National Park Service
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Natural Resource Stewardship and Science

Aquatic Macroinvertebrate and Physical Habitat Monitoring for Capulin Creek and the Rito de los Frijoles in Bandelier National Monument

2009 Summary Report

Natural Resource Data Series NPS/SCPN/NRDS—2011/284

ON THE COVER
Bandelier National Monument
Photograph courtesy of SCPN

Aquatic Macroinvertebrate and Physical Habitat Monitoring for Capulin Creek and the Rito de los Frijoles in Bandelier National Monument

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September 2011

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Funding for the SCPN water resources field crew was provided to Northern Arizona University by the National Park Service through Colorado Plateau CESU Agreement H1200040002 (Tasks NAU-285/289). Funding for aquatic macroinvertebrate identification and enumeration was provided by the National Park Service to Utah State University through Colorado Plateau CESU Agreement H1200090005 (Task USUCP-36).

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The corresponding author and project manager for this project is Stephen Monroe(stephen_monroe@nps.gov). Stacy Stumpf is the Water Resources Lead Technician for the project. The 2009 crew consisted additionally of Kelly Lawrence and Clayton Bliss. SCPN staff provided support for the project.

Please cite this publication as:

Stumpf, S. E., and S. A. Monroe. 2011. Aquatic macroinvertebrate and physical habitat monitoring for Capulin Creek and the Rito de los Frijoles in Bandelier National Monument: 2009 summary report. Natural Resource Data Series NPS/SCPN/NRDS—2011/284. National Park Service, Fort Collins, Colorado.

NPS 315/109928, September 2011

1 Introduction and background

The National Park Service Inventory and Monitoring Program was designed to determine the current status and monitor long-term trends in the condition of park natural resources, providing park managers with a strong scientific foundation for making decisions and working with other agencies and the public to protect park ecosystems. The Southern Colorado Plateau Network (SCPN) is monitoring aquatic macroinvertebrates as an overall indicator of aquatic ecosystem integrity (Thomas et al. 2006).

In 2007, SCPN implemented annual monitoring of aquatic macroinvertebrates at two sites on Capulin Creek in Bandelier National Monument (BAND) (Stumpf and Monroe 2009), and in 2009, the network implemented annual monitoring at two sites on the Rito de los Frijoles in BAND.

This year at Capulin Creek, the SCPN water resources field crew collected macroinvertebrate samples and physical habitat data from two monitoring sites established in 2007:

Capulin Creek at Base Camp Gauging Station (BANDCAP01), identified in this report as CAP01 (see Appendix A for list of locations, codes, and common names of monitoring sites), is located less than 0.3 km upstream from the backcountry ranger cabin and was selected to be co-located with a network water quality monitoring site. The site is located at a discontinued U.S. Geological Survey (USGS) streamflow gauging station (Capulin Canyon at Ranger Cabin, stn # 083133655). The channel substrate at this site is primarily cobble, and the stream flows through an alder (*Alnus* sp.), boxelder (*Acer negundo*) and narrowleaf cottonwood (*Populus angustifolia*) woodland.

Capulin Creek above Painted Cave (BANDCAP02), identified in this report as CAP02, is located 1.8 km up canyon from the Painted Cave and 2.6 km downstream from base camp. This site was selected using the Generalized Random-Tessellation Stratified (GRTS) design, and is surrounded by ponderosa pine (*Pinus ponderosa*), alder, boxelder, and New Mexico olive (*Forestiera pubescens*), and has a mostly fine/sand substrate.

The Capulin Creek watershed is a designated wilderness area, managed for recreational use within park boundaries. The U.S. Forest Service manages land in the upper reaches of the watershed for recreation and timber harvest. In 1996 the Dome Fire burned several thousand acres in Capulin Creek watershed, and, although terrestrial and aquatic communities appear to have been recovering over the past 10 years, effects of the fire are still apparent. Large quantities of woody debris have accumulated on the floodplain and in the stream channel, and fine sediments are abundant and mobile in the system. Roads and timber harvest on the Santa Fe National Forest also have the potential to affect the stream ecosystem. Aquatic macroinvertebrates were sampled in streams at BAND, before the fire, by Pippin and Pippin (1981), and post-fire by Vieira et al. (2004) and MacRury and Clements (2002).

Native Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) populations were extirpated from Capulin Creek by flood events following the Dome fire. The New Mexico Department of Game and Fish, Bandelier National Monument, and the Santa Fe National Forest have been collaborating to reintroduce this species to the creek. One hundred Rio Grande cutthroat trout were reintroduced in March 2006, and land managers have been evaluating whether to reintroduce native Rio Grande Sucker and native Rio Grande Chub in Capulin Creek as well (NPS, S. Fettig, wildlife biologist, phone conversation with Stephen Monroe, NPS, Flagstaff, 27 February 2008).

This year at the Rito de los Frijoles, the SCPN water resources field crew collected macroinvertebrate samples and physical habitat data from two monitoring sites:

Rito de los Frijoles near Visitor Center (BANDRIT01), identified in this report as RIT01 (see appendix A for list of locations, codes, and common names of monitoring sites). The site was co-located with a SCPN water quality monitoring site and a streamflow gauging station (LANL stn # E350, Rito de los Frijoles in Bandelier NM, New Mexico) currently operated by Los Alamos National Laboratory during low flows and the USGS during high flows (fig. 1). Riparian vegetation in the reach is dominated by narrowleaf cottonwood and boxelder.

Rito de los Frijoles at Upper Crossing (BANDRIT02), identified in this report as RIT02, is located at Upper Crossing Trail intersection. Vegetation is dominated by a Ponderosa Pine / Broadleaf Mixed Montane Riparian Forest.

The Rito de los Frijoles is a perennial stream flowing eastward from the Sierra de los Valles to the Rio Grande. The upper reaches of the Rito de los Frijoles watershed is a designated wilderness area, managed for recreational use within park boundaries. The BAND Visitor Center and numerous archeological sites are located near the stream in the lower portion of the watershed, resulting in high levels of visitor use. In 1977 the La Mesa Fire burned about 15,000 acres (6070 ha) in and near the Rito de los Frijoles watershed. As a result of this fire, the frequency and magnitude of stormflows, and suspended sediment concentrations, increased along the Rito de los Frijoles (Veenhuis 2002).

The primary purpose of this report is to (a) document the monitoring activities that occurred at CAP01, CAP02, RIT01, and RIT02 in 2009, (b) summarize data that were collected, and (c) where appropriate, place these data in the context of aquatic habitat, biological condition, and management actions within the park through time.

2 Methods

2.1 Field methods

In New Mexico, the sampling window is from August to mid-November (New Mexico Environment Department, Surface Water Quality Bureau 2007). On October 14–18, 2009, we collected aquatic macroinvertebrate samples and physical habitat data at monitoring sites CAP01 and CAP02 on Capulin Creek, as well as monitoring sites RIT01 and RIT02 on the Rito de los Frijoles. Each site consists of a 150 m reach, composed of 11 transects, spaced 15 m apart (fig. 2). A brief description of field methods is provided here, and a detailed description of sampling methods can be found in Brasher et al. (in press).

Two types of aquatic macroinvertebrate samples were collected in each site:

- Replicate quantitative samples were collected from five targeted riffle habitats to provide estimates of abundances of organisms. We used a Slack sampler to collect a timed sample from a 0.25 m^2 area at each targeted riffle.
- A qualitative sample was collected to develop a comprehensive list of species present at the site. A Slack sampler was used to collect samples from all habitat types within the sampling reach and compiled into one composite sample. A list of existing habitat types from which qualitative samples were collected can be found in sections 3.2 and 3.4 of this report.

We collected physical habitat data at three spatial scales: microhabitat, transect, and reach:

- For each of the quantitative targeted riffle microhabitats, we
  - measured depth

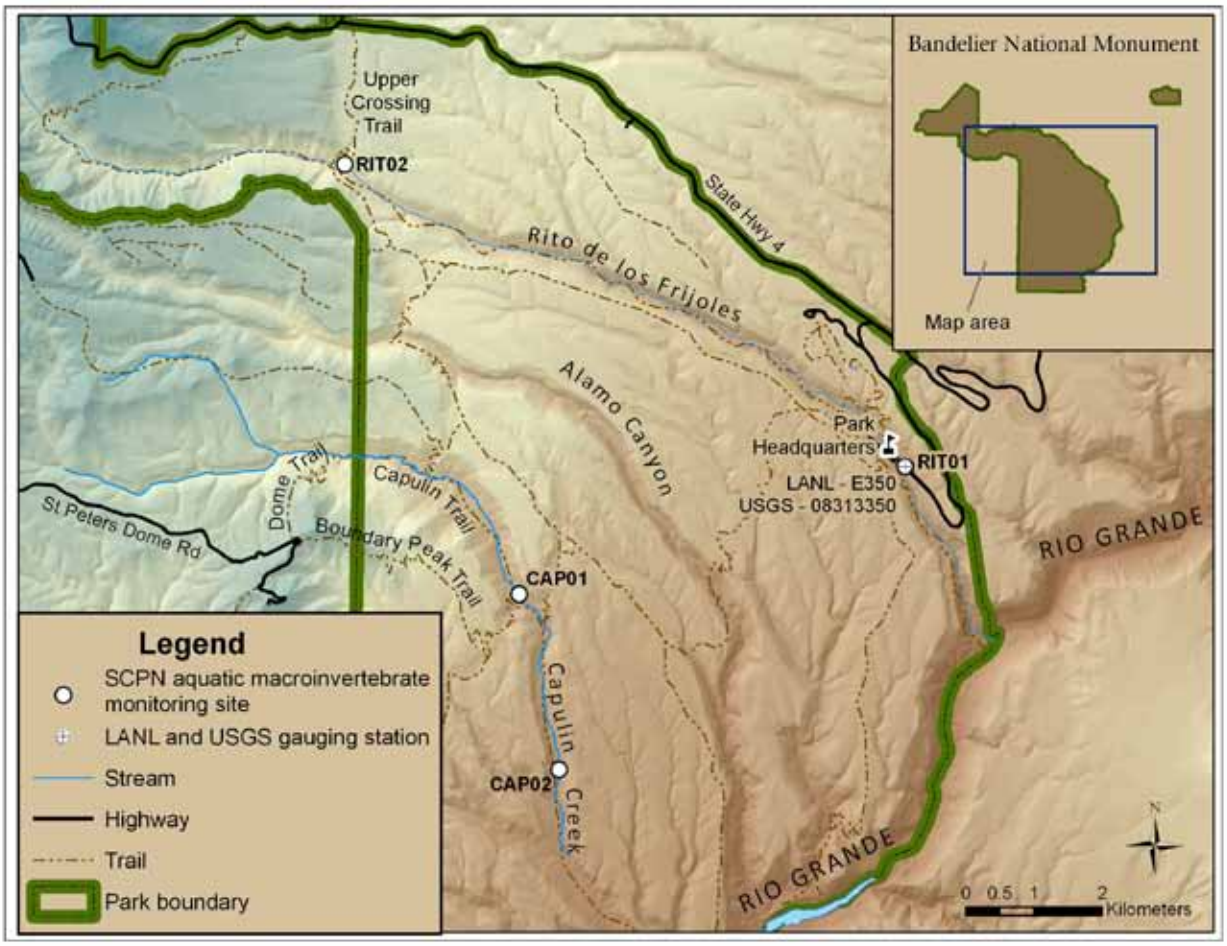


Figure 1. Map showing locations of SCPN monitoring sites CAP01 and CAP02 in Capulin Creek, and RIT01 and RIT02 in the Rito de los Frijoles at Bandelier National Monument, New Mexico, in 2009

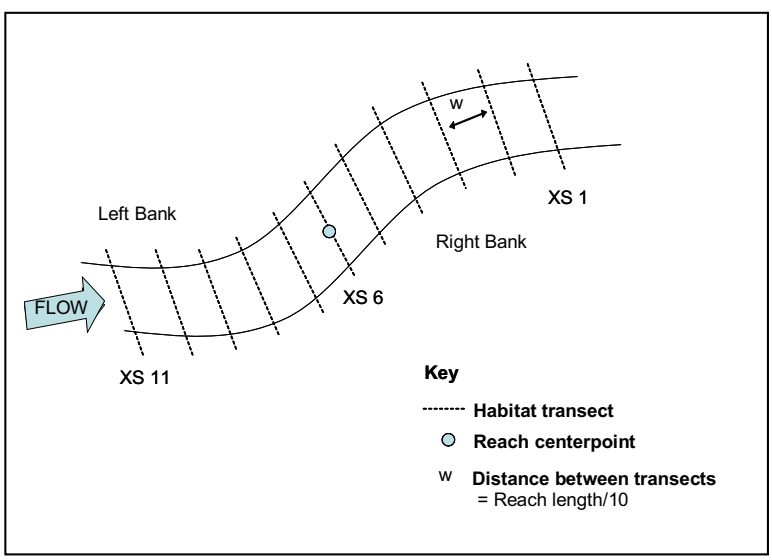


Figure 2. General aquatic-macroinvertebrate sampling reach layout

  - measured velocity
  - measured substrate particle size
  - and measured substrate particle embeddedness
- For each of the 11 transects, we
  - measured wetted and active channel widths
  - measured water depth, velocity, and canopy closure at five equally spaced points along each transect
  - observed and recorded the presence or absence, and types of macroinvertebrate habitats, represented by point data (5 points/transect) across the entire reach
  - measured geomorphic channel units (GCU) at five equally spaced points along each transect
- For the entire reach, we
  - identified and measured the length of GCUs (reach characterization data represents the proportion of the reach characterized by that particular GCU)
  - identified the dominant vegetation and land cover
  - recorded descriptions of flow conditions
  - recorded weather conditions
  - observed and recorded evidence of anthropogenic or natural disturbances
  - measured NPS core water quality parameters of temperature, specific conductivity, pH, dissolved oxygen, and turbidity
  - measured stream discharge along the Rito de los Frijoles only
  - conducted a zig-zag pebble count measuring the size of a minimum of 400 randomly-selected particles using a modified Wolman pebble count across the length of the entire reach

2.2 Laboratory methods

Aquatic macroinvertebrate samples were sent to the National Aquatic Monitoring Center's Bug Lab, a Bureau of Land Management laboratory at Utah State University in Logan, Utah. Samples were sorted under a dissecting scope at 10× magnification, and a 500-organism, fixed-count method was used for sub-sampling large samples. Ten percent of the sorted samples were resorted for quality assurance.

A taxonomist, certified by the North American Benthological Society, identified all aquatic macroinvertebrates to the family or genus level. To ensure data quality, 10 percent of the identified samples were re-identified by a second certified taxonomist.

Quantitative and qualitative macroinvertebrate samples will be maintained by the contract aquatic laboratory for at least five years to allow for repeat subsampling should any data questions arise. For a more detailed description of laboratory methods see Brasher et al. (in press).

2.3 Data analysis

In this report we summarize aquatic macroinvertebrate data in terms of community structure and function. Genera were classified into functional feeding guilds using the classifications presented in Barbour et al. (1999). If functional class information was not available for a particular genus, we applied a more generalized, family-level classification.

We selected aquatic macroinvertebrate metrics that are generally considered to be sensitive, reliable indicators of water quality and/or stream health (see appendix B for a list of metrics and their definitions). Most of these metrics have been used to detect changes in water quality and habitat conditions in other streams in the Southern Rocky Mountains ecoregion (Griffith et al. 2005). Also, they enable a comprehensive assessment of multiple aspects of community structure because they represent a range of ecological characteristics. SCPN will periodically evaluate the interpretive value of the listed metrics and may drop or add additional metrics based upon these evaluations.

3 Results

The following sections of this report present a brief summary of aquatic macroinvertebrate and physical habitat data collected from streams at Bandelier NM during 2009.

3.1 Aquatic macroinvertebrate community data for Capulin Creek

Key metrics are presented in Table 1 (qualitative) and in Table 2 (quantitative) , describing aquatic macroinvertebrate communities from samples collected at CAP01 and CAP02 from 2007 to 2009. For all tables and figures listed in this section, monitoring site results are presented in left to right order corresponding to upstream to downstream position along the stream. Figures in this section refer to quantitative data unless otherwise noted. Appendix C lists all aquatic macroinvertebrate species identified at the site.

Abundance. Overall, mean abundance was greater at CAP01 than at CAP02 again in 2009. Mean abundance at CAP01 was 40% higher compared to the downstream site at CAP02. Total abundance at CAP01 averaged 655.6 individuals per sample. Downstream at CAP02 total abundance averaged 467.6 (fig. 3).

Taxa richness. Mean taxa richness from quantitative samples at CAP01 was twice as high as samples collected from CAP02. Quantitative samples averaged 33.2 taxa per sample at CAP01 and 17.2 taxa at CAP02. Qualitative samples, as expected, had greater taxa richness than quantitative samples at both monitoring sites. Taxa richness in quantitative samples measured 42.0 taxa at CAP01 and 25.0 taxa at CAP02 (fig. 4).

Diversity. Taxonomic diversity was 46% higher at CAP01 than at CAP02. Taxonomic diversity measured 0.87 at CAP01 compared to 0.60 at CAP02 (fig. 5a). Similarly we found that functional diversity was greatest at CAP01. Functional diversity measured 0.71 at CAP01 and 0.56 at CAP02 at Capulin Creek (fig. 5b).

Tolerant taxa. Relative abundances of tolerance classes were greatest for intolerant taxa at both monitoring sites. Nearly 65% of the individuals sampled at CAP01 and 73% of the individuals from CAP02 are considered intolerant to perturbation (fig. 6a). Intolerant taxa richness dominated samples at CAP01. Sixty-four percent of the taxa collected from CAP01 are considered intolerant. Additionally we found 31% of the taxa at CAP01 to be moderately tolerant and 7% to be tolerant. Forty-seven percent of the taxa found at CAP02 are considered moderately tolerant, and intolerant taxa made up 40% of the samples collected (fig. 6b).

EPT taxa. Our CAP02 monitoring site had the greatest relative abundance of EPT taxa (Ephemeroptera [mayflies], Plecoptera [stoneflies], and Trichoptera [caddisflies]). EPT taxa averaged

Table 1. Qualitative metrics for aquatic macroinvertebrate samples from CAP01 and CAP02 at Capulin Creek in Bandelier National Monument, 2007–2009. Richness-based metrics are expressed as the percentage of taxa in a given order, tolerance or functional feeding group.

	CAP01			CAP02		
Qualitative metric	**2007**	**2008**	**2009**	**2007**	**2008**	**2009**
Taxa richness	43.00	30.00	42.00	27.00	32.00	25.00
Tolerance group						
Richness of tolerant taxa (%)	9.30	7.41	15.00	11.54	25.81	26.09
Richness of moderately tolerant taxa (%)	23.26	25.93	30.00	42.31	25.81	56.52
Richness of intolerant taxa (%)	67.44	66.67	55.00	46.15	48.39	17.39
Functional group						
Richness of collector-filterers (%)	11.63	10.34	9.76	15.38	6.45	8.33
Richness of collector-gatherers (%)	32.56	27.59	31.71	30.77	22.58	37.50
Richness of scrapers (%)	9.30	6.90	12.20	3.85	6.45	4.17
Richness of shredders (%)	13.95	17.24	14.63	11.54	16.13	12.50
Richness of predators (%)	32.56	37.93	31.71	38.46	45.16	33.33
Taxonomic group						
Number of EPT taxa	19.00	14.00	15.00	8.00	10.00	4.00
Richness of EPT taxa (%)	44.19	46.67	35.71	29.63	31.25	16.00
Richness of Ephemeroptera (%)	16.28	16.67	9.52	7.41	9.38	8.00
Richness of Plecoptera (%)	9.30	10.00	9.52	7.41	12.50	4.00
Richness of Trichoptera (%)	18.60	20.00	16.67	14.81	9.38	4.00
Richness of noninsect taxa (%)	6.98[a]	3.33	11.90	7.41	6.25	20.00
Richness of Chironomid Diptera (%)	6.98	10.00	7.14	11.11	9.38	12.00
Richness of non-Chironomid Diptera (%)	4.65	20.00	26.19	7.41	37.50	32.00
Richness of Coleoptera (%)	16.23	10.00	11.90	18.52	12.50	20.00
Richness of Odonata (%)	6.98	10.00	7.14	7.41	3.13	0.00

[a]Pre-2009 reports labeled the "noninsect" category as "Other". The "Other" category was less inclusive of species, resulting in a different richness count.

Table 2. Quantitative metrics for aquatic macroinvertebrate samples from CAP01 and CAP02 at Capulin Creek in Bandelier National Monument, 2007–2009. For a given order, tolerance or functional feeding group, abundance-based metrics are expressed as the percentage of individuals in the group, while richness-based metrics are expressed as the percentage of taxa in the group.

	CAP01						CAP02					
	2007		2008		2009		2007		2008		2009	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total abundance	456.30	278.53	545.00	191.79	655.60	137.52	240.40	196.25	229.20	245.08	467.60	110.44
Total richness	24.40	8.26	28.00	5.15	34.20	1.64	13.40	7.09	17.40	9.07	17.20	2.68
Simpson's Diversity—taxonomic	0.86	0.03	0.87	0.02	0.87	0.04	0.73	0.06	0.80	0.13	0.60	0.06
Simpson's Diversity—functional group	0.67	0.05	0.70	0.01	0.71	0.02	0.65	0.05	0.62	0.09	0.57	0.04
Dominant taxa	28.95	8.78	22.58	4.00	25.59	6.21	43.57	7.79	37.05	17.50	59.28	6.34
Tolerance group												
Relative abundance of tolerant taxa (%)	2.23	3.78	0.47	0.27	2.77	4.01	7.02	9.87	6.87	6.99	3.43	0.91
Relative abundance of moderately tolerant taxa (%)	38.11	13.37	25.27	4.07	32.26	6.04	38.00	11.60	48.08	22.48	23.24	6.81
Relative abundance of intolerant taxa (%)	59.66	12.31	74.26	0.27	64.96	9.75	54.98	15.54	6.87	6.99	73.34	6.54
Richness of tolerant taxa (%)	4.61	4.89	7.41	3.96	7.16	3.04	10.78	7.25	16.88	7.33	13.21	5.08
Richness of moderately tolerant taxa (%)	30.24	3.08	26.33	5.03	31.14	5.60	49.75	17.14	35.25	18.36	46.86	6.32
Richness of intolerant taxa (%)	65.15	5.01	66.26	3.60	61.70	4.90	39.48	15.92	47.87	7.33	39.93	5.62
Functional group												
Relative abundance of collector-filterers (%)	15.84	3.20	29.64	9.83	10.10	1.36	4.85	4.71	2.08	3.18	1.68	0.81
Relative abundance of collector-gatherers (%)	47.45	8.48	40.86	6.13	36.50	4.84	31.19	11.44	50.76	15.75	23.86	7.72
Relative abundance of scrapers (%)	4.64	2.11	10.49	6.38	33.25	8.39	2.59	2.95	22.24	13.48	10.47	3.47
Relative abundance of shredders (%)	6.75	1.65	6.18	2.06	5.70	4.47	44.69	7.76	6.85	7.44	59.62	6.36
Relative abundance of predators (%)	25.32	6.60	12.84	2.28	11.48	5.16	16.68	9.85	18.08	9.11	4.38	0.81
Richness of collector-filterers (%)	14.50	2.97	11.87	3.95	10.42	1.40	13.56	10.81	7.06	6.54	9.10	2.01
Richness of collector-gatherers (%)	22.12	6.14	30.49	4.11	29.79	3.36	31.22	8.11	30.59	5.45	31.26	7.87
Richness of scrapers (%)	12.88	3.10	14.73	3.19	15.37	3.40	6.40	5.95	15.14	6.69	10.84	3.70
Richness of shredders (%)	15.61	2.82	10.46	4.70	11.32	2.48	14.04	4.79	13.06	7.33	16.10	3.09
Richness of predators (%)	34.90	3.51	32.43	4.09	33.42	5.27	34.78	10.58	34.15	5.49	32.69	5.30
Taxonomic group												
Number of EPT taxa	11.40	2.70	12.80	1.92	13.20	0.84	4.60	3.05	4.80	4.82	5.20	0.84

Table 2 *(cont'd.)*

	CAP01						CAP02					
	2007		2008		2009		2007		2008		2009	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Taxonomic group (*cont'd.*)												
Relative abundance of EPT Taxa (%)	54.41	12.45	66.28	12.87	40.55	9.04	52.33	13.17	15.63	13.47	63.12	5.96
Relative abundance of Ephemeroptera (%)	29.10	10.08	26.11	4.79	15.88	3.25	1.14	0.92	5.55	5.69	3.15	1.54
Relative abundance of Plecoptera (%)	13.80	6.65	12.25	3.24	8.17	2.46	49.07	11.56	9.35	8.70	59.78	6.38
Relative abundance of Trichoptera (%)	11.61	3.84	27.91	10.41	16.50	5.79	2.12	4.02	0.73	1.01	0.19	0.23
Relative abundance of noninsect taxa (%)	1.03[a]	1.07[a]	0.69[a]	0.29[a]	5.00	3.30	1.15	1.52	6.08[a]	7.37[a]	3.25	1.37
Relative abundance of Chironomid Diptera (%)	27.49	12.60	13.33	8.85	15.90	7.79	35.73	17.62	41.97	20.50	18.45	6.40
Relative abundance of non-Chironomid Diptera (%)	7.33	6.44	7.16	5.32	7.94	5.02	6.55	3.77	9.17	2.46	1.62	0.59
Relative abundance of Coleoptera (%)	4.52	1.49	8.77	3.23	27.81	7.29	4.15	2.96	24.45	13.31	13.48	3.46
Relative abundance of Odonata (%)	5.12	1.21	3.78	1.09	2.80	1.83	0.09	0.12	2.70	3.15	0.08	0.11

[a]Pre-2009 reports labeled the "noninsect" category as "Other". The "Other" category was less inclusive of species, resulting in a different richness count.

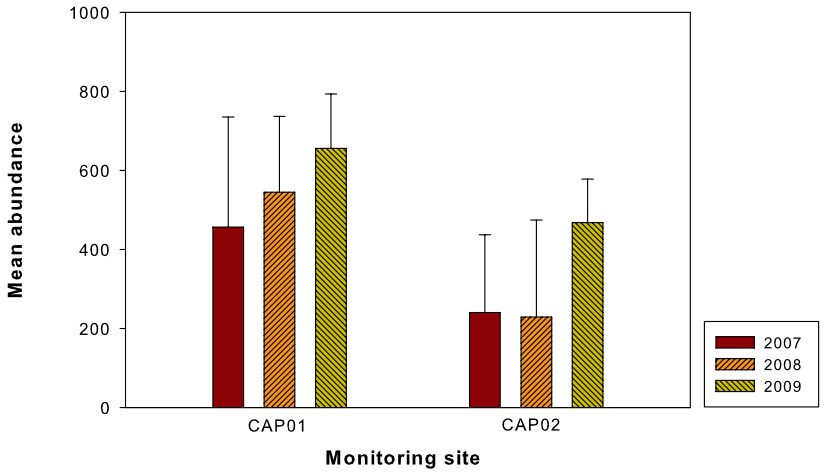


Figure 3. Total abundance expressed as the mean number of individuals per quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009

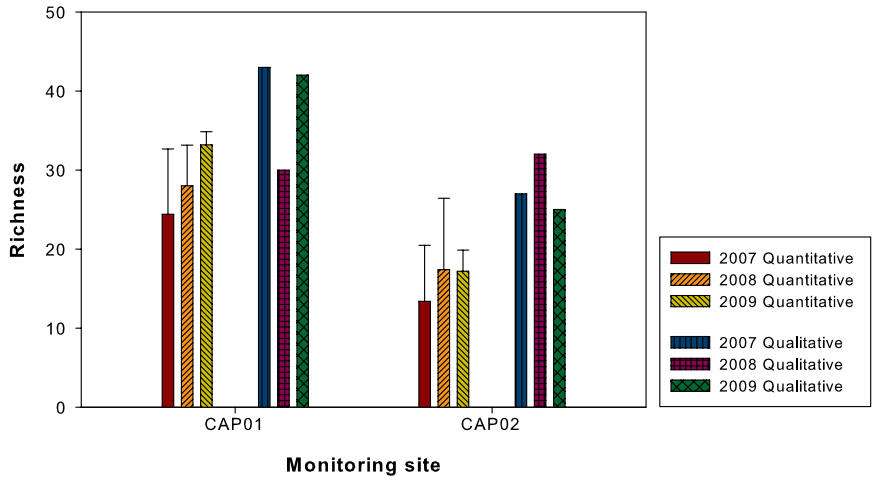


Figure 4. Mean taxa richness in quantitative targeted riffle and qualitative multihabitat samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009

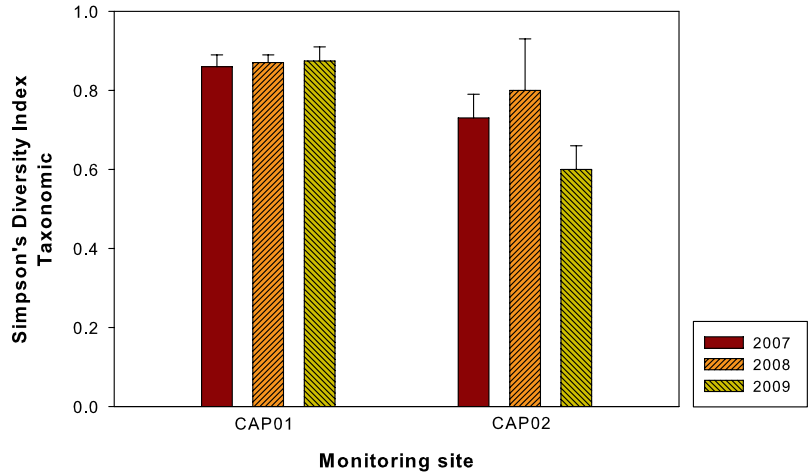


Figure 5a. Simpson's Diversity Index for taxonomic diversity in quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009. Values expressed are means of all quantitative samples collected from each site.

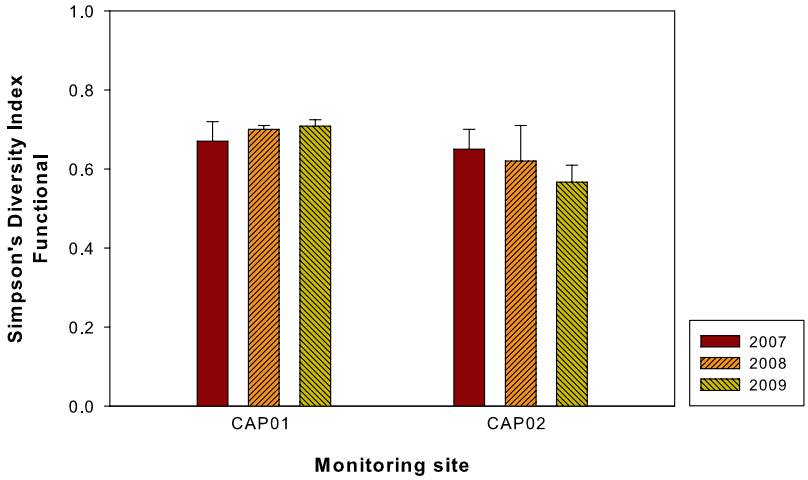


Figure 5b. Simpson's Diversity Index for functional diversity in quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009. Values expressed are means of all quantitative samples collected from each site.

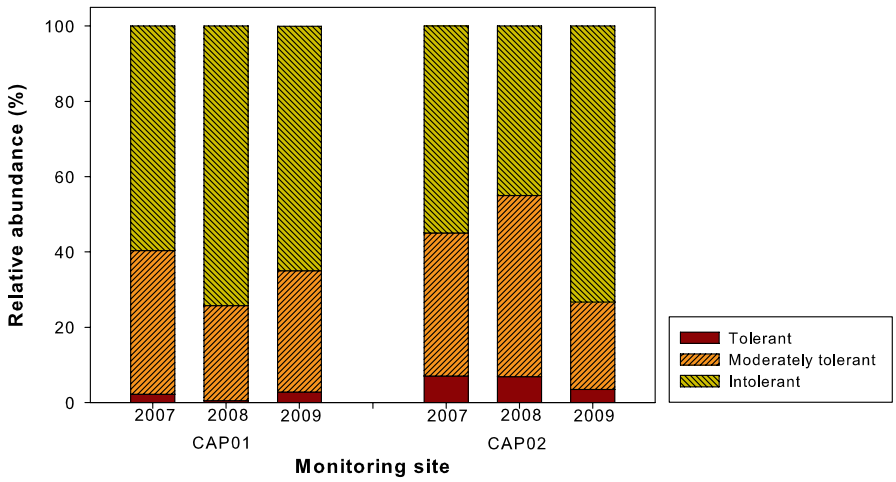


Figure 6a. Mean relative abundance of aquatic macroinvertebrate taxa in quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009, based on their tolerance to perturbation

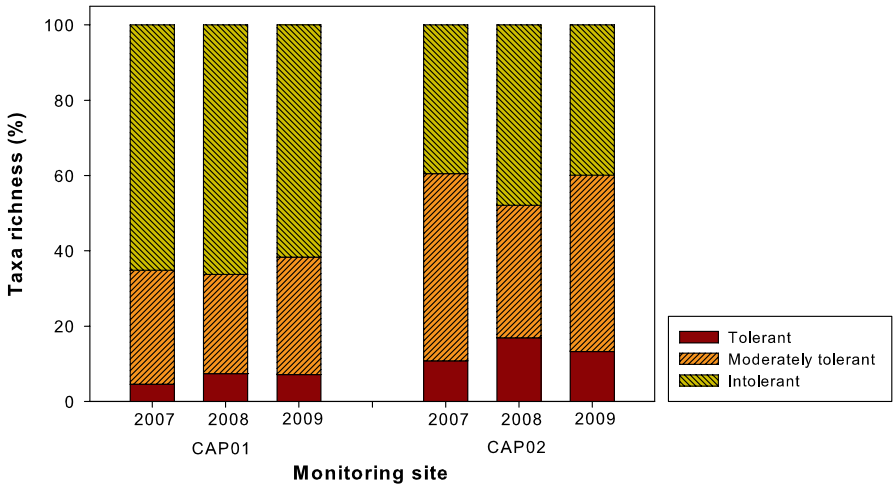


Figure 6b. Mean richness of aquatic macroinvertebrate taxa in quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009, based on their tolerance to perturbation

63.1% of individuals per sample at CAP02 compared to 40.5% at CAP01. Plecoptera were the largest group of EPT taxa at CAP02, making up 59.8% of the samples collected there. Ephemeroptera and Trichoptera combined made up only 3.3% of the taxa collected from CAP02. Trichoptera at CAP01 were the most abundant EPT group, averaging 16.5% of the taxa collected. Ephemeroptera were next at 15.9% followed by Plecoptera at 8.2% (fig. 7).

Aquatic macroinvertebrate orders. Coleopterans (beetles) and Plecopterans were the most abundant orders at CAP01 and CAP02 respectively. Coleopterans averaged 27.8% of the taxa collected at CAP01 and Plecopterans, as described above, averaged 59.8% of taxa at CAP02. Dipterans belonging to the order Chironomidae (midges) were abundant at both monitoring sites, making up 15.9% of the taxa from CAP01 and 18.5% of the taxa from CAP02. Odonates (damselflies/dragonflies) were the least abundant order of aquatic macroinvertebrates at both monitoring sites, averaging 2.8% and 0.08% at CAP01 and CAP02 respectively (fig. 8).

Functional feeding groups. Relative abundance of functional feeding groups differed greatly among sites in 2009. Collector-gatherers and scrapers were the most abundant groups at CAP01 averaging 36.5% and 33.3% of the individuals collected, respectively. Shredders were the least abundant group at CAP01 making up 5.7% of the individuals. Shredders were the most abundant functional group at CAP02, making up 59.6% of the individuals collected. Collector-filterers were the least abundant group making up 1.7% of the individuals from CAP02 (fig. 9).

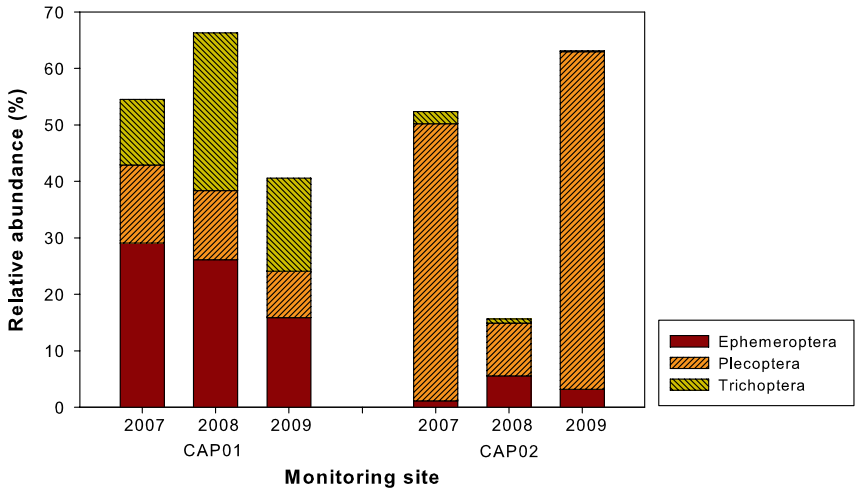


Figure 7. Relative abundance of sensitive EPT orders in qualitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009

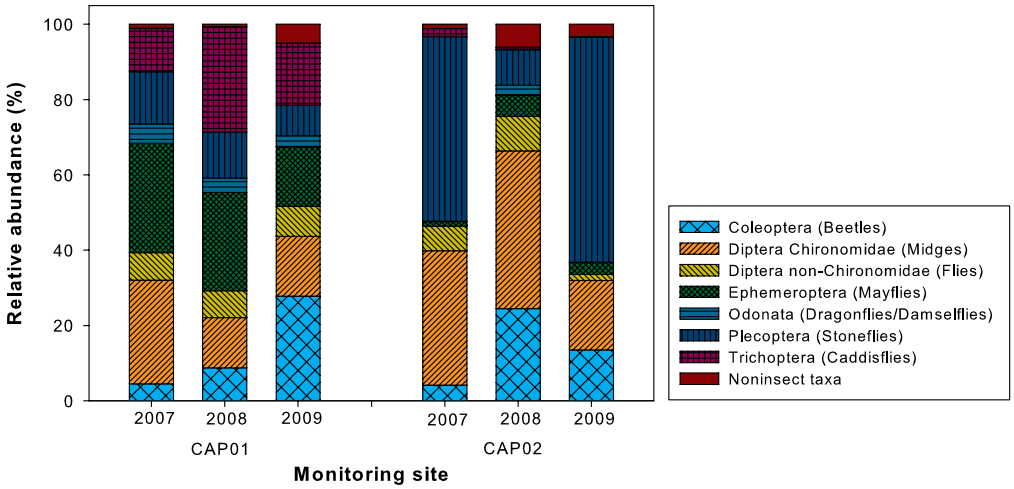


Figure 8. Relative abundance of individuals by taxonomic order in quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009

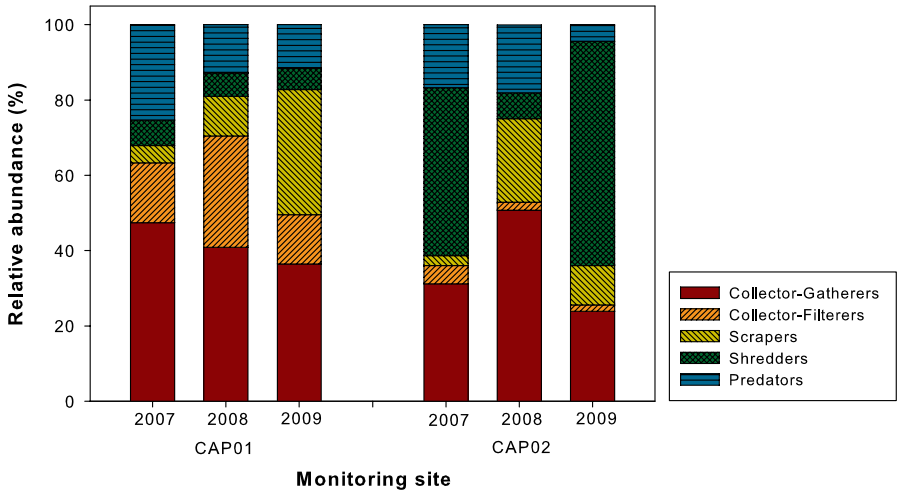


Figure 9. Relative abundance of functional feeding groups in quantitative targeted riffle samples collected from CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009

3.2 Physical habitat characteristics for Capulin Creek

This section presents data describing physical habitat characteristics collected at CAP01 and CAP02 during 2007, 2008, and 2009. These data are summarized in Table 3; additional transect and microhabitat data can be found in Appendix D. We could not measure velocity or depth at transect 4 in CAP01 due to the large amount of woody debris present, or in CAP02 because a large rock bridge had forced flow below the surface at the time of our visit.

Microhabitat. Mean velocity at the quantitative targeted riffle habitat was greatest upstream at CAP01. Velocity at riffle habitat averaged 0.33 m/s at CAP01 compared to 0.01 m/s at CAP02. Stream depth at riffles sampled averaged 0.25 m at CAP01 and 0.07 m at CAP02. Riffle particle size was distributed across three size classes at CAP01: fines (4%), fine gravels (92%) and coarse gravels (4%). Particles at CAP02 fit into two particle size classes: fine gravels (96%) and coarse gravels (4%). Particles were slightly more embedded at downstream riffles along CAP02 (29.4%) than at CAP01 (26.3%) (table 3).

Transect. Mean velocity along each transect (table 3) was higher at CAP02 (0.29 m/s) than CAP01 (0.16 m/s). Average depth along transects was identical at both sites, measuring 0.07 m. Wetted channel distance was widest at CAP02, averaging 3.9 m compared to 1.44 m at CAP01. Similarly, active channel widths were wider downstream at CAP02, averaging 13.6 m. Active channel widths at CAP01 averaged 9.6 m. Riparian cover, as described by canopy closure, was greatest in the CAP02 site, with 96% of the site enclosed in the riparian canopy compared to 92% at CAP01 (table 3).

Aquatic macroinvertebrate habitat was dominated by rock at CAP01, making up 63.8% of the habitat found. Nineteen percent of CAP01 did not fall into one of our delineated aquatic macroinvertebrate habitat types ("Other").Woody debris was found along 12.1% of the site. Rock was the most abundant known aquatic macroinvertebrate habitat type found along 40.9% of the site at CAP02. Likewise, habitat types not known to be associated with aquatic macroinvertebrates were found along 40.9% of CAP02. Leaf packs were found along 12.1% of the site and aquatic vegetation along 6% (fig. 10).

Reach. Channel structure dynamics are represented by particle size distributions in Figure 11a and 11b, based on modified Wolman pebble counts. A minimum of 400 particles were sampled across the entirety of the reach. Particle size distributions were well distributed among all size classes in both reaches. At CAP01 fine particles (<2 mm) and coarse gravels in the 8–64 mm range had the highest percentages of all size classes. Cobbles (64–128 mm) and bedrock (>256 mm) were the next most abundant classes found (fig. 11a). At CAP02 cobbles and bedrock were the most abundant size classes making up 18% and 20% of the particles measured. Fines and fine gravels (8–16 mm) were the next most abundant at each making up 14% of the particles collected (fig. 11b).

Cascades were the dominant geomorphic channel unit (GCU) at CAP01, making up 40.2% of the reach. Riffles and glides were the next most abundant at 20.9% and 18.5% of reach respectively. In CAP02, similarly to CAP01, we found that cascades dominated the reach at 44.3% of its length. Glides and riffles were the next most abundant GCU's, making up 34.4% and 19.7% of the reach, respectively (fig. 12). For a complete description of GCUs see Brasher et al. (in press).

This was the second consecutive year in which we collected water quality data while sampling aquatic macroinvertebrates at Capulin Creek. Values presented in Table 3 represent recorded measurements at or near midday of the sample date. The water temperature was 9.7°C at CAP01 and 10.6°C at CAP02. Specific conductivity was slightly higher at CAP01, measuring 146 μS/cm and172 μS/cm at CAP02. The pH was 8.0 at CAP01 and 7.9 at CAP02, and dissolved oxygen measured 8.4 mg/L at

Table 3. Physical habitat characteristics for CAP01 and CAP02 at Capulin Creek in Bandelier National Monument, 2007-2009. Particle embeddedness and canopy closure measurements are expressed as percentages.

	CAP01						CAP02					
	2007		2008		2009		2007		2008		2009	
Physical habitat metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Microhabitat												
Riffles												
Velocity (m/s)	0.23	0.10	0.35	0.20	0.33	0.17	0.19	0.23	0.21	0.14	0.01	0.12
Depth (m)	0.07	0.02	0.09	0.02	0.25	0.39	0.06	0.03	0.05	0.02	0.07	0.22
Embeddedness (%)	14.36	5.09	30.28	12.86	26.28	6.34	9.20	6.10	29.52	10.62	29.36	11.43
Transect												
Channel dimensions												
Velocity (m/s)	0.06	0.04	0.14	0.06	0.16	0.08	0.04	0.03	0.02	0.02	0.29	0.38
Depth (m)	0.07	0.05	0.06	0.04	0.07	0.03	0.06	0.03	0.07	0.05	0.07	0.04
Wetted channel width (m)	1.30	0.39	1.31	0.40	1.44	0.30	1.18	0.35	0.86	0.41	3.90	3.51
Active channel width (m)	2.29	0.87	5.47	2.26	9.62	5.08	1.70	0.44	4.16	1.89	13.62	6.76
Riparian cover												
Canopy closure (%)	87.39	21.03	91.09	20.83	92.00	11.12	70.56	15.18	97.93	7.04	96.33	6.20
Reach												
Water quality[a]	**Value**		**Value**		**Value**		**Value**		**Value**		**Value**	
Temperature (°C)	11.5		11.4		9.7		11.4		11.2		10.6	
Specific conductivity (µS/cm)	n.d.[b]		151		146		n.d.[b]		165		172	
pH	n.d.[b]		8.0		8.0		n.d.[b]		7.8		7.8	
Dissolved oxygen (% saturation)	n.d.[b]		96.6		95.9		n.d.[b]		96.4		96.1	
Dissolved oxygen (mg/L)	n.d.[b]		10.5		8.4		n.d.[b]		10.6		8.2	
Turbidity (NTU)	n.d.[b]		0.50		1.25		n.d.[b]		1.90		2.61	

Note: See Appendix B for detailed description of metrics in this table.
[a]One water quality measurement only is reported for the site, based on the sampling event closest to 12:00 noon on the sampling day.
[b]Data was not collected.

Figure 10. Macroinvertebrate habitat characterization based upon line point intercept data collected from habitat transects at CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009. Some habitat structure types were not observed. The category, "Other" at these sites refers to sandy substrates.

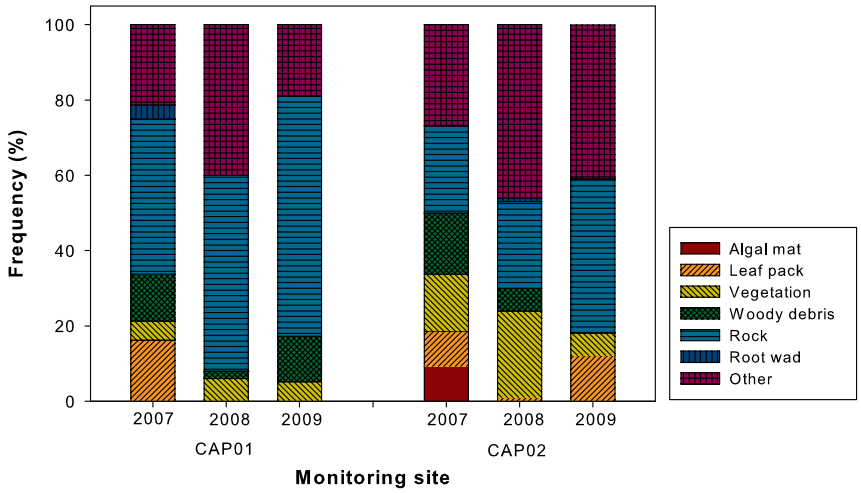


Figure 11a. Particle size distribution, based on modified Wolman pebble counts (minimum 400 particles), for macroinvertebrate sampling from CAP01 at Capulin Creek in BAND, 2007–2009. Differences between 2009 data and previous years may be a reflection of a change in methodology.

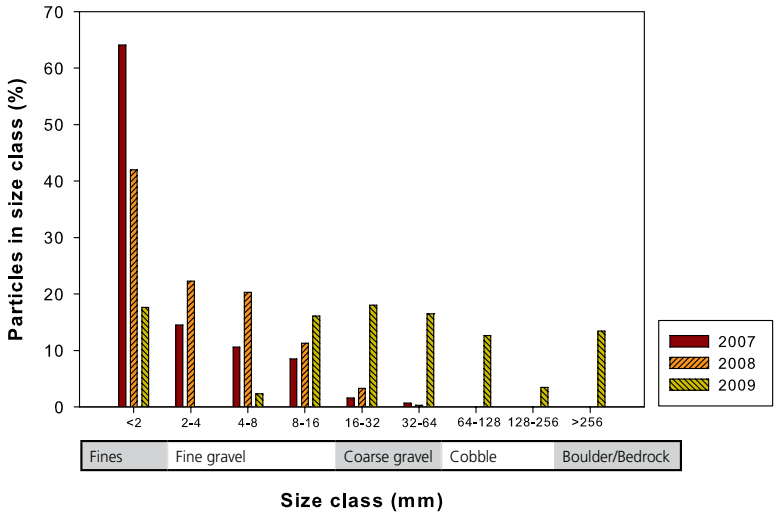
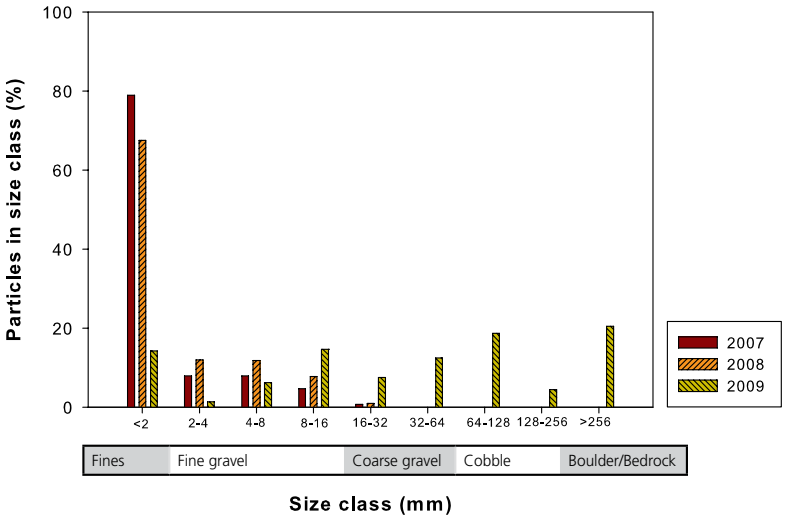


Figure 11b. Particle size distribution, based on modified Wolman pebble counts (minimum 400 particles), for macroinvertebrate sampling from CAP02 at Capulin Creek in BAND, 2007–2009. Differences between 2009 data and previous years may be a reflection of a change in methodology.



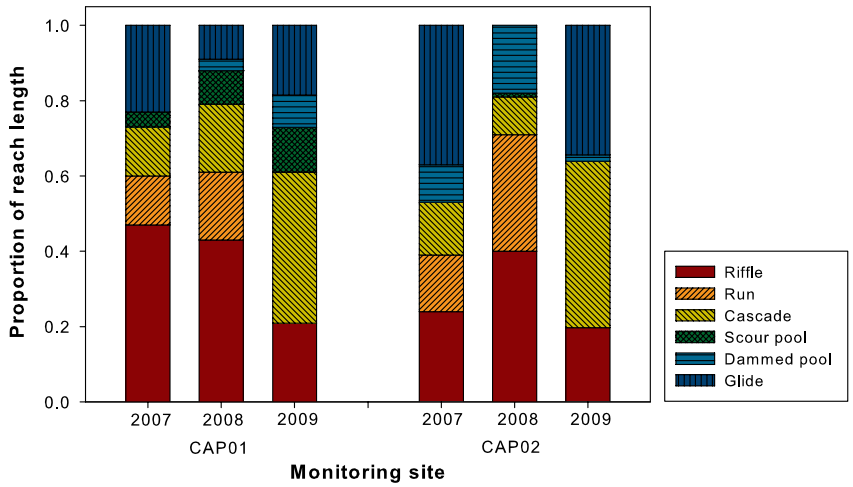


Figure 12. Geomorphic channel unit characterization of CAP01 and CAP02 at Capulin Creek in BAND, 2007–2009

CAP01 and 8.37 mg/L at CAP02 (table 3).

3.3 Aquatic macroinvertebrate community data for the Rito de los Frijoles

Key metrics are presented in Table 4 (qualitative) and in Table 5 (quantitative), describing aquatic macroinvertebrate communities from samples collected at RIT01 and RIT02 in 2009. For all tables and figures listed in this section, monitoring site results are presented in left to right order corresponding to upstream to downstream position along the stream. Figures in this section refer to quantitative data unless otherwise noted.

Abundance. Abundance values for both sites on the Rito de los Frijoles were among the highest found at any monitoring site in our network. Aquatic macroinvertebrate abundances averaged 700.9 individuals at RIT02 and 688 individuals for quantitative targeted riffle samples collected at RIT01 (fig. 13).

Taxa richness. Qualitative multi-habitat samples were highest downstream at RIT01. We found 38 taxa in our qualitative sample at RIT01 and 37 in our sample at RIT02. Quantitative targeted riffle samples were slightly higher at RIT02 compared to RIT01. We found an average of 28.4 taxa at RIT02 compared to 27 taxa at RIT01 (fig. 14).

Diversity. Taxonomic diversity was greater than functional diversity at both of our sites. Taxonomic diversity was 0.89 at RIT02 and 0.86 at RIT01 (fig 15a). Functional diversity was greatest at RIT01 at 0.72 compared to 0.65 at RIT02 (fig. 15b).

Tolerant taxa. Intolerant individuals were the most abundant of any of the tolerance classes at our sites. Relative abundance of intolerant taxa was 74.7% at RIT01 and 68.3% at RIT02. Relative abundance of moderately tolerant taxa made up 31.5% of the samples from RIT02 and 25.2% of the samples from RIT01. Tolerant taxa relative abundance made up <1% of the samples from either of our sites (fig. 16a). Similar to the abundance values, intolerant taxa dominated richness of tolerance classes at both of our sites. Intolerant taxa made up 72.7% of the taxa from RIT02 and 67.7% of the taxa from RIT01. Richness of moderately tolerant taxa was the next highest, making up 30.0% of the taxa from RIT01 and 24.4% of the taxa from RIT02. Only 2.3% and 2.8% of the taxa collected at RIT01 and RIT02 were tolerant to perturbation(fig. 16b).

Table 4. Qualitative metrics for aquatic macroinvertebrate samples collected from RIT01 and RIT02 at the Rito de los Frijoles in Bandelier National Monument, 2009. Richness-based metrics are expressed as the percentage of taxa in a given order, tolerance or functional feeding group.

Qualitative metric	RIT02	RIT01
Taxa richness	37.00	38.00
Tolerance group		
Richness of tolerant taxa (%)	11.76	10.81
Richness of moderately tolerant taxa (%)	32.35	35.14
Richness of intolerant taxa (%)	55.88	54.05
Functional group		
Richness of collector-filterers (%)	10.81	10.53
Richness of collector-gatherers (%)	29.73	26.32
Richness of scrapers (%)	8.11	10.53
Richness of shredders (%)	10.81	18.42
Richness of predators (%)	40.54	34.21
Taxonomic group		
Number of EPT taxa	15.00	15.00
Richness of EPT taxa (%)	40.54	39.47
Richness of Ephemeroptera (%)	10.81	13.16
Richness of Plecoptera (%)	8.11	13.16
Richness of Trichoptera (%)	21.62	13.16
Richness of noninsect taxa (%)	13.51	10.53
Richness of Chironomid Diptera (%)	8.11	7.89
Richness of non-Chironomid Diptera (%)	18.92	26.32
Richness of Coleoptera (%)	13.51	13.16
Richness of Odonata (%)	5.41	2.63

EPT taxa. EPT taxa—those belonging to the orders Ephemeroptera, Plecoptera and Trichoptera—averaged 43.7% of the individuals from RIT01 and 41.5% of the individuals from RIT02. Ephemeropetera dominated samples collected from RIT02, making up 25.3% of the individuals collected there. Trichopetera were next, making up 11.5% of the samples, followed by Plecoptera at 4.8%. At RIT01 Trichoptera was the most abundant EPT order at 16.4%. Ephemeroptera made up 14.5% and Plecoptera made up 12.8% of the individuals collected at RIT01 (fig. 17).

Aquatic macroinvertebrate orders. Coleopterans were the most abundant order sampled in either site. Coleopterans made up 38.6% of the individuals collected from RIT01 and 35.1 of the individuals from RIT02. At RIT02 Ephemeroptera and organisms fitting in the category "noninsect taxa" were the next most abundant, at 25.3% and 14.5%, respectively. At RIT02, "noninsect taxa" was represented by water mites, bivalves, and worms. At RIT01, the second and third most abundant orders collected were Trichopetera (16.4%) and Ephemeroptera (14.5%). Odonates were the least abundant order at both sites (fig. 18).

Table 5. Quantitative metrics for aquatic macroinvertebrate samples collected from RIT01 and RIT02 at the Rito de los Frijoles in Bandelier National Monument, 2009. For a given order, tolerance or functional feeding group, abundance-based metrics are expressed as the percentage of individuals in the group, while richness-based metrics are expressed as the percentage of taxa in the group.

	RIT02		RIT01	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**
Total abundance	700.90	134.75	688.00	172.57
Total richness	28.40	3.29	27.00	2.74
Simpson's Diversity—taxonomic	0.89	0.02	0.86	0.02
Simpson's Diversity—functional group	0.65	0.04	0.72	0.02
Dominant taxa	20.16	3.93	26.42	4.22
Tolerance group				
Relative abundance of tolerant taxa (%)	0.20	0.32	0.12	0.13
Relative abundance of moderately tolerant taxa (%)	31.52	8.14	25.19	3.98
Relative abundance of intolerant taxa (%)	68.28	8.04	74.68	4.00
Richness of tolerant taxa (%)	2.87	2.88	2.33	2.15
Richness of moderately tolerant taxa (%)	24.43	3.22	30.01	4.85
Richness of intolerant taxa (%)	72.70	5.44	67.66	5.27
Functional group				
Relative abundance of collector-filterers (%)	21.18	9.31	17.91	7.10
Relative abundance of collector-gatherers (%)	48.11	7.55	29.45	6.89
Relative abundance of scrapers (%)	23.50	3.41	36.90	5.51
Relative abundance of shredders (%)	1.12	0.70	10.34	4.29
Relative abundance of predators (%)	6.09	1.31	5.40	3.63
Richness of collector-filterers (%)	14.35	3.21	11.29	1.20
Richness of collector-gatherers (%)	38.53	2.95	29.27	4.30
Richness of scrapers (%)	18.71	3.16	15.90	4.89
Richness of shredders (%)	4.84	1.29	14.67	4.66
Richness of predators (%)	23.57	6.32	28.86	4.84
Taxonomic group				
Number of EPT taxa	14.40	1.52	11.80	1.64
Relative abundance of EPT taxa (%)	41.54	11.16	43.70	4.83
Relative abundance of Ephemeroptera (%)	25.30	6.87	14.53	5.11
Relative abundance of Plecoptera (%)	4.76	1.58	12.81	2.74
Relative abundance of Trichoptera (%)	11.48	4.41	16.37	5.72
Relative abundance of noninsect taxa (%)	14.49	11.10	1.60	1.57
Relative abundance of Chironomid Diptera (%)	6.08	2.29	10.80	4.65
Relative abundance of non-Chironomid Diptera (%)	2.73	1.11	4.86	2.09
Relative abundance of Coleoptera (%)	35.12	4.71	38.55	4.43
Relative abundance of Odonata (%)	0.04	0.09	0.49	0.92

Figure 13. Total abundance expressed as the mean number of individuals per quantitative targeted riffle habitat sample collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009

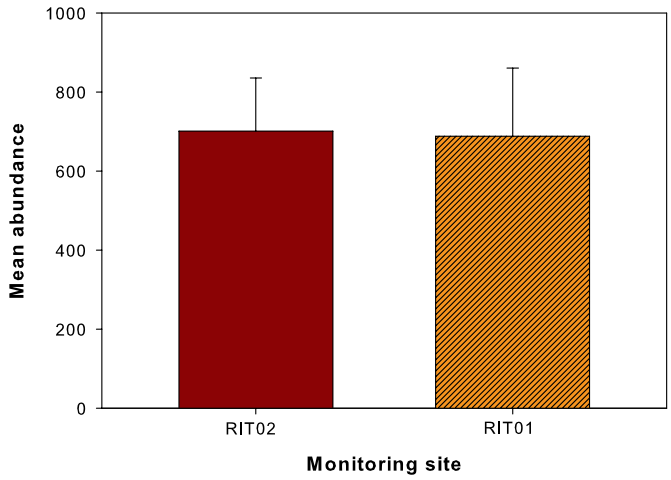


Figure 14. Mean taxa richness in qualitative multihabitat and quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009

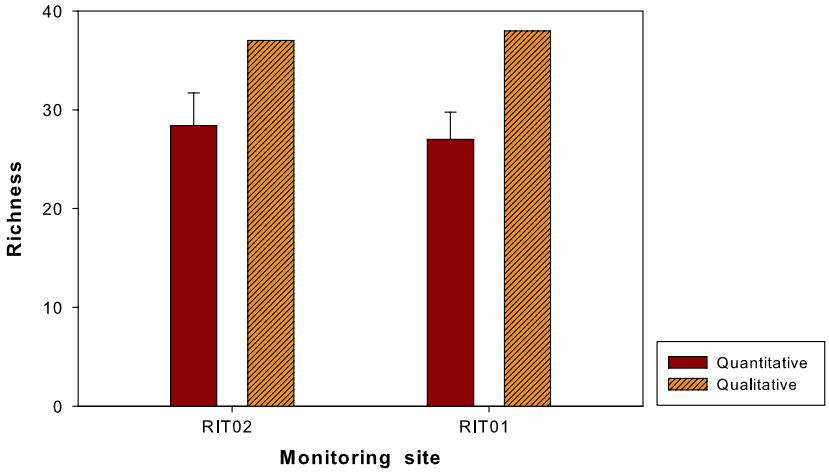
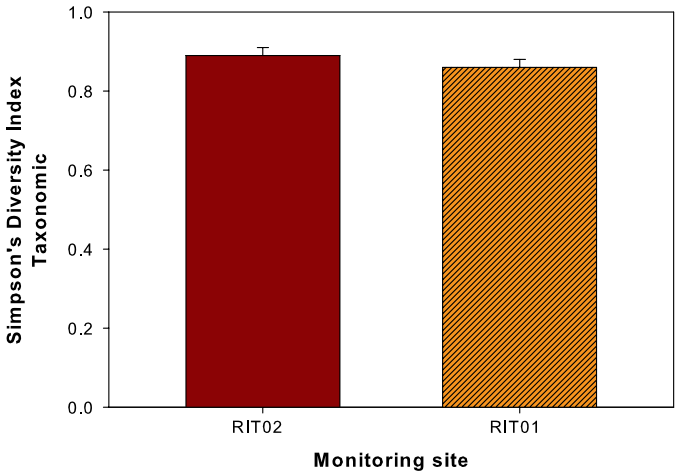


Figure 15a. Simpson's Diversity Index for taxonomic diversity in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009. Values expressed are means of all quantitative samples collected from each site.



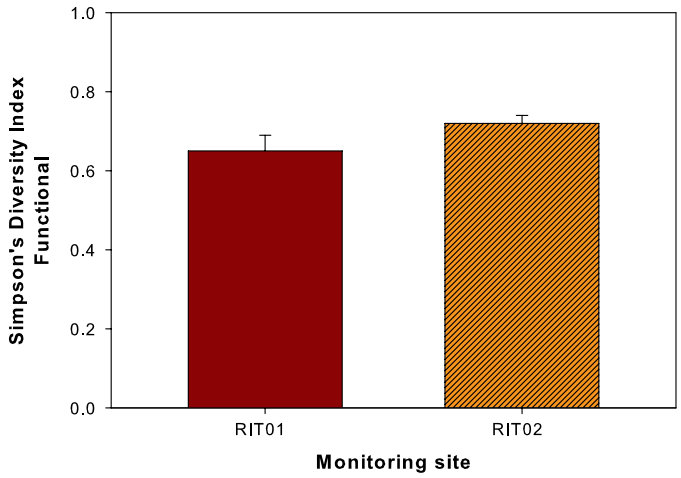


Figure 15b. Simpson's Diversity Index for functional diversity in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009. Values expressed are means of all quantitative samples collected from each site.

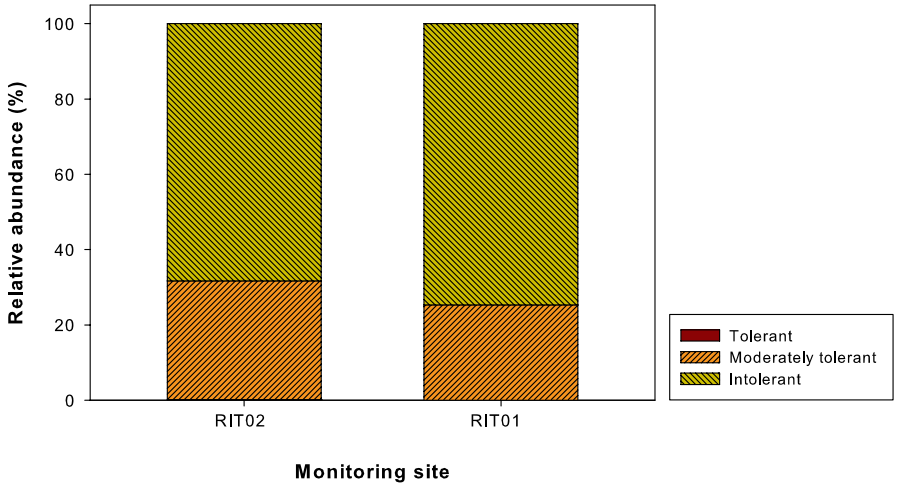


Figure 16a. Mean relative abundance of aquatic macroinvertebrate taxa in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009, based on their tolerance to perturbation

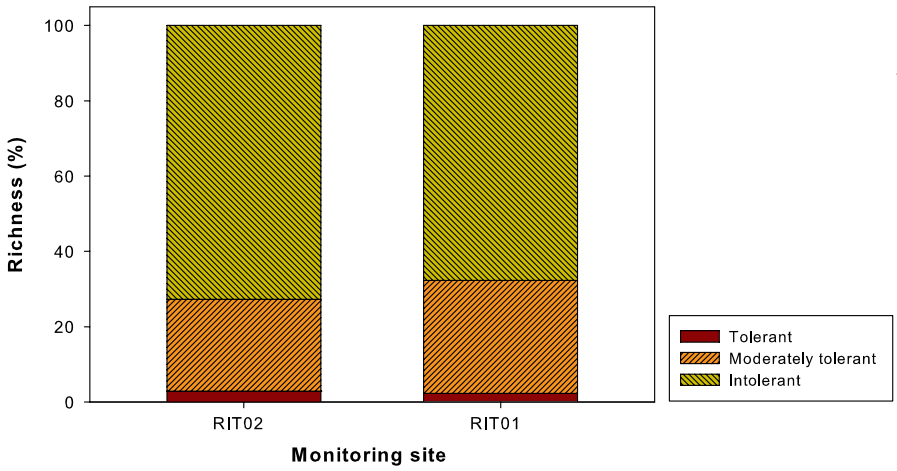


Figure 16b. Mean richness of aquatic macroinvertebrate taxa in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009, based on their tolerance to perturbation

Figure 17. Relative abundance of sensitive EPT orders in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009

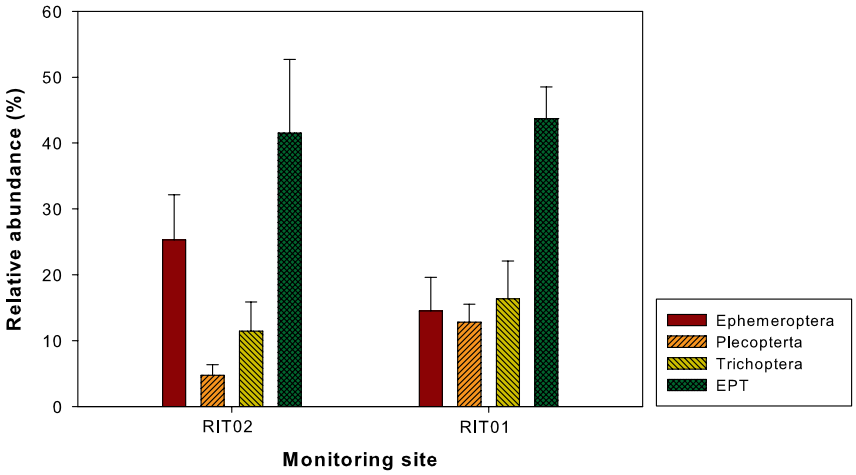
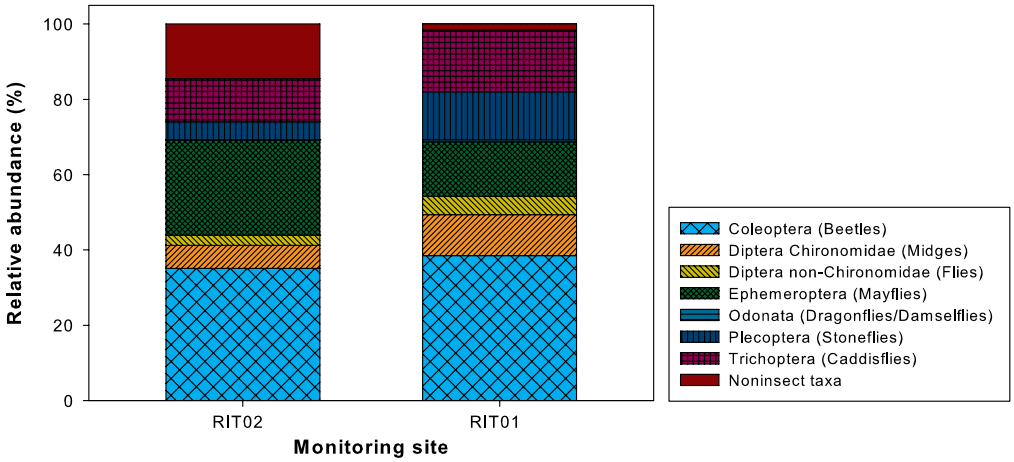
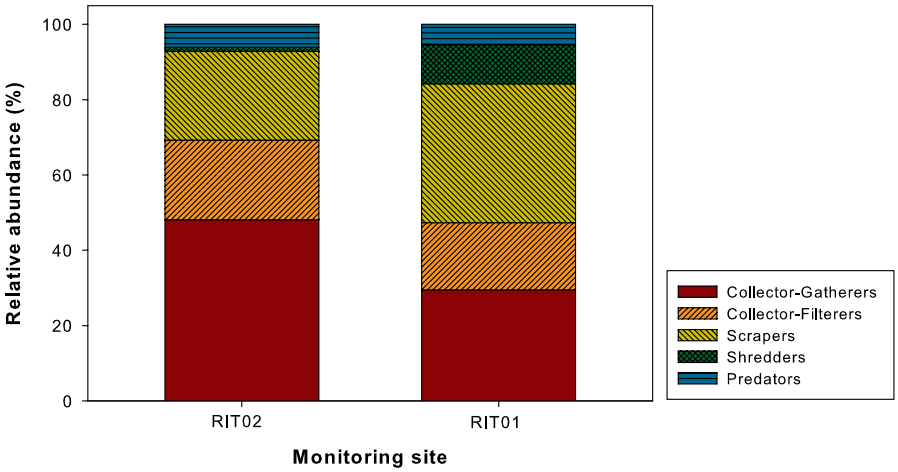


Figure 18. Relative abundance of individuals by taxonomic order in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009



Functional feeding groups. Relative abundance of functional groups differed between our two sites. At RIT02 collector-gatherers dominated the samples, making up 48.1% of the individuals collected. Scrapers and collector-filterers were the next most abundant at 23.5% and 21.2% respectively. At RIT01 scrapers were the most abundant, making up 36.9% of the individuals collected. Collector-gatherers and collector-filterers were the next most abundant at 29.5% and 17.9% respectively (fig. 19).

Figure 19. Relative abundance of functional feeding groups in quantitative targeted riffle samples collected from RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009



3.4 Physical habitat characteristics for the Rito de los Frijoles

This section presents data describing physical habitat characteristics collected at RIT01 and RIT02. These data are summarized in Table 6; additional transect and microhabitat data can be found in Appendix D.

Microhabitat. Stream velocity values at quantitative targeted riffles along our sites were very similar. Riffle velocity averaged 0.50 m/s upstream at RIT02 and 0.46 m/s at RIT01. Average stream depths at riffles were identical at both sites. Fine gravels made up 92% of the particles at riffles along RIT01. The remaining 8% of particles sampled were coarse gravels. Fine gravels were less abundant at riffles along RIT02, making up 76% of the particles sampled. Coarse gravels increased to 24% downstream at RIT02. Embeddedness differed between the two sites, averaging 50% at RIT01 compared to 30.6% at RIT02 (table 6).

Table 6. Physical habitat characteristics from RIT01 and RIT02 at the Rito de los Frijoles in Bandelier National Monument, 2009. Particle embeddedness and canopy closure measurements are expressed as percentages.

	RIT02		RIT01	
Physical habitat metric	**Mean**	**SD**	**Mean**	**SD**
Microhabitat				
Riffles				
Velocity (m/s)	0.50	0.18	0.46	0.13
Depth (m)	0.12	0.03	0.12	0.02
Embeddedness (%)	30.60	13.76	50.00	24.36
Transect				
Channel dimensions				
Velocity (m/s)	0.25	0.12	0.20	0.17
Depth (m)	0.09	0.05	0.09	0.06
Wetted channel width (m)	2.31	0.59	2.26	2.44
Active channel width (m)	4.19	0.83	10.48	3.16
Riparian cover				
Canopy closure (%)	72.90	22.42	79.63	14.10
Reach				
Water quality[a]	**Value**		**Value**	
Temperature (°C)	10.3		12.3	
Specific conductivity (µS/cm)	107		111	
pH	7.9		7.8	
Dissolved oxygen (% saturation)	94.7		94.4	
Dissolved oxygen (mg/L)	8.2		7.8	
Turbidity (NTU)	2.23		2.23	

Note: See Appendix B for detailed description of metrics in this table.

[a]One water quality measurement only is reported for the site, based on the sampling event closest to 12:00 noon on the sampling day.

Transect. Stream velocity differed little between the two monitoring sites. The average velocity at transects was 0.20 m/s at RIT01 and 0.25 m/s at RIT02. Stream depths were identical at both sites, averaging 0.09 m/s. Wetted channel widths averaged 2.2 m at RIT01 and 2.3 m at RIT02. Active channel widths averaged 10.5 m at RIT01 and 4.2 m at RIT02. Riparian canopy closure was slightly higher at RIT01 (79.6%) than at RIT02 (72.9%) (table 6).

Aquatic macroinvertebrate habitat was dominated by rock at RIT02. Rock made up 69% of the available habitat at RIT02. Habitat that does not fit into one of our delineated aquatic macroinvertebrate habitat types ("Other") occurred along 12% of the transects. Woody debris and vegetation both made up 8.6% of the habitat found. Thirty-five percent of RIT01 lacked habitat that fit into one of our macroinvertebrate habitat types, making "Other" the most abundant habitat category. Rock was the second most abundant at 30.7%, followed by woody debris at 14.5% (fig. 20).

Reach. Channel structure dynamics are represented by particle size distributions in Figure 21, and are based on modified Wolman pebble counts. Particle size distributions were well distributed among size classes in both reaches. RIT02 was dominated by larger size particles. Coarse gravels (16–64 mm) made up 34.2% of the reach, followed by boulder/bedrock particles (>256 mm) at 20.4%. Conversely, fine particles (<2 mm) dominated RIT01, making up 46.7% of the reach. Coarse gravels (16 –64 mm) and fine gravels (2–16 mm) were the next most abundant size classes for RIT01, at 19.2% and 16.5% respectively.

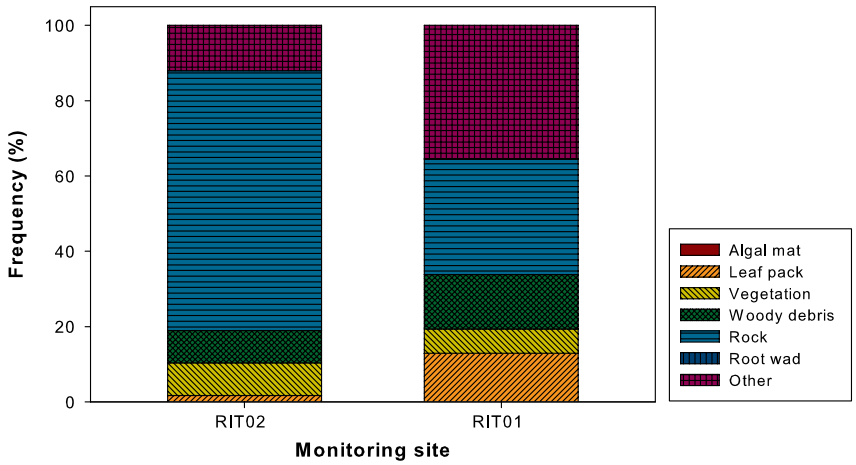


Figure 20. Macroinvertebrate habitat characterization based upon line point intercept data collected from habitat transects at RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009. Some habitat structure types were not observed. The category, "Other" at these sites refers to sandy substrates.

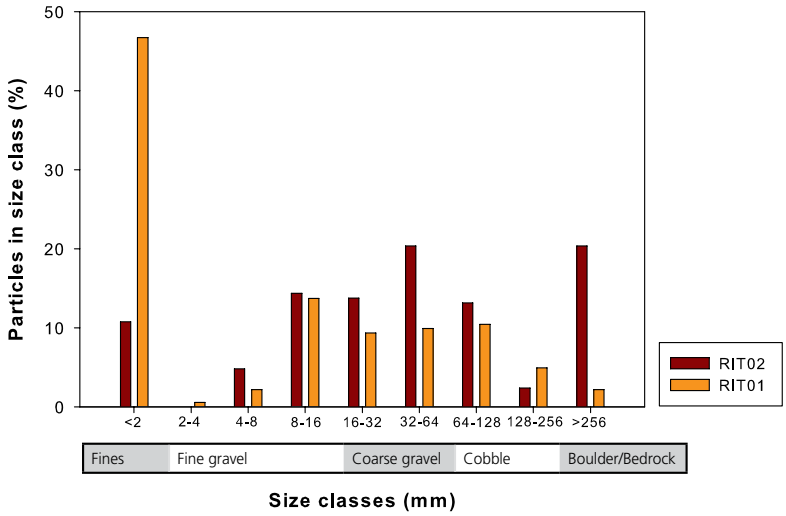


Figure 21. Particle size distribution, based on modified Wolman pebble counts (minimum 400 particles), for RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009

Geomorphic channel units (GCU) differed slightly among our two reaches. Riffles and runs were the dominant GCU's at RIT01. Runs were the most abundant GCU making up 62.9% of the reach while riffles were found along 39.8%. Cascades, dammed pools, root wads and scour pools were also found along RIT01 but in abundances of <1%. At RIT02 we found only 4 different GCU's with riffles dominating the reach at 58.9%. Cascades were the second most abundant at 19.7% followed by dammed pools at 15.0% and, runs at 6.3%. (fig. 22). For a complete description of GCUs see Brasher et al. (in press).

NPS water quality core parameters are reported as measurements recorded at or nearest to mid-day on the day of the sampling event. Water temperature was 10°C at RIT01 and 10.8°C at RIT02. Specific conductivity was slightly higher at RIT02 measuring 110 µS/cm compared to 107 µS/cm at RIT01. The pH measured 8.0 and 7.9 at RIT01 and RIT02 respectively. Dissolved oxygen was similar between the two sites, measuring 8.2 mg/L at RIT01 and 8.1 mg/L at RIT02. Turbidity was identical at the two reaches, measuring 2.23 NTU (table 6).

Discharge at the streamflow gauging station at RIT01 on October 14th, our sampling date, averaged 0.77 cfs, ranging from a low of 0.72 cfs to a high of 0.86 cfs. Discharge for the year reached a low of 0.24 cfs on 11 August, and a high of 2.84 cfs from 27–30 December (fig. 23).

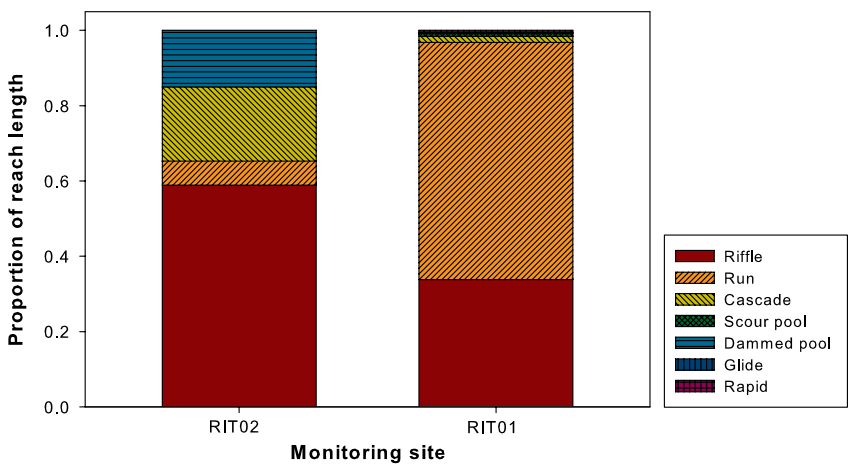


Figure 22. Geomorphic channel unit characterization of RIT01 and RIT02 at the Rito de los Frijoles in BAND, 2009

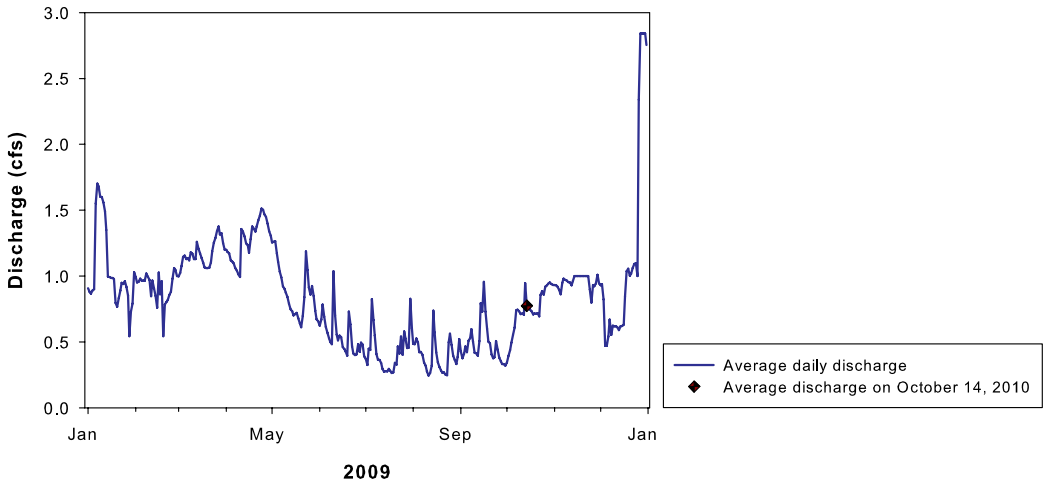


Figure 23. Hydrograph from the LANL E350 streamflow gauging station at the Rito de los Frijoles, in BAND, showing mean daily discharge for 2009

Daily water temperature was collected at the Rito de los Frijoles every 15 minutes for our sampling window and is presented in Figure 24. The average temperature for the period was 12.9°C. A minimum temperature of 2.0°C was recorded on 17 November at 0715 hrs. A maximum temperature of 20.9°C was recorded on 08 September at 1330 hrs.

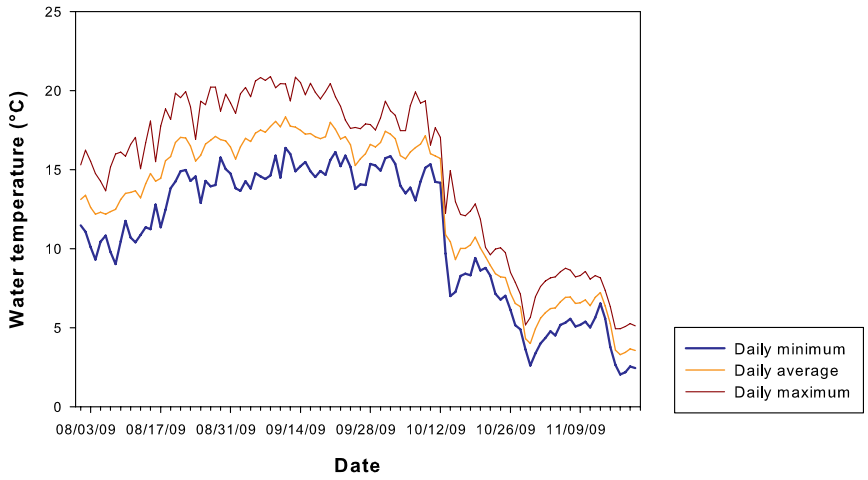


Figure 24. Water temperature recorded at 15 minute intervals in 2009 from RIT01 at the Rito de los Frijoles in BAND

4 Discussion

This report presents data from SCPN's third year of monitoring aquatic macroinvertebrates and physical habitat at Capulin Creek, as well as our first year of monitoring aquatic macroinvertebrates and physical habitat at the Rito de los Frijoles in Bandelier National Monument, New Mexico. We stress that any differences between sampling years and locations should not to be interpreted as ecologically significant trends, as trends cannot be determined with confidence from one or three years of sampling data.

Differences may be attributed to multiple factors, including ecological variability, sampling error, or observer bias. SCPN attempts to minimize sampling error and observer bias by thoroughly training crew members in the proper field techniques prior to each sampling season.

4.1 Aquatic macroinvertebrate communities

Data collected from our two monitoring sites at Capulin Creek show that our upper site, CAP01, averaged 40% more individuals, and was more taxa rich for both quantitative and qualitative samples than our lower monitoring site, CAP02. Additionally, data collected from CAP01 shows that the site is more diverse both taxonomically and functionally, providing a greater number of taxa, as well as a greater number of different taxa filling the multiple functional roles that exist in aquatic communities.

Aquatic macroinvertebrate communities on the Rito de los Frijoles were quite robust during our sampling visit in 2009. Sample abundance averaged close to 700 individuals at both monitoring sites. Taxonomic diversity was quite high at both sites. We found 38 different taxa in quantitative samples collected at RIT01 and 37 taxa at RIT02.

4.2 Functional roles in aquatic communities

Assignment of functional feeding groups allows categorization of aquatic macroinvertebrate taxa

based on morphological differences in feeding appendages. These groups describe how energy in the system is utilized and transferred by the macroinvertebrate community. A detailed description of functional grouping and trophic organization in aquatic ecosystems can be found in Merritt and Cummins (1984). At CAP02 in 2009, shredder taxa made up nearly 60% of the functional taxa. Shredder taxa are responsible for breaking down organic matter, typically riparian vegetation in the form of leafs and twigs, that enter the stream. In 2009 we found an abundance of leaf packs along CAP02. In heavily canopied, low order or headwater streams such as Capulin Creek, shredder taxa are extremely important ecologically because of their utility in breaking down organic materials such as leaf packs, and transferring that energy into biomass within the aquatic community.

4.3 Ecological tolerance of aquatic communities

Aquatic macroinvertebrate taxa differ in their abilities to withstand perturbations to the aquatic environment. Separating taxa based on their tolerance to perturbation allow us to make inferences about the response of macroinvertebrate populations to stream conditions during our sampling period. The data we collected in the Rito de los Frijoles in 2009 show that both monitoring sites have high relative abundance and richness values for taxa that are intolerant to perturbation. Additionally, relative abundance and richness values for tolerant taxa were less than 3% at both sites. Our data suggests that stream conditions were extremely favorable for aquatic macroinvertebrates at the time of our sampling visit. The high number of intolerant and moderately tolerant taxa suggests that the stream may not have been experiencing much stress. Alternatively, if a perturbation or stress was introduced or affecting the stream, our data was not able capture it.

4.3 Sensitive taxa (EPT)

Relative abundances for sensitive taxa in the EPT orders were very different among our two monitoring sites on Capulin Creek in 2009. EPT taxa made up 41% of the taxa collected at CAP01. This number was fairly evenly distributed among the orders, with the Trichoptera having the highest abundance for the site. At CAP02, where EPT orders made up 63% of the taxa collected, 60% of those individuals were Plecoptera.

The presence of sensitive taxa, such as the EPT taxa, will allow us to interpret how conditions in water quality have changed over the time of our sampling at these sites. EPT values for 2009 were high at both sites. Approximately 41% percent of the individuals collected at RIT02 and 43% of the individuals collected from RIT01 belonged to EPT taxa. The relatively high abundances of EPT taxa suggest that water quality was not degraded during the time of our visit.

The ability to track annual values of ecologically tolerant and sensitive taxa will allow us to infer trends in the condition of aquatic macroinvertebrates and stream health over time.

4.4 Physical habitat

Differences in physical habitat characteristics occurred at Capulin Creek at both the microhabitat and transect scales. Velocity was higher and depth greater at microhabitat sites at CAP01 compared to CAP02. At the broader transect scale, velocity was higher at CAP02, and average depth was identical between the two sites. Wetted channel and active channel widths were wider at CAP02 compared to CAP01.

Physical habitat characteristics at the microhabitat and transect scales were similar at both monitoring sites on the Rito de los Frijoles. Differences in physical habitat between the two sites were only captured at the reach scale. Our downstream site (RIT01) was characterized by more abundant smaller particles sizes, which translated to a large concentration of runs along that reach. Conversely, RIT02 was characterized by an abundance of larger particle sizes which resulted in a greater concen-

tration of riffles throughout the reach.

The data in this report should be viewed as a snapshot of conditions existing within the aquatic community at the time of our visit. Data and analyses within this report are provisional and subject to change. When sufficient data are available, SCPN plans to produce an interpretive report including trend analysis of macroinvertebrate metrics and physical habitat data for both Capulin Creek and the Rito de los Frijoles.

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Appendix A Monitoring sites at Bandelier National Monument, New Mexico, 2009

Site Code	Common name	Report name	UTM X	UTM Y	Elevation (m)
BANDCAP01	Capulin Creek at Base Camp Gauging Station	CAP01	379713	3958026	1904
BANDCAP02	Capulin Creek above Painted Cave	CAP02	380300.359968	3955457.32904	1791
BANDRIT01	Rito de los Frijo-les near Visitor Center	RIT01	385363.31	3959889.0356	1840
BANDRIT02	Rito de los Frijoles at Upper Crossing	RIT02	377109.8806	3964316.9175	2151

Appendix B Selected aquatic macroinvertebrate metrics

Metric type	Metric	Definition
Abundance	Total abundance	Total number of individuals.
Richness	Taxa richness	Total number of taxa (measures the overall diversity of macroinvertebrates in a sample).
Diversity	Simpson's diversity	A measure of the variety of taxa that takes into account the relative abundance of each taxon. $DS = 1-[(\sum n(n-1))/(N(N-1))]$
Tolerance	Dominant taxa	Measures the dominance of the most abundant taxa. Typically calculated as dominant 2, 3, 4, or 5 taxa.
	Relative abundance for tolerant taxa	Percent of individuals considered to be tolerant to perturbation.
	Percent richness for tolerant taxa	Percent of taxa considered to be tolerant to perturbation.
Functional-feeding	Relative abundance collector-filterers	Percent of individuals that filter fine particulate organic matter from the water column.
	Percent richness collector-filterers	Percent of taxa that filter fine particulate matter from the water column.
	Relative abundance scrapers	Percent of individuals that scrape or graze upon periphyton.
Functional-habit	Relative abundance burrowers	Percent of individuals that move between substrate particles (typically finer substrates).
	Percent richness burrowers	Percent of taxa that move between substrate particles (typically finer substrates).
	Relative abundance clingers	Percent of individuals that have fixed retreats or adaptations for attachment to surfaces in flowing water.
	Percent richness clingers	Percent of taxa that have fixed retreats or adaptations for attachment to surfaces in flowing water.
Composition	Number of EPT taxa	Number of taxa in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).
	Relative abundance EPT	Percent of individuals in the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).
	Relative abundance Ephemeroptera	Percent of individuals that are mayflies.
	Relative abundance Plecoptera	Percent of individuals that are stoneflies (for streams > 1,500 m in elevation).
	Relative abundance Trichoptera	Percent of individuals that are caddisflies.
	Relative abundance of Hydroptilidae or Hydropsychidae within Trichoptera	Percent of Trichopteran individuals belonging to Hydroptilidae or Hydropsychidae families (ratio of tolerant caddisfly abundance to total caddisfly abundance).
	Relative abundance non-insect taxa	Percent of individuals that are not insects.
	Relative abundance Chironomidae	Percent of individuals that are midges.

Source: Data from Brasher et al. (in press)

Appendix C Aquatic macroinvertebrate species list from all monitoring sites in Bandelier National Monument, New Mexico, 2009. A bold X under the site column denotes a new record for this SCPN monitoring site.

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Annelida							segmented worms	X	X	**X**	**X**
Arthropoda	Arachnida	Trombidi-formes	Arrenuridae		*Arrenurus* sp.		water mites	**X**			
Arthropoda	Arachnida	Trombidi-formes	Hygrobatidae		*Hygrobates* sp.		water mites	X		**X**	**X**
Arthropoda	Arachnida	Trombidi-formes	Hygrobatidae				water mites				**X**
Arthropoda	Arachnida	Trombidi-formes	Lebertiidae		*Lebertia* sp.		water mites	**X**			
Arthropoda	Arachnida	Trombidi-formes	Sperchonidae		*Sperchon* sp.		water mites	X	X	**X**	**X**
Arthropoda	Arachnida	Trombidi-formes	Sperchonidae		*Sperchonopsis* sp.		water mites	**X**		**X**	**X**
Arthropoda	Arachnida	Trombidi-formes	Sperchonidae				water mites	X		**X**	**X**
Arthropoda	Arachnida	Trombidi-formes	Torrenticolidae		*Testudacarus* sp.		water mites	X			
Arthropoda	Arachnida	Trombidi-formes	Torrenticolidae		*Torrenticola* sp.		water mites	X			**X**
Arthropoda	Entognatha	Collembola					springtail	X	X		
Arthropoda	Insecta	Coleoptera	Dryopidae		*Helichus* sp.		long toed wa-ter beetles			**X**	
Arthropoda	Insecta	Coleoptera	Dytiscidae	Agabinae	*Agabus* sp.		predaceous diving beetle	**X**	**X**	**X**	
Arthropoda	Insecta	Coleoptera	Dytiscidae	Hydroporinae	*Liodessus*	*obscurellus*	predaceous diving beetle	**X**	**X**		
Arthropoda	Insecta	Coleoptera	Dytiscidae				predaceous diving beetle	X	X	**X**	
Arthropoda	Insecta	Coleoptera	Elmidae		*Narpus*	*concolor*	riffle beetles	X	**X**		**X**

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Coleoptera	Elmidae		*Narpus* sp.		riffle beetles	**X**			**X**
Arthropoda	Insecta	Coleoptera	Elmidae		*Optioservus*	*divergens*	riffle beetles	X	X	**X**	**X**
Arthropoda	Insecta	Coleoptera	Elmidae		*Optioservus*	*quadrimac-ulatus*	riffle beetles		X	**X**	**X**
Arthropoda	Insecta	Coleoptera	Elmidae		*Optioservus* sp.		riffle beetles	X	X	**X**	**X**
Arthropoda	Insecta	Coleoptera	Elmidae		*Zaitzevia*	*parvula*	riffle beetles	X	X	**X**	**X**
Arthropoda	Insecta	Coleoptera	Elmidae		*Zaitzevia* sp.		riffle beetles	**X**		**X**	**X**
Arthropoda	Insecta	Coleoptera	Elmidae				riffle beetles	X	X	**X**	**X**
Arthropoda	Insecta	Coleoptera	Hydraenidae		*Hydraena* sp.		minute moss beetles		**X**		**X**
Arthropoda	Insecta	Coleoptera	Hydrophilidae		*Anacaena* sp.		water scaven-ger beetles		**X**	**X**	**X**
Arthropoda	Insecta	Coleoptera	Hydrophilidae				water scaven-ger beetle	**X**			
Arthropoda	Insecta	Diptera	Ceratopogo-nidae	Ceratopogo-ninae	*Culicoides* sp.		biting midges	**X**		**X**	
Arthropoda	Insecta	Diptera	Ceratopogo-nidae	Ceratopogo-ninae	*Probezzia* sp.		biting midges	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Ceratopogo-nidae				biting midges	X		**X**	**X**
Arthropoda	Insecta	Diptera	Chironomidae	Chironominae			non biting midges	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Chironomidae	Orthocladiinae			non biting midges	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Chironomidae	Tanypodinae			non biting midges	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Chironomidae				non biting midges	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Culicidae				mosquitoes		**X**		
Arthropoda	Insecta	Diptera	Dixidae		*Dixa* sp.		meniscus midges	X		**X**	**X**

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Diptera	Dolichopodi-dae				longlegged flies		X	**X**	
Arthropoda	Insecta	Diptera	Empididae	Hemero-dromiinae	*Chelifera* sp.		dance flies	X	X	**X**	
Arthropoda	Insecta	Diptera	Empididae		*Neoplasta* sp.		dance flies	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Empididae				dance flies			**X**	
Arthropoda	Insecta	Diptera	Muscidae				house flies		X		
Arthropoda	Insecta	Diptera	Psychodidae		*Maruina* sp.		moth flies and sand flies	X		**X**	
Arthropoda	Insecta	Diptera	Psychodidae		*Pericoma* sp.		moth flies and sand flies	X		**X**	**X**
Arthropoda	Insecta	Diptera	Ptychopteridae		*Ptychoptera* sp.		phantom crane flies				**X**
Arthropoda	Insecta	Diptera	Simuliidae	Simuliinae	*Prosimulium* sp.		black flies				**X**
Arthropoda	Insecta	Diptera	Simuliidae	Simuliinae	*Simulium* sp.		black flies	X	X	**X**	**X**
Arthropoda	Insecta	Diptera	Simuliidae				black flies	X	X	**X**	
Arthropoda	Insecta	Diptera	Stratiomyidae		*Caloparyphus* sp.		soldier flies	X			
Arthropoda	Insecta	Diptera	Stratiomyidae				soldier flies	X	X	**X**	
Arthropoda	Insecta	Diptera	Thaumaleidae				trickle midge		X		
Arthropoda	Insecta	Diptera	Tipulidae	Limoniinae	*Antocha*	*monticola*	crane flies	**X**		**X**	**X**
Arthropoda	Insecta	Diptera	Tipulidae	Limoniinae	*Limnophila* sp.		crane flies	X		**X**	
Arthropoda	Insecta	Diptera	Tipulidae	Limoniinae	*Limonia* sp.		crane flies	**X**			
Arthropoda	Insecta	Diptera	Tipulidae	Tipulinae	*Tipula* sp.		crane flies	X	X	**X**	
Arthropoda	Insecta	Diptera	Tipulidae		*Dicranota* sp.		crane flies	X		**X**	**X**
Arthropoda	Insecta	Diptera	Tipulidae		*Hexatoma* sp.		crane flies			**X**	
Arthropoda	Insecta	Diptera	Tipulidae		*Pedicia* sp.		crane flies	X	X		
Arthropoda	Insecta	Diptera	Tipulidae				crane flies	X	X	**X**	

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Diptera					flies	X	X		
Arthropoda	Insecta	Ephemeroptera	Ameletidae		*Ameletus* sp.		combmouthed minnow mayfly			**X**	
Arthropoda	Insecta	Ephemeroptera	Baetidae		*Acentrella* sp.		small minnow mayflies	**X**	**X**		
Arthropoda	Insecta	Ephemeroptera	Baetidae		*Baetis* sp.		small minnow mayflies	X	**X**	**X**	**X**
Arthropoda	Insecta	Ephemeroptera	Baetidae		*Diphetor*	*hageni*	small minnow mayflies				**X**
Arthropoda	Insecta	Ephemeroptera	Baetidae		*Fallceon*	*quilleri*	small minnow mayflies	X		**X**	
Arthropoda	Insecta	Ephemeroptera	Baetidae				small minnow mayflies	X	X	**X**	**X**
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Ephemerella*	*dorothea*	spiny crawler mayflies	X		**X**	
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Ephemerella*	*excrucians*	spiny crawler mayflies				**X**
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae		*Ephemerella* sp.		spiny crawler mayflies			**X**	**X**
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae				spiny crawler mayflies	X	X	**X**	**X**
Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Cinygmula* sp.		stream mayflies				**X**
Arthropoda	Insecta	Ephemeroptera	Heptageniidae		*Epeorus* sp.		stream mayflies			**X**	**X**
Arthropoda	Insecta	Ephemeroptera	Heptageniidae				stream mayflies	X			**X**
Arthropoda	Insecta	Ephemeroptera	Leptohyphidae		*Tricorythodes* sp.		mayflies			**X**	

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae		*Paraleptophlebia* sp.		pronggilled mayflies	X		**X**	**X**
Arthropoda	Insecta	Ephemeroptera	Leptophlebiidae				pronggilled mayflies	X		X	**X**
Arthropoda	Insecta	Ephemeroptera	Oligoneuriidae		*Homoeoneuria* sp.		mayflies		**X**		
Arthropoda	Insecta	Hemiptera	Veliidae	Microveliinae	*Microvelia* sp.		broad shouldered water striders		X	**X**	**X**
Arthropoda	Insecta	Hemiptera	Veliidae				broad shouldered water striders	X			
Arthropoda	Insecta	Lepidoptera	Crambidae	Nymphulinae	*Petrophila* sp.		crambid snout moths	**X**		**X**	
Arthropoda	Insecta	Odonata	Aeshnidae		*Oplonaeschna*	*armata*	darners	X		**X**	
Arthropoda	Insecta	Odonata	Aeshnidae				darners	X		**X**	
Arthropoda	Insecta	Odonata	Coenagrionidae		*Argia* sp.		narrow winged damselflies	X		**X**	
Arthropoda	Insecta	Odonata	Coenagrionidae				narrow winged damselflies	X	X	**X**	**X**
Arthropoda	Insecta	Odonata	Cordulegastridae		*Cordulegaster*	*dorsalis*	darners	X			
Arthropoda	Insecta	Odonata	Cordulegastridae		*Cordulegaster* sp.		spiketail dragonflies				**X**
Arthropoda	Insecta	Odonata					damselflies and dragonflies			**X**	
Arthropoda	Insecta	Plecoptera	Capniidae	Capniinae			small winter stoneflies	X	X	**X**	

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Plecoptera	Chloroperlidae		*Sweltsa* sp.		green stone-flies	X		**X**	**X**
Arthropoda	Insecta	Plecoptera	Chloroperlidae				green stone-flies	X	X	**X**	
Arthropoda	Insecta	Plecoptera	Nemouridae		*Zapada*	*cinctipes*	spring stone-flies	X		**X**	**X**
Arthropoda	Insecta	Plecoptera	Nemouridae		*Zapada* sp.		spring stone-flies				**X**
Arthropoda	Insecta	Plecoptera	Nemouridae				spring stone-flies	X	X	**X**	**X**
Arthropoda	Insecta	Plecoptera	Perlidae		*Hesperoperla*	*pacifica*	common stoneflies	**X**		**X**	**X**
Arthropoda	Insecta	Plecoptera	Perlidae				perlodid ston-flies				**X**
Arthropoda	Insecta	Plecoptera	Perlodidae	Isoperlinae	*Isoperla* sp.		perlodid ston-flies	X		**X**	**X**
Arthropoda	Insecta	Plecoptera	Perlodidae				perlodid stoneflies	X	X	**X**	
Arthropoda	Insecta	Plecoptera	Pteronarcyidae	Pteronarcyinae	*Pteronarcella*	*badia*	giant stone-flies	**X**		**X**	
Arthropoda	Insecta	Plecoptera					stoneflies	X	X	**X**	**X**
Arthropoda	Insecta	Trichoptera	Brachycentri-dae		*Brachycentrus*	*americanus*	humpless casemaker caddisflies	X		**X**	
Arthropoda	Insecta	Trichoptera	Brachycentri-dae		*Micrasema* sp.		humpless casemaker caddisflies				**X**
Arthropoda	Insecta	Trichoptera	Calamocera-tidae	Calamocera-tinae	*Heteroplec-tron*	*californi-cum*	tube case making cad-disflies	X			

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Trichoptera	Glossosomatidae	Glossosomatinae	*Glossosoma* sp.		little black caddisflies	X		**X**	**X**
Arthropoda	Insecta	Trichoptera	Glossosomatidae				little black caddisflies	X		**X**	**X**
Arthropoda	Insecta	Trichoptera	Helicopsychidae		*Helicopsyche* sp.		snail-case caddisflies	X		**X**	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychinae	*Cheumatopsyche* sp.		netspinning caddisflies	X		**X**	
Arthropoda	Insecta	Trichoptera	Hydropsychidae	Hydropsychinae	*Hydropsyche* sp.		netspinning caddisflies	X		**X**	**X**
Arthropoda	Insecta	Trichoptera	Hydropsychidae				netspinning caddisflies	X		**X**	**X**
Arthropoda	Insecta	Trichoptera	Hydroptilidae				microcaddisflies	**X**			
Arthropoda	Insecta	Trichoptera	Lepidostomatidae	Lepidostomatinae	*Lepidostoma* sp.		bizzare caddisflies	X		**X**	**X**
Arthropoda	Insecta	Trichoptera	Leptoceridae	Leptocerinae	*Oecetis* sp.		longhorned caddisflies	X			**X**
Arthropoda	Insecta	Trichoptera	Limnephilidae				northern caddisflies	X	X	**X**	**X**
Arthropoda	Insecta	Trichoptera	Philopotamidae	Philopotaminae	*Dolophilodes* sp.		fingernet caddisflies				**X**
Arthropoda	Insecta	Trichoptera	Philopotamidae	Philopotaminae	*Wormaldia* sp.		fingernet caddisflies				**X**
Arthropoda	Insecta	Trichoptera	Polycentropodidae	Polycentropodinae	*Polycentropus* sp.		tube maker caddisflies	**X**			
Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila*	*brunnea/vemna group*	free-living caddisflies				**X**
Arthropoda	Insecta	Trichoptera	Rhyacophilidae		*Rhyacophila* sp.		free-living caddisflies				**X**

Appendix C (*cont'd.*)

Phylum	Class	Order	Family	SubFamily	Genus	Species	Common name	CAP01	CAP02	RIT01	RIT02
Arthropoda	Insecta	Trichoptera	Sericostoma-tidae				bushtailed caddisflies				**X**
Arthropoda	Insecta	Trichoptera	Uenoidae		*Oligophle-bodes* sp.		stonecase cad-disflies				**X**
Arthropoda	Insecta	Trichoptera					caddisflies	X	X	**X**	**X**
Mollusca	Bivalvia	Veneroida	Pisidiidae	Pisidiinae	*Pisidium* sp.		peaclams	X	X	**X**	**X**
Nemata							nematodes	X		**X**	
Platyhel-minthes	Turbellaria						flatworms	**X**			

Appendix D Channel characteristics at 4 monitoring sites in Bandelier National Monument, New Mexico, 2009

	Velocity (m/s)		Depth (m)		Wetted channel width (m)	Active channel width (m)
Transect	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Value**	**Value**
CAP01						
1	0.14	0.11	0.06	0.03	1.31	4.46
2	0.06	0.07	0.08	0.03	1.45	4.07
3	0.08	0.06	0.08	0.03	1.69	14.70
4	n.d.[a]	n.d.[a]	n.d.[a]	n.d.[a]	1.61	13.00
5	0.26	0.23	0.05	0.02	0.82	13.04
6	0.07	0.08	0.07	0.04	1.70	7.66
7	0.11	0.11	0.12	0.03	1.31	8.50
8	0.27	0.42	0.04	0.03	1.05	6.31
9	0.20	0.08	0.05	0.04	1.80	6.00
10	0.24	0.27	0.11	0.06	1.46	7.62
11	0.18	0.15	0.04	0.02	1.64	20.50
CAP02						
1	0.13	0.10	0.08	0.02	0.87	7.05
2	0.07	0.10	0.14	0.04	0.87	5.90
3	0.38	0.00	0.03	0.01	1.35	4.74
4	0.04	0.03	0.13	0.07	1.45	11.15
5	n.d.[a]	n.d.[a]	0.02	0.01	0.49	18.30
6	0.10	0.06	0.06	0.03	1.64	28.61
7[b]	0.01	n.a.[c]	1.34	n.a.[c]	4.70	17.24
8[b]	0.35	n.a.[c]	0.06	n.a.[c]	4.95	12.47
9[b]	0.16	n.a.[c]	0.09	n.a.[c]	9.00	16.30
10[b]	0.20	n.a.[c]	0.09	n.a.[c]	8.86	14.85
11[b]	0.14	n.a.[c]	0.10	n.a.[c]	8.75	13.20
RIT01						
1	0.26	0.11	0.09	0.03	0.96	7.50
2	0.06	0.11	0.20	0.07	1.51	6.80
3	0.16	0.10	0.05	0.02	2.59	7.35
4	0.12	0.07	0.18	0.03	1.19	11.80
5	0.45	0.08	0.08	0.05	0.69	8.85
6	0.12	0.13	0.09	0.04	2.19	9.90
7	0.57	0.22	0.06	0.04	1.03	9.83
8	0.06	0.14	0.04	0.06	1.48	8.90
9	0.02	0.05	0.02	0.04	9.37	16.35
10	0.24	0.14	0.07	0.03	1.45	14.30
11	0.18	0.25	0.06	0.05	2.41	13.75

Appendix D (*cont'd.*)

	Velocity (m/s)		Depth (m)		Wetted channel width (m)	Active channel width (m)
Transect	**Mean**	**Std Dev**	**Mean**	**Std Dev**	**Value**	**Value**
RIT02						
1	0.23	0.08	0.07	0.02	2.77	4.45
2	0.22	0.21	0.19	0.23	2.43	4.1
3	0.22	0.15	0.05	0.04	2.74	5.27
4	0.14	0.14	0.06	0.06	1.81	4.27
5	0.32	0.33	0.04	0.05	3.28	4.20
6	0.08	0.07	0.19	0.02	2.11	2.55
7	0.16	0.16	0.10	0.06	2.72	3.75
8	0.19	0.15	0.13	0.08	1.52	4.25
9	0.11	0.09	0.06	0.01	2.60	3.90
10	0.33	0.34	0.04	0.04	1.35	3.60
11	0.33	0.34	0.06	0.02	2.10	5.70

[a]Data was not collected.
[b]We were only able to take one reading at this transect.
[c]Not applicable.