9
Physa sp.	9
Ferrissia rivularis	4
Dicrotendipes sp.	3
Parachironomus sp.	3
Cricotopus bicinctus group	3
Simulium sp.	3
Gammarus lacustris	3
Cricotopus sp.	2
Nanocladius sp.	2
Liodessus obscurellus	1
Limnophyes sp.	1
Tipulidae	1
Corisella inscripta	1
Coenagrionidae	1
Eudistylia vancouveri	1
Ophidonais serpentina	1
Tubificidae unid. imm.	1
	181

Lowest Taxa	TV	FFG	TOTAL
Americorophium spinicorne	4	CF	346
Cricotopus bicinctus group	7	CG	94
Eudistylia vancouveri			36
Corbicula sp.	6	CF	32
Hydropsyche californica	4	CF	28
Cricotopus sp.			28
Tanypus sp.	10	P	22
Cricotopus sp.	7	CG	22
Physa sp.	8	SC	14
Corixidae	10	P	13
Nanocladius sp.	3	CG	12
Tubificidae unid. imm.	10	CG	11
Paratanytarsus sp.	6	CF	10
Gammarus lacustris	4	CG	10
Slavina appendiculata		CG	8
Hyalella sp.	8	CG	8
Ferrissia rivularis	6	SC	8
Harnischia sp.	6	CG	7
Coenagrionidae		P	7
Simulium sp.	6	CF	6
Cladotanytarsus sp.	7	CG	5
Trichocorixa sp.	8	P	4
Trichocorixa calva	8	P	4
Dicrotendipes sp.	8	CG	4
Prostoma sp.	8	P	3
Parachironomus sp.	10	P	3
Palaemon macrodactylus			3
Ophidonais serpentina			3
Nais communis/ variabilis		CG	3
Limnodrilus hoffmeisteri		CG	3
Harnischia sp.			3
Rheocricotopus sp.			2
Procladius sp.	9	P	2
Orthocladius complex	6	CG	2
Microchironomus sp.	6	CG	2
Chironomus sp.	10	CG	2
Tipulidae			1
Thermonectus intermedius	5	P	1
Quistadrilus multisetosus	10	CG	1
Microchironomus sp.			1
Liodessus obscurellus	5	P	1
Limnophyes sp.	8	CG	1
Cryptochironomus sp.	8	P	1
Corisella sp.	8	P	1
Corisella inscripta	10	P	1
Cladopelma sp.	7	CG	1
Branchiura sowerbyi	10	CG	1
			781

Salt Slough 4

Lowest Taxa	T1
Ferrissia rivularis	18
Physa sp.	13
Americorophium spinicorne	10
Cricotopus bicinctus group	9
Cricotopus sp.	8
Eudistylia vancouveri	8
Slavina appendiculata	8
Corixidae	7
Prostoma sp.	7
Coenagrionidae	6
Tubificidae unid. imm.	6
Corbicula sp.	6
Dicrotendipes sp.	5
Chironomus sp.	4
Cricotopus sp.	4
Tanypus sp.	3
Hyalella sp.	3
Nais communis/ variabilis	3
Ophidonais serpentina	3
Parachironomus sp.	2
Paratanytarsus sp.	2
Harnischia sp.	1
Microchironomus sp.	1
Limnophyes sp.	1
Tanypodinae	1
Trichocorixa sp.	1
Manayunkia speciosa	1
Chaetogaster diaphanus	1
Dugesia tigrina	1
	143

Lowest Taxa	T2
Tubificidae unid. imm.	29
Chironomus sp.	10
Branchiura sowerbyi	10
Cricotopus sp.	7
Corbicula sp.	7
Tanypus sp.	6
Eudistylia vancouveri	6
Cryptochironomus sp.	5
Limnodrilus hoffmeisteri	5
Harnischia sp.	3
Ophidonais serpentina	3
Paratanytarsus sp.	2
Cricotopus bicinctus group	2
Cricotopus sp.	2
Tubificidae w/hair cheatae	2
Dicrotendipes sp.	1
Microchironomus sp.	1
Chironomini	1
Chironomus sp.	1
Paratanytarsus sp.	1
Procladius sp.	1
Corixidae	1
Palmacorixa sp.	1
Slavina appendiculata	1
Ferrissia rivularis	1
Physa sp.	1
	110

Lowest Taxa	T3
Physa sp.	99
Hyalella sp.	57
Ferrissia rivularis	55
Coenagrionidae	16
Prostoma sp.	16
Ophidonais serpentina	12
Menetus opercularis	10
Cricotopus sp.	7
Slavina appendiculata	6
Eudistylia vancouveri	3
Fossaria sp.	3
Liodessus obscurellus	2
Chironomus sp.	2
Aeshnidae	2
Enallagma sp.	2
Nais communis/ variabilis	2
Tubificidae unid. imm.	2
Dugesia tigrina	2
Laccophilus sp.	1
Microchironomus sp.	1
Dicrotendipes sp.	1
Tanypus sp.	1
Dolichopodidae	1
Americorophium spinicorne	1
Corbicula sp.	1
	305

Lowest Taxa	TV	FFG	TOTAL
Physa sp.	8	SC	113
Ferrissia rivularis	6	SC	74
Hyalella sp.	8	CG	60
Tubificidae unid. imm.		CG	37
Prostoma sp.	8	P	23
Coenagrionidae		P	22
Ophidonais serpentina			18
Eudistylia vancouveri			17
Chironomus sp.	10	CG	16
Slavina appendiculata		CG	15
Cricotopus sp.	7	CG	15
Corbicula sp.	6	CF	14
Cricotopus sp.			13
Cricotopus bicinctus group	7	CG	11
Americorophium spinicorne	4	CF	11
Tanypus sp.	10	P	10
Menetus opercularis	6	SC	10
Branchiura sowerbyi	10	CG	10
Corixidae	10	P	8
Dicrotendipes sp.	8	CG	6
Nais communis/ variabilis		CG	5
Limnodrilus hoffmeisteri		CG	5
Cryptochironomus sp.	8	P	5
Paratanytarsus sp.	6	CF	4
Harnischia sp.	6	CG	4
Microchironomus sp.	6	CG	3
Fossaria sp.	8	SC	3
Dugesia tigrina	4	P	3
Tubificidae w/hair cheatae	10	CG	2
Parachironomus sp.	10	P	2
Liodessus obscurellus	5	P	2
Enallagma sp.	9	P	2
Aeshnidae	5	P	2
Trichocorixa sp.	8	P	1
Tanypodinae			1
Procladius sp.	9	P	1
Paratanytarsus sp.			1
Palmacorixa sp.		P	1
Manayunkia speciosa		CF	1
Limnophyes sp.	8	CG	1
Laccophilus sp.	5	P	1
Dolichopodidae	4	P	1
Dicrotendipes sp.			1
Chironomus sp.			1
Chironomini			1
Chaetogaster diaphanus			1
			558

Salt Slough 5

Lowest Taxa	T1
Physa sp.	92
Corixidae	64
Paratanytarsus sp.	25
Nais communis/ variabilis	22
Coenagrionidae	20
Enallagma sp.	10
Cricotopus sp.	9
Callibaetis sp.	8
Cyprididae	5
Ferrissia rivularis	5
Trichocorixa sp.	4
Goeldichironomus sp.	3
Tanypus sp.	3
Tubificidae unid. imm.	3
Apedilum sp.	2
Chironomus sp.	2
Paratanytarsus sp.	2
Hyalella sp.	2
Fossaria sp.	2
Corynoneura sp.	1
Trichocorixa calva	1
Slavina appendiculata	1
	286

Lowest Taxa	T2
Physa sp.	94
Paratanytarsus sp.	29
Coenagrionidae	21
Ferrissia rivularis	17
Tanypus sp.	13
Enallagma sp.	12
Nais communis/ variabilis	7
Cricotopus sp.	6
Callibaetis sp.	6
Trichocorixa sp.	6
Hyalella sp.	4
Goeldichironomus sp.	3
Apedilum sp.	2
Chironomus sp.	2
Paratanytarsus sp.	2
Aeshnidae	2
Chironomini	1
Procladius sp.	1
Limonia sp.	1
Anax sp.	1
Chaetogaster diaphanus	1
Fossaria sp.	1
	232

Lowest Taxa	T3
Physa sp.	119
Paratanytarsus sp.	36
Corixidae	34
Ferrissia rivularis	17
Cricotopus sp.	16
Nais communis/ variabilis	16
Tanypus sp.	11
Tubificidae unid. imm.	10
Coenagrionidae	6
Apedilum sp.	3
Chironomus sp.	3
Callibaetis sp.	3
Hyalella sp.	3
Enallagma sp.	2
Cyprididae	2
Endotribelos sp.	1
Goeldichironomus sp.	1
Trichocorixa sp.	1
Tubificidae w/hair cheatae	1
	285

Lowest Taxa	TV	FFG	TOTAL
Physa sp.	8	SC	305
Corixidae	10	P	98
Paratanytarsus sp.	6	CF	90
Coenagrionidae		P	47
Nais communis/ variabilis		CG	45
Ferrissia rivularis	6	SC	39
Cricotopus sp.	7	CG	31
Tanypus sp.	10	P	27
Enallagma sp.	9	P	24
Callibaetis sp.	9	CG	17
Tubificidae unid. imm.	10	CG	13
Trichocorixa sp.	8	P	11
Hyalella sp.	8	CG	9
Goeldichironomus sp.	6	CG	7
Cyprididae	8	CG	7
Chironomus sp.	10	CG	7
Apedilum sp.	6	CG	7
Paratanytarsus sp.			4
Fossaria sp.	8	SC	3
Aeshnidae		P	2
Tubificidae w/hair cheatae	10	CG	1
Trichocorixa calva	8	P	1
Slavina appendiculata		CG	1
Procladius sp.	9	P	1
Limonia sp.	6	SH	1
Endotribelos sp.	6	CG	1
Corynoneura sp.	7	CG	1
Chironomini	6	CG	1
Chaetogaster diaphanus			1
Anax sp.	8	P	1
			803