Lower Fryingpan River
Benthic Macroinvertebrate Study
October 2013 and April 2014

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Executive Summary

Benthic macroinvertebrate communities serve as indicators of stream and ecosystem function. Previous work completed on the Fryingpan River by Miller Ecological Consultants, Inc was used to determine the stream conditions in 2001 through 2003. In those previous studies, a fall and spring sampling regimen was used to determine changes due to winter flow conditions. This study used the same fall and spring sampling period and two of same locations to update the current condition of the macroinvertebrate community in the Fryingpan River in three locations. Sampling took place at three sites, Site 1 – at Basalt, Site 2 – downstream of Taylor Creek, and Site 3 – downstream of Ruedi Dam. Site 2 and Site 3 were the same sites sampled during the fishery studies conducted in 2001 through 2003. Sampling efforts followed the same protocols as the 2001-2003 study. The results from 2013 -2014 provide an update on the stream conditions since the last sampling in 2003. The main evaluation factors of diversity, evenness, taxa richness, EPT and functional feeding groups all provide insight into the current stream conditions.

In general, results of fall 2013 and spring 2014 were similar to results from the previous study in 2001 through 2003; however, some differences were observed in taxa richness, evenness and EPT values. The difference in sample analysis (600 count for 2013-2014 and full count for 2001-2003) may account for some of the difference. Results of the 2013-2014 sampling are most similar to the data from spring 2003 for most metrics. Functional groups exhibited similar composition during all years with slight variation occurring mostly in the scraper and predator groups. The distribution of the functional feeding groups is similar to the species distribution. There is more complexity in the types of feeding groups in the downstream section of the Fryingpan River compared with the area near the dam.

The current condition of the macroinvertebrate community is similar to conditions monitored in 2003. The metrics used for the evaluation show that the macroinvertebrate community does not show signs of impairment, especially in the downstream reaches. Taxa richness and EPT values are somewhat lower than those in 2001 – 2003. It may be useful to conduct additional sampling in future years to determine if this signifies a downward trend or is within the natural variability of the river. Overall, the data show that the lower Fryingpan River has the expected stream conditions for a tailwater stream. The macroinvertebrate community indicates generally good stream conditions, however, the reduced number of taxa may be the result of recent changes in the flow regime. The following recommendations are made to monitor the benthic macroinvertebrate community.

- Monitor the three sites at least every 2-3 years to track any changes resulting from the late summer flow releases.
- Continue to monitor water temperatures at all three locations (dam, Taylor Creek and Basalt).
- Compile an annual summary of discharge and water temperature for the lower Fryingpan River.

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Table of Contents

List of Tables

List of Figures

Introduction

Benthic macroinvertebrate communities serve as indicators of stream and ecosystem function. Previous work completed on the Fryingpan River by Miller Ecological Consultants, Inc was used to determine the stream conditions in 2001 through 2003. In those previous studies, a fall and spring sampling regimen was used to determine changes due to winter flow conditions. This study used the same fall and spring sampling period and two of same locations to update the current condition of the macroinvertebrate community in the Fryingpan River in three locations.

Methods

Benthic macroinvertebrate samples were collected by personnel from Roaring Fork Conservancy. Benthic macroinvertebrate samples were analyzed by Miller Ecological Consultants located in Fort Collins, CO. Benthic macroinvertebrate sampling were conducted in late October, 2013 and early April, 2014.

Sampling took place at three sites, Site 1 – at Basalt, Site 2 – downstream of Taylor Creek, and Site 3 – downstream of Ruedi Dam. Site 2 and Site 3 were the same sites sampled during the fishery studies conducted in 2001 through 2003. At each site, three samples were taken in riffle habitat with a modified Hess sampler. All samples were taken in areas of similar size substrate and similar depth to avoid bias that may be directly related to habitat. Substrates within the sampler were thoroughly disturbed and individual rocks were scrubbed by hand to dislodge all benthic organisms. All organisms and debris in the capture cup were transferred to a labeled nalgene container. The collection cup was flushed with water to clear all invertebrates into the sample container. A solution of 85% Ethyl alcohol was added to the container as a preservative.

Benthic macroinvertebrates were transported to the lab to be sorted, enumerated, and identified to the lowest practical taxonomic level (Merritt and Cummins 1996; Ward et al. 2002). All containers were labeled internally and externally during sample sorting, identification and weighing. Each sample was sorted using a 600 count random subsample technique in a gridded tray. Identification to the "lowest practical taxonomic level" means that all specimens were identified down to the level that is permitted by the available morphological characteristics. Early life stages of many species sometimes lack certain anatomical characteristics that allow the specimen to be identified to the genus or species level. In these cases the "lowest practical taxonomic level" may mean only the family level; however, if the available characteristics are consistent with a species that has been previously confirmed then the individual may be included as a member of that taxa. In instances where proper identification is possible, the orders Ephemeroptera, Plecoptera, and Trichoptera were identified to genus (and many down to the species level). Most specimens of other orders, including Diptera, were identified to genus; however, members of the family Chironomidae will only be identified to subfamily or tribe.

Data collected were used in various indices recommended by the Rapid Bioassessment Protocols (Barbour et al. 1999) to provide information regarding macroinvertebrate community structure, function, and general aquatic conditions. The following indices were used in this study:

Shannon-Weaver diversity (diversity) and Shannon-Weaver evenness (evenness) values are used to detect changes in macroinvertebrate community structure. In pristine waters, diversity values typically range from near 3.0 to 4.0. In polluted waters this value is generally less than 1.0. The overall evenness value ranges between 0.0 and 1.0, with values lower than 0.3 indicative of organic pollution (Ward et al. 2002). Diversity and evenness are similar measurements because they both rely heavily on the numerical distribution of taxa, (although taxa richness also influences diversity). Both indices are designed to detect imbalance in communities (where a few species are represented by a large number of individuals). These situations are usually the result of pollution/disturbance-induced changes to the aquatic community.

The Hilsenhoff Biotic Index (HBI) is another metric that is used to measure balance in macroinvertebrate community structure. Its primary value lies in detecting organic pollution. Organic pollution includes such factors as sewage runoff, feedlot or grazing area runoff and other types of contaminants that deplete dissolved oxygen from the water. It is derived from the proportion of taxa, and their assigned tolerance values, based on sensitivity to organic pollution (Barbour et al. 1999). Because the structure of macroinvertebrate communities changes in different regions, the number indicating a certain water quality rating for organic pollution will vary among rivers. A comparison of the values produced within a given system provides information regarding the location and sources of potential impact from organic pollution. Values for the HBI range from 0.0 to 10.0. Lower HBI values indicate better water quality.

The Ephemeroptera, Plecoptera, Trichoptera (EPT) index is a direct measure of taxa richness among species that are generally considered to be sensitive to disturbances (Barbour et al. 1999). Most macroinvertebrate species have specific habitat requirements. The value produced by this metric will indicate locations with preferred habitat as well as areas of disturbance or habitat modification. The EPT index is reported as the total number of distinguishable taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera found at each site. Results provided by this metric will naturally vary among river drainages, but can be valuable when describing habitat changes in a restricted area. Increasing richness correlates with increasing health of the macroinvertebrate community.

Taxa richness also was reported for each location in the study area. This measurement is simply reported as the total number of identifiable taxa collected from each site. It is similar to the EPT index, except that it includes all aquatic macroinvertebrate species (including those that are thought to be tolerant to disturbance). Taxa richness is useful when describing differences in habitat complexity or aquatic conditions between rivers or site locations.

Taxa richness values also provide an indication of habitat preference and complexity. As with the EPT index, increasing richness correlates with increasing health of the macroinvertebrate community.

A measure of macroinvertebrate standing crop at each site is determined using density and biomass. Macroinvertebrate density is reported as the mean number of macroinvertebrates/m^2 found at each location. Biomass is reported as the mean dry weight (in grams) of macroinvertebrates/m^2 at each site location. Biomass values are obtained by drying macroinvertebrates from each sample in an oven at 100°C for 24 hours or until all water content has evaporated (no decrease in weight could be detected). Biomass values offer production-related information in terms of quantitative weight of macroinvertebrates produced at each site. Density and biomass provide a means of measuring and comparing standing crop and provide an indication of productivity for the macroinvertebrate portion of the food web at each sampling location.

The final metric used in this study were an analysis of macroinvertebrate functional feeding groups. This process provides a measurement of macroinvertebrate community function as opposed to other metrics that measure community structure. Aquatic macroinvertebrates are categorized according to feeding strategy to determine the relative proportion of various groups. Taxa are placed into functional feeding groups based on acquisition of nutritional resources (Merritt and Cummins 1996; Ward et al. 2002). The proportion of certain functional feeding groups in the macroinvertebrate community can provide insight to various types of stress in river systems (Ward et al. 2002). In Colorado streams, the Collector-Gatherer group is usually dominant, but balanced ecosystems should provide a variety of feeding opportunities that maintain a good representation of the other functional feeding groups. Numerous variables (including habitat quality) may affect the proportions of certain functional feeding groups.

Results

The results from 2013 -2014 provide an update on the stream conditions since the last sampling in 2003. The main evaluation factors of diversity, evenness, taxa richness, EPT and functional feeding groups all provide insight into the current stream conditions. Invertebrate communities in the Fryingpan River from Ruedi Dam downstream to Basalt respond as expected as distance from the dam increases. The relatively constant cold water release limits the diversity of the invertebrate community in the vicinity of the dam until the water temperatures are more influenced by ambient conditions further downstream. The community near the dam is dominated by may flies and chironomids. Stone fly genera are absent from the samples near the dam. Some of the univoltine species (species with a single generation per year) have specific thermal requirements to complete their life cycle. The near constant water temperature precludes them from inhabiting the river near the dam. These species are present in the samples at Taylor Creek and even more abundant at Basalt (See Appendix A).

In general, results of fall 2013 and spring 2014 were similar to results from the previous study in 2001 through 2003; however, some differences were observed in taxa richness, evenness and EPT values (Tables 1- 4; Figure 1 – 4). The difference in sample analysis (600 count for 2013-2014 and full count for 2001-2003) may account for some of the difference. Results of the 2013-2014 sampling are most similar to the data from spring 2003 for most metrics (Figures 1 – 4). Functional groups exhibited similar composition during all years with slight variation occurring mostly in the scraper and predator groups (Figures 5 – 8). The distribution of the functional feeding groups is similar to the species distribution. There is more complexity in the types of feeding groups in the downstream section of the Fryingpan River compared with the area near the dam.

Evaluation of data collected during spring 2003 indicated that there had been substantial changes in macroinvertebrate communities compared to results from the previous spring sampling events (Rees et al. 2003). The lack of similarities in response of the metric values at each site suggested that the changes in benthic macroinvertebrate communities were somewhat different at each location. The metrics that remained relatively unaffected (diversity, evenness, FBI and functional feeding groups) are often more sensitive to pollution-related disturbance. These metrics have always indicated some disturbance that was thought to be an influence of the Ruedi Dam.

Aquatic macroinvertebrate communities were evaluated as a means to understand the relationships between winter base flows, anchor ice and macroinvertebrates community structure. The results provide a description of the composition of existing macroinvertebrate communities at the time and location of sampling. The mechanisms that influence the community assemblages are numerous and include variables not directly related to flow manipulations (biological interactions, air temperature, etc.). However, the direct and indirect effects of the flow regime and regulated discharge in the Fryingpan River provide a major influence on benthic macroinvertebrates.

The flow regime in 2001 and 2002 was much different than the winter of 2013-14 (Figure 9). The water temperature regime near the dam was very similar even though the flow regime was quite different (Figures 10 and 11). The water temperatures in the middle to lower Fryingpan River show much more variability through the winter (Figures 12,13, and 14). The water temperature at Basalt shows the influence of the combination of flow regime and ambient conditions. In the winter of 2001-2002 the flows were below 60 cfs for most of the late winter (Figure 9). The water temperatures in Basalt decreased and had many days near zero in the late winter with these low flows (Figure 13). In contrast, the flow regime in 2013-2014 was above 90 cfs in the early winter and have increased flows starting in January through February (Figure 9). This resulted in water temperatures that only occasionally dropped to near zero and increase in February with the increased water volume (Figure 14).

Summary and Recommendations

The current condition of the macroinvertebrate community is similar to conditions monitored in 2003. The metrics used for the evaluation show that the macroinvertebrate community does not show signs of impairment, especially in the downstream reaches. Taxa richness and EPT values are somewhat lower than those in 2001 – 2003. It may be useful to conduct additional sampling in future years to determine if this signifies a downward trend or is within the natural variability of the river. Overall, the data show that the lower Fryingpan River has the expected stream conditions for a tailwater stream. The macroinvertebrate community indicates generally good stream conditions, however, the reduced number of taxa may be the result of recent changes in the flow regime. The following recommendations are made to monitor the benthic macroinvertebrate community.

- Monitor the three sites at least every 2-3 years to track any changes resulting from the late summer flow releases.
- Continue to monitor water temperatures at all three locations (dam, Taylor Creek and Basalt).
- Compile an annual summary of discharge and water temperature for the lower Fryingpan River.

Table 1. Metrics for macroinvertebrate samples collected from each study site, October 2013.

	Site		
Metric	Below Ruedi Dam	Below Taylor Creek	In Basalt
Density (#/m^2)	6,574	6,616	6,287
Biomass (g/m^2)	0.707	1.691	3.173
S-W Diversity	1.73	2.94	3.98
S-W Evenness	0.432	0.642	0.782
Taxa Richness	16	24	34
# EPT Taxa	7	12	19
HBI	5.20	4.90	3.41
Functional Feeding Group			
% Filterers	0.6	2.2	4.9
% Gatherers	95.8	89.2	59.8
% Scrapers	0.0	0.7	12.5
% Predators	0.8	2.9	4.7
% Shredders	0.0	4.5	17.6

Table 2. Metrics for macroinvertebrate samples collected from each study site, April 2014.

Metric	Site: Below Ruedi Dam	Below Taylor Creek	In Basalt
Density (#/m^2)	6,853	7,132	6,457
Biomass (g/m^2)	2.759	7.406	7.233
S-W Diversity	1.97	3.52	3.94
S-W Evenness	0.473	0.711	0.768
Taxa Richness	18	31	35
# EPT Taxa	9	15	18
HBI	5.25	4.69	4.66
Functional Feeding Group			
% Filterers	0.0	4.4	8.8
% Gatherers	97.4	77.2	70.3
% Scrapers	0.7	3.5	8.1
% Predators	0.5	2.5	4.6
% Shredders	1.1	12.2	8.1

Table 3. Metrics for macroinvertebrate samples collected from the Fryingpan River below Ruedi Dam and below Taylor Creek during the fall of 2001 and 2002 (from Rees et al. 2003).

	Below Ruedi Dam		Below Taylor Creek	
Metric	Fall 2001	Fall 2002	Fall 2001	Fall 2002
Density (#/m^2)	16,509	28,220	10,318	17,530
Biomass (g/m^2)	1.382	2.010	2.434	2.486
S-W Diversity	2.29	2.34	3.76	3.35
S-W Evenness	0.453	0.478	0.701	0.639
Taxa Richness	33	30	41	38
# EPT Taxa	19	14	23	19
FBI	5.86	6.62	4.76	5.27

Table 4. Metrics for macroinvertebrate samples collected from the Fryingpan River below Ruedi Dam and below Taylor Creek during the spring of 2001, 2002 and 2003 (from Rees et al. 2003).

	Below Ruedi Dam			Below Taylor Creek		
Metric	Spring 2001	Spring 2002	Spring 2003	Spring 2001	Spring 2002	Spring 2003
Density (#/m^2)	36,770	62,996	25,198	18,366	21,458	20,970
Biomass (g/m^2)	7.411	9.292	4.387	8.795	4.377	2.063
S-W Diversity	2.03	2.37	2.03	3.71	3.66	1.93
S-W Evenness	0.406	0.471	0.47	0.707	0.683	0.386
Taxa Richness	32	33	20	38	41	32
# EPT Taxa	17	20	9	21	22	18
FBI	5.72	6.06	5.90	3.97	4.86	5.66

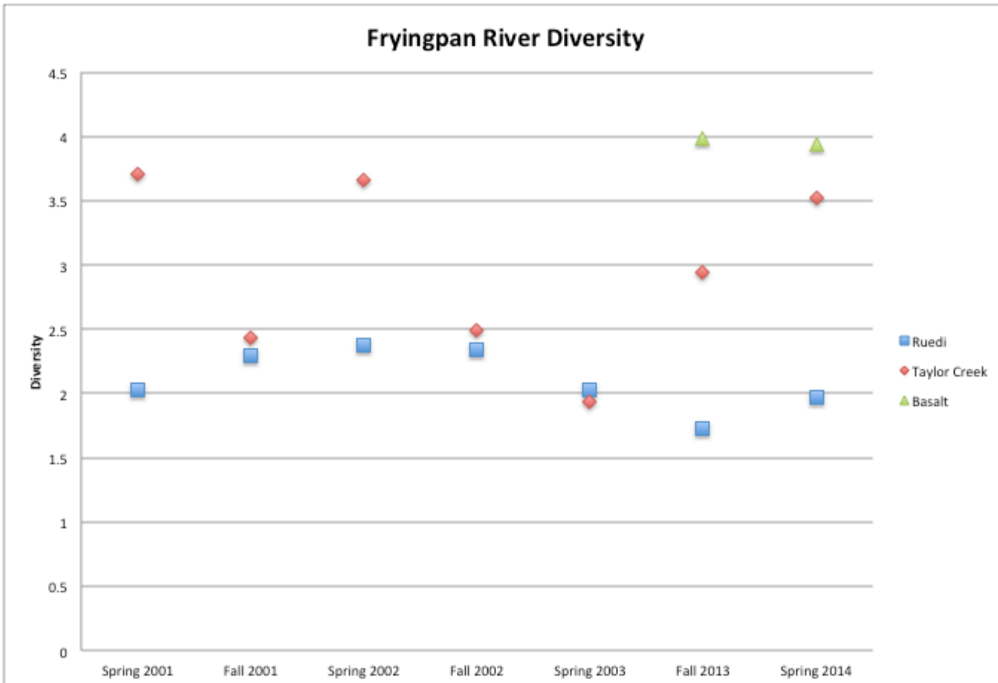


Figure 1. Comparison of macroinvertebrate diversity in the Fryingpan River, 2001, 2002, 2003, 2013, and 2014.

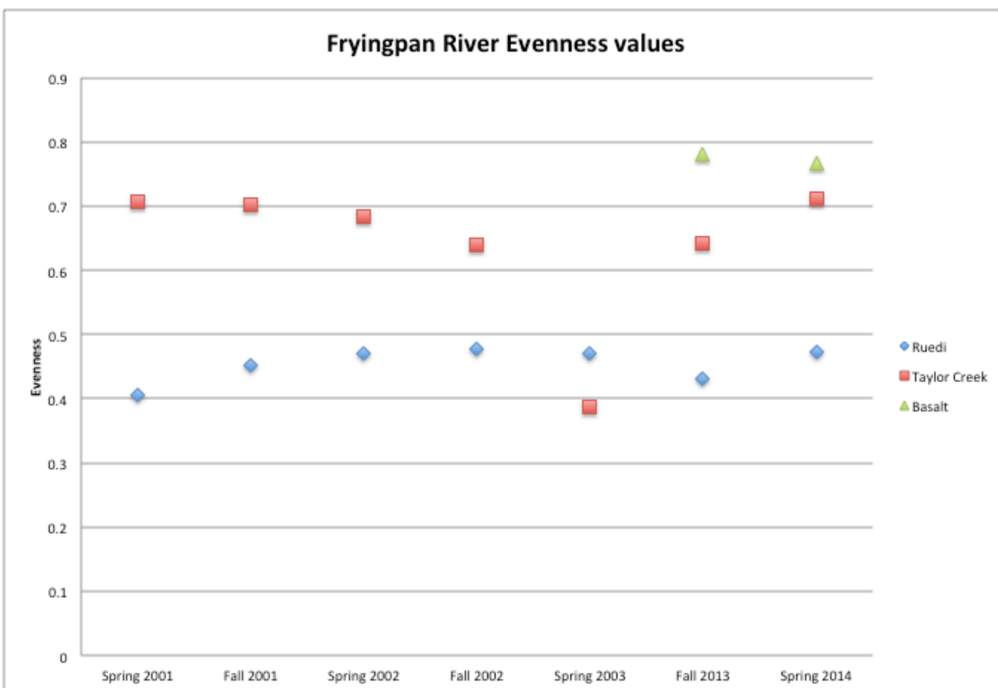


Figure 2. Comparison of macroinvertebrate evenness in the Fryingpan River, 2001, 2002, 2003, 2013, and 2014.

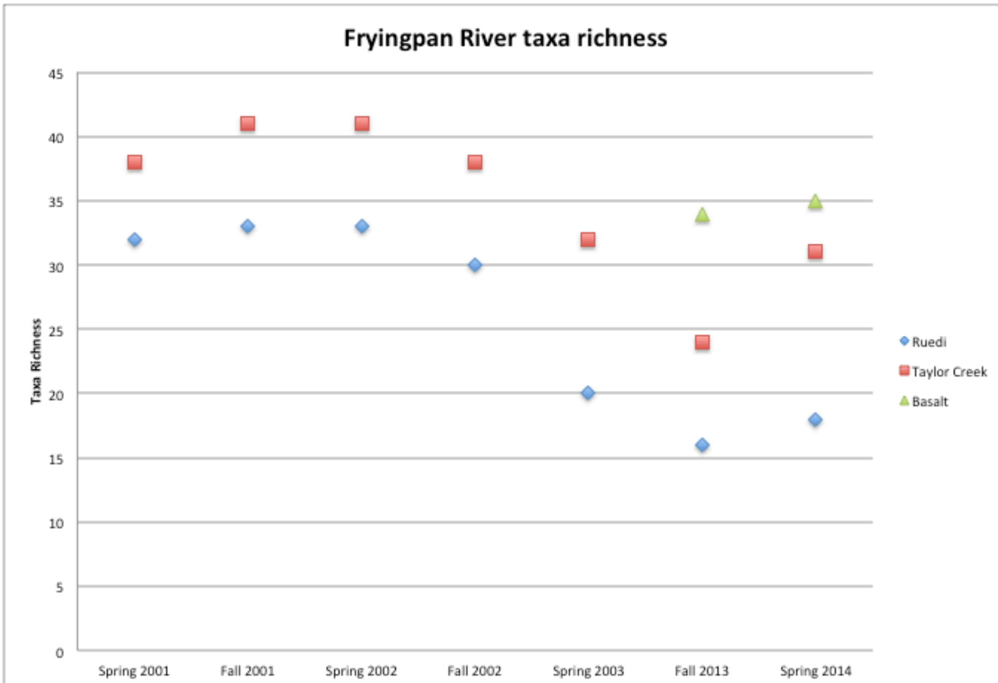


Figure 3. Comparison of macroinvertebrate taxa richness in the Fryingpan River, 2001, 2002, 2003, 2013, and 2014.

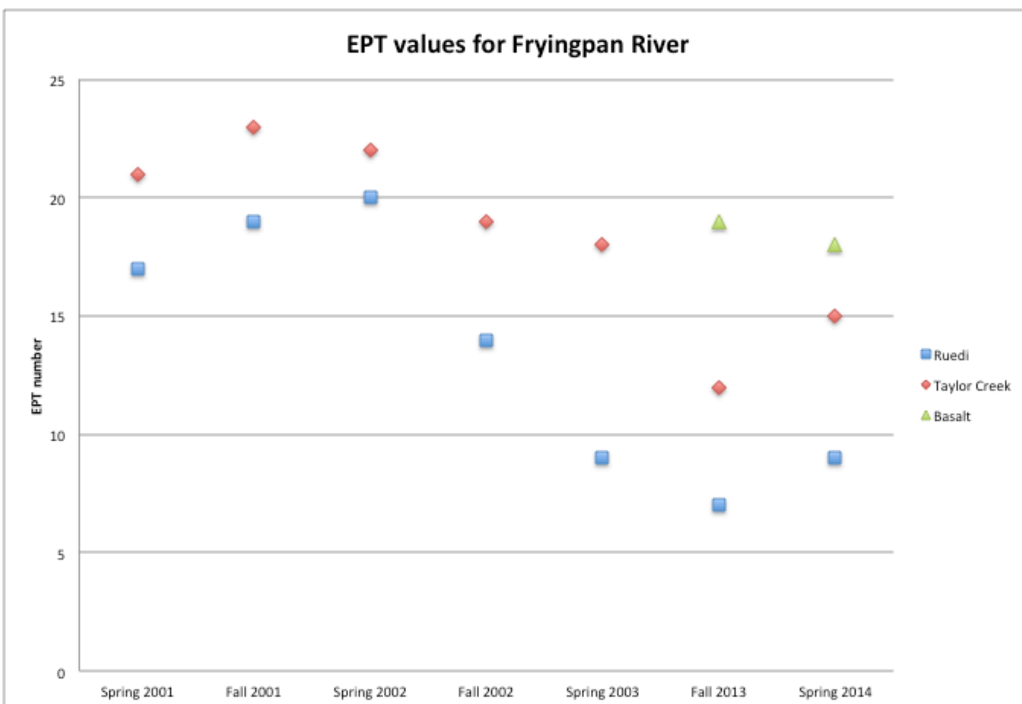


Figure 4. Comparison of macroinvertebrate EPT values in the Fryingpan River, 2001, 2002, 2003, 2013, and 2014.

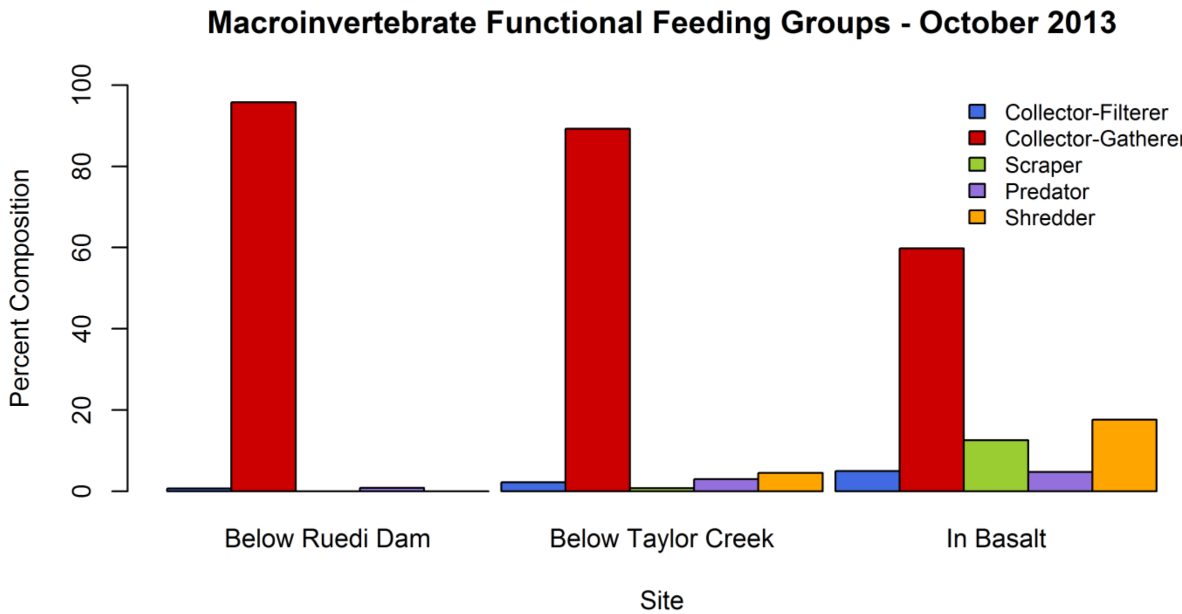


Figure 5. Functional feeding groups by study site, October 2013.

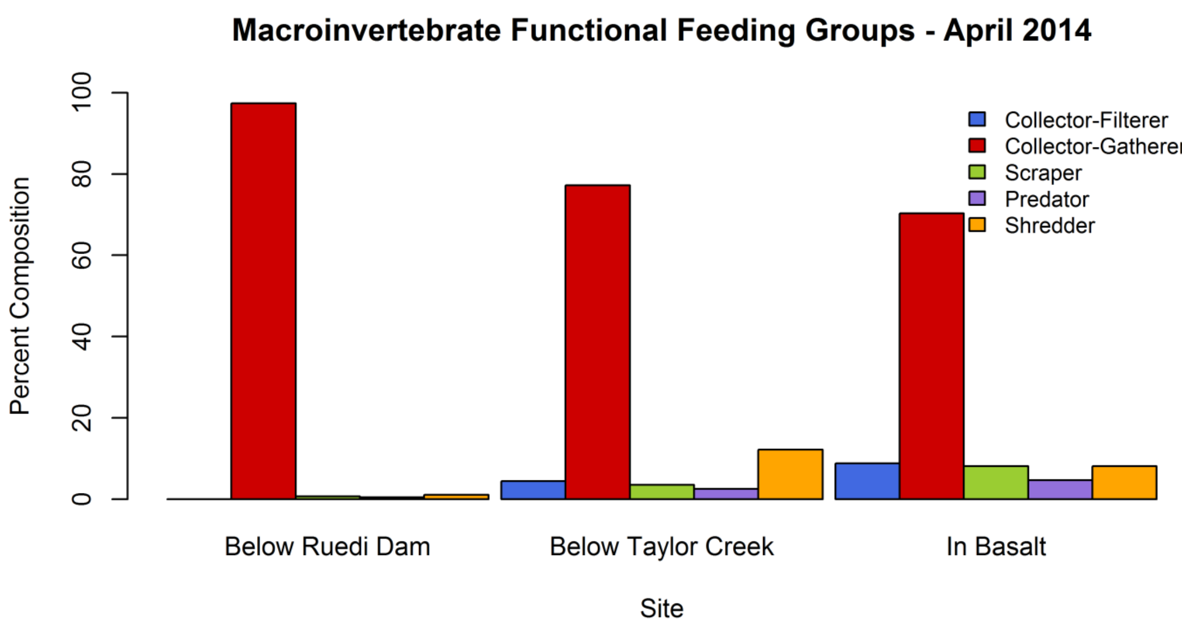
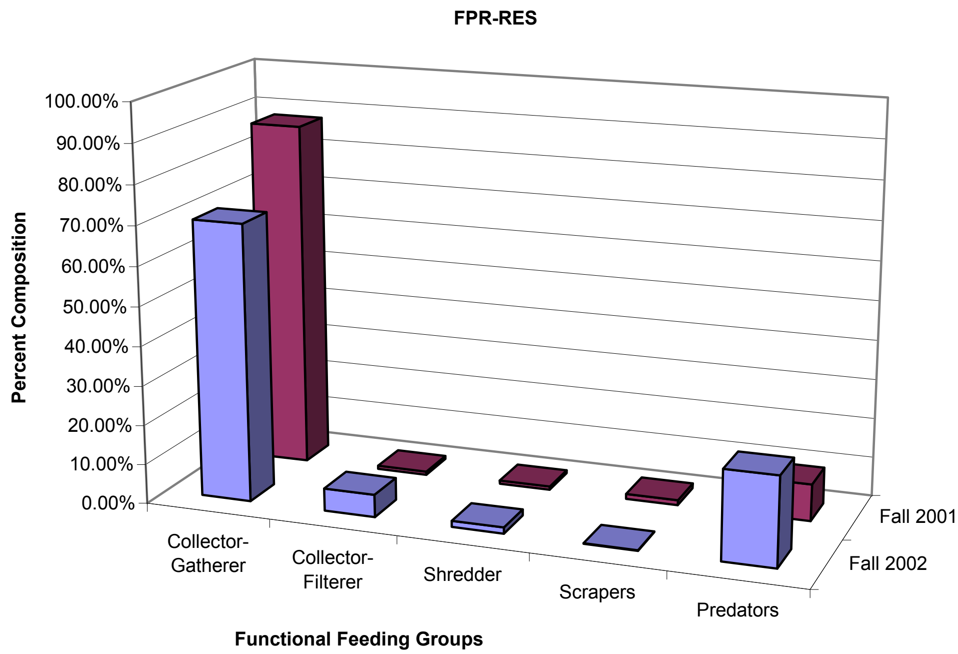


Figure 6. Functional feeding groups by study site, April 2014.



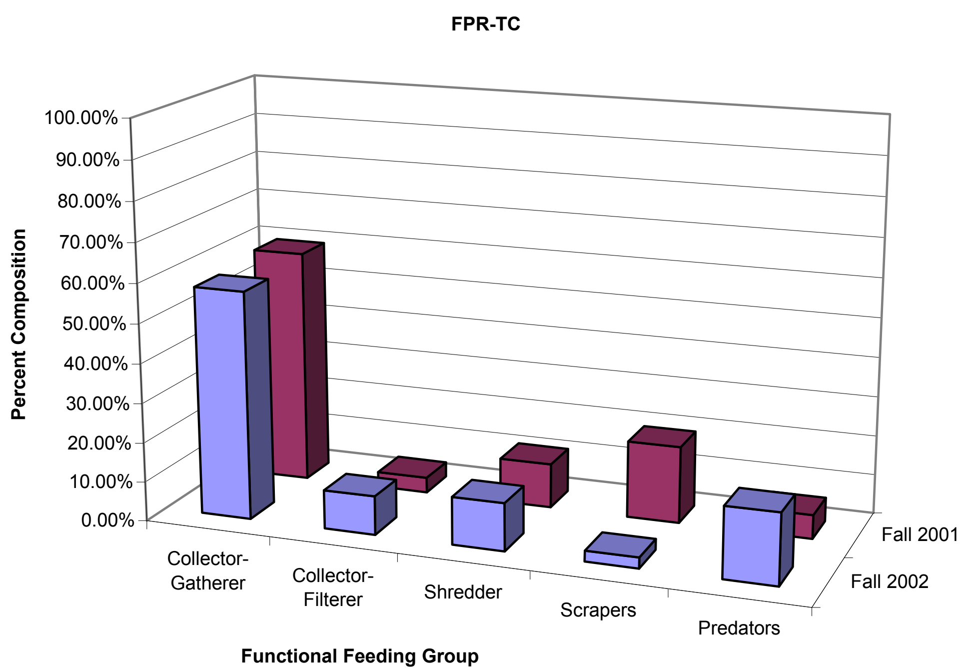
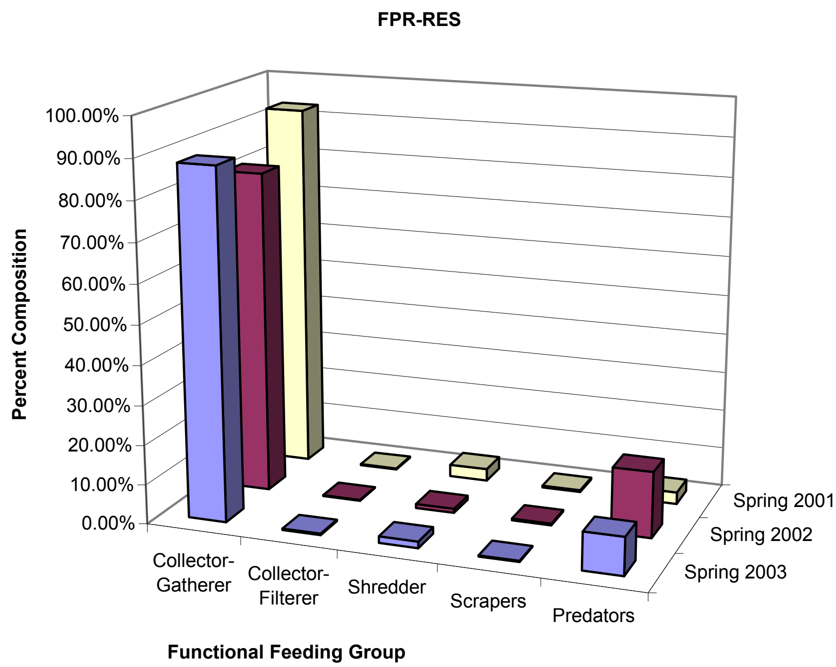


Figure 7. Percentages of functional feeding groups collected from the Fryingpan River below Ruedi Dam (top) and below Taylor Creek (bottom) during the fall of 2001 and 2002 (from Rees et al. 2003).



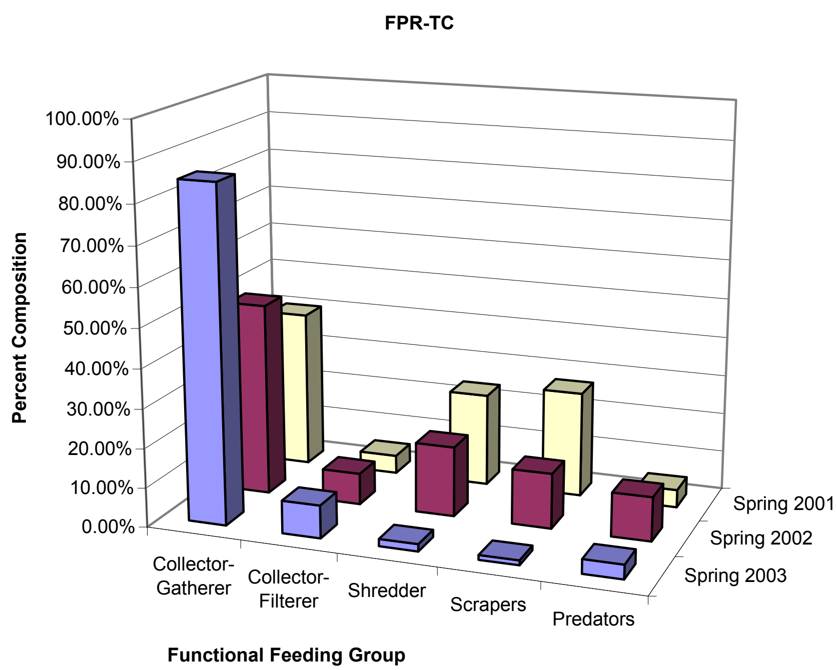


Figure 8. Percentages of functional feeding groups collected from the Fryingpan River below Ruedi Dam (top) and below Taylor Creek (bottom) during the spring of 2001, 2002 and 2003 (from Rees et al. 2003).

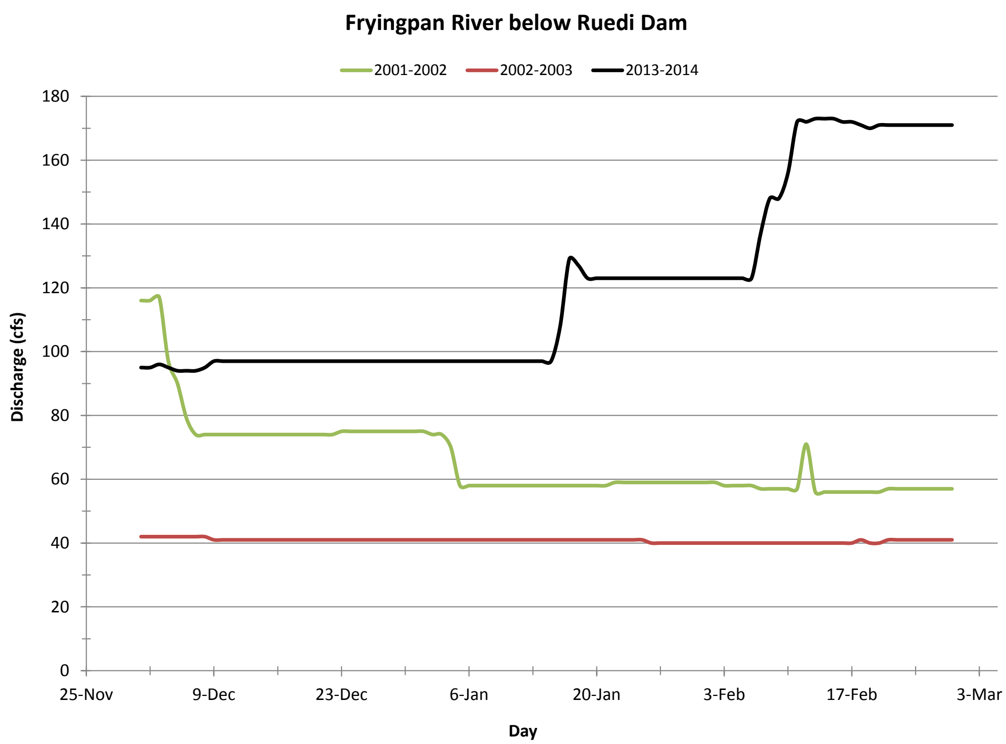


Figure 9. Winter discharge (December-February) for the Fryingpan River below Ruedi Dam, 2001-2002, 2002-2003 and 2013-2014.

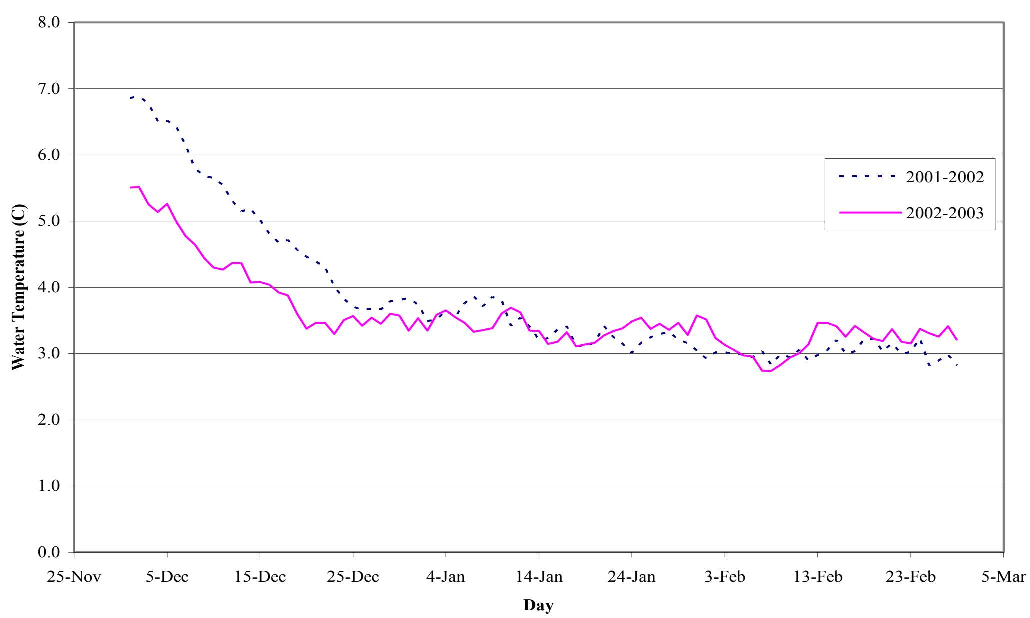


Figure 10. Winter water temperatures for Fryingpan River below Ruedi Reservoir, Colorado (Rees et al. 2003).

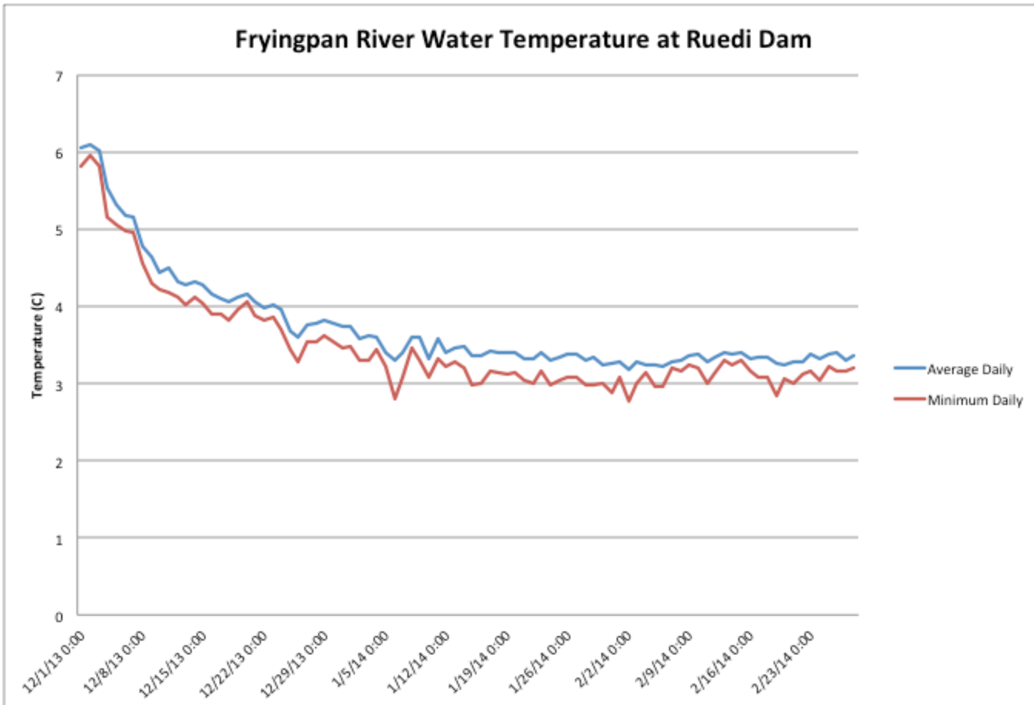


Figure 11. Winter water temperatures for the Fryinpan River below Ruedi Reservoir, Colorado, November 2013 through February 2014.

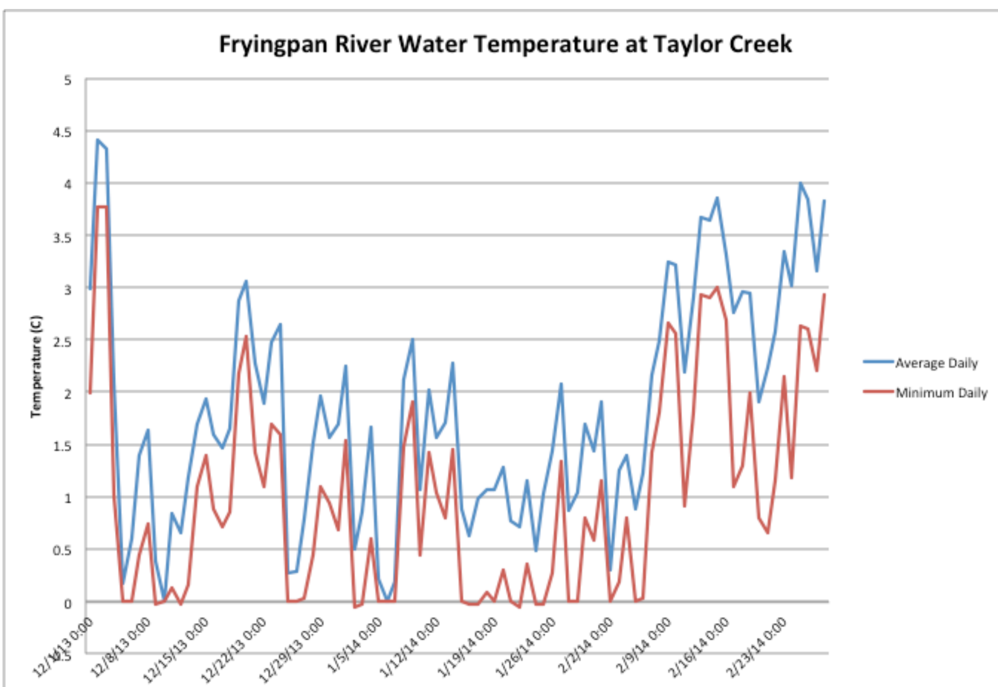


Figure 12. Winter water temperatures for the Fryingpan River at Taylor Creek, Colorado, November 2013 through February 2014.

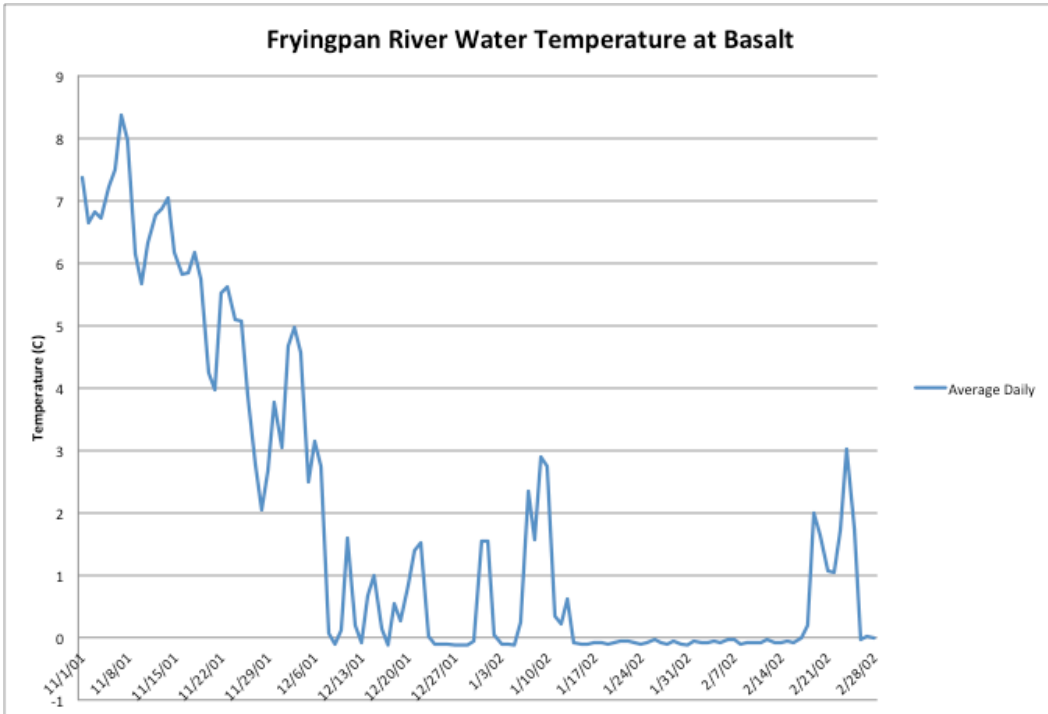


Figure 13. Winter water temperatures for the Fryingpan River at Basalt, Colorado, November 2001 through February 2002.

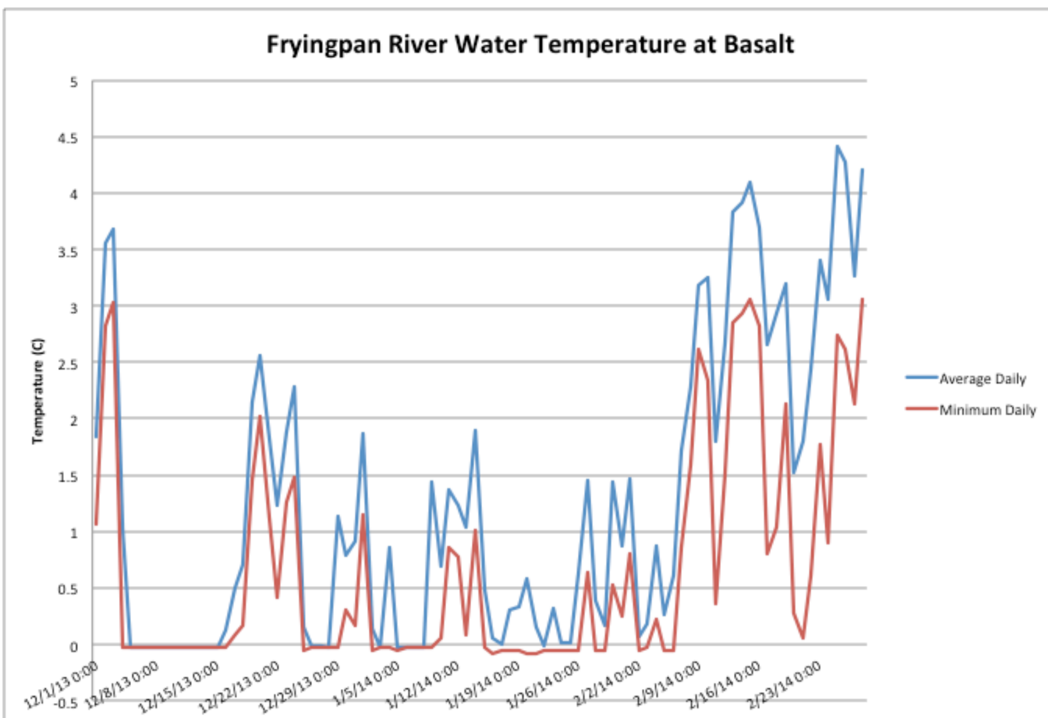


Figure 14. Winter water temperatures for the Fryingpan River at Basalt, Colorado, November 2013 through February 2014.

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Appendix A – Macroinvertebrate sample data

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Table A-1. Fryingpan River below Ruedi 10-28-2013.

Frying Pan River below Ruedi Dam 10-28-13			Rep 1	Rep 2	Rep 3
Ephemeroptera					
Baetidae	Acentrella	sp.	2	9	3
	Baetis	sp.			
	Baetis	bicaudatus	30	33	20
	Baetis	tricaudatus	5	7	8
Ephemerellidae	Drunella	doddsi		5	2
	Drunella	grandis	1		3
	Ephemerella	inermis/infrequens			
Heptageniidae	Cinygmula	sp.			
	Epeorus	sp.			
Leptophlebiidae	Paraleptophlebia	sp.	1		
Plecoptera					
Chloroperlidae	Sweltsa	sp.			
Nemouridae	Zapada	sp.			
Perlidae	Hesperoperla	sp.			
Perlodidae	Diura	sp.			
	Isoperla	sp.			
	Skwala	sp.			
Trichoptera					
Brachycentridae	Brachycentrus	sp.			
Hydropsychidae	Arctopsyche	grandis			
	Hydropsyche	sp.			
Lepidostomatidae	Lepidostoma	sp.			
Rhyacophilidae	Rhyacophila	sp. (no gills)		1	2
	Rhyacophila	sp. (gills)			
Glossosomatidae	Glossosoma	sp.			
Coleoptera					
Elmidae	Heterlimnius	corpulentus (L)	1	1	1
	Heterlimnius	corpulentus (A)	1		1
	Optioservus	sp. (L)			
Chironomidae					
Chironomidae	Tanypodinae				
	Chironominae	Tanytarsini		5	6
	Diamesinae		121	162	96
	Orthocladiinae		346	321	407
	pupae		11	8	6
Other Diptera					
Empididae	Chelifera	sp.			
	Clinocera	sp.			
Simuliidae	Simulium	sp.			
	pupae				
Tipulidae	Antocha	sp.		1	
	Dicranota	sp.			
Other					
Hydridae					
Naididae			12	3	2
Nematoda					
Turbellaria	Dugesia	sp.	14	16	17
Sperchonidae	Sperchon	sp.			
Ostracoda			2	1	2
Totals			547	573	576

Table A-2. Fryingpan River at Taylor Creek 10-28-2013.

Frying Pan River below Taylor Creek 10-28-13			**Rep 1**	**Rep 2**	**Rep 3**
Ephemeroptera					
Baetidae	Acentrella	sp.			
	Baetis	sp.			
	Baetis	bicaudatus	19	24	33
	Baetis	tricaudatus	5	8	41
Ephemerellidae	Drunella	doddsi			
	Drunella	grandis	13	10	11
	Ephemerella	inermis/infrequens	18	13	16
Heptageniidae	Cinygmula	sp.	2	1	3
	Epeorus	sp.			
Leptophlebiidae	Paraleptophlebia	sp.	11	9	17
Plecoptera					
Chloroperlidae	Sweltsa	sp.			
Nemouridae	Zapada	sp.			
Perlidae	Hesperoperla	sp.	2	2	3
Perlodidae	Diura	sp.		1	
	Isoperla	sp.			
	Skwala	sp.			
Trichoptera					
Brachycentridae	Brachycentrus	sp.	4	2	2
Hydropsychidae	Arctopsyche	grandis	2	1	
	Hydropsyche	sp.			
Lepidostomatidae	Lepidostoma	sp.	6	21	3
Rhyacophilidae	Rhyacophila	sp. (no gills)			
	Rhyacophila	sp. (gills)			
Glossosomatidae	Glossosoma	sp.			5
Coleoptera					
Elmidae	Heterlimnius	corpulentus (L)	57	51	50
	Heterlimnius	corpulentus (A)			
	Optioservus	sp. (L)			
Chironomidae					
Chironomidae	Tanypodinae		3		2
	Chironominae	Tanytarsini	16	6	4
	Diamesinae		47	38	32
	Orthocladiinae		215	302	242
	pupae		6	5	11
Other Diptera					
Empididae	Chelifera	sp.			
	Clinocera	sp.	1		1
Simuliidae	Simulium	sp.			
	pupae				
Tipulidae	Antocha	sp.	21	26	24
	Dicranota	sp.			
Other					
Hydridae					
Naididae			94	77	52
Nematoda					
Turbellaria	Dugesia	sp.		7	1
Sperchonidae	Sperchon	sp.		1	1
Ostracoda			2	2	2
Totals			544	607	556

Table A-3. Fryingpan River at Basalt 10-28-2013.

Frying Pan River in Basalt 10-28-13				Rep 1	Rep 2	Rep 3
Ephemeroptera						
	Baetidae	Acentrella	sp.			
		Baetis	sp.			
		Baetis	bicaudatus	29	21	43
		Baetis	tricaudatus	93	71	58
	Ephemerellidae	Drunella	doddsi			
		Drunella	grandis		2	9
		Ephemerella	inermis/infrequens	12	11	14
	Heptageniidae	Cinygmula	sp.	6	12	13
		Epeorus	sp.	1		
	Leptophlebiidae	Paraleptophlebia	sp.	31	46	65
Plecoptera						
	Chloroperlidae	Sweltsa	sp.	1		
	Nemouridae	Zapada	sp.			1
	Perlidae	Hesperoperla	sp.	7	5	4
	Perlodidae	Diura	sp.			
		Isoperla	sp.	3	6	
		Skwala	sp.			2
Trichoptera						
	Brachycentridae	Brachycentrus	sp.	5	2	14
	Hydropsychidae	Arctopsyche	grandis	12	8	13
		Hydropsyche	sp.	22	2	
	Lepidostomatidae	Lepidostoma	sp.	58	84	105
	Rhyacophilidae	Rhyacophila	sp. (no gills)	8	1	9
		Rhyacophila	sp. (gills)	2	1	
	Glossosomatidae	Glossosoma	sp.	31	44	19
Coleoptera						
	Elmidae	Heterlimnius	corpulentus (L)	44	32	15
		Heterlimnius	corpulentus (A)	2		2
		Optioservus	sp. (L)	18	23	36
Chironomidae						
	Chironomidae	Tanypodinae			2	3
		Chironominae	Tanytarsini			
		Diamesinae		12	6	8
		Orthocladiinae		36	17	38
		pupae		2		
Other Diptera						
	Empididae	Chelifera	sp.	3	2	1
		Clinocera	sp.	3		
	Simuliidae	Simulium	sp.	1	1	
		pupae				
	Tipulidae	Antocha	sp.	43	19	71
		Dicranota	sp.	1	1	
Other						
	Hydridae					
	Naididae			67	44	49
	Nematoda			1		
	Turbellaria	Dugesia	sp.	3		4
	Sperchonidae	Sperchon	sp.	3	1	2
	Ostracoda					
Totals				560	464	598

Table A-4. Fryingpan River at Ruedi Dam 4-23-2014.

Frying Pan River below Ruedi Dam 4-23-14			Rep 1	Rep 2	Rep 3
Ephemeroptera					
Baetidae	Acentrella	sp.			
	Baetis	sp.			
	Baetis	bicaudatus	24	25	34
	Baetis	tricaudatus	37	29	58
Ephemerellidae	Drunella	doddsi		1	1
	Drunella	grandis		1	
	Ephemerella	inermis/infrequens	1	3	5
Heptageniidae	Cinygmula	sp.	1	5	6
	Epeorus	sp.			
Leptophlebiidae	Paraleptophlebia	sp.			
Plecoptera					
Chloroperlidae	Sweltsa	sp.			
Nemouridae	Podmosta	sp.		2	
	Zapada	sp.			
Perlidae	Hesperoperla	sp.			
Perlodidae	Diura	sp.			
	Isogenoides	sp.			
	Isoperla	sp.			
	Skwala	sp.			
Trichoptera					
Brachycentridae	Brachycentrus	sp.			
Hydropsychidae	Arctopsyche	grandis			
	Hydropsyche	sp.			
Lepidostomatidae	Lepidostoma	sp.			
Rhyacophilidae	Rhyacophila	sp. (no gills)		1	
	Rhyacophila	sp. (gills)		2	
Glossosomatidae	Glossosoma	sp.			
Coleoptera					
Elmidae	Heterlimnius	corpulentus (L)		8	
	Heterlimnius	corpulentus (A)			
	Narpus	concolor			
	Optioservus	sp. (L)			
Chironomidae					
Chironomidae	Tanypodinae				
	Chironominae	Tanytarsini			
	Diamesinae		43	58	17
	Orthocladiinae		362	345	404
	pupae		94	44	62
Other Diptera					
Ceratopogonidae	Bezzia/Palpomyia	sp.			
Empididae	Chelifera	sp.			
	Clinocera	sp.			
Simuliidae	Simulium	sp.			
	pupae				
Tipulidae	Antocha	sp.			
	Dicranota	sp.			
	Hexatoma	sp.		2	
	Tipula	sp.		8	
Other					
Hydridae					
Naididae			2	61	10
Nematoda					
Haplotaxida	Lumbricidae				
Turbellaria	Dugesia	sp.	3	2	2
Sperchonidae	Sperchon	sp.			
Ostracoda			3		2
Totals			570	597	601

Table A-5. Fryingpan River at Taylor Creek 4-23-2014.

Frying Pan River below Taylor Creek 4-23-14			Rep 1	Rep 2	Rep 3
Ephemeroptera					
Baetidae	Acentrella	sp.			
	Baetis	sp.	41	35	23
	Baetis	bicaudatus			
	Baetis	tricaudatus	45	33	24
Ephemerellidae	Drunella	doddsi			
	Drunella	grandis	9	6	6
	Ephemerella	inermis/infrequens	61	69	46
Heptageniidae	Cinygmula	sp.	19	17	21
	Epeorus	sp.	2	2	
Leptophlebiidae	Paraleptophlebia	sp.	21	4	12
Plecoptera					
Chloroperlidae	Sweltsa	sp.			
Nemouridae	Podmosta	sp.			
	Zapada	sp.			
Perlidae	Hesperoperla	sp.	3	6	1
Perlodidae	Diura	sp.			
	Isogenoides	sp.			
	Isoperla	sp.	1	2	
	Skwala	sp.			
Trichoptera					
Brachycentridae	Brachycentrus	sp.	5	4	6
Hydropsychidae	Arctopsyche	grandis	1		
	Hydropsyche	sp.			
Lepidostomatidae	Lepidostoma	sp.	12	3	21
Rhyacophilidae	Rhyacophila	sp. (no gills)		1	
	Rhyacophila	sp. (gills)		2	1
Glossosomatidae	Glossosoma	sp.		1	1
Coleoptera					
Elmidae	Heterlimnius	corpulentus (L)	54	41	51
	Heterlimnius	corpulentus (A)	5	5	
	Narpus	concolor		1	
	Optioservus	sp. (L)	1	1	
Chironomidae					
Chironomidae	Tanypodinae		1	3	
	Chironominae	Tanytarsini	10	38	16
	Diamesinae		15	9	7
	Orthocladiinae		161	210	242
	pupae		11	12	17
Other Diptera					
Ceratopogonidae	Bezzia/Palpomyia	sp.			
Empididae	Chelifera	sp.			
	Clinocera	sp.			
Simuliidae	Simulium	sp.		1	
	pupae				
Tipulidae	Antocha	sp.	51	19	27
	Dicranota	sp.			
	Hexatoma	sp.	1	2	
	Tipula	sp.	5	3	4
Other					
Hydridae					
Naididae			58	38	31
Nematoda					
Haplotaxida	Lumbricidae		14	43	61
Turbellaria	Dugesia	sp.	1	2	
Sperchonidae	Sperchon	sp.		1	
Ostracoda					
Totals			608	614	618

Table A-6. Fryingpan River at Basalt 4-23-2014.

Frying Pan River in Basalt 4-23-14			Rep 1	Rep 2	Rep 3
Ephemeroptera					
Baetidae	Acentrella	sp.			
	Baetis	sp.	7	9	4
	Baetis	bicaudatus			
	Baetis	tricaudatus	82	66	68
Ephemerellidae	Drunella	doddsi			
	Drunella	grandis	4	6	4
	Ephemerella	inermis/infrequens	27	10	14
Heptageniidae	Cinygmula	sp.	14	23	12
	Epeorus	sp.	21	22	9
Leptophlebiidae	Paraleptophlebia	sp.	9	2	1
Plecoptera					
Chloroperlidae	Sweltsa	sp.		3	
Nemouridae	Podmosta	sp.			
	Zapada	sp.			
Perlidae	Hesperoperla	sp.	7	7	
Perlodidae	Diura	sp.			
	Isogenoides	sp.		1	
	Isoperla	sp.	8	4	2
	Skwala	sp.			
Trichoptera					
Brachycentridae	Brachycentrus	sp.	25	26	43
Hydropsychidae	Arctopsyche	grandis	11	8	5
	Hydropsyche	sp.	9	1	3
Lepidostomatidae	Lepidostoma	sp.	59	11	14
Rhyacophilidae	Rhyacophila	sp. (no gills)	3		2
	Rhyacophila	sp. (gills)	1	9	1
Glossosomatidae	Glossosoma	sp.	1	6	
Coleoptera					
Elmidae	Heterlimnius	corpulentus (L)	13	4	5
	Heterlimnius	corpulentus (A)	1	1	3
	Narpus	concolor			
	Optioservus	sp. (L)	9	8	10
Chironomidae					
Chironomidae	Tanypodinae			2	
	Chironominae	Tanytarsini	6	4	2
	Diamesinae		12	24	18
	Orthocladiinae		36	206	116
	pupae		16	22	17
Other Diptera					
Ceratopogonidae	Bezzia/Palpomyia	sp.			1
Empididae	Chelifera	sp.	3	4	1
	Clinocera	sp.	1	2	3
Simuliidae	Simulium	sp.	2	1	
	pupae				
Tipulidae	Antocha	sp.	49	28	58
	Dicranota	sp.			
	Hexatoma	sp.	2	2	
	Tipula	sp.			
Other					
Hydridae					
Naididae			11	19	45
Nematoda					
Haplotaxida	Lumbricidae		33	57	121
Turbellaria	Dugesia	sp.	2		
Sperchonidae	Sperchon	sp.	2		
Ostracoda					
Totals			486	598	582

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