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

Lenwood W. Hall, Jr.
and
William D. Killen

University of Maryland
Agricultural Experiment Station
Wye Research and Education Center
P. O. Box 169
Queenstown, Maryland 21658

ABSTRACT

The primary goal of this study was to characterize physical habitat and benthic communities (macroinvertebrates) in three representative agricultural streams in California's San Joaquin Valley. These streams have been listed as impaired water bodies (303d list) by the State of California due to the presence of the organophosphate (OP) insecticides chlorpyrifos and diazinon. A secondary goal of this study was to 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 59 to 140 (maximum possible total score is 200). All habitat metrics were highly variable among Del Puerto Creek sites. The channel flow metric decreased significantly from downstream to upstream sites. Orestimba Creek physical habitat scores ranged from 83 to 149; less variability was reported for the habitat metrics in this stream when compared with Del Puerto Creek. Epifaunal substrate decreased downstream to upstream while bank stability increased downstream to upstream. Salt Slough physical habitat scores ranged from 39 to 119. The habitat at the upstream site was poor. Habitat scores at the other four sites were fairly consistent and significantly higher than the upstream site. Based on spatial analysis, habitat quality generally decreased from downstream to upstream at the various Salt Slough sites.

Approximately 3,900 individual macroinvertebrates from 83 taxa were collected from five Del Puerto Creek sites. Chironomids and oligochaetes were the two most dominant taxa. Chironomids can be either sensitive or tolerant to environmental stressors depending on the species; oligochaetes are generally found in stressful environments. Pollution sensitive species such as

Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies) - EPT taxa - were generally found in low numbers at most of the sites. Total taxa richness in Del Puerto Creek ranged from 28 at one upstream site to 50 at the most upstream site. The number of individuals collected at each site increased incrementally from downstream to upstream. Percent collectors - a feeding guild typically dominant in a stressed environment - were dominant at three of the Del Puerto Creek sites. At the other two sites, the percent of both collectors and shredders were approximately equal. Shredders (macrobenthos that shred coarse material) are typically found in non-stressed environments.

Approximately 5,500 individual macroinvertebrates from 108 taxa were collected from 10 sites in Orestimba Creek. Oligochaetes and chironomids were the two most dominant taxa collected. As discussed above, oligochaetes are generally found in stressful environments while Chironomids can be either sensitive or tolerant to environmental stressors depending on the species. Two non-insect taxa - Amphipoda and Pelecypoda - also comprised approximately 13% of the individuals collected at this stream. Amphipods are generally considered sensitive to OP insecticides such as chlorpyrifos and diazinon as well as other stressors. Pollution-sensitive species (EPT taxa) were generally collected in low numbers in this creek with the highest numbers collected at the upstream site. Total taxa richness ranged from 23 to 59 at the two upstream sites. Benthic abundance was generally greater at the two upstream sites with lowest abundance reported downstream. Collectors, a feeding guild that dominates in stressed environments, were the dominant feeding group for the various benthic taxa collected in Orestimba Creek.

Approximately 3,100 individual macroinvertebrates from 70 taxa were collected from five Salt Slough sites. Amphipods, chironomids, and oligochaetes comprised over half of the individuals collected. The amphipod, *Corophium spinicorne,* was the most dominant taxa collected. Chironomids can be either tolerant or sensitive to environmental degradation depending upon the species; oligochaetes are generally found in stressful environments. Pollution sensitive EPT taxa were found in low numbers at all sites. Total taxa richness ranged from 27 to 44 at the most upstream sites. Richness was variable among the transects. The number of individuals per transect at each site was also variable. Benthic abundance increased from downstream to upstream. The % tolerant taxa and % collectors (generally associated with stressed environments) were higher at the upstream site in Salt Slough.

Bend/riffle frequency, epifaunal substrate, and velocity/depth were the most important physical habitat metrics influencing the various benthic metrics. Bank vegetation and riparian buffer were the two least important habitat metrics influencing the various benthic metrics.

A qualitative comparison of OP-sensitive benthic species in the three agricultural streams based on single species toxicity data was limited due to lack of data. The most dominant macroinvertebrate species collected in Salt Slough (the amphipod, *Corophium spinicorne*) is a member of a taxa considered sensitive to OPs. The second most dominant species in Salt Slough (the chironomid, *Chironomus sp.*) is also within a gensus (*Chironomus*) reported to be sensitive to the OP insecticide chlorpyrifos. Daphnids, another OP-sensitive taxa of benthic macroinvertebrates, were the 11th most dominant species in Salt Slough but this taxa was collected in low numbers in Del Puerto Creek and Orestimba Creek. Less than optimum habitat was considered the primary factor responsible for these results although, the use of standardized sampling gear with somewhat low efficiency for collecting daphnids was also a possible factor. The amphipod, *Gammarus lacustris*, which is sensitive to chlorpyrifos at environmentally realistic concentrations, was the 4th

most dominant taxa found in Orestimba Creek. However, this species was collected in low numbers in the other two agricultural streams.

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INTRODUCTION

The agricultural economy in California's San Joaquin Valley is highly productive due to abundant water and long growing seasons. In 1987, approximately 10.2% of the total value of agricultural production in the United States came from California - approximately half of this total valued at $6.82 billion came from the San Joaquin Valley (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) postulated 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 have been initiated in wadeable streams in California's Central Valley (Brown and May, 2000; Jim Harrington, personal communication). 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.

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. 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, 13 and 14 miles in Del Puerto Creek, Orestimba Creek and Salt Slough, respectively. Agriculture is the predominate land use type in all of these water bodies. 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 were selected in Del Puerto Creek and Salt Slough and ten sites were selected in Orestimba Creek using a stratified random design with approximate equal spacing among sample sites (Table 1; Figures 2-4). The ten sites in Orestimba Creek were previously sampled in similar bioassessment studies conducted in the late spring/early summer of 2000 (Hall and Killen, 2001). Initial site visits were conducted for all streams in April of 2001. Exact sample stations were determined in each stream and landowner contacts were made to access the sample sites for the late spring 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 (1999) and 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, % gradient, and substrate composition that were also measured are described in Appendix A.

<u>Benthic Macroinvertebrate Sampling</u>

Benthic macroinvertebrates were collected in the late spring of 2001 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 (1999) and 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 then 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, 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 was used to compare habitat and benthic metrics among the three streams.

RESULTS

Physical Habitat

Del Puerto Creek

The total physical habitat scores in Del Puerto Creek ranged from 59 to 140 for the ten metrics that were scored on a 0 to 20 scale (Table 2). All metrics were highly variable across the five stations within Del Puerto Creek indicating diverse physical habitat conditions in this waterbody. For example, velocity/depth/diversity ranged from 5 to 16, channel alteration ranged from 2 to 17 and bend/riffle frequency ranged from 2 to 18. The site with the lowest total physical habitat score (DLP4) had particularly low scores for epifaunal substrate, channel alteration, bends/riffle frequency, and vegetative protection. In contrast, the site with the highest physical habitat score (DLP1) had higher scores for all of these metrics.

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 to 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 0.27 m/s upstream to 0.68 m/s downstream. The mean value across all five sites was 0.45 m/s. The percent canopy for the five Del Puerto Creek sites ranged from 0% at DLP2 and DLP5 to 67% at downstream site DLP1. Gradient was consistent at all sites (1%). The percent fines for substrate percentages ranged from 20% DLP5 (upstream site) to 60% at DLP3.

Orestimba Creek

Orestimba Creek total physical habitat scores for the 10 metrics that were scored on a 0 to 20 scale ranged from 83 to 149 (Table 2). With the exception of the upstream site ORE10, these 10 metrics were generally less variable at the Orestimba Creek sites when compared with sites in Del

Puerto Creek. The lowest total habitat score (83) was reported for the upstream site ORE10 (Figure 3). This site had particularly low scores for vegetative protection and riparian vegetation. The highest total habitat score (149) was reported at ORE7. The following metrics were reasonably high at this site: velocity/depth/diversity, sediment deposition, channel flow status, and bends/riffle frequency. Other descriptive habitat metrics for the 10 Orestimba Creek sites in Table 3 showed that mean site flow ranged from 0.19 to 0.65 m/s (mean stream value of 0.47 m/s), % canopy ranged from 0 to 66%, % gradient was consistently 1%, and % fines ranged from 10% to 75%.

Salt Slough

The total physical habitat scores in Salt Slough ranged from 39 to 119 for the 10 metrics that were scored on a 0 to 20 scale (Table 2). The lowest total physical habitat score (39) was reported at the most upstream site (SSL5). This site had particularly low scores for epifaunal substrate, embeddedness, velocity/depth diversity, sediment deposition, bank stability, vegetative protection, and riparian vegetation. The highest total physical habitat score (119) was reported at the downstream site (SSL1). Channel flow status, channel alteration, and bends/riffle frequency were optimal (a high rating) at this site. The embeddedness metric, which is an rough measure of sediment loading, was particularly low at all sites in this stream when compared with either Del Puerto Creek or Orestimba Creek. In contrast, the channel flow status (the degree to which the channel is filled with water) for all sites in this stream was optimal when compared with the other two streams.

Other descriptive physical habitat metrics for the five Salt Slough sites in Table 3 showed that mean site flow ranged from 0 to 0.40 m/s (mean stream value was 0.28 m/s), % canopy ranged from 0 to 1%, % gradient was consistently 1% and % fines all 100%. The lack of canopy and dominance of substrate by % fines clearly differentiated 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 (ie. 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 81% of the variance in the data set. In Table 5, the metrics important to each factor are identified. Velocity/depth/diversity, epifaunal substrate, bend/riffle frequency, and channel alteration were heavily loaded on the first factor. These metrics were actual instream habitat measurements (not riparian metrics). Bank vegetation - a riparian metric - is somewhat split between factor one and two. Metric loading on factor two included: embeddedness, sediment deposition, bank stability, bank vegetative protection and riparian buffer width. All of these metrics were related to sediment. Factor three had loading for embeddedness and channel flow status. Both of these metrics were related to the degree of scouring.

Correlations among raw physical habitat metrics grouped by factors identified by PCA showed correlations are high among the four metrics supporting factor 1 (Table 6). Bank vegetation is associated with metrics in Factor 1 and 2. In factor 2, sediment deposition and embeddedness have correlations of 0.77 but neither correlates strongly with riparian width. Channel flow had a relatively low correlation (0.31) with total physical habitat score (Table 6). Other metrics had correlations exceeding 0.47 with final physical habitat scores.

The correlation matrix in Table 7 showed significant correlations among stream characteristics that were not scored on a 0 to 20 scale (ie. width, depth) and some metrics that were scored on a 0 to 20 scale. The largest number of significant correlations occurred for the stream canopy metric. Canopy was positively correlated with velocity/depth, epifaunal substrate, bend/riffle frequency, sediment deposition, embeddedness, and total score. Stream width was negatively correlated with sediment deposition, embeddedness, and positively correlated with channel flow. Depth was also positively correlated with channel flow status. Velocity was correlated with velocity/depth, 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 as the ranks of the total habitat score align very well with the upstream-downstream position. All metrics show a negative correlation with site indicating a decrease in value moving upstream. Although only the individual metrics of bank vegetation and riparian buffer have significant trends in Salt Slough, the lack of significance for other metrics may be due to small sample size. In Orestimba Creek, epifaunal substrate and bank stability are both significant. Epifaunal substrate decreases from downstream to upstream while bank stability increases downstream to upstream. There appears to be no significant spatial trends in habitat metrics in Del Puerto Creek with the exception of channel flow, which decreased from downstream to upstream.

Habitat scores for most metrics were greater in Orestimba Creek when compared with the other two agricultural streams (Table 9). The total habitat score in Orestimba Creek was significantly higher than Salt Slough. Significant differences were reported for four metrics among the three streams. Pairwise regression showed the following: epifaunal substrate and embeddedness were significantly lower in Del Puerto Creek when compared with Orestimba Creek; sediment deposition and embeddedness were significantly lower in Salt Slough when compared with Del Puerto Creek; and velocity/depth , epifaunal substrate, sediment deposition and embeddedness were significantly lower in Salt Slough when compared with Orestimba Creek.

Benthic Macroinvertebrates

Del Puerto Creek

Approximately 3,900 individual macroinvertebrates from 83 taxa were collected from five Del Puerto Creek sites (Table 10; Appendix B). The four most abundant taxa - *Cricotopus sp.*, *Naris communis/variabilis*, *Simulium sp.* and *Cricotopus bicinctus* - comprised over 50% of the total individuals collected (Table 10). Chironomids and oligochaetes were the two most dominant taxa. Chironomids can be either sensitive or tolerant to environmental stressors depending on the species (Stribling et al., 1998) while oligochaetes are generally found in stressful environments (Harrington and Born, 2000). Pollution sensitive species such as Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies), i.e. EPT taxa, were generally found in low numbers at most of the sites.

Total taxa richness ranged from 28 at upstream site (DLP4) to 50 at the most upstream site (DLP5) (Figure 5). 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 but the number of individuals per site was more variable (Figure 6). The number of individuals collected at each site increased incrementally from downstream at DLP1 to upstream at DLP5.

Most of the benthic metrics summarized in Table 11 were generally consistent among sites with only a few exceptions. EPT taxa and percent Baetidae (mayflies) were more dominant at the upstream site (DLP5). The mean % Chironomidae were higher (72%) at DLP4 when compared with the other sites. Percent collectors - a feeding guild typically dominant in a stressed environment (Harrington and Born, 2000) - were dominant at DLP1, DLP2 and DLP5. At DLP3 and DLP4, the percent of both collectors and shredders were approximately equal. Shredders (macrobenthos that shred coarse material) are typically found in non-stressed environments (Harrington and Born, 2000).

Orestimba Creek

Approximately 5,500 individual macroinvertebrates from 108 taxa were collected from 10 sites in Orestimba Creek (Table 12; Appendix C). The following taxa comprised over 50% of the total number of individuals collected: undetermined *Enchytraeidae, Ophindonais serpentina, Simulium sp., Gammarus lacustris, Corbicula fluminea, and Cricotopus sp.* Oligochaetes and chironomids were the two most dominant taxa collected. As discussed above, oligochaetes are generally found in stressful environments while chironomids can be either sensitive or tolerant depending on the species. Two non-insect taxa - Amphipoda and Pelecypoda - also comprised approximately 13% of the individuals collected at this stream. Amphipods are generally considered sensitive to OP insecticides such as chlorpyrifos (Giesy et al., 1999) and diazinon (Giddings et al., 2000), as well as other stressors (Harrington and Born, 2000). Pollution-sensitive species (EPT taxa) were generally collected in low numbers in this creek with the highest numbers collected at the upstream site (ORE10).

Total taxa richness ranged from 23 at ORE9 to 59 at the most upstream site ORE 10 (Figure 7). Richness was variable among the transects. The number of individuals per transect at each site was somewhat variable for approximately half the sites (Figure 8). Benthic abundance was generally greater at the two upstream sites (ORE 9 and ORE10) with the lowest abundance reported at ORE 3.

Various benthic metrics for the Orestimba Creek sites summarized in Table 13 were fairly consistent among sites. It is noteworthy that the mean % tolerance value, % collectors (generally associated with stressed enviroments) and % non-insect taxa were higher at ORE9 when compared with the other sites. The most upstream site (ORE10) also had a higher percent of Baetidae (mayflies). The % chironomids were higher at one of the downstream sites (ORE2) when compared with the other sites. Collectors, a feeding guild that dominates in stressed environments, were the dominant feeding group for the various benthic taxa collected in Orestimba Creek. The amphipod, *Gammarus lacustris*, which is considered sensitive to organophosphate insecticides such as diazinon (Giddings et al. 2000) and chlorpyrifos (Giesy et al. 1999), was the 4th most dominant taxa in Orestimba Creek.

<u>Salt Slough</u>

Approximately 3,100 individual macroinvertebrates from 70 taxa were collected from five Salt Slough sites (Table 14, Appendix D). *Corophium spinicorne, Chironomus sp., Cricotopus sp., Paratanytarus sp.* and undetermined *Tubificidae* comprised over half of the individuals collected. The most dominant species (*C. 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). Oligochaetes and chironomids were also dominant taxa collected in this stream. Oligochaetes are generally found in stressful environments (Harrington and Born, 2000) while chironomids can be either tolerant or sensitive to environmental degradation depending upon the species (Stribling et al., 1998). The chironomid *(Chironomus sp.)* was the second most dominant species collected in Salt Slough. This genus (specifically *Chironomus tentans*) is highly sensitive to chlorpyrifos (Giesy et al., 1999).

Pollution sensitive EPT taxa were found in low numbers at all sites. Total taxa richness ranged from 27 at SSL5 (the most upstream site) to 44 at SSL4 (Figure 9). Richness was variable among the transects. The number of individuals per transect at each site was also variable (Figure 10). Benthic abundance increased from downstream to upstream.

With a few exceptions, most of the benthic metrics presented in Table 15 were similar among the five Salt Slough sites. The % tolerant taxa and % collectors (generally associated with stressed environments) were higher at the upstream site (SSL5). Percent chironomids were higher at both upstream sites (SSL4 and SSL5) when compared with the downstream sites. The % Hydropsychidae (caddisflies) were higher at the SSL3 when compared to the upstream and downstream sites. Daphnids - which are highly sensitive to OP insecticides (Giesy et al., 1999 ; Giddings et al. 2000) - were the 11th most dominant taxa found in this stream. The lower flow conditions (lentic-like habitat) in Salt Slough may have influenced the higher abundance of daphnids.

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. Cumulative taxa, EPT taxa, and Ephemeroptera taxa were heavily loaded on the first factor (Table 17). Factor 2 was composed of abundance, percent collectors, and percent dominant taxa. Non-insect taxa, percent Chironomidae, percent non-insect taxa and percent shredders were significant metrics for Factor 3. Factor 4 was composed of percent grazers, percent Hydropsychidae and Trichoptera Taxa. Percent filterers, and percent predators were heavily loaded on Factor 5. Non-insect taxa, percent predators, percent Diptera and taxonomic richness were significant metrics for Factor 6 (Table 17).

Spearmans Rank Correlation Analysis showed no significant ($p<0.05$) spatial trends (downstream to upstream) for the various benthic metrics in Orestimba Creek (Table 18). For Del Puerto Creek, abundance showed a significant increase from downstream to upstream while percent tolerant taxa and tolerance values showed a significant decrease from downstream to upstream. A significant increase from downstream (Wildlife Refuge areas) to upstream (agricultural areas) was reported for both abundance and percent Chironomidae in Salt Slough. A significant decrease was reported from downstream to upstream in Salt Slough for percent non-insect taxa and percent predators.

A comparison among benthic metrics in Del Puerto Creek, Orestimba Creek and Salt Slough in Table 19 showed the following: (1) percent collectors and percent non-insect taxa were significantly ($p < 0.05$) higher in Orestimba Creek than Del Puerto Creek; (2) percent Diptera were significantly higher in Del Puerto Creek when compared with Salt Slough but percent tolerant taxa and tolerance values were significantly lower in Del Puerto Creek when compared with Salt Slough ;and (3) non-insect taxa, percent Diptera and percent non insect taxa were higher in Orestimba Creek when compared to Salt Slough while the tolerance value metric was significantly lower in Orestimba Creek when compared to Salt Slough.

Relationship of Physical Habitat and Benthos

Spearman's Rank Correlation Analysis showed that bend/riffle frequency, epifaunal substrate and velocity/depth were the most important physical habitat metrics influencing the various benthic metrics (Table 20). Bend/riffle frequency was significant and positively correlated with Diperta taxa, percent non-insect taxa and Shannon Diversity index; significant but negative correlations were reported for this metric with abundance, percent Chironomidae and percent dominant taxa. Epifaunal substrate was significant and positively correlated with non-insect taxa, percent collectors, percent Diptera, and percent non-insect taxa. Significant but negative correlations were reported for abundance, percent Chironomidae, and percent dominant taxa with this habitat metric. The velocity/depth habitat metric was significant and positively correlated with non-insect taxa, percent Diptera, percent filterers, and percent non-insect taxa; significant but negative correlations were reported for this metric with abundance, percent Chironomidae and percent dominant taxa. The total physical habitat scores were significant and positively correlated with non-insect taxa, percent non-insect taxa and Shannon Diversity Index. Significant but negative correlations were reported for abundance, percent Chironomidae, and percent dominant taxa with total physical habitat score. Bank vegetation and riparian buffer were the two least important habitat metrics influencing the various benthic metrics.

The correlation matrix in Table 21 for habitat metrics not scored on a 0-20 scale shows that canopy has the highest number of significant relationships with the various benthic metrics. Canopy was significant but negatively correlated with abundance, cumulative EPT taxa, EPT taxa, percent grazers, and trichoptera taxa; a significant but positive correlation was reported with non-insect taxa. Velocity had the lowest number of significant correlations with the various benthic metrics (Table 21).

Water Quality

Del Puerto Creek

Various water quality conditions such as pH and salinity were reasonably consistent at all five sample sites in Del Puerto Creek (Table 1). Parameters such as temperature (18.2 to 30.5 C), conductivity (628 to 1086 umhos/L), dissolved oxygen (4 to 9 mg/L) and turbidity (0.64 to 103 NTU) were variable. Spatial patterns showed that dissolved oxygen and turbidity were higher at the downstream site (DLP1) when compared with the upstream sites. Both temperature and conductivity were higher at the mid-stream site (DLP3) when compared with either the upstream or downstream sites.

<u>Orestimba Creek</u>

Salinity and pH were fairly consistent among all 10 sites in Orestimba Creek (Table 1). Temperature ranged from 18.8 to 30.3 C with higher values generally reported at the upstream sites. The same pattern was reported for conductivity as values were also generally higher at the upstream sites. Dissolved oxygen varied from 3.3 mg/L at one of the upstream sites (ORE8) to 8.4 mg/L at the most downstream site (ORE1). With the exception of the downstream site, all dissolved oxygen values were below 5.0 mg/L in Orestimba Creek - a concentration range likely to 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) and 2001 showed the following: (1) temperature was lower at ORE7 in 2001; (2) specific conductance was lower at ORE 4 in 2001; (3) pH was consistent among all sites for both years; (4) dissolved oxygen was significantly less at all sites in 2001 except ORE1; and (5) turbidity was lower at ORE9 in 2001.

Salt Slough

Most of the water quality conditions were consistent in all five Salt Slough sites with the exception of conductivity which ranged from 495 to 1011 umhos/L (Table 1). Specifically, the following ranges of water quality conditions were reported: temperature (20.6 to 24.5 C), pH (7.3 to 7.74), dissolved oxygen (2.7 to 3.2 mg/L), salinity (0.3 to 0.5 ppt) and turbidity (61 to 80 NTU). There was no apparent spatial trend of these water quality conditions. It is noteworthy that dissolved oxygen concentrations less than 3.2 mg/L at all Salt Slough sites were likely stressful to aquatic life (Lee and Jones-Lee, 2000).

DISCUSSION

Physical Habitat

It has been reported that the 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). The presence of altered habitat structure is also considered one of the major stressors of aquatic systems throughout the United States (Karr et al., 1986). Identifying degraded physical habitat in streams is 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.

The limited number of sites sampled in the three agricultural streams in the present study hinders an extensive discussion or comparison of these physical habitat data across large spatial scales. Based on our limited sampling, the physical habitat in Orestimba Creek was significantly higher in quality than Salt Slough and marginally higher than Del Puerto Creek. Various metrics such as velocity/depth, epifaunal substrate, sediment deposition, and embeddedness were generally higher in Orestimba Creek when compared with the other two streams.

An exact extensive historical comparison of total physical habitat scores (maximum of 200) for Del Puerto Creek (59 to 140), Orestimba Creek (83 to 149) and Salt Slough (39 to 119) 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 at the 10 Orestimba Creek sites sampled in 2001 can be cautiously compared with same type of assessments conducted in 2000 with the caveat that these are only two temporally limited evaluations (Hall and Killen, 2001). Mean scores for velocity /depth diversity, channel flow, stream width, and stream depth significantly increased ($p<0.05$) between 2000 and 2001 (Table 23). The increase in both stream width and stream depth between the two years implies that available aquatic habitat for benthic species increased between the two years. Although the mean total physical habitat score across all sites was similar between 2000 (122) and 2001 (131), the most significant changes in habitat by site occurred at both the downstream (ORE1) and upstream (ORE10) site (Table 24). A significant improvement occurred in physical habitat at ORE1 between 2000 and 2001 (an increase in total score from 74 to 128). Improved epifaunal substrate, velocity/depth/diversity, bank stability and vegetative protection were critical metrics that improved over the one year period. In contrast to the improved habitat at the downstream site, the total physical score at the most upstream site (ORE10) declined from 2000 to 2001 (112 to 83). Qualitative observations by the field crew during the 2001 sampling noted the presence of wading cows in this stream site. We therefore speculate that the presence of cows (which were not observed in 2000) may have contributed to impaired physical habitat. Waste contamination from cows may have also increased nutrient concentrations in this stream.

<u>Presence of OP-Sensitive Species</u>

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 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 (ie. daphnids)? Ranges of chlorpyrifos and diazinon concentrations presented in Table 25 have been reported during high use periods for the various streams (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 22 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 lacustris* (LC50 = 110 ng/L), *Neomysis mercedis* (LC50 = 140 -160 ng/L), Daphnidae (LC50 = 210 ng/L), *Ephemerella maculata* (LC50 = 300 ng/), *Culicoides sp.* (LC50 = 500 ng/L), *Peltodytes sp.* (LC50 = 800 ng/L), *Hyalella azteca* (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 but was clearly more dominant in Salt Slough, particularly at the upstream site. *Gammarus lacustris* are also predicted to be sensitive to chlorpyrifos based on single species toxicity tests and the effect concentrations are enviromentally realistic. However, this scud was found in all three streams and was the 4th most dominant taxa in Orestimba Creek. *N. mercedis* was rare in all streams as only 2 individuals were collected in ORE3. Failure to collect *N. mercedis* was likely related to the use of stream bioassessment sampling gear and unsuitable habitat. *N. mercedis* is found throughout the Delta but is most abundant in the entrapment zone (Obrebski et al., 1992).

Daphniidae (cladocerans) were collected in all three streams with higher numbers in Salt Slough, particularly the upstream sites. Collecting low numbers of cladocerans in Del Puerto Creek and Orestimba Creek may be related to their habitat preference as daphnids prefer lentic environments such as ponds and lakes rather than lotic environments such as streams and creeks (Pennack, 1989). The low flow (actually no flow conditions at SSL5 in Table 3) at the upper Salt Slough sites were more lentic and may have contributed to higher numbers of cladocerans at this site. The sampling gear used for collection of benthic macroinvertebrates in lotic habitats (D net with .5 mm mesh) is also somewhat inefficient for daphnids which may have influenced the numbers collected. The mayfly, *Ephemerella maculata* (one individual) was collected at the upstream site in Orestimba Creek. The Dipteran, *Culicoides sp.*, was also collected in low numbers at upstream sites in both Orestimba Creek and Del Puerto Creek. The Coleoptera, *Peltodytes sp.*, was only collected at the upstream site in Del Puerto Creek. The amphipod, *Hyalella azteca*, was only collected in at the downstream site in Salt Slough (one specimen). The chironomid, *Tanypus sp.*, was only collected in Salt Slough but was found at found at four of the five sites in this stream. The chironomid, *Paratanytarsus sp.*, was collected in all three streams but was clearly more dominant in Salt Slough. The flatworm, *Dugesia tigrina*, - a species fairly resistent to chlorpyrifos - was found at most sites in both Del Puerto and Orestimba Creeks.

Diazinon acute toxicity data were available for seven 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: daphniids (LC50 = 780 to 1,020 ng/L); *Neomysis mercedis* (LC50 = 4,150 ng/L); *Hyalella azteca* (LC50 = 22,000 ng/L); and *Baetis tricaudatus* (LC50 = 24,000 ng/L). Daphniids (cladocerans) were collected in all streams but were more dominant in Salt Slough. Unsuitable habitat for this lentic species was likely a factor contributing to the low number collected and to a lesser degree the use of stream bioassessment sampling gear may have also been a factor. *Neomysis mercedis* were only collected in very low numbers in Orestimba Creek - likely due to unsuitable habitat and to a lesser degree the use of bioassessment sampling gear. The amphipod, *Hyalella azteca,* was only collected at the site in Salt Slough (one specimen). The mayfly *B. tricaudatus* - a species potentially sensitive to maximum reported environmental concentrations of diazinon - was collected at sites upstream from agricultural activity in both Del Puerto Creek and Orestimba Creek. Of the remaining three taxa in Table 27, *Physa/Physella* (gastropod), *Gammarus lacustris* (scud), and undetermined tubificidae were found in all three streams.

Historical Comparisons of Benthic Assemblages

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 ORE 2 and ORE 3 (Larry

Brown, personal communication). Dominant taxa reported by these investigators were mayflies, oligochaetes and gastropods. The dominant taxa we reported in Orestimba Creek (particularly at ORE 2 and 3) were oligochaetes and chironomids. Mayflies were not collected during our 2001 sampling at these two sites and gastropods were collected in very low numbers. Due to the eight 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 study at the 10 Orestimba Creek sites can be compared with similar studies conducted at the same sites in 2000 (Hall and Killen, 2001). A comparison of mean benthic metrics across all 10 sites between the two years showed a significant increase for % filterers and taxononic richness from 2000 to 2001 (Table 28). A significant decrease in percent collectors (a feeding guild generally associated with stressed environments) was also reported between 2000 and 2001. These data suggest some improvements in benthic communities between the two years; however, continued annual bioassessments over multiple years will be needed to confirm that these benthic assemblages are improving.

Regulatory and Ecological Implications

Del Puerto Creek, Orestimba Creek and Salt Slough are classified by the State of California 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 (narrative water quality criteria) or toxicity reported from single species toxicity tests (i.e. *Ceriodaphnia dubia* toxicity tests). 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 from this study is therefore useful for providing another line of evidence for determining the biological condition of these creeks. 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.

Benthic communities in all three agricultural streams were generally comprised of tolerant species such as Oligochaetes and Chironomids. Dominance by tolerant species is expected in these streams due to fluctuating flow conditions and stressful water quality conditions such elevated temperature and low dissolved oxygen. Historical data from permanent gaging stations near ORE 10 (USGS) and ORE 8 (CA DWR) show 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). An amphipod species (*G. lacustris*) with a moderate to sensitive tolerance rating to general environmental stressors, but highly sensitive to chlorpyrifos based on laboratory toxicity tests, was the 4th most dominant species in Orestimba Creek. Three other OP sensitive species - the amphipod, *Corophium spinicorne,* the Chironomid, *Chironomus sp.* and Daphnids - were also dominant species in Salt Slough.

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 watersheds to compare benthic communities for each stream. Therefore, the traditional approach often used to interpret the status of benthic communities is not feasible. The presence of 83 taxa in Del Puerto Creek, 108 taxa in Orestimba Creek, and 70 taxa in Salt Slough implies that these streams are fairly robust, considering their ephemeral environments, but without a clear definition of benthic community expectations it is unknown if these water bodies are actually impaired. Extensive spatial and temporal assessments of benthic communities in concert with physical habitat assessments are needed 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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TABLES AND FIGURES

Table 1. Sample site names, coordinates and water quality parameters measured during late spring 2001 in Del Puerto Creek (DLP), Orestimba Creek (ORE) and Salt Slough (SSL).

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	20.2	910	8.17	9	0.4	103
DLP2	37 32 03	121 07 46	23.7	900	-	5.9	0.5	59
DLP3	37 31 20	121 08 54	30.5	1086	8.51	4.7	0.5	25
DLP4	37 30 43	121 09 38	18.2	628	8.05	4.5	0.4	56
DLP5	37 28 59	121 12 41	22.1	992	8.32	4.0	0.5	0.64
ORE1	37 25 10	121 00 09	18.8	648	7.96	8.4	0.4	142
ORE2	37 25 12	121 00 21	20.3	662	8.12	5.0	0.4	126
ORE3	37 24 47	121 00 59	20.3	675	7.86	4.9	0.4	142
ORE4	37 24 19	121 01 28	21.4	334	8.17	4.2	0.2	104
ORE5	37 23 54	121 02 02	22.8	636	8.08	4.3	0.3	110
ORE6	37 23 21	121 02 34	24.7	584	7.80	4.0	0.3	128
ORE7	37 22 59	121 03 00	19.5	663	8.04	4.2	0.4	136
ORE8	37 22 37	121 03 31	21.6	695	7.87	3.3	0.4	92
ORE9	37 21 53	121 03 45	30.3	1000	8.59	4.0	0.4	108
ORE10	37 19 08	121 07 18	27.1	1044	8.37	4.8	0.5	0.82
SSL1	37 14 54	120 51 12	22.1	989	7.62	2.8	0.5	61
SSL2	37 11 59	120 49 33	22.1	1011	7.73	3.2	0.5	78
SSL3	37 09 33	120 48 44	24.5	495	7.74	2.8	0.3	68
SSL4	37 08 21	120 46 04	20.6	542	7.30	2.9	0.3	65
SSL5	37 07 45	120 42 28	23.2	552	7.37	2.7	0.3	80

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. All physical habitat metrics are defined in Appendix A.

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	9	7	16	14	19	15	18	7	8	7	8	5	7	140
DPL2	7	7	14	16	16	12	7	2	2	2	2	1	1	89
DPL3	6	5	7	7	15	13	7	6	4	6	6	3	4	89
DPL4	2	10	5	6	8	2	2	5	3	5	3	4	4	59
DPL5	10	11	13	11	9	17	15	7	9	7	7	8	8	132
ORE1	13	6	13	6	17	16	15	8	2	9	7	8	8	128
ORE2	14	11	16	10	20	15	12	5	6	9	9	8	6	141
ORE3	15	16	18	16	20	15	15	3	6	6	4	3	3	140
ORE4	12	16	19	15	20	14	11	4	2	5	3	3	3	127
ORE5	16	15	19	9	15	15	16	6	5	8	8	5	5	142
ORE6	13	16	16	13	15	14	15	8	8	6	5	3	2	134
ORE7	10	16	18	16	20	15	16	8	6	6	9	3	6	149
ORE8	11	15	15	15	20	13	10	8	8	6	6	3	3	133
ORE9	10	12	14	5	20	15	15	8	8	7	7	5	5	131
ORE10	7	6	7	5	6	15	13	5	6	4	3	3	3	83
SSL1	8	1	11	4	20	15	15	7	6	8	6	9	9	119
SSL2	5	1	12	5	19	16	7	9	9	7	7	9	9	115
SSL3	2	1	11	4	19	14	8	8	8	6	6	8	5	100
SSL4	6	0	12	2	20	15	11	5	6	4	4	3	3	91
SSL5	2	0	2	1	18	6	6	1	1	1	1	0	0	39

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	Canopy Cover %	Gradient %	Substrate Percentages: Fines %	Gravel %	Cobble %	Boulder %	Bedrock %
DLP1	0.60	67	1	55	20	25	0	0
DLP2	0.68	0	1	50	40	10	0	0
DLP3	0.39	8	1	60	40	0	0	0
DLP4	0.31	1	1	58	40	2	0	0
DLP5	0.27	0	1	20	50	30	0	0
ORE1	0.42	23	1	75	25	0	0	0
ORE2	0.59	23	1	60	40	0	0	0
ORE3	0.29	32	1	15	45	20	20	0
ORE4	0.60	49	1	40	50	10	0	0
ORE5	0.55	66	1	20	60	20	0	0
ORE6	0.65	6	1	20	50	30	0	0
ORE7	0.38	52	1	10	70	20	0	0
ORE8	0.65	0	1	10	70	20	0	0
ORE9	0.37	33	1	30	60	10	0	0
ORE10	0.19	5	1	40	40	20	0	0
SSL1	0.40	1	1	100	0	0	0	0
SSL2	0.30	0	1	100	0	0	0	0
SSL3	0.38	0	1	100	0	0	0	0
SSL4	0.31	0	1	100	0	0	0	0
SSL5	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
PRIN 1	4.709*	0.471	0.471
PRIN 2	2.368*	0.237	0.708
PRIN 3	1.036*	0.104	0.811
PRIN 4	0.671	0.067	0.878
PRIN 5	0.496	0.050	0.928
PRIN 6	0.328	0.033	0.961
PRIN 7	0.192	0.019	0.980
PRIN 8	0.099	0.010	0.990
PRIN 9	0.058	0.006	0.996
PRIN 10	0.043	0.004	1.000

* 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
VEL DPTH	0.413*	-.195	0.170
EPI SUB	0.390*	-.222	-.054
BEN RIFF	0.380*	0.030	-.42
CHAN ALT	0.361*	0.205	0.130
BANK VEG	0.354*	0.313+	-.124
RIP BUFF	0.203	0.511*	-.128
SED DEP	0.261	-.435*	-.057
EMBEDDED	0.276	-.428*	-.311+
BANK STAB	0.255	0.373*	-.210
CH FLOW	0.164	0.023	0.880*

* coefficients >= 0.35 for each factor

\+ 0.30 <= coefficient < 0.35 for each factor

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 hypotheses that the correlation is 0.0.

	VEL DPTH	EPI SUB	BENRIFF	CHAN ALT	BANKVEG	RIPBUFF	SED DEP	EMBEDDED	BANKSTAB	CH FLOW	TOTAL
VEL DPTH	1.0000 0.0	0.8114 0.0001	0.6504 0.0019	0.6239 0.0033	0.5077 0.0223	0.1707 0.4716	0.7200 0.0003	0.6787 0.0010	0.3042 0.1922	0.4512 0.0458	0.8764 0.0001
EPI SUB	0.8114 0.0001	1.0000 0.0	0.7276 0.0003	0.5617 0.0100	0.5183 0.0192	0.1236 0.6036	0.5766 0.0078	0.7310 0.0003	0.1384 0.5605	0.2127 0.3679	0.7961 0.0001
BENRIFF	0.6504 0.0019	0.7276 0.0003	1.0000 0.0	0.7271 0.0003	0.5685 0.0089	0.3131 0.1789	0.3309 0.1541	0.3968 0.0832	0.4060 0.0757	0.1946 0.4110	0.7200 0.0003
CHAN ALT	0.6239 0.0033	0.5617 0.0100	0.7271 0.0003	1.0000 0.0	0.5894 0.0062	0.4893 0.0285	0.2154 0.3615	0.1142 0.6315	0.5520 0.0116	0.2946 0.2073	0.6169 0.0038
BANKVEG	0.5077 0.0223	0.5183 0.0192	0.5685 0.0089	0.5894 0.0062	1.0000 0.0	0.7880 0.0001	0.1216 0.6093	0.2439 0.3001	0.6784 0.0010	0.2393 0.3094	0.7911 0.0001
RIPBUFF	0.1707 0.4716	0.1236 0.6036	0.3131 0.1789	0.4893 0.0285	0.7880 0.0001	1.0000 0.0	-0.2034 0.3896	-0.1993 0.3990	0.6102 0.0043	0.0854 0.7201	0.4727 0.0353
SED DEP	0.7200 0.0003	0.5766 0.0078	0.3309 0.1541	0.2154 0.3615	0.1216 0.6093	-0.2034 0.3896	1.0000 0.0	0.7688 0.0001	0.0258 0.9140	0.1434 0.5463	0.6067 0.0046
EMBEDDED	0.6787 0.0010	0.7310 0.0003	0.3968 0.0832	0.1142 0.6315	0.2439 0.3001	-0.1993 0.3990	0.7688 0.0001	1.0000 0.0	0.0928 0.6969	-0.0193 0.9355	0.6781 0.0010
BANKSTAB	0.3042 0.1922	0.1384 0.5605	0.4060 0.0757	0.5520 0.0116	0.6784 0.0010	0.6102 0.0043	0.0258 0.9140	0.0928 0.6969	1.0000 0.0	0.0978 0.6815	0.5666 0.0092
CH FLOW	0.4512 0.0458	0.2127 0.3679	0.1946 0.4110	0.2946 0.2073	0.2393 0.3094	0.0854 0.7201	0.1434 0.5463	-0.0193 0.9355	0.0978 0.6815	1.0000 0.0	0.3064 0.1887
TOTAL	0.9000 0.0001	0.8222 0.0001	0.7846 0.0001	0.7432 0.0002	0.7766 0.0001	0.4524 0.0452	0.5931 0.0058	0.6165 0.0038	0.5688 0.0089	0.3890 0.0900	1.0000 0.0

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / N = 20

Table 7. Correlation matrix for stream width, depth, velocity and canopy measurements against raw physical habitat metrics and the total habitat metric score. In the body of the table, the top entry is the correlation coefficient and the bottom entry is the p-value for that correlation coefficient.

Metric	WIDTH	DEPTH	VELOC	CANOPY
VEL DPTH	-0.1454	0.0227	0.6951*	0.6539*
	0.5405	0.9240	0.0007	0.0018
EPI SUB	-0.3527	-0.0950	0.5607*	0.5803*
	0.1272	0.6901	0.0101	0.0073
BENRIFF	-0.2040	-0.0955	0.2826	0.6077*
	0.3883	0.6885	0.2272	0.0045
CHAN ALT	0.1620	0.0524	0.2711	0.2855
	0.4949	0.8261	0.2476	0.2222
BANKVEG	0.0860	-0.1089	0.3769	0.4267
	0.7184	0.6476	0.1014	0.0606
RIPBUFF	0.4113	0.0493	0.0305	0.0604
	0.0715	0.8365	0.8983	0.8000
SED DEP	-0.4919*	-0.1023	0.6690*	0.4445*
	0.0276	0.6676	0.0013	0.0495
EMBEDDED	-0.6397*	-0.4212	0.5299*	0.5244*
	0.0024	0.0644	0.0162	0.0176
BANKSTAB	0.2525	-0.2830	0.2044	0.0204
	0.2827	0.2266	0.3873	0.9318
CH FLOW	0.4717*	0.7119*	0.3040	0.2826
	0.0357	0.0004	0.1924	0.2273
TOTAL	-0.1054	-0.0627	0.6079*	0.5956*
	0.6583	0.7926	0.0045	0.0056
Number Significant	3	1	5	6

Pearson Correlation Coefficients /Prob > |R| under Ho: Rho=0
Number of Observations =19
*$p < 0.05$

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.

Metric	Del Puerto	Orestimba	Salt Slough
VEL DPTH	-0.70000 0.1881	-0.33029 0.3513	-0.31623 0.6042
EPI SUB	0.00000 1.0000	-0.75611* 0.0114	-0.61559 0.2690
BENRIFF	-0.35909 0.5528	-0.03764 0.9178	-0.60000 0.2848
CHAN ALT	0.10000 0.8729	-0.34957 0.3221	-0.66689 0.2189
BANKVEG	-0.10000 0.8729	-0.45593 0.1854	-0.97468* 0.0048
RIPBUFF	0.40000 0.5046	-0.42659 0.2189	-0.97468* 0.0048
SED DEP	-0.60000 0.2848	-0.24466 0.4957	-0.82078 0.0886
EMBEDDED	0.66689 0.2189	-0.03147 0.9312	-0.86603 0.0577
BANKSTAB	0.30000 0.6238	0.63995* 0.0463	-0.70000 0.1881
CH FLOW	-0.90000* 0.0374	-0.18507 0.6088	-0.52705 0.3615
TOTAL	-0.35909 0.5528	-0.21212 0.5563	-1.00000* 0.0001
Sample size	5	10	5

*$p < 0.05$

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

	Mean for each creek			Kruskal-Wallace	Pairwise
Metric	Del Puerto	Orestimba	Salt Slough	p-value	Comparisons
VEL DPTH	11.00	15.50	9.60	0.0159	OS [a]
EPI SUB	6.80	12.10	4.60	0.0019	DO [b] OS [a]
BENRIFF	9.80	13.80	9.40	0.1134	
CHAN ALT	11.80	14.70	13.20	0.5811	
BANKVEG	10.60	12.70	10.00	0.5087	
RIPBUFF	9.00	8.80	11.00	0.7297	
SED DEP	10.80	11.00	3.20	0.0060	DS [c] OS [a]
EMBEDDED	8.00	12.90	0.60	0.0013	DO [b] DS [c] OS [a]
BANKSTAB	10.60	12.00	12.00	0.6797	
CH FLOW	13.40	17.30	19.20	0.0815	
TOTAL	101.80	130.80	92.80	0.0354	OS [a]

[a] OS - Orestimba significantly different from Salt Slough ($p <= 0.05$)
[b] DO - Del Puerto significantly different from Orestimba ($p <= 0.05$)
[c] DS - Del Puerto significantly different from Salt Slough ($p <= 0.05$)

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

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Cricotopus sp.	*Chironomidae*	597	15.502	15.502
Nais communis/variabilis	*Oligochaeta*	500	12.984	28.486
Simulium sp.	*Chironomidae*	483	12.542	41.028
Cricotopus bicinctus	*Chironomidae*	393	10.205	51.233
Undetermined Tubificidae	*Oligochaeta*	322	8.361	59.595
Dugesia tigrina	*Platyhelminthes*	160	4.155	63.750
Baetis tricaudatus	*Ephemeroptera*	140	3.635	67.385
Dicrotendipes sp.	*Chironomidae*	130	3.376	70.761
Physa sp./ Physella sp.	*Gastropoda*	116	3.012	73.773
Erpobdellidae	Hirudnea	77	1.999	75.773
Fallceon quilleri	*Ephemeroptera*	73	1.896	77.668
Cricotopus trifascia	*Chironomidae*	70	1.818	79.486
Prostoma sp.	*Enopla*	62	1.610	81.096
Pentaneura sp.	*Chironomidae*	54	1.402	82.498
Megadrile	*Oligochaeta*	50	1.298	83.796
Hydropsyche occidentalis	*Trichoptera*	47	1.220	85.017
Parachironomus sp.	*Chironomidae*	45	1.169	86.185
Cladotanytarsus sp	*Chironomidae*	39	1.013	87.198
Undetermined Enchytraeidae	*Oligochaeta*	36	0.935	88.133
Undetermined Corixidae	Hemiptera	35	0.909	89.042
Rheotanytarsus sp.	*Chironomidae*	35	0.909	89.951
Nematoda	Nematoda	33	0.857	90.808
Cyprididae	Ostracoda	29	0.753	91.561
Cricotopus/Orthocladius sp.	*Chironomidae*	28	0.727	92.288
Hydra sp.	*Hydrozoa*	27	0.701	92.989
Micropsectra sp.	*Chironomidae*	24	0.623	93.612
Sperchon sp.	*Arachnoida*	23	0.597	94.209
Slavina appendiculata	*Oligochaeta*	22	0.571	94.781
Helobdella stagnalis	Hirudnea	16	0.415	95.196
Eukiefferiella sp.	*Chironomidae*	15	0.390	95.586
Peltodytes sp.	*Coleoptera*	13	0.338	95.923
Daphniidae	Cladocera	13	0.338	96.261
Ophidonais serpentina	*Oligochaeta*	12	0.312	96.572
Nanocladius sp.	*Chironomidae*	11	0.286	96.858
Tropisternus sp.	*Coleoptera*	10	0.260	97.118
Branchiura sowerbyi	*Oligochaeta*	9	0.234	97.351

Table 10. - continued

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Corisella decolor	Hemiptera	8	0.208	97.559
Parametriocnemus sp.	*Chironomidae*	6	0.156	97.715
Gyraulus parvus	*Gastropoda*	6	0.156	97.871
Undetermined Hydrophilidae	*Coleoptera*	5	0.130	98.001
Tricorythodes sp.	*Ephemeroptera*	5	0.130	98.130
Trichocorixa calva	Hemiptera	5	0.130	98.260
Chironomus sp.	*Chironomidae*	5	0.130	98.390
Pseudochironomus sp.	*Chironomidae*	4	0.104	98.494
Argia sp.	*Odonata*	4	0.104	98.598
Peltodytes callosus	*Coleoptera*	3	0.078	98.676
Limnophyes sp.	*Chironomidae*	3	0.078	98.754
Corbicula fluminea	*Pelecypoda*	3	0.078	98.831
Tvetenia sp.	*Chironomidae*	2	0.052	98.883
Tanytarsus sp.	*Chironomidae*	2	0.052	98.935
Pristina aequiseta	*Oligochaeta*	2	0.052	98.987
Paratanytarsus sp.	*Chironomidae*	2	0.052	99.039
Hydroptila sp.	*Trichoptera*	2	0.052	99.091
Gastropoda	Gastropoda	2	0.052	99.143
Haliplus sp.	*Coleoptera*	2	0.052	99.195
Cyclopidae	Copepoda	2	0.052	99.247
Corynoneura sp.	*Chironomidae*	2	0.052	99.299
Bryophaenocladius sp.	*Chironomidae*	2	0.052	99.351
Undetermined Dytiscidae	*Coleoptera*	1	0.026	99.377
Undetermined Belostomidae	Hemiptera	1	0.026	99.403
Trichocorixa reticulata	Hemiptera	1	0.026	99.429
Stictochironomus sp.	*Chironomidae*	1	0.026	99.455
Sphaerium sp.	*Pelecypoda*	1	0.026	99.481
Psychoda sp.	*Chironomidae*	1	0.026	99.507
Rheocricotopus sp.	*Chironomidae*	1	0.026	99.533
Phaenopsectra sp.	*Chironomidae*	1	0.026	99.559
Paraphaenocladius sp.	*Chironomidae*	1	0.026	99.585
Microtendipes pedellus	*Chironomidae*	1	0.026	99.610
Lebertiidae	*Arachnoida*	1	0.026	99.636
Hygrobatidae	*Arachnoida*	1	0.026	99.662
Helisoma anceps	*Gastropoda*	1	0.026	99.688
Gammarus lacustris	*Amphipoda*	1	0.026	99.714
Fossaria sp.	*Gastropoda*	1	0.026	99.740

Table 10. - continued

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Eudistylia vancouveri	*Polychaeta*	1	0.026	99.766
Culicoides sp.	*Diptera*	1	0.026	99.792
Corophium spinicorne	*Amphipoda*	1	0.026	99.818
Coenagrion/ Enallagma	*Odonata*	1	0.026	99.844
Chironominae	*Chironomidae*	1	0.026	99.870
Chaetogaster diaphanus	*Oligochaeta*	1	0.026	99.896
Ceratopogonidae	Diptera	1	0.026	99.922
Caloparyphus sp.	*Chironomidae*	1	0.026	99.948
Argia hinei	*Odonata*	1	0.026	99.974
Ambrysus mormon	Hemiptera	1	0.026	100.000
		3851		

Table 11. Benthic metrics by transect (including the means) for the 5 Del Puerto Creek sites.

	DLP 1					DLP 2					DLP 3					DLP 4					DLP 5				
Transect Number:	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV
Taxonomic Richness	28	25	21	25	14	16	19	20	18	11	16	18	17	17	6	17	19	15	17	12	37	27	32	32	16
Cumulative Taxa				36					30					29					28					50	
Percent Dominant Taxon	19	27	19	22	20	16	42	36	31	44	28	29	40	32	22	31	36	45	37	19	17	24	39	27	43
Ephemeroptera Taxa	1	1	0	1	87	0	0	1	0	-	0	0	0	0	-	0	0	0	0	-	3	3	3	3	0
Plecoptera Taxa	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Trichoptera Taxa	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	2	1	1	1	43
EPT Taxa	1	1	0	1	87	0	0	1	0	-	0	0	0	0	-	0	0	0	0	-	5	4	4	4	13
Cumulative EPT Taxa				1					1					0					0					5	
EPT Index (%)	1	1	0	1	100	0	0	1	0	-	0	0	0	0	-	0	0	0	0	-	25	37	29	30	21
Sensitive EPT Index (%)	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Shannon Diversity	2.8	2.6	2.6	2.6	4	2.5	1.6	1.8	2.0	23	1.8	2.2	1.8	1.9	12	2.0	1.9	1.7	1.9	9	2.9	2.4	2.3	2.6	13
Tolerance Value	6.1	7.1	6.5	6.6	8	7.9	6.3	6.6	6.9	13	7.3	6.3	6.0	6.5	10	6.5	6.4	5.7	6.2	7	6.0	5.7	6.7	6.1	8
Percent Intolerant Taxa (0-2)	0	0	0			0	0	0			0	0	0			0	0	0			0	0	0		
Percent Tolerant Taxa (8-10)	45	53	47	48	8	75	37	42	51	41	28	55	32	38	38	45	40	26	37	26	35	15	50	33	52
Percent Baetidae	1	1	0	1	100	0	0	1	0	-	0	0	0	0	-	0	0	0	0	-	19	31	22	24	25
Percent Hydropsychidae	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	4	6	6	5	24
Percent Chironomidae	36	27	34	32	13	19	20	14	18	18	44	31	61	45	33	69	68	79	72	8	21	9	12	14	46
Dipteran Taxa	2	1	1	1	43	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	4	1	1	2	87
Percent Diptera	12	5	2	6	80	14	42	30	29	49	28	7	6	13	91	7	4	3	5	45	5	23	1	10	121
Non-Insect Taxa	11	12	12	12	5	10	8	9	9	11	5	13	11	10	43	8	8	7	8	8	12	10	13	12	13
Percent Non-Insect Taxa	48	62	62	57	14	61	37	54	51	25	27	62	33	40	47	20	25	18	21	16	41	26	56	41	37
Percent Collectors	45	48	39	44	10	28	38	42	36	19	27	49	14	30	60	39	36	25	34	22	38	42	68	49	33
Percent Filterers	15	12	22	16	32	14	42	32	29	48	28	8	6	14	86	7	6	4	6	29	13	31	9	18	67
Percent Grazers	2	0	2	1	89	12	0	0	4	166	0	5	2	2	113	0	2	1	1	83	19	5	5	10	79
Percent Predators	20	24	28	24	17	42	2	15	20	104	3	7	18	9	84	6	4	3	4	41	19	18	13	17	20
Percent Shredders	1	13	2	5	130	2	3	4	3	40	42	11	40	31	55	31	36	45	37	19	6	3	2	3	62
Abundance (# /sample)	183	182	252	206	19	57	742	524	441	79	326	733	489	516	40	408	853	1659	973	65	1262	3023	2280	2188	40

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

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Undetermined Enchytraeidae	Oligochaeta	836	15.079	15.079
Ophidonais serpentina	Oligochaeta	579	10.444	25.523
Simulium sp.	*Chironomidae*	451	8.135	33.658
Gammarus lacustris	*Amphipoda*	380	6.854	40.512
Corbicula fluminea	*Pelecypoda*	337	6.079	46.591
Cricotopus sp.	*Chironomidae*	304	5.483	52.074
Cricotopus bicinctus	*Chironomidae*	267	4.816	56.890
Nais communis/variabilis	Oligochaeta	228	4.113	61.003
Torrenticola sp.	*Arachnoida*	215	3.878	64.881
Dicrotendipes sp.	*Chironomidae*	198	3.571	68.452
Prostoma sp.	*Enopla*	160	2.886	71.338
Megadrile	Oligochaeta	157	2.832	74.170
Undetermined Tubificidae	Oligochaeta	121	2.183	76.352
Nematoda	Nematoda	102	1.840	78.192
Eudistylia vancouveri	*Polychaeta*	85	1.533	79.725
Centroptilum/Procloeon sp.	*Ephemeroptera*	81	1.461	81.187
Physa sp./ Physella sp.	*Gastropoda*	74	1.335	82.521
Paratanytarsus sp.	*Chironomidae*	68	1.227	83.748
Fallceon quilleri	*Ephemeroptera*	58	1.046	84.794
Baetis tricaudatus	*Ephemeroptera*	54	0.974	85.768
Slavina appendiculata	Oligochaeta	51	0.920	86.688
Undetermined Trichoptera(lost vial)	Trichoptera	44	0.794	87.482
Nanocladius sp.	*Chironomidae*	38	0.685	88.167
Sperchon sp.	*Arachnoida*	37	0.667	88.834
Polypedilum sp.	*Chironomidae*	33	0.595	89.430
Dugesia tigrina	*Platyhelminthes*	28	0.505	89.935
Cyprididae	Ostracoda	25	0.451	90.386
Eukiefferiella sp.	*Chironomidae*	24	0.433	90.819
Cricotopus/Orthocladius sp.	*Chironomidae*	22	0.397	91.215
Stictotarsus sp.	*Coleoptera*	21	0.379	91.594
Micropsectra sp.	*Chironomidae*	21	0.379	91.973
Chironomus sp.	*Chironomidae*	21	0.379	92.352
Odontomyia sp.	*Chironomidae*	20	0.361	92.712
Hydra sp.	*Hydrozoa*	20	0.361	93.073
Gyraulus parvus	*Gastropoda*	20	0.361	93.434
Rheotanytarsus sp.	*Chironomidae*	19	0.343	93.777

Table 12 - continued

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Limnophyes sp.	*Chironomidae*	19	0.343	94.119
Fossaria sp.	*Gastropoda*	19	0.343	94.462
Thienemanniella sp.	*Chironomidae*	18	0.325	94.787
Phaenopsectra sp.	*Chironomidae*	18	0.325	95.111
Hexatoma sp.	*Chironomidae*	17	0.307	95.418
Undetermined Corixidae	Hemiptera	15	0.271	95.689
Corisella decolor	Hemiptera	12	0.216	95.905
Rheocricotopus sp.	*Chironomidae*	10	0.180	96.085
Planorbula sp.	*Gastropoda*	10	0.180	96.266
Erpobdellidae	Hirudnea	10	0.180	96.446
Corynoneura sp.	*Chironomidae*	10	0.180	96.627
Hydropsyche californica	*Trichoptera*	9	0.162	96.789
Calanoida	Copepoda	9	0.162	96.951
Pseudosuccinea columella	*Gastropoda*	7	0.126	97.078
Peltodytes sp.	*Coleoptera*	7	0.126	97.204
Oxyethira sp.	*Trichoptera*	7	0.126	97.330
Orthocladiinae	*Chironomidae*	7	0.126	97.456
Chaetogaster diaphanus	Oligochaeta	7	0.126	97.583
Branchiura sowerbyi	Oligochaeta	7	0.126	97.709
Parachironomus sp.	*Chironomidae*	6	0.108	97.817
Nereis limnicola	*Polychaeta*	6	0.108	97.925
Helisoma anceps	*Gastropoda*	6	0.108	98.034
Gyraulus sp.	*Gastropoda*	6	0.108	98.142
Bezzia/ Palpomyia	*Diptera*	6	0.108	98.250
Stratiomys sp.	*Chironomidae*	5	0.090	98.340
Hygrobatidae	*Arachnoida*	5	0.090	98.430
Enochrus sp.	*Coleoptera*	5	0.090	98.521
Hydroptila sp.	*Trichoptera*	5	0.090	98.611
Daphniidae	Cladocera	5	0.090	98.701
Cyclopidae	Copepoda	5	0.090	98.791
Undetermined Dytiscidae	*Coleoptera*	4	0.072	98.863
Tanytarsus sp.	*Chironomidae*	4	0.072	98.935
Pristina aequiseta	Oligochaeta	4	0.072	99.008
Microtendipes pedellus	*Chironomidae*	4	0.072	99.080
Undetermined Hydrophilidae	*Coleoptera*	3	0.054	99.134
Smittia sp.	*Chironomidae*	3	0.054	99.188

Table 12. - continued

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Cladotanytarsus sp	*Chironomidae*	3	0.054	99.242
Caloparyphus sp.	*Chironomidae*	3	0.054	99.296
Psychoda sp.	*Chironomidae*	2	0.036	99.332
Pristina leidyi	Oligochaeta	2	0.036	99.368
Neomysis mercedis	*Mysidacea*	2	0.036	99.404
Erioptera sp.	*Chironomidae*	2	0.036	99.440
Agabus sp.	*Coleoptera*	2	0.036	99.477
Tricorythodes sp.	*Ephemeroptera*	1	0.018	99.495
Sphaerium sp.	*Pelecypoda*	1	0.018	99.513
Pseudochironomus sp.	*Chironomidae*	1	0.018	99.531
Psectrocladius sp.	*Chironomidae*	1	0.018	99.549
Parametriocnemus sp.	*Chironomidae*	1	0.018	99.567
Orthocladius sp.	*Chironomidae*	1	0.018	99.585
Nais barbata	Oligochaeta	1	0.018	99.603
Microchironomus sp.	*Chironomidae*	1	0.018	99.621
Menetus opercularis	*Gastropoda*	1	0.018	99.639
Manayunkia speciosa	*Polychaeta*	1	0.018	99.657
Liodessus sp.	*Coleoptera*	1	0.018	99.675
Leucrocuta sp.	*Ephemeroptera*	1	0.018	99.693
Hemerodromia sp.	*Chironomidae*	1	0.018	99.711
Heleniella sp.	*Chironomidae*	1	0.018	99.729
Harpacticoida	Copepoda	1	0.018	99.747
Graptocorixa californica	*Hemiptera*	1	0.018	99.765
Glossiphoniidae	Hirudnea	1	0.018	99.783
Ephemerella maculata	*Ephemeroptera*	1	0.018	99.801
Enallagma sp.	*Odonata*	1	0.018	99.819
Ferrissia rivularis	*Gastropoda*	1	0.018	99.837
Hydrochus sp.	*Coleoptera*	1	0.018	99.855
Demicryptochironomus sp.	*Chironomidae*	1	0.018	99.873
Culicoides sp.	*Diptera*	1	0.018	99.891
Cryptochironomus	*Chironomidae*	1	0.018	99.909
Chironomini	*Chironomidae*	1	0.018	99.927
Chironominae	*Chironomidae*	1	0.018	99.946
Ceratopogonidae	Diptera	1	0.018	99.964
Caenis sp.	*Ephemeroptera*	1	0.018	99.982
Berosus sp.	*Coleoptera*	1	0.018	100.000
		5544		

Table 13. Benthic metrics by transect (including the means) for the 10 Orestimba Creek sites.

Site Name:		ORE 1					ORE 2					ORE 3					ORE 4					ORE 5			
Transect Number:	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV
Taxonomic Richness	13	30	23	22	39	29	30	28	29	3	8	29	11	16	71	21	25	24	23	9	22	22	14	19	24
Cumulative Taxa				42					43					34					32					30	
Percent Dominant Taxon	42	26	21	30	37	24	17	19	20	17	45	21	24	30	43	25	24	37	29	25	19	29	33	27	27
Ephemeroptera Taxa	1	0	1	1	87	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Plecoptera Taxa	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Trichoptera Taxa	1	0	0	0	-	0	0	0	0	-	0	1	0	0	-	0	0	0	0	-	0	0	0	0	-
EPT Taxa	2	0	1	1	100	0	0	0	0	-	0	1	0	0	-	0	0	0	0	-	0	0	0	0	-
Cumulative EPT Taxa				3					0					1					0					0	
EPT Index (%)	43	0	1	15	169	0	0	0	0	-	0	1	0	0	-	0	0	0	0	-	0	0	0	0	-
Sensitive EPT Index (%)	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Shannon Diversity	1.7	2.4	2.6	2.2	20	2.5	2.7	2.6	2.6	5	1.7	2.8	2.1	2.2	27	2.2	2.5	2.3	2.4	6	2.5	2.4	2.0	2.3	12
Tolerance Value	4.7	6.5	7.5	6.3	23	6.8	5.7	7.0	6.5	11	7.4	6.7	7.8	7.3	7	6.5	7.4	6.9	6.9	7	7.0	6.1	6.7	6.6	6
Percent Intolerant Taxa (0-2)	0	0	0			0	0	0			0	0	0			0	0	0			0	0	0		
Percent Tolerant Taxa (8-10)	47	58	64	56	16	46	43	53	47	11	74	39	76	63	33	44	71	58	58	23	59	39	42	47	23
Percent Baetidae	1	0	1	1	88	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Percent Hydropsychidae	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Percent Chironomidae	5	34	22	20	73	45	53	34	44	22	0	28	0	9	-	8	11	7	9	21	6	16	7	10	57
Dipteran Taxa	1	1	2	1	43	2	2	2	2	0	0	1	1	1	87	1	1	1	1	0	1	1	1	1	0
Percent Diptera	1	5	3	3	67	8	3	13	8	66	0	21	6	9	120	25	5	11	14	74	12	12	11	12	6
Non-Insect Taxa	8	13	11	11	24	13	11	10	11	13	7	14	8	10	39	12	15	14	14	11	15	13	9	12	25
Percent Non-Insect Taxa	51	60	58	57	8	46	43	54	48	11	90	48	67	69	31	57	66	75	66	14	81	72	83	79	7
Percent Collectors	51	61	48	54	13	49	46	56	50	10	81	48	49	59	32	50	65	66	60	14	57	58	52	56	6
Percent Filterers	1	7	9	6	73	10	3	14	9	60	0	23	6	10	122	26	7	15	16	60	27	29	37	31	18
Percent Grazers	0	0	9	3	163	1	2	4	2	68	3	7	16	9	76	1	3	1	2	57	6	0	0	2	-
Percent Predators	3	3	20	9	111	4	4	6	5	20	16	12	29	19	46	17	20	14	17	17	6	2	8	5	55
Percent Shredders	3	11	6	7	62	28	24	12	21	40	0	10	0	3	-	4	3	3	3	25	2	3	2	3	26
Abundance (# /sample)	105	532	129	255	94	238	156	443	279	53	31	128	49	69	74	171	156	274	200	32	124	143	92	120	22

Table 13. - continued

Site Name:	ORE 6					ORE 7					ORE 8					ORE 9					ORE 10				
Transect Number:	**T1**	**T2**	**T3**	**Mean**	**CV**	**T1**	**T2**	**T3**	**Mean**	**CV**	**T1**	**T2**	**T3**	**Mean**	**CV**	**T1**	**T2**	**T3**	**Mean**	**CV**	**T1**	**T2**	**T3**	**Mean**	**CV**
Taxonomic Richness	13	15	20	16	23	17	19	19	18	6	29	29	25	28	8	16	18	16	17	7	35	33	38	35	7
Cumulative Taxa				25					28					37					23					59	
Percent Dominant Taxon	40	22	23	28	36	17	18	27	21	27	28	27	16	24	28	75	80	84	80	6	26	33	42	33	23
Ephemeroptera Taxa	1	0	0	0	-	0	0	0	0	-	1	0	0	0	-	0	0	0	0	-	6	3	4	4	35
Plecoptera Taxa	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Trichoptera Taxa	0	1	0	0	-	1	1	1	1	0	1	2	2	2	35	0	0	0	0	-	0	1	1	1	87
EPT Taxa	1	1	0	1	87	1	1	1	1	0	2	2	2	2	0	0	0	0	0	-	6	4	5	5	20
Cumulative EPT Taxa				2					2					3					0					8	
EPT Index (%)	1	1	0	1	87	2	1	1	1	44	1	1	2	1	50	0	0	0	0	-	36	26	10	24	54
Sensitive EPT Index (%)	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Shannon Diversity	1.8	2.3	2.4	2.2	14	2.6	2.5	2.4	2.5	5	2.5	2.6	2.7	2.6	4	1.1	1.0	0.9	1.0	14	2.6	2.6	2.5	2.5	3
Tolerance Value	6.5	7.0	7.4	7.0	6	6.1	6.3	6.7	6.4	4	6.8	6.0	6.4	6.4	6	9.2	9.5	9.4	9.4	2	5.5	4.9	5.6	5.4	7
Percent Intolerant Taxa (0-2)	0	0	0			0	0	0			0	0	0			0	0	0			4	2	1		
Percent Tolerant Taxa (8-10)	45	55	67	56	20	34	41	48	41	17	47	33	51	44	22	89	92	91	91	2	38	13	23	25	52
Percent Baetidae	1	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	35	23	9	22	57
Percent Hydropsychidae	0	1	0	0	-	0	0	1	0	-	1	0	1	1	70	0	0	0	0	-	0	0	0	0	-
Percent Chironomidae	4	14	6	8	65	37	38	4	26	75	24	30	31	28	14	10	6	6	7	28	33	10	22	22	53
Dipteran Taxa	1	1	2	1	43	1	1	1	1	0	1	1	0	1	87	1	3	1	2	69	3	5	6	5	33
Percent Diptera	9	12	8	10	22	17	7	4	9	75	28	27	0	19	87	0	1	3	1	79	8	7	5	7	23
Non-Insect Taxa	8	11	14	11	27	9	11	14	11	22	15	14	15	15	4	10	11	9	10	10	9	14	12	12	22
Percent Non-Insect Taxa	85	73	86	81	9	44	54	92	63	40	47	42	67	52	26	90	93	91	91	2	16	51	56	41	54
Percent Collectors	63	49	70	61	17	39	34	65	46	36	39	32	60	44	33	86	88	89	88	1	74	38	34	49	45
Percent Filterers	32	30	19	27	25	31	23	26	26	14	48	41	12	34	56	3	4	4	4	19	1	3	2	2	53
Percent Grazers	3	4	4	3	21	2	3	4	3	35	1	2	4	3	66	1	1	1	1	3	5	6	7	6	15
Percent Predators	0	3	4	2	89	3	7	5	5	33	3	4	5	4	23	1	2	2	1	49	15	44	50	36	52
Percent Shredders	1	10	3	5	94	17	21	0	13	88	3	9	11	8	57	5	3	3	4	36	1	0	4	2	94
Abundance (# /sample)	75	73	135	94	37	59	152	85	99	49	432	534	522	496	11	5399	1494	2464	3119	65	454	1549	1443	1148	53

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

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Corophium spinicorne	*Amphipoda*	508	16.256	16.256
Chironomus sp.	*Chironomidae*	358	11.456	27.712
Cricotopus sp.	*Chironomidae*	305	9.760	37.472
Paratanytarsus sp.	*Chironomidae*	292	9.344	46.816
Undetermined Tubificidae	Oligochaeta	283	9.056	55.872
Physa sp./ Physella sp.	*Gastropoda*	223	7.136	63.008
Corbicula fluminea	*Pelecypoda*	160	5.120	68.128
Cricotopus bicinctus	*Chironomidae*	83	2.656	70.784
Hydropsyche californica	*Trichoptera*	79	2.528	73.312
Nais communis/variabilis	*Oligochaeta*	77	2.464	75.776
Daphniidae	Cladocera	73	2.336	78.112
Undetermined Corixidae	Hemiptera	72	2.304	80.416
Glyptotendipes sp.	*Chironomidae*	53	1.696	82.112
Ferrissia rivularis	*Gastropoda*	50	1.600	83.712
Eudistylia vancouveri	*Polychaeta*	49	1.568	85.280
Corisella decolor	*Hemiptera*	39	1.248	86.528
Dicrotendipes sp.	*Chironomidae*	34	1.088	87.616
Tanypus sp.	*Chironomidae*	30	0.960	88.576
Undetermined Coenagrionidae	Odonata	29	0.928	89.504
Polypedilum sp.	*Chironomidae*	27	0.864	90.368
Parachironomus sp.	*Chironomidae*	27	0.864	91.232
Ophidonais serpentina	*Oligochaeta*	27	0.864	92.096
Limnodrilus hoffmeisteri	*Oligochaeta*	27	0.864	92.960
Cambarincola sp.	Branchiobdellida	21	0.672	93.632
Slavina appendiculata	*Oligochaeta*	20	0.640	94.272
Prostoma sp.	*Enopla*	19	0.608	94.880
Simulium sp.	*Chironomidae*	18	0.576	95.456
Nematoda	Nematoda	10	0.320	95.776
Cyclopoida	Copepoda	10	0.320	96.096
Hydrellia sp.	*Chironomidae*	9	0.288	96.384
Gammarus lacustris	*Amphipoda*	9	0.288	96.672
Procladius sp.	*Chironomidae*	7	0.224	96.896
Chironominae	*Chironomidae*	7	0.224	97.120
Branchiura sowerbyi	*Oligochaeta*	7	0.224	97.344
Ablabesmyia sp.	*Chironomidae*	6	0.192	97.536
Limnophyes sp.	*Chironomidae*	5	0.160	97.696

Table 14. - continued

Lowest Taxa	Higher Taxa	Total N	Total %	Cumulative %
Ischnura sp.	*Odonata*	5	0.160	97.856
Harnischia sp.	*Chironomidae*	5	0.160	98.016
Calanoida	Copepoda	5	0.160	98.176
Trichocorixa calva	*Hemiptera*	4	0.128	98.304
Nanocladius sp.	*Chironomidae*	4	0.128	98.432
Cladotanytarsus sp	*Chironomidae*	4	0.128	98.560
Undetermined Hydropsychidae	Trichoptera	3	0.096	98.656
Hydroptila sp.	*Trichoptera*	3	0.096	98.752
Goeldichironomus sp.	*Chironomidae*	3	0.096	98.848
Ancylidae	Gastropoda	3	0.096	98.944
Trichocorixa sp.	*Hemiptera*	2	0.064	99.008
Pacifasticus sp.	*Decapoda*	2	0.064	99.072
Hetaerina americana	*Odonata*	2	0.064	99.136
Menetus opercularis	*Gastropoda*	2	0.064	99.200
Megadrile	Oligochaeta	2	0.064	99.264
Hydropsyche sp.	*Trichoptera*	2	0.064	99.328
Endotribelos sp.	*Chironomidae*	2	0.064	99.392
Cricotopus/Orthocladius sp.	*Chironomidae*	2	0.064	99.456
Coenagrion/ Enallagma	*Odonata*	2	0.064	99.520
Xenopelopia sp.	*Chironomidae*	1	0.032	99.552
Tanytarsini	*Chironomidae*	1	0.032	99.584
Tanypus neopunctipennis	*Chironomidae*	1	0.032	99.616
Ormosia sp.	*Chironomidae*	1	0.032	99.648
Liodessus obscurellus	*Coleoptera*	1	0.032	99.680
Nereis limnicola	*Polychaeta*	1	0.032	99.712
Hyalella azteca	*Amphipoda*	1	0.032	99.744
Helophorus sp.	*Coleoptera*	1	0.032	99.776
Eristalis sp	*Chironomidae*	1	0.032	99.808
Endochironomus sp.	*Chironomidae*	1	0.032	99.840
Corisella inscripta	*Hemiptera*	1	0.032	99.872
Chironomini	Chironomidae	1	0.032	99.904
Ceratopogon sp.	Diptera	1	0.032	99.936
Centroptilum/Procloeon sp.	*Ephemeroptera*	1	0.032	99.968
Berosus styliferus	Coleoptera	1	0.032	100.000
		3125		

Table 15. Benthic metrics by transect (including the means) for the 5 Salt Slough sites.

Site Name:	SSL 1					SSL 2					SSL 3					SSL 4					SSL 5				
Transect Number:	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV	T1	T2	T3	Mean	CV
Taxonomic Richness	18	25	28	24	22	23	23	12	19	33	19	18	26	21	21	33	27	27	29	12	16	17	20	18	12
Cumulative Taxa				39					33					35					44					27	
Percent Dominant Taxon	28	31	31	30	6	44	32	41	39	17	23	33	54	37	43	23	23	18	21	14	35	63	22	40	53
Ephemeroptera Taxa	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	1	0	-	0	0	0	0	-
Plecoptera Taxa	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Trichoptera Taxa	0	1	2	1	100	2	2	0	1	87	1	2	1	1	43	1	0	1	1	87	1	0	0	0	-
EPT Taxa	0	1	2	1	100	2	2	0	1	87	1	2	1	1	43	1	0	2	1	100	1	0	0	0	-
Cumulative EPT Taxa				2					3					2					2					1	
EPT Index (%)	0	1	1	1	99	2	1	0	1	93	2	34	1	12	150	0	0	1	1	120	0	0	0	0	-
Sensitive EPT Index (%)	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Shannon Diversity	2.2	2.3	2.5	2.3	4	2.0	2.4	1.8	2.1	15	2.4	2.1	1.8	2.1	15	2.7	2.4	2.6	2.6	6	1.7	1.5	2.2	1.8	20
Tolerance Value	8.2	7.7	7.4	7.7	5	7.3	7.9	8.6	8.0	8	8.1	6.1	7.3	7.2	15	6.9	6.9	7.7	7.2	7	9.1	9.5	8.8	9.1	4
Percent Intolerant Taxa (0-2)	0	0	0			0	0	0			0	0	0			0	0	0			0	0	0		
Percent Tolerant Taxa (8-10)	88	79	79	82	6	69	80	92	80	14	78	37	66	60	35	35	41	60	46	29	93	91	90	91	2
Percent Baetidae	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-	0	0	0	0	-
Percent Hydropsychidae	0	0	1	0	-	2	1	0	1	93	2	33	1	12	149	0	0	1	0	106	0	0	0	0	-
Percent Chironomidae	10	19	18	16	32	29	16	4	16	76	38	34	27	33	18	58	60	42	53	18	43	84	45	57	40
Dipteran Taxa	1	1	2	1	43	1	0	1	1	87	1	1	1	1	0	1	0	2	1	100	0	0	0	0	-
Percent Diptera	2	2	3	2	24	0	0	1	1	122	2	3	1	2	62	2	0	1	1	109	0	0	0	0	-
Non-Insect Taxa	7	8	8	8	8	8	14	6	9	45	4	4	11	6	64	14	11	10	12	18	8	4	8	7	35
Percent Non-Insect Taxa	61	51	60	57	9	60	59	51	56	9	27	28	67	41	57	36	35	40	37	7	54	13	52	40	58
Percent Collectors	48	39	43	43	10	60	55	54	56	6	39	33	57	43	29	26	33	31	30	13	76	74	58	69	15
Percent Filterers	3	6	4	4	30	18	11	1	10	83	16	44	11	24	75	21	21	19	20	5	1	1	4	2	89
Percent Grazers	15	14	19	16	15	0	2	0	1	-	4	2	10	5	76	15	6	13	11	40	13	3	16	11	66
Percent Predators	29	29	20	26	21	10	25	44	26	65	36	4	5	15	122	10	7	18	12	51	4	11	5	6	57
Percent Shredders	4	6	6	6	17	7	6	1	5	62	2	13	16	10	71	23	25	16	21	21	7	12	18	12	46
Abundance (# /sample)	89	160	167	139	31	417	139	71	209	88	100	195	370	222	62	350	441	239	343	29	815	762	1678	1085	47

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

	Eigenvalue	Difference	Proportion	Cumulative
PRIN 1	9.06503	4.51428	0.362601	0.36260
PRIN 2	4.55075	1.30259	0.182030	0.54463
PRIN 3	3.24816	0.92455	0.129927	0.67456
PRIN 4	2.32362	0.63917	0.092945	0.76750
PRIN 5	1.68445	0.59119	0.067378	0.83488
PRIN 6	1.09326	0.29384	0.043730	0.87861
PRIN 7	0.79942	0.18771	0.031977	0.91059
PRIN 8	0.61171	0.14003	0.024468	0.93506
PRIN 9	0.47167	0.09723	0.018867	0.95392
PRIN 10	0.37444	0.09377	0.014978	0.96890
PRIN 11	0.28068	0.08801	0.011227	0.98013
PRIN 12	0.19267	0.07400	0.007707	0.98783
PRIN 13	0.11867	0.02948	0.004747	0.99258
PRIN 14	0.08919	0.04736	0.003568	0.99615
PRIN 15	0.04183	0.01747	0.001673	0.99782
PRIN 16	0.02436	0.00711	0.000974	0.99880
PRIN 17	0.01724	0.00895	0.000690	0.99949
PRIN 18	0.00829	0.00374	0.000332	0.99982
PRIN 19	0.00455	0.00455	0.000182	1.00000
PRIN 20	0.00000	0.00000	0.000000	1.00000
PRIN 21	0.00000	0.00000	0.000000	1.00000
PRIN 22	0.00000	0.00000	0.000000	1.00000
PRIN 23	0.00000	0.00000	0.000000	1.00000
PRIN 24	0.00000	0.00000	0.000000	1.00000
PRIN 25	0.00000	-	0.000000	1.00000

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

	PRIN 1	PRIN 2	PRIN 3	PRIN 4	PRIN 5	PRIN 6
factor 1						
Cumulative Taxa	0.3037*	-.0014	-.0676	0.0307	-.1534	0.1520
EPT Taxa	0.3093*	0.1076	-.0012	0.0856	0.1244	0.0257
Ephemeroptera Taxa	0.3073*	0.1215	0.0126	-.1282	0.0388	-.0508
factor 2						
Abundance (# /sample)	0.0336	0.3261*	-.0737	-.2343	0.3396	0.2011
Percent Collectors	-.1014	0.3639*	0.1982	-.0407	-.0208	0.2381
Percent Dominant Taxon	-.1201	0.3814*	-.0565	-.1632	0.1864	-.0910
factor 3						
Non-Insect Taxa	0.1090	-.1358	0.3812*	-.1586	-.0011	0.4427*
Percent Chironomidae	-.0337	-.1866	-.4551*	-.1487	0.0338	0.1625
Percent Non-Insect Taxa	-.1252	0.1732	0.4380*	0.0109	-.0731	0.0724
Percent Shredders	-.0747	-.2222	-.3915*	-.2420	0.1117	0.1098
factor 4						
Percent Grazers	0.0806	0.0812	-.1960	0.3464*	-.2485	0.0963
Percent Hydropsychidae	0.0686	0.0377	-.1290	0.3590*	0.4502*	-.1752
Trichoptera Taxa	0.1391	0.0195	-.0282	0.4624*	0.2247	0.1635
factor 5						
Percent Filterers	-.0146	-.2652	0.2983	0.1831	0.3418*	-.0589
Percent Predators	0.1921	0.0889	-.0159	0.1459	-.3632*	-.4417*
factor 6						
Percent Diptera	0.0167	-.2155	0.2929	-.1166	0.1607	-.3569*
Taxonomic Richness	0.2831	-.0298	-.0159	0.0022	-.0757	0.3408*
not associated with a factor						
Cumulative EPT Taxa	0.2956	0.1146	0.0076	0.1032	0.0109	-.0245
Dipteran Taxa	0.2585	0.1279	0.0346	-.2712	-.0824	-.0852
EPT Index (%)	0.2769	0.1324	-.0421	0.0431	0.2385	-.0287
Percent Baetidae	0.2917	0.1383	-.0071	-.0798	0.1368	-.0072
Percent Intolerant Taxa	0.2436	0.1226	-.0114	-.2204	-.1742	-.2137
Shannon Diversity	0.2058	-.2825	0.0944	0.1642	-.2053	0.2208
Tolerance Value	-.2206	0.2826	-.0711	0.1662	-.0692	0.1149

Table 18. Spearman rank correlation coefficients and significance levels for upstream-downstream trend in the benthic metrics.

Metric	Del Puerto	Orestimba	Salt Slough
Abundance (# /sample)	1.00000 0.0001	0.45455 0.1869	1.00000 0.0001
Cumulative EPT Taxa	0.10541 0.8660	0.29581 0.4066	-0.67082 0.2152
Cumulative Taxa	0.00000 1.0000	-0.24848 0.4888	-0.30000 0.6238
Dipteran Taxa	0.22361 0.7177	0.16670 0.6453	-0.66689 0.2189
EPT Index (%)	0.05130 0.9347	0.25093 0.4844	-0.60000 0.2848
EPT Taxa	0.05130 0.9347	0.38267 0.2751	-0.52705 0.3615
Ephemeroptera Taxa	0.05130 0.9347	0.22619 0.5298	0.35355 0.5594
Non-Insect Taxa	-0.10260 0.8696	0.25532 0.4765	-0.10000 0.8729
Percent Baetidae	0.05130 0.9347	0.09694 0.7899	- -
Percent Chironomidae	-0.10000 0.8729	-0.10303 0.7770	1.00000 0.0001
Percent Collectors	0.10000 0.8729	-0.12727 0.7261	0.10000 0.8729
Percent Diptera	-0.20000 0.7471	0.01818 0.9602	-0.70000 0.1881
Percent Dominant Taxon	0.40000 0.5046	0.27273 0.4458	0.30000 0.6238
Percent Filterers	-0.20000 0.7471	-0.03030 0.9338	-0.10000 0.8729
Percent Grazers	0.30000 0.6238	-0.06707 0.8539	-0.10000 0.8729

Table 18. - continued

Percent Hydropsychidae	0.70711 0.1817	0.35957 0.3075	-0.46169 0.4338
Percent Intolerant Taxa (0-2)	- -	0.52223 0.1215	- -
Percent Non-Insect Taxa	-0.70000 0.1881	0.04242 0.9074	-0.90000 0.0374
Percent Predators	-0.70000 0.1881	-0.22424 0.5334	-0.90000 0.0374
Percent Shredders	0.20000 0.7471	-0.27964 0.4339	0.80000 0.1041
Percent Tolerant Taxa (8-10)	-0.90000 0.0374	-0.39394 0.2600	0.00000 1.0000
Plecoptera Taxa	- -	- -	- -
Sensitive EPT Index (%)	- -	- -	- -
Shannon Diversity	-0.40000 0.5046	0.05471 0.8807	-0.30000 0.6238
Taxonomic Richness	0.05130 0.9347	0.08511 0.8152	-0.30000 0.6238
Tolerance Value	-0.90000 0.0374	-0.05455 0.8810	0.15390 0.8048
Trichoptera Taxa	0.70711 0.1817	0.38646 0.2700	-0.66689 0.2189

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

Metric	Mean for each Creek: Del Puerto	Orestimba	Salt Slough	Kruskal-Wallace p-value	Pairwise Comparisons
Abundance (# /sample)	864.866	588.033	399.533	0.2873	
Cumulative EPT Taxa	1.400	1.900	2.000	0.4890	
Cumulative Taxa	34.600	35.300	35.600	0.8893	
Dipteran Taxa	1.266	1.533	0.800	0.3042	
EPT Index (%)	6.266	4.233	2.866	0.9290	
EPT Taxa	1.066	1.000	1.000	0.3725	
Ephemeroptera Taxa	0.800	0.566	0.066	0.3618	
Non-Insect Taxa	9.933	11.633	8.333	0.0443	OS [a]
Percent Baetidae	5.000	2.333	0.000	0.1319	
Percent Chironomidae	36.266	18.366	35.133	0.1063	
Percent Collectors	38.533	56.566	48.400	0.0382	DO [b]
Percent Diptera	12.600	9.066	1.133	0.0074	DS [c] OS [a]
Percent Dominant Taxon	29.866	32.133	33.400	0.3538	
Percent Filterers	16.600	16.433	12.066	0.7063	
Percent Grazers	3.666	3.366	8.800	0.2311	
Percent Hydropsychidae	1.066	0.133	2.733	0.1151	
Percent Intolerant Taxa	0.000	0.233	0.000	0.6065	
Percent Non-Insect Taxa	42.133	64.600	46.266	0.0271	DO [b] OS [a]
Percent Predators	14.800	10.400	17.133	0.2013	
Percent Shredders	16.066	6.733	10.800	0.3163	

Table 19. - continued

Percent Tolerant Taxa	41.666	52.666	71.866	0.0421	DS [c]
Plecoptera Taxa	0.0	0.0	0.0	1.0000	
Sensitive EPT Index (%)	0.0	0.0	0.0	1.0000	
Shannon Diversity	2.193	2.250	2.173	0.5384	
Taxonomic Richness	21.800	22.366	22.133	0.8907	
Tolerance Value	6.473	6.800	7.833	0.0198	DS [c] OS [a]
Trichoptera Taxa	0.266	0.433	0.933	0.0788	

[a] OS - Orestimba significantly different from Salt Slough ($p <= 0.05$)
[b] DO - Del Puerto significantly different from Orestimba ($p <= 0.05$)
[c] DS - Del Puerto significantly different from Salt Slough ($p <= 0.05$)

Table 20. Spearman Rank Correlation Analysis of benthic metrics vs. habitat metrics. For each benthic metric, there are two rows. The first row shows the Spearman Correlation Coefficient and the second row shows the p-value for the correlation coefficient.

	Habitat Metrics										
Benthic Metrics	BANK STAB	BANK VEG	BEN RIFF	CHAN ALT	CHAN FLOW	EMBE DDED	EPI SUB	RIP BUFF	SED DEP	TOTAL	VEL DPTH
Abundance (# /sample)	-0.0608	-0.2863	-0.4613	-0.1588	-0.3382	-0.3809	-0.4650	-0.0788	-0.3910	-0.5763	-0.6213
	0.7988	0.2209	0.0406	0.5036	0.1447	0.0975	0.0388	0.7410	0.0882	0.0078	0.0035
Cumulative EPT Taxa	0.4660	-0.0128	0.1129	0.4435	-0.1408	-0.2352	-0.1155	0.1768	-0.1271	-0.0610	-0.2333
	0.0383	0.9572	0.6354	0.0501	0.5536	0.3180	0.6276	0.4558	0.5932	0.7982	0.3220
Cumulative Taxa	0.1313	0.1736	0.1513	0.5235	0.0432	-0.2845	0.0970	0.3639	-0.1182	0.0305	-0.0880
	0.5810	0.4641	0.5242	0.0178	0.8562	0.2240	0.6839	0.1147	0.6195	0.8984	0.7121
Dipteran Taxa	0.2487	0.3590	0.4771	0.4369	-0.2264	0.0818	0.2538	0.3681	-0.0623	0.1818	0.0259
	0.2903	0.1200	0.0334	0.0540	0.3371	0.7315	0.2801	0.1102	0.7939	0.4429	0.9137
EPT Index (%)	0.5195	0.1534	0.2713	0.4784	-0.1558	-0.0947	-0.0317	0.3071	0.0398	0.0972	-0.0987
	0.0189	0.5184	0.2472	0.0328	0.5118	0.6912	0.8943	0.1877	0.8675	0.6835	0.6789
EPT Taxa	0.5287	-0.0142	0.0958	0.3984	-0.0770	-0.2780	-0.2086	0.2092	-0.1512	-0.0636	-0.2502
	0.0165	0.9523	0.6879	0.0818	0.7467	0.2353	0.3774	0.3760	0.5243	0.7897	0.2873
Ephemeroptera Taxa	0.1558	-0.0786	0.2448	0.2725	-0.3890	-0.0610	0.0869	-0.0994	0.1267	-0.0315	-0.0488
	0.5118	0.7417	0.2982	0.2449	0.0900	0.7983	0.7155	0.6767	0.5943	0.8948	0.8380
Non-Insect Taxa	0.1766	0.2405	0.4677	0.2982	0.1076	0.4912	0.5792	-0.0823	0.4112	0.5100	0.5921
	0.4564	0.3069	0.0375	0.2016	0.6514	0.0278	0.0074	0.7301	0.0717	0.0216	0.0059
Percent Baetidae	0.0915	0.0060	0.3219	0.3209	-0.5675	0.0121	0.1178	0.0238	0.1873	-0.0037	-0.0260
	0.7011	0.9797	0.1663	0.1677	0.0091	0.9594	0.6206	0.9204	0.4291	0.9876	0.9130
Percent Chironomidae	-0.2792	-0.1704	-0.5208	-0.3919	-0.1153	-0.5679	-0.6077	-0.0887	-0.3412	-0.4424	-0.5738
	0.2332	0.4724	0.0185	0.0874	0.6282	0.0090	0.0045	0.7099	0.1409	0.0508	0.0082

Table 20. - continued

	Habitat Metrics										
Benthic Metrics	BANK STAB	BANK VEG	BEN RIFF	CHAN ALT	CHAN FLOW	EMBE DDED	EPI SUB	RIP BUFF	SED DEP	TOTAL	VEL DPTH
Percent Collectors	0.0814 0.7329	0.1098 0.6446	0.2868 0.2200	0.2510 0.2858	0.1290 0.5877	0.3958 0.0840	0.4667 0.0380	-0.0591 0.8043	0.0551 0.8174	0.3233 0.1644	0.3799 0.0985
Percent Diptera	-0.1587 0.5038	-0.0155 0.9481	0.1188 0.6177	-0.2582 0.2717	-0.1618 0.4955	0.6377 0.0025	0.4835 0.0308	-0.3214 0.1670	0.8020 0.0001	0.3226 0.1653	0.5164 0.0197
Percent Dominant Taxon	-0.1362 0.5668	-0.4437 0.0500	-0.5256 0.0173	-0.2869 0.2199	-0.3017 0.1961	-0.3822 0.0963	-0.5551 0.0111	-0.0792 0.7397	-0.4875 0.0292	-0.6823 0.0009	-0.6072 0.0045
Percent Filterers	0.2779 0.2355	0.1186 0.6183	0.1532 0.5189	-0.1261 0.5962	0.0397 0.8678	0.3740 0.1043	0.2531 0.2816	-0.1688 0.4766	0.5364 0.0147	0.4254 0.0615	0.5243 0.0176
Percent Grazers	-0.1795 0.4487	-0.3405 0.1418	0.0409 0.8639	0.0431 0.8566	0.0164 0.9453	-0.3218 0.1664	-0.1017 0.6694	-0.2181 0.3554	-0.2308 0.3276	-0.2051 0.3856	-0.2765 0.2378
Percent Hydropsychidae	0.7291 0.0003	0.1168 0.6237	-0.0177 0.9408	0.2375 0.3133	0.1445 0.5433	-0.1391 0.5585	-0.2157 0.3609	0.3174 0.1727	-0.1370 0.5646	0.0955 0.6885	-0.1031 0.6651
Percent Intolerant Taxa (0-2)	-0.0402 0.8662	-0.3006 0.1977	0.0202 0.9326	0.1045 0.6609	-0.3917 0.0876	-0.1202 0.6137	-0.1198 0.6147	-0.1806 0.4461	-0.1797 0.4482	-0.2986 0.2009	-0.2796 0.2324
Percent Non-Insect Taxa	0.2856 0.2222	0.3947 0.0850	0.6843 0.0009	0.3192 0.1701	0.3327 0.1517	0.6675 0.0013	0.7082 0.0005	0.0918 0.7001	0.4504 0.0462	0.6945 0.0007	0.7600 0.0001
Percent Predators	-0.0928 0.6971	-0.1894 0.4239	-0.0122 0.9592	0.3089 0.1850	-0.0849 0.7218	-0.4044 0.0770	-0.2642 0.2602	0.1812 0.4444	-0.0709 0.7662	-0.2784 0.2346	-0.1713 0.4700
Percent Shredders	-0.0457 0.8482	0.1013 0.6708	-0.3653 0.1132	-0.2941 0.2081	0.1608 0.4981	-0.3357 0.1478	-0.4031 0.0780	0.1048 0.6599	-0.2768 0.2373	-0.1703 0.4727	-0.3982 0.0820

Table 20. - continued

	Habitat Metrics										
Benthic Metrics	BANK STAB	BANK VEG	BEN RIFF	CHAN ALT	CHAN FLOW	EMBE DDED	EPI SUB	RIP BUFF	SED DEP	TOTAL	VEL DPTH
Percent Tolerant Taxa (8-10)	-0.0030 0.9898	-0.0151 0.9494	-0.0336 0.8881	0.0110 0.9631	0.4707 0.0362	-0.1711 0.4706	-0.0060 0.9798	0.0750 0.7530	-0.2710 0.2477	-0.0293 0.9023	0.0407 0.8645
Plecoptera Taxa	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Sensitive EPT Index (%)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Shannon Diversity	0.2432 0.3014	0.3377 0.1453	0.4815 0.0316	0.4013 0.0794	0.2448 0.2981	0.1754 0.4594	0.3898 0.0893	0.1795 0.4489	0.2799 0.2319	0.4841 0.0305	0.3838 0.0948
Taxonomic Richness	0.1898 0.4229	0.1848 0.4353	0.1281 0.5902	0.4022 0.0787	0.0570 0.8114	-0.2629 0.2628	0.0128 0.9571	0.3168 0.1734	-0.1463 0.5380	0.0260 0.9133	-0.0525 0.8258
Tolerance Value	0.0749 0.7534	-0.1712 0.4703	-0.1211 0.6110	-0.0806 0.7354	0.4806 0.0319	-0.2375 0.3133	-0.1582 0.5052	-0.0804 0.7361	-0.3493 0.1311	-0.1031 0.6653	-0.0128 0.9572
Trichoptera Taxa	0.5624 0.0098	0.0055 0.9816	-0.0146 0.9510	0.3073 0.1875	0.1373 0.5636	-0.2181 0.3555	-0.2009 0.3955	0.2263 0.3372	-0.1978 0.4031	-0.0062 0.9791	-0.2272 0.3352

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 / N = 20

Table 21. Spearman Rank Correlation Analysis of benthic metrics vs. physical habitat measurements (not scored on a 0-20 scale). For each metric, there are two rows. The first row shows the Spearman Correlation Coefficient and the second row shows the p-value for the correlation coefficient.

Benthic Metric	WIDTH	DEPTH	VELOC	CANOPY
Abundance (# /sample)	-0.4180	-0.4034	-0.3974	-0.4397
	0.0666	0.0777	0.0827	0.0523
Cumulative EPT Taxa	0.3081	0.0487	-0.1998	-0.4824
	0.1863	0.8384	0.3983	0.0312
Cumulative Taxa	0.2362	-0.0192	-0.1058	-0.2281
	0.3159	0.9359	0.6570	0.3334
Dipteran Taxa	-0.3727	-0.4745	0.0927	0.2677
	0.1055	0.0345	0.6974	0.2538
EPT Index (%)	0.1773	-0.0385	-0.0779	-0.2932
	0.4545	0.8717	0.7439	0.2095
EPT Taxa	0.3189	0.0207	-0.2080	-0.5025
	0.1705	0.9309	0.3788	0.0239
Ephemeroptera Taxa	-0.2209	-0.3134	0.0785	-0.1788
	0.3492	0.1784	0.7419	0.4506
Non-Insect Taxa	-0.2380	-0.5204	0.3404	0.3720
	0.3123	0.0186	0.1420	0.1063
Percent Baetidae	-0.3554	-0.2926	0.0213	-0.0189
	0.1241	0.2105	0.9287	0.9367
Percent Chironomidae	0.1157	0.0993	-0.1859	-0.3359
	0.6269	0.6768	0.4326	0.1475
Percent Collectors	0.0834	0.0666	-0.0715	0.3261
	0.7264	0.7801	0.7644	0.1606
Percent Diptera	-0.4717	-0.3785	0.5604	0.2215
	0.0357	0.0998	0.0102	0.3478
Percent Dominant Taxon	-0.0511	0.1091	-0.5120	-0.2980
	0.8304	0.6468	0.0210	0.2019

Table 21. - continued

Benthic Metric	WIDTH	DEPTH	VELOC	CANOPY
Percent Filterers	0.0052 0.9824	-0.1581 0.5053	0.6007 0.0051	-0.0423 0.8594
Percent Grazers	0.2999 0.1989	0.3730 0.1052	-0.3078 0.1868	-0.4284 0.0595
Percent Intolerant Taxa	-0.2188 0.3540	-0.3783 0.1000	-0.3385 0.1443	-0.0203 0.9322
Percent Non-Insect Taxa	-0.0338 0.8873	-0.0071 0.9761	0.4084 0.0738	0.6461 0.0021
Percent Predators	0.1894 0.4237	0.3086 0.1855	-0.3244 0.1629	-0.1522 0.5217
Percent Shredders	0.1943 0.4116	0.1583 0.5048	-0.0158 0.9472	-0.1879 0.4275
Percent Tolerant Taxa	0.5654 0.0094	0.6910 0.0007	-0.0112 0.9623	-0.0053 0.9820
Plecoptera Taxa	- -	- -	- -	- -
Sensitive EPT Index (%)	- -	- -	- -	- -
Shannon Diversity	0.1030 0.6654	-0.1981 0.4024	0.2979 0.2020	0.1846 0.4358
Taxonomic Richness	0.1506 0.5261	-0.1859 0.4326	0.0245 0.9183	-0.1941 0.4122
Tolerance Value	0.5054 0.0230	0.5707 0.0086	-0.1186 0.6185	-0.1130 0.6351
Trichoptera Taxa	0.4910 0.0279	0.1592 0.5024	-0.2434 0.3010	-0.5716 0.0085

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 /N = 20

Table 22. Comparison of individual water quality measurements for Orestimba Creek in 2000 and 2001.

	Temperature (C)		Specific Conductance (μmhos/L)		pH		Dissolved Oxygen (mg/L)		Turbidity (NTU)	
Site	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000
Orestimba 1	18.8	21.5	648	754	7.96	8.01	8.4	6.7	142	115
Orestimba 2	20.3	22.5	662	744	8.12	8.23	5.0	8.2	126	158
Orestimba 3	20.3	23.0	675	739	7.86	8.18	4.9	7.5	142	156
Orestimba 4	21.4	21.4	334	683	8.17	8.01	4.2	7.8	104	107
Orestimba 5	22.8	22.0	636	654	8.08	8.1	4.3	8.1	110	107
Orestimba 6	24.7	22.9	584	644	7.8	8.25	4.0	8.9	128	131
Orestimba 7	19.5	29.5	663	620	8.04	8.48	4.2	8.9	136	153
Orestimba 8	21.6	22.9	695	840	7.87	8.21	3.3	8.2	92	80
Orestimba 9	30.3	27.7	1000	857	8.59	8.4	4.0	7.8	108	213
Orestimba 10	27.1	27.4	1044	878	8.37	8.37	4.8	13.0	0.82	0.51

Table 23. Mean scores for each physical habitat metric, total score and stream measurements for 2000 (Hall and Killen, 2001) and 2001 sampling in Orestimba Creek. A p-value based on a Wilcoxon Rank-Sum Test was used.

Habitat Metrics	Mean 2000	Mean 2001	Difference	Wilcoxon P-value
Epifaunal Substrate	11.70	12.10	0.40	0.8750
Embeddedness	11.40	12.90	1.50	0.0957
Velocity Depth	12.10	15.50	3.40	0.0586
Sediment Deposition	11.90	11.00	-0.90	0.9102
Channel Flow Status	14.00	17.30	3.30	0.0391
Channel Alteration	15.70	14.70	-1.00	0.1250
Frequency of Bends/Riffle	12.70	13.80	1.10	0.5391
Bank Stability	11.40	12.00	0.60	0.7891
Bank Vegetative Protection	11.30	12.70	1.40	0.8672
Riparian Zone width	10.10	8.80	-1.30	0.4688
Total Habitat Score	122.30	130.80	8.50	0.3848
Stream Width	3.86	6.17	2.31	0.0137
Stream Depth	0.22	0.47	0.25	0.0059
Stream Velocity	0.44	0.51	0.06	0.4453
Canopy Cover	32.90	28.90	-4.00	0.8008

Table 24. Comparison of individual physical habitat metrics and total scores for Orestimba Creek in 2000 (Hall and Killen, 2001) and 2001.

	Epi. Subs Avail Cover		Embedded.		Velocity Depth Div.		Sediment Deposition		Channel Flow Status		Channel Alteration		Frequency Riffles/Bends	
Site Number	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000
Orestimba 1	13	6	6	4	13	7	6	4	17	16	16	18	15	5
Orestimba 2	14	10	11	13	16	10	10	5	20	15	15	18	12	17
Orestimba 3	15	14	16	14	18	10	16	15	20	19	15	15	15	18
Orestimba 4	12	15	16	14	19	17	15	16	20	15	14	15	11	10
Orestimba 5	16	17	15	13	19	19	9	15	15	15	15	15	16	18
Orestimba 6	13	10	16	11	16	13	13	10	15	15	14	14	15	8
Orestimba 7	10	8	16	13	18	12	16	14	20	11	15	15	16	10
Orestimba 8	11	13	15	11	15	10	15	14	20	10	13	13	10	15
Orestimba 9	10	14	12	14	14	10	5	14	20	15	15	15	15	10
Orestimba 10	7	10	6	7	7	13	5	12	6	9	15	19	13	16

	Left Bank Stability		Right Bank Stability		Left Bank Veget. Protect.		Right Bank Veget. Protect.		Left Bank Ripar. Zone		Right Bank Ripar. Zone		Total Score	
Site Number	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000	2001	2000
Orestimba 1	8	1	2	1	9	2	7	2	8	5	8	3	128	74
Orestimba 2	5	1	6	1	9	2	9	2	8	5	6	5	141	104
Orestimba 3	3	7	6	7	6	6	4	6	3	3	3	3	140	137
Orestimba 4	4	5	2	5	5	4	3	4	3	4	3	5	127	129
Orestimba 5	6	7	5	6	8	9	8	8	5	8	5	8	142	158
Orestimba 6	8	8	8	8	6	9	5	8	3	6	2	4	134	124
Orestimba 7	8	4	6	5	6	6	9	9	3	3	6	6	149	116
Orestimba 8	8	7	8	9	6	7	6	7	3	6	3	6	133	128
Orestimba 9	8	9	8	9	7	8	7	8	5	7	5	8	131	141
Orestimba 10	5	7	6	7	4	3	3	3	3	3	3	3	83	112

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	Waterborne Environmental Inc., 2002
Chlorpyrifos	Orestimba Creek	0 - 2,282	1996/97	Poletika and Robb, 1998
Chlorpyrifos	Salt Slough	0 - 120	1991/93	Waterborne Environmental Inc., 2002
Diazinon	Del Puerto Creek	0 - 2,600	1991/93	Waterborne Environmental Inc., 2002
Diazinon	Orestimba Creek	0 - 29,371	1996/97	Poletika and Robb, 1998
Diazinon	Salt Slough	0 - 330	1991/93	Waterborne Environmental Inc., 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.

Species	Collection Site	Abundance	EC or LC50 Values (µg/L)
Dugesia tigrina	DLP 1	82	2.0-4.3[A]
Dugesia tigrina	DLP 2	38	2.0-4.3[A]
Dugesia tigrina	DLP 3	20	2.0-4.3[A]
Dugesia tigrina	DLP 4	7	2.0-4.3[A]
Dugesia tigrina	DLP 5	13	2.0-4.3[A]
Dugesia tigrina	ORE 1	1	2.0-4.3[A]
Dugesia tigrina	ORE 3	4	2.0-4.3[A]
Dugesia tigrina	ORE 4	6	2.0-4.3[A]
Dugesia tigrina	ORE 5	6	2.0-4.3[A]
Dugesia tigrina	ORE 6	3	2.0-4.3[A]
Dugesia tigrina	ORE 7	1	2.0-4.3[A]
Dugesia tigrina	ORE 8	7	2.0-4.3[A]
Gammarus lacustris	DLP 4	1	0.11[B]
Gammarus lacustris	ORE 1	1	0.11[B]
Gammarus lacustris	ORE 2	5	0.11[B]
Gammarus lacustris	ORE 3	20	0.11[B]
Gammarus lacustris	ORE 4	80	0.11[B]
Gammarus lacustris	ORE 5	95	0.11[B]
Gammarus lacustris	ORE 6	61	0.11[B]
Gammarus lacustris	ORE 7	35	0.11[B]
Gammarus lacustris	ORE 8	83	0.11[B]
Gammarus lacustris	SSL 1	4	0.11[B]
Gammarus lacustris	SSL 2	3	0.11[B]
Gammarus lacustris	SSL 3	2	0.11[B]
Daphniidae	DLP 1	9	0.21[C]

Table 26. - continued

Daphniidae	DLP 2	2	0.21[C]
Daphniidae	DLP 4	1	0.21[C]
Daphniidae	DLP 5	1	0.21[C]
Daphniidae	ORE 1	1	0.21[C]
Daphniidae	ORE 2	1	0.21[C]
Daphniidae	ORE 3	1	0.21[C]
Daphniidae	ORE 4	1	0.21[C]
Daphniidae	ORE 10	1	0.21[C]
Daphniidae	SSL 2	3	0.21[C]
Daphniidae	SSL 3	1	0.21[C]
Daphniidae	SSL 4	32	0.21[C]
Daphniidae	SSL 5	37	0.21[C]
Neomysis mercedis	ORE 3	2	0.14-0.16
Simulium sp.	DLP 1	35	27[D]
Simulium sp.	DLP 2	207	27
Simulium sp.	DLP 3	117	27[D]
Simulium sp.	DLP 4	42	27[D]
Simulium sp.	DLP 5	82	27[D]
Simulium sp.	ORE 1	17	27[D]
Simulium sp.	ORE 2	54	27[D]
Simulium sp.	ORE 3	30	27[D]
Simulium sp.	ORE 4	80	27[D]
Simulium sp.	ORE 5	42	27[D]
Simulium sp.	ORE 6	26	27[D]
Simulium sp.	ORE 7	24	27[D]
Simulium sp.	ORE 8	161	27[D]
Simulium sp.	ORE 9	11	27[D]

Table 26. - continued

Simulium sp.	ORE 10	6	27^{D}
Simulium sp.	SSL 2	1	27^{D}
Simulium sp.	SSL 3	10	27^{D}
Simulium sp.	SSL 4	7	27^{D}
Hydropsyche californica	SSL 2	4	30.6^{E}
Hydropsyche californica	SSL 3	71	30.6^{E}
Hydropsyche californica	SSL 4	3	30.6^{E}
Hydropsyche californica	SSL 5	1	30.6^{E}
Hydropsyche californica	ORE 6	1	30.6^{E}
Hydropsyche californica	ORE 7	1	30.6^{E}
Hydropsyche californica	ORE 8	7	30.6^{E}
Hydropsyche occidentalis	DLP 5	47	30.6^{E}
Hydropsyche sp.	SSL 1	1	30.6^{E}
Hydropsyche sp.	SSL 2	4	30.6^{E}
Paratanytarsus sp.	DLP 4	1	<1.6
Paratanytarsus sp.	DLP 5	1	<1.6
Paratanytarsus sp.	ORE 1	9	<1.6
Paratanytarsus sp.	ORE 2	8	<1.6
Paratanytarsus sp.	ORE 3	2	<1.6
Paratanytarsus sp.	ORE 4	7	<1.6
Paratanytarsus sp.	ORE 6	2	<1.6
Paratanytarsus sp.	ORE 7	5	<1.6
Paratanytarsus sp.	ORE 8	32	<1.6
Paratanytarsus sp.	ORE 9	2	<1.6
Paratanytarsus sp.	ORE 10	1	<1.6
Paratanytarsus sp.	SSL 1	17	<1.6
Paratanytarsus sp.	SSL 2	55	<1.6

Table 26. - continued

Paratanytarsus sp.	SSL 3	53	<1.6
Paratanytarsus sp.	SSL 4	155	<1.6
Paratanytarsus sp.	SSL 5	12	<1.6
Caenis sp.	ORE 10	1	>3[F]
Chironomus sp.	DLP 1	1	0.07[G]
Chironomus sp.	DLP 4	4	0.07[G]
Chironomus sp.	ORE 2	10	0.07[G]
Chironomus sp.	ORE 3	2	0
Chironomus sp.	ORE 7	3	0.07[G]
Chironomus sp.	ORE 8	1	0.07[G]
Chironomus sp.	ORE 9	5	0.07[G]
Chironomus sp.	SSL 1	4	0.07[G]
Chironomus sp.	SSL 3	19	0.07[G]
Chironomus sp.	SSL 4	11	0.07[G]
Chironomus sp.	SSL 5	324	0.07[G]
Cricotopus sp.	DLP 1	21	3.5-90
Cricotopus sp.	DLP 2	5	3.5-90
Cricotopus sp.	DLP 3	229	3.5-90
Cricotopus sp.	DLP 4	332	3.5-90
Cricotopus sp.	DLP 5	10	3.5-90
Cricotopus sp.	ORE 1	33	3.5-90
Cricotopus sp.	ORE 2	106	3.5-90
Cricotopus sp.	ORE 3	3	3.5-90
Cricotopus sp.	ORE 4	10	3.5-90
Cricotopus sp.	ORE 5	7	3.5-90
Cricotopus sp.	ORE 6	11	3.5-90
Cricotopus sp.	ORE 7	35	3.5-90

Table 26. - continued

Cricotopus sp.	ORE 8	58	3.5-90
Cricotopus sp.	ORE 9	32	3.5-90
Cricotopus sp.	ORE 10	9	3.5-90
Cricotopus sp.	SSL 1	12	3.5-90
Cricotopus sp.	SSL 2	24	3.5-90
Cricotopus sp.	SSL 3	53	3.5-90
Cricotopus sp.	SSL 4	172	3.5-90
Cricotopus sp.	SSL 5	44	3.5-90
Dicrotendipes sp.	DLP 1	1	7-40[H]
Dicrotendipes sp.	DLP 2	1	7-40[H]
Dicrotendipes sp.	DLP 4	128	7-40[H]
Dicrotendipes sp.	ORE 1	4	7-40[H]
Dicrotendipes sp.	ORE 2	9	7-40[H]
Dicrotendipes sp.	ORE 3	2	7-40[H]
Dicrotendipes sp.	ORE 4	1	7-40[H]
Dicrotendipes sp.	ORE 5	2	7-40[H]
Dicrotendipes sp.	ORE 7	4	7-40[H]
Dicrotendipes sp.	ORE 8	55	7-40[H]
Dicrotendipes sp.	ORE 9	1	7-40[H]
Dicrotendipes sp.	ORE 10	120	7-40[H]
Dicrotendipes sp.	SSL 1	1	7-40[H]
Dicrotendipes sp.	SSL 2	2	7-40[H]
Dicrotendipes sp.	SSL 3	7	7-40[H]
Dicrotendipes sp.	SSL 4	24	7-40[H]
Helisoma anceps	DLP 3	1	>2000[I]
Helisoma anceps	ORE 10	6	>2000[I]
Limnodrilus hoffmeisteri	SSL 1	1	>36

Table 26. - continued

Limnodrilus hoffmeisteri	SSL 2	15	>36
Limnodrilus hoffmeisteri	SSL 3	1	>36
Limnodrilus hoffmeisteri	SSL 4	7	>36
Limnodrilus hoffmeisteri	SSL 5	3	>36
Hyalella azteca	SSL 1	1	1.3[J]
Peltodytes sp.	DLP 5	13	0.8
Enallagma sp.	ORE 7	1	11.4[K]
Ischnura sp.	SSL 1	2	11.4[K]
Ischnura sp.	SSL 3	1	11.4[K]
Ischnura sp.	SSL 5	2	11.4[K]
Ephemerella maculata	ORE 10	1	0.3[L]
Tanypus sp.	SSL 1	3	1.5[M]
Tanypus sp.	SSL 3	17	1.5[M]
Tanypus sp.	SSL 4	1	1.5[M]
Tanypus sp.	SSL 5	19	1.5[M]
Culicoides sp.	DLP 5	1	0.5-1[N]
Culicoides sp.	ORE 9	1	0.5-1[N]

[A] Listed toxicity value was for *Dugesia dorotocephala*.
[B] 2 values listed for this species, used conservative value, other value = 0.76 µg/L.
[C] Several genera listed, toxicity value used was for *Daphnia pulex*.
[D] Listed toxicity value was for *Simulium vitattum*.
[E] Listed toxicity value was for *Hydropsyche/Cheumatopsyche sp.*
[F] Listed toxicity value was for *Caenis horaria*.
[G] Listed toxicity value was for *Chironomus tentans*.
[H] Listed toxicity value was for *Dicrotendipes californicus*.
[I] Listed toxicity value was for *Helisoma trivolvis*.
[J] Listed toxicity value was for *Hyalella sp.*
[K] Listed toxicity value was for *Enallagma/Ischnura sp.*
[L] Listed toxicity value was for *Ephemerella sp.*
[M] Listed toxicity value was for *Tanypus grodhaus.*
[N] Listed toxicity value was for *Culicoides variipennis.*

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
Gammarus lacustris	DLP 4	1	184
Gammarus lacustris	ORE 1	1	184
Gammarus lacustris	ORE 2	5	184
Gammarus lacustris	ORE 3	20	184
Gammarus lacustris	ORE 4	80	184
Gammarus lacustris	ORE 5	95	184
Gammarus lacustris	ORE 6	61	184
Gammarus lacustris	ORE 7	35	184
Gammarus lacustris	ORE 8	83	184
Gammarus lacustris	SSL 1	4	184
Gammarus lacustris	SSL 2	3	184
Gammarus lacustris	SSL 3	2	184
Daphniidae	DLP 1	9	0.78[A]
Daphniidae	DLP 2	2	0.78[A]
Daphniidae	DLP 4	1	0.78[A]
Daphniidae	DLP 5	1	0.78[A]
Daphniidae	ORE 1	1	0.78[A]
Daphniidae	ORE 2	1	0.78[A]
Daphniidae	ORE 3	1	0.78[A]
Daphniidae	ORE 4	1	0.78[A]
Daphniidae	ORE 10	1	0.78[A]
Daphniidae	SSL 2	3	0.78[A]
Daphniidae	SSL 3	1	0.78[A]
Daphniidae	SSL 4	32	0.78[A]
Daphniidae	SSL 5	37	0.78[A]
Daphniidae	DLP 1	9	1.02[B]

Table 27. - continued

Daphniidae	DLP 2	2	1.02^{B}
Daphniidae	DLP 4	1	1.02^{B}
Daphniidae	DLP 5	1	1.02^{B}
Daphniidae	ORE 1	1	1.02^{B}
Daphniidae	ORE 2	1	1.02^{B}
Daphniidae	ORE 3	1	1.02^{B}
Daphniidae	ORE 4	1	1.02^{B}
Daphniidae	ORE 10	1	1.02^{B}
Daphniidae	SSL 2	3	1.02^{B}
Daphniidae	SSL 3	1	1.02^{B}
Daphniidae	SSL 4	32	1.02^{B}
Daphniidae	SSL 5	37	1.02^{B}
Neomysis mercedis	ORE 3	2	4.15
Hyalella azteca	SSL 1	1	22
Baetis tricaudatus	DLP 5	140	24^{C}
Baetis tricaudatus	ORE 1	1	24^{C}
Baetis tricaudatus	ORE 10	53	24^{C}
Physa/ Physella	DLP 1	7	48^{D}
Physa/ Physella	DLP 2	8	48^{D}
Physa/ Physella	DLP 3	18	48^{D}
Physa/ Physella	DLP 4	7	48^{D}
Physa/ Physella	DLP 5	76	48^{D}
Physa/ Physella	ORE 1	1	48^{D}
Physa/ Physella	ORE 2	2	48^{D}
Physa/ Physella	ORE 3	5	48^{D}
Physa/ Physella	ORE 4	9	48^{D}
Physa/ Physella	ORE 5	3	48^{D}
Physa/ Physella	ORE 6	10	48^{D}

Table 27. - continued

Physa/ Physella	ORE 7	5	48[D]
Physa/ Physella	ORE 8	20	48[D]
Physa/ Physella	ORE 9	12	48[D]
Physa/ Physella	ORE 10	7	48[D]
Physa/ Physella	SSL 1	63	48[D]
Physa/ Physella	SSL 2	2	48[D]
Physa/ Physella	SSL 3	24	48[D]
Physa/ Physella	SSL 4	52	48[D]
Physa/ Physella	SSL 5	82	48[D]
Physa/ Physella	ORE 1	1	4800[E]
Physa/ Physella	ORE 2	2	4800[E]
Physa/ Physella	ORE 3	5	4800[E]
Physa/ Physella	ORE 4	9	4800[E]
Physa/ Physella	ORE 5	3	4800[E]
Physa/ Physella	ORE 6	10	4800[E]
Physa/ Physella	ORE 7	5	4800[E]
Physa/ Physella	ORE 8	20	4800[E]
Physa/ Physella	ORE 9	12	4800[E]
Physa/ Physella	ORE 10	7	4800[E]
Physa/ Physella	SSL 1	63	4800[E]
Physa/ Physella	SSL 2	2	4800[E]
Physa/ Physella	SSL 3	24	4800[E]
Physa/ Physella	SSL 4	52	4800[E]
Physa/ Physella	SSL 5	82	4800[E]
Helisoma anceps	DLP 3	1	528[F]
Helisoma anceps	ORE 10	6	528[F]
Undetermined Tubificidae	DLP 1	20	3160[G]
Undetermined Tubificidae	DLP 2	15	3160[G]

Table 27. - continued

Undetermined Tubificidae	DLP 3	173	3160[G]
Undetermined Tubificidae	DLP 4	114	3160[G]
Undetermined Tubificidae	ORE 1	8	3160[G]
Undetermined Tubificidae	ORE 2	30	3160[G]
Undetermined Tubificidae	ORE 3	16	3160[G]
Undetermined Tubificidae	ORE 4	16	3160[G]
Undetermined Tubificidae	ORE 5	11	3160[G]
Undetermined Tubificidae	ORE 6	21	3160[G]
Undetermined Tubificidae	ORE 8	8	3160[G]
Undetermined Tubificidae	ORE 9	11	3160[G]
Undetermined Tubificidae	SSL 1	17	3160[G]
Undetermined Tubificidae	SSL 2	47	3160[G]
Undetermined Tubificidae	SSL 3	12	3160[G]
Undetermined Tubificidae	SSL 4	39	3160[G]
Undetermined Tubificidae	SSL 5	163	3160[G]

[A] Listed toxicity value was for *Daphnia pulex*.
[B] Listed toxicity value was for *Daphnia magna*.
[C] Listed toxicity value was for *Baetis intermedius*.
[D] Listed toxicity value was for *Physa gyrina*.
[E] Listed toxicity value was for *Physa acuta*.
[F] Listed toxicity value was for *Helisoma trivolvis*.
[G] Listed toxicity value was for *Tubifex* species.

Table 28. Mean scores for each benthic metric for 2000 (Hall and Killen, 2001) and 2001 sampling in Orestimba Creek. A p-value based on a Wilcoxon Rank-Sum Test was used.

Benthic Metrics	Mean 2000	Mean 2001	Difference	Wilcoxon P-value
Abundance {#/ sample}	1012.00	588.03	-423.96	0.9219
EPT Index {%}	2.03	4.23	2.20	0.1563
EPT Taxa	0.93	1.00	0.06	0.7813
Ephemeroptera Taxa	0.60	0.56	-0.03	0.7500
Percent Collectors	75.83	56.56	-19.26	0.0137
Percent Dominant Taxon	44.20	32.13	-12.06	0.1367
Percent Filterers	7.06	16.43	9.36	0.0273
Percent Grazers	3.73	3.36	-0.36	0.9453
Percent Intolerant Taxa	0.30	0.23	-0.06	1.0000
Percent Predators	7.10	10.40	3.30	0.4180
Percent Shredders	6.06	6.73	0.66	0.8652
Percent Tolerant Taxa	52.56	52.66	0.10	0.9219
Plecoptera Taxa	0	0	-	-
Sensitive EPT Index %	0.43	0.00	-0.43	-
Shannon Diversity	1.83	2.25	0.41	0.0645
Taxonomic Richness	17.33	22.36	5.03	0.0273
Tolerance Value	6.81	6.80	-0.01	0.9219
Trichoptera Taxa	0.33	0.43	0.10	0.7188

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

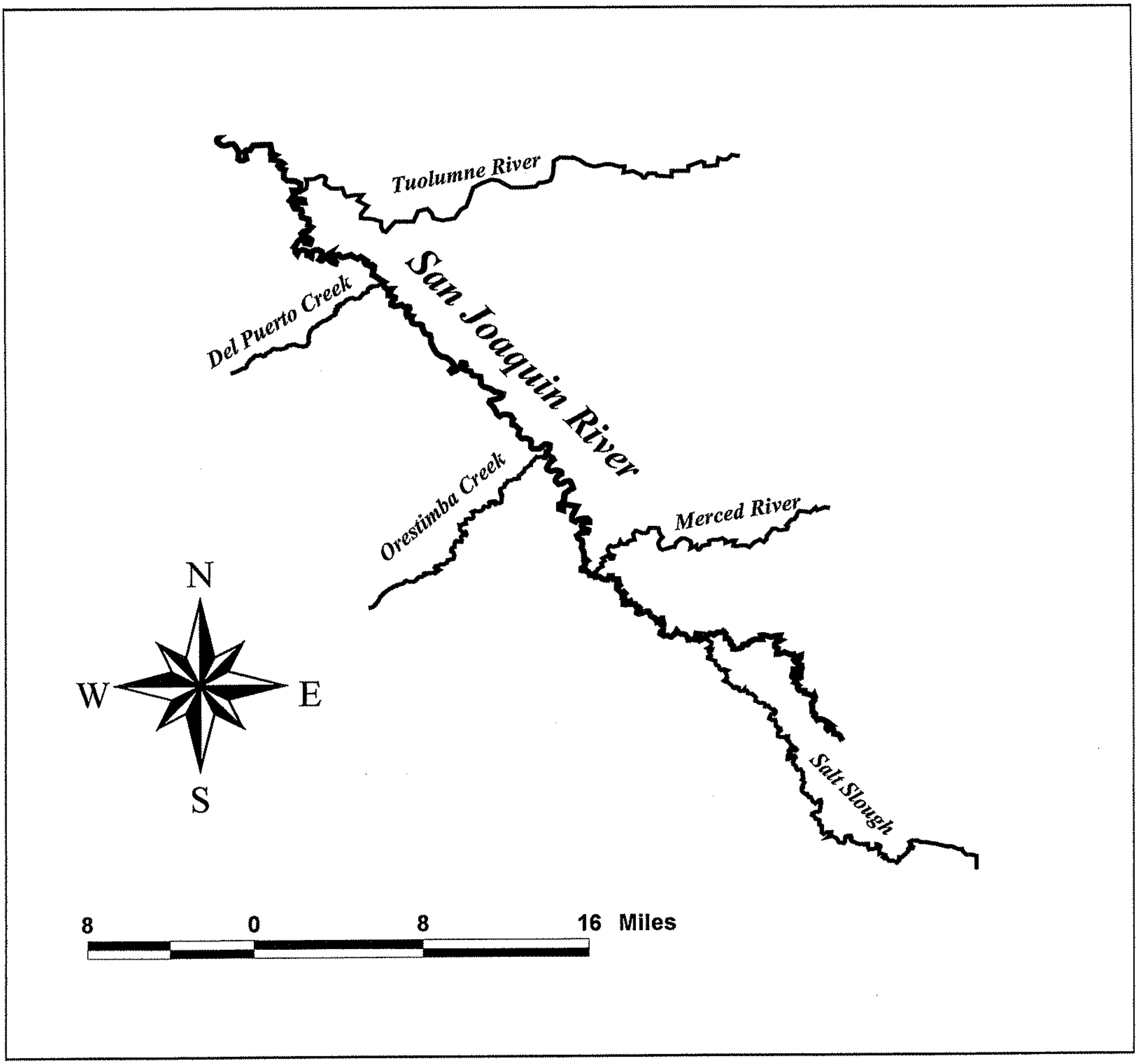


Figure 2. Del Puerto Creek sample sites.

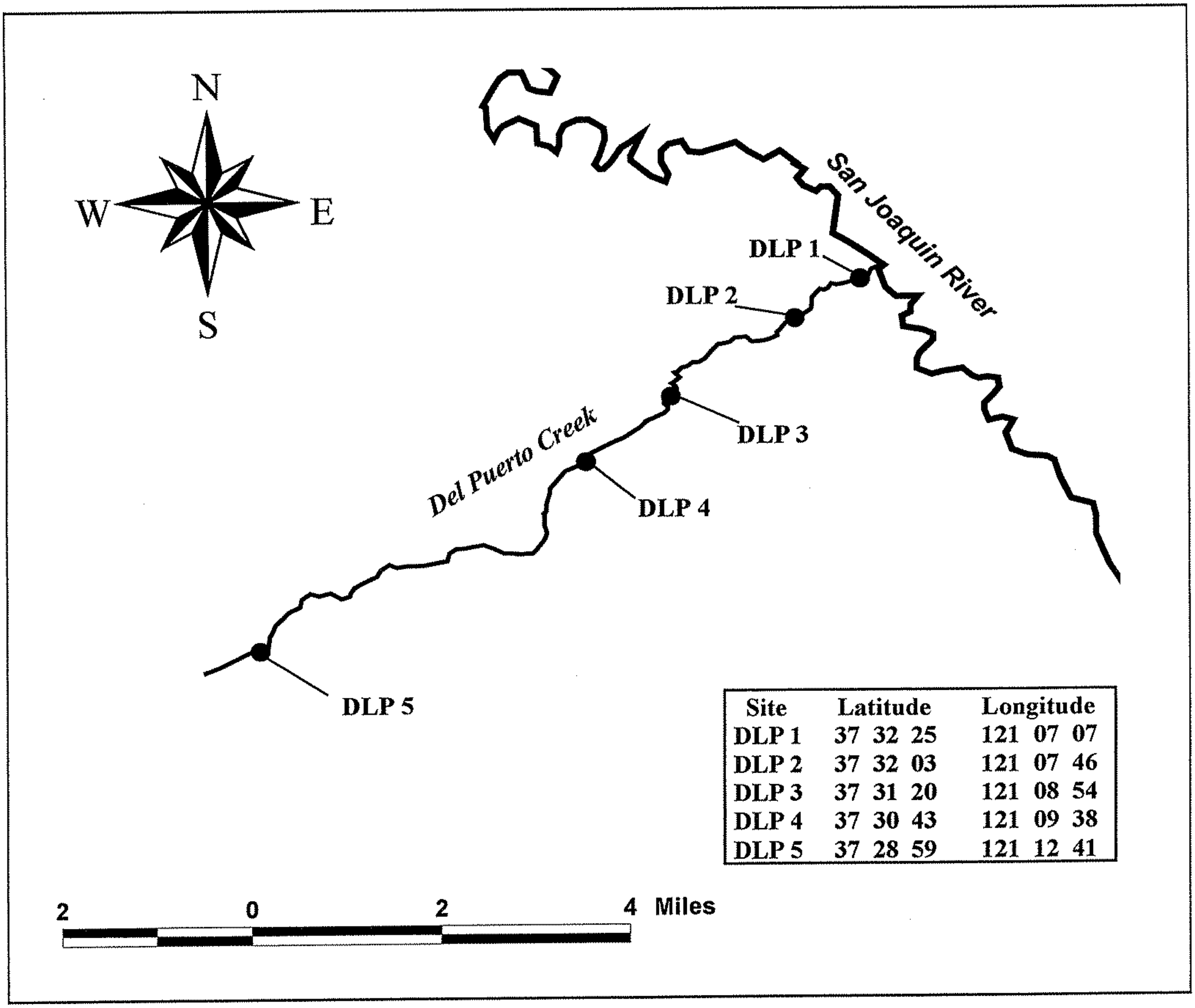
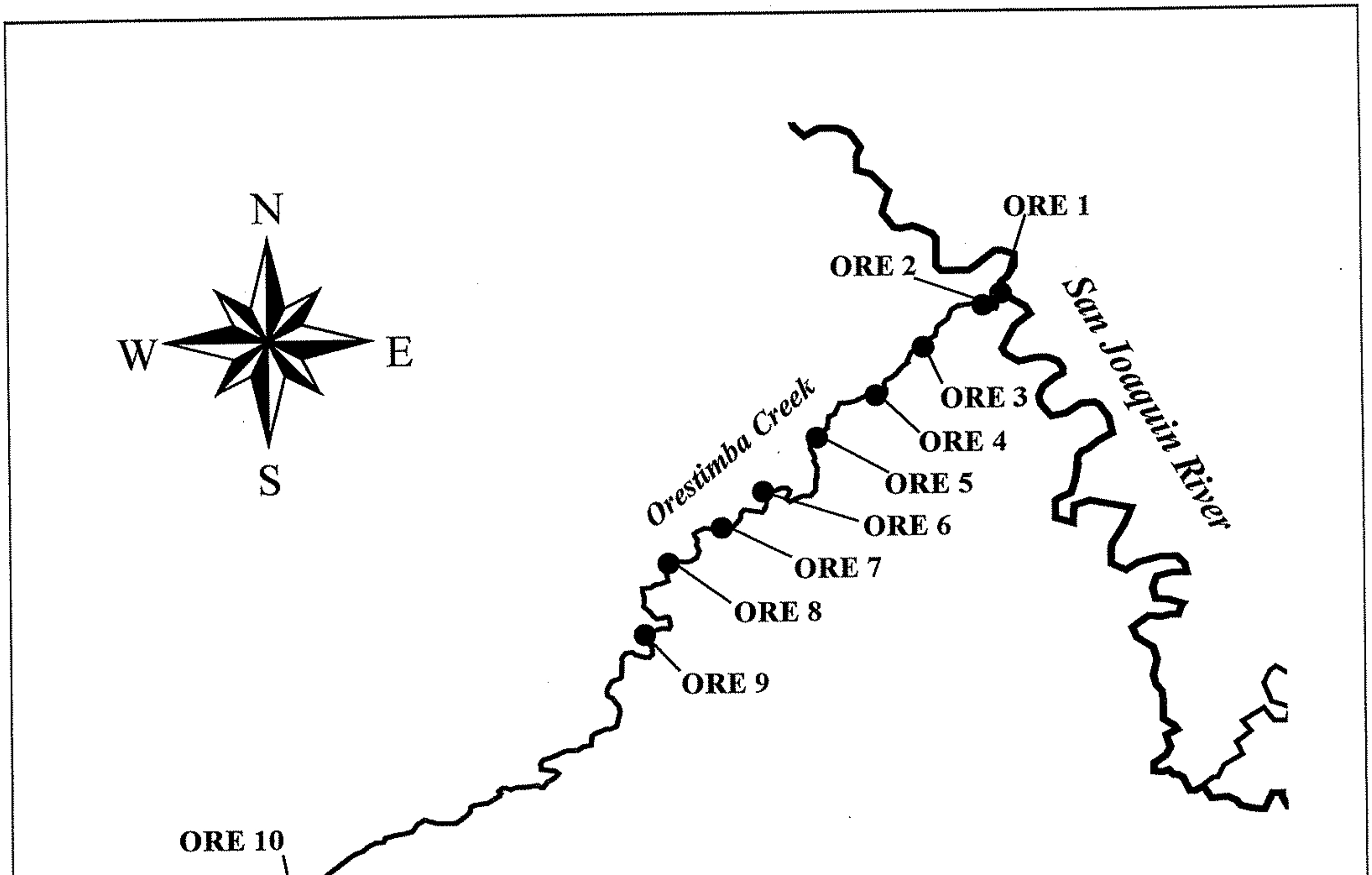
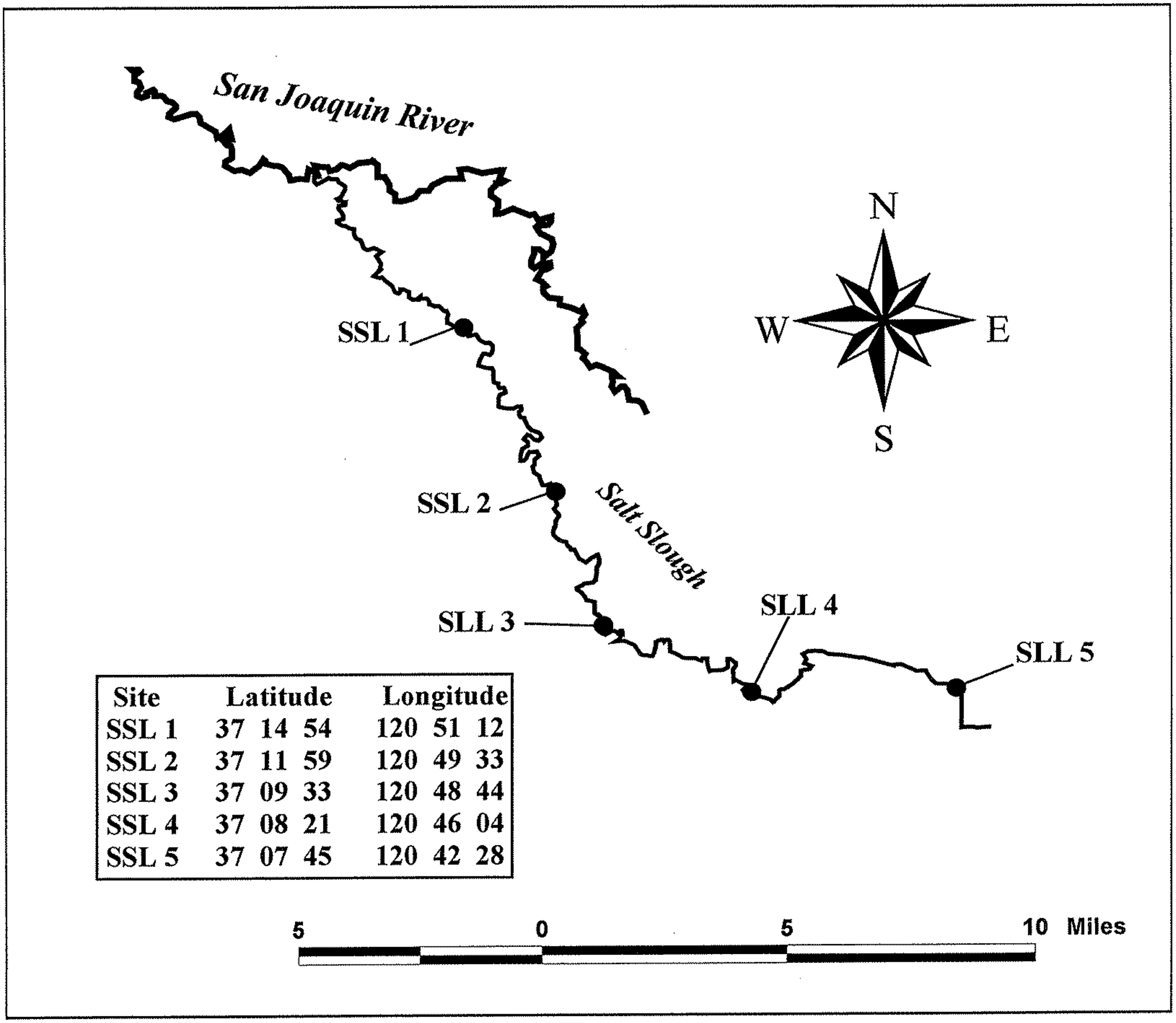


Figure 3. Orestimba Creek sample sites.



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.

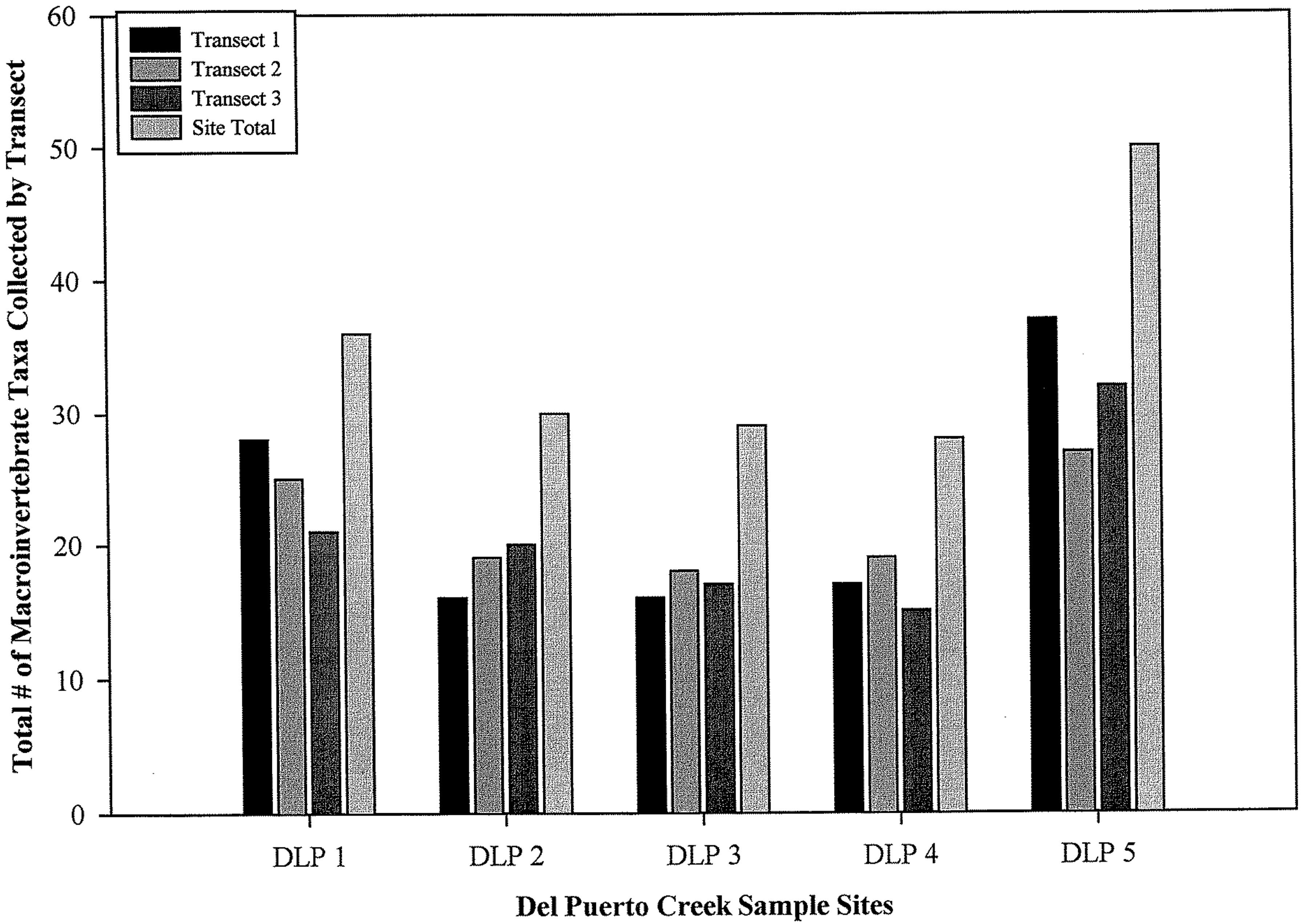


Figure 6. Macroinvertebrate abundance for each transect and site total for the 5 Del Puerto Creek sites.

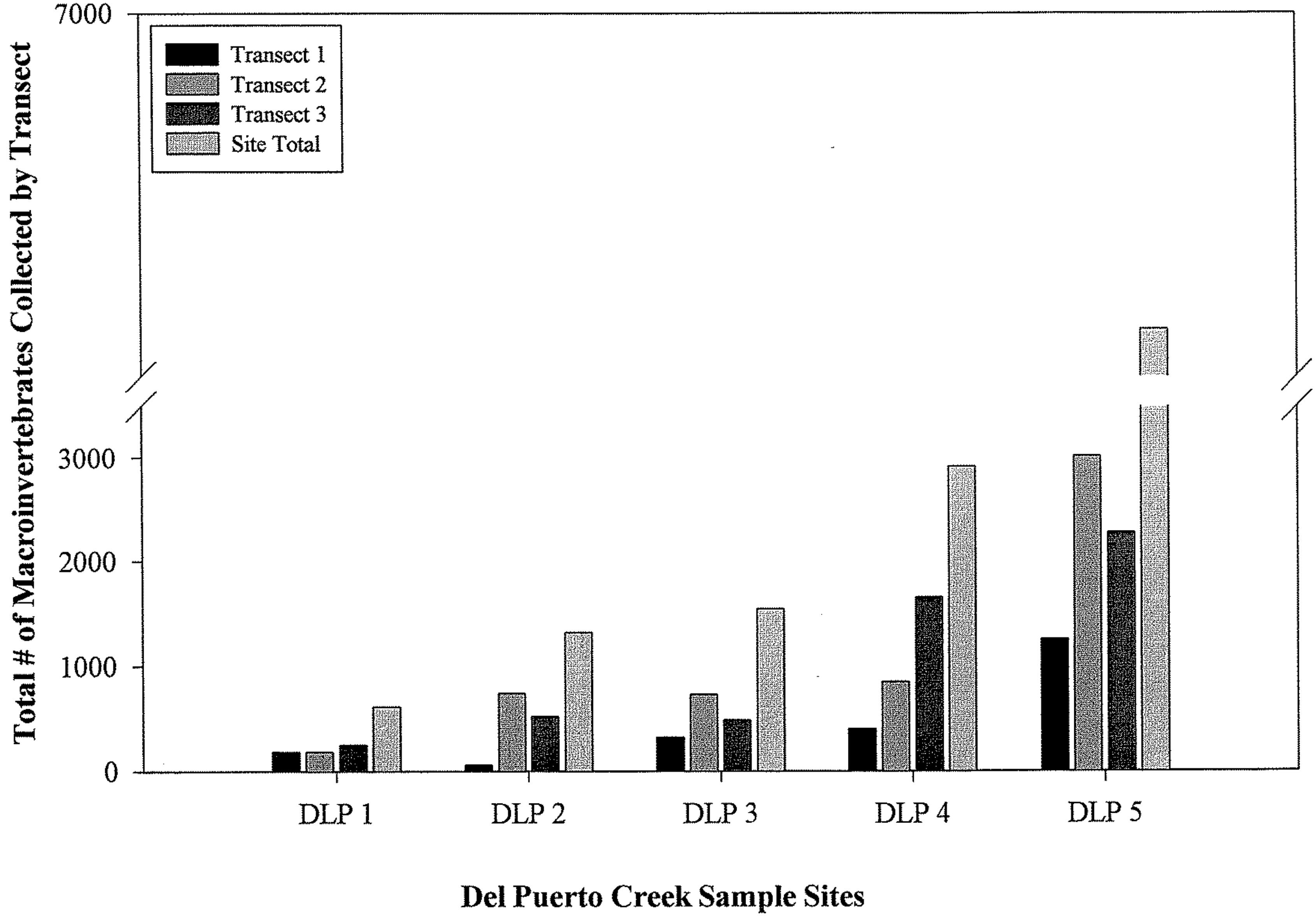


Figure 7. Macroinvertebrate richness for each transect and site total for the 10 Orestimba Creek sites.

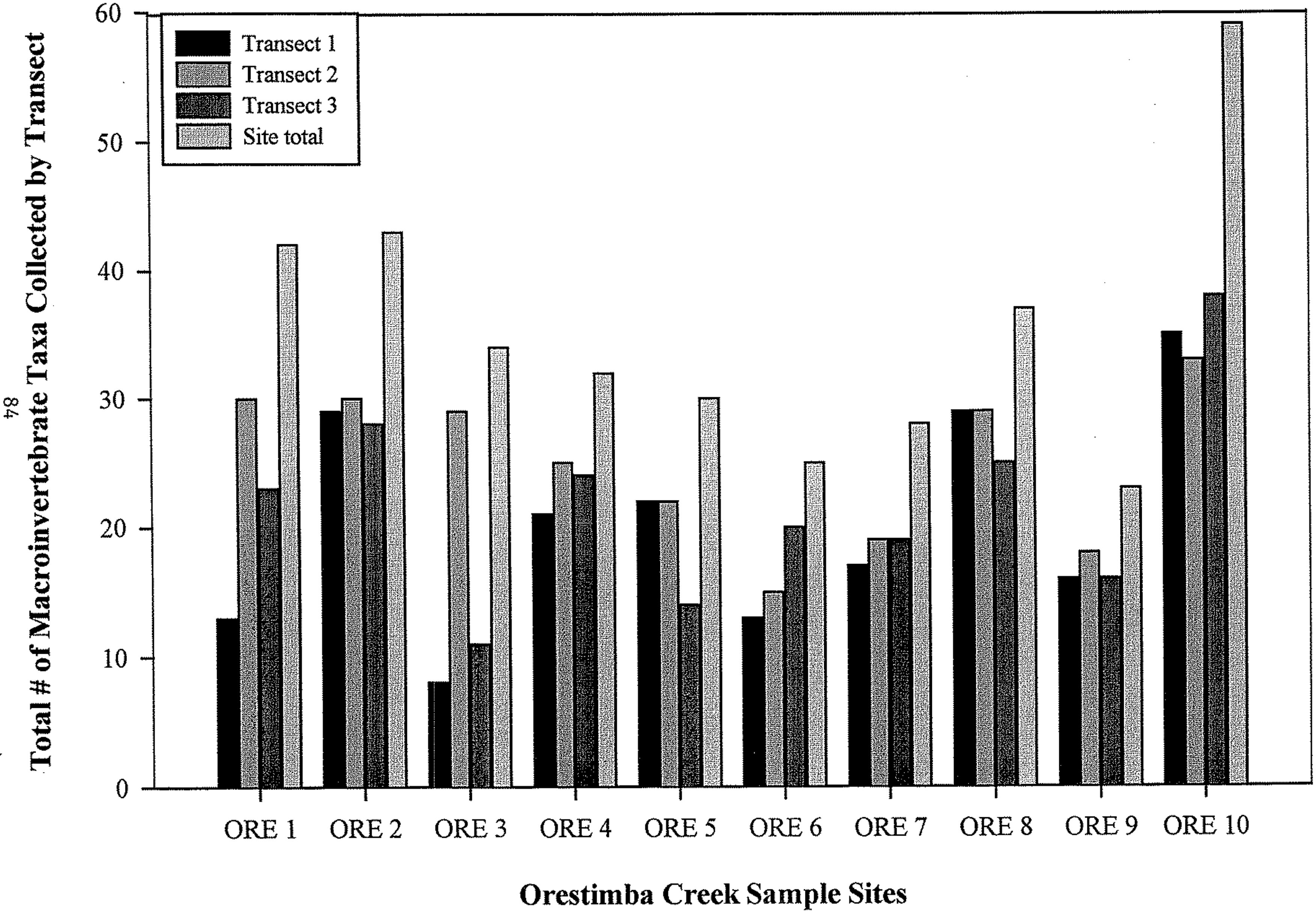


Figure 8. Macroinvertebrate abundance for each transect and site total for the 10 Orestimba Creek sites.

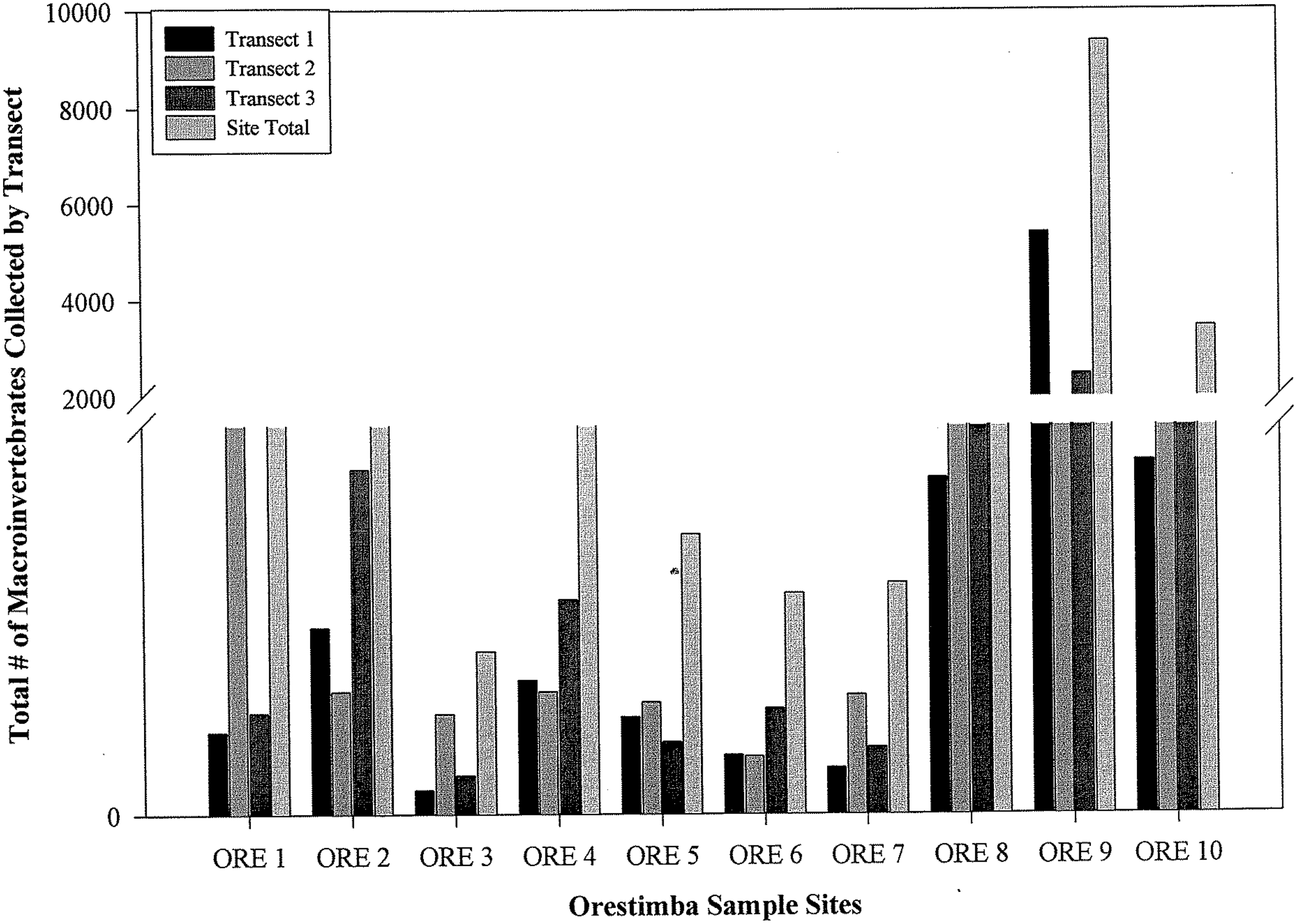


Figure 9. Macroinvertebrate richness for each transect and site total for the 5 Salt Slough sites.

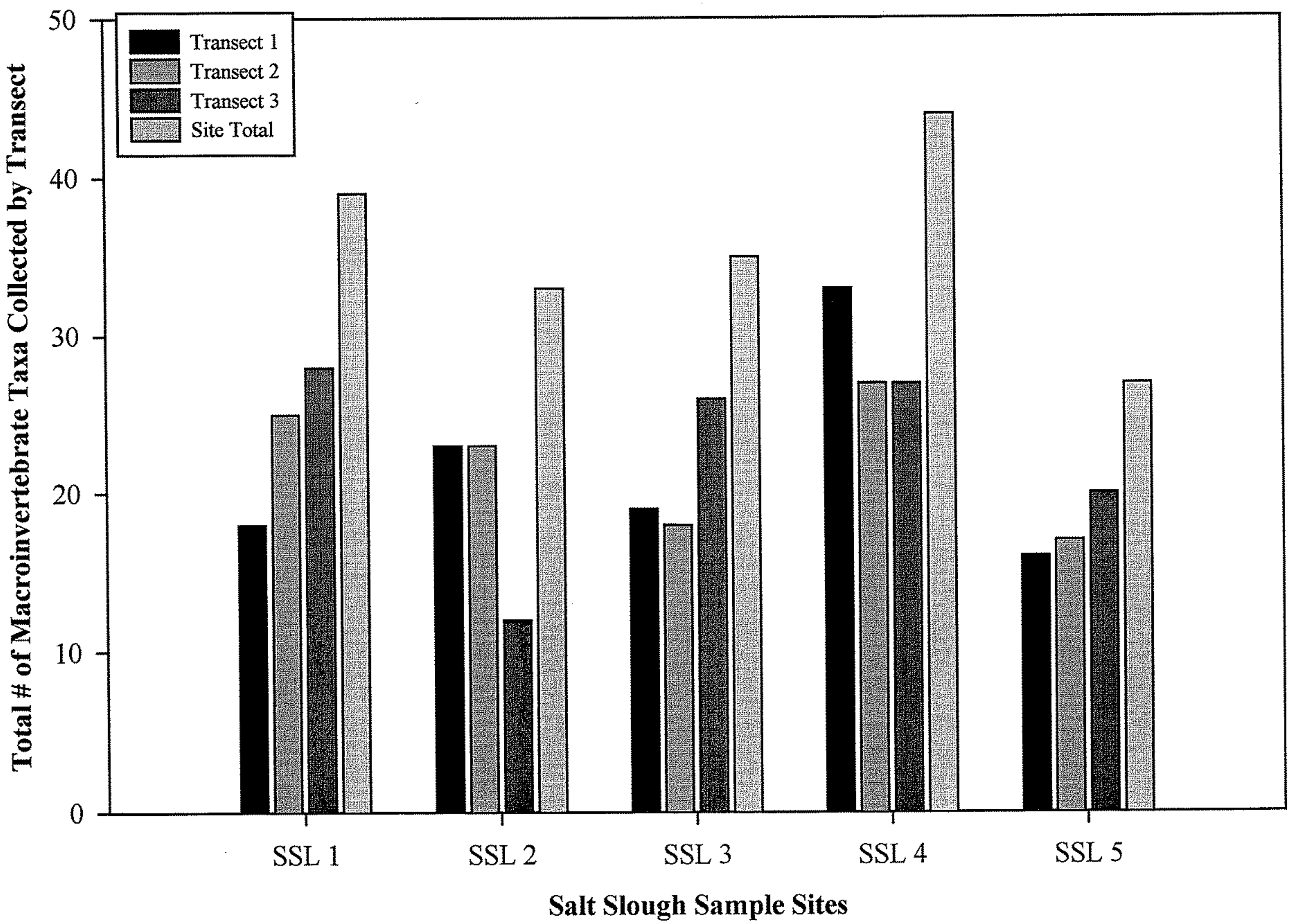
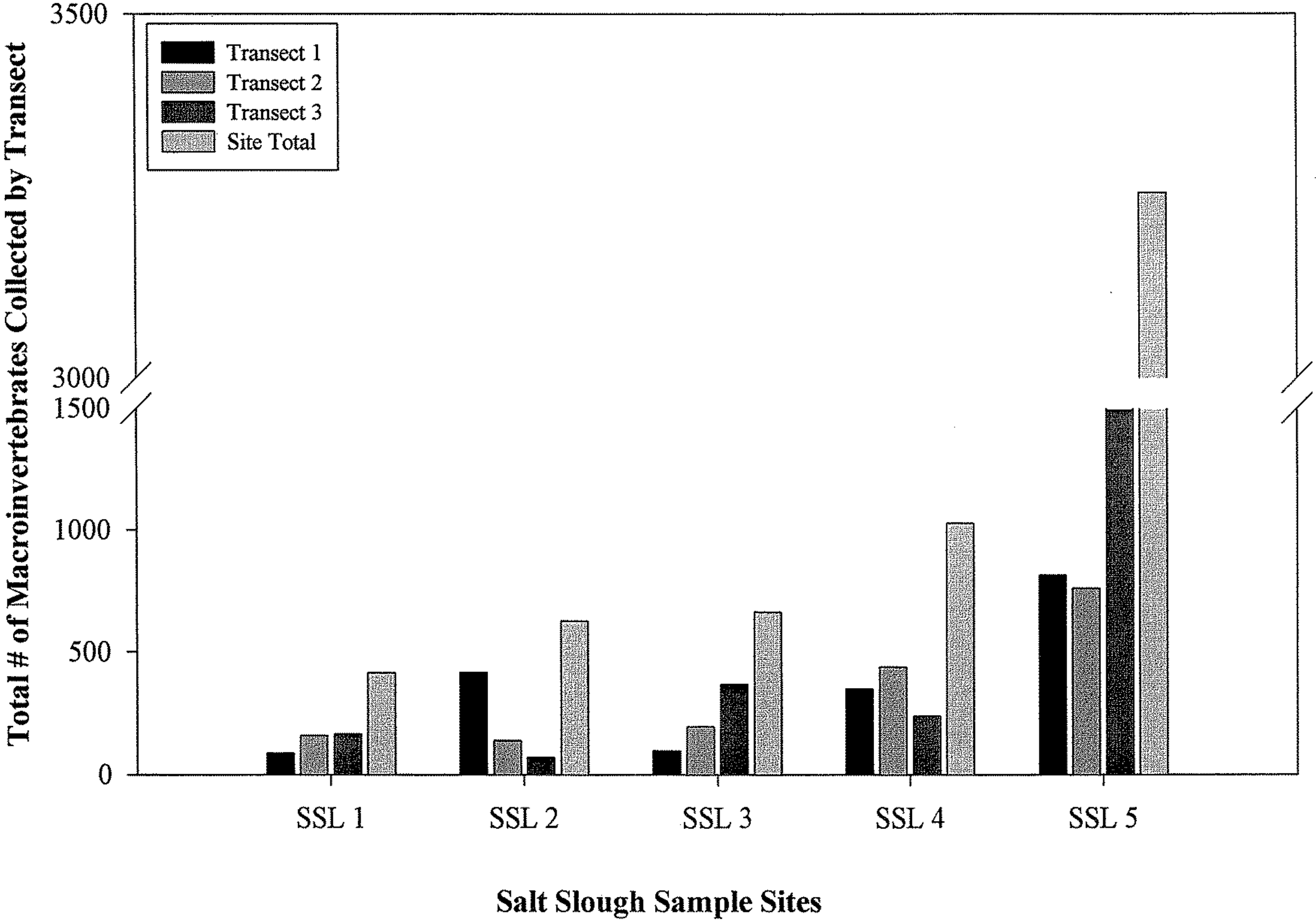


Figure 10. Macroinvertebrate abundance for each transect and site total for the 5 Salt Slough sites.



Appendix A

California bioassessment worksheet 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 Characteristcs 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:

____

____

____

____

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 the most tolerant value. Feeding guilds are defined as follows: c = collector; f = filterer; g = grazer; p = producer and s = shredder.

Del Puerto 1

Lowest Taxa	T1
Nais communis/variabilis	35
Simulium sp.	21
Dugesia tigrina	21
Cricotopus bicinctus	18
Cricotopus/Orthocladius sp.	13
Micropsectra sp.	9
Undetermined Enchytraeidae	8
Parachironomus sp.	7
Cladotanytarsus sp	7
Undetermined Tubificidae	7
Prostoma sp.	6
Parametriocnemus sp.	5
Undetermined Corixidae	4
Megadrile	4
Physa sp./ Physella sp.	3
Eukiefferiella sp.	2
Fallceon quilleri	2
Erpobdellidae	2
Slavina appendiculata	2
Chironomus sp.	1
Dicrotendipes sp.	1
Phaenopsectra sp.	1
Nanocladius sp.	1
Psychoda sp.	1
Corisella decolor	1
Corbicula fluminea	1
Cyprididae	1
Nematoda	1
	185

Lowest Taxa	T2
Nais communis/variabilis	49
Dugesia tigrina	27
Cricotopus sp.	21
Rheotanytarsus sp.	11
Simulium sp.	9
Undetermined Corixidae	7
Megadrile	6
Eukiefferiella sp.	5
Erpobdellidae	5
Undetermined Enchytraeidae	5
Slavina appendiculata	5
Cricotopus bicinctus	4
Daphniidae	4
Cyprididae	4
Undetermined Tubificidae	4
Parachironomus sp.	3
Nanocladius sp.	3
Micropsectra sp.	2
Corbicula fluminea	2
Gastropoda	2
Cladotanytarsus sp	1
Coenagrion/ Enallagma	1
Fallceon quilleri	1
Ophidonais serpentina	1
Prostoma sp.	1
	183

Lowest Taxa	T3
Nais communis/variabilis	46
Dugesia tigrina	34
Parachironomus sp.	23
Cladotanytarsus sp	23
Hydra sp.	23
Micropsectra sp.	11
Cricotopus bicinctus	11
Prostoma sp.	11
Undetermined Tubificidae	9
Cricotopus/Orthocladius sp.	8
Nanocladius sp.	5
Simulium sp.	5
Daphniidae	5
Erpobdellidae	5
Physa sp./ Physella sp.	4
Slavina appendiculata	4
Megadrile	4
Undetermined Corixidae	2
Cyprididae	2
Trichocorixa calva	1
Undetermined Enchytraeidae	1
	237

Lowest Taxa	TV	FFG	TOTAL
Nais communis/variabilis	9	c	130
Dugesia tigrina	4	p	82
Simulium sp.	6	f	35
Parachironomus sp.	10	p	33
Cricotopus bicinctus	7	c	33
Cladotanytarsus sp	6	f	31
Hydra sp.	5	f	23
Micropsectra sp.	7	c	22
Cricotopus sp.	7	s	21
Cricotopus/Orthocladius sp.	7	s	21
Undetermined Tubificidae	9	c	20
Prostoma sp.		c	18
Undetermined Enchytraeidae	10	c	14
Megadrile	5	c	14
Undetermined Corixidae	10	p	13
Erpobdellidae	8	p	12
Rheotanytarsus sp.	6	f	11
Slavina appendiculata	7	c	11
Nanocladius sp.	3	s	9
Daphniidae	8	c	9
Eukiefferiella sp.	8	c	7
Cyprididae	8	c	7
Physa sp./ Physella sp.	8	g	7
Parametriocnemus sp.	5	c	5
Corbicula fluminea	10	f	3
Fallceon quilleri	4	c	3
Gastropoda	7	g	2
Chironomus sp.	10	c	1
Dicrotendipes sp.	8	c	1
Phaenopsectra sp.	7	g	1
Psychoda sp.	10	c	1
Corisella decolor	10	p	1
Trichocorixa calva	10	p	1
Coenagrion/ Enallagma	9	p	1
Nematoda	5	p	1
Ophidonais serpentina	8	c	1
			605

Del Puerto 2

Lowest Taxa	T1
Parachironomus sp.	9
Simulium sp.	8
Physa sp./ Physella sp.	7
Unidentified Tubificidae	7
Erpobdellidae	5
Dugesia tigrina	4
Helobdella stagnalis	3
Prostoma sp.	3
Undetermined Corixidae	2
Daphniidae	2
Megadrile	2
Cricotopus bicinctus	1
Cricotopus sp.	1
Trichocorixa reticulata	1
Nais communis/variabilis	1
Eudistylia vancouveri	1
	57

Lowest Taxa	T2
Simulium sp.	115
Nais communis/variabilis	80
Cricotopus bicinctus	40
Cricotopus trifascia	8
Undetermined Enchytraeidae	6
Slavina appendiculata	6
Eukiefferiella sp.	3
Erpobdellidae	3
unidentified Tubificidae	2
Prostoma sp.	2
Dicrotendipes sp.	1
Micropsectra sp.	1
Nanocladius sp.	1
Paraphaenocladius sp.	1
Rheocricotopus sp.	1
Undetermined Corixidae	1
Trichocorixa calva	1
Physa sp./ Physella sp.	1
Helobdella stagnalis	1
	274

Lowest Taxa	T3
Nais communis/variabilis	102
Simulium sp.	84
Dugesia tigrina	34
Cricotopus bicinctus	22
Cricotopus trifascia	7
unidentified Tubificidae	6
Cladotanytarsus sp	5
Cricotopus sp.	4
Slavina appendiculata	4
Fallceon quilleri	3
Erpobdellidae	3
Helobdella stagnalis	2
Prostoma sp.	2
Parachironomus sp.	1
Eukiefferiella sp.	1
Nanocladius sp.	1
Corisella decolor	1
Undetermined Corixidae	1
Hydra sp.	1
Undetermined Enchytraeidae	1
Megadrile	1
	286

Lowest Taxa	TV	FFG	TOTAL
Simulium sp.	6	f	207
Nais communis/variabilis	9	c	183
Cricotopus bicinctus	7	c	63
Dugesia tigrina	4	p	38
Cricotopus trifascia	7	s	15
unidentified Tubificidae	9	c	15
Erpobdellidae	8	p	11
Parachironomus sp.	10	p	10
Slavina appendiculata	7	c	10
Physa sp./ Physella sp.	8	g	8
Undetermined Enchytraeidae	10	c	7
Prostoma sp.		c	7
Helobdella stagnalis	10	p	6
Cladotanytarsus sp	6	f	5
Cricotopus sp.	7	s	5
Eukiefferiella sp.	8	c	4
Undetermined Corixidae	10	p	4
Fallceon quilleri	4	c	3
Megadrile	5	c	3
Nanocladius sp.	3	s	2
Daphniidae	8	c	2
Dicrotendipes sp.	8	c	1
Micropsectra sp.	7	c	1
Paraphaenocladius sp.	5	c	1
Rheocricotopus sp.	6	c	1
Corisella decolor	10	p	1
Trichocorixa calva	10	p	1
Trichocorixa reticulata	10	p	1
Hydra sp.	5	f	1
Eudistylia vancouveri	8	c	1
			617

Del Puerto 3

Lowest Taxa	T1
Simulium sp.	79
Cricotopus sp.	65
Undetermined Tubificidae	62
Cricotopus trifascia	53
Helobdella stagnalis	5
Megadrile	5
Undetermined Enchytraeidae	3
Bryophaenocladius sp.	2
Eukiefferiella sp.	2
Tvetenia sp.	2
Trichocorixa calva	2
Haliplus sp.	1
Chironominae	1
Tanytarsus sp.	1
Undetermined Corixidae	1
Erpobdellidae	1
	285

Lowest Taxa	T2
Undetermined Tubificidae	77
Cricotopus bicinctus	52
Cricotopus sp.	30
Nais communis/variabilis	24
Simulium sp.	18
Dugesia tigrina	14
Prostoma sp.	14
Physa sp./ Physella sp.	13
Ophidonais serpentina	9
Megadrile	5
Hydra sp.	3
Erpobdellidae	2
Eukiefferiella sp.	1
Undetermined Corixidae	1
Helisoma anceps	1
Sphaerium sp.	1
Nematoda	1
Slavina appendiculata	1
	267

Lowest Taxa	T3
Cricotopus sp.	134
Cricotopus bicinctus	66
Erpobdellidae	47
Undetermined Tubificidae	34
Simulium sp.	20
Dugesia tigrina	6
Physa sp./ Physella sp.	5
Helobdella stagnalis	4
Nais communis/variabilis	4
Undetermined Corixidae	2
Ophidonais serpentina	2
Megadrile	2
Prostoma sp.	2
Parachironomus sp.	1
Eukiefferiella sp.	1
Gyraulus parvus	1
Nematoda	1
	332

Lowest Taxa	TV	FFG	TOTAL
Undetermined Tubificidae	9	c	173
Undetermined Enchytraeidae	10	c	3
Undetermined Corixidae	10	p	4
Tvetenia sp.	5	c	2
Trichocorixa calva	10	p	2
Tanytarsus sp.	6	f	1
Sphaerium sp.	8	f	1
Slavina appendiculata	7	c	1
Simulium sp.	6	f	117
Prostoma sp.		c	16
Physa sp./ Physella sp.	8	g	18
Parachironomus sp.	10	p	1
Ophidonais serpentina	8	c	11
Nematoda	5	p	2
Nais communis/variabilis	9	c	28
Megadrile	5	c	12
Hydra sp.	5	f	3
Helobdella stagnalis	10	p	9
Helisoma anceps	7	g	1
Haliplus sp.	5	s	1
Gyraulus parvus	8	g	1
Eukiefferiella sp.	8	c	4
Erpobdellidae	8	p	50
Dugesia tigrina	4	p	20
Cricotopus trifascia	7	s	53
Cricotopus sp.	7	s	229
Cricotopus bicinctus	7	c	118
Chironominae	6	c	1
Bryophaenocladius sp.	5	c	2
			884

Del Puerto 4

Lowest Taxa	T1
Cricotopus sp.	92
Dicrotendipes sp.	60
Cricotopus bicinctus	49
Undetemined Tubificidae	38
Simulium sp.	21
Branchiura sowerbyi	8
Undetermined Corixidae	6
Corisella decolor	5
Megadrile	5
Erpobdellidae	4
Chironomus sp.	2
Undetermined Enchytraeidae	2
Parachironomus sp.	1
Trichocorixa calva	1
Daphniidae	1
Gammarus lacustris	1
Physa sp./ Physella sp.	1
	297

Lowest Taxa	T2
Cricotopus sp.	101
Cricotopus bicinctus	48
Undetemined Tubificidae	46
Dicrotendipes sp.	36
Simulium sp.	12
Megadrile	10
Undetermined Corixidae	7
Physa sp./ Physella sp.	4
Nais communis/variabilis	4
Chironomus sp.	2
Cladotanytarsus sp	2
Nematoda	2
Micropsectra sp.	1
Paratanytarsus sp.	1
Rheotanytarsus sp.	1
Corisella decolor	1
Gyraulus parvus	1
Undetermined Enchytraeidae	1
Branchiura sowerbyi	1
	281

Lowest Taxa	T3
Cricotopus sp.	139
Cricotopus bicinctus	71
Dicrotendipes sp.	32
Undetemined Tubificidae	30
Simulium sp.	9
Dugesia tigrina	7
Prostoma sp.	7
Megadrile	6
Undetermined Enchytraeidae	3
Physa sp./ Physella sp.	2
Microtendipes pedellus	1
Cladotanytarsus sp	1
Rheotanytarsus sp.	1
Undetermined Corixidae	1
Corophium spinicorne	1
	311

Lowest Taxa	TV	FFG	TOTAL
Cricotopus sp.	7	s	332
Cricotopus bicinctus	7	c	168
Dicrotendipes sp.	8	c	128
Undetemined Tubificidae	9	c	114
Simulium sp.	6	f	42
Megadrile	5	c	21
Undetermined Corixidae	10	p	14
Branchiura sowerbyi	10	c	9
Physa sp./ Physella sp.	8	g	7
Dugesia tigrina	4	p	7
Prostoma sp.		c	7
Corisella decolor	10	p	6
Undetermined Enchytraeidae	10	c	6
Chironomus sp.	10	c	4
Erpobdellidae	8	p	4
Nais communis/variabilis	9	c	4
Cladotanytarsus sp	6	f	3
Rheotanytarsus sp.	6	f	2
Nematoda	5	p	2
Microtendipes pedellus	6	f	1
Parachironomus sp.	10	p	1
Micropsectra sp.	7	c	1
Paratanytarsus sp.	6	f	1
Trichocorixa calva	10	p	1
Daphniidae	8	c	1
Corophium spinicorne	8	c	1
Gammarus lacustris	4	c	1
Gyraulus parvus	8	g	1
			889

Del Puerto 5

Lowest Taxa	T1
Physa sp./Physella sp.	47
Baetis tricaudatus	37
Pentaneura sp.	25
Nais communis/variabilis	21
Cyprididae	19
Fallceon quilleri	16
Rheotanytarsus sp.	13
Simulium sp.	11
Hydropsyche occidentalis	11
Peltodytes sp.	9
Cricotopus bicinctus	9
Sperchon sp.	7
Tropisternus sp.	5
Nematoda	5
Cricotopus sp.	3
Cricotopus/Orthocladius sp.	3
Limnophyes sp.	3
Argia sp.	3
Dugesia tigrina	3
Prostoma sp.	3
Peltodytes callosus	2
Corynoneura sp.	2
Tricorythodes sp.	2
Hydroptila sp.	2
Gyraulus parvus	2
Undetermined Enchytraeidae	2
Haliplus sp.	1
Tropisternus sp.	1
Undetermined Dytiscidae	1
Ceratopogonidae	1
Culicoides sp.	1
Cricotopus trifascia	1
Caloparyphus sp.	1
Undetermined Belostomidae	1
Cyclopidae	1
Fossaria sp.	1
Helobdella stagnalis	1
	276

Lowest Taxa	T2
Baetis tricaudatus	70
Simulium sp.	68
Nais communis/variabilis	22
Fallceon quilleri	21
Nematoda	20
Hydropsyche occidentalis	18
Physa sp./Physella sp.	16
Pentaneura sp.	13
Sperchon sp.	8
Undetermined Hydrophilidae	5
Rheotanytarsus sp.	5
Cricotopus sp.	4
Peltodytes sp.	3
Dugesia tigrina	3
Prostoma sp.	3
Tropisternus sp.	2
Cricotopus/Orthocladius sp.	2
Cyprididae	2
Peltodytes callosus	1
Tropisternus sp.	1
Tanytarsus sp.	1
Cricotopus bicinctus	1
Argia hinei	1
Tricorythodes sp.	1
Lebertiidae	1
Daphniidae	1
Undetermined Enchytraeidae	1
	294

Lowest Taxa	T3
Nais communis/variabilis	112
Baetis tricaudatus	33
Fallceon quilleri	30
Hydropsyche occidentalis	18
Pentaneura sp.	16
Physa sp./Physella sp.	13
Sperchon sp.	8
Prostoma sp.	8
Dugesia tigrina	7
Pseudochironomus sp.	4
Rheotanytarsus sp.	4
Cricotopus sp.	3
Simulium sp.	3
Nematoda	3
Undetermined Enchytraeidae	3
Cricotopus/Orthocladius sp.	2
Tricorythodes sp.	2
Gyraulus parvus	2
Pristina aequiseta	2
Tropisternus sp.	1
Peltodytes sp.	1
Stictochironomus sp.	1
Paratanytarsus sp.	1
Cricotopus bicinctus	1
Cricotopus trifascia	1
Parametriocnemus sp.	1
Ambrysus mormon	1
Argia sp.	1
Hygrobatidae	1
Cyclopidae	1
Cyprididae	1
Chaetogaster diaphanus	1
	286

Lowest Taxa	TV	FFG	TOTAL
Nais communis/variabilis	9	c	155
Baetis tricaudatus	5	c	140
Simulium sp.	6	f	82
Physa sp./Physella sp.	8	g	76
Fallceon quilleri	4	c	67
Pentaneura sp.	6	p	54
Hydropsyche occidentalis	4	f	47
Nematoda	5	p	28
Sperchon sp.	5	p	23
Rheotanytarsus sp.	6	f	22
Cyprididae	8	c	22
Prostoma sp.		c	14
Peltodytes sp.	5	s	13
Dugesia tigrina	4	p	13
Cricotopus bicinctus	7	c	11
Cricotopus sp.	7	s	10
Cricotopus/Orthocladius sp.	7	s	7
Tropisternus sp.	5	p	6
Undetermined Enchytraeidae	10	c	6
Undetermined Hydrophilidae	5	p	5
Tricorythodes sp.	5	c	5
Tropisternus sp.	5	c	4
Pseudochironomus sp.	6	c	4
Argia sp.	7	p	4
Gyraulus parvus	8	g	4
Peltodytes callosus	5	s	3
Limnophyes sp.	8	c	3
Corynoneura sp.	7	c	2
Cricotopus trifascia	7	s	2
Hydroptila sp.	6	g	2
Cyclopidae	8	c	2
Pristina aequiseta	9	c	2
Haliplus sp.	5	s	1
Undetermined Dytiscidae	5	p	1
Ceratopogonidae	6	p	1
Culicoides sp.	6	p	1
Stictochironomus sp.	6	c	1
Paratanytarsus sp.	6	f	1
Tanytarsus sp.	6	f	1
Parametriocnemus sp.	5	c	1
Caloparyphus sp.	7	c	1
Undetermined Belostomidae	8	p	1
Ambrysus mormon	5	p	1
Argia hinei	7	p	1
Hygrobatidae	5	p	1
Lebertiidae	5	p	1
Daphniidae	8	c	1
Fossaria sp.	6	g	1
Helobdella stagnalis	10	p	1
Chaetogaster diaphanus	8	c	1
			856

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 the most tolerant value. Feeding guilds are defined as follows: c = collector; f = filterer; g = grazer; p = producer and s = shredder.

Orestimba 1

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Undetermined (vial lost)	44	*Ophidonais serpentina*	68	Ceratopogonidae	1
Ophidonais serpentina	22	*Nais communis/variabilis*	53	*Dicrotendipes sp.*	3
Nais communis/variabilis	19	*Cricotopus bicinctus*	37	*Polypedilum sp.*	1
Undetermined Enchytraeidae	4	*Cricotopus sp.*	23	*Paratanytarsus sp.*	7
Cricotopus sp.	3	Undetermined Enchytraeidae	14	*Cricotopus bicinctus*	7
Nematoda	3	*Simulium sp.*	13	*Cricotopus sp.*	7
Thienemanniella sp.	2	*Thienemanniella sp.*	6	*Limnophyes sp.*	3
Slavina appendiculata	2	Undetermined Tubificidae	6	*Simulium sp.*	3
Undetermined Tubificidae	2	*Cricotopus/Orthocladius sp.*	4	*Corisella decolor*	10
Simulium sp.	1	*Nanocladius sp.*	4	Undetermined Corixidae	4
Centroptilum/Procloeon sp.	1	Nematoda	4	*Corbicula fluminea*	7
Pristina leidyi	1	*Sperchon sp.*	3	*Baetis tricaudatus*	1
Prostoma sp.	1	Calanoida	3	Calanoida	2
	105	*Polypedilum sp.*	2	Cyprididae	1
		Paratanytarsus sp.	2	*Hydra sp.*	1
		Rheotanytarsus sp.	2	*Ferrissia rivularis*	1
		Eukiefferiella sp.	2	*Fossaria sp.*	3
		Limnophyes sp.	2	*Pseudosuccinea columella*	7
		Dicrotendipes sp.	1	*Physa sp./ Physella sp.*	1
		Phaenopsectra sp.	1	Nematoda	4
		Cladotanytarsus sp	1	*Dugesia tigrina*	1
		Micropsectra sp.	1	Undetermined Enchytraeidae	27
		Corisella decolor	1	*Ophidonais serpentina*	26
		Corbicula fluminea	1	Megadrile	2
		Daphniidae	1	*Prostoma sp.*	2
		Gammarus lacustris	1		132
		Hydra sp.	1		
		Slavina appendiculata	1		
		Eudistylia vancouveri	1		
		Prostoma sp.	1		
			260		

Lowest Taxa	TV	FFG	TOTAL
Ophidonais serpentina	8	c	116
Nais communis/variabilis	9	c	72
Undetermined Enchytraeidae	10	c	45
Cricotopus bicinctus	7	c	44
Undetermined (vial lost)			44
Cricotopus sp.	7	s	33
Simulium sp.	6	f	17
Corisella decolor	10	p	11
Nematoda	5	p	11
Paratanytarsus sp.	6	f	9
Thienemanniella sp.	6	c	8
Corbicula fluminea	10	f	8
Undetermined Tubificidae	9	c	8
Pseudosuccinea columella	6	g	7
Limnophyes sp.	8	c	5
Calanoida	8	c	5
Dicrotendipes sp.	8	c	4
Cricotopus/Orthocladius sp.	7	s	4
Nanocladius sp.	3	s	4
Undetermined Corixidae	10	p	4
Prostoma sp.		c	4
Polypedilum sp.	6	s	3
Sperchon sp.	5	p	3
Fossaria sp.	6	g	3
Slavina appendiculata	7	c	3
Rheotanytarsus sp.	6	f	2
Eukiefferiella sp.	8	c	2
Hydra sp.	5	f	2
Megadrile	5	c	2
Ceratopogonidae	6	p	1
Phaenopsectra sp.	7	g	1
Cladotanytarsus sp	6	f	1
Micropsectra sp.	7	c	1
Baetis tricaudatus	5	c	1
Centroptilum/Procloeon sp.	3	c	1
Daphniidae	8	c	1
Gammarus lacustris	4	c	1
Cyprididae	8	c	1
Ferrissia rivularis	6	g	1
Physa sp./ Physella sp.	8	g	1
Dugesia tigrina	4	p	1
Pristina leidyi	9	c	1
Eudistylia vancouveri	8	c	1
			497

Orestimba 2

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Cricotopus sp.	57	*Cricotopus bicinctus*	27	*Nais communis/variabilis*	52
Ophidonais serpentina	56	*Ophidonais serpentina*	27	*Ophidonais serpentina*	48
Cricotopus bicinctus	19	*Cricotopus sp.*	22	*Simulium sp.*	33
Simulium sp.	18	Undetermined Tubificidae	17	*Cricotopus sp.*	27
Nais communis/variabilis	17	*Nanocladius sp.*	11	Undetermined Enchytraeidae	16
Undetermined Enchytraeidae	14	Megadrile	6	Nematoda	14
Polypedilum sp.	9	*Polypedilum sp.*	5	*Cricotopus bicinctus*	11
Undetermined Tubificidae	8	*Gammarus lacustris*	4	*Cricotopus/Orthocladius sp.*	11
Dicrotendipes sp.	5	*Nais communis/variabilis*	4	*Phaenopsectra sp.*	10
Rheocricotopus sp.	4	*Simulium sp.*	3	*Chironomus sp.*	9
Paratanytarsus sp.	3	*Sperchon sp.*	3	Undetermined Tubificidae	5
Eukiefferiella sp.	3	*Prostoma sp.*	3	*Polypedilum sp.*	4
Nematoda	3	*Dicrotendipes sp.*	2	*Eudistylia vancouveri*	4
Limnophyes sp.	2	*Phaenopsectra sp.*	2	*Paratanytarsus sp.*	3
Corbicula fluminea	2	*Paratanytarsus sp.*	2	*Eukiefferiella sp.*	3
Sperchon sp.	2	*Cricotopus/Orthocladius sp.*	2	*Dicrotendipes sp.*	2
Phaenopsectra sp.	1	*Limnophyes sp.*	2	*Limnophyes sp.*	2
Micropsectra sp.	1	*Thienemanniella sp.*	2	*Rheocricotopus sp.*	2
Tanytarsus sp.	1	*Corbicula fluminea*	2	*Smittia sp.*	2
Cricotopus/Orthocladius sp.	1	Undetermined Enchytraeidae	2	Chironomini	1
Thienemanniella sp.	1	Chironominae	1	*Microtendipes pedellus*	1
Hemerodromia sp.	1	*Chironomus sp.*	1	*Micropsectra sp.*	1
Daphniidae	1	*Cryptochironomus*	1	Orthocladiinae	1
Cyclopidae	1	*Micropsectra sp.*	1	*Psychoda sp.*	1
Hydra sp.	1	Orthocladiinae	1	*Sperchon sp.*	1
Physa sp./ Physella sp.	1	*Eukiefferiella sp.*	1	Calanoida	1
Erpobdellidae	1	*Psychoda sp.*	1	Harpacticoida	1
Prostoma sp.	1	Calanoida	1	*Gammarus lacustris*	1
	234	*Physa sp./ Physella sp.*	1		267
		Nematoda	1		
			158		

Lowest Taxa	TV	FFG	TOTAL
Ophidonais serpentina	8	c	131
Cricotopus sp.	7	s	106
Nais communis/variabilis	9	c	73
Cricotopus bicinctus	7	c	57
Simulium sp.	6	f	54
Undetermined Enchytraeidae	10	c	32
Undetermined Tubificidae	9	c	30
Polypedilum sp.	6	s	18
Nematoda	5	p	18
Cricotopus/Orthocladius sp.	7	s	14
Phaenopsectra sp.	7	g	13
Nanocladius sp.	3	s	11
Chironomus sp.	10	c	10
Dicrotendipes sp.	8	c	9
Paratanytarsus sp.	6	f	8
Eukiefferiella sp.	8	c	7
Limnophyes sp.	8	c	6
Rheocricotopus sp.	6	c	6
Sperchon sp.	5	p	6
Megadrile	5	c	6
Gammarus lacustris	4	c	5
Corbicula fluminea	10	f	4
Eudistylia vancouveri	8	c	4
Prostoma sp.		c	4
Micropsectra sp.	7	c	3
Thienemanniella sp.	6	c	3
Orthocladiinae	5	c	2
Smittia sp.	6	c	2
Psychoda sp.	10	c	2
Calanoida	8	c	2
Physa sp./ Physella sp.	8	g	2
Chironominae	6	c	1
Chironomini	6	c	1
Cryptochironomus	8	p	1
Microtendipes pedellus	6	f	1
Tanytarsus sp.	6	f	1
Hemerodromia sp.	6	p	1
Daphniidae	8	c	1
Cyclopidae	8	c	1
Harpacticoida	8	c	1
Hydra sp.	5	f	1
Erpobdellidae	8	p	1
			659

Orestimba 3

Lowest Taxa	T1
Undetermined Tubificidae	14
Gammarus lacustris	5
Eudistylia vancouveri	5
Corbicula fluminea	3
Prostoma sp.	3
Neomysis mercedis	2
Erpobdellidae	2
Menetus opercularis	1
Branchiura sowerbyi	1
Megadrile	1
	37

Lowest Taxa	T2
Simulium sp.	27
Ophidonais serpentina	21
Polypedilum sp.	9
Sperchon sp.	8
Gammarus lacustris	7
Undetermined Enchytraeidae	6
Micropsectra sp.	5
Phaenopsectra sp.	4
Rheocricotopus sp.	4
Dugesia tigrina	4
Prostoma sp.	4
Cricotopus sp.	3
Physa sp./ Physella sp.	3
Chironomus sp.	2
Dicrotendipes sp.	2
Paratanytarsus sp.	2
Eukiefferiella sp.	2
Corbicula fluminea	2
Undetermined Tubificidae	2
Megadrile	2
Limnophyes sp.	1
Nanocladius sp.	1
Thienemanniella sp.	1
Hydroptila sp.	1
Daphniidae	1
Gyraulus parvus	1
Nematoda	1
Nais communis/variabilis	1
Pristina aequiseta	1
	128

Lowest Taxa	T3
Corbicula fluminea	12
Gammarus lacustris	8
Undetermined Enchytraeidae	8
Gyraulus parvus	6
Ophidonais serpentina	4
Simulium sp.	3
Prostoma sp.	3
Physa sp./ Physella sp.	2
Corisella decolor	1
Nematoda	1
Nais communis/variabilis	1
	49

Lowest Taxa	TV	FFG	TOTAL
Simulium sp.	6	f	30
Ophidonais serpentina	8	c	25
Gammarus lacustris	4	c	20
Corbicula fluminea	10	f	17
Undetermined Tubificidae	9	c	16
Undetermined Enchytraeidae	10	c	14
Prostoma sp.		c	10
Polypedilum sp.	6	s	9
Sperchon sp.	5	p	8
Gyraulus parvus	8	g	7
Micropsectra sp.	7	c	5
Physa sp./ Physella sp.	8	g	5
Eudistylia vancouveri	8	c	5
Phaenopsectra sp.	7	g	4
Rheocricotopus sp.	6	c	4
Dugesia tigrina	4	p	4
Cricotopus sp.	7	s	3
Megadrile	5	c	3
Chironomus sp.	10	c	2
Dicrotendipes sp.	8	c	2
Paratanytarsus sp.	6	f	2
Eukiefferiella sp.	8	c	2
Neomysis mercedis		p	2
Nematoda	5	p	2
Erpobdellidae	8	p	2
Nais communis/variabilis	9	c	2
Limnophyes sp.	8	c	1
Nanocladius sp.	3	s	1
Thienemanniella sp.	6	c	1
Corisella decolor	10	p	1
Hydroptila sp.	6	g	1
Daphniidae	8	c	1
Menetus opercularis	7	g	1
Pristina aequiseta	9	c	1
Branchiura sowerbyi	10	c	1
			214

Orestimba 4

Lowest Taxa	T1
Simulium sp.	42
Ophidonais serpentina	37
Gammarus lacustris	29
Corbicula fluminea	17
Nematoda	9
Megadrile	8
Undetermined Enchytraeidae	6
Nanocladius sp.	4
Sperchon sp.	3
Prostoma sp.	3
Polypedilum sp.	2
Paratanytarsus sp.	2
Cricotopus bicinctus	2
Eukiefferiella sp.	2
Rheotanytarsus sp.	1
Cricotopus sp.	1
Cyprididae	1
Physa sp./ Physella sp.	1
Gyraulus parvus	1
Nais communis/variabilis	1
Undetermined Tubificidae	1
Eudistylia vancouveri	1
	174

Lowest Taxa	T2
Ophidonais serpentina	38
Corbicula fluminea	28
Gammarus lacustris	16
Undetermined Tubificidae	14
Eudistylia vancouveri	14
Simulium sp.	8
Megadrile	8
Prostoma sp.	7
Nais communis/variabilis	6
Micropsectra sp.	5
Cricotopus bicinctus	4
Physa sp./ Physella sp.	4
Cricotopus sp.	3
Branchiura sowerbyi	3
Nematoda	2
Dicrotendipes sp.	1
Paratanytarsus sp.	1
Tanytarsus sp.	1
Nanocladius sp.	1
Thienemanniella sp.	1
Sperchon sp.	1
Daphniidae	1
Hydra sp.	1
Gyraulus parvus	1
Undetermined Enchytraeidae	1
Slavina appendiculata	1
	171

Lowest Taxa	T3
Ophidonais serpentina	101
Gammarus lacustris	35
Simulium sp.	30
Corbicula fluminea	18
Nematoda	12
Prostoma sp.	11
Megadrile	10
Nais communis/variabilis	7
Cricotopus sp.	6
Dugesia tigrina	6
Hydra sp.	5
Slavina appendiculata	5
Paratanytarsus sp.	4
Sperchon sp.	4
Physa sp./ Physella sp.	4
Undetermined Enchytraeidae	4
Eudistylia vancouveri	3
Micropsectra sp.	2
Rheotanytarsus sp.	2
Cricotopus bicinctus	2
Nanocladius sp.	2
Smittia sp.	1
Thienemanniella sp.	1
Undetermined Tubificidae	1
	276

Lowest Taxa	TV	FFG	TOTAL
Ophidonais serpentina	8	c	176
Simulium sp.	6	f	80
Gammarus lacustris	4	c	80
Corbicula fluminea	10	f	63
Megadrile	5	c	26
Nematoda	5	p	23
Prostoma sp.		c	21
Eudistylia vancouveri	8	c	18
Undetermined Tubificidae	9	c	16
Nais communis/variabilis	9	c	14
Undetermined Enchytraeidae	10	c	11
Cricotopus sp.	7	s	10
Physa sp./ Physella sp.	8	g	9
Cricotopus bicinctus	7	c	8
Sperchon sp.	5	p	8
Micropsectra sp.	7	c	7
Paratanytarsus sp.	6	f	7
Nanocladius sp.	3	s	7
Hydra sp.	5	f	6
Dugesia tigrina	4	p	6
Slavina appendiculata	7	c	6
Rheotanytarsus sp.	6	f	3
Branchiura sowerbyi	10	c	3
Polypedilum sp.	6	s	2
Eukiefferiella sp.	8	c	2
Thienemanniella sp.	6	c	2
Gyraulus parvus	8	g	2
Dicrotendipes sp.	8	c	1
Tanytarsus sp.	6	f	1
Smittia sp.	6	c	1
Daphniidae	8	c	1
Cyprididae	8	c	1
			621

Orestimba 5

Lowest Taxa	T1
Gammarus lacustris	23
Corbicula fluminea	17
Simulium sp.	15
Prostoma sp.	14
Megadrile	13
Eudistylia vancouveri	8
Undetermined Tubificidae	6
Gyraulus sp.	5
Sperchon sp.	4
Physa sp./ Physella sp.	3
Ophidonais serpentina	3
Cricotopus bicinctus	2
Nanocladius sp.	2
Dicrotendipes sp.	1
Rheotanytarsus sp.	1
Cricotopus sp.	1
Thienemanniella sp.	1
Calanoida	1
Nematoda	1
Dugesia tigrina	1
Erpobdellidae	1
Undetermined Enchytraeidae	1
	124

Lowest Taxa	T2
Gammarus lacustris	42
Corbicula fluminea	24
Simulium sp.	17
Ophidonais serpentina	9
Prostoma sp.	9
Cricotopus bicinctus	8
Slavina appendiculata	7
Cricotopus sp.	4
Eukiefferiella sp.	4
Megadrile	3
Eudistylia vancouveri	3
Cricotopus/Orthocladius sp.	2
Thienemanniella sp.	2
Nematoda	2
Undetermined Enchytraeidae	2
Dicrotendipes sp.	1
Limnophyes sp.	1
Nanocladius sp.	1
Cyclopidae	1
Dugesia tigrina	1
Nais communis/variabilis	1
Undetermined Tubificidae	1
	145

Lowest Taxa	T3
Gammarus lacustris	30
Corbicula fluminea	22
Simulium sp.	10
Megadrile	9
Eudistylia vancouveri	5
Dugesia tigrina	4
Undetermined Tubificidae	4
Rheotanytarsus sp.	2
Cricotopus sp.	2
Nematoda	2
Nais communis/variabilis	2
Slavina appendiculata	2
Parachironomus sp.	1
Cricotopus bicinctus	1
Branchiura sowerbyi	1
	97

Lowest Taxa	TV	FFG	TOTAL
Gammarus lacustris	4	c	95
Corbicula fluminea	10	f	63
Simulium sp.	6	f	42
Megadrile	5	c	25
Prostoma sp.		c	23
Eudistylia vancouveri	8	c	16
Ophidonais serpentina	8	c	12
Cricotopus bicinctus	7	c	11
Undetermined Tubificidae	9	c	11
Slavina appendiculata	7	c	9
Cricotopus sp.	7	s	7
Dugesia tigrina	4	p	6
Gyraulus sp.	8	g	5
Nematoda	5	p	5
Eukiefferiella sp.	8	c	4
Sperchon sp.	5	p	4
Rheotanytarsus sp.	6	f	3
Nanocladius sp.	3	s	3
Thienemanniella sp.	6	c	3
Physa sp./ Physella sp.	8	g	3
Undetermined Enchytraeidae	10	c	3
Nais communis/variabilis	9	c	3
Dicrotendipes sp.	8	c	2
Cricotopus/Orthocladius sp.	7	s	2
Parachironomus sp.	10	p	1
Limnophyes sp.	8	c	1
Calanoida	8	c	1
Cyclopidae	8	c	1
Erpobdellidae	8	p	1
Branchiura sowerbyi	10	c	1
			366

Orestimba 6

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Gammarus lacustris	30	Megadrile	16	Megadrile	31
Corbicula fluminea	16	*Corbicula fluminea*	12	*Gammarus lacustris*	20
Prostoma sp.	11	*Gammarus lacustris*	11	*Prostoma sp.*	17
Megadrile	9	*Simulium sp.*	9	*Corbicula fluminea*	15
Simulium sp.	7	*Cricotopus sp.*	7	Undetermined Tubificidae	14
Undetermined Tubificidae	3	Undetermined Tubificidae	4	*Simulium sp.*	10
Physa sp./ Physella sp.	2	*Cricotopus bicinctus*	3	*Physa sp./ Physella sp.*	5
Branchiura sowerbyi	2	*Physa sp./ Physella sp.*	3	*Cricotopus sp.*	4
Polypedilum sp.	1	Undetermined Enchytraeidae	2	Nematoda	3
Paratanytarsus sp.	1	*Hydropsyche californica*	1	Undetermined Enchytraeidae	3
Cricotopus bicinctus	1	Calanoida	1	*Eukiefferiella sp.*	2
Fallceon quilleri	1	Nematoda	1	*Dugesia tigrina*	2
Cyclopidae	1	*Dugesia tigrina*	1	*Slavina appendiculata*	2
Ophidonais serpentina	1	*Eudistylia vancouveri*	1	*Eudistylia vancouveri*	2
	86	*Prostoma sp.*	1	*Paratanytarsus sp.*	1
			73	*Cricotopus bicinctus*	1
				Erioptera sp.	1
				Cyclopidae	1
				Nais communis/variabilis	1
				Ophidonais serpentina	1
					136

Lowest Taxa	TV	FFG	TOTAL
Gammarus lacustris	4	c	61
Megadrile	5	c	56
Corbicula fluminea	10	f	43
Prostoma sp.		c	29
Simulium sp.	6	f	26
Undetermined Tubificidae	9	c	21
Cricotopus sp.	7	s	11
Physa sp./ Physella sp.	8	g	10
Cricotopus bicinctus	7	c	5
Undetermined Enchytraeidae	10	c	5
Nematoda	5	p	4
Dugesia tigrina	4	p	3
Eudistylia vancouveri	8	c	3
Paratanytarsus sp.	6	f	2
Eukiefferiella sp.	8	c	2
Cyclopidae	8	c	2
Ophidonais serpentina	8	c	2
Slavina appendiculata	7	c	2
Branchiura sowerbyi	10	c	2
Polypedilum sp.	6	s	1
Erioptera sp.	3	c	1
Fallceon quilleri	4	c	1
Hydropsyche californica	4	f	1
Calanoida	8	c	1
Nais communis/variabilis	9	c	1
			295

Orestimba 7

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Simulium sp.	10	*Cricotopus sp.*	27	*Gammarus lacustris*	23
Cricotopus sp.	8	*Corbicula fluminea*	22	*Corbicula fluminea*	16
Cricotopus bicinctus	5	*Cricotopus bicinctus*	20	*Slavina appendiculata*	8
Ophidonais serpentina	5	*Eudistylia vancouveri*	17	*Prostoma sp.*	8
Prostoma sp.	5	*Simulium sp.*	11	*Ophidonais serpentina*	6
Dicrotendipes sp.	4	*Prostoma sp.*	11	*Simulium sp.*	3
Gammarus lacustris	4	*Gammarus lacustris*	8	Nematoda	3
Corbicula fluminea	3	Nematoda	8	Megadrile	3
Eudistylia vancouveri	3	*Ophidonais serpentina*	6	*Eudistylia vancouveri*	3
Paratanytarsus sp.	2	*Slavina appendiculata*	6	*Physa sp./ Physella sp.*	2
Nanocladius sp.	2	*Nanocladius sp.*	5	Undetermined Enchytraeidae	2
Sperchon sp.	2	*Chironomus sp.*	3	*Nereis limnicola*	2
Hydra sp.	2	*Physa sp./ Physella sp.*	3	*Microtendipes pedellus*	1
Slavina appendiculata	2	*Paratanytarsus sp.*	2	*Paratanytarsus sp.*	1
Microtendipes pedellus	1	*Nais communis/variabilis*	2	*Cricotopus bicinctus*	1
Hydroptila sp.	1	Megadrile	2	*Hydropsyche californica*	1
Megadrile	1	*Enallagma sp.*	1	*Gyraulus sp.*	1
	60	*Hydroptila sp.*	1	*Dugesia tigrina*	1
		Sperchon sp.	1	*Pristina leidyi*	1
			156		86

Lowest Taxa	TV	FFG	TOTAL
Corbicula fluminea	10	f	41
Cricotopus sp.	7	s	35
Gammarus lacustris	4	c	35
Cricotopus bicinctus	7	c	26
Simulium sp.	6	f	24
Prostoma sp.		c	24
Eudistylia vancouveri	8	c	23
Ophidonais serpentina	8	c	17
Slavina appendiculata	7	c	16
Nematoda	5	p	11
Nanocladius sp.	3	s	7
Megadrile	8	c	6
Paratanytarsus sp.	6	f	5
Physa sp./ Physella sp.	8	g	5
Dicrotendipes sp.	8	c	4
Chironomus sp.	10	c	3
Sperchon sp.	5	p	3
Microtendipes pedellus	6	f	2
Hydroptila sp.	6	g	2
Hydra sp.	5	f	2
Undetermined Enchytraeidae	10	c	2
Nais communis/variabilis	9	c	2
Nereis limnicola		c	2
Enallagma sp.	9	p	1
Hydropsyche californica	4	f	1
Gyraulus sp.	8	g	1
Dugesia tigrina	4	p	1
Pristina leidyi	9	c	1
			302

Orestimba 8

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Simulium sp.	84	Simulium sp.	77	Gammarus lacustris	43
Corbicula fluminea	41	Cricotopus bicinctus	27	Prostoma sp.	35
Ophidonais serpentina	39	Gammarus lacustris	26	Cricotopus sp.	28
Dicrotendipes sp.	27	Corbicula fluminea	24	Ophidonais serpentina	28
Cricotopus bicinctus	15	Cricotopus sp.	23	Cricotopus bicinctus	21
Gammarus lacustris	14	Ophidonais serpentina	13	Corbicula fluminea	17
Paratanytarsus sp.	12	Dicrotendipes sp.	12	Dicrotendipes sp.	16
Megadrile	11	Megadrile	11	Physa sp./ Physella sp.	11
Eudistylia vancouveri	8	Paratanytarsus sp.	10	Paratanytarsus sp.	10
Cricotopus sp.	7	Nais communis/variabilis	10	Nais communis/variabilis	9
Nais communis/variabilis	5	Nematoda	8	Nematoda	8
Nematoda	4	Physa sp./ Physella sp.	6	Slavina appendiculata	8
Hydra sp.	3	Hydra sp.	5	Megadrile	7
Physa sp./ Physella sp.	3	Eudistylia vancouveri	5	Undetermined Tubificidae	6
Undetermined Enchytraeidae	3	Prostoma sp.	5	Eukiefferiella sp.	4
Slavina appendiculata	3	Parachironomus sp.	3	Hydropsyche californica	4
Parachironomus sp.	2	Nanocladius sp.	3	Dugesia tigrina	4
Micropsectra sp.	2	Limnophyes sp.	2	Cladotanytarsus sp	2
Limnophyes sp.	2	Undetermined Tubificidae	2	Eudistylia vancouveri	2
Hydropsyche californica	2	Chironomus sp.	1	Micropsectra sp.	1
Dugesia tigrina	2	Microchironomus sp.	1	Nanocladius sp.	1
Nereis limnicola	2	Orthocladiinae	1	Hydroptila sp.	1
Prostoma sp.	2	Cricotopus/Orthocladius sp.	1	Erpobdellidae	1
Microtendipes pedellus	1	Thienemanniella sp.	1	Undetermined Enchytraeidae	1
Orthocladiinae	1	Hydropsyche californica	1	Manayunkia speciosa	1
Eukiefferiella sp.	1	Hydroptila sp.	1	Nereis limnicola	1
Nanocladius sp.	1	Dugesia tigrina	1		270
Fallceon quilleri	1	Slavina appendiculata	1		
Glossiphoniidae	1	Nereis limnicola	1		
	299		282		

Lowest Taxa	TV	FFG	TOTAL
Simulium sp.	6	f	161
Gammarus lacustris	4	c	83
Corbicula fluminea	10	f	82
Ophidonais serpentina	8	c	80
Cricotopus bicinctus	7	c	63
Cricotopus sp.	7	s	58
Dicrotendipes sp.	8	c	55
Prostoma sp.		c	42
Paratanytarsus sp.	6	f	32
Megadrile	8	c	29
Nais communis/variabilis	9	c	24
Physa sp./ Physella sp.	8	g	20
Nematoda	5	p	20
Eudistylia vancouveri	8	c	15
Slavina appendiculata	7	c	12
Hydra sp.	5	f	8
Undetermined Tubificidae	9	c	8
Hydropsyche californica	4	f	7
Dugesia tigrina	4	p	7
Parachironomus sp.	10	p	5
Eukiefferiella sp.	8	c	5
Nanocladius sp.	3	s	5
Limnophyes sp.	8	c	4
Undetermined Enchytraeidae	10	c	4
Nereis limnicola		c	4
Micropsectra sp.	7	c	3
Cladotanytarsus sp	6	f	2
Orthocladiinae	5	c	2
Hydroptila sp.	6	g	2
Chironomus sp.	10	c	1
Microtendipes pedellus	6	f	1
Microchironomus sp.			1
Cricotopus/Orthocladius sp.	7	s	1
Thienemanniella sp.	6	c	1
Fallceon quilleri	4	c	1
Glossiphoniidae	8	p	1
Erpobdellidae	8	p	1
Manayunkia speciosa			1
			851

Orestimba 9

Lowest Taxa	T1
Undetermined Enchytraeidae	223
Nais communis/variabilis	16
Cricotopus sp.	15
Cricotopus bicinctus	10
Ophidonais serpentina	10
Corbicula fluminea	6
Physa sp./ Physella sp.	4
Slavina appendiculata	3
Paratanytarsus sp.	2
Undetermined Tubificidae	2
Prostoma sp.	2
Chironomus sp.	1
Limnophyes sp.	1
Simulium sp.	1
Nematoda	1
Erpobdellidae	1
	298

Lowest Taxa	T2
Undetermined Enchytraeidae	235
Cricotopus sp.	9
Corbicula fluminea	8
Undetermined Tubificidae	7
Ophidonais serpentina	6
Physa sp./ Physella sp.	4
Nematoda	4
Chironomus sp.	3
Cricotopus bicinctus	3
Rheotanytarsus sp.	2
Simulium sp.	2
Nais communis/variabilis	2
Megadrile	2
Culicoides sp.	1
Erioptera sp.	1
Hydra sp.	1
Erpobdellidae	1
Prostoma sp.	1
	292

Lowest Taxa	T3
Undetermined Enchytraeidae	258
Cricotopus sp.	8
Simulium sp.	8
Cricotopus bicinctus	6
Physa sp./ Physella sp.	4
Ophidonais serpentina	4
Erpobdellidae	3
Nais communis/variabilis	3
Micropsectra sp.	2
Rheotanytarsus sp.	2
Corbicula fluminea	2
Nematoda	2
Undetermined Tubificidae	2
Megadrile	2
Chironomus sp.	1
Dicrotendipes sp.	1
	308

Lowest Taxa	TV	FFG	TOTAL
Undetermined Enchytraeidae	10	c	716
Cricotopus sp.	7	s	32
Nais communis/variabilis	9	c	21
Ophidonais serpentina	8	c	20
Cricotopus bicinctus	7	c	19
Corbicula fluminea	10	f	16
Physa sp./ Physella sp.	8	g	12
Simulium sp.	6	f	11
Undetermined Tubificidae	9	c	11
Nematoda	5	p	7
Chironomus sp.	10	c	5
Erpobdellidae	8	p	5
Rheotanytarsus sp.	6	f	4
Megadrile	5	c	4
Slavina appendiculata	7	c	3
Prostoma sp.		c	3
Micropsectra sp.	7	c	2
Paratanytarsus sp.	6	f	2
Culicoides sp.	6	p	1
Dicrotendipes sp.	8	c	1
Limnophyes sp.	8	c	1
Erioptera sp.	3	c	1
Hydra sp.	5	f	1
			898

Orestimba 10

Lowest Taxa	T1
Dicrotendipes sp.	80
Centroptilum/Procloeon sp.	69
Fallceon quilleri	30
Torrenticola sp.	14
Odontomyia sp.	13
Cricotopus bicinctus	10
Hexatoma sp.	10
Undetermined Corixidae	10
Baetis tricaudatus	8
Gyraulus parvus	8
Nais communis/variabilis	8
Fossaria sp.	7
Stictotarsus sp.	5
Rheotanytarsus sp.	3
Orthocladiinae	3
Undetermined Enchytraeidae	3
Chaetogaster diaphanus	3
Pristina aequiseta	3
Peltodytes sp.	2
Undetermined Dytiscidae	2
Cricotopus sp.	2
Caloparyphus sp.	2
Liodessus sp.	1
Undetermined Hydrophilidae	1
Demicryptochironomus sp.	1
Tanytarsus sp.	1
Corynoneura sp.	1
Parametriocnemus sp.	1
Psectrocladius sp.	1
Graptocorixa californica	1
Caenis sp.	1
Ephemerella maculata	1
Tricorythodes sp.	1
Planorbula sp.	1
Nematoda	1
	308

Lowest Taxa	T2
Torrenticola sp.	77
Baetis tricaudatus	34
Cricotopus bicinctus	16
Fallceon quilleri	16
Cyprididae	10
Stictotarsus sp.	9
Nais communis/variabilis	7
Odontomyia sp.	6
Hexatoma sp.	5
Centroptilum/Procloeon sp.	5
Oxyethira sp.	5
Rheotanytarsus sp.	4
Fossaria sp.	4
Enochrus sp.	3
Bezzia/ Palpomyia	3
Sperchon sp.	3
Gyraulus parvus	3
Helisoma anceps	3
Planorbula sp.	3
Chaetogaster diaphanus	3
Agabus sp.	2
Simulium sp.	2
Hygrobatidae	2
Hydrochus sp.	1
Tanytarsus sp.	1
Cricotopus sp.	1
Cricotopus/Orthocladius sp.	1
Orthocladius sp.	1
Stratiomys sp.	1
Cyclopidae	1
Physa sp./ Physella sp.	1
Sphaerium sp.	1
Undetermined Enchytraeidae	1
	235

Lowest Taxa	T3
Torrenticola sp.	124
Dicrotendipes sp.	40
Cyprididae	13
Baetis tricaudatus	11
Fallceon quilleri	10
Corynoneura sp.	9
Cricotopus bicinctus	8
Stictotarsus sp.	7
Cricotopus sp.	6
Centroptilum/Procloeon sp.	6
Physa sp./ Physella sp.	6
Planorbula sp.	6
Peltodytes sp.	5
Fossaria sp.	5
Simulium sp.	4
Stratiomys sp.	4
Bezzia/ Palpomyia	3
Hygrobatidae	3
Helisoma anceps	3
Undetermined Dytiscidae	2
Enochrus sp.	2
Undetermined Hydrophilidae	2
Hexatoma sp.	2
Oxyethira sp.	2
Sperchon sp.	2
Berosus sp.	1
Pseudochironomus sp.	1
Paratanytarsus sp.	1
Heleniella sp.	1
Limnophyes sp.	1
Caloparyphus sp.	1
Odontomyia sp.	1
Undetermined Corixidae	1
Leucrocuta sp.	1
Daphniidae	1
Chaetogaster diaphanus	1
Nais communis/variabilis	1
Nais barbata	1
	298

Lowest Taxa	TV	FFG	TOTAL
Torrenticola sp.	5	p	215
Dicrotendipes sp.	8	c	120
Centroptilum/Procloeon sp.	3	c	80
Fallceon quilleri	4	c	56
Baetis tricaudatus	5	c	53
Cricotopus bicinctus	7	c	34
Cyprididae	8	c	23
Stictotarsus sp.	5	p	21
Odontomyia sp.	5	c	20
Hexatoma sp.	2	p	17
Fossaria sp.	6	g	16
Nais communis/variabilis	9	c	16
Undetermined Corixidae	10	p	11
Gyraulus parvus	8	g	11
Corynoneura sp.	7	c	10
Planorbula sp.	7	g	10
Cricotopus sp.	7	s	9
Peltodytes sp.	5	s	7
Rheotanytarsus sp.	6	f	7
Oxyethira sp.	3	c	7
Physa sp./ Physella sp.	8	g	7
Chaetogaster diaphanus	8	c	7
Bezzia/ Palpomyia	6	p	6
Simulium sp.	6	f	6
Helisoma anceps	7	g	6
Enochrus sp.	5	p	5
Stratiomys sp.	8	c	5
Hygrobatidae	5	p	5
Sperchon sp.	5	p	5
Undetermined Dytiscidae	5	p	4
Undetermined Enchytraeidae	10	c	4
Undetermined Hydrophilidae	5	p	3
Orthocladiinae	5	c	3
Caloparyphus sp.	7	c	3
Pristina aequiseta	9	c	3
Agabus sp.	8	p	2
Tanytarsus sp.	6	f	2
Liodessus sp.	5	p	1
Hydrochus sp.			1
Berosus sp.	5	p	1
Demicryptochironomus sp.	6	c	1
Pseudochironomus sp.			1
Paratanytarsus sp.	6	f	1
Cricotopus/Orthocladius sp.	7	s	1
Heleniella sp.	5	c	1
Limnophyes sp.	8	c	1
Orthocladius sp.	6	c	1
Parametriocnemus sp.	5	c	1
Psectrocladius sp.	8	c	1
Graptocorixa californica	10	p	1
Caenis sp.	7	c	1
Ephemerella maculata	1	c	1
Leucrocuta sp.	1	g	1
Tricorythodes sp.	5	c	1
Daphniidae	8	c	1
Cyclopidae	8	c	1
Sphaerium sp.	8	f	1
Nematoda	5	p	1
Nais barbata	9	c	1
			841

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 the most tolerant value. Feeding guilds are defined as follows: c = collector; f = filterer; g = grazer; p = producer and s = shredder.

Salt Slough 1

Lowest taxa	T1	Lowest taxa	T2	Lowest taxa	T3
Corophium spinicorne	25	*Corophium spinicorne*	50	*Corophium spinicorne*	52
Corbicula fluminea	19	*Corbicula fluminea*	28	*Physa sp./ Physella sp.*	29
Physa sp./ Physella sp.	13	*Physa sp./ Physella sp.*	21	*Cricotopus bicinctus*	13
Undetermined Tubificidae	5	*Paratanytarsus sp.*	9	Undetermined Corixidae	10
Eudistylia vancouveri	5	*Cricotopus bicinctus*	9	Undetermined Tubificidae	10
Paratanytarsus sp.	3	*Cricotopus sp.*	7	*Corbicula fluminea*	9
Undetermined Corixidae	3	Undetermined Corixidae	7	*Corisella decolor*	8
Gammarus lacustris	3	*Ophidonais serpentina*	5	*Paratanytarsus sp.*	5
Cricotopus sp.	2	*Hydrellia sp.*	3	*Hydrellia sp.*	4
Hydrellia sp.	2	*Chironomus sp.*	2	*Eudistylia vancouveri*	4
Branchiura sowerbyi	2	*Tanypus sp.*	2	*Cricotopus sp.*	3
Chironomus sp.	1	*Hetaerina americana*	2	*Cricotopus/Orthocladius sp.*	2
Harnischia sp.	1	*Ischnura sp.*	2	Undetermined Coenagrionidae	2
Ablabesmyia sp.	1	Undetermined Tubificidae	2	*Ophidonais serpentina*	2
Procladius sp.	1	Chironominae	1	*Helophorus sp.*	1
Corisella decolor	1	*Parachironomus sp.*	1	*Ceratopogon sp.*	1
Undetermined Coenagrionidae	1	*Corisella inscripta*	1	*Chironomus sp.*	1
Limnodrilus hoffmeisteri	1	*Corisella decolor*	1	*Dicrotendipes sp.*	1
	89	*Trichocorixa calva*	1	*Parachironomus sp.*	1
		Undetermined Coenagrionidae	1	*Polypedilum sp.*	1
		Hydroptila sp.	1	*Nanocladius sp.*	1
		Gammarus lacustris	1	*Procladius sp.*	1
		Hyalella azteca	1	*Tanypus sp.*	1
		Ferrissia rivularis	1	*Hydropsyche sp.*	1
		Eudistylia vancouveri	1	*Hydroptila sp.*	1
		Nereis limnicola	1	Ancylidae	1
			161	*Menetus opercularis*	1
				Branchiura sowerbyi	1
					167

Lowest taxa	TV	FFG	TOTAL
Corophium spinicorne	8	c	127
Physa sp./ Physella sp.	8	g	63
Corbicula fluminea	10	f	56
Cricotopus bicinctus	7	c	22
Undetermined Corixidae	10	p	20
Paratanytarsus sp.	6	f	17
Undetermined Tubificidae	9	c	17
Cricotopus sp.	7	s	12
Corisella decolor	10	p	10
Eudistylia vancouveri	8	c	10
Hydrellia sp.	6	s	9
Ophidonais serpentina	8	c	7
Chironomus sp.	10	c	4
Undetermined Coenagrionidae	9	p	4
Gammarus lacustris	4	c	4
Tanypus sp.	10	p	3
Branchiura sowerbyi	10	c	3
Parachironomus sp.	10	p	2
Cricotopus/Orthocladius sp.	7	s	2
Procladius sp.	9	p	2
Hetaerina americana	6	p	2
Ischnura sp.	9	p	2
Hydroptila sp.	6	g	2
Helophorus sp.		s	1
Ceratopogon sp.	6	p	1
Chironominae	6	c	1
Dicrotendipes sp.	8	c	1
Harnischia sp.	6	c	1
Polypedilum sp.	6	s	1
Nanocladius sp.	3	s	1
Ablabesmyia sp.	8	p	1
Corisella inscripta	10	p	1
Trichocorixa calva	10	p	1
Hydropsyche sp.	4	f	1
Hyalella azteca	8	c	1
Ancylidae			1
Ferrissia rivularis	6	g	1
Menetus opercularis	7	g	1
Limnodrilus hoffmeisteri	9	c	1
Nereis limnicola		c	1
			417

Salt Slough 2

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Corophium spinicorne	116	*Corophium spinicorne*	44	*Corbicula fluminea*	29
Paratanytarsus sp.	41	*Corbicula fluminea*	22	Undetermined Tubificidae	18
Undetermined Tubificidae	20	*Paratanytarsus sp.*	13	*Limnodrilus hoffmeisteri*	7
Cricotopus sp.	16	Undetermined Tubificidae	10	*Corophium spinicorne*	5
Cricotopus bicinctus	13	*Eudistylia vancouveri*	9	*Eudistylia vancouveri*	3
Corbicula fluminea	13	*Prostoma sp.*	8	Undetermined Corixidae	2
Eudistylia vancouveri	9	*Cricotopus sp.*	7	*Gammarus lacustris*	2
Undetermined Corixidae	7	Undetermined Corixidae	7	Chironominae	1
Limnodrilus hoffmeisteri	7	Daphniidae	3	*Paratanytarsus sp.*	1
Hydropsyche californica	3	*Nanocladius sp.*	2	*Cricotopus sp.*	1
Undetermined Hydropsychidae	3	*Corisella decolor*	2	*Ormosia sp.*	1
Dicrotendipes sp.	2	Undetermined Coenagrionidae	2	*Branchiura sowerbyi*	1
Trichocorixa calva	2	Calanoida	2	*Prostoma sp.*	1
Calanoida	2	*Physa sp./ Physella sp.*	2		72
Ophidonais serpentina	2	Nematoda	2		
Chironominae	1	*Hydropsyche californica*	1		
Parachironomus sp.	1	*Hydropsyche sp.*	1		
Polypedilum sp.	1	*Gammarus lacustris*	1		
Nanocladius sp.	1	*Ferrissia rivularis*	1		
Simulium sp.	1	*Nais communis/variabilis*	1		
Corisella decolor	1	*Ophidonais serpentina*	1		
Nematoda	1	*Branchiura sowerbyi*	1		
	263	*Limnodrilus hoffmeisteri*	1		
			143		

Lowest Taxa	TV	FFG	TOTAL
Corophium spinicorne	8	c	165
Corbicula fluminea	10	f	64
Paratanytarsus sp.	6	f	55
Undetermined Tubificidae	9	c	48
Cricotopus sp.	7	s	24
Eudistylia vancouveri	8	c	21
Undetermined Corixidae	10	p	16
Limnodrilus hoffmeisteri	9	c	15
Cricotopus bicinctus	7	c	13
Prostoma sp.	8	c	9
Hydropsyche californica	4	f	4
Calanoida	8	c	4
Nanocladius sp.	3	s	3
Corisella decolor	10	p	3
Undetermined Hydropsychidae	4	f	3
Daphniidae	8	c	3
Gammarus lacustris	4	c	3
Nematoda	5	p	3
Ophidonais serpentina	8	c	3
Chironominae	6	c	2
Dicrotendipes sp.	8	c	2
Trichocorixa calva	10	p	2
Undetermined Coenagrionidae	9	p	2
Physa sp./ Physella sp.	8	g	2
Branchiura sowerbyi	10	c	2
Parachironomus sp.	10	p	1
Polypedilum sp.	6	s	1
Simulium sp.	6	f	1
Ormosia sp.	3	c	1
Hydropsyche sp.	4	f	1
Ferrissia rivularis	6	g	1
Nais communis/variabilis	9	c	1
			478

Salt Slough 3

Lowest Taxa	T1
Corbicula fluminea	23
Corophium spinicorne	15
Chironomus sp.	14
Paratanytarsus sp.	12
Undetermined Tubificidae	6
Undetermined Coenagrionidae	4
Physa sp./ Physella sp.	4
Cricotopus bicinctus	3
Undetermined Corixidae	3
Parachironomus sp.	2
Cricotopus sp.	2
Tanypus sp.	2
Simulium sp.	2
Hydropsyche californica	2
Eudistylia vancouveri	2
Dicrotendipes sp.	1
Harnischia sp.	1
Procladius sp.	1
Corisella decolor	1
	100

Lowest Taxa	T2
Hydropsyche californica	65
Corophium spinicorne	45
Cricotopus sp.	19
Paratanytarsus sp.	15
Cricotopus bicinctus	8
Polypedilum sp.	6
Simulium sp.	6
Chironomus sp.	5
Dicrotendipes sp.	5
Tanypus sp.	5
Undetermined Tubificidae	5
Harnischia sp.	3
Physa sp./ Physella sp.	3
Undetermined Corixidae	1
Ischnura sp.	1
Undetermined Coenagrionidae	1
Hydroptila sp.	1
Megadrile	1
	195

Lowest Taxa	T3
Corophium spinicorne	155
Cricotopus sp.	32
Paratanytarsus sp.	26
Physa sp./ Physella sp.	17
Polypedilum sp.	13
Ferrissia rivularis	10
Undetermined Coenagrionidae	7
Hydropsyche californica	4
Endotribelos sp.	2
Simulium sp.	2
Corbicula fluminea	2
Gammarus lacustris	2
Ancylidae	2
Nematoda	2
Slavina appendiculata	2
Berosus styliferus	1
Dicrotendipes sp.	1
Endochironomus sp.	1
Cricotopus bicinctus	1
Ablabesmyia sp.	1
Corisella decolor	1
Undetermined Corixidae	1
Daphniidae	1
Undetermined Tubificidae	1
Branchiura sowerbyi	1
Limnodrilus hoffmeisteri	1
	289

Lowest Taxa	TV	FFG	TOTAL
Corophium spinicorne	8	c	215
Hydropsyche californica	4	f	71
Paratanytarsus sp.	6	f	53
Cricotopus sp.	7	s	53
Corbicula fluminea	10	f	25
Physa sp./ Physella sp.	8	g	24
Chironomus sp.	10	c	19
Polypedilum sp.	6	s	19
Cricotopus bicinctus	7	c	12
Undetermined Coenagrionidae	9	p	12
Undetermined Tubificidae	9	c	12
Simulium sp.	6	f	10
Ferrissia rivularis	6	g	10
Dicrotendipes sp.	8	c	7
Tanypus sp.	10	p	7
Undetermined Corixidae	10	p	5
Harnischia sp.	6	c	4
Endotribelos sp.			2
Parachironomus sp.	10	p	2
Corisella decolor	10	p	2
Gammarus lacustris	4	c	2
Ancylidae			2
Nematoda	5	p	2
Slavina appendiculata	7	c	2
Eudistylia vancouveri	8	c	2
Berosus styliferus	5	g	1
Endochironomus sp.	10	s	1
Ablabesmyia sp.	8	p	1
Procladius sp.	9	p	1
Ischnura sp.	9	p	1
Hydroptila sp.	6	g	1
Daphniidae	8	c	1
Branchiura sowerbyi	10	c	1
Limnodrilus hoffmeisteri	9	c	1
Megadrile	5	c	1
			584

Salt Slough 4

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Cricotopus sp.	63	*Cricotopus sp.*	70	*Paratanytarsus sp.*	42
Paratanytarsus sp.	50	*Paratanytarsus sp.*	63	*Cricotopus sp.*	39
Ferrissia rivularis	33	*Nais communis/variabilis*	59	*Physa sp./ Physella sp.*	30
Ophidonais serpentina	16	*Cricotopus bicinctus*	19	Undetermined Tubificidae	24
Cricotopus bicinctus	15	*Physa sp./ Physella sp.*	14	Daphniidae	23
Undetermined Tubificidae	15	*Dicrotendipes sp.*	11	*Cambarincola sp.*	21
Parachironomus sp.	10	*Slavina appendiculata*	8	*Corisella decolor*	19
Physa sp./ Physella sp.	8	*Corbicula fluminea*	6	Undetermined Corixidae	13
Nais communis/variabilis	8	Daphniidae	6	*Dicrotendipes sp.*	6
Dicrotendipes sp.	7	*Limnophyes sp.*	5	*Parachironomus sp.*	6
Chironomus sp.	6	*Ferrissia rivularis*	5	*Corbicula fluminea*	5
Simulium sp.	6	*Eudistylia vancouveri*	5	*Eudistylia vancouveri*	5
Slavina appendiculata	5	*Polypedilum sp.*	4	*Nais communis/variabilis*	4
Corbicula fluminea	4	Undetermined Corixidae	4	*Limnodrilus hoffmeisteri*	4
Prostoma sp.	4	Undetermined Tubificidae	4	*Chironomus sp.*	3
Ablabesmyia sp.	3	*Parachironomus sp.*	3	*Slavina appendiculata*	3
Daphniidae	3	Chironominae	2	*Prostoma sp.*	3
Limnodrilus hoffmeisteri	3	*Chironomus sp.*	2	*Cricotopus bicinctus*	2
Eudistylia vancouveri	3	*Corisella decolor*	2	*Hydropsyche californica*	2
Chironominae	2	Undetermined Coenagrionidae	2	*Cladotanytarsus sp*	1
Polypedilum sp.	2	Nematoda	2	*Tanypus neopunctipennis*	1
Corisella decolor	2	*Prostoma sp.*	2	*Xenopelopia sp.*	1
Undetermined Corixidae	2	*Glyptotendipes sp.*	1	*Eristalis sp*	1
Trichocorixa sp.	2	*Ablabesmyia sp.*	1	*Simulium sp.*	1
Coenagrion/ Enallagma	2	*Trichocorixa calva*	1	Undetermined Coenagrionidae	1
Tanytarsini	1	*Corophium spinicorne*	1	*Centroptilum/Procloeon sp.*	1
Cladotanytarsus sp	1	*Ophidonais serpentina*	1	*Pacifasticus sp.*	1
Tanypus sp.	1		303	*Branchiura sowerbyi*	1
Hydropsyche californica	1			Megadrile	1
Pacifasticus sp.	1				264
Menetus opercularis	1				
Nematoda	1				
	281				

Lowest Taxa	TV	FFG	TOTAL
Cricotopus sp.	7	s	172
Paratanytarsus sp.	6	f	155
Nais communis/variabilis	9	c	71
Physa sp./ Physella sp.	8	g	52
Undetermined Tubificidae	9	c	43
Ferrissia rivularis	6	g	38
Cricotopus bicinctus	7	c	36
Daphniidae	8	c	32
Dicrotendipes sp.	8	c	24
Corisella decolor	10	p	23
Cambarincola sp.		p	21
Parachironomus sp.	10	p	19
Undetermined Corixidae	10	p	19
Ophidonais serpentina	8	c	17
Slavina appendiculata	7	c	16
Corbicula fluminea	10	f	15
Eudistylia vancouveri	8	c	13
Chironomus sp.	10	c	11
Prostoma sp.		c	9
Simulium sp.	6	f	7
Limnodrilus hoffmeisteri	9	c	7
Polypedilum sp.	6	s	6
Limnophyes sp.	8	c	5
Chironominae	6	c	4
Ablabesmyia sp.	8	p	4
Undetermined Coenagrionidae	9	p	3
Hydropsyche californica	4	f	3
Nematoda	5	p	3
Cladotanytarsus sp	6	f	2
Trichocorixa sp.	10	p	2
Coenagrion/ Enallagma	9	p	2
Pacifasticus sp.	6	c	2
Glyptotendipes sp.	10	s	1
Tanytarsini	6	f	1
Tanypus sp.	10	p	1
Tanypus neopunctipennis			1
Xenopelopia sp.			1
Eristalis sp			1
Trichocorixa calva	10	p	1
Centroptilum/Procloeon sp.	3	c	1
Corophium spinicorne	8	c	1
Menetus opercularis	7	g	1
Branchiura sowerbyi	10	c	1
Megadrile	8	c	1
			848

Salt Slough 5

Lowest Taxa	T1	Lowest Taxa	T2	Lowest Taxa	T3
Chironomus sp.	88	*Chironomus sp.*	180	*Chironomus sp.*	56
Undetermined Tubificidae	86	Undetermined Tubificidae	22	Undetermined Tubificidae	55
Physa sp./ Physella sp.	32	*Cricotopus sp.*	21	*Physa sp./ Physella sp.*	42
Cricotopus sp.	13	*Tanypus sp.*	16	*Glyptotendipes sp.*	36
Daphniidae	10	*Glyptotendipes sp.*	12	Daphniidae	22
Undetermined Corixidae	5	*Physa sp./ Physella sp.*	8	*Cricotopus sp.*	10
Glyptotendipes sp.	4	Daphniidae	5	*Paratanytarsus sp.*	9
Tanypus sp.	3	Undetermined Corixidae	4	Cyclopoida	7
Eudistylia vancouveri	3	*Paratanytarsus sp.*	3	*Nais communis/variabilis*	5
Undetermined Coenagrionidae	2	*Procladius sp.*	3	Undetermined Corixidae	3
Slavina appendiculata	2	Undetermined Coenagrionidae	3	Undetermined Coenagrionidae	3
Limnodrilus hoffmeisteri	2	*Parachironomus sp.*	2	*Goeldichironomus sp.*	2
Cladotanytarsus sp	1	Cyclopoida	2	Nematoda	2
Hydropsyche californica	1	Chironomini	1	*Liodessus obscurellus*	1
Calanoida	1	*Goeldichironomus sp.*	1	*Parachironomus sp.*	1
Cyclopoida	1	*Corisella decolor*	1	*Cladotanytarsus sp*	1
	254	*Ischnura sp.*	1	*Procladius sp.*	1
			285	*Ischnura sp.*	1
				Limnodrilus hoffmeisteri	1
				Prostoma sp.	1
					259

Lowest Taxa	TV	FFG	TOTAL
Chironomus sp.	10	c	324
Undetermined Tubificidae	9	c	163
Physa sp./ Physella sp.	8	g	82
Glyptotendipes sp.	10	s	52
Cricotopus sp.	7	s	44
Daphniidae	8	c	37
Tanypus sp.	10	p	19
Paratanytarsus sp.	6	f	12
Undetermined Corixidae	10	p	12
Cyclopoida	8	c	10
Undetermined Coenagrionidae	9	p	8
Nais communis/variabilis	9	c	5
Procladius sp.	9	p	4
Goeldichironomus sp.	6	c	3
Parachironomus sp.	10	p	3
Limnodrilus hoffmeisteri	9	c	3
Eudistylia vancouveri	8	c	3
Cladotanytarsus sp	6	f	2
Ischnura sp.	9	p	2
Nematoda	5	p	2
Slavina appendiculata	7	c	2
Liodessus obscurellus	5	p	1
Chironomini	6	c	1
Corisella decolor	10	p	1
Hydropsyche californica	4	f	1
Calanoida	8	c	1
Prostoma sp.		c	1
			798