Baseline Monitoring of the Benthos in Winter Quarters Canyon Creek & Woods Canyon Creek

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INTRODUCTION

The coal underlying both Woods Canyon and Winter Quarters Canyon is scheduled to be mined. This report gives the results of the first year of monitoring of the benthos of the stream system. These data will establish baseline conditions against which any impacts due to the mining and subsequent subsidence can be compared.

METHODS

Sample placement was determined by examination of the stream systems on USGS 7.5 minute quadrangles. Two to three reaches were examined on each stream, with each reach being defined by the inflow of a side stream and the general distance from the previous reach. The lowest reaches in the two streams were established on U. S. Forest Service land above the boundary with private grazing lands. The location of each reach is given in Table 1. Four riffles were sampled within each reach in the fall of 2002, but this was increased to 8 riffles in the spring of 2004. Two samples were taken at each riffle and were bulked together in the field.

Table 1. Location of reach stations on each stream.

Canyon	Reach	GPS coordinates	Elevation
Woods	Upper	N 39° 44.340' W 111° 13.471' UTM4398045 12S0480808	2609 m (8560 ft)
Woods	Lower	N 39° 44.071' W 111° 12.592'	2552 m (8374 ft)
Winter Quarters	Upper	N 39° 42.763' W 111° 13.907'	2587 m (8488 ft)
Winter Quarters	Middle	N 39° 42.933' W 111° 13.378'	2571 m (8434 ft)
Winter Quarters	Lower	N 39° 43.126' W 111° 12.807'	2519 m (8265 ft)

Physical characteristics for each reach were recorded (Table 2, 3). These included pH, conductivity, in micro-Siemens/cm (uS/cm), alkalinity, and hardness. Alkalinity and hardness were measured with a Hach water chemistry kit. Slope was recorded with an inclinometer, across a 100 meter length of stream, beginning at the first (starting downstream) riffle. The stream channel within each reach was characterized by measuring the width, depth, and velocity of the stream every five meters, beginning with the first riffle. Three depth and velocity measures were taken at each five meter interval, these being at the center and approximately 10% of the width from either shore.

Quantitative invertebrate samples were taken with a modified box sampler (Shiozawa 1986) using a capture net with a net mesh of 253 microns. Samples were taken from each of the three reaches in Winter Quarters Canyon and the two reaches in Woods Canyon. Samples were concentrated in

the field in sieves with 63 micron mesh, preserved with ethyl alcohol, and were returned to the laboratory for processing. In the laboratory the samples were sorted in an illuminated pan. Organisms were identified to the lowest taxonomic unit possible. Small specimens and those of questionable identity were further examined under magnification. Identification was based on the keys of Merritt and Cummins (1994). The mean values for each taxon were used to determine the density of invertebrates per square meter. Standing crop was estimated from wet weights of total invertebrates collected at the station.

The USFS Biotic Condition Index (Winget and Mangum 1979) was calculated with the community tolerance quotient (CTQa). The predicted community tolerance quotient (CTQp), based on water chemistry data provided in Winget (1972) for the Huntington Creek drainage, is 80. Diversity was calculated for each reach using the Shannon-Weiner index (Pielou 1977). Diversity indices take the number of taxa and their individual densities into account, generating a single value for each station. The greater the number of species or taxa and generally the more even the distribution of densities between taxa, the higher the diversity index value.

Cluster analysis was run with NTSYS-pc (Rolf 2000), using the Bray-Curtis dissimilarity index with the UPGM clustering algorithm. Data from all reaches for the first two sampling periods (fall 2002 and spring 2003) and from both Woods Canyon Creek and Winter Quarters Canyon Creek were included in the cluster analysis.

Since these samples are to be used to establish pre-mining base-line information, the most important information for future assessment will be the actual densities and taxa lists. The CTQa, diversity indices, and cluster analysis will serve to help understand relative associations between the two streams, seasonality effects, and within stream trends. As with all field collected data, annual variations in weather patterns (e.g. the ongoing drought in Utah) will need to be taken into account in interpreting the data.

RESULTS AND DISCUSSION

Physical Characterization

The stream channel slopes also become more shallow as the streams proceed down the canyons, a typical geomorphological profile for stream systems draining mountainous areas (Horton 1945). Channel depth and width increase downstream, as would be expected with the influx of additional water from the watershed and mean velocity also increased downstream, despite the decline in the stream channel slope. The increase in velocity is likely related to the increase in

Table 2. Physical characterization of Woods Canyon Creek.

1 - Upper site 2 - Lower Site

Date	Site	Alkalinity mg/L $CaCO_3$ equvalents	Hardness mg/L $CaCO_3$ equvalents	Conductivity (uS/cm)	slope	mean depth (cm)	mean width (m)	mean velocity (m/s)	pH
10/19/02	1	136.8	273.6	415	4.0°	3.6	1.213	0.268	8.30
	2	188.1	324.9	452	3.5°	4.333	1.157	0.327	8.23
6/27/03	1	119.7	222.3	351	4.0°	5.267	1.645	0.187	8.18
	2	136.8	239.4	393	3.5°	6.250	1.345	0.276	8.42

Table 3. Physical characterization of Winter Quarters Canyon Creek.

1 - Upper site 2 - Middle site 3 - Lower Site

Date	Site	Alkalinity mg/L $CaCO_3$ equvalents	Hardness mg/L $CaCO_3$ equvalents	Conductivity (uS/cm)	slope	mean depth (cm)	mean width (m)	mean velocity (m/s)	pH
10/18/02	1	119.7	188.1	343	4.0°	5.8	1.028	0.199	8.26
	2	136.8	273.6	371	3.0°	6.367	1.252	0.240	8.34
	3	136.8	256.5	390	2.5°	6.983	2.129	0.222	8.32
6/20/03	1	51.3	136.8	239	4.0°	8.633	1.215	0.224	8.39
	2	85.5	153.9	275	3.0°	8.3	1.799	0.333	8.60
	3	119.7	205.2	352	2.5°	11.433	2.07	0.399	8.62

discharge in the lower reaches of the stream system, the greater mean depth, and the reduced turbulence associated with the increase in depth.

The chemical characteristics of the streams appear typical for high desert systems draining exposed sedimentary bedrock. As a general rule, alkalinity, hardness, and conductivity increased in the downstream reaches as the water in the channel accumulated salts from streams, springs, and seeps enters the main channel. All three are measures of ions in the water. Alkalinity is generally a measure of carbonate concentration, while hardness is a measure of divalent cations (mainly Ca and Mg). In these two streams the total hardness is consistently greater than alkalinity. If the ions in the systems were purely due to carbonates of calcium and magnesium, we would expect alkalinity to equal hardness. However higher hardness readings indicates that the remaining anions in the system are chlorides, sulfates, silicates, or nitrates (Boyd 1990). Given the origin of the bedrock it is likely that the major anions are sulfates and chlorides. It does appear that in the spring, the upper reach of Winter Quarters Canyon has a higher portion of its anions made up of these unmeasured species, even though the total ion loads are about a third of the fall concentration. This could be associated with a differential mobilization of anions during the higher discharge associate with the spring runoff.

The pH shows a general trend of increasing downstream. The pH, while at the high end of the normal scale for natural waters (about 8.5; Hem 1971) may be partially confounded with time of day, since our standard sampling protocol starts with sample collection in the upstream reach first and then we progressively sample the downstream reaches. Such an approach could be biased by the amount of photosynthetic activity taking place in the stream channel. The upper reaches of these two stream systems often have a greater amounts of sand and that the lower reaches tend to be embedded and often somewhat cemented in by travertine, a calcium carbonate deposit. The photosynthetic activity of algae, as well as the physical loss of carbon dioxide from the stream water will cause the precipitation of travertine on the substratum (Hynes 1972). Algae utilizes bicarbonate for the carbon source in photosynthesis, and in the process increases the pH. This facilitates the precipitation of calcium carbonate. Photosynthesis takes place during the day, increasing as the light intensity increases. Thus in the afternoon, photosynthesis would be maximum and that is the same time that we tend to be sampling the downstream reaches of the two streams.

Biological Characterization

Density and Number of Taxa

Thirty five taxa were collected in the upper site of Woods Canyon in the fall of 2002 (Table 4; Appendix 1a), with a mean density of 16,081 organisms per square meter. The dominant taxa, ranked by the most abundant first, with the minimum abundance level included being 500 per square meter, were chironomids, *Cinygmula*, *Optioservus*, *Pericoma*, Ostracoda, *Ephemerella*, *Zapada*, *Baetis*, and *Rhyacophila*. The lower reach of Woods Canyon in the fall of 2002, had a mean density of 21,212 organisms per square meter and 36 taxa (Table 4; Appendix 1b). The dominant taxa in that

reach using the same ranking criteria, were chironomids, ostracods, *Pericoma*, *Zapada*, *Optioservus*, and *Cinygmula*.

During that same fall sampling period, the three reaches sampled in Winter Quarters Canyon showed a total of 9,377 invertebrates per square meter and 37 taxa in the upper reach (Table 5; Appendix 2a), 8,095 invertebrates per square meter and 30 taxa in the middle reach (Table 5; Appendix 2b), and 16,040 invertebrates per square meter and 40 taxa in the lower reach (Table 5; Appendix 2c). The most abundant taxa, in order of decreasing abundance, in upper Winter Quarters Canyon, were *Optioservus*, *Pericoma*, chironomids, *Baetis*, and oligochaetes. Middle Winter Quarters Canyon had four abundant taxa, chironomids, *Baetis*, *Optioservus*, and ostracods. Lower Winter Quarters Canyon was dominated by *Antocha*, chironomids, *Baetis*, *Cinygmula*, *Optioservus*, *Hydropsyche*, Ostracoda, and Oligochaeta. In Winter Quarters Canyon chironomids were not always the most abundant taxon.

The spring 2003 samples uniformly showed an increase in the number of individual organisms. Upper and Lower Woods Canyon had 26,400 and 40,251 organisms per square meter respectively (Table 4; Appendix 3a, 3b), compared with the 16,081 and 21,212 per square meter in the fall of 2002. Winter Quarters Canyon density estimates changed from 9,377 in the upper reach, fall 2002, to 36,246 in the spring sampling period (Table 5; Appendix 4a). The middle reach increased from 8,095 in the fall to 40,680 in the spring (Table 5; Appendix 4b). The lower reach increased from 16,040 to 42,421 organisms per square meter (Table 5; Appendix 4c). The number of taxa ranged from 31 to 45 in Woods Canyon and 30 to 43 in Winter Quarters Canyon.

The number of taxa at any given reach is within the range seen in the early sampling of Eccles Creek (Shiozawa 2002). There the number of taxa ranged from 20 to 40. Since the sampling methods utilized in the Eccles study included fewer samples, but a larger area per sample, those studies were likely to have fewer total taxa collected per site. Never-the-less, the similarities in total taxa counts indicates that the benthic communities in Woods and Winter Quarters canyons are relatively good estimates. Densities are also well within the range found in the early Eccles Creek studies. The procedures being utilized in our lab are likely to increase total invertebrate recovery, and thus density estimates, since the samples are sorted both on a light tray and then the remaining material is subsampled so that the number of small organisms, which were incompletely removed when the samples were sorted with the unaided eye, can be estimated.

Biotic Condition Index

Winget and Magnum (1979) proposed a community tolerance measure as a part of their Biotic Condition Index. After surveying invertebrates over a wide range of habitat and water quality conditions, they assigned a tolerance value to each taxon. Species that are capable of surviving under a range of conditions receive a tolerance value of 108. Those species requiring more pristine conditions receive a lower tolerance value. The actual community tolerance quotient, or CTQa is the mean tolerance value for all taxa in the community surveyed. The CTQa value should increase with increasing stress on a system. The community tolerance quotient was calculated for all sampled

reaches on the two streams (Table 6). The values ranged from 49 to 67, all lower than the CTQp of 80 based on Huntington Canyon water chemistry data. The CTQa valuse are very similar to those recorded for Eccles Creek between 1979 and 1985 (Shiozawa 2002).

The Biotic Condition Index of Winget and Magnum (1979) is the percent of the predicted community tolerance quotient (CTQp) found in the actual community tolerance quotient (CTQa). That is it is the CTQp divided by CTQa times 100. The CTQp was estimated at 80, using water chemistry data from nearby streams, since sulfate levels were not measured in either Woods or Winter Quarters Canyons. The BCI values (Table 7) were all greater than 100, indicating that the stream reaches were all of higher quality than predicted by the water quality and slope parameters for the streams.

Table 4. Summary of densities for Woods Canyon, in #/m^2

Woods Canyon Summary		Upper Woods Canyon		Lower Woods Canyon	
Order	Taxa	10-19-02	6-27-03	10-19-02	6-27-03
Ephemeroptera	Early instar ephemerilids		5992		4206
	Baetis	708	2547	303	8533
	Cinygmula	2257	597	595	835
	Drunella doddsi		172		8
	Drunella grandis				98
	Epeorus iron	311	9		165
	Ephemerella	739		140	
	Paraleptophlebia	87	6	193	
	Rhithrogena	91		27	
Plecoptera	Early instar Plecoptera	542	303	129	835
	Allopera severa				
	Alloperla				
	Claassenia sabulosa				
	Hesperoperla pacifica	424	159	341	142
	Isocapnia				
	Isoperla	45		19	6
	Malenka				
	Megarcys signata	4			
	Paraperla		42		9
	Pteronarcella badia			8	
	Skwalla parallela			11	
	Sweltza			53	
	Zapada	731	30	1015	49
Trichoptera	Pupae		47		95
	Arctopsyche	250	15	38	8
	Brachycentrus echo	4	72		78

Woods Canyon Summary		Upper Woods Canyon		Lower Woods Canyon	
	Chyranda				
	Dicosmoecus	4	19	4	36
	Dolophilodes				
	Hesperophylax				6
	Hydropsyche	38		11	36
	Hydroptila sp.				
	Lepidostoma	148		68	
	Limnephilus				32
	Micrasema				2
	Neothremma alicia	216	55	53	38
	Oecetis				
	Oligophlebodes				2
	Psychomyia		106		195
	Rhyacophila (larvae)	633	66	314	49
Coleoptera	*Agabus*				
	Heterlimnius (larvae)		9		384
	Heterlimnius (adult)	34		91	27
	Hydrophilidae	23			
	Optioservus (larvae)	1011	1566	864	1083
	Optioservus (adult)	15	25	30	6
	Peltodytes callosus				2
	Staphylinidae				
Diptera	pupae				4
	Antocha (Tipulidae)	163		27	4
	Atherix				8
	Ceratopogonidae		502	186	447
	Chelifera				27
	Chironomidae (larvae)	5405	7940	7655	13707

Woods Canyon Summary		Upper Woods Canyon		Lower Woods Canyon	
	Chironomidae (pupae)	23	17	42	144
	Chrysops				
	Dicranota				
	Dixa				13
	Euparyphus	4		182	
	Hemerodromia			45	2
	Limnophora			4	
	Pericoma (Psychodidae)	985		3553	61
	Simulium (larvae)	91	4	261	19
	Simulium (pupae)				
	Tipula	30	47	30	40
Hemiptera	Corixidae				
Collembola		49		64	
Crustacea	Cladocera				
	Copeopoda		3600		1481
	Isopod		2		
	Ostracoda	784	581	4030	5865
Arachnida	*Hydracarina*	114	1553	424	659
Mollusca	*Gyraulus*				
	Sphaerium	4	76		320
Annelida	Hirudinea				
	Oligochaeta	42	241	288	485
Platyhelimenthes	Planariidae	72		114	
Total density		16,081	26,400	21,212	40,251
Number of taxa		35	31	36	45

Table 5. Summary of densities for Winter Quarters Canyon, in #/m^2

Winter Quarters Summary		Upper Winter Quarters Canyon		Middle Winter Quarters Canyon		Lower Winter Quarters Canyon	
		10-18-02	6-20-03	10-18-02	6-20-03	10-18-02	6-20-03
Ephemeroptera	Early instar ephemerilids		1261		3664		1924
	Baetis	1034	3305	1432	5704	1962	13851
	Cinygmula	159	502	473	1045	1519	828
	Drunella doddsi		123		74	4	40
	Drunella grandis		6		57	68	15
	Epeorus iron		93		91		259
	Ephemerella	470	30	417	34	250	148
	Paraleptophlebia	61		19		80	
	Rhithrogena	19		80		23	
Plecoptera	Early instar Plecoptera	34	1165	34	1642	49	415
	Allopera severa				4		
	Alloperla						
	Claassenia sabulosa				2		2
	Hesperoperla pacifica	49	25		72	15	8
	Isocapnia				4		
	Isoperla	11	6		9	8	
	Malenka						
	Megarcys signata						
	Paraperla				2		
	Pteronarcella badia					4	
	Skwalla parallela	27		19	2	4	
	Sweltza	159		129	19	261	27
	Zapada	163	17	38	23	45	8
Trichoptera	Pupae		30		40		19
	Arctopsyche	4	2		4	8	

Winter Quarters Summary		Upper Winter Quarters Canyon		Middle Winter Quarters Canyon		Lower Winter Quarters Canyon	
	Brachycentrus echo		2				2
	Chyranda	4					
	Dicosmoecus					8	2
	Dolophilodes		2				
	Hesperophylax		2				
	Hydropsyche	42	4	98	11	1004	83
	Hydroptila sp.	11					
	Lepidostoma	144		98		49	
	Limnephilus				9		6
	Micrasema	15					
	Neothremma alicia	45	256	4	278	8	13
	Oecetis	95					
	Oligophlebodes		72		4		
	Psychomyia		178		280		216
	Rhyacophila (larvae)	57		170		261	
Coleoptera	*Agabus*						6
	Heterlimnius (larvae)		142		27		
	Heterlimnius (adult)	144	38	68	2	45	
	Hydrophilidae						
	Optioservus (larvae)	1799	3070	1326	3314	1125	1712
	Optioservus (adult)	19	174	15	97	30	30
	Peltodytes callosus						
	Staphylinidae		2				
Diptera	pupae						51
	Antocha (Tipulidae)	133	2	462	333	4693	2411
	Atherix						
	Ceratopogonidae	269	795	76	786	178	216
	Chelifera				102		59

Winter Quarters Summary		Upper Winter Quarters Canyon		Middle Winter Quarters Canyon		Lower Winter Quarters Canyon	
	Chironomidae (larvae)	1288	19426	2079	17233	2504	11622
	Chironomidae (pupae)		337	19	473	102	294
	Chrysops	38		8		4	
	Dicranota		19		2		
	Dixa		2		6		
	Euparyphus	38				163	
	Hemerodromia	27	6			8	
	Limnophora	4				8	
	Pericoma (Psychodidae)	1773	61		2	216	95
	Simulium (larvae)	136	8	189	331	38	4625
	Simulium (pupae)						
	Tipula	45	34	4	6	11	2
Hemiptera	Corixidae		2		2		
Collembola		38				4	
Crustacea	Cladocera		91		116		
	Copeopoda		875		699		233
	Isopod						
	Ostracoda		1371	534	2195	708	1417
Arachnida	*Hydracarina*	276	1638	34	1240	19	1280
Mollusca	*Gyraulus*				2		2
	Sphaerium	114	837	8	619	8	481
Annelida	Hirudinea			8			
	Oligochaeta	633	231	114	19	538	19
Platyhelimenthes	Planariidae			140		8	
Total density		9,377	36,246	8,095	40,680	16,040	42,421
Number of taxa		37	43	30	36	40	37

Table 6. Actual Community Tolerance Quotient, CTQa values.

CTQa	Woods Canyon		Winter Quarters Canyon		
	Upper	Lower	Upper	Middle	Lower
Fall 2002	58.85	61.35	67.04	55.00	67.87
Spring 2003	65.82	65.49	61.62	61.05	49.15

Table 7. Biotic Condition Index, based on a CTQp value of 80.

BCI	Woods Canyon		Winter Quarters Canyon		
	Upper	Lower	Upper	Middle	Lower
Fall 2002	135.9	130.4	119.3	145.5	117.9
Spring 2003	121.5	122.2	129.8	131.0	162.8

Diversity

Generally, the higher the diversity value, the higher the information content of the community and thus the higher the quality of the community. Systems with low diversity tend to be dominated by high densities of just a few species or taxa, while those with high diversity values tend to have many species with a more even proportional distribution of density per species. The diversity values for all reaches of both streams (Table 8) were similar to one another, ranging between 1.8785 to 2.5944. These values are in the low range for those recorded in the upper reaches of Eccles Creek in the late 1970s and 1980s (Winget 1980, Baumann 1985, Shiozawa 2002). However the samples taken from Woods Canyon and Winter Quarters Canyon are from small systems that had been exposed to four to five years of drought conditions. Combined effects of a drought and road construction in 1980 was similarly detected in Eccles Creek data (Shiozawa 2002). For that reason the diversity values, while lower than the average in the early Eccles Creek studies, should still help identify significant changes in the system.

Table 8. Diversity indices based on natural logs.

Diversity	Woods Canyon		Winter Quarters Canyon		
	Upper	Lower	Upper	Middle	Lower
Fall 2002	2.30245	2.1379	2.29948	2.40171	2.59438
Spring 2003	1.87974	2.06276	1.8785	2.09277	2.03368

Cluster Analysis

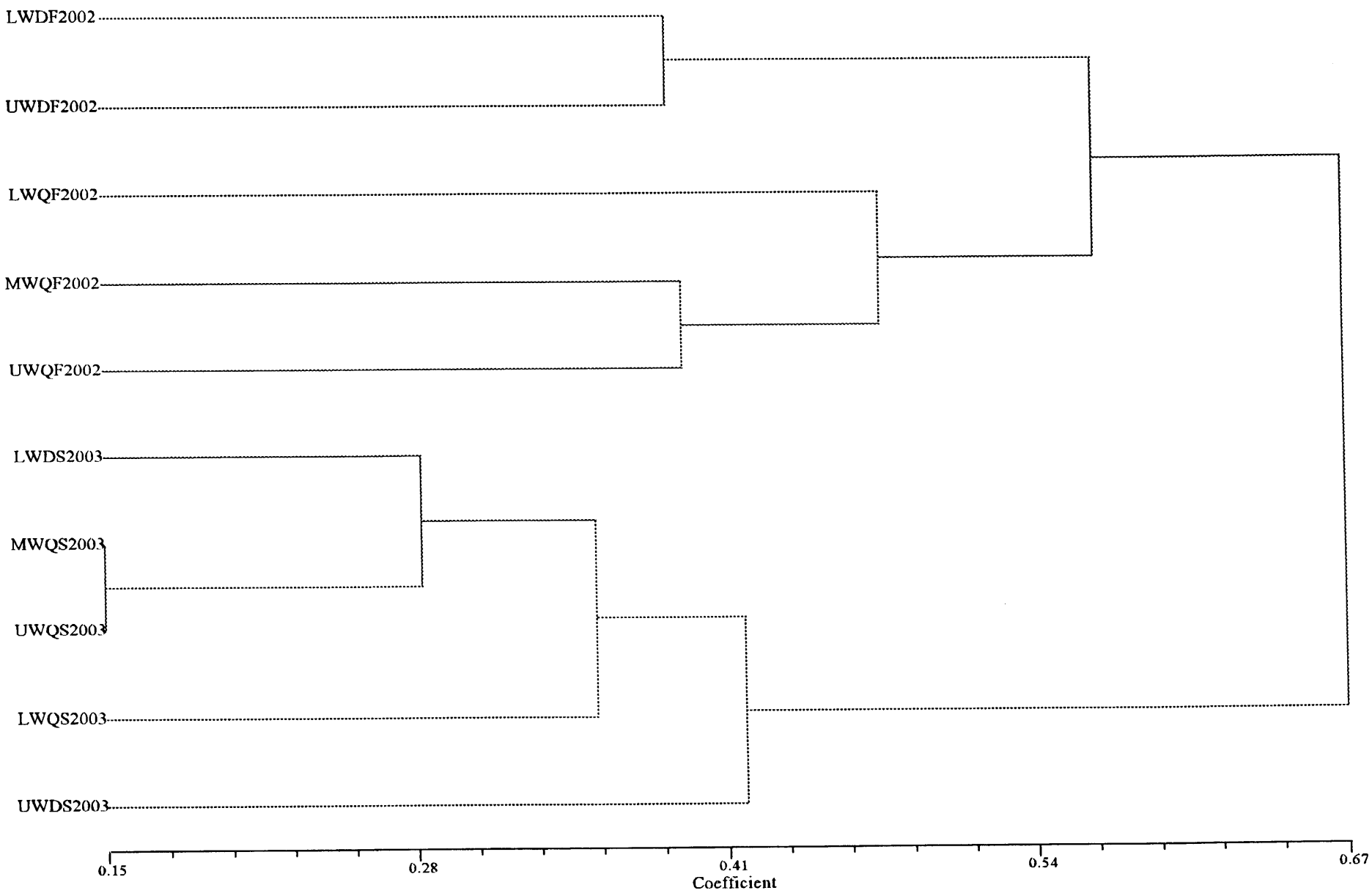
The cluster analysis, utilizing the Bray Curtis index of dissimilarity (Poole 1974) is depicted in Figure 1. Two notable factors are apparent. First the sampling shows a distinct seasonal signal, with all fall 2002 samples forming one cluster and all spring 2003 samples forming another. Such seasonal signals were expected. The second factor is that the reaches samples in the fall separated into two sub clusters, one with Woods Canyon and the other with Winter Quarters Canyon. This may suggest that the two streams are somewhat different in their fall composition. The major differences (see tables 3 and 4) are associated with 11 taxa. Woods canyon has fewer *Baetis*, more early instar plecopterans, more *Hesperoperla pacifica*, fewer *Sweltza*, more *Zapada*, more *Arctopsyche*, fewer *Hydropsyche*, more *Neothremma*, more *Rhyacophila*, fewer *Heterolimnius*, and more chironomid larvae. Since this report represents only two sampling period, it is not possible to determine whether or not a broader pattern exists where all or some of these taxa are more dominant in one or the other stream system. This is something to examine in future summaries since it could reflect some basic differences between the trophic make up of the two streams.

CONCLUSIONS

These data are the first of a series of sampling periods where the baseline conditions of the stream systems will be established. These data will ultimately give a cumulative picture of the dynamics of the system prior to subsidence. The confounding dynamics of the drought do need to be taken into account since it is possible that fall conditions along the stream riparian will differ significantly if more forage is available during normal water years. It is also possible that higher spring runoff during years with more normal snow packs could act to physically restructure the spring invertebrate community. Hopefully more normal weather conditions will return during the period while the baseline data is being generated.

At this point in time only one adjustment is recommended, that we establish the slope of the stream reach as being just the distance of the reach that is measured for stream flow information rather than from the lowest riffle to the upper rifle of the sample series. That would require determining the slope at the end of each sampling session on the measured portion of the stream reach. This distance is relatively fixed since measurements are taken every 5 meters from the starting riffle. However the fractal nature of stream channels is such that unless permanent markers are placed along the stream, each time the stream length is measured it will vary by how closely one follows the stream border when determining linear distance. The slope along the length of stream measured for physical parameters would more accurately reflect the other measured physical stream parameters.

Figure 1. Culster dendrogram for Woods (WD) and Winter Quarters (WQ) canyons. U= upper, M = middle, L = lower, F = fall, S =spring



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APPENDIX

Appendix 1a. Fall 2002 invertebrate data for the four riffles sampled from upper Woods Canyon

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m²
Ephemeroptera	Early instar ephemerilids						
	Baetis	36	52	33	66	46.75	708
	Cinygmula	82	167	121	226	149	2257
	Drunella doddsi						
	Drunella grandis						
	Epeorus iron	73	7	2	0	20.5	311
	Ephemerella	36	42	24	93	48.75	739
	Paraleptophlebia	3	13	3	4	5.75	87
	Rhithrogena	7	7	9	1	6	91
Plecoptera	Early instar Plecoptera	24	53	34	32	35.75	542
	Allopera severa						
	Alloperla						
	Claassenia sabulosa						
	Hesperoperla pacifica	8	59	30	15	28	424
	Isocapnia						
	Isoperla	6	6	0	0	3	45
	Malenka						
	Megarcys signata	0	1	0	0	0.25	4
	Paraperla						
	Pteronarcella badia						
	Skwalla parallela						
	Sweltza						
	Zapada	26	72	36	59	48.25	731
Trichoptera	Pupae						
	Arctopsyche	4	30	19	13	16.5	250
	Brachycentrus echo	0	0	0	1	0.25	4

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chyranda						
	Dicosmoecus	0	0	0	1	0.25	4
	Dolophilodes						
	Hesperophylax						
	Hydropsyche	0	7	3	0	2.5	38
	Hydroptila sp.						
	Lepidostoma	16	8	2	13	9.75	148
	Limnephilus						
	Micrasema						
	Neothremma alicia	19	21	16	1	14.25	216
	Oecetis						
	Oligophlebodes						
	Psychomyia						
	Rhyacophila (larvae)	22	36	71	38	41.75	633
Coleoptera	*Agabus*						
	Heterlimnius (larvae)						
	Heterlimnius (adult)	0	0	6	3	2.25	34
	Hydrophilidae	3	3	0	0	1.5	23
	Optioservus (larvae)	53	63	54	97	66.75	1011
	Optioservus (adult)	1	2	0	1	1	15
	Peltodytes callosus						
	Staphylinidae						
Diptera	pupae						
	Antocha (Tipulidae)	13	16	8	6	10.75	163
	Atherix						
	Ceratopogonidae						
	Chelifera						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m²
	Chironomidae (larvae)	181	516	429	301	356.75	5405
	Chironomidae (pupae)	1	1	0	4	1.5	23
	Chrysops						
	Dicranota						
	Dixa						
	Euparyphus	0	0	1	0	0.25	4
	Hemerodromia						
	Limnophora						
	Pericoma (Psychodidae)	39	112	64	45	65	985
	Simulium (larvae)	4	4	8	8	6	91
	Simulium (pupae)						
	Tipula	2	2	1	3	2	30
Hemiptera	Corixidae						
Collembola		0	0	1	12	3.25	49
Crustacea	Cladocera						
	Copeopoda						
	Isopod						
	Ostracoda	4	48	31	124	51.75	784
Arachnida	Hydracarina	0	6	6	18	7.5	114
Mollusca	Gyraulus						
	Sphaerium	0	0	1	0	0.25	4
Annelida	Hirudinea						
	Oligochaeta	6	5	0	0	2.75	42
Platyhelimenthes	Planariidae	4	3	6	6	4.75	72
							16081
	No. of Taxa	26	29	27	27	35	

Appendix 1b. Fall 2002 invertebrate data for the four riffles sampled from lower Woods Canyon

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
Ephemeroptera	Early instar ephemerilids						
	Baetis	17	22	5	36	20	303
	Cinygmula	18	52	29	58	39.25	595
	Drunella doddsi						
	Drunella grandis						
	Epeorus iron						
	Ephemerella	4	10	13	10	9.25	140
	Paraleptophlebia	2	11	5	33	12.75	193
	Rhithrogena	0	2	2	3	1.75	27
Plecoptera	Early instar Plecoptera	4	13	5	12	8.5	129
	Allopera severa						
	Alloperla						
	Claassenia sabulosa						
	Hesperoperla pacifica	6	39	30	15	22.5	341
	Isocapnia						
	Isoperla	5	0	0	0	1.25	19
	Malenka						
	Megarcys signata						
	Paraperla						
	Pteronarcella badia	0	0	0	2	0.5	8
	Skwalla parallela	0	1	0	2	0.75	11
	Sweltza	0	3	4	7	3.5	53
	Zapada	31	81	63	93	67	1015
Trichoptera	Pupae						
	Arctopsyche	2	5	2	1	2.5	38
	Brachycentrus echo						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chyranda						
	Dicosmoecus	0	0	0	1	0.25	4
	Dolophilodes						
	Hesperophylax						
	Hydropsyche	0	0	0	3	0.75	11
	Hydroptila sp.						
	Lepidostoma	4	1	5	8	4.5	68
	Limnephilus						
	Micrasema						
	Neothremma alicia	5	1	1	7	3.5	53
	Oecetis						
	Oligophlebodes						
	Psychomyia						
	Rhyacophila (larvae)	22	25	18	18	20.75	314
Coleoptera	Agabus						
	Heterlimnius (larvae)						
	Heterlimnius (adult)	4	6	4	10	6	91
	Hydrophilidae						
	Optioservus (larvae)	20	98	47	63	57	864
	Optioservus (adult)	0	2	2	4	2	30
	Peltodytes callosus						
	Staphylinidae						
Diptera	pupae						
	Antocha (Tipulidae)	1	4	1	1	1.75	27
	Atherix						
	Ceratopogonidae	4	11	14	20	12.25	186
	Chelifera						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chironomidae (larvae)	223	626	689	483	505.25	7655
	Chironomidae (pupae)	0	1	8	2	2.75	42
	Chrysops						
	Dicranota						
	Dixa						
	Euparyphus	4	14	8	22	12	182
	Hemerodromia	0	0	6	6	3	45
	Limnophora	0	0	0	1	0.25	4
	Pericoma (Psychodidae)	173	200	308	257	234.5	3553
	Simulium (larvae)	24	2	6	37	17.25	261
	Simulium (pupae)						
	Tipula	2	2	1	3	2	30
Hemiptera	Corixidae						
Collembola		0	1	15	1	4.25	64
Crustacea	Cladocera						
	Copeopoda						
	Isopod						
	Ostracoda	102	246	278	438	266	4030
Arachnida	Hydracarina	8	25	35	44	28	424
Mollusca	Gyraulus						
	Sphaerium						
Annelida	Hirudinea						
	Oligochaeta	9	19	6	42	19	288
Platyhelimenthes	Planariidae	7	6	5	12	7.5	114
							21212
	No. of Taxa	25	30	30	35	36	

Appendix 2a. Fall 2002 invertebrate data for the four riffles sampled from upper Winter Quarters Canyon

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
Ephemeroptera	Early instar ephemerilids						
	Baetis	37	101	19	116	68.25	1034
	Cinygmula	8	8	3	23	10.5	159
	Drunella *doddsi*						
	Drunella grandis						
	Epeorus iron						
	Ephemerella	31	28	6	59	31	470
	Paraleptophlebia	4	6	0	6	4	61
	Rhithrogena	2	2	0	1	1.25	19
Plecoptera	Early instar Plecoptera	5	3	0	1	2.25	34
	Allopera severa						
	Alloperla						
	Claassenia sabulosa						
	Hesperoperla pacifica	1	4	2	6	3.25	49
	Isocapnia						
	Isoperla	0	0	0	3	0.75	11
	Malenka						
	Megarcys signata						
	Paraperla						
	Pteronarcella badia						
	Skwalla parallela	0	1	1	5	1.75	27
	Sweltza	14	11	6	11	10.5	159
	Zapada	13	17	6	7	10.75	163
Trichoptera	Pupae						
	Arctopsyche	0	0	0	1	.25	4

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Brachycentrus echo						
	Chyranda	1	0	0	0	0.25	4
	Dicosmoecus						
	Dolophilodes						
	Hesperophylax						
	Hydropsyche	4	0	4	3	2.75	42
	Hydroptila sp.	0	0	3	0	0.75	11
	Lepidostoma	28	4	3	3	9.5	144
	Limnephilus						
	Micrasema	0	4	0	0	1	15
	Neothremma alicia	4	3	0	5	3	45
	Oecetis	3	0	2	20	6.25	95
	Oligophlebodes						
	Psychomyia						
	Rhyacophila (larvae)	5	6	3	1	3.75	57
Coleoptera	Agabus						
	Heterlimnius (larvae)						
	Heterlimnius (adult)	3	6	9	20	9.5	144
	Hydrophilidae						
	Optioservus (larvae)	85	128	60	202	118.75	1799
	Optioservus (adult)	1	1	0	3	1.25	19
	Peltodytes callosus						
	Staphylinidae						
Diptera	pupae						
	Antocha (Tipulidae)	7	2	5	21	8.75	133
	Atherix						
	Ceratopogonidae	13	17	9	32	17.75	269

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chelifera						
	Chironomidae (larvae)	92	101	10	137	85	1288
	Chironomidae (pupae)						
	Chrysops	2	0	0	8	2.5	38
	Dicranota						
	Dixa						
	Euparyphus	4	2	1	3	2.5	38
	Hemerodromia	0	0	0	7	1.75	27
	Limnophora	0	0	1	0	0.25	4
	Pericoma (Psychodidae)	41	93	26	308	117	1773
	Simulium (larvae)	4	18	5	9	9	136
	Simulium (pupae)						
	Tipula	2	1	4	5	3	45
Hemiptera	Corixidae						
Collembola		1	0	9	0	2.5	38
Crustacea	Cladocera						
	Copeopoda						
	Isopod						
	Ostracoda						
Arachnida	Hydracarina	8	32	3	30	18.25	276
Mollusca	Gyraulus						
	Sphaerium	5	4	8	13	7.5	114
Annelida	Hirudinea						
	Oligochaeta	124	12	5	26	41.75	633
Platyhelimenthes	Planariidae						
							9377
	No. of Taxa	30	27	26	32	37	

Appendix 2b. Fall 2002 invertebrate data for the four riffles sampled from middle Winter Quarters Canyon

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
Ephemeroptera	Early instar ephemerilids						
	Baetis	215	72	45	46	94.5	1432
	Cinygmula	44	14	37	30	31.25	473
	Drunella *doddsi*						
	Drunella grandis						
	Epeorus iron						
	Ephemerella	82	15	5	8	27.5	417
	Paraleptophlebia	1	1	1	2	1.25	19
	Rhithrogena	9	4	6	2	5.25	80
Plecoptera	Early instar Plecoptera	1	1	3	4	2.25	34
	Allopera severa						
	Alloperla						
	Claassenia sabulosa						
	Hesperoperla pacifica						
	Isocapnia						
	Isoperla						
	Malenka						
	Megarcys signata						
	Paraperla						
	Pteronarcella badia						
	Skwalla parallela	0	1	4	0	1.25	19
	Sweltza	15	2	10	7	8.5	129
	Zapada	5	0	2	3	2.5	38
Trichoptera	Pupae						
	Arctopsyche						
	Brachycentrus echo						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m²
	Chryanda						
	Dicosmoecus						
	Dolophilodes						
	Hesperophylax						
	Hydropsyche	8	5	6	7	6.5	98
	Hydroptila sp.						
	Lepidostoma	9	3	8	6	6.5	98
	Limnephilus						
	Micrasema						
	Neothremma alicia	0	0	1	0	.25	4
	Oecetis						
	Oligophlebodes						
	Psychomyia						
	Rhyacophila (larvae)	16	3	15	11	11.25	170
Coleoptera	Agabus						
	Heterlimnius (larvae)						
	Heterlimnius (adult)	3	0	14	1	4.5	68
	Hydrophilidae						
	Optioservus (larvae)	75	28	87	160	87.5	1326
	Optioservus (adult)	0	1	2	1	1	15
	Peltodytes callosus						
	Staphylinidae						
Diptera	pupae						
	Antocha (Tipulidae)	23	37	14	48	30.5	462
	Atherix						
	Ceratopogonidae	7	0	0	13	5	76
	Chelifera						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chironomidae (larvae)	128	97	41	283	137.25	2079
	Chironomidae (pupae)	2	0	1	2	1.25	19
	Chrysops	0	0	0	0.25	4	8
	Dicranota						
	Dixa						
	Euparyphus						
	Hemerodromia						
	Limnophora						
	Pericoma (Psychodidae)						
	Simulium (larvae)	29	3	15	3	12.5	189
	Simulium (pupae)						
	Tipula	1	0	0	0	0.25	4
Hemiptera	Corixidae						
Collembola							
Crustacea	Cladocera						
	Copeopoda						
	Isopod						
	Ostracoda	16	18	3	104	35.25	534
Arachnida	Hydracarina	2	2	0	5	2.25	34
Mollusca	Gyraulus						
	Sphaerium	0	1	0	1	.5	8
Annelida	Hirudinea	2	0	0	0	.5	8
	Oligochaeta	10	4	9	7	7.5	114
Platyhelimenthes	Planariidae	3	1	4	29	9.25	140
							8095
	No. of Taxa	25	21	24	26	30	

Appendix 2c. Fall 2002 invertebrate data for the four riffles sampled from lower Winter Quarters Canyon

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
Ephemeroptera	Early instar ephemerilids						
	Baetis	90	162	90	176	129.5	1962
	Cinygmula	108	125	55	113	100.25	1519
	Drunella doddsi	1	0	0	0	0.25	4
	Drunella grandis	4	14	0	0	4.5	68
	Epeorus iron						
	Ephemerella	16	33	0	17	16.5	250
	Paraleptophlebia	3	14	2	2	5.25	80
	Rhithrogena	2	0	4	0	1.5	23
Plecoptera	Early instar Plecoptera	1	4	3	5	3.25	49
	Allopera severa						
	Alloperla						
	Claassenia sabulosa						
	Hesperoperla pacifica	0	0	1	3	1	15
	Isocapnia						
	Isoperla	0	2	0	0	0.5	8
	Malenka						
	Megarcys signata						
	Paraperla						
	Pteronarcella badia	1	0	0	0	0.25	4
	Skwalla parallela	1	0	0	0	0.25	4
	Sweltza	29	20	7	13	17.25	261
	Zapada	1	0	1	10	3	45
Trichoptera	Pupae						
	Arctopsyche	2	0	0	0	0.5	8
	Brachycentrus echo						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chyranda						
	Dicosmoecus	2	0	0	0	0.5	8
	Dolophilodes						
	Hesperophylax						
	Hydropsyche	0	66	60	139	66.25	1004
	Hydroptila sp.						
	Lepidostoma	0	4	5	4	3.25	49
	Limnephilus						
	Micrasema						
	Neothremma alicia	1	0	1	0	0.5	8
	Oecetis						
	Oligophlebodes						
	Psychomyia						
	Rhyacophila (larvae)	0	16	38	15	17.25	261
Coleoptera	*Agabus*						
	Heterlimnius (larvae)						
	Heterlimnius (adult)	0	1	8	3	3	45
	Hydrophilidae						
	Optioservus (larvae)	32	125	54	86	74.25	1125
	Optioservus (adult)	2	2	2	2	2	30
	Peltodytes callosus						
	Staphylinidae						
Diptera	pupae						
	Antocha (Tipulidae)	102	544	390	203	309.75	4693
	Atherix						
	Ceratopogonidae	8	34	1	4	11.75	178
	Chelifera						

		Riffle Number					
	Taxa	1	2	3	4	mean	#/m^2
	Chironomidae (larvae)	92	165	169	235	165.25	2504
	Chironomidae (pupae)	1	6	0	3	2.5	102
	Chrysops	1	0	0	0	0.25	4
	Dicranota						
	Dixa						
	Euparyphus	12	16	8	7	10.75	163
	Hemerodromia	0	0	0	2	0.5	8
	Limnophora	0	0	0	2	0.5	8
	Pericoma (Psychodidae)	9	23	18	7	14.25	216
	Simulium (larvae)	1	3	2	4	2.5	38
	Simulium (pupae)						
	Tipula	2	1	0	0	0.75	11
Hemiptera	Corixidae						
Collembola		1	0	0	0	0.25	4
Crustacea	Cladocera						
	Copeopoda						
	Isopod						
	Ostracoda	14	143	21	9	46.75	708
Arachnida	Hydracarina	0	3	2	0	1.25	19
Mollusca	Gyraulus						
	Sphaerium	1	1	0	0	.5	8
Annelida	Hirudinea						
	Oligochaeta	60	64	7	11	35.5	538
Platyhelimenthes	Planariidae	0	1	0	1	0.5	8
							16040
	No. of Taxa	30	27	24	25	40	

Appendix 3a. Spring 2003 invertebrate data for the four riffles sampled from upper Woods Canyon

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
Ephemeroptera	Early instar ephemerilids	213	327	94	740	311	545	663	271	395.5	5992
	Baetis	184	201	17	149	363	242	88	101	168.125	2547
	Cinygmula	36	72	23	35	25	24	31	69	39.375	597
	Drunella *doddsi*	9	31	2	4	27	9	2	7	11.375	172
	Drunella grandis										
	Epeorus iron	0	0	0	1	2	2	0	0	0.625	9
	Ephemerella										
	Paraleptophlebia	0	0	0	0	1	0	1	1	0.375	6
	Rhithrogena										
Plecoptera	Early instar Plecoptera	33	31	30	1	2	30	30	3	20	303
	Allopera severa										
	Alloperla										
	Claassenia sabulosa										
	Hesperoperla pacifica	12	8	0	18	8	16	5	17	10.5	159
	Isocapnia										
	Isoperla										
	Malenka										
	Megarcys signata										
	Paraperla	0	4	1	6	4	2	1	4	2.75	42
	Pteronarcella badia										
	Skwalla parallela										
	Sweltza										
	Zapada	1	5	2	1	3	0	1	3	2	30
Trichoptera	Pupae	3	3	3	0	4	8	1	3	3.125	47
	Arctopsyche	1	0	0	1	0	5	1	0	1	15
	Brachycentrus echo	0	2	0	1	11	14	3	7	4.75	72

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m^2
	Chyranda										
	Dicosmoecus	4	0	1	2	0	1	1	1	1.25	19
	Dolophilodes										
	Hesperophylax										
	Hydropsyche										
	Hydroptila sp.										
	Lepidostoma										
	Limnephilus										
	Micrasema										
	Neothremma alicia	0	0	1	1	2	19	2	4	3.625	55
	Oecetis										
	Oligophlebodes										
	Psychomyia	1	1	3	0	1	19	8	23	7	106
	Rhyacophila (larvae)	7	5	0	10	12	0	1	0	4.375	66
Coleoptera	Agabus										
	Heterlimnius (larvae)	0	0	0	0	0	3	0	2	0.625	9
	Heterlimnius (adult)										
	Hydrophilidae										
	Optioservus (larvae)	23	53	3	20	18	271	115	324	103.375	1566
	Optioservus (adult)	0	2	1	1	0	4	0	5	1.625	25
	Peltodytes callosus										
	Staphylinidae										
Diptera	pupae										
	Antocha (Tipulidae)										
	Atherix										
	Ceratopogonidae	1	30	0	7	1	33	61	132	33.125	502
	Chelifera										

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
	Chironomidae (larvae)	1195	212	407	294	453	722	441	469	524.125	7940
	Chironomidae (pupae)	0	1	3	1	1	2	0	1	1.125	17
	Chrysops										
	Dicranota										
	Dixa										
	Euparyphus										
	Hemerodromia										
	Limnophora										
	Pericoma (Psychodidae)										
	Simulium (larvae)	0	0	0	0	1	0	1	0	0.25	4
	Simulium (pupae)										
	Tipula	7	3	1	2	1	2	6	3	3.13	47
Hemiptera	Corixidae										
Collembola											
Crustacea	Cladocera										
	Copeopoda	60	393	90	181	60	423	180	514	237.625	3600
	Isopod	0	0	0	0	0	1	0	0	0.125	2
	Ostracoda	64	61	1	1	0	60	30	90	38.375	581
Arachnida	Hydracarina	121	91	30	91	2	121	121	243	102.5	1553
Mollusca	Gyraulus										
	Sphaerium	6	8	0	1	0	2	4	19	5	76
Annelida	Hirudinea										
	Oligochaeta	4	0	0	15	44	49	0	15	15.875	241
Platyhelimenthes	Planariidae										
											26400
	No. of Taxa	21	22	19	25	24	27	25	26	31	

Appendix 3b. Spring 2003 invertebrate data for the eight riffles sampled from lower Woods Canyon

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m^2
Ephemeroptera	Early instar ephemerilids	248	125	40	37	706	22	888	155	277.625	4206
	Baetis	886	1234	733	380	101	183	210	779	563.25	8533
	Cinygmula	31	33	62	35	143	37	58	42	55.125	835
	Drunella doddsi	0	0	3	0	0	0	1	0	0.5	8
	Drunella grandis	5	7	2	7	14	0	3	8	6.5	98
	Epeorus iron	14	48	8	8	0	9	0	0	10.875	165
	Ephemerella										
	Paraleptophlebia										
	Rhithrogena										
Plecoptera	Early instar Plecoptera	30	34	34	35	168	10	66	64	55.125	835
	Allopera severa										
	Alloperla										
	Claassenia sabulosa										
	Hesperoperla pacifica	8	4	6	6	16	3	14	18	9.375	142
	Isocapnia										
	Isoperla	2	1	0	0	0	0	0	0	0.375	6
	Malenka										
	Megarcys signata										
	Paraperla	0	0	1	0	0	2	1	1	0.625	9
	Pteronarcella badia										
	Skwalla parallela										
	Sweltza										
	Zapada	5	2	2	7	1	1	5	3	3.25	49
Trichoptera	Pupae	10	3	0	5	5	7	9	11	6.25	95
	Arctopsyche	0	0	0	0	1	0	1	2	0.5	8
	Brachycentrus echo	0	0	30	0	5	0	1	5	5.125	78

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
	Chyranda										
	Dicosmoecus	0	1	9	3	3	0	0	3	2.375	36
	Dolophilodes										
	Hesperophylax	0	0	0	0	0	0	3	0	0.375	6
	Hydropsyche	2	4	0	0	1	4	6	2	2.375	36
	Hydroptila sp.										
	Lepidostoma										
	Limnephilus	7	6	0	3	0	1	0	0	2.125	32
	Micrasema	0	0	1	0	0	0	0	0	0.125	2
	Neothremma alicia	5	4	3	2	0	4	1	1	2.5	38
	Oecetis										
	Oligophlebodes	0	0	1	0	0	0	0	0	0.125	2
	Psychomyia	33	33	4	11	3	12	6	1	12.875	195
	Rhyacophila (larvae)	0	0	4	0	5	1	11	5	3.25	49
Coleoptera	Agabus										
	Heterlimnius (larvae)	0	0	78	0	107	0	18	0	25.375	384
	Heterlimnius (adult)	0	0	2	1	3	3	4	1	1.75	27
	Hydrophilidae										
	Optioservus (larvae)	60	138	0	85	0	66	60	163	71.5	1083
	Optioservus (adult)	1	1	0	0	0	0	0	1	0.375	6
	Peltodytes callosus	0	1	0	0	0	0	0	0	0.125	2
	Staphylinidae										
Diptera	pupae	2	0	0	0	0	0	0	0	0.25	4
	Antocha (Tipulidae)	0	0	0	2	0	0	0	0	0.25	4
	Atherix	0	0	0	0	0	0	4	0	0.5	8
	Ceratopogonidae	2	3	32	111	30	21	33	34	29.5	447
	Chelifera	3	7	0	3	0	1	0	0	1.75	27

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
	Chironomidae (larvae)	915	1357	1226	789	410	216	1449	896	904.75	13707
	Chironomidae (pupae)	2	31	0	34	0	3	3	3	9.5	144
	Chrysops										
	Dicranota										
	Dixa	0	3	2	1	0	0	1	0	0.875	13
	Euparyphus										
	Hemerodromia	0	0	1	0	0	0	0	0	0.125	2
	Limnophora										
	Pericoma (Psychodidae)	7	5	1	9	0	4	1	5	4	61
	Simulium (larvae)	0	0	1	0	0	3	0	0	1.25	19
	Simulium (pupae)										
	Tipula	2	0	1	7	8	0	0	3	2.625	40
Hemiptera	Corixidae										
Collembola											
Crustacea	Cladocera										
	Copeopoda	219	159	0	217	0	6	30	151	97.75	1481
	Isopod										
	Ostracoda	1413	377	243	401	249	8	32	374	387.125	5865
Arachnida	Hydracarina	62	30	122	5	32	1	92	4	43.5	659
Mollusca	Gyraulus										
	Sphaerium	1	64	0	68	0	1	0	35	21.125	320
Annelida	Hirudinea										
	Oligochaeta	0	0	49	0	59	0	44	104	32	485
Platyhelimenthes	Planariidae										
											40251
	No. of Taxa	27	28	29	27	22	26	30	29	45	

Appendix 4a. Spring 2003 invertebrate data for the four riffles sampled from upper Winter Quarters Canyon

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
Ephemeroptera	Early instar ephemerilids	24	39	19	75	131	87	217	74	83.25	1261
	Baetis	147	201	120	241	261	301	288	186	218.13	3305
	Cinygmula	13	13	41	37	50	28	7	76	33.125	502
	Drunella *doddsi*	15	21	5	7	4	0	10	3	8.125	123
	Drunella grandis	0	0	0	0	0	0	2	1	.375	6
	Epeorus iron	11	1	1	4	4	1	20	7	6.125	93
	Ephemerella	0	0	2	1	3	6	0	4	2	30
	Paraleptophlebia										
	Rhithrogena										
Plecoptera	Early instar Plecoptera	2	20	39	54	282	39	139	40	76.875	1165
	Allopera severa										
	Alloperla										
	Claassenia sabulosa										
	Hesperoperla pacifica	0	0	0	1	4	0	3	5	1.625	25
	Isocapnia										
	Isoperla	0	0	0	0	0	1	0	2	0.375	6
	Malenka										
	Megarcys signata										
	Paraperla										
	Pteronarcella badia										
	Skwalla parallela										
	Sweltza										
	Zapada	5	2	0	0	0	0	2	0	1.125	17
Trichoptera	Pupae	1	2	0	0	0	2	11	0	2	30
	Arctopsyche	1	0	0	0	0	0	0	0	0.125	2
	Brachycentrus echo	0	1	0	0	0	0	0	0	0.125	2

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
	Chyranda										
	Dicosmoecus										
	Dolophilodes	0	0	0	0	0	0	1	0	0.125	2
	Hesperophylax	0	1	0	0	0	0	0	0	0.125	2
	Hydropsyche	0	0	1	0	0	0	0	1	0.25	4
	Hydroptila sp.										
	Lepidostoma										
	Limnephilus										
	Micrasema										
	Neothremma alicia	13	18	43	38	11	0	9	3	16.875	256
	Oecetis										
	Oligophlebodes	5	0	6	10	11	1	3	2	4.75	72
	Psychomyia	14	15	5	5	33	5	11	6	11.75	178
	Rhyacophila (larvae)										
Coleoptera	Agabus										
	Heterlimnius (larvae)	44	10	11	3	1	2	3	1	9.375	142
	Heterlimnius (adult)	4	8	5	1	0	1	1	0	2.5	38
	Hydrophilidae										
	Optioservus (larvae)	89	163	195	353	199	98	378	146	202.63	3070
	Optioservus (adult)	0	16	18	39	7	3	8	1	11.5	174
	Peltodytes callosus										
	Staphylinidae	1	0	0	0	0	0	0	0	0.125	2
Diptera	pupae										
	Antocha (Tipulidae)	0	0	0	1	0	0	0	0	0.125	2
	Atherix										
	Ceratopogonidae	46	36	55	70	38	103	52	20	52.5	795
	Chelifera	0	2	0	0	0	0	0	0	0.25	4

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
	Chironomidae (larvae)	653	1129	811	917	2816	1052	871	2009	1282.3	19426
	Chironomidae (pupae)	57	26	7	0	4	34	43	7	22.25	337
	Chrysops										
	Dicranota	0	1	1	1	2	5	0	0	1.25	19
	Dixa	1	0	0	0	0	0	0	0	0.125	2
	Euparyphus										
	Hemerodromia	0	3	0	0	0	0	0	0	0.375	6
	Limnophora										
	Pericoma (Psychodidae)	0	0	1	0	30	1	0	0	4	61
	Simulium (larvae)	0	2	0	0	0	0	1	1	0.5	8
	Simulium (pupae)										
	Tipula	0	4	4	0	2	3	2	3	2.25	34
Hemiptera	Corixidae	0	0	0	1	0	0	0	0	0.125	2
Collembola											
Crustacea	Cladocera	0	15	0	31	0	0	0	2	6	91
	Copeopoda	31	64	30	152	1	91	32	61	57.75	875
	Isopod										
	Ostracoda	62	53	118	69	187	64	38	133	90.5	1371
Arachnida	Hydracarina	107	21	77	68	278	91	129	94	108.13	1638
Mollusca	Gyraulus										
	Sphaerium	0	61	44	140	67	40	62	28	55.25	837
Annelida	Hirudinea										
	Oligochaeta	35	24	21	0	32	4	4	2	15.25	231
Platyhelimenthes	Planariidae										
											36246
	No. of Taxa	24	30	26	25	25	25	28	28	43	

Appendix 4b. Spring 2003 invertebrate data for the eight riffles sampled from middle Winter Quarters Canyon

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m^2
Ephemeroptera	Early instar ephemerilids	330	237	181	393	303	225	10	256	241.875	3664
	Baetis	319	452	315	428	320	147	682	349	376.5	5704
	Cinygmula	69	73	63	150	42	34	39	82	69	1045
	Drunella *doddsi*	2	4	5	5	3	9	5	6	4.875	74
	Drunella grandis	2	2	3	7	4	9	0	3	3.75	57
	Epeorus iron	11	8	10	2	2	1	5	9	6	91
	Ephemerella	0	0	0	1	4	1	4	8	2.25	34
	Paraleptophlebia										
	Rhithrogena										
Plecoptera	Early instar Plecoptera	190	54	21	115	126	183	106	72	108.375	1642
	Allopera severa	0	1	1	0	0	0	0	0	0.25	4
	Alloperla										
	Claassenia sabulosa	0	0	0	0	1	0	0	0	0.125	2
	Hesperoperla pacifica	35	0	2	0	0	0	0	1	4.75	72
	Isocapnia	2	0	0	0	0	0	0	0	0.25	4
	Isoperla	0	0	0	0	1	3	1	0	0.625	9
	Malenka										
	Megarcys signata										
	Paraperla	0	1	0	0	0	0	0	0	0.125	2
	Pteronarcella badia										
	Skwalla parallela	0	0	0	0	1	0	0	0	0.125	2
	Sweltza	0	0	0	4	2	2	1	1	1.25	19
	Zapada	1	1	1	0	1	6	1	1	1.5	23
Trichoptera	Pupae	3	7	3	0	0	3	3	2	2.625	40
	Arctopsyche	2	0	0	0	0	0	0	0	0.25	4

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m^2
	Brachycentrus echo										
	Chyranda										
	Dicosmoecus										
	Dolophilodes										
	Hesperophylax										
	Hydropsyche	1	0	1	1	0	1	0	2	0.75	11
	Hydroptila sp.										
	Lepidostoma										
	Limnephilus	0	2	0	0	0	0	1	2	0.625	9
	Micrasema										
	Neothremma alicia	3	5	34	4	33	34	30	4	18.375	278
	Oecetis										
	Oligophlebodes	2	0	0	0	0	0	0	0	0.25	4
	Psychomyia	12	19	28	16	17	18	11	27	18.5	280
	Rhyacophila (larvae)										
Coleoptera	Agabus										
	Heterlimnius (larvae)	6	1	4	3	0	0	0	0	1.75	27
	Heterlimnius (adult)	0	0	0	0	1	0	0	0	0.125	2
	Hydrophilidae										
	Optioservus (larvae)	132	329	148	186	179	312	136	328	218.75	3314
	Optioservus (adult)	3	3	35	2	1	2	0	5	6.375	97
	Peltodytes callosus										
	Staphylinidae										
Diptera	pupae										
	Antocha (Tipulidae)	5	40	47	10	37	7	14	16	22	333
	Atherix										
	Ceratopogonidae	56	54	75	51	70	50	16	43	51.875	786

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m^2
	Chelifera	2	5	1	1	7	1	36	1	6.75	102
	Chironomidae (larvae)	1324	855	773	954	1875	726	997	1596	1137.5	17233
	Chironomidae (pupae)	37	4	34	36	31	34	7	67	31.25	473
	Chrysops										
	Dicranota	0	1	0	0	0	0	0	0	0.125	2
	Dixa	2	1	0	0	0	0	0	0	0.375	6
	Euparyphus										
	Hemerodromia										
	Limnophora										
	Pericoma (Psychodidae)	0	0	1	0	0	0	0	0	0.125	2
	Simulium (larvae)	31	1	4	3	133	1	0	2	21.875	331
	Simulium (pupae)										
	Tipula	0	0	0	0	2	0	0	1	0.375	6
Hemiptera	Corixidae	0	0	1	0	0	0	0	0	0.125	2
Collembola											
Crustacea	Cladocera	0	61	0	0	0	0	0	0	7.625	116
	Copeopoda	61	0	0	30	151	31	5	91	46.125	699
	Isopod										
	Ostracoda	338	65	38	60	254	32	247	125	144.875	2195
Arachnida	Hydracarina	94	65	35	0	328	64	33	36	81.875	1240
Mollusca	Gyraulus	0	0	0	0	0	0	1	0	0.125	2
	Sphaerium	43	61	36	35	138	2	8	4	40.875	619
Annelida	Hirudinea										
	Oligochaeta	1	3	3	1	2	0	0	0	1.25	19
Platyhelimenthes	Planariidae										
											40680
	No. of Taxa	31	30	29	25	30	27	25	29	36	

Appendix 4c. Spring 2003 invertebrate data for the eight riffles sampled from lower Winter Quarters Canyon

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
Ephemeroptera	Early instar ephemerilids	218	292	130	111	7	187	1	70	127	1924
	Baetis	795	1181	858	1250	99	1234	267	1630	914.25	13851
	Cinygmula	31	43	81	107	58	29	67	21	54.625	828
	Drunella *doddsi*	2	6	4	2	4	2	0	1	2.625	40
	Drunella grandis	1	2	0	2	3	0	0	0	1	15
	Epeorus iron	0	22	12	34	43	12	4	10	17.125	259
	Ephemerella	2	2	5	12	11	10	22	14	9.75	148
	Paraleptophlebia										
	Rhithrogena										
Plecoptera	Early instar Plecoptera	63	99	10	8	7	31	0	1	27.375	415
	Allopera severa										
	Alloperla										
	Claassenia sabulosa	0	0	0	1	0	0	0	0	0.125	2
	Hesperoperla pacifica	0	0	0	3	0	1	0	0	0.5	8
	Isocapnia										
	Isoperla										
	Malenka										
	Megarcys signata										
	Paraperla										
	Pteronarcella badia										
	Skwalla parallela										
	Sweltza	0	2	0	4	3	0	5	0	1.75	27
	Zapada	0	1	0	1	2	0	0	0	0.5	8
Trichoptera	Pupae	3	3	1	0	1	0	2	0	1.25	19
	Arctopsyche										
	Brachycentrus echo	0	1	0	0	0	0	0	0	.125	2

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m^2
	Chyranda										
	Dicosmoecus	0	0	0	0	0	0	0	1	.125	2
	Dolophilodes										
	Hesperophylax										
	Hydropsyche	2	7	2	14	5	10	1	3	5.5	83
	Hydroptila sp.										
	Lepidostoma										
	Limnephilus	2	0	0	0	0	1	0	0	0.375	6
	Micrasema										
	Neothremma alicia	1	1	1	1	2	0	1	0	0.875	13
	Oecetis										
	Oligophlebodes										
	Psychomyia	14	22	6	18	22	7	17	8	14.25	216
	Rhyacophila (larvae)										
Coleoptera	Agabus	0	0	0	1	1	0	0	1	.375	6
	Heterlimnius (larvae)										
	Heterlimnius (adult)										
	Hydrophilidae										
	Optioservus (larvae)	69	177	123	80	10	17	386	42	113	1712
	Optioservus (adult)	3	2	5	2	1	1	2	0	2	30
	Peltodytes callosus										
	Staphylinidae										
Diptera	pupae	2	1	0	4	5	3	10	2	3.375	51
	Antocha (Tipulidae)	438	230	41	32	119	178	192	43	159.125	2411
	Atherix										
	Ceratopogonidae	0	100	3	0	2	0	3	6	14.25	216
	Chelifera	4	9	5	2	2	0	7	2	3.875	59

		Riffle Number									
	Taxa	1	2	3	4	5	6	7	8	mean	#/m²
	Chironomidae (larvae)	1000	763	545	917	613	970	507	822	767.125	11622
	Chironomidae (pupae)	36	4	2	33	9	3	64	4	19.375	294
	Chrysops										
	Dicranota										
	Dixa										
	Euparyphus										
	Hemerodromia										
	Limnophora										
	Pericoma (Psychodidae)	1	2	3	4	2	1	7	30	6.25	95
	Simulium (larvae)	93	564	8	120	1588	8	31	32	305.25	4625
	Simulium (pupae)										
	Tipula	0	0	0	0	0	0	0	1	0.125	2
Hemiptera	Corixidae										
Collembola											
Crustacea	Cladocera										
	Copeopoda	0	0	0	0	1	30	0	92	15.375	233
	Isopod										
	Ostracoda	60	120	30	60	2	32	93	351	93.5	1417
Arachnida	Hydracarina	63	159	91	31	0	122	180	30	84.5	1280
Mollusca	Gyraulus	0	0	1	0	0	0	0	0	0.125	2
	Sphaerium	32	30	1	31	62	30	30	38	31.75	481
Annelida	Hirudinea										
	Oligochaeta	1	1	2	2	1	1	1	1	1.25	19
Platyhelimenthes	Planariidae										
											42421
	No. of Taxa	25	29	25	29	30	24	24	26	37	

Appendix 5a CTQa computation for upper Woods Canyon.

Woods Canyon Summary		TQ	10-19-02 den. (m^2)	6-27-03 den. (m^2)
Ephemeroptera	Early instar ephemerilids	48	0	48
	Baetis	72	72	72
	Cinygmula	21	21	21
	Drunella doddsi	4	0	4
	Drunella grandis	24	0	0
	Epeorus iron	21	21	21
	Ephemerella	48	48	0
	Paraleptophlebia	24	24	24
	Rhithrogena	21	21	0
Plecoptera	Early instar Plecoptera	48	48	48
	Alloperla severa	24	0	0
	Alloperla	24	0	0
	Claassenia sabulosa	6	0	0
	Hesperoperla pacifica	18	18	18
	Isocapnia	24	0	0
	Isoperla	48	45	0
	Malenka	36	0	0
	Megarcys signata	24	24	0
	Paraperla	24	0	24
	Pteronarcella badia	24	0	0
	Skwala parallela	18	0	0
	Sweltza	24	0	0
	Zapada	16	16	16
Trichoptera	Pupae	0	0	0
	Arctopsyche	18	18	18
	Brachycentrus echo	24	24	24

Woods Canyon Summary		TQ	10-19-02 den. (m^2)	6-27-03 den. (m^2)
	Chyranda	18	0	0
	Dicosmoecus	24	24	24
	Dolophilodes	24	0	0
	Hesperophylax	108	0	0
	Hydropsyche	108	108	108
	Hydroptila sp.	108	0	0
	Lepidostoma	18	18	0
	Limnephilus	108	0	0
	Micrasema	24	0	0
	Neothremma alicia	8	8	8
	Oecetis	54	0	0
	Oligophlebodes	24	0	0
	Psychomyia	108	0	108
	Rhyacophila (larvae)	18	18	18
Coleoptera	*Agabus*	72	0	0
	Heterlimnius (larvae)	108	108	108
	Heterlimnius (adult)*	0	0	0
	Hydrophilidae	72	72	0
	Optioservus (larvae)	108	108	108
	Optioservus (adult)*	0	0	0
	Peltodytes callosus	54	0	0
	Staphylinidae	108	0	0
Diptera	pupae	0	0	0
	Antocha (Tipulidae)	24	24	0
	Atherix	24	0	0
	Ceratopogonidae	108	0	108
	Chelifera	108	0	0
	Chironomidae (larvae)	108	108	108

Woods Canyon Summary		TQ	10-19-02 den. (m^2)	6-27-03 den. (m^2)
	Chironomidae (pupae)*	0	0	0
	Chrysops	108	0	0
	Dicranota	24	0	0
	Dixa	108	0	0
	Euparyphus	108	108	0
	Hemerodromia	108	0	0
	Limnophora	108	0	0
	Pericoma (Psychodidae)	36	36	0
	Simulium (larvae)	108	108	108
	Simulium (pupae)*	108	0	0
	Tipula	36	36	36
Hemiptera	Corixidae	108	0	0
Collembola		108	108	0
Crustacea	Cladocera	108	0	0
	Copepoda	108	0	108
	Isopoda	108	0	108
	Ostracoda	108	108	108
Arachnida	Hydracarina	108	108	108
Mollusca	*Gyraulus*	108	0	0
	Sphaerium	108	108	108
Annelida	Hirudinea	108	0	0
	Oligochaeta	108	108	108
Platyhelimenthes	Planariidae	108	108	0
	Total TQ values:		1942	1834
	# of Taxa in column:		33	28
	TQ values/ # of Taxa:		58.85	65.82

* = taxa combined with appropriate life stage

Appendix 5b. CTQa computation for lower Woods Canyon.

Woods Canyon Summary		TQ	10-19-02 den. (m^2)	6-27-03 den. (m^2)
Ephemeroptera	Early instar ephemerilids	48	0	48
	Baetis	72	72	72
	Cinygmula	21	21	21
	Drunella doddsi	4	0	4
	Drunella grandis	24	0	24
	Epeorus iron	21	0	21
	Ephemerella	48	48	0
	Paraleptophlebia	24	24	0
	Rhithrogena	21	21	0
Plecoptera	Early instar Plecoptera	48	48	48
	Alloperla severa	24	0	0
	Alloperla	24	0	0
	Claassenia sabulosa	6	0	0
	Hesperoperla pacifica	18	18	18
	Isocapnia	24	0	0
	Isoperla	48	48	48
	Malenka	36	0	0
	Megarcys signata	24	0	0
	Paraperla	24	0	24
	Pteronarcella badia	24	24	0
	Skwala parallela	18	18	0
	Sweltza	24	24	0
	Zapada	16	16	16
Trichoptera	Pupae	0	0	0
	Arctopsyche	18	18	18
	Brachycentrus echo	24	0	24

Woods Canyon Summary		TQ	10-19-02 den. (m^2)	6-27-03 den. (m^2)
	Chyranda	18	0	0
	Dicosmoecus	24	24	24
	Dolophilodes	24	0	0
	Hesperophylax	108	0	108
	Hydropsyche	108	108	108
	Hydroptila sp.	108	0	0
	Lepidostoma	18	18	0
	Limnephilus	108	0	108
	Micrasema	24	0	24
	Neothremma alicia	8	8	8
	Oecetis	54	0	0
	Oligophlebodes	24	0	24
	Psychomyia	108	0	108
	Rhyacophila (larvae)	18	18	18
Coleoptera	*Agabus*	72	0	0
	Heterlimnius (larvae)	108	108	108
	Heterlimnius (adult)*	0	0	0
	Hydrophilidae	72	0	0
	Optioservus (larvae)	108	108	108
	Optioservus (adult)*	0	0	0
	Peltodytes callosus	54	0	108
	Staphylinidae	108	0	0
Diptera	pupae	0	0	0
	Antocha (Tipulidae)	24	24	24
	Atherix	24	0	24
	Ceratopogonidae	108	108	108
	Chelifera	108	0	108
	Chironomidae (larvae)	108	108	108

Woods Canyon Summary		TQ	10-19-02 den. (m^2)	6-27-03 den. (m^2)
	Chironomidae (pupae)*	0	0	0
	Chrysops	108	0	0
	Dicranota	24	0	0
	Dixa	108	0	108
	Euparyphus	108	108	0
	Hemerodromia	108	108	108
	Limnophora	108	108	0
	Pericoma (Psychodidae)	36	36	36
	Simulium (larvae)	108	108	108
	Simulium (pupae)*	108	0	0
	Tipula	36	36	36
Hemiptera	Corixidae	108	0	0
Collembola		108	108	0
Crustacea	Cladocera	108	0	0
	Copepoda	108	0	108
	Isopoda	108	0	0
	Ostracoda	108	108	108
Arachnida	Hydracarina	108	108	108
Mollusca	*Gyraulus*	108	0	0
	Sphaerium	108	0	108
Annelida	Hirudinea	108	0	0
	Oligochaeta	108	108	108
Platyhelimenthes	Planariidae	108	108	0
	Total TQ values:		2086	2554
	# of Taxa in column:		34	39
	TQ values/ # of Taxa:		61.35	65.49

* = taxa combined with appropriate life stage

Appendix 6a. CTQa computation for upper Winter Quarters Canyon.

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
Ephemeroptera	Early instar ephemerilids	48	0	48
	Baetis	72	72	72
	Cinygmula	21	21	21
	Drunella doddsi	4	0	4
	Drunella grandis	24	0	24
	Epeorus iron	21	0	24
	Ephemerella	48	48	48
	Paraleptophlebia	24	24	0
	Rhithrogena	21	21	0
Plecoptera	Early instar Plecoptera	48	48	48
	Alloperla severa	24	0	0
	Alloperla	24	0	0
	Claassenia sabulosa	6	0	0
	Hesperoperla pacifica	18	18	18
	Isocapnia	24	0	0
	Isoperla	48	48	48
	Malenka	36	0	0
	Megarcys signata	24	0	0
	Paraperla	24	0	0
	Pteronarcella badia	24	0	0
	Skwala parallela	18	18	0
	Sweltza	24	24	0
	Zapada	16	16	16
Trichoptera	Pupae	0	0	0
	Arctopsyche	18	18	18

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
	Brachycentrus echo	24	0	24
	Chyranda	18	18	0
	Dicosmoecus	24	0	0
	Dolophilodes	24	0	24
	Hesperophylax	108	0	108
	Hydropsyche	108	108	108
	Hydroptila sp.	108	108	108
	Lepidostoma	18	18	0
	Limnephilus	108	0	0
	Micrasema	24	24	0
	Neothremma alicia	8	8	8
	Oecetis	54	54	0
	Oligophlebodes	24	0	24
	Psychomyia	108	0	108
	Rhyacophila (larvae)	18	18	0
Coleoptera	*Agabus*	72	0	0
	Heterlimnius (larvae)	108	108	108
	Heterlimnius (adult)*	0	0	0
	Hydrophilidae	72	0	0
	Optioservus (larvae)	108	108	108
	Optioservus (adult)*	0	0	0
	Peltodytes callosus	54	0	0
	Staphylinidae	108	0	108
Diptera	pupae	0	0	0
	Antocha (Tipulidae)	24	24	24
	Atherix	24	0	0
	Ceratopogonidae	108	108	108
	Chelifera	108	0	108

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
	Chironomidae (larvae)	108	108	108
	Chironomidae (pupae)*	0	0	0
	Chrysops	108	108	0
	Dicranota	24	0	24
	Dixa	108	0	108
	Euparyphus	108	108	0
	Hemerodromia	108	108	108
	Limnophora	108	108	0
	Pericoma (Psychodidae)	36	36	36
	Simulium (larvae)	108	108	108
	Simulium (pupae)*	108	0	0
	Tipula	36	36	36
Hemiptera	Corixidae	108	0	108
Collembola		108	108	0
Crustacea	Cladocera	108	0	108
	Copepoda	108	0	108
	Isopoda	108	0	0
	Ostracoda	108	0	108
Arachnida	Hydracarina	108	108	108
Mollusca	*Gyraulus*	108	0	0
	Sphaerium	108	108	108
Annelida	Hirudinea	108	0	0
	Oligochaeta	108	108	108
Platyhelimenthes	Planariidae	108	0	0
	Total TQ values:		1980	2442
	# of Taxa in column:		36	40
	TQ values/ # of Taxa:		55.00	61.05

* = taxa combined with appropriate life stage

Appendix 6b. CTQa computation for middle Winter Quarters Canyon.

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
Ephemeroptera	Early instar ephemerilids	48	0	48
	Baetis	72	72	72
	Cinygmula	21	21	21
	Drunella doddsi	4	0	4
	Drunella grandis	24	0	24
	Epeorus iron	21	0	21
	Ephemerella	48	48	48
	Paraleptophlebia	24	24	0
	Rhithrogena	21	21	0
Plecoptera	Early instar Plecoptera	48	48	48
	Alloperla severa	24	0	24
	Alloperla	24	0	0
	Claassenia sabulosa	6	0	6
	Hesperoperla pacifica	18	0	18
	Isocapnia	24	0	24
	Isoperla	48	0	48
	Malenka	36	0	0
	Megarcys signata	24	0	0
	Paraperla	24	0	24
	Pteronarcella badia	24	0	0
	Skwala parallela	18	18	18
	Sweltza	24	24	24
	Zapada	16	16	16
Trichoptera	Pupae	0	0	0
	Arctopsyche	18	0	18
	Brachycentrus echo	24	0	0

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
	Chyranda	18	0	0
	Dicosmoecus	24	0	0
	Dolophilodes	24	0	0
	Hesperophylax	108	0	0
	Hydropsyche	108	108	108
	Hydroptila sp.	108	0	0
	Lepidostoma	18	18	0
	Limnephilus	108	0	108
	Micrasema	24	0	0
	Neothremma alicia	8	8	8
	Oecetis	54	0	0
	Oligophlebodes	24	0	4
	Psychomyia	108	0	108
	Rhyacophila (larvae)	18	18	0
Coleoptera	*Agabus*	72	0	0
	Heterlimnius (larvae)	108	108	108
	Heterlimnius (adult)*	0	0	0
	Hydrophilidae	72	0	0
	Optioservus (larvae)	108	108	108
	Optioservus (adult)*	0	0	0
	Peltodytes callosus	54	0	0
	Staphylinidae	108	0	0
Diptera	pupae	0	0	0
	Antocha (Tipulidae)	24	24	24
	Atherix	24	0	0
	Ceratopogonidae	108	108	108
	Chelifera	108	0	108
	Chironomidae (larvae)	108	108	108

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
	Chironomidae (pupae)*	0	0	0
	Chrysops	108	108	0
	Dicranota	24	0	24
	Dixa	108	0	108
	Euparyphus	108	0	0
	Hemerodromia	108	0	0
	Limnophora	108	0	0
	Pericoma (Psychodidae)	36	0	36
	Simulium (larvae)	108	108	108
	Simulium (pupae)*	108	0	0
	Tipula	36	36	36
Hemiptera	Corixidae	108	0	108
Collembola		108	0	0
Crustacea	Cladocera	108	0	108
	Copepoda	108	0	108
	Isopoda	108	0	0
	Ostracoda	108	108	108
Arachnida	Hydracarina	108	108	108
Mollusca	*Gyraulus*	108	0	108
	Sphaerium	108	108	108
Annelida	Hirudinea	108	108	0
	Oligochaeta	108	108	108
Platyhelimenthes	Planariidae	108	108	0
	Total TQ values:		1810	2588
	# of Taxa in column:		27	42
	TQ values/ # of Taxa:		67.04	61.62

* = taxa combined with appropriate life stage

Appendix 6c. CTQa computation for lower Winter Quarters Canyon.

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
Ephemeroptera	Early instar ephemerilids	48	0	48
	Baetis	72	72	72
	Cinygmula	21	21	21
	Drunella doddsi	4	4	4
	Drunella grandis	24	24	24
	Epeorus iron	21	0	21
	Ephemerella	48	48	48
	Paraleptophlebia	24	24	0
	Rhithrogena	21	21	0
Plecoptera	Early instar Plecoptera	48	48	48
	Alloperla severa	24	0	0
	Alloperla	24	0	0
	Claassenia sabulosa	6	0	6
	Hesperoperla pacifica	18	18	18
	Isocapnia	24	0	0
	Isoperla	48	48	0
	Malenka	36	0	0
	Megarcys signata	24	0	0
	Paraperla	24	0	0
	Pteronarcella badia	24	24	0
	Skwala parallela	18	24	0
	Sweltza	24	24	24
	Zapada	16	16	16
Trichoptera	Pupae	0	0	0
	Arctopsyche	18	18	0
	Brachycentrus echo	24	0	24

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
	Chyranda	18	0	0
	Dicosmoecus	24	24	24
	Dolophilodes	24	0	
	Hesperophylax	108	0	0
	Hydropsyche	108	108	108
	Hydroptila sp.	108	0	0
	Lepidostoma	18	18	0
	Limnephilus	108	0	108
	Micrasema	24	0	0
	Neothremma alicia	8	8	8
	Oecetis	54	0	0
	Oligophlebodes	24	0	0
	Psychomyia	108	0	108
	Rhyacophila (larvae)	18	261	0
Coleoptera	*Agabus*	72	0	6
	Heterlimnius (larvae)	108	108	0
	Heterlimnius (adult)*	0	0	0
	Hydrophilidae	72	0	0
	Optioservus (larvae)	108	108	108
	Optioservus (adult)*	0	0	0
	Peltodytes callosus	54	0	0
	Staphylinidae	108	0	0
Diptera	pupae	0	0	0
	Antocha (Tipulidae)	24	24	24
	Atherix	24	0	0
	Ceratopogonidae	108	108	108
	Chelifera	108	0	108
	Chironomidae (larvae)	108	108	108

Winter Quarters Summary		TQ	10-18-02 den. (m^2)	6-20-03 den. (m^2)
	Chironomidae (pupae)*	0	0	0
	Chrysops	108	108	0
	Dicranota	24	0	0
	Dixa	108	0	0
	Euparyphus	108	108	0
	Hemerodromia	108	108	0
	Limnophora	108	108	0
	Pericoma (Psychodidae)	36	36	36
	Simulium (larvae)	108	108	108
	Simulium (pupae)*	108	0	0
	Tipula	36	36	36
Hemiptera	Corixidae	108	0	0
Collembola		108	108	0
Crustacea	Cladocera	108	0	0
	Copepoda	108	0	108
	Isopoda	108	0	0
	Ostracoda	108	108	108
Arachnida	Hydracarina	108	108	108
Mollusca	*Gyraulus*	108	0	108
	Sphaerium	108	108	108
Annelida	Hirudinea	108	0	0
	Oligochaeta	108	108	108
Platyhelimenthes	Planariidae	108	108	0
	Total TQ values:		2579	1622
	# of Taxa in column:		38	33
	TQ values/ # of Taxa:		67.87	49.15

* = taxa combined with appropriate life stage