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R2 Resource Consultants, Inc

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Prepared for:

Bureau of Indian Affairs
Portland, Oregon

Prepared by:

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EXECUTIVE SUMMARY

Streams within the Upper Klamath Basin (UKB), Oregon support populations of a variety of fish species, six of special interest to resource agencies and the Klamath Tribes owing to their current, historic and/or cultural importance. These include three sucker species; Lost River sucker (*Deltistes luxatus*), shortnose sucker (*Chasmistes brevirostris*), and Klamath largescale sucker (*Catostomus snyderi*); and two salmonid species; redband trout (*Oncorhynchus mykiss)* and bull trout (*Salvelinus confluentus*). In addition, Chinook salmon (*O. tshawytscha*) and steelhead trout (*O. mykiss*) were historically present within the basin. Studies have been conducted to evaluate factors responsible for fish population declines so that appropriate recovery measures can be prescribed. Of equal importance is the identification and understanding of factors that serve to promote population sustainability, such as special habitats and/or water quality conditions that may serve as refugia under periods of climatologically and anthropogenically induced extremes. R2 Resource Consultants (R2), working under contract to the Bureau of Indian Affairs, has conducted Physical Habitat Simulation (PHABSIM) studies of selected streams in the UKB to develop flow - habitat relationships. Streams sampled have included both run-off dominated streams (RDS) such as the Sprague, Sycan and upper Williamson rivers, as well as a number of spring-dominated streams (SDS) including Wood River, Fort Creek, Spring Creek and Crooked Creek. In addition to monitoring flow and water temperature, fish microhabitat data related to adult holding, juvenile rearing, and spawning habitat have likewise been collected. The results of those studies have served to highlight some of the unique characteristics of SDS systems including those related to water quality (temperature constancy), flow variability (flow constancy), and channel morphology.

In this study, we were interested in comparing the biological communities in a subset of these systems and focused on benthic macroinvertebrates (BMI) since they are a part of the food web that links primary production to fish. We postulated that because of the differences in flow and temperature regimes between SDS and RDS systems, the BMI communities would likewise differ. We were interested in identifying these differences and their potential biological significance relative to the sustainability of fish populations in streams in the UKB. We selected nine streams for macroinvertebrate sampling in the UKB: five SDS (Wood River, Fort Creek, Crooked Creek, Spring Creek and Larkin Creek) and four RDS (lower Sprague River, Demming Creek, Long Creek and Trout Creek). Quantitative sampling efforts were based on a Level 3 Assessment described in Oregon's Stream Macroinvertebrate Protocol (OWEB 1999). Four replicate kick samples and one qualitative sample were collected in each stream using a D-frame kick-net with 500-µm Nitex mesh. Sample processing consisted of: 1) sample preparation through elutriation, 2) subsampling, and 3) a large-rare organism sort, and 4) specimen identification and enumeration. Laboratory protocols outlined by Oregon's Stream Macroinvertebrate Protocol (OWEB 1999) and the Environmental Protection Agency's Rapid Bioassessment Protocol (EPA-RBP, Barbour et al. 1999) were used to process the macroinvertebrate samples. The following metrics and indices were calculated for each kick sample: density, taxa richness, EPT richness, diversity, evenness, modified Hilsenhof Biotic Index, percent dominant taxa, community composition, and functional feeding group composition. A total of 134 taxa were collected during the study.

Study results revealed distinct taxonomic differences between SDS and RDS systems. Overall, the BMI communities in the SDS were lower in taxa richness, EPT richness measures, and diversity, and showed an increased dominance of non-insects in community compositions, compared to the RDS sites. One of the most dominant non-insect taxa, the hydrobiid pebblesnail or "spring snail," *Fluminicola*, was abundant in several SDS, but absent from nearly all RDS, with the exception of lower Sprague River. In the stonefly family Perlidae, SDS were populated with *Hesperoperla pacifica*, averaging from about 3 to 968 individuals/m^2. Run-off streams recorded only one sample with *Hesperoperla pacifica* (at SY8), but were abundant with another perlid, *Doroneuria*, not found in the SDS. In UKB SDS, 11 species of pebblesnails (*Fluminicola*) have been found to be endemic to the basin, three of which have been designated as Record of Decision (ROD) 1994 Survey and Manage freshwater mollusk taxa under the Northwest Forest Plan (Frest and Johannes 1999). Each SDS displayed some uniqueness setting it apart from most other sites. The Wood River site displayed the highest mean percent abundances of Ephemeroptera and Trichoptera, the lowest mean HBI score of the study, and the highest diversity and evenness of the SDS. The highest mean densities of *Hesperoperla pacifica* were collected in Crooked Creek (968 individuals/m^2) and Fort Creek (330 individuals/m^2). In addition, Fort Creek was one of two sites (the other being Demming Creek) where the apatanid caddisfly *Pedomoecus sierra* was collected. Larking Creek was unique in that it was the only site in the study where *Margaritifera falcata*, the Western Pearlshell mussel, was found. Sampling in Spring Creek revealed the largest population of the perlid *Rickera sorpta* (983 individuals/m^2) in the study, and overall contained the highest density of organisms of all sites with 41,797 individuals/m^2.

This study has shown that each of the SDS contain unique assemblages of BMI organisms that likely exist due in large part to prevailing stable flow and temperature conditions. These same systems afford important rearing and refuge habitats for native fish populations during periods of flooding, drought and low flow conditions, and during periods of elevated stream temperatures. Given the unique characteristics of the SDS, we believe that anthropogenic actions that result in hydrologic modifications should be avoided or minimized. Such actions may serve to decouple ecologically sensitive linkages and disrupt food-webs thereby impacting regional patterns of biodiversity that threaten the overall survival of native fish populations dependent on these spring-dominated systems.

1. INTRODUCTION

Since 1991, the Bureau of Indian Affairs (BIA) has been working cooperatively with the Klamath Tribes in evaluating the instream flow needs of important fish species in major streams and rivers within the Upper Klamath Basin (UKB), Oregon. This work has included studies to define and prescribe instream flow claims, evaluate riparian habitat-flow relationships, collect and analyze fish microhabitat use information, and assess selected water quality characteristics. The work included the development of 45 instream flow recommendations that pertain to 22 streams in the UKB.

Streams within the Upper Klamath Basin (UKB), Oregon support populations of a variety of fish species, six of special interest to resource agencies and the Klamath Tribes owing to their current, historic and/or cultural importance. These include three sucker species; Lost River sucker (*Deltistes luxatus*), shortnose sucker (*Chasmistes brevirostris*), and Klamath largescale sucker (*Catostomus snyderi*); and two salmonid species; redband trout (*Oncorhynchus mykis)* and bull trout (*Salvelinus confluentus*). In addition, Chinook salmon (*O. tshawytscha*) and steelhead trout (*O. mykiss*) were historically important but were presumably extirpated from the basin due to downstream dams on the lower Klamath Basin (Hamilton et al. 2005). Of the fish species currently using the UKB, two (shortnose sucker and Lost River sucker) are listed as endangered and one (bull trout) as threatened under the federal Endangered Species Act (ESA). Adfluvial stocks of redband trout that utilize the Upper Klamath Lake (UKL) and its tributaries are also of special importance since they provide a regionally popular high quality sport-fishery. Studies have been and are continuing to be conducted to evaluate factors responsible for population declines so that appropriate recovery and protective measures can be prescribed and implemented. Of equal importance is the identification and understanding of factors or conditions that serve to protect or promote population sustainability of these species, such as special habitats and/or water quality characteristics that may serve as habitat refugia under periods of climatologically and anthropogenically induced extremes.

Because many of the streams and rivers in the UKB have been severely degraded due to livestock grazing and irrigation withdrawals, the availability of refuge habitats becomes even more important relative to maintaining population viability. In the UKB, there are a number of relatively large spring-dominated streams that have been and continue to be used by fish populations. These include streams both tributary to other rivers, as well as a number of springs that directly enter UKL (e.g., Harriman, Ouxy, Odessa, and others). Reiser et al. (2004) reviewed major differences between spring-dominated (SDS) and run-off dominated streams (RDS) noting that stability of flow and temperature are the two characteristics most often associated with SDS systems. Several other ecosystem attributes often associated with SDS may also be different from RDS systems including pH, nutrient levels, dissolved gasses, invertebrate community diversity and abundance, fish community composition, aquatic macrophytes, and riparian plants. This can occur even when such systems share common topographic, geologic and climatologic characteristics. Because ecosystem characteristics may vary between spring- and runoff-dominated streams, the effects of altered flow regimes may also be quite different. Reiser et al. (2004) postulated that the unique combination of physical, hydraulic, chemical and biological characteristics of SDS render them more susceptible to impacts associated with flow abstraction than RDS systems.

R2 Resource Consultants (R2), working under contract to the BIA, has conducted a hydrological analysis of streams in the UKB and has coupled this with Physical Habitat Simulation (PHABSIM) studies of selected streams to develop flow:habitat relationships. These have included both RDS such as the Sprague, Sycan and upper Williamson rivers, as well as a number of SDS including Wood River, Fort Creek, Spring Creek and Crooked Creek. In addition to monitoring flow and water temperature, fish microhabitat data related to adult holding, juvenile rearing, and spawning habitat have likewise been collected on a number of these streams. The results of those studies have served to highlight some of the unique characteristics of SDS systems including those related to water quality (temperature constancy), flow variability (flow constancy), and channel morphology.

In this study, we were interested in comparing the biological communities of these systems and focused on benthic macroinvertebrates (BMI) since they are a part of the food web that links primary production to fish. We postulated that because of the differences in flow and temperature regimes between SDS and RDS systems, the BMI communities would likewise differ. We were interested in identifying these differences and their potential biological significance relative to the sustainability of fish populations in streams in the UKB.

Specific study objectives were to:

- Collect and analyze BMI samples from representative SDS and RDS systems in the UKB;
- Collect ancillary water quality data from these same systems;
- Statistically compare metrics between the SDS and RDS systems; and to the extent possible;
- Relate findings to fluvial characteristics of these systems.

2. STUDY AREA

The Upper Klamath Basin (UKB) is located on the eastern side of the Cascade Mountains in south-central Oregon. Three major streams drain the basin - the Williamson, Sprague, and Wood rivers (Figure 1). Numerous streams in the UKB are dominated by flow from cold water springs. Spring-dominated streams are especially common in the Wood River basin including Wood River, Fork Creek, and Crooked Creek along the east side of the basin and Four-mile, Crystal, and Recreation creeks along the west side of the basin. In the Williamson River basin, the upper Williamson River and Spring Creek emerge from large springs, and smaller tributaries such as Irving and Larkin creeks are also spring-dominated.

The hydrologic source of springs in the UKB is ultimately the high amount of precipitation falling mainly as snow in the Cascade Mountains, which form the western rim of the two basins. Additionally, there are high elevation areas in the eastern portion of the UKB (Yamsay and Gearhart mountains) that intercept moisture and receive relatively high amounts of snow. Annual precipitation averages 1720 mm at Crater Lake, which is located at the crest of the Cascade Mountains on the western edge of the UKB. The complex volcanic geology of the Cascade Mountains in Oregon is characterized by highly porous pumice surfaces and fractured basaltic bedrock. Snowmelt rapidly infiltrates into soils, collects in fissures within the volcanic strata, and ultimately discharges along faults where water-bearing fissures are exposed. Some of these springs (Spring Creek, Wood River, Metolius River) are among the largest springs in the United States, with discharges exceeding 200 cubic feet second (cfs) (Meinzer 1927).

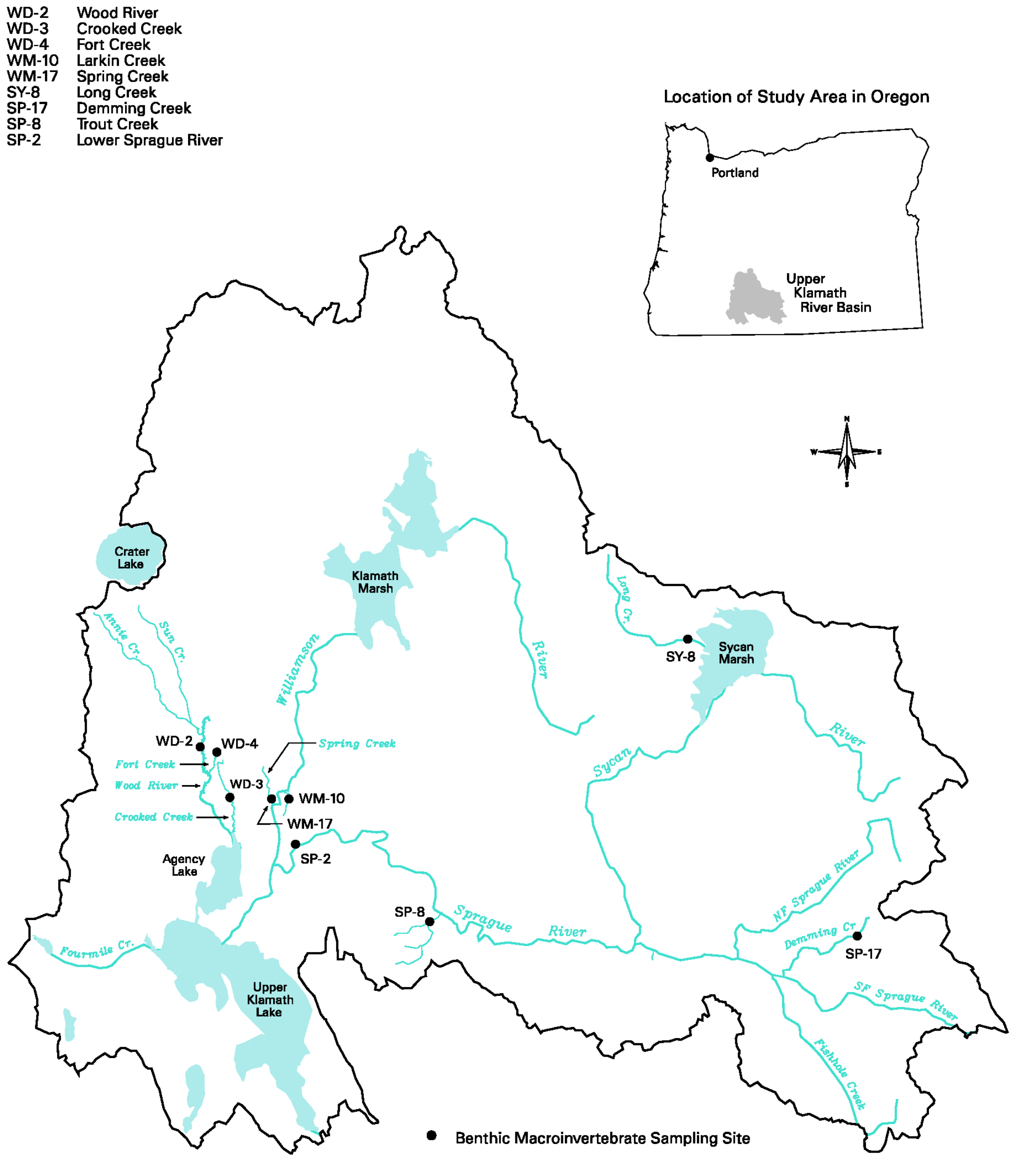

Figure 1. Location map of the nine streams sampled for benthic macroinvertebrates in the Upper Klamath Basin, Oregon, September 1-2, 2004.

3. SAMPLING SITES

We selected nine streams for macroinvertebrate sampling in the UBK: five SDS and four RDS (Figure 1, Table 1). To provide a linkage to instream flow needs of fish and aquatic biota in streams within the basin, the streams selected were also known to provide important adult spawning and juvenile rearing habitat for adfluvial, fluvial and resident redband trout, and in the case of Demming Creek, for bull trout as well. For spring-dominated streams, we selected Wood River, Fort Creek, and Crooked Creek from the Wood River basin (Figure 2); and Spring Creek and Larkin Creek from the Williamson River basin (Figure 3). For RDS, we established sampling sites on the Lower Sprague River and two of its tributaries, Trout Creek and Demming Creek (Figure 4). Our fourth run-off site was located on Long Creek in the Sycan River watershed (Figure 5). A further consideration in the selection of sites was that Reiser et al. (2004) had made an earlier comparison of annual flow and temperature patterns between representative spring-dominated (Fort Creek and Crooked Creek), and run-off dominated (Sprague River and Long Creek) streams and we therefore wanted to sample those same systems.

Table 1. Upper Klamath Basin streams sampled for macroinvertebrates, with physical and water quality data.

			Physical			Water Quality			
Watershed	**Stream**	**Site Code**	**Width (ft)**	**Max. Depth (ft)**	**Dominant Substrate**	**Temp (ºC)**	**pH**	**D.O. (mg/L)**	**SpCond (mS/cm)**
Wood	Wood River	WD-2	49.0	2.40	Fine/Coarse Gravel	7.28	7.38	10.99	0.085
Wood	Crooked Creek	WD-3	31.2	3.18	Coarse Gravel/Sand	9.67	8.16	9.45	0.105
Wood	Fort Creek	WD-4	67.1	1.40	Coarse Gravel/Sand	8.43	7.78	10.51	0.094
Williamson	Larkin Creek	WM-10	8.8	0.57	Coarse/Fine Gravel	18.16	7.48	6.71	0.090
Williamson	Spring Creek	WM-17	115.1	2.85	Coarse/Fine Gravel	8.64	7.75	11.18	0.070
Sprague	Lower Sprague River	LSpr	143.0	1.80	Cobble/Coarse Gravel	15.88	8.18	8.40	0.117
Sprague	Trout Creek	SP-8	10.2	0.57	Coarse Gravel/Cobble	9.78	7.92	10.66	0.100
Sprague	Demming Creek	SP-17	6.8	0.60	Coarse Gravel/Cobble	8.36	7.47	9.54	0.056
Sycan	Long Creek	SY-8	15.6	1.35	Fine/Coarse Gravel	12.11	7.84	9.36	0.051

Figure 2. Spring-fed streams sampled from the Wood River basin, Oregon, September 1, 2004: Wood River (WD2, upper), Crooked Creek (WD3, middle), and Fort Creek (WD4, lower).

Figure 3. Spring-fed streams sampled from the Williamson River basin, Oregon, September 1, 2004: Larkin Creek (WM10, upper) and Spring Creek (WM17, lower).

Figure 4. Run-off dominated streams sampled from the Sprague River basin, Oregon, September 2, 2004: Lower Sprague River (LSpr, upper), Trout Creek (SP8), and Demming Creek (SP17, lower).

Figure 5. Long Creek (SY8), a run-off dominated stream sampled from the Sycan River basin, Oregon, September 2, 2004.

4. METHODS

4.1 FIELD METHODS

Quantitative sampling efforts were based on a Level 3 Assessment described in Oregon's Stream Macroinvertebrate Protocol (OWEB 1999). Four replicate kick samples were collected in each stream using a D-frame kick-net with 500-µm Nitex mesh. Sampling locations were randomly selected, but were confined to riffle habitat, with water depths no greater than 46 cm (1.5 ft) and current velocities between 30.5 and 91.4 cm per second (1.0-3.0 ft per second) to reduce intersample variability.

Sampling was conducted moving upstream, so as not to disturb the substrate to be sampled. Selected locations were measured for depth, current velocity, and substrate composition, which were recorded in a field notebook. In addition, basic water quality measurements were taken at each stream site with a Hydrolab Quanta multiparameter water quality meter. Temperature (ºC), dissolved oxygen (DO) and percent saturation, pH, and specific conductance were measured and recorded in a field notebook for each stream site.

Once a location was selected, the kick net was then positioned immediately downstream of the selected location and an area measuring 1 ft wide and 2 ft long (2 ft^2 or 0.18 m^2) was vigorously kicked for a period of at least one minute. All large substrate within the kick-area was then hand-scrubbed to dislodge remaining organisms. The contents of the net were emptied into a large 500-µm stainless-steel sieve, rinsed, and washed into a 500-ml wide-mouth Nalgene jar with a wash bottle containing 95% Dehydrant (an isopropyl-alcohol/ethanol mixture). Any insects clinging to the kick net and sieve were transferred to the sample jar with forceps before filling the container to capacity with alcohol.

Kick samples were not combined into composite samples for each site, as recommended in Oregon's Stream Macroinvertebrate Protocol (OWEB 1999), but remained separate in order to allow for stronger independent statistical analyses among streams. A paper label (standard label hereafter) defining the date, stream name, sample number, and collector initials was added to the sample. The same information was also applied to the lid of the sample jar with an alcohol-proof/waterproof marker.

A fifth, qualitative sample, referred to hereafter as the "hand collection," was also collected at each stream site. Additional habitats, such as streamside vegetation, overhanging banks, woody debris, and backwater areas, were sampled with a D-net for approximately 10 minutes.

Collected material was emptied into a large, white pan and sorted for macroinvertebrates for 20 minutes. Total quantitative effort was therefore approximately 30 minutes. Organisms were placed in a 60-ml Nalgene bottle filled with 95% Dehydrant, which was labeled with the standard sample information.

4.2 LABORATORY METHODS

Upon completion of field collection efforts, all samples were transported to the laboratory for processing. Sample processing consisted of: 1) sample preparation through elutriation, 2) subsampling, and 3) a large-rare organism sort, and 4) specimen identification and enumeration. Laboratory protocols outlined by Oregon's Stream Macroinvertebrate Protocol (OWEB 1999) and the Environmental Protection Agency's Rapid Bioassessment Protocol (EPA-RBP, Barbour et al. 1999) were used to process the macroinvertebrate samples.

Samples were first rinsed through a 500-µm sieve, to remove the preservative fluid and fine sediments. The sample was then transferred to a bucket, and the material was elutriated to separate the organic material and invertebrates from the non-organic sediments. Large organic material was removed from the sample after being washed and examined closely for attached invertebrates. The remaining organics and invertebrates were then returned to the sample jar. Next, the flushed sediment component was scanned for invertebrate specimens using a magnifier lamp (x3). Specimens were returned to the sample jar for subsampling. Flushed gravels and sands were placed in a 250-ml bottle, labeled, preserved with 95% Dehydrant, and stored for later QA/QC assessment.

A Caton subsampling tray (Caton 1991) was used to acquire a 250-organism fixed-count (±20%) subsample. All invertebrates were removed from debris with the aid of a dissecting microscope (x 7-45), and sorted into major taxonomic groups. Sorted debris was retained in a labeled, 60-ml bottle and stored for later QA/QC assessment. At the conclusion of the subsampling effort, a large-rare organism sort was performed on the unsorted portion of the sample to sort taxa that were not accurately represented in the sorted grids. This step is included in methods employed by the U.S. Geological Survey's National Water Quality Laboratory Biological Group (Moulton et al. 2000).

All invertebrates were then identified using appropriate taxonomic keys (Adams 2004, Merritt and Cummins 1996, Stewart and Stark 2002, Thorp and Covich 2001, Wiggins 1996) and enumerated. Large-rare organisms were tabulated separately from the subsample results. Insects were identified to the lowest practical taxonomic level, usually genus or, in some cases, species. Exceptions were the family Chironomidae (midge flies), which require additional specimen preparation for identifications lower than family, and immature and damaged specimens. Non-insects were identified to the lowest practical taxon (class, order, family, or genus).

Ten percent of the kick samples were re-sorted to determine the sorting efficiency. For this procedure, the processed detritus from a sample was obtained and sorted under a dissecting microscope at 12x magnification. All invertebrates were removed from the debris, identified, and enumerated. The target for a sample's sorting efficiency was 90% or better. If a sample failed, then an additional 10% of the samples were re-sorted. Percent sorting efficiency of the original samples was calculated as:

$$efficiency = \frac{A_o}{A_o + A_b}$$

where A_o is the abundance in the original sorting of the sample and A_b is the abundance of the re-sorted portion.

4.3 DATA ANALYSIS

The taxonomic composition of each sample was used to generate a taxa-abundance matrix representing all samples. Before the data were used to generate metric scores, large-rare organisms were combined with the subsample counts. In order to do this, large-rare counts were multiplied by the proportion of the sample that was subsampled. For example, if a large-rare sort retrieved 10 *Pteronarcys* stoneflies in a sample which required a 10% subsample, then 10 x 10% = 1 stonefly would be added to the subsample data.

After combining the components of each sample, the matrix was then adjusted for different levels of taxonomy. When identifying macroinvertebrates, some specimens were either too immature or too damaged for identification at the genus-level, and therefore could only be assigned to a taxonomic family or order. For instance, a sample may contain individuals identifiable only to the caddisfly family Hydropsychidae, yet also contain individuals clearly identified to one or more genera within this family (e.g., *Hydropsyche* sp., *Cheumatopsyche* sp.). This situation can lead to inflated estimates of the number of taxa in a sample.

To prevent the inflation of metrics, the abundances of these "parent" taxa were distributed proportionately among their composite taxa. This apportioning is similar to the method used by the USGS NAWQA studies to correct for "ambiguous taxa" (Cuffney et al. 1997). The abundances of “parent” taxa (orders, families) were retained in analysis when there were no composite taxa identified in the sample.

After applying the corrective measures used in preparing the taxa-abundance matrix, the data were used to calculate several descriptive metrics commonly used in aquatic ecological studies. The following metrics and indices were calculated for each kick sample collected in the Upper Klamath basin streams:

Density – The total number of individuals collected in a unit area. Subsample enumerations were expanded to provide a density estimate (individuals/m^2) for each sample. Density may be reduced by environmental disturbances, or elevated if a disturbance provides resources for tolerant organisms. However, density is subject to a large amount of natural variability and is sometimes considered an insensitive indicator of disturbance.

Taxa Richness – The number of different types, or taxa, of invertebrates occurring in a given ecosystem or sample. It is usually not as variable as density and typically is depressed in disturbed environments. It is important to discern the two different taxa richness values generated for this report:

The *mean taxa richness* is the average number of taxa collected from the four samples collected at a site, not the site’s total taxa richness. By averaging the taxa richness of the samples, the influence of rare taxa is minimized, thus reducing the taxa richness score.

The *total taxa richness* for a site is simply a tally of all taxa collected at a site, utilizing all four samples. Thus, the occurrence of rare taxa is given a weight equal to common taxa. As a result, total taxa richness indicates larger estimates of taxa richness than mean taxa richness. While total taxa richness may not lend itself to statistical analysis in the short-term study, it does provide yet another measure of contrast between sites, and may become statistically useful in a long-term program.

EPT Richness – The number of taxa from the insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These orders are generally considered pollution sensitive and values are usually depressed in disturbed ecosystems. Following protocols from numerous state and federal agencies, taxa richness values were calculated separately for each order.

Diversity – We calculated the Shannon-Wiener diversity index (H') according to the formulas in Ludwig and Reynolds (1988), using natural logarithms. Diversity incorporates the number of taxa and their relative abundances and usually decreases with decreasing water quality.

Evenness – We calculated evenness (J') according to Pielou (1975). Community evenness is a numerical representation of the relative abundance of all taxa. If all taxa collected from an environment had exactly the same abundance, evenness would equal 1. Conversely, evenness values approaching zero are indicative of communities lacking an equitable distribution of taxa. Typically, disturbance causes a decrease in the evenness of aquatic communities.

Modified Hilsenhoff Biotic Index – The modified Hilsenhoff Biotic Index (HBI; Hilsenhoff 1987) uses the relative organic pollution tolerance of all taxa and their relative abundances to assign a numerical value to aquatic communities. This value ranges between 0 and 10, with lower values indicative of a community dominated by highly sensitive organisms and high values indicative of dominance by pollution-tolerant organisms. The HBI is calculated as:

$$HBI = \sum \frac{x_i t_i}{n}$$

where x_i is the number of individuals within a given taxa, t_i is the tolerance value for the given taxa, and n is the total number of individuals in the sample. Tolerance values used for this study were obtained from Oregon’s Stream Macroinvertebrate Protocol (OWEB 1999).

Percent Dominant Taxa – The percent contribution of the numerically dominant taxon to the total number of invertebrates in a sample. Disturbances usually cause the abundance of a few taxa to increase and an elevation of the percent dominance of the most abundant taxon.

Community Compositions – The relative abundance of major taxonomic groups provides information on a stream community’s structure and the relative contribution of the populations to the total fauna (Barbour et al. 1999). Eight major taxonomic groups were used to describe the community structure in our analysis: Ephemeroptera, Plecoptera, Trichoptera, Coleoptera (beetles), Chironomidae (midges), Diptera (true flies other than midges), Other Insects, and Non-insects. Composition measures of certain taxonomic groups are often used as indicators of impairment in streams. For example, an increase in the relative abundance of Chironomidae or non-insect taxa, or a decrease in the relative abundance of Plecoptera or Trichoptera, may indicate environmental stress in a stream.

Functional Feeding Group compositions – The major functional-feeding groups used in our analysis were: collector-gatherers, collector-filterers, scrapers, shredders, predators, and parasites as defined by Merritt and Cummins (1996). All other functional feeding groups were consolidated into a sixth group, "Others." Aquatic invertebrate taxa abundances were allocated into functional-feeding group categories based on their preferred methods of gathering food, based on determinations by Wisseman and Doughty (2004) and Barbour et al. (1999). We then calculated the proportional contribution of invertebrates from different functional feeding group categories to the total abundance for each sample.

Some disturbances may cause shifts in the overall trophic function of aquatic ecosystems by affecting an invertebrate food source. For example, if a disturbance increased the availability of suspended organic particles, several taxa from the collector-filterer group might respond by expressing increased success (survival, biomass, fecundity, etc.). Due to the proportional nature of this analysis, increases in the contribution of one group are accompanied by decreases in contribution of other groups.

Using the NCSS 2001 statistical program (Hintze 1999), one-way ANOVAs were performed on each metric to look for an overall significant difference among sites. If a "site" effect was significant ($p \leq 0.05$) for the metric, then a Tukey-Kramer multiple comparison test was used to describe which sites were significantly different from each other. Assumptions of normality and equal variance were also tested with each ANOVA. In the event of the data violating an assumption, the data were first transformed (either log+1 or square root) for site's metric scores. If the data still failed tests of normality, the data set was analyzed with a Kruskal-Wallis one-way ANOVA on ranks, followed by a Kruskal-Wallis multiple comparison z-value test. If the data failed the modified-Levene-equal-variance test, a series of unequal-variance-two-sample t-tests were utilized to test for significant differences.

5. RESULTS

A total of 36 macroinvertebrate kick samples were collected in five SDS and four RDS in the UKB on September 1-2, 2004. Sample sorting efficiency checks performed on the sorted debris of 10% of the samples (i.e., 4 samples), revealed an average percent efficiency rate of 95.7%, well above the desired 90% efficiency level.

A total of 108 separate taxa were collected in the semi-quantitative kick samples, with an additional 26 taxa contributed by hand-collection efforts, for a survey total of 134 separate taxa. A presence/absence list of taxa collected, both quantitatively and qualitatively, at each site is provided in Appendix A. Summary tables of mean metric values are given in Tables 2 and 3 for spring-dominated streams and in Tables 4 and 5 for RDS. Detailed results of each macroinvertebrate sample are provided in Appendix B.

General water quality conditions and physical characteristics measured at each site are summarized in Table 1. With the exception of Larkin Creek, all of the SDS had temperatures below 10^{o}C and dissolved oxygen concentrations > 9.45 mg/L. The water temperature in Larkin Creek was the highest of all sites (> 18^{o}C); Larkin Creek also possessed the lowest DO concentrations (6.7 mg/L). Larkin Creek clearly represented an SDS that was atypical of other SDS in the basin. Of the RDS systems, the Lower Sprague River site had the highest water temperature (15.88^{o}C) and lowest DO (8.4 mg/L) of all sites; Demming Creek had the lowest temperature (8.36^{o}C) of all sites.

5.1 DENSITY

Mean macroinvertebrate densities in SDS exhibited a wide range, from 4,216 individuals/m^2 at Wood River (WD2) to 41,797 individuals/m^2 at Spring Creek (WM17), whereas run-off streams had densities ranging from 15,181 individuals/m^2 at Lower Sprague River (LSpr) to 27,588 individuals/m^2 at Trout Creek (SP8) (Figure 6; Tables 2 and 4). One-way ANOVA tests reveal WD2 to be significantly lower in density than all RDS, and significantly lower than spring-dominated streams WM10 and WM17 ($p < 0.05$). Density estimates at WM17 were found to be significantly higher than all the other SDS, whereas RDS showed no significantly differences in densities.

Table 2. Mean metric values for spring-dominated streams sampled in the Upper Klamath Basin, Oregon, September 1, 2004.

Metric	**Wood River WD2**	**Crooked River WD3**	**Fort Creek WD4**	**Larkin Creek WM10**	**Spring Creek WM17**
Density (Individuals/m^2)	4,216	11,369	10,871	15,849	41,797
Taxa Richness (Mean / Total)	17.75 / 26	17 / 24	21.75 / 24	22.75 / 33	21.5 / 32
EPT Richness (Mean / Total)	10 / 16	6.75 / 10	9.5 / 11	9 / 15	10 / 14
Ephemeroptera Taxa (Mean / Total)	3.5 / 5	1.5 / 3	3 / 3	2 / 4	2.25 / 3
Plecoptera Taxa (Mean / Total)	3.75 / 5	2.25 / 3	3.25 / 4	4.5 / 6	3 / 5
Trichoptera Taxa (Mean / Total)	2.75 / 6	3 / 4	3.25 / 4	2.5 / 5	4.75 / 6
Shannon-Weiner Diversity (H')	2.20	1.81	1.92	1.94	2.02
Pielou's Evenness (J')	0.77	0.64	0.62	0.62	0.66
Modified HBI	3.45	4.87	5.26	4.76	5.02
% Dominant Taxon	29.2	39.6	38.9	36.7	34.7
Abundance by Functional Feeding Group (%):					
Collector-Gatherers	40.8	60.6	55.4	69.0	61.3
Collector-Filterers	0.2	0.3	0.2	3.6	0.1
Scrapers	37.4	20.2	26.8	14.4	18.9
Shredders	11.1	4.8	0.6	8.5	3.8
Predators	9.1	13.9	9.4	3.6	11.2
Parasites	1.2	0.3	7.3	0.3	3.5
Other FFGs	0.2	0.0	0.4	0.7	1.3

Table 3. Mean percent abundances for major taxonomic groups in spring-dominated streams sampled in the Upper Klamath Basin, Oregon, September 1, 2004.

Abundance by Taxonomic Group (%):					
Ephemeroptera	22.7	0.4	5.7	3.4	2.0
Plecoptera	16.8	14.8	5.4	12.4	7.4
Trichoptera	23.0	1.8	0.7	3.6	3.7
Coleoptera	5.3	5.5	2.4	21.0	7.7
Chironomidae	6.1	6.5	12.9	32.9	34.7
Other Diptera	12.0	2.2	3.9	4.4	0.7
Other insect	0.1	0.0	0.0	0.6	0.0
Non-insect	14.0	68.9	69.1	21.7	43.8

Table 4. Mean metric values for run-off dominated streams sampled in the Upper Klamath Basin, Oregon, September 2, 2004.

Metric	L. Sprague River LSpr	Trout Creek SP8	Demming Creek SP17	Long Creek SY8
Density (Individuals/m^2)	15,181	27,588	18,340	22,344
Taxa Richness (Mean / Total)	28 / 41	32.5 / 50	37.5 / 51	30.5 / 46
EPT Richness (Mean / Total)	10.25 / 17	16.25 / 22	21.75 / 31	17.75 / 24
Ephemeroptera Taxa (Mean / Total)	5.75 / 9	5.5 / 7	7.5 / 10	5.75 / 8
Plecoptera Taxa (Mean / Total)	0 / 0	3.75 / 5	6.25 / 8	5 / 7
Trichoptera Taxa (Mean / Total)	4.5 / 8	7 / 10	8 / 13	7 / 9
Shannon-Weiner Diversity (H')	2.35	2.19	2.90	2.29
Pielou's Evenness (J')	0.70	0.63	0.80	0.67
Modified HBI	5.15	4.17	3.82	4.69
% Dominant Taxon	35.0	35.1	15.4	34.0
Abundance by Functional Feeding Group (%):				
Collector-Gatherers	32.6	58.2	42.8	53.5
Collector-Filterers	18.4	2.5	2.9	5.8
Scrapers	39.8	19.4	23.0	11.0
Shredders	0.4	10.8	9.1	1.2
Predators	6.8	7.3	14.6	10.8
Parasites	1.5	1.2	7.5	16.8
Other FFGs	0.5	0.6	0.2	1.0

Table 5. Mean percent abundances for major taxonomic groups in run-off dominated streams sampled in the Upper Klamath Basin, Oregon, September 2, 2004.

Abundance by Taxonomic Group (%):				
Ephemeroptera	7.1	7.2	7.4	8.1
Plecoptera	0.0	14.7	12.3	5.1
Trichoptera	11.9	9.9	14.2	10.7
Coleoptera	10.2	23.2	14.5	9.7
Chironomidae	7.2	34.2	11.7	27.7
Other Diptera	7.9	6.2	20.5	8.2
Other insect	9.3	0.2	0.0	0.0
Non-insect	46.4	4.5	19.5	30.5

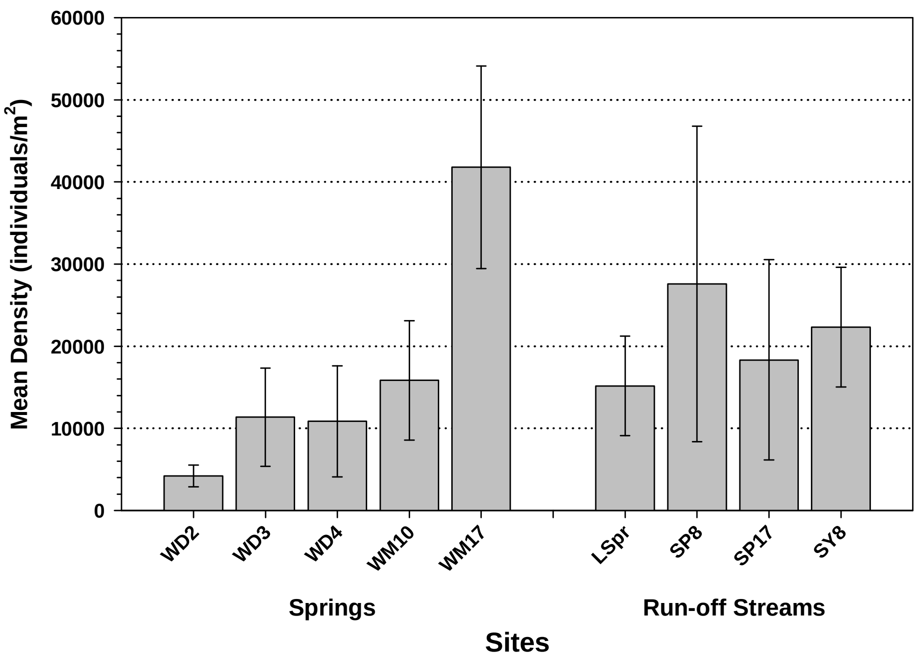

Figure 6. Mean density (individuals/m^2 ± 95% confidence interval) of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

5.2 TAXA RICHNESS MEASURES

Mean taxa richness for this study ranged from 10.5 taxa at Crooked River (WD3) to 37.5 taxa at Demming Creek (SP17) (Figure 7; Tables 2 and 4). Statistically, all SDS were significantly lower than the smaller run-off streams ($p < 0.00001$). Taxa richness at the Lower Sprague River site (LSpr) was only significantly higher than WD2 and WD3, and was significantly lower than SP17. Comparisons among only SDS showed Larkin Creek (WM10) had significantly more taxa than WD2 and WD3 ($p=0.002$), and that WD3 was also lower in taxa richness than WD4 and WM17.

Total taxa richness measures, compositing all four kicks at a site for one tally, showed a low of 24 taxa at both WD3 and WD4 and a high of 51 taxa at SP17 (Figure 7; Tables 2 and 4). Increased taxa richness resulting from the tallies ranged from 2.25 taxa at Fort Creek (WD4) to 17.5 taxa at SP8. SDS benefited from an average of 7.65 additional taxa, whereas RDS averaged an additional 14.88 taxa.

Mean EPT taxa richness measures ranged from 6.75 at WD3 to 21.75 at SP17 (Figure 8; Tables 2 and 4). A one-way ANOVA shows SDS were significantly lower in EPT richness than run-off streams, with the exception of LSpr, which was also significantly lower in EPT than other run-off streams ($p = 4.69 \times 10^{-4}$). EPT richness did not differ among SDS.

Total EPT richness resulted in a range of 10 taxa at WD3 to 31 at SP17, an addition of 1.5 to 9.25 taxa to the site's mean EPT numbers (Figure 8; Tables 2 and 4). Spring-fed streams benefited from an average of 4.15 additional taxa, whereas RDS averaged an additional 6.125 taxa.

Individual contributions of the EPT orders ranged from 0 for Plecoptera at LSpr to 13 Trichoptera taxa at SP17 (Figure 9; Tables 2 and 4). Run-off streams were significantly higher in the mean number of Ephemeroptera taxa than SDS, with only one exception (WD2 = SY8). For Plecoptera taxa richness, SP17 was significantly than most other sites, whereas LSpr was significantly lower (with no stoneflies collected) than all sites except WD3. In general, Trichoptera taxa richness was significantly higher for the smaller run-off streams (SP8, SP17, SY8) than for all SDS except WM17.

5.3 DIVERSITY AND EVENNESS

Mean diversity in UKB streams ranged from 1.81 at WD3 to 2.90 at SP17 (Figure 10; Tables 2 and 4). Statistically, SP17 displayed significantly higher diversity than all other streams

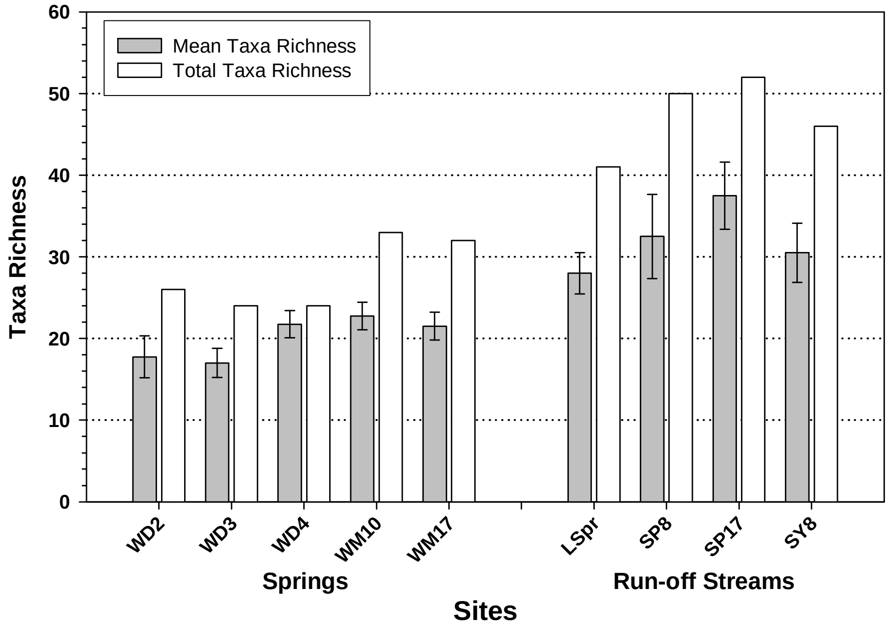

Figure 7. Mean taxa richness (± 95% confidence interval) and total taxa richness of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

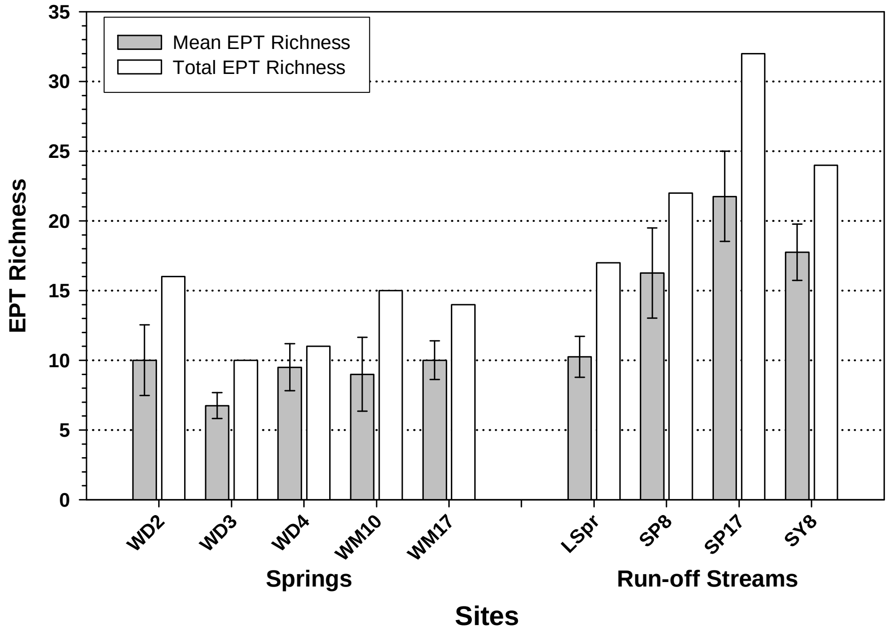

Figure 8. Mean EPT taxa richness (± 95% confidence interval) and total EPT taxa richness of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

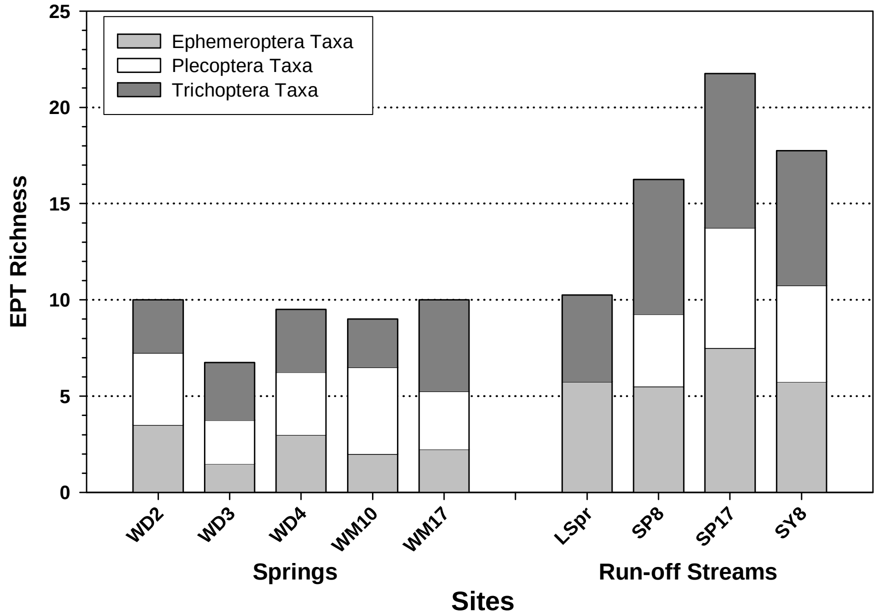

Figure 9. Composition of mean EPT richness of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

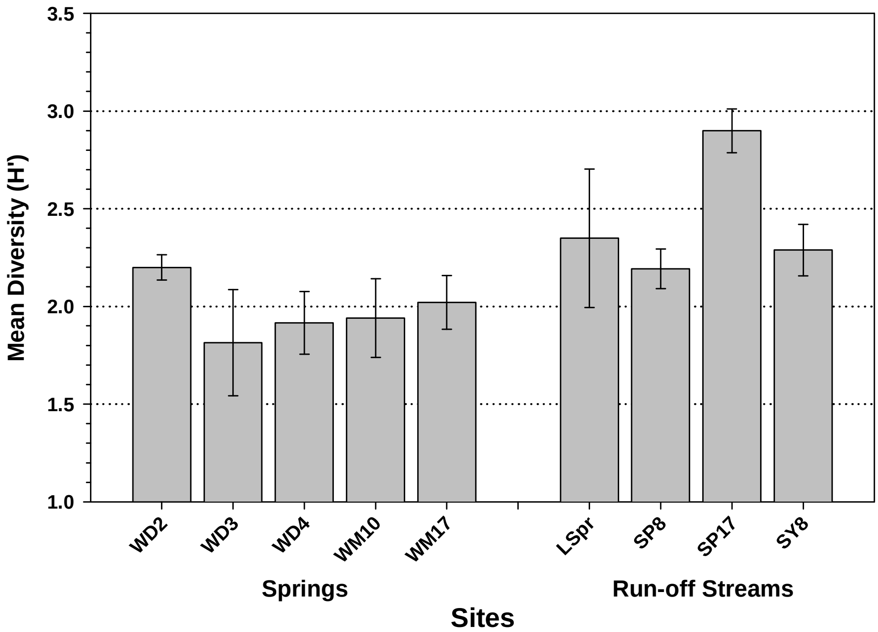

Figure 10. Mean Shannon-Weiner diversity (± 95% confidence interval) of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

($p < 0.00001$). Comparisons among only SDS showed no significant differences ($p > 0.05$). In terms of community evenness, mean scores ranged from 0.64 at WD4 and WM10 to 0.80 at SP17 (Figure 11; Tables 2 and 4). Overall, evenness was significantly higher at SP17 than all other sites except WD2 (0.77), and LSpr (0.70). Among SDS, WD2 showed significantly higher evenness than WD3, WD4, and WM10 ($p = 0.005$).

5.4 MODIFIED HBI SCORES

Mean scores of the modified HBI ranged from 3.45 at WD2 to 5.26 at WD4 (Figure 12; Tables 2 and 4). According to Hilsenhoff (1987), scores in this range indicate water quality from Excellent/Very Good to Good. Statistically, HBI scores at WD2 and SP17 were significantly lower than all other streams sampled except SP8, which averaged 4.17. Lower scores at WD2 were due to higher abundances of taxa with low tolerance values; specifically, *Zapada* (2), *Glossosoma* (1), and *Heterlimnius* (4). Conversely, higher scores at WD4 were caused by dominance of Oligochaeta (6) and *Fluminicola* snails (5).

5.5 PERCENT DOMINANT TAXON

Mean percent abundance of the single dominant taxon for streams in the UKB ranged from 15.4% at SP17 to 39.6% at WD3 (Figure 13; Tables 2 and 4). Statistically, mean percent dominance at SP17 was significantly lower than mean values at all other sites sampled. There were no significant differences among any of the other streams, regardless of stream type.

Dominant taxa varied from site to site. Chironomidae were the dominant taxa at SP8, SY8, and WM10. Two dipteran taxa, Chironomidae and *Pericoma*, shared dominance among the four kick samples at SP17. Chironomidae shared dominance with *Zapada* stoneflies at WM17. At WD3 and WD4, Oligochaeta worms were the dominant taxon. Finally, *Glossosoma* caddisflies, *Zapada*, and Oligochaeta all dominated abundance in at least one of the WD2 samples.

5.6 COMMUNITY COMPOSITIONS

Taxonomic compositions of UKB streams revealed the uniqueness of each stream site sampled. Samples collected at WD2 were largely comprised of EPT taxa, accounting for a mean of 62.5% of the abundance (Figure 14; Table 3). Statistical analysis determined that the percent abundance of Ephemeroptera was significantly higher at WD2 than at all other sites ($p = 4.3 \times 10^{-5}$; Figure 15). In addition, percent Trichoptera abundance was significantly higher at WD2 than at other SDS (Figure 16). Most Trichoptera at WD2 were *Glossosoma* spp.

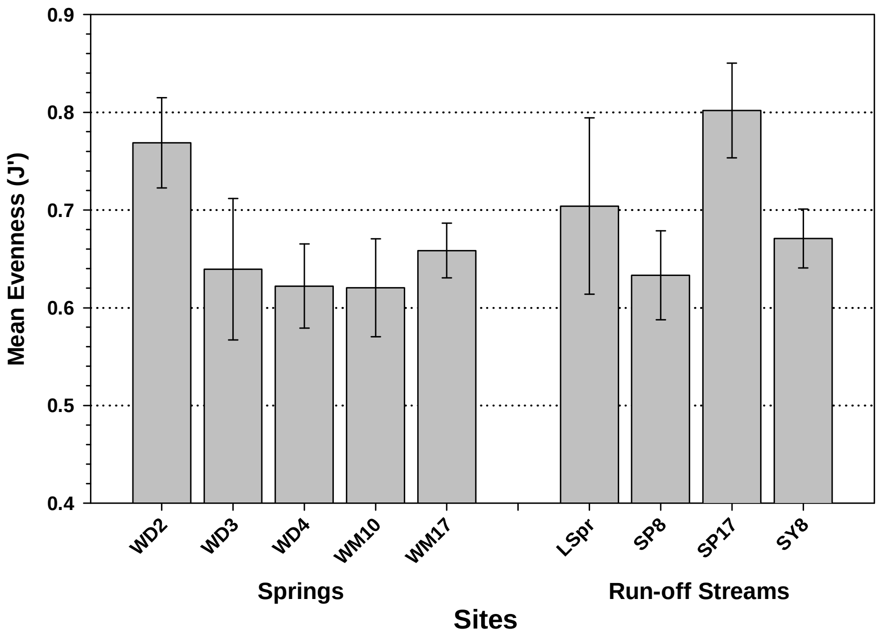

Figure 11. Mean community evenness (± 95% confidence interval) of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

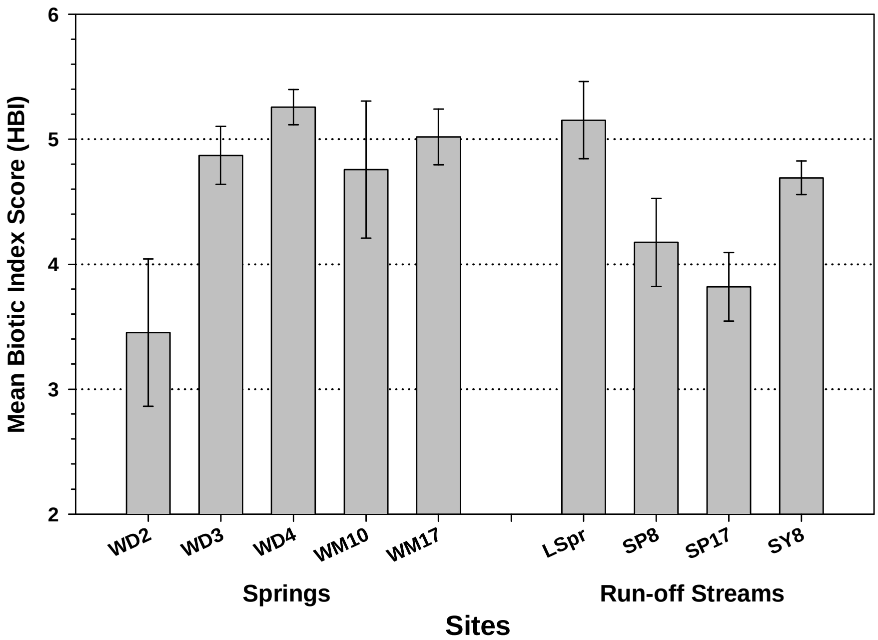

Figure 12. Mean modified Hilsenhoff Biotic Index scores (± 95% confidence interval) of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

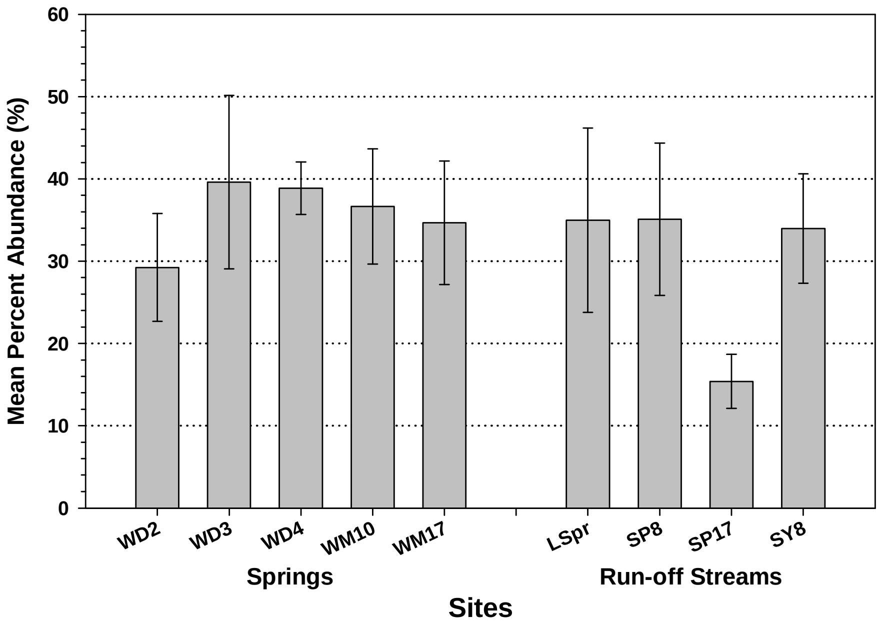

Figure 13. Mean percent dominant taxon (± 95% confidence interval) of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

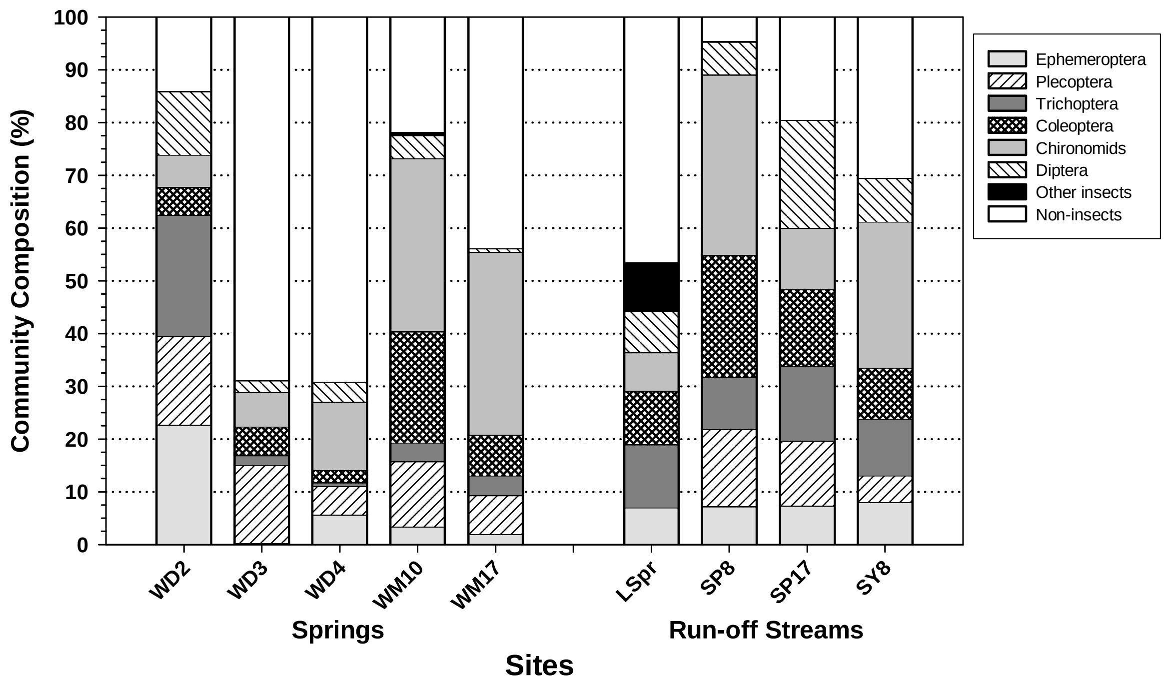

Figure 14. Community composition by relative abundance of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

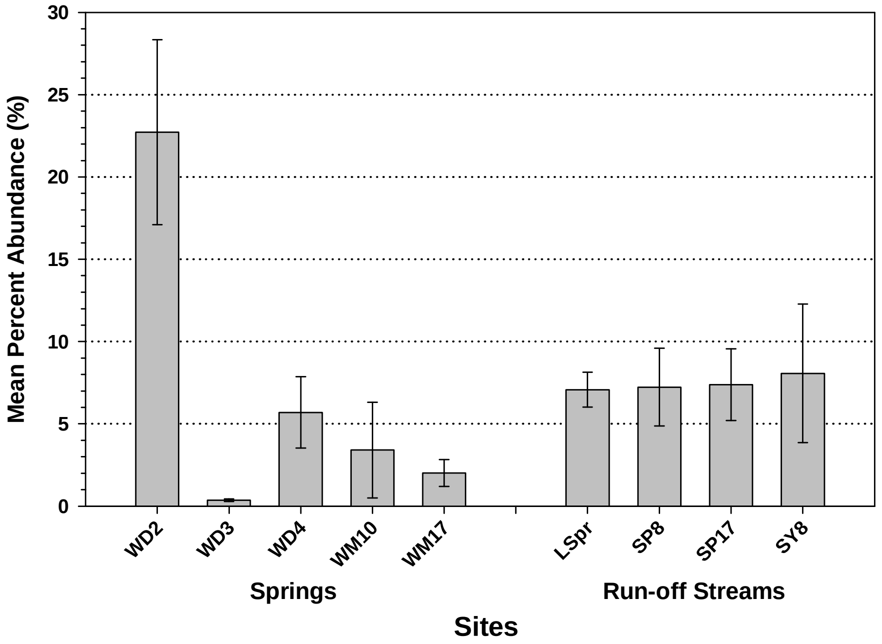

Figure 15. Mean percent abundance of Ephemeroptera (± 95% confidence interval) from macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

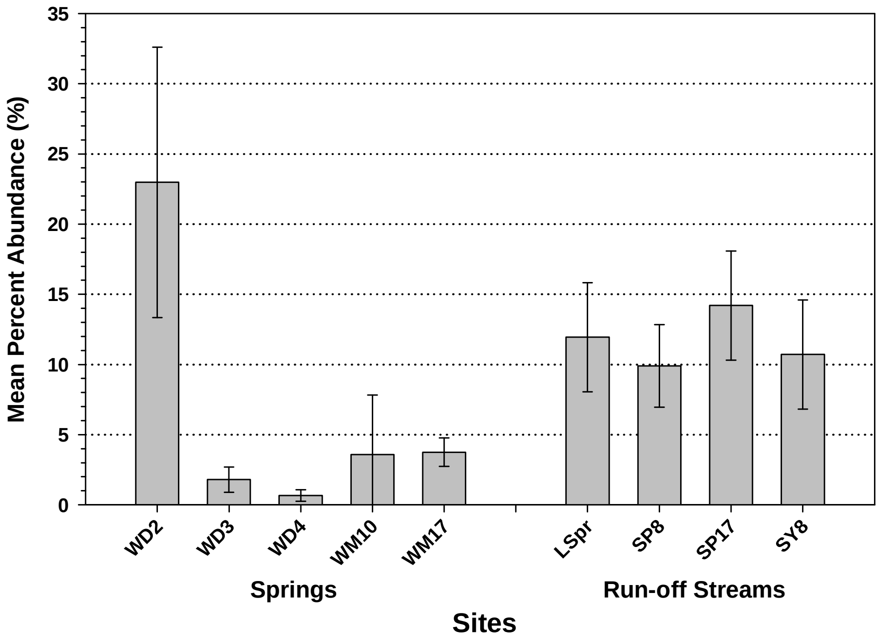

Figure 16. Mean percent abundance of Trichoptera (± 95% confidence interval) from macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

Community compositions at WD3 and WD4 were dominated by non-insect taxa, comprising nearly 70% of the mean abundance (Figure 14; Table 3). One-way ANOVA tests indicate non-insect contributions at these two streams were significantly higher than at all other streams sampled (Figure 17). Oligochaeta worms and hydrobiid snails, *Fluminicola* spp. comprised most of the non-insects collected at WD3 and WD4. The two sites differed slightly in the remaining taxa compositions. WD3 was nearly 3x higher in percent Plecoptera (14.8% vs. 5.4%), but lacked any substantial Ephemeroptera contribution, whereas WD4 had 5.7% mayflies. Additionally, WD3 had significantly higher percent abundances of stoneflies from the family Perlidae (8.33%) than all other eight sites. Relative abundances of Perlidae were also significantly higher at WD4 (3.67%) than at all remaining sites except SP17 (1.9%).

At WM10 and WM17, Chironomidae comprised over 30% of the community composition (Figures 14 and 18; Table 3). Among the SDS, percent Chironomidae was significantly higher at WM10 and WM17 in comparison to the other SDS. The rest of WM17's community was mostly comprised of Oligochaeta worms and hydrobiid snails, *Fluminicola* spp.(Figure 17; Table 3).

WM10 was unique in that it was the only site in the study where plentiful beds of Western Pearlshell mussels, *Margaritifera falcata*, were found and collected. WM10 was also the only spring-fed stream in which *Optioservus* riffle beetles were collected. Conversely, the riffle beetle *Heterlimnius*, collected in the other SDS, was not collected at WM10.

For RDS, taxonomic compositions were similar among the Sprague River tributaries and Long Creek (SY8), but were markedly different at LSpr (Figure 14, Table 5). Sampling at LSpr failed to collect any Plecoptera during the study; however, the percentage of Other Insects was significantly higher at LSpr compared to all other sites (Table 5). The Other Insects grouping was comprised of a variety of Odonata nymphs, including the damselfly *Argia* and the dragonfly *Ophiogomphus,* and the aquatic moth *Petrophila.* LSpr was also the only run-off stream in the study in which the hydrobiid snail, *Fluminicola* spp was collected, which accounts for a majority of the 46.4% relative abundance of Non-insects.

5.7 FUNCTIONAL FEEDING GROUP COMPOSITIONS

Streams sampled in the UKB were largely comprised of collector-gatherers (Figure19; Tables 2 and 3). All sites showed mean percent abundance of collector-gatherers above 40%, except LSpr which had the lowest relative abundance at 32.6%. The second most abundant feeding group was scrapers, ranging from 11% at SY8 to 39.8% at LSpr (Figure 19; Tables 2 and 4). Generally, those streams with higher collector-gatherer abundance were lower in scraper contributions.

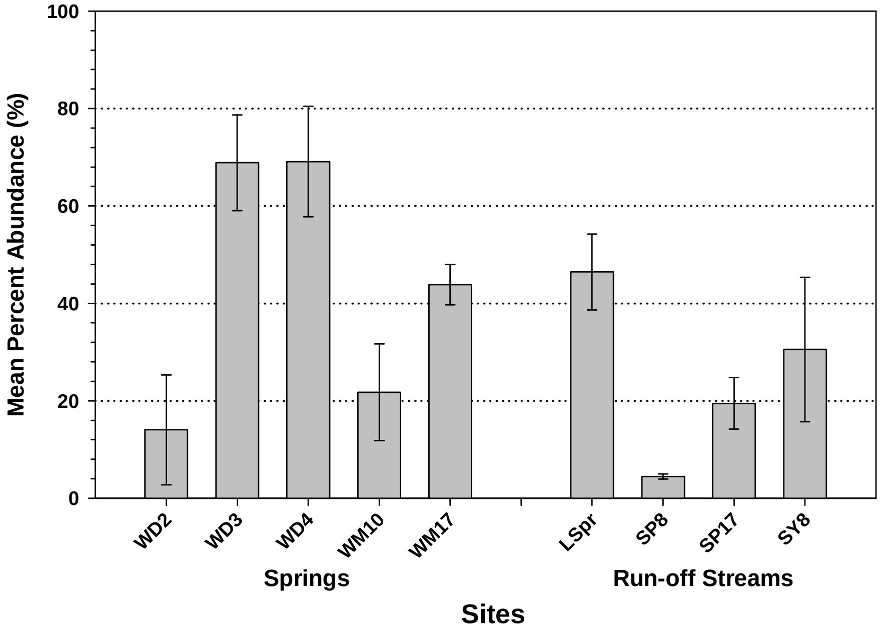

Figure 17. Mean percent abundance of Non-Insects (± 95% confidence interval) from macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

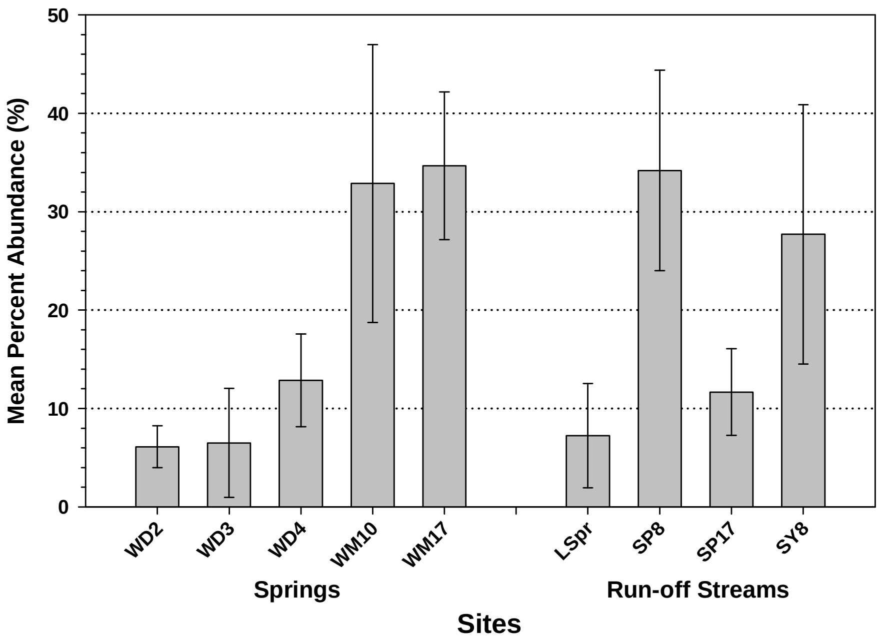

Figure 18. Mean percent abundance of Chironomidae (± 95% confidence interval) from macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

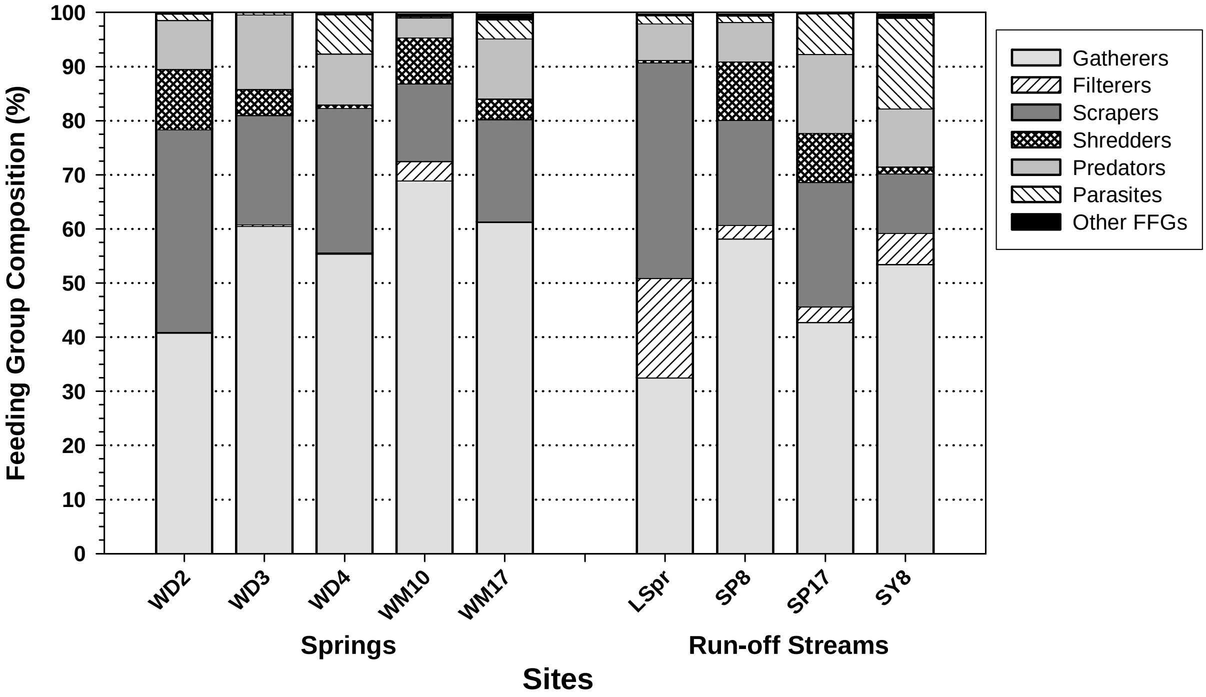

Figure 19. Functional feeding group composition by relative abundance of macroinvertebrate samples collected from nine streams in the Upper Klamath Basin, Oregon on September 1-2, 2004.

Collector-filterers were not as common in most streams sampled, ranging from a low of 0.2% at WD2 and WD4 to 18.4% at LSpr (Figure 19; Tables 2 and 4). Among most SDS, filterer abundance was below 0.5%, with WM10 as the exception at 3.6%. For RDS, LSpr was significantly higher than the other 3 streams, with percent filterers over 3 times higher than the next highest percentage, 5.8%, at SY8.

Percent shredder abundances were also relatively low in UKB streams, ranging from 0.4% at LSpr to 11.1% at WD2 (Figure 19; Tables 2 and 4). Among SDS, WD2 was significantly higher in percent shredders than WD4, which had the lowest value, 0.6%. For RDS, LSpr was distinguished with lowest in percent abundance shredders.

The functional feeding groups of predators and parasites were generally lower in relative abundances, seldom exceeding 15% (Figure 19; Tables 2 and 4). Statistically, the only significant difference for percent predators was among the SDS; WM10 possessed the lowest abundance at 3.6%. For percent parasites, SY8 had the highest value at 16.8%, due to a high abundance of Nematoda in the samples.

6. DISCUSSION AND CONCLUSIONS

Results of the BMI sampling in the UKB revealed distinct taxonomic differences between SDS and RDS systems. The river continuum concept (Vannote et al. 1980) predicts that diversity of invertebrates should increase from lower to higher order streams, as streams accumulate species from upstream to downstream. Therefore, spring-dominated streams, which are by definition at the upper end of a river continuum, should have lower species richness compared to higher order streams. In addition, the constancy of environmental conditions found in spring-dominated streams is believed to result in less diverse BMI communities. Two of the most important factors influencing these communities are flow and temperature (Minshall 1968; Ward and Stanford 1979). In RDS, fluctuations in discharge and water temperature sustain a non-equilibrium BMI community, with different taxa thriving as environmental conditions change (Ward and Stanford 1983). The relative constancy of stream temperature and streamflow exhibited by SDS may result in an equilibrium community, with lower taxa richness and diversity (LaPerriere 1994).

Thermal constancy may also affect the growth and emergence of some benthic macroinvertebrate taxa. Species that require some thermal cue, such as an increase in water temperature in the spring for hatching or emergence timing would be at a disadvantage compared to those species able to complete their life cycles under constant thermal conditions, such as the amphipod *Gammarus* (Ward and Stanford 1979). Minshall (1968) considered constant temperatures in a Kentucky spring-fed stream to be an important factor responsible for lower macroinvertebrate diversity, because relatively few species had temperature optima in the narrow range of temperatures that occurred in the spring waters.

Overall, the BMI communities in SDS in the UKB were lower in taxa richness, EPT richness measures, and diversity; and showed an increased dominance of non-insects in community compositions at the expense of various insect taxa abundances. Several studies examining springs support the prediction of lower species richness and diversity, and the dominance of non-insect taxa. In a study examining seven springs in southern Illinois, Webb et al. (1995) found a low but stable diversity of macroinvertebrates, with communities dominated by flatworms, amphipods, and oligochaetes. Oligochaeta also represented the most diverse faunal group observed during the study. Only a few aquatic insects were collected and when they were present, they seldom were abundant. In Tyee Springs within the Wind River basin of the southern Washington Cascade Mountains, non-insects comprised 46-85% of the average abundance (Davidson and Wilding 1943). Chironomids were the most abundant insect group, contributing 9-38% of the abundance estimates. A study of fauna in Cone Spring in Iowa collected 32 taxa, dominated by the amphipod *Gammarus*, *Physa* snails, the caddisfly *Frensia*, and the chironomid *Pentaneura* (Tilly 1968). Diversity of the spring was considered to be "relatively low and seasonally stable." Minshall's (1968) survey of a Kentucky spring-fed stream also found a dominance of non-insect taxa, with *Gammarus minus* representing 82% of the density.

Wetzel and Webb (2004) maintain that non-insect dominant communities appear in hard water limestone springs with a pH > 7.0 and alkalinity above 25 mg/L. Measurements of pH taken in the UKB springs ranged from 7.38 to 8.16, with the highest pH values taken from WD3, WD4, and WM17, streams with significant relative abundances of non-insects. We did not measure alkalinity during our study, so that criteria cannot be assessed. However, many of the springs studies revealing high non-insect abundance agree with this pH/alkalinity criteria. In the spring-dominated stream of the Cascade Mountains in southern Washington examined by Davidson and Wilding (1943), pH levels varied from 6.95 to 7.45. Minshall (1968) found that Morgan's Creek in Kentucky had a pH of 7.2 to 8.1, with alkalinity measuring 88-225 mg/L. Stern and Stern (1969) sampled a coldspring brook in Tennessee with a pH of 7.3 and an alkalinity of 30.6 mg/L, and found a community abundant in Isopoda, *Gammarus*, and chironomids. Amphipods and isopods dominated the macroinvertebrate community in OZ Spring in Ohio, which exhibited a pH ranging from 7.0 to 7.6 and an alkalinity of 280-315 mg/L (Butler and Hobbs 1982).

In addition to differences in taxa richness and diversity between SDS and RDS, there were also differences in specific taxa. One of the most dominant non-insect taxa, the hydrobiid pebblesnail or "spring snail," *Fluminicola*, was abundant in several SDS, but absent from nearly all RDS, with the exception of LSpr. In the stonefly family Perlidae, SDS were populated with *Hesperoperla pacifica*, averaging from about 3 to 968 individuals/m^2. Run-off streams recorded only one sample with *Hesperoperla pacifica* (at SY8), but were abundant with another perlid, *Doroneuria*, which was not found in any spring-fed stream.

In another example regarding riffle beetles (family Elmidae), *Heterlimnius* was found in both stream types; however, it was not collected at WM10 and LSpr, which recorded the highest stream temperatures in the study. Conversely, *Optioservus* was collected in all run-off streams, but was absent from all SDS except WM10. Interestingly, *Optioservus* is designated as a "tolerant" taxon (OWEB 1999), suggesting that streams in which it is present have a potentially higher level of disturbance. The fact that spring-fed systems are relatively stable may be a factor that prevents successful colonization of *Optioservus*.

Despite the apparent differences in taxa richness and diversity between the two stream types, springs are also considered to be important contributors of biodiversity in aquatic systems.

Because of their unique conditions and often-disjunct distribution, spring communities have received increasing attention as foci of biodiversity, harboring rare and endemic species and providing stable conditions for the persistence of meta-populations. For example, in springs of the Sierra Nevada, California, caddisfly (Trichoptera) species richness was related to spring permanence, with more rare and relict species in permanent springs (Erman and Erman 1995). Death and Winterbourn (1994) reported a higher persistence of rare species in invertebrate communities in "stable" streams originating from springs than in "unstable" streams that were runoff-dominated in New Zealand. Webb et al. (1995) found several Oligochaeta species rare to Illinois as well as some new, undescribed Oligochaeta species in seven springs in southern Illinois.

In UKB SDS, 11 species of pebblesnails (*Fluminicola*) have been found to be endemic to the basin (Frest and Johannes 1995, 1996, 1998). Three species from the UKB (the Klamath pebblesnail, tall pebblesnail, and Klamath Rim pebblesnail) have been designated as Record of Decision (ROD) 1994 Survey and Manage freshwater mollusk taxa under the Northwest Forest Plan (Frest and Johannes 1999). All hydrobiid snails have gills that make them dependent upon dissolved oxygen in the water in which they live. Hydrobiids are highly sensitive to water pollution, oxygen deficits, elevated water temperatures, and sedimentation. Both the tall and Klamath Rim pebblesnails are crenophiles (i.e., organisms living only in spring environments); whereas the Klamath pebblesnail prefers clear, cold, oligotrophic, flowing waters found in UKB and major spring-fed tributaries (Frest and Johannes 1999). Current management recommendations for these taxa are to protect the required environmental conditions at known sites (USDA Forest Service and USDI Bureau of Land Management 1998). Among the activities listed that may impact these environmental conditions were dredging, grazing, nutrient enrichment, water pollution, decreased water flow as a result of irrigation or other activities, and construction activities (USDA Forest Service and USDI Bureau of Land Management 1998).

In addition to the occurrence of endemic pebblesnails, each spring-fed stream we studied displayed some uniqueness setting it apart from most other sites. WD2 displayed the highest mean percent abundances of Ephemeroptera and Trichoptera, the lowest mean HBI score of the study, and the highest diversity and evenness of the SDS. The highest mean densities of *Hesperoperla pacifica* were collected at WD3 (968 individuals/m^2) and WD4 (330 individuals/m^2). In addition, WD4 was one of two sites (the other being SP17) where the apatanid caddisfly *Pedomoecus sierra* was collected. WM10 was unique in that it was the only site in the study where *Margaritifera falcata*, the Western Pearlshell mussel, was found and collected; the site was also the only spring-fed stream with Odonata taxa and, as previously mentioned, *Optioservus* were collected. Sampling at WM17 revealed the largest population of the perlid *Rickera sorpta* (983 individuals/m^2) in the study, and overall contained the highest density of organisms of all sites with 41,797 individuals/m^2.

Although we found distinct differences in taxonomic compositions among the SDS in the UKB, results from several studies on macroinvertebrate communities in springs suggest longitudinal differences within the springs themselves. Resh (1983) found considerable variation in invertebrate species richness within 30 meters downstream of the source in a small northern California spring, with higher species diversity at the spring source compared to downstream. Resh suggested this was due to the spring source being an ecotone, where species diversity is often higher than in individual habitats. Longitudinal variation in taxonomic groups of invertebrates also occurred over short distances in a spring-fed stream in southern Ontario, with higher secondary production nearer the spring source (Williams and Hogg 1988). Minshall (1968) found higher numbers and densities of invertebrates nearer the source in a Kentucky spring-fed stream. Ferrington et al. (1995) examined chironomids in five habitats in a western Kansas spring, including the spring source and a spring run. They concluded that each habitat consisted of a small number of species characteristic of the habitat, as well as a larger number of species that are known to occur in small, low order streams elsewhere in the United States. Since we only sampled one time and at only one location on each spring-fed stream, it may be useful in future studies to examine macroinvertebrate communities, and species richness in particular, as one progresses from source to mouth, and over an annual cycle perhaps with seasonal sampling.

The results of this study support our belief that the SDS in the UKB represent unique ecosystems that singly and in combination have helped to sustain native fish populations in spite of large scale losses of habitat, water withdrawals, and other human induced disturbances. This study has shown that each of the SDS contain unique assemblages of organisms that likely exist due in large part to prevailing stable flow and temperature conditions. For example, the high abundance of organisms in Spring Creek (WM17) we postulate is a function of its overall excellent water quality conditions and a stable environment that allows for year-round BMI production, that it turn provides a food-web capable of supporting year-round fish production. We suspect other SDS systems such as Fort Creek, upper Wood River, and Crooked Creek function similarly. Unlike in RDS where salmonid populations spawn during discrete seasonal conditions that are most conducive to a given species, the constancy of conditions in SDS potentially renders them suitable for spawning year-round, provided the prevailing conditions match salmonid spawning and egg incubation needs. Indeed, year-round spawning by adfluvial redband trout in Spring Creek has been documented by the ODFW (R. Smith, pers. comm.). Moreover, tagging studies of adult adfluvial redband trout conducted by the ODFW have documented that repeat/multi-year spawning occurs in this system. In contrast, ODFW has not documented repeat spawning of adfluvial redband trout in the segment of the Williamson River (a largely RDS) just above the mouth of Spring Creek. The ODFW has postulated that the reason for this relates to degraded water quality characteristics in the RDS leading to perhaps greater vulnerability of fish to certain pathogens or parasites that may be more prevalent in those streams. Clearly the value of these SDS systems as recruitment sources for adfluvial and resident salmonid populations in the UKB is apparent. In addition, these systems afford important rearing and refuge habitats for native fish populations during periods of flooding, drought and low flow conditions, and during periods of elevated stream temperatures.

Given the unique characteristics of the SDS, we believe that anthropogenic actions that result in hydrologic modifications to these systems (such as irrigation withdrawals) should be avoided or minimized. Such actions may serve to decouple ecologically sensitive linkages and disrupt food-webs thereby impacting regional patterns of biodiversity that threaten the overall survival of native fish populations dependent on these spring-dominated systems. Pringle and Triska (2000) cited an example of this, where water withdrawals from a particular catchment resulted in the loss of cold-water spring refugia for striped bass (*Morone saxatilis*).

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APPENDIX A

Presence / Absence Taxa List

Table A-1. Taxonomic "Presence/Absence" list of macroinvertebrate taxa collected in kick samples and hand collections in nine streams in the Upper Klamath Basin, Oregon, September 1-2, 2004.

*: Taxa collected ONLY in hand collection; X: Taxa collected at site; **X**: Taxa collected ONLY at this site (Unique).

Date Stream Site Code	9/1/2004 Wood River WD2	9/1/2004 Crooked River WD3	9/1/2004 Fort Creek WD4	9/1/2004 Spring Creek WM17	9/1/2004 Larkin Creek WM10	9/2/2004 Lower Sprague LSpr	9/2/2004 Trout Creek SP8	9/2/2004 Demming Creek SP17	9/2/2004 Long Creek SY8
INSECT TAXA									
Ephemeroptera									
Ameletidae									
Ameletus	X	X	X	X			X	X	X
Ametropodidae									
*Ametropus**	**X**								
Baetidae									
Acentrella						X			X
Baetis (early instar)				X					
Baetis bicaudatus						X	X	X	
Baetis tricaudatus	X	X	X		X	X	X	X	X
Diphetor hageni					X			X	X
Procleon						X	X		
*Pseudocleon**		**X**							
Heptageniidae									
early instar		X							X
Cinygma						X	X		
Cinygmula	X		X				X	X	
Epeorus albertae					X	X			
Rhithrogena								**X**	
Ephemerellidae									
early instar						X			
Attenella									**X**
Drunella doddsi								**X**	
Drunella grandis/spinifera	X			X		X	X	X	X
Serratella tibialis	X		X	X				X	X
Leptohyphidae									
Asioplax						**X**			
*Tricorythodes**						**X**			
Leptophlebiidae									
Paraleptophlebia		X	X		X		X	X	X

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Odonata									
Aeshnidae									
*Aeshna/Anax**					X	X			
Calopterygidae									
*Calopteryx aequabilis**					X	X			
Coenagrionidae									
Argia					X	X	X		
*Enallagma/Coenagrion**						**X**			
Gomphidae									
Ophiogomphus					X	X			X
Libellulidae									
*Libellula**						**X**			
Plecoptera									
Nemouridae									
Malenka		X	X	X	X		X	X	
Visoka cataractae								**X**	
Zapada (early instar)			X						
Zapada cinctipes	X	X		X	X		X	X	X
Zapada Oregonensis Grp								**X**	
Chloroperlidae									
early instar		X							
Sweltsa	X		X		X		X	X	X
Perlidae									
Doroneuria							X	X	X
Hesperoperla pacifica	X	X	X	X	X				X
Perlodidae									
Isoperlinae									X
Rickera sorpta	X			X					
Skwala					X		X		X
Peltoperlidae									
Yoraperla brevis	X						X	X	X

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Plecoptera (continued)									
Pteronarcyidae									
Pteronarcys	X		X		X		X	X	
Leuctridae									
early instar								X	
Moselia infuscata			X	X					
Trichoptera									
Apataniidae									
Pedomoecus sierra			X					X	
Brachycentridae									
Amiocentrus	X		X	X					X
*Brachycentrus americanus**	X								
Brachycentrus occidentalis	X					X			
Micrasema	X	X					X	X	X
Glossomatidae									
early instar									
Agapetus							<u>**X**</u>		
Anagapetus/Glossosoma								X	X
Glossosoma	X	X	X	X	X		X		
Protoptila									<u>**X**</u>
Helicopsychidae									
Helicopsyche borealis						<u>**X**</u>			
Hydropsychidae									
Cheumatopsyche					X	X			
Hydropsyche						X			X
Parapsyche almota							X	X	
Parapsyche elsis								<u>**X**</u>	
Hydroptilidae									
early instar									
Hydroptila					X	X	X		X
Leucotrichia						<u>**X**</u>			

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Trichoptera (continued)									
Leptoceridae									
early instar							X		
Nectopsyche						**X**			
Limnephilidae									
early instar								X	
Allocosmoecus	**X**								
*Dicosmoecus atripes**			**X**						
*Hesperophylax**		X		X					
Psychoglypha bella		X	X	X			X		
Psychoglypha subborealis	X	X	X	X	X		X		
Philopotamidae									
Dolophilodes								**X**	
Wormaldia						X	X		
Phryganeidae									
Yphria californica								**X**	
Psychomyiidae									
Psychomyia									**X**
Tinodes					**X**				
Rhyacophilidae									
Rhyacophila									
Betteni Grp.		X	X	X				X	
Brunnea/Vemna Grp.				X			X	X	X
Lieftincki Grp.	X			X				X	X
Sericostomatidae									
*Gumaga**									**X**
Uenoidae									
Neophylax		X						X	
Megaloptera									
Sialidae									
Sialis					X		X		

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Lepidoptera									
Pyralidae									
Petrophila						X	X		
Hemiptera									
Corixidae*		X	X		X	X	X		X
Gelastocoridae									
Gelastocoris	**X**								
Gerridae									
*Aquarius**					X	X	X		
*Gerris**		X			X		X		
Nepidae									
*Ranatra**		X							X
Notonectidae									
*Notonecta**							**X**		
Coleoptera									
Amphizoidae									
*Amphizoa**			X					X	
Elmidae									
Ampumixis								**X**	
Heterlimnius	X	X	X	X			X	X	X
Optioservus					X	X	X	X	X
Lara								**X**	
Narpus							X	X	X
Rhizelmis									X
Zaitzevia						X			X
Haliplidae									
early instar									
Brychius					X	X			
Hydrophilidae									
*Ametor**		X						X	
Enochrus						**X**			

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Coleoptera (continued)									
Dytiscidae									
*Anacaena**			X					X	
Hygrotus							**X**		
*Oreodytes**	X								X
Tropisternus					**X**				
Gyrinidae									
*Gyrinus**							X		X
Staphylinidae									
*Stenus**	X							X	
Diptera									
Ceratopogonidae									
Ceratopogoninae							X	X	X
Forcipomyiinae							**X**		
Chironomidae	X	X	X	X	X	X	X	X	X
Dixidae									
Dixa							**X**		
Empididae									
Chelifera	X	X	X	X			X	X	X
Clinocera	X	X	X	X					
Hemerodromia					X	X			
Wiedemannia									**X**
Ephydridae						**X**			
Pelecorhynchidae									
Glutops								**X**	
Psychodidae									
Pericoma							X	X	
Ptychopteridae									
*Ptychoptera**							**X**		
Simuliidae									
Simulium	X	X			X	X	X	X	X

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Diptera (continued)									
Tabanidae							X		X
Thaumeleidae									
Thaumalea								**X**	
Tipulidae									
Antocha		X	X	X	X	X	X	X	X
Dicranota		X	X		X		X	X	X
Hesperoconopa	X		X						X
Hexatoma									**X**
*Limnophila**	**X**								
Yamatotipula							X	X	X
NON-INSECT TAXA									
Acari	X	X	X	X	X	X	X	X	X
Nematoda	X	X	X	X	X	X	X	X	X
Nematomorpha				X		X			
Oligochaeta	X	X	X	X	X	X	X	X	X
Turbellaria									
Tricladida		X		X		X	X	X	
Polycelis				X			X	X	
Amphipoda									
Crangonyctidiae									
Crangonyx					**X**				
Stygobromus				**X**					
Hyalellidae									
Hyalella		X	X	X		X			
Decapoda									
Astacidae									
Pacifasticus leniusculus		X			X				X

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Date **Stream** **Site Code**	**9/1/2004** **Wood** **River** **WD2**	**9/1/2004** **Crooked** **River** **WD3**	**9/1/2004** **Fort** **Creek** **WD4**	**9/1/2004** **Spring** **Creek** **WM17**	**9/1/2004** **Larkin** **Creek** **WM10**	**9/2/2004** **Lower** **Sprague** **LSpr**	**9/2/2004** **Trout** **Creek** **SP8**	**9/2/2004** **Demming** **Creek** **SP17**	**9/2/2004** **Long** **Creek** **SY8**
Isopoda									
Asellidae									
Caecidotea		X		X					
Ostracoda							**X**		
Bivalvia									
Sphaeriidae	X	X	X	X	X	X	X	X	X
Margaritiferidae									
Margaritifera falcata					**X**				
Gastropoda									
Ancylidae					**X**				
Hydrobiidae									
Fluminicola		X	X	X		X			
Lymnaeidae									
Lanx				**X**					
*Stagnicola**						X	X		
Physidae									
Physa						X	X		X
Planorbidae									
early instar							X		
*Menetus**				X		X			
Vorticifex		X		X		X			
Total Taxa per Site	34	37	34	36	39	48	59	56	53
Unique Taxa per Site	4	1	1	2	5	9	7	11	6

APPENDIX B

Sample Enumeration and Metric Scores

Table B-1. Taxonomic enumeration and metrics for each kick sample collected at the Wood River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Wood River	Wood River	Wood River	Wood River
Site	WD2	WD2	WD2	WD2
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus	0.333			
Baetidae				
Baetis (early instar)	18			
Baetis tricaudatus		33	29	51
Baetis bicaudatus				
Acentrella				
Diphetor hageni				
Procleon				
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi				
Drunella grandis/spinifera		0.5		
Serratella tibialis	12	3.5	14.7	4
Heptageniidae				
early instar				
Cinygma				
Cinygmula	9	19	12	22
Epeorus				
Epeorus albertae				
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia				
Odonata				
Coenagrionidae				
Argia				
Gomphidae				
early instar				
Ophiogomphus				
Plecoptera				
Chloroperlidae				
early instar				
Sweltsa	2.333	2	1.7	0.733
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka				
Visoka cataractae				
Zapada (early instar)				
Zapada cinctipes	86	16	26	24
Zapada Oregonensis Grp.				

Table B-1. Taxonomic enumeration and metrics for each kick sample collected at the Wood River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Wood River WD2 1	9/1/2004 Wood River WD2 2	9/1/2004 Wood River WD2 3	9/1/2004 Wood River WD2 4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis	1			
Perlidae				
early instar				
Doroneuria				
Hesperoperla pacifica	2.333	4	2.167	3.1
Perlodidae				
early instar	2			
Isoperlinae				
Rickera sorpta				0.367
Skwala				
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar				
Amiocentrus	1			
Brachycentrus occidentalis	0.333			0.367
Micrasema				
Glossomatidae				
early instar				
Agapetus				
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma	52	81	33	58
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche				
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila				
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar	0.333			
Allocosmoecus				0.367
Psychoglypha bella				
Psychoglypha subborealis		0.5		

Table B-1. Taxonomic enumeration and metrics for each kick sample collected at the Wood River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Wood River WD2 1	9/1/2004 Wood River WD2 2	9/1/2004 Wood River WD2 3	9/1/2004 Wood River WD2 4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia				
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.				
Brunnea/Vemna Grp.				
Lieftincki Grp.				0.733
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris		0.5		
Coleoptera				
Elmidae				
Optioservus				
Heterlimnius	21	20.5	3	8
Ampumixis				
Lara				
Narpus				
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	12	9	20	21
Ceratopogonidae				
Ceratopogoninae				
Forcipomyiinae				
Dixidae				
Dixa				

Table B-1. Taxonomic enumeration and metrics for each kick sample collected at the Wood River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Wood River	Wood River	Wood River	Wood River
Site	WD2	WD2	WD2	WD2
Kick	1	2	3	4
Diptera (continued)				
Empididae				
Chelifera	12	8.4	13	13
Clinocera	5	5.6	2	
Hemerodromia				
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium		0.5		0.733
Tabanidae				
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha				
Dicranota				
Hesperoconopa	9	13	13	26
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari	4			2
Nematoda		2	3	4
Nematomorpha				
Turbellaria				
Tricladida				
Polycelis				
Oligochaeta	21	2	66	39
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella				
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea				
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar				

Table B-1. Taxonomic enumeration and metrics for each kick sample collected at the Wood River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Wood River	Wood River	Wood River	Wood River
Site	WD2	WD2	WD2	WD2
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola				
Lymnaeidae				
early instar				
Lanx				
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex				
Subsample Total	270.667	221	238.567	278.4
Subsample factor	0.333	0.5	0.233	0.367
Expansion Factor	3	2	4.29	2.73
Kick total	812	442	1022.43	759.27
Density (sq m)	4511.11	2455.556	5680.16	4218.18
Taxa Richness	20	18	14	19
EPT Richness	13	9	7	11
Ephem Taxa	4	4	3	3
Plecop Taxa	5	3	3	4
Trichop Taxa	4	2	1	4
H'	2.22	2.11	2.20	2.27
J'	0.74	0.73	0.83	0.77
Mod. HBI	2.90	3.00	4.14	3.77
% Dominance	31.77	36.65	27.67	20.83
% CG	33.81	27.88	55.27	46.34
% CF	0.06	0.23	0.00	0.33
% SC	30.33	55.66	25.85	37.88
% SH	24.29	5.54	8.17	6.50
% PR	10.38	9.50	9.27	7.09
% PA	0.74	0.90	1.26	1.80
% Other FFG	0.40	0.28	0.18	0.07
% Ephem	14.53	25.34	23.35	27.66
% Plecop	34.61	9.95	12.52	10.13
% Trichop	19.83	36.88	13.83	21.36
% Coleop	7.76	9.28	1.26	2.87
% Chiros	4.43	4.07	8.38	7.54
% Diptera	9.61	12.44	11.74	14.27
% other insect	0.00	0.23	0.00	0.00
% non-insect	9.24	1.81	28.92	16.16

Table B-2. Taxonomic enumeration and metrics for each kick sample collected at the Crooked River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/04	9/1/04	9/1/04	9/1/04
Stream	Crooked River	Crooked River	Crooked River	Crooked River
Site	WD3	WD3	WD3	WD3
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus		0.167		
Baetidae				
Baetis (early instar)	1			
Baetis tricaudatus		0.5	1	0.75
Baetis bicaudatus				
Acentrella				
Diphetor hageni				
Procleon				
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi				
Drunella grandis/spinifera				
Serratella tibialis				
Heptageniidae				
early instar	0.1			
Cinygma				
Cinygmula				
Epeorus				
Epeorus albertae				
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia				
Odonata				
Coenagrionidae				
Argia				
Gomphidae				
early instar				
Ophiogomphus				
Plecoptera				
Chloroperlidae				
early instar				1
Sweltsa				
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka				
Visoka cataractae				
Zapada (early instar)				
Zapada cinctipes	24	10	3	26
Zapada Oregonensis Grp.				

Table B-2. Taxonomic enumeration and metrics for each kick sample collected at the Crooked River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/04	9/1/04	9/1/04	9/1/04
Stream	Crooked River	Crooked River	Crooked River	Crooked River
Site	WD3	WD3	WD3	WD3
Kick	1	2	3	4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis				
Perlidae				
early instar				
Doroneuria				
Hesperoperla pacifica	27	18	17.933	18.9
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta				
Skwala				
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar				
Amiocentrus				
Brachycentrus occidentalis				
Micrasema	1			
Glossomatidae				
early instar				
Agapetus				
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma	3	2	3	0.075
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche				
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila				
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar				
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis				

Table B-2. Taxonomic enumeration and metrics for each kick sample collected at the Crooked River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/04	9/1/04	9/1/04	9/1/04
Stream	Crooked River	Crooked River	Crooked River	Crooked River
Site	WD3	WD3	WD3	WD3
Kick	1	2	3	4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia				
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.	3.2	0.167	1.333	3.1
Brunnea/Vemna Grp.				
Lieftincki Grp.				
Uenoidae				
Neophylax	0.3		0.267	0.15
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus				
Heterlimnius	6	7	20	21
Ampumixis				
Lara				
Narpus				
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	37	11	7	9
Ceratopogonidae				
Ceratopogoninae				
Forcipomyiinae				
Dixidae				
Dixa				

Table B-2. Taxonomic enumeration and metrics for each kick sample collected at the Crooked River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/04	9/1/04	9/1/04	9/1/04
Stream	Crooked River	Crooked River	Crooked River	Crooked River
Site	WD3	WD3	WD3	WD3
Kick	1	2	3	4
Diptera (continued)				
Empididae				
Chelifera	1			
Clinocera				0.15
Hemerodromia				
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium				
Tabanidae				
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	5	3	4	1
Dicranota	2	2	2	1.35
Hesperoconopa				
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari		1		1
Nematoda	1		1	
Nematomorpha				
Turbellaria				
Tricladida	10	4	6	29
Polycelis				
Oligochaeta	71	100	129	87
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella	9.1	1	2	
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea				0.075
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar	6	2		2

Table B-2. Taxonomic enumeration and metrics for each kick sample collected at the Crooked River site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/04	9/1/04	9/1/04	9/1/04
Stream	Crooked River	Crooked River	Crooked River	Crooked River
Site	WD3	WD3	WD3	WD3
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola	40	78	43	51
Lymnaeidae				
early instar				
Lanx				
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex				
Subsample Total	247.7	239.833	240.533	252.55
Subsample factor	0.1	0.167	0.267	0.075
Expansion Factor	10	6	3.75	13.33
Kick total	2477	1439	902	3367.33
Density (sq m)	13761.11	7994.44	5011.11	18707.41
Taxa Richness	19	16	15	18
EPT Richness	8	6	6	7
Ephem Taxa	2	2	1	1
Plecop Taxa	2	2	2	3
Trichop Taxa	4	2	3	3
H'	2.16	1.61	1.58	1.91
J'	0.73	0.58	0.58	0.66
Mod. HBI	4.76	5.03	5.10	4.59
% Dominance	28.66	41.70	53.63	34.45
% CG	60.00	59.76	68.81	53.82
% CF	0.61	0.21	0.00	0.20
% SC	15.19	26.82	19.13	19.54
% SH	7.37	3.13	0.94	7.72
% PR	16.43	9.87	10.71	18.41
% PA	0.40	0.21	0.42	0.20
% Other FFG	0.00	0.00	0.00	0.11
% Ephem	0.44	0.28	0.42	0.30
% Plecop	20.59	11.67	8.70	18.17
% Trichop	3.03	0.90	1.91	1.32
% Coleop	2.42	2.92	8.31	8.32
% Chiros	14.94	4.59	2.91	3.56
% Diptera	3.23	2.08	2.49	0.99
% other insect	0.00	0.00	0.00	0.00
% non-insect	55.35	77.55	75.25	67.34

Table B-3. Taxonomic enumeration and metrics for each kick sample collected at the Fort Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Fort Creek	Fort Creek	Fort Creek	Fort Creek
Site	WD4	WD4	WD4	WD4
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus	1	0.167	0.267	0.233
Baetidae				
Baetis (early instar)				
Baetis tricaudatus	6	18	13	10
Baetis bicaudatus				
Acentrella				
Diphetor hageni				
Procleon				
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi				
Drunella grandis/spinifera				
Serratella tibialis				
Heptageniidae				
early instar				
Cinygma				
Cinygmula	1.067	1	1	1
Epeorus				
Epeorus albertae				
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia				
Odonata				
Coenagrionidae				
Argia				
Gomphidae				
early instar				
Ophiogomphus				
Plecoptera				
Chloroperlidae				
early instar	1	3	2	3
Sweltsa				
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka				
Visoka cataractae				
Zapada (early instar)		5	1	1
Zapada cinctipes				
Zapada Oregonensis Grp.				

Table B-3. Taxonomic enumeration and metrics for each kick sample collected at the Fort Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Fort Creek	Fort Creek	Fort Creek	Fort Creek
Site	WD4	WD4	WD4	WD4
Kick	1	2	3	4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis				
Perlidae				
early instar				
Doroneuria				
Hesperoperla pacifica	3.267	7	14.4	9.167
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta				
Skwala				
Pteronarcyidae				
Pteronarcys (early instar)		0.167	0.133	
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra	0.133	0.5	0.133	0.233
Brachycentridae				
early instar				
Amiocentrus			1	1
Brachycentrus occidentalis				
Micrasema				
Glossomatidae				
early instar	0.067	0.167		1
Agapetus				
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma			0.133	
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche				
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila				
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar				
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis				

Table B-3. Taxonomic enumeration and metrics for each kick sample collected at the Fort Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Fort Creek WD4 1	9/1/2004 Fort Creek WD4 2	9/1/2004 Fort Creek WD4 3	9/1/2004 Fort Creek WD4 4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia				
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.		1	0.533	0.233
Brunnea/Vemna Grp.				
Lieftincki Grp.				
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus				
Heterlimnius	4	7	7	4
Ampumixis				
Lara				
Narpus				
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	17	40	26	36
Ceratopogonidae				
Ceratopogoninae				
Forcipomyiinae				
Dixidae				
Dixa				

Table B-3. Taxonomic enumeration and metrics for each kick sample collected at the Fort Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date Stream Site Kick	9/1/2004 Fort Creek WD4 1	9/1/2004 Fort Creek WD4 2	9/1/2004 Fort Creek WD4 3	9/1/2004 Fort Creek WD4 4
Diptera (continued)				
Empididae				
Chelifera	1	2	3	5
Clinocera	1	5	3	0.233
Hemerodromia				
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium				
Tabanidae				
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	1.067	3	2.6	4
Dicranota	0.467	2	0.533	
Hesperoconopa	0.067	1.333	0.267	
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari	7	9	11	15
Nematoda	34	7	2	6
Nematomorpha				
Turbellaria				
Tricladida				
Polycelis				
Oligochaeta	97	88	56	30
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella	1		1	1
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea				
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar	2	1	2	3

Table B-3. Taxonomic enumeration and metrics for each kick sample collected at the Fort Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Fort Creek	Fort Creek	Fort Creek	Fort Creek
Site	WD4	WD4	WD4	WD4
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola	73	26	80	99
Lymnaeidae				
early instar				
Lanx				
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex				
Subsample Total	251.133	227.333	228	230.1
Subsample factor	0.067	0.167	0.133	0.233
Expansion Factor	15	6	7.5	4.29
Kick total	3767	1364	1710	986.14
Density (sq m)	20927.78	7577.78	9500	5478.57
Taxa Richness	20	22	24	21
EPT Richness	7	10	11	10
Ephem Taxa	3	3	3	3
Plecop Taxa	2	4	4	3
Trichop Taxa	2	3	4	4
H'	1.68	2.06	1.99	1.93
J'	0.56	0.67	0.62	0.63
Mod. HBI	5.42	5.34	5.15	5.12
% Dominance	38.62	38.71	35.09	43.02
% CG	56.40	67.60	51.75	45.90
% CF	0.20	0.11	0.22	0.33
% SC	24.39	14.75	31.44	36.44
% SH	0.00	1.69	0.36	0.33
% PR	3.98	10.47	12.50	10.60
% PA	14.93	5.06	3.29	5.87
% Other FFG	0.10	0.33	0.44	0.54
% Ephem	3.21	8.43	6.26	4.88
% Plecop	1.70	6.67	7.69	5.72
% Trichop	0.08	0.73	0.79	1.07
% Coleop	1.59	3.08	3.07	1.74
% Chiros	6.77	17.60	11.40	15.65
% Diptera	1.43	5.87	4.12	4.01
% other insect	0.00	0.00	0.00	0.00
% non-insect	85.21	57.62	66.67	66.93

Table B-4. Taxonomic enumeration and metrics for each kick sample collected at the Larkin Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Larkin Creek	Larkin Creek	Larkin Creek	Larkin Creek
Site	WM10	WM10	WM10	WM10
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus				
Baetidae				
Baetis (early instar)				
Baetis tricaudatus	4	11.333		8
Baetis bicaudatus				
Acentrella				
Diphetor hageni	2	5.667		3
Procleon				
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi				
Drunella grandis/spinifera				
Serratella tibialis				
Heptageniidae				
early instar				
Cinygma				
Cinygmula				
Epeorus				
Epeorus albertae		0.3		
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia		9		
Odonata				
Coenagrionidae				
Argia	2	1	0.267	1
Gomphidae				
early instar			1	
Ophiogomphus	0.533			0.067
Plecoptera				
Chloroperlidae				
early instar				
Sweltsa	0.667	3.9	2.133	1
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka	0.133	2	1	0.067
Visoka cataractae				
Zapada (early instar)		99	14	8
Zapada cinctipes	15			
Zapada Oregonensis Grp.				
Peltoperlidae				

Table B-4. Taxonomic enumeration and metrics for each kick sample collected at the Larkin Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Larkin Creek WM10 1	9/1/2004 Larkin Creek WM10 2	9/1/2004 Larkin Creek WM10 3	9/1/2004 Larkin Creek WM10 4
Plecoptera (continued)				
Yoraperla brevis				
Perlidae				
early instar				
Doroneuria				
Hesperoperla pacifica		0.2		
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta				
Skwala	3.333	5.1	0.667	1
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica		0.2		
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar				
Amiocentrus				
Brachycentrus occidentalis				
Micrasema				
Glossomatidae				
early instar				0.133
Agapetus				
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma		15		
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche	4	13	1	4
Hydropsyche				
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila		9		
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar			0.133	
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis				

Table B-4. Taxonomic enumeration and metrics for each kick sample collected at the Larkin Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date Stream Site Kick	9/1/2004 Larkin Creek WM10 1	9/1/2004 Larkin Creek WM10 2	9/1/2004 Larkin Creek WM10 3	9/1/2004 Larkin Creek WM10 4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia				
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes	0.267		1	
Rhyacophilidae				
Rhyacophila				
Betteni Grp.				
Brunnea/Vemna Grp.				
Lieftincki Grp.				
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis	0.267		0.267	0.067
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus	50.133	97	61	23
Heterlimnius				
Ampumixis				
Lara				
Narpus				
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius	1.267		0.933	0.133
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	83	43	101	113
Ceratopogonidae				
Ceratopogoninae				
Forcipomyiinae				
Dixidae				
Dixa				

Table B-4. Taxonomic enumeration and metrics for each kick sample collected at the Larkin Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Larkin Creek WM10 1	9/1/2004 Larkin Creek WM10 2	9/1/2004 Larkin Creek WM10 3	9/1/2004 Larkin Creek WM10 4
Diptera (continued)				
Empididae				
Chelifera				
Clinocera				
Hemerodromia	4	4	4	8
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium	3	3		13
Tabanidae				
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	4		0.267	1
Dicranota		3	1	
Hesperoconopa				
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari	1	2		
Nematoda				2
Nematomorpha				
Turbellaria				
Tricladida				
Polycelis				
Oligochaeta	23	37	17	26
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx	17	1	14	71
Stygobromus				
Hyalellidae				
Hyalella				
Decapoda				
Astacidae				
Pacifasticus leniusculus	0.133	0.2	0.267	0.133
Isopoda				
Asellidae				
Caecidotea				
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar		1		

Table B-4. Taxonomic enumeration and metrics for each kick sample collected at the Larkin Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Larkin Creek	Larkin Creek	Larkin Creek	Larkin Creek
Site	WM10	WM10	WM10	WM10
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar			1	
Margaritiferidae				
Margaritifera falcata	0.133			
Gastropoda				
Ancylidae	8	2	9	3
Hydrobiidae				
Fluminicola				
Lymnaeidae				
early instar				
Lanx				
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex				
Subsample Total	226.867	367.9	230.933	286.6
Subsample factor	0.133	0.1	0.133	0.067
Expansion Factor	7.5	10	7.5	15
Kick total	1701.5	3679	1732	4299
Density (sq m)	9452.778	20438.889	9622.22	23883.333
Taxa Richness	23	25	21	22
EPT Richness	8	13	7	8
Ephem Taxa	2	4	0	2
Plecop Taxa	4	6	4	4
Trichop Taxa	2	3	3	2
H'	2.03	2.17	1.70	1.86
J'	0.65	0.68	0.56	0.60
Mod. HBI	4.97	3.93	4.97	5.16
% Dominance	36.59	26.91	43.74	39.43
% CG	72.13	48.20	73.95	81.59
% CF	3.13	4.42	0.76	5.93
% SC	14.88	19.67	16.45	6.50
% SH	5.42	21.23	5.22	2.15
% PR	4.11	4.09	3.33	3.02
% PA	0.22	0.27	0.00	0.70
% Other FFG	0.10	2.13	0.29	0.11
% Ephem	2.64	7.15	0.00	3.84
% Plecop	8.43	30.01	7.71	3.51
% Trichop	1.88	10.06	0.92	1.44
% Coleop	22.66	26.37	26.82	8.07
% Chiros	36.59	11.69	43.74	39.43
% Diptera	4.85	2.72	2.28	7.68
% other insect	1.23	0.27	0.66	0.40
% non-insect	21.72	11.74	17.87	35.64

Table B-5. Taxonomic enumeration and metrics for each kick sample collected at the Spring Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Spring Creek	Spring Creek	Spring Creek	Spring Creek
Site	WM17	WM17	WM17	WM17
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus	0.1	1.4	3.033	3.333
Baetidae				
Baetis (early instar)				
Baetis tricaudatus				
Baetis bicaudatus				
Acentrella				
Diphetor hageni				
Procleon				
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi				
Drunella grandis/spinifera			1.1	
Serratella tibialis	7	0.933	3.067	2.933
Heptageniidae				
early instar				
Cinygma				
Cinygmula				
Epeorus				
Epeorus albertae				
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia				
Odonata				
Coenagrionidae				
Argia				
Gomphidae				
early instar				
Ophiogomphus				
Plecoptera				
Chloroperlidae				
early instar				
Sweltsa				
Leuctridae				
early instar				
Moselia infuscata		1		
Nemouridae				
Malenka			1	0.833
Visoka cataractae				
Zapada (early instar)		2	33	
Zapada cinctipes				18
Zapada Oregonensis Grp.				

Table B-5. Taxonomic enumeration and metrics for each kick sample collected at the Spring Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Spring Creek WM17 1	9/1/2004 Spring Creek WM17 2	9/1/2004 Spring Creek WM17 3	9/1/2004 Spring Creek WM17 4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis				
Perlidae				
early instar				
Doroneuria				
Hesperoperla pacifica	1			0.033
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta	2.667	7.067	12.433	4.967
Skwala				
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar				
Amiocentrus	4	8.133	6	9.033
Brachycentrus occidentalis				
Micrasema				
Glossomatidae				
early instar				
Agapetus				
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma		1		
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche				
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila				
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar		1		
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis			0.033	

Table B-5. Taxonomic enumeration and metrics for each kick sample collected at the Spring Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date Stream Site Kick	9/1/2004 Spring Creek WM17 1	9/1/2004 Spring Creek WM17 2	9/1/2004 Spring Creek WM17 3	9/1/2004 Spring Creek WM17 4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia				
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.	0.25	1.533	1.1	0.133
Brunnea/Vemna Grp.	4.81	1.467	1.133	1.1
Lieftincki Grp.	0.25	0.267	0.033	1.033
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus				
Heterlimnius	34	51	7	1
Ampumixis				
Lara				
Narpus				
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	104	75	111	104
Ceratopogonidae				
Ceratopogoninae				
Forcipomyiinae				
Dixidae				
Dixa				

Table B-5. Taxonomic enumeration and metrics for each kick sample collected at the Spring Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date **Stream** **Site** **Kick**	9/1/2004 Spring Creek WM17 1	9/1/2004 Spring Creek WM17 2	9/1/2004 Spring Creek WM17 3	9/1/2004 Spring Creek WM17 4
Diptera (continued)				
Empididae				
Chelifera	0.033			
Clinocera	1	4		
Hemerodromia				
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium				
Tabanidae				
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	1	2		
Dicranota				
Hesperoconopa				
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari	15	5	10	11
Nematoda	5	14		
Nematomorpha			1	
Turbellaria				
Tricladida	3	10		
Polycelis			28	33
Oligochaeta	62	44	17	16
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus		1		
Hyalellidae				
Hyalella	2		1	2
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea			2	1
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar		3		

Table B-5. Taxonomic enumeration and metrics for each kick sample collected at the Spring Creek site in the Upper Klamath Basin, Oregon, September 1, 2004.

Date	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Stream	Spring Creek	Spring Creek	Spring Creek	Spring Creek
Site	WM17	WM17	WM17	WM17
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola	35	47	73	18
Lymnaeidae				
early instar				
Lanx	0.2	0.2		2
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex	20	17	2	8
Subsample Total	302.3	299	313.933	237.4
Subsample factor	0.033	0.067	0.033	0.033
Expansion Factor	30	15	30	30
Kick total	9069	4485	9418	7122
Density (sq m)	50383.333	24916.667	52322.222	39566.667
Taxa Richness	21	24	21	20
EPT Richness	8	11	11	10
Ephem Taxa	2	2	3	2
Plecop Taxa	2	3	3	4
Trichop Taxa	4	6	5	4
H'	1.99	2.23	1.94	1.93
J'	0.65	0.70	0.64	0.64
Mod. HBI	5.31	5.04	4.76	4.97
% Dominance	34.40	25.08	35.36	43.81
% CG	69.19	58.37	54.90	62.70
% CF	0.00	0.25	0.00	0.00
% SC	18.91	25.20	20.64	10.92
% SH	0.00	1.09	8.13	5.95
% PR	7.11	8.22	13.30	16.11
% PA	4.13	5.52	1.91	2.32
% Other FFG	0.66	1.36	1.12	2.01
% Ephem	2.35	0.78	2.29	2.64
% Plecop	1.21	3.37	14.79	10.04
% Trichop	3.08	4.48	2.64	4.76
% Coleop	11.25	17.06	2.23	0.42
% Chiros	34.40	25.08	35.36	43.81
% Diptera	0.67	2.01	0.00	0.00
% other insect	0.00	0.00	0.00	0.00
% non-insect	47.04	47.22	42.68	38.33

Table B-6. Taxonomic enumeration and metrics for each kick sample collected at the Lower Sprague River site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date Stream Site Kick	9/2/2004 L. Sprague LSpr 1	9/2/2004 L. Sprague LSpr 2	9/2/2004 L. Sprague LSpr 3	9/2/2004 L. Sprague LSpr 4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus				
Baetidae				
Baetis (early instar)				
Baetis tricaudatus	7	10		4
Baetis bicaudatus	3	4	3	2
Acentrella	6	1	6	
Diphetor hageni				
Procleon				
Ephemerellidae				
early instar	1	1	1	2
Attenella				
Drunella doddsi				
Drunella grandis/spinifera	1			
Serratella tibialis				
Heptageniidae				
early instar		3		7
Cinygma			3	
Cinygmula				
Epeorus		0.1	4	1
Epeorus albertae	3			
Rhithrogena				
Leptohyphidae				
Asioplax				1
Leptophlebiidae				
Paraleptophlebia				
Odonata				
Coenagrionidae				
Argia	21.333	11.5	3.333	2.1
Gomphidae				
early instar				
Ophiogomphus	5.667	2.8	0.067	0.3
Plecoptera				
Chloroperlidae				
early instar				
Sweltsa				
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka				
Visoka cataractae				
Zapada (early instar)				
Zapada cinctipes				
Zapada Oregonensis Grp.				

Table B-6. Taxonomic enumeration and metrics for each kick sample collected at the Lower Sprague River site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date **Stream** **Site** **Kick**	9/2/2004 L. Sprague LSpr 1	9/2/2004 L. Sprague LSpr 2	9/2/2004 L. Sprague LSpr 3	9/2/2004 L. Sprague LSpr 4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis				
Perlidae				
early instar				
Doroneuria				
Hesperoperla pacifica				
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta				
Skwala				
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar			1	
Amiocentrus				
Brachycentrus occidentalis	1.833	0.7		
Micrasema				
Glossomatidae				
early instar				
Agapetus				
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma				
Protoptila				
Helicopsychidae				
Helicopsyche borealis	2		1	
Hydropsychidae				
Cheumatopsyche	10.182	16.421	18.9	45
Hydropsyche	5.818	9.579	2.1	
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila		4.8		1
Leucotrichia	3	1.2		
Leptoceridae				
early instar				
Nectopsyche			0.067	
Limnephilidae				
early instar				
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis				

Table B-6. Taxonomic enumeration and metrics for each kick sample collected at the Lower Sprague River site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date **Stream** **Site** **Kick**	9/2/2004 L. Sprague LSpr 1	9/2/2004 L. Sprague LSpr 2	9/2/2004 L. Sprague LSpr 3	9/2/2004 L. Sprague LSpr 4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia			1	
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.				
Brunnea/Vemna Grp.				
Lieftincki Grp.				
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila	19	11	8	10
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus	14	11	22	46
Heterlimnius				
Ampumixis				
Lara				
Narpus				
Rhizelmis				
Zaitzevia	1	2	4	5
Haliplidae				
Brychius	1	1	0.667	0.8
Hydrophilidae				
Enochrus	0.333			
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	34	25	6	9
Ceratopogonidae				
Ceratopogoninae				
Forcipomyiinae				
Dixidae				
Dixa				

Table B-6. Taxonomic enumeration and metrics for each kick sample collected at the Lower Sprague River site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date **Stream** **Site** **Kick**	9/2/2004 L. Sprague LSpr 1	9/2/2004 L. Sprague LSpr 2	9/2/2004 L. Sprague LSpr 3	9/2/2004 L. Sprague LSpr 4
Diptera (continued)				
Empididae				
Chelifera				
Clinocera				
Hemerodromia			1	1
Wiedemannia				
Ephydridae	1			
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium	12	28	34	5
Tabanidae				
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	1	0.1		0.1
Dicranota				
Hesperoconopa				
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari	1	2		2
Nematoda		1		
Nematomorpha		4	4	4
Turbellaria				
Tricladida	6	2	6	3
Polycelis				
Oligochaeta	7	9	3	4
Amphipoda				
early instar	2			
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella				
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea				
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar	7			2

Table B-6. Taxonomic enumeration and metrics for each kick sample collected at the Lower Sprague River site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	L. Sprague	L. Sprague	L. Sprague	L. Sprague
Site	LSpr	LSpr	LSpr	LSpr
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium		3	1.067	
Pisidium		23	1.067	
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola	67	63	138	105
Lymnaeidae				
early instar	2			
Lanx				
Physidae				
Physa	1			
Planorbidae				
early instar	3			
Vorticifex		3	7	6
Subsample Total	250.167	254.2	280.267	268.3
Subsample factor	0.167	0.1	0.067	0.1
Expansion Factor	6	10	15	10
Kick total	1501	2542	4204	2683
Density (sq m)	8338.889	14122.222	23355.556	14905.556
Taxa Richness	31	29	27	25
EPT Richness	11	11	11	8
Ephem Taxa	6	6	5	6
Plecop Taxa	0	0	0	0
Trichop Taxa	5	5	6	2
H'	2.67	2.65	2.01	2.07
J'	0.78	0.79	0.61	0.64
Mod. HBI	5.23	5.56	4.94	4.88
% Dominance	26.78	24.78	49.24	39.14
% CG	38.27	36.06	26.06	29.84
% CF	11.68	23.00	20.07	18.82
% SC	35.44	29.22	48.28	46.40
% SH	0.30	0.30	0.75	0.22
% PR	13.71	7.65	3.36	2.57
% PA	0.20	2.36	1.43	1.86
% Other FFG	0.40	1.42	0.04	0.28
% Ephem	8.39	7.51	6.07	6.34
% Plecop	0.00	0.00	0.00	0.00
% Trichop	9.13	12.86	8.59	17.14
% Coleop	6.53	5.51	9.51	19.31
% Chiros	13.59	9.83	2.14	3.35
% Diptera	5.60	11.05	12.49	2.27
% other insect	18.39	9.95	4.07	4.62
% non-insect	38.37	43.27	57.14	46.96

Table B-7. Taxonomic enumeration and metrics for each kick sample collected at the Trout Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Trout Creek	Trout Creek	Trout Creek	Trout Creek
Site	SP8	SP8	SP8	SP8
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus	1	1	2	3
Baetidae				
Baetis (early instar)				
Baetis tricaudatus	4	9.625	1	2
Baetis bicaudatus		1.375	1	
Acentrella				
Diphetor hageni				
Procleon				2
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi				
Drunella grandis/spinifera	4	6	4	4
Serratella tibialis				
Heptageniidae				
early instar		4	14	
Cinygma				
Cinygmula				2
Epeorus				
Epeorus albertae				
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia	2	1	4	4
Odonata				
Coenagrionidae				
Argia		0.033		0.1
Gomphidae				
early instar				
Ophiogomphus				
Plecoptera				
Chloroperlidae				
early instar				
Sweltsa			0.2	1.174
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka	35	35	26	39.494
Visoka cataractae				
Zapada (early instar)				
Zapada cinctipes				
Zapada Oregonensis Grp.				

Table B-7. Taxonomic enumeration and metrics for each kick sample collected at the Trout Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date **Stream** **Site** **Kick**	9/2/2004 Trout Creek SP8 1	9/2/2004 Trout Creek SP8 2	9/2/2004 Trout Creek SP8 3	9/2/2004 Trout Creek SP8 4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis		0.033	0.05	
Perlidae				
early instar				
Doroneuria		0.067	0.1	0.427
Hesperoperla pacifica				
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta				
Skwala	1.8	1.4	5	6.404
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar				
Amiocentrus				
Brachycentrus occidentalis				
Micrasema	7	14	5	5
Glossomatidae				
early instar				
Agapetus	1.1	3	6	9
Anagapetus				
Anagapeus/Glossosoma				
Glossosoma			3	
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche				
Parapsyche almota	16	0.533	0.55	0.4
Parapsyche elsis				
Hydroptilidae				
Hydroptila		6	2	
Leucotrichia				
Leptoceridae				
early instar	1			
Nectopsyche				
Limnephilidae				
early instar				
Allocosmoecus				
Psychoglypha bella			0.1	1.4
Psychoglypha subborealis		0.067	0.1	

Table B-7. Taxonomic enumeration and metrics for each kick sample collected at the Trout Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date Stream Site Kick	9/2/2004 Trout Creek SP8 1	9/2/2004 Trout Creek SP8 2	9/2/2004 Trout Creek SP8 3	9/2/2004 Trout Creek SP8 4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia	3	3	3	3
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.				
Brunnea/Vemna Grp.	9	1.4	0.35	1.2
Lieftincki Grp.				
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis			0.05	1
Lepdioptera				
Pyralidae				
Petrophila		1		
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus	10	25.65	7.972	
Heterlimnius	30	35.35	75.028	58
Ampumixis				
Lara				
Narpus				1
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus		0.033	0.15	
Diptera				
Chironomidae	100	154	69	55
Ceratopogonidae				
Ceratopogoninae	1	3	4	2
Forcipomyiinae	1			
Dixidae				
Dixa		1		

Table B-7. Taxonomic enumeration and metrics for each kick sample collected at the Trout Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date **Stream** **Site** **Kick**	9/2/2004 Trout Creek SP8 1	9/2/2004 Trout Creek SP8 2	9/2/2004 Trout Creek SP8 3	9/2/2004 Trout Creek SP8 4
Diptera (continued)				
Empididae				
Chelifera	1		1	
Clinocera				
Hemerodromia				
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma	1	2	4	4
Simuliidae				
Simulium	6	3		0.1
Tabanidae		0.067	0.15	
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	12	2	6	7
Dicranota	2	1	0.1	0.1
Hesperoconopa				
Hexatoma				
Yamatotipula				0.2
NON-INSECT TAXA				
Acari	7	6	5	1
Nematoda	2	0.033		1
Nematomorpha				
Turbellaria				
Tricladida			2	
Polycelis				6
Oligochaeta	1	6	4	
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella				
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea				
Ostracoda			1	
Bivalvia				
Sphaeriidae				
early instar		1		2

Table B-7. Taxonomic enumeration and metrics for each kick sample collected at the Trout Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Trout Creek	Trout Creek	Trout Creek	Trout Creek
Site	SP8	SP8	SP8	SP8
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola				
Lymnaeidae				
early instar		1	0.05	
Lanx				
Physidae				
Physa			0.1	0.3
Planorbidae				
early instar				1
Vorticifex				
Subsample Total	258.9	329.667	257.05	224.3
Subsample factor	0.1	0.033	0.05	0.1
Expansion Factor	10	30	20	10
Kick total	2589	9890	5141	2243
Density (sq m)	14383.333	54944.444	28561.111	12461.111
Taxa Richness	25	35	37	33
EPT Richness	12	17	20	16
Ephem Taxa	4	6	6	6
Plecop Taxa	2	4	5	4
Trichop Taxa	6	7	9	6
H'	2.21	2.04	2.26	2.26
J'	0.69	0.57	0.63	0.65
Mod. HBI	4.17	4.64	4.12	3.76
% Dominance	38.62	46.71	29.19	25.86
% CG	57.72	66.09	55.78	53.31
% CF	5.02	1.94	1.42	1.65
% SC	11.82	17.06	26.77	22.02
% SH	11.10	9.12	8.52	14.57
% PR	12.11	3.50	5.92	7.49
% PA	2.12	0.92	0.97	0.67
% Other FFG	0.10	1.37	0.62	0.29
% Ephem	4.25	6.98	10.11	7.58
% Plecop	14.21	11.07	12.20	21.18
% Trichop	14.33	8.49	7.82	8.92
% Coleop	15.45	18.51	32.35	26.30
% Chiros	38.62	46.71	26.84	24.52
% Diptera	9.27	3.66	5.93	5.97
% other insect	0.00	0.31	0.02	0.49
% non-insect	3.86	4.26	4.73	5.04

Table B-8. Taxonomic enumeration and metrics for each kick sample collected at the Demming Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Demming Creek	Demming Creek	Demming Creek	Demming Creek
Site	SP17	SP17	SP17	SP17
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus			0.4	0.467
Baetidae				
Baetis (early instar)				
Baetis tricaudatus		5	7	2
Baetis bicaudatus		2	2	1
Acentrella				
Diphetor hageni	7			
Procleon				
Ephemerellidae				
early instar				
Attenella				
Drunella doddsi		4	8	4
Drunella grandis/spinifera	1	2	2	2
Serratella tibialis	0.033	0.4	0.933	0.133
Heptageniidae				
early instar				
Cinygma				
Cinygmula	1	1	2	1.4
Epeorus				
Epeorus albertae				
Rhithrogena	2	0.4		0.067
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia	4		2	1
Odonata				
Coenagrionidae				
Argia				
Gomphidae				
early instar				
Ophiogomphus				
Plecoptera				
Chloroperlidae				
early instar	3	2	2	0.133
Sweltsa				
Leuctridae				
early instar		1		0.133
Moselia infuscata				
Nemouridae				
Malenka				
Visoka cataractae				1
Zapada (early instar)				
Zapada cinctipes	8	5	14	2
Zapada Oregonensis Grp.		7	4	4

Table B-8. Taxonomic enumeration and metrics for each kick sample collected at the Demming Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Demming Creek	Demming Creek	Demming Creek	Demming Creek
Site	SP17	SP17	SP17	SP17
Kick	1	2	3	4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis	15	8	14	3
Perlidae				
early instar				
Doroneuria	7.2	3.933	2.133	3.467
Hesperoperla pacifica				
Perlodidae				
early instar				
Isoperlinae				
Rickera sorpta				
Skwala				
Pteronarcyidae				
Pteronarcys (early instar)		0.133		0.067
Pteronarcys californica				
Pteronarcys princeps	0.2			
Trichoptera				
Apataniidae				
Pedomoecus sierra		0.133		0.067
Brachycentridae				
early instar				
Amiocentrus				
Brachycentrus occidentalis				
Micrasema	2	0.267	5	3
Glossomatidae				
early instar				
Agapetus				
Anagapetus	8			
Anagapeus/Glossosoma		17	16	6
Glossosoma				
Protoptila				
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche				
Parapsyche almota	7.333	3.368	2.667	2.765
Parapsyche elsis	3.667	0.898		0.369
Hydroptilidae				
Hydroptila				
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar			0.133	
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis				

Table B-8. Taxonomic enumeration and metrics for each kick sample collected at the Demming Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Demming Creek	Demming Creek	Demming Creek	Demming Creek
Site	SP17	SP17	SP17	SP17
Kick	1	2	3	4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes	4	3	5	5
Wormaldia				
Phryganeidae				
Yphria californica			1	
Psychomyiidae				
Psychomyia				
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.	1.033	0.133		
Brunnea/Vemna Grp.	1.133	1	0.267	1
Lieftincki Grp.				0.067
Uenoidae				
Neophylax			16	10
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus	8	8	7.4	1
Heterlimnius	20	30	21.6	28
Ampumixis		1		1
Lara	0.1	0.267	1.267	0.2
Narpus	0.033	0.533	1	0.133
Rhizelmis				
Zaitzevia				
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	37	29	24	14
Ceratopogonidae				
Ceratopogoninae	2	4	1	3
Forcipomyiinae				
Dixidae				
Dixa				

Table B-8. Taxonomic enumeration and metrics for each kick sample collected at the Demming Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Demming Creek	Demming Creek	Demming Creek	Demming Creek
Site	SP17	SP17	SP17	SP17
Kick	1	2	3	4
Diptera (continued)				
Empididae				
Chelifera	4	3	4	19
Clinocera				
Hemerodromia				
Wiedemannia				
Ephydridae				
Pelecorhynchidae				
Glutops	2	0.133		0.2
Psychodidae				
Pericoma	33	37	23	39
Simuliidae				
Simulium	1	1		
Tabanidae				
Thaumeleidae				
Thaumalea				1
Tipulidae				
Antocha		1		
Dicranota	2	1	1	
Hesperoconopa				
Hexatoma				
Yamatotipula				
NON-INSECT TAXA				
Acari	2	3	11	9
Nematoda	7	8	10	29
Nematomorpha				
Turbellaria				
Tricladida				2
Polycelis	12	9	5	
Oligochaeta	10	22	10	17
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella				
Decapoda				
Astacidae				
Pacifasticus leniusculus				
Isopoda				
Asellidae				
Caecidotea				
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar		3	3	2

Table B-8. Taxonomic enumeration and metrics for each kick sample collected at the Demming Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Demming Creek	Demming Creek	Demming Creek	Demming Creek
Site	SP17	SP17	SP17	SP17
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola				
Lymnaeidae				
early instar				
Lanx				
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex				
Subsample Total	215.733	228.6	229.8	219.667
Subsample factor	0.033	0.133	0.133	0.067
Expansion Factor	30	7.5	7.5	15
Kick total	6472	1714.5	1723.5	3295
Density (sq m)	35955.556	9525	9575	18305.556
Taxa Richness	33	40	35	42
EPT Richness	18	22	21	26
Ephem Taxa	6	7	8	9
Plecop Taxa	5	7	5	8
Trichop Taxa	7	8	8	9
H'	2.87	2.88	3.06	2.79
J'	0.82	0.78	0.86	0.75
Mod. HBI	3.71	3.88	3.51	4.17
% Dominance	17.15	16.19	10.44	17.75
% CG	46.48	49.46	36.86	38.23
% CF	3.59	2.54	2.79	2.86
% SC	16.72	23.42	29.34	22.54
% SH	10.52	8.05	13.32	4.38
% PR	18.62	12.15	10.72	16.72
% PA	3.71	4.16	6.74	15.25
% Other FFG	0.35	0.22	0.22	0.02
% Ephem	6.97	6.47	10.59	5.49
% Plecop	15.48	11.84	15.72	6.28
% Trichop	12.59	11.29	20.05	12.87
% Coleop	13.04	17.41	13.61	13.81
% Chiros	17.15	12.69	10.44	6.37
% Diptera	20.40	20.62	12.62	28.32
% other insect	0.00	0.00	0.00	0.00
% non-insect	14.37	19.69	16.97	26.86

Table B-9. Taxonomic enumeration and metrics for each kick sample collected at the Long Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Long Creek	Long Creek	Long Creek	Long Creek
Site	SY8	SY8	SY8	SY8
Kick	1	2	3	4
INSECT TAXA				
Ephemeroptera				
Ameletidae				
Ameletus	0.033	1.133		0.2
Baetidae				
Baetis (early instar)				
Baetis tricaudatus	6	7	5	2
Baetis bicaudatus				
Acentrella				1
Diphetor hageni				
Procleon				
Ephemerellidae				
early instar				
Attenella	14	19	6	6
Drunella doddsi				
Drunella grandis/spinifera	0.033	0.067	0.067	1
Serratella tibialis	0.033	0.067	0.2	0.2
Heptageniidae				
early instar			2	
Cinygma				
Cinygmula				
Epeorus				
Epeorus albertae				
Rhithrogena				
Leptohyphidae				
Asioplax				
Leptophlebiidae				
Paraleptophlebia		2	1	
Odonata				
Coenagrionidae				
Argia				
Gomphidae				
early instar				
Ophiogomphus		0.067		
Plecoptera				
Chloroperlidae				
early instar	1	8		14
Sweltsa			10	
Leuctridae				
early instar				
Moselia infuscata				
Nemouridae				
Malenka				
Visoka cataractae				
Zapada (early instar)				
Zapada cinctipes	1	2	3	5
Zapada Oregonensis Grp.				

Table B-9. Taxonomic enumeration and metrics for each kick sample collected at the Long Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Long Creek	Long Creek	Long Creek	Long Creek
Site	SY8	SY8	SY8	SY8
Kick	1	2	3	4
Plecoptera (continued)				
Peltoperlidae				
Yoraperla brevis		1		1
Perlidae				
early instar	1			
Doroneuria		0.2	0.2	0.2
Hesperoperla pacifica		0.067		
Perlodidae				
early instar				
Isoperlinae	0.267			
Rickera sorpta				
Skwala	0.1	1	2	1
Pteronarcyidae				
Pteronarcys (early instar)				
Pteronarcys californica				
Pteronarcys princeps				
Trichoptera				
Apataniidae				
Pedomoecus sierra				
Brachycentridae				
early instar				
Amiocentrus	1	1		1
Brachycentrus occidentalis				
Micrasema	1	1	0.4	2
Glossomatidae				
early instar				
Agapetus				
Anagapetus				
Anagapeus/Glossosoma	6	8	3	4
Glossosoma				
Protoptila		1	5	1
Helicopsychidae				
Helicopsyche borealis				
Hydropsychidae				
Cheumatopsyche				
Hydropsyche	22	13	15	8
Parapsyche almota				
Parapsyche elsis				
Hydroptilidae				
Hydroptila		0.067		
Leucotrichia				
Leptoceridae				
early instar				
Nectopsyche				
Limnephilidae				
early instar				
Allocosmoecus				
Psychoglypha bella				
Psychoglypha subborealis				

Table B-9. Taxonomic enumeration and metrics for each kick sample collected at the Long Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Long Creek	Long Creek	Long Creek	Long Creek
Site	SY8	SY8	SY8	SY8
Kick	1	2	3	4
Trichoptera (continued)				
Philopotamidae				
Dolophilodes				
Wormaldia				
Phryganeidae				
Yphria californica				
Psychomyiidae				
Psychomyia				1
Tinodes				
Rhyacophilidae				
Rhyacophila				
Betteni Grp.				
Brunnea/Vemna Grp.	1.033	0.2	0.8	0.5
Lieftincki Grp.	0.2	0.733	0.8	0.7
Uenoidae				
Neophylax				
Megaloptera				
Sialidae				
Sialis				
Lepdioptera				
Pyralidae				
Petrophila				
Hemiptera				
Gelastocoridae				
Gelastocoris				
Coleoptera				
Elmidae				
Optioservus	8	21	30.8	33
Heterlimnius			1.2	
Ampumixis				
Lara				
Narpus		1	1	1
Rhizelmis		1		
Zaitzevia			0.067	
Haliplidae				
Brychius				
Hydrophilidae				
Enochrus				
Dytiscidae				
Hygrotus				
Diptera				
Chironomidae	20	76	68	116
Ceratopogonidae				
Ceratopogoninae			2	
Forcipomyiinae				
Dixidae				
Dixa				

Table B-9. Taxonomic enumeration and metrics for each kick sample collected at the Long Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date / **Stream** / **Site** / **Kick**	9/2/2004 Long Creek SY8 1	9/2/2004 Long Creek SY8 2	9/2/2004 Long Creek SY8 3	9/2/2004 Long Creek SY8 4
Diptera (continued)				
Empididae				
Chelifera	1	6	11	9
Clinocera				
Hemerodromia				
Wiedemannia			2	
Ephydridae				
Pelecorhynchidae				
Glutops				
Psychodidae				
Pericoma				
Simuliidae				
Simulium	6			
Tabanidae		0.067		
Thaumeleidae				
Thaumalea				
Tipulidae				
Antocha	7	6	3	5
Dicranota			0.067	
Hesperoconopa			0.2	0.2
Hexatoma	1	8.2	2	10
Yamatotipula				0.1
NON-INSECT TAXA				
Acari	3	2	3	3
Nematoda	69	12	40	26
Nematomorpha				
Turbellaria				
Tricladida				
Polycelis				
Oligochaeta	26	17	50	24
Amphipoda				
early instar				
Crangonyctidiae				
Crangonyx				
Stygobromus				
Hyalellidae				
Hyalella				
Decapoda				
Astacidae				
Pacifasticus leniusculus				0.1
Isopoda				
Asellidae				
Caecidotea				
Ostracoda				
Bivalvia				
Sphaeriidae				
early instar		9	1	1

Table B-9. Taxonomic enumeration and metrics for each kick sample collected at the Long Creek site in the Upper Klamath Basin, Oregon, September 2, 2004.

Date	9/2/2004	9/2/2004	9/2/2004	9/2/2004
Stream	Long Creek	Long Creek	Long Creek	Long Creek
Site	SY8	SY8	SY8	SY8
Kick	1	2	3	4
Bivalvia (continued)				
Sphaerium				
Pisidium				
Unionoidea				
early instar				
Margaritiferidae				
Margaritifera falcata				
Gastropoda				
Ancylidae				
Hydrobiidae				
Fluminicola				
Lymnaeidae				
early instar				
Lanx				
Physidae				
Physa				
Planorbidae				
early instar				
Vorticifex				
Subsample Total	195.7	225.867	269.8	278.2
Subsample factor	0.033	0.067	0.067	0.1
Expansion Factor	30	15	15	10
Kick total	5871	3388	4047	2782
Density (sq m)	32616.667	18822.222	22483.333	15455.556
Taxa Richness	25	33	32	32
EPT Richness	16	20	16	19
Ephem Taxa	5	6	6	6
Plecop Taxa	5	6	4	5
Trichop Taxa	6	8	6	8
H'	2.18	2.44	2.37	2.17
J'	0.68	0.70	0.68	0.63
Mod. HBI	4.59	4.57	4.86	4.74
% Dominance	35.26	33.65	25.20	41.70
% CG	36.22	61.05	54.90	61.73
% CF	11.50	5.31	4.26	2.25
% SC	9.09	13.55	11.27	10.03
% SH	0.51	1.44	0.96	1.91
% PR	6.27	11.76	12.30	12.75
% PA	36.02	5.76	15.38	9.88
% Other FFG	0.38	1.13	0.93	1.46
% Ephem	10.27	12.96	5.29	3.74
% Plecop	1.72	5.43	5.63	7.62
% Trichop	15.96	11.07	9.27	6.54
% Coleop	4.09	10.18	12.26	12.22
% Chiros	10.22	33.65	25.20	41.70
% Diptera	7.66	8.97	7.51	8.73
% other insect	0.00	0.03	0.00	0.00
% non-insect	50.08	17.71	34.84	19.45