Benthic Macroinvertebrates
Dolores River
McPhee Dam to donwstream

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Draft

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Introduction

The purpose of this study was to identify significant changes in the benthic macroinvertebrate (BMI) community compostion on the Dolores River from McPhee Dam downstream.

Benthic biological communities include periphyton, macroinvertebrates, and some species of fish. Periphyton (or biofilm) is composed mostly of the primary producer, algae, which grows on top of rocks and other benthic substrates. Benthic macroinvertebrates feed upon periphyton, dead organic material and a wide range of small organisms, and are themselves an important food resource for fish, amphibians, reptiles, birds, and mammals. Of the fish, some species, such as suckers and fathead minnows, graze primarily upon periphyton. Trout and speckled dace, however, rely primarily upon benthic macroinvertebrates for their food.

Two indicators of aquatic ecosystem health are species composition and species diversity, which researchers can evaluate by determining the number of taxa (taxa richness) and the relative densities of the taxa or the taxa evenness (May 1988). In general, healthy aquatic ecosystems are reflected by high numbers of taxa and even taxa distribution.

Although monitoring water chemistry in streams provides information on exposure concentrations and chemical loading, it does not directly address species composition and diversity or the quality of benthic community habitat (Karr and others, 1986; Yoder and Rankin, 1999). Because of the abundance and mobility of benthic macroinvertebrates, coupled with their ability to recolonize impaired ecosystems, benthic macroinvertebrates are commonly used in monitoring studies of aquatic ecosystem health throughout the United States (Davis and others, 1996). The methods for collection, analysis, and interpretation of benthic macroinvertebrate data are well established through works including the Rapid Bioassessment Protocol (RBP) developed for the Environmental Protection Agency (Shackleford, 1988; Plafkin and others, 1989; Barbour and others, 1992, 1995, 1996; Hayslip, 1993), the benthic Index of Biotic Integrity (IBI; Kerans and Karr, 1994; Fore and others, 1996) and the Invertebrate Community Index (DeShon, 1995). Their use as indicators of water and habitat quality has been justified by Hutchinson (1993), Karr and Chu (1999), Resh and Jackson (1993), and Rosenburg and Resh (1993).

Moreover, using macroinvertebrates for monitoring and assessing the health of an aquatic ecosystem directly addresses the concept of ecosystem health by recognizing that benthic macroinvertebrates integrate a variety of variables of concern over both space, (such as benthic habitat and water quality) and time (because they live in the stream year round and any ephemeral change in water quality will appear in the composition of the macroinvertebrate community).

A large number of community metrics can be calculated from counts of individual taxa in an ecosystem. Most metrics incorporate knowledge of the type of taxa, taxa richness, and relative numbers (evenness). There have been several attempts to apply a single number to taxa richness and evenness. The most

widely accepted attempt is the Shannon-Weiner diversity index. The problem is that such an integrative index loses important information and may not wholly define and encompass all the intricacies of a macroinvertebrate community (Hurlbert, 1971; Purvis and Hector, 2000).

Benthic macroinvertebrate samples were collected between April 23rd and April 28th, 2007 from 18 sites below McPhee Dam to below the confluence with the San Miguel River (Table 1). A 300um kick net was used to collect BMIs from 3 locations in each riffle. A targeted, richest habitat approach was utilized. Samples were emptied into a white plastic pan and all BMIs were collected, preserved and identified to the lowest taxonomic level. A number of metrics were calculated and scrutinized to identify significant changes from one sample site to the next (Table 2).

Table 1. Sample sites and description.

Sample Site Name	Sample Site Location Description
Below Dam	Approximately ½ mile below McPhee Dam
Old Cabin	~2 miles below dam
Up. Salter Creek	Riffle just upstream of Salter Creek, ~3 miles below dam
Dwn. Salter Creek	Riffle just downstream of Salter Creek ~3 miles below dam
Ferris Crk. Cmpgrnd	Riffle adjacent to Ferris Creek Campground, ~ 4 miles downstream of dam
Bradfield Bridge	Riffle just upstream of Bradfield Bridge, ~ 10 miles below dam
Dove Creek Pumps	~ 25 miles below dam, fist riffle below pumphouse
1 Mile Below Pumps	
3 Miles Below Pumps	
Up. Bell Canyon	Just downstream of confluence with Bell Canyon
River Crossing	First riffle downstream of ATV crossing
Up. Slickrock	Riffle ~ ½ mile upstream of Slickrock
Up. Big Gyp Valley	Accessible riffle upstream end of Big Gypsum Valley
Dwn. Big Gyp Valley	Accessible Riffle downstream end of Big Gypsum Valley
Up. Paradox Valley	Accessible Riffle upstream of Paradox
Dwn. Paradox Valley	Riffle downstream end of Paradox Valley
Up. San Miguel	~1/2 mile upstream of confluence with San Miguel River
Dwn. San Miguel	~ 1 mile downstream of San Miguel River

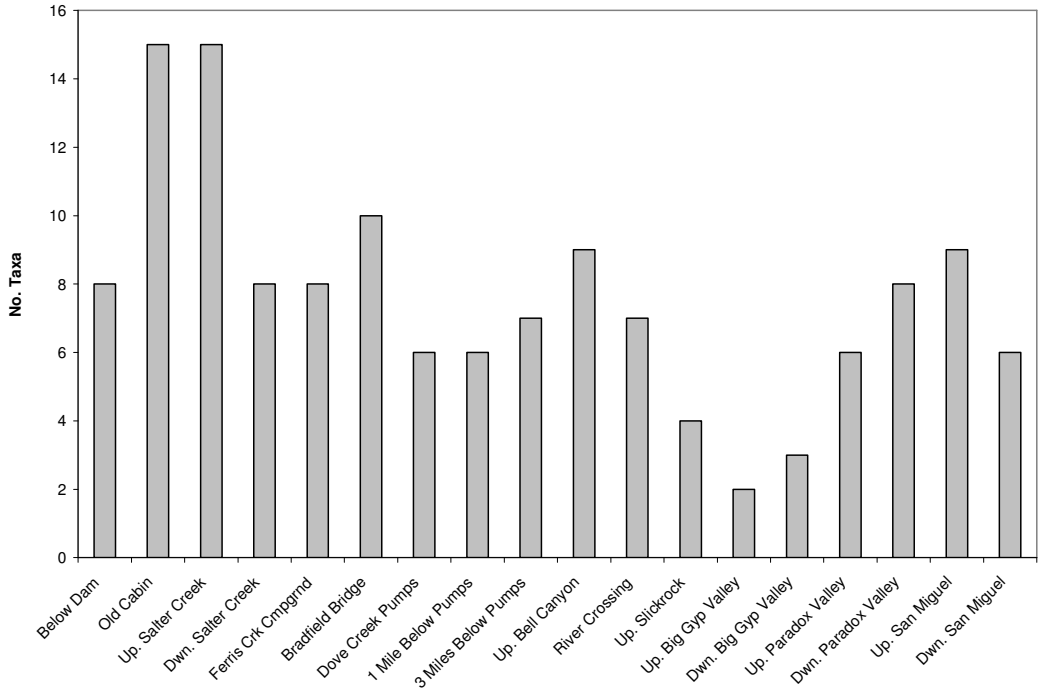

Figure 1. No. Taxa. Changes in number of taxa occur below Salter Creek, between Bradfield Bridge and Dove Creek Pumps, at Slickrock and at Paradox Valley.

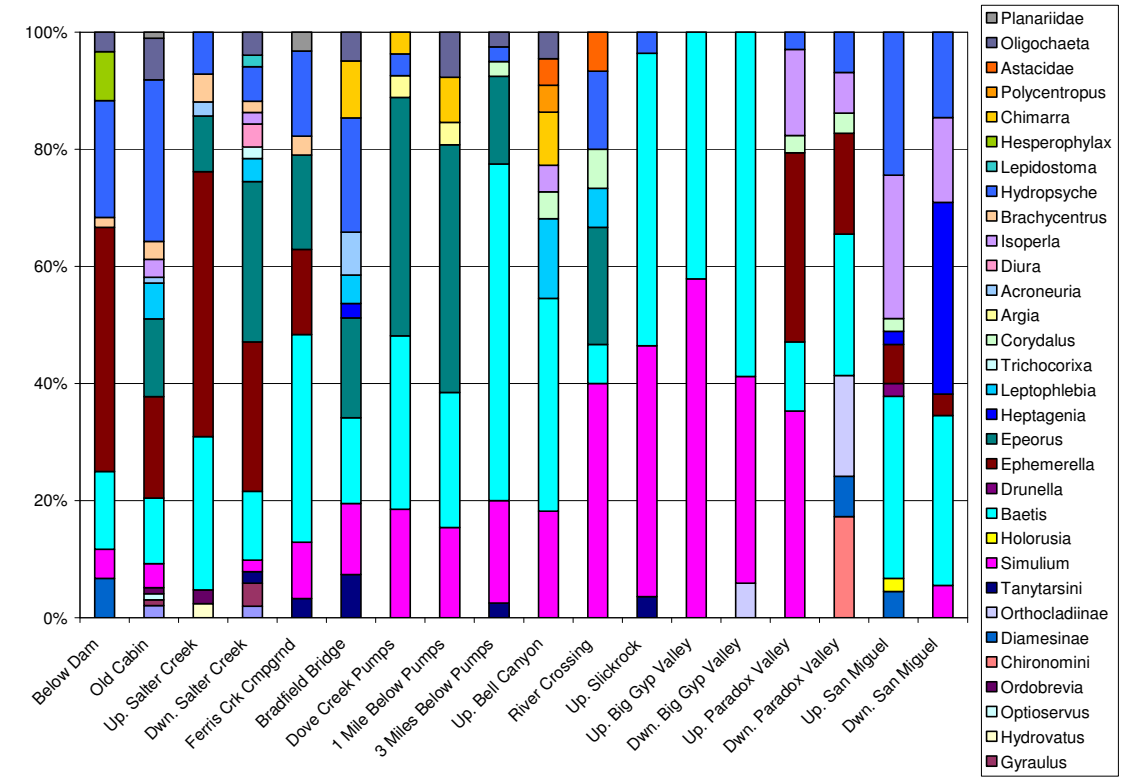

Figure 2. Proportion of taxa type. The lack of the mayfly, *Ephemerella* along with much fewer stoneflies and the presence of the Trichoptera, *Chimarra* below Bradfield Bridge to Paradox is significant. Also, the loss of Heptageniid mayflies at Slickrock is significant.

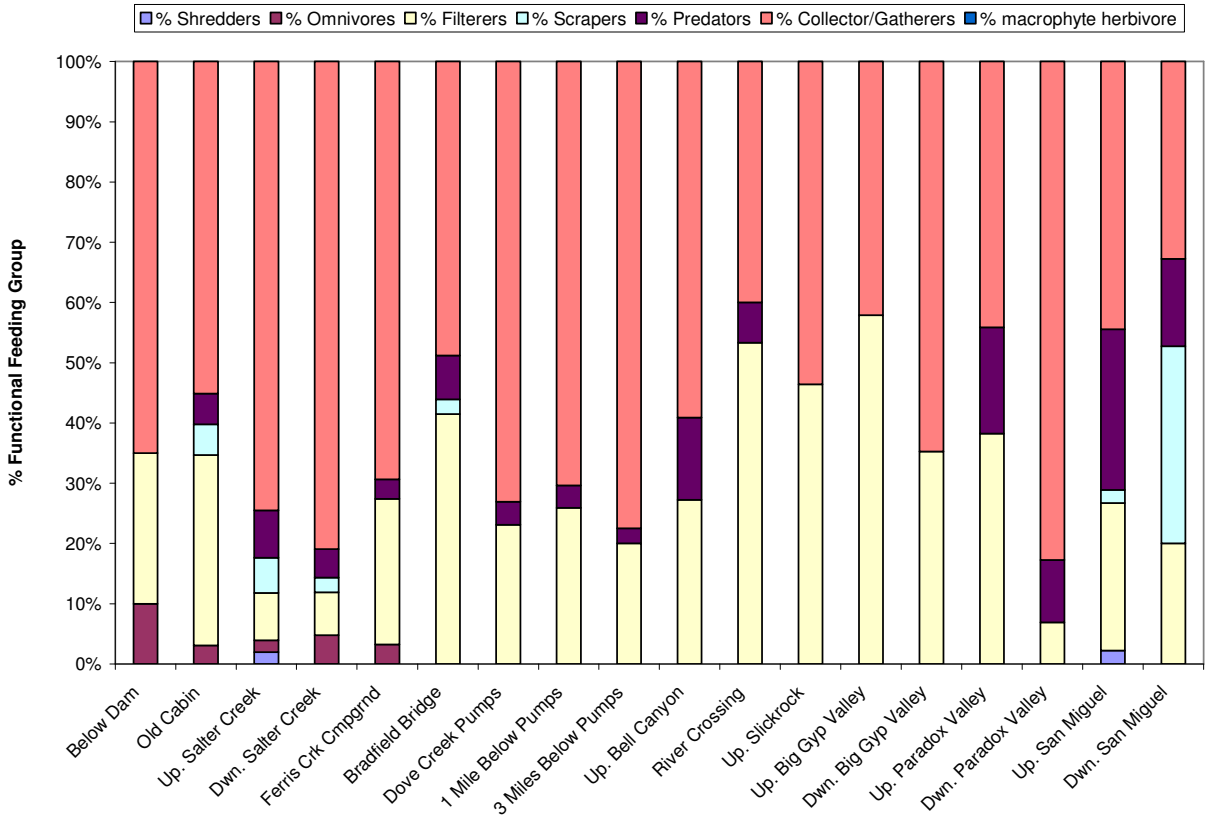

Figure 3. Proportion of Functional Feeding Groups. Loss of scrapers below Bradfield Bridge and predators in Big Gypsum Valley are significant along with recovery of some functional feeding groups below Paradox Valley.

Results

There were significant decreases in the health of the BMI community composition between Bradfield Bridge and Dove Creek Pumps, upstream of Slickrock, and in Big Gyp Valley. There appeared to be recovery of BMIs at Paradox Valley and downstream of the confluence with the San Miguel River. Changes in number of taxa occurred below Salter Creek, between Bradfield Bridge and Dove Creek Pumps, at Slickrock and at Paradox Valley (Figure 1).

The loss of the mayfly, *Ephemerella* along with much fewer stoneflies and the presence of the Trichoptera, *Chimarra* below Bradfield Bridge to Paradox was significant along with the loss of Heptageniid mayflies at Slickrock (Figure 2).

Loss of the functional feeding group (FFG), scrapers, below Bradfield Bridge and predators in Big Gypsum Valley were significant along with recovery of some functional feeding groups below Paradox Valley (**Figure 3**).

Discussion

There were apparent changes in BMIs at several locations: below Bradfield bridge, above Slickrock, at Big Gypsum Valley, downstream of Paradox and downstream of the confluence with the San Miguel.

Below Bradfield Bridge to the ATV crossing benthic substrate appeared to be suitable for a healthy BMI population. There was abundant cobble supstrate with plenty of interstitial space for refuge of BMI taxa. Some places within these reaches had significant amounts of filamentous algae that may have coincided with a decrease in diatoms, a significant source of food for a number of BMI taxa, especially the FFG, Scrapers. Water remained clear to Slickrock where it was turbid. From the slickrock sample site to Paradox, benthic habitat was embedded resulting in little interstitial space and reduced refuge for BMIs. The San Miguel River is a relatively healthy, free flowing river with a healthy BMI community. Although flows were too high to sample the San Miguel upstream of the Dolores, BMI community composition is known from samples obtained by the Colorado Department of Public Health and Environment.

Compared to other, turbid, dam control streams, the Pine River and the Florida Rivers in Southern Colorado, the BMI community composition of the Dolores has fewer taxa in addition to having Corydalus, a benthic macroinvertebrate that is not found on the other streams. The Dolores is different from the Pine and Florida in that it recieves no irrigation return flow, is slightly lower in elevation and is in an area with different geologic substrate.

Compared to data collected at Bradfield Bridge and Ferris Creek Campground in 2003, 2004, 2005 and 2006 there appears to be some change in the community compostion at Ferris Creek Campground. A caddisfly, Philopotomidae, made up a significant porportion of the BMI community in 2003, 2004 and 2005 and was completely absence in 2006 and 2007. Appearing in 2006 and 2007, not present in 2003, 2004 and 2005, were an ephemerella mayfly and a hydropsyche caddisfly. The BMI composition at Bradfield Bridge was similar to previous year's data. The change at Ferris Creek Campground may be attributed to the drought and low flows of 2002 and 2003 and subsequent recovery.

Recomendations

It is recommended that the reach between Bradfield Bridge and Dove Creek Pumps be studied to identify potential sources that may be altering water quality. The source of turbidity upstream of Slickrock should be identified and its impact on water quality quantified. Also the source of the effect on the BMI community upstream of the area of Big Gypsum valley should be identified. It was suprising that

the BMI community improved below Paradox and should be a point of discussion that may shed light on negative effects found at other reaches. The capacity the Dolores has in removing pollutants (assimilative capacity), both natural and man made, along with identifying sources of pollution should be an integral aspect of this discussion.

Table 2. BMI metrics.

Sample Site	Below Dam	Old Cabin	Up. Salter Creek	Dwn. Salter Creek	Ferris Crk. Cmpgrnd	Bradfield Bridge	Dove Creek Pumps	1 Mile Below Pumps	3 Miles Below Pumps
Number of Taxa ID	8	15	15	8	8	10	6	6	7
Total Number	60	98	51	42	62	41	26	27	40
Average of Tol. Value	4.24	4.17	4.50	3.42	4.19	4.48	4.39	4.70	4.71
Sum of Hilsenhoff	226.33	407.98	150.91	124.72	250.36	180.90	84.16	92.42	178.09
Hilsenhoff BI	3.77	4.16	2.96	2.97	4.04	4.41	3.24	3.42	4.45
No. Ephemeroptera taxa	2	4	4	3	3	4	2	2	2
No. Plecoptera taxa	0	2	2	1	0	1	0	0	0
No. Trichoptera taxa	3	2	3	2	2	2	1	2	1
No. EPT taxa	5	8	9	6	5	7	3	4	3
% EPT taxa	62.50%	53.33%	60.00%	75.00%	62.50%	70.00%	50.00%	66.67%	42.86%
% Ephemeroptera taxa	25.00%	26.67%	26.67%	37.50%	37.50%	40.00%	33.33%	33.33%	28.57%
% Trichoptera taxa	37.50%	13.33%	20.00%	25.00%	25.00%	20.00%	16.67%	33.33%	14.29%
% Plecoptera Taxa	0.00%	13.33%	13.33%	12.50%	0.00%	10.00%	0.00%	0.00%	0.00%
No. Ephemeroptera	33	47	35	34	41	16	17	19	29
No. Plecoptera	0	4	3	1	0	3	0	0	0
No. Trichoptera	18	30	5	5	11	12	2	2	1
% EPT	85.00%	82.65%	84.31%	95.24%	83.87%	75.61%	73.08%	77.78%	75.00%
% Ephemeroptera	55.00%	47.96%	68.63%	80.95%	66.13%	39.02%	65.38%	70.37%	72.50%
% Plecoptera	0.00%	4.08%	5.88%	2.38%	0.00%	7.32%	0.00%	0.00%	0.00%
% Trichoptera	30.00%	30.61%	9.80%	11.90%	17.74%	29.27%	7.69%	7.41%	2.50%
No. Diptera taxa	2	1	2		3	2	1	1	2
No. Chironomidae taxa	1	0	1	0	1	1	0	0	1
% Tribe Tanytarsini	100.00%	0.00%	0.00%	0.00%	6.38%	0.00%	0.00%	0.00%	100.00%
% Oligochaeta	2.86%	3.15%	8.13%	0.00%	0.00%	4.17%	0.70%	0.47%	0.33%
Dominant Taxa	Ephemerella	Hydropsyche	Epeorus	Ephemerella	Baetis	Hydropsyche	Epeorus	Epeorus	Baetis
% Dom of most abund taxa	41.67%	27.55%	27.45%	45.24%	35.48%	19.51%	40.74%	40.74%	57.50%
% Shredders	0.00%	0.00%	1.96%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Omnivores	10.00%	3.06%	1.96%	4.76%	3.23%	0.00%	0.00%	0.00%	0.00%
% Filterers	25.00%	31.63%	7.84%	7.14%	24.19%	41.46%	23.08%	25.93%	20.00%
% Scrapers	0.00%	5.10%	5.88%	2.38%	0.00%	2.44%	0.00%	0.00%	0.00%
% Predators	0.00%	5.10%	7.84%	4.76%	3.23%	7.32%	3.85%	3.70%	2.50%
% Collector/Gatherers	65.00%	55.10%	74.51%	80.95%	69.35%	48.78%	73.08%	70.37%	77.50%
% macrophyte herbivore	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Sample Site	Up. Bell Canyon	River Crossing	Up. Slickrock	Up. Big Gyp Valley	Dwn. Big Gyp Valley	Up. Paradox Valley	Dwn. Paradox Valley	Up. San Miguel	Dwn. San Miguel
Number of Taxa ID	9	7	4	2	3	6	8	9	6
Total Number	22	15	28	19	17	34	29	45	55
Average of Tol. Value	4.63	4.80	5.84	5.37	5.40	4.14	4.31	3.85	4.49
Sum of Hilsenhoff	104.80	69.96	148.66	100.80	88.31	125.82	129.75	193.75	275.39
Hilsenhoff BI	4.76	4.66	5.31	5.31	5.19	3.70	4.47	4.31	5.01
No. Ephemeroptera taxa	2	3	1	1	1	2	2	4	3
No. Plecoptera taxa	1	0	0	0	0	1	1	1	1
No. Trichoptera taxa	2	1	1	0	0	1	1	1	1
No. EPT taxa	5	4	2	1	1	4	4	6	5
% EPT taxa	55.56%	57.14%	50.00%	50.00%	33.33%	66.67%	50.00%	66.67%	83.33%
% Ephemeroptera taxa	22.22%	42.86%	25.00%	50.00%	33.33%	33.33%	25.00%	44.44%	50.00%
% Trichoptera taxa	22.22%	14.29%	25.00%	0.00%	0.00%	16.67%	12.50%	11.11%	16.67%
% Plecoptera Taxa	11.11%	0.00%	0.00%	0.00%	0.00%	16.67%	12.50%	11.11%	16.67%
No. Ephemeroptera	11	5	14	8	10	15	12	19	36
No. Plecoptera	1	0	0	0	0	5	2	11	8
No. Trichoptera	3	2	1	0	0	1	2	11	8
% EPT	68.18%	46.67%	53.57%	42.11%	58.82%	61.76%	55.17%	91.11%	94.55%
% Ephemeroptera	50.00%	33.33%	50.00%	42.11%	58.82%	44.12%	41.38%	42.22%	65.45%
% Plecoptera	4.55%	0.00%	0.00%	0.00%	0.00%	14.71%	6.90%	24.44%	14.55%
% Trichoptera	13.64%	13.33%	3.57%	0.00%	0.00%	2.94%	6.90%	24.44%	14.55%
No. Diptera taxa	1	1	2	2	2	1	3	2	1
No. Chironomidae taxa	0	0	1	0	1	0	3	1	0
% Tribe Tanytarsini	1.67%	0.00%	12.50%	0.00%	100.00%	100.00%	0.00%	0.00%	0.00%
% Oligochaeta	0.26%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Dominant Taxa	Baetis	Simulium	Baetis	Simulium	Baetis	Simulium	Baetis	Baetis	Heptagenia
% Dom of most abund taxa	36.36%	40.00%	50.00%	57.89%	58.82%	35.29%	24.14%	31.11%	32.73%
% Shredders	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.22%	0.00%
% Omnivores	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Filterers	27.27%	53.33%	46.43%	57.89%	35.29%	38.24%	6.90%	24.44%	20.00%
% Scrapers	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.22%	32.73%
% Predators	13.64%	6.67%	0.00%	0.00%	0.00%	17.65%	10.34%	26.67%	14.55%
% Collector/Gatherers	59.09%	40.00%	53.57%	42.11%	64.71%	44.12%	82.76%	44.44%	32.73%
% macrophyte herbivore	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

ID	Below Dam	Old Cabin	Up. Salter Creek	Dwn. Salter Creek	Ferris Crk Cmpgrnd	Bradfield Bridge	Dove Creek Pumps	1 Mile Below Pumps	3 Miles Below Pumps	Up. Bell Canyon	River Crossing	Up. Slickrock	Up. Big Gyp Valley	Dwn. Big Gyp Valley	Up. Paradox Valley	Dwn. Paradox Valley	Up. San Miguel	Dwn. San Miguel
		2		1														
lus		1		2														
ovatus			1															
servus		1																
previa		1	1															
nomini																5		
esinae	4															2	2	
cladiinae														1		5		
arsini				1	2	3			1			1						
ium	3	4		1	6	5	5	4	7	4	6	12	11	6	12			3
usia																	1	
s	8	11	11	6	22	6	8	6	23	8	1	14	8	10	4	7	14	16
ella																	1	
nerella	25	17	19	13	9										11	5	3	2
us		13	4	14	10	7	11	11	6		3							
genia						1											1	18
phlebia		6		2		2				3	1							
ocorixa				1														
dalus									1	1	1				1	1	1	
							1	1										
neuria		1	1			3												
				2														
rla		3		1						1					5	2	11	8
ycentrus	1	3	2	1	2													
opsyche	12	27	3	3	9	8	1		1		2	1			1	2	11	8
ostoma				1														
erophylax	5																	
arra						4	1	2		2								
entropus										1								
idae										1	1							
chaeta	2	7		2		2		2	1	1								
riidae		1			2													