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

2014 Summary Report

Natural Resource Data Series NPS/SCPN/NRDS—2016/1059

ON THE COVER
SCPN staff collecting physical habitat data on El Rito de los Frijoles in Bandelier NM.
Photography by: NPS

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

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1 Introduction

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 scientific foundation for making decisions and working with other agencies and the public to protect park ecosystems. Water-related vital signs are the fundamental components defining overall riparian and aquatic ecosystem integrity. The Southern Colorado Plateau Network (SCPN) has identified 7 vital signs pertaining to riparian and spring ecosystems: 1) aquatic macroinvertebrates, 2) stream water quality, 3) stream flow and depth to groundwater, 4) spring water quality, 5) fluvial geomorphology, 6) riparian vegetation, composition, and structure, and 7) spring ecosystems. We focus on the first two of these in this report. These vital signs are closely related, and are all included in the Vital Signs Monitoring Plan for the Southern Colorado Plateau Network (Thomas et al. 2006). The context and ecological significance of these vital signs are further explained in Scott et al. (2005).

In 2007, SCPN implemented annual monitoring of aquatic macroinvertebrates and physical habitat at 2 sites on Capulin Creek in Bandelier National Monument (BAND) (Stumpf and Monroe 2009); and in 2009, the network implemented monitoring at 2 sites on the Rito de los Frijoles in BAND (Figure 1) (Stumpf and Monroe 2011). SCPN collects samples at these sites once a year. Appendix A lists locations, codes, and common names of all sampling sites.

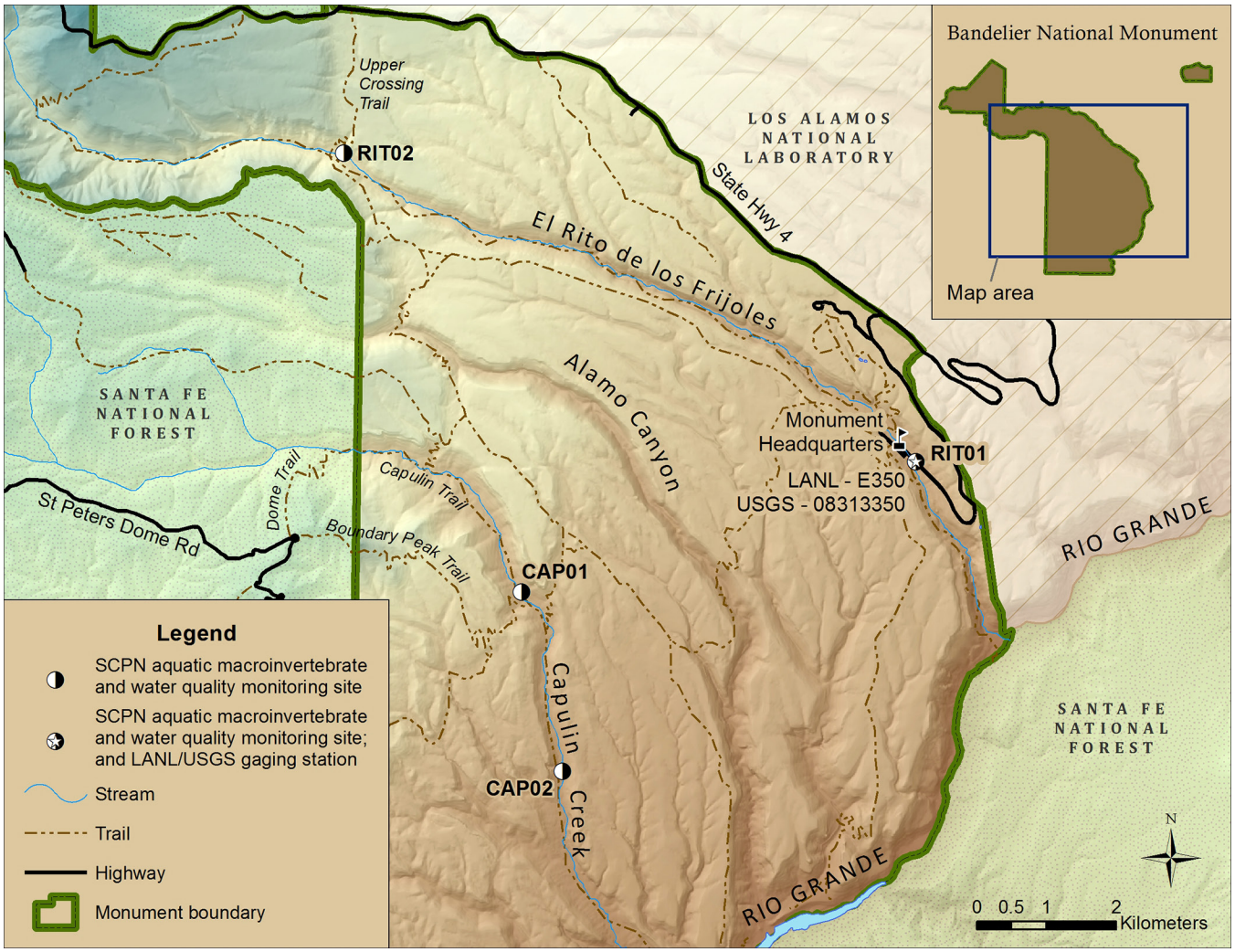

Figure 1. Locations of SCPN monitoring sites, CAP01 and CAP02, on Capulin Creek, and RIT01 and RIT02 on the Rito de los Frijoles in Bandelier NM, New Mexico, in 2014.

1.1 Capulin Creek

During 2014 the SCPN water resources field crew collected one qualitative aquatic macroinvertebrate sample and physical habitat data at 2 monitoring sites on Capulin Creek:

Capulin Creek at Base Camp Gaging Station (BANDCAP01), identified in this report as CAP01, is located less than 0.3 km upstream from the site of the historic backcountry ranger cabin, and was selected to be co-located with an SCPN water quality monitoring site. The site is located at a discontinued U.S. Geological Survey (USGS) streamflow gaging station (*Capulin Canyon at Ranger Cabin*, # 083133655). The channel substrate at this site is primarily cobble and fine sediments. Riparian vegetation was scoured from the site as a result of the Las Conchas Fire and subsequent flooding.

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 the base camp gaging station. This site was selected using the Generalized Random-Tessellation Stratified (GRTS) design. The stream at CAP02 flows through primarily fine/sand substrate. Riparian vegetation was scoured from the site as a result of the Las Conchas Fire and subsequent flooding.

The Capulin Creek watershed is a designated wilderness area, managed for recreational use within park boundaries. The upper reaches of the watershed outside of park boundaries are managed for recreation and timber harvest by the U.S. Forest Service. In 1996 the Dome Fire burned several thousand acres in the Capulin Creek watershed. Aquatic macroinvertebrates had been sampled in streams at BAND before the Dome fire by Pippin and Pippin (1981), and were sampled postfire by Vieira et al. (2004). On 26 June 2011, the Las Conchas Fire ignited and ultimately burned approximately 60% of the monument, including the majority of the upper portions of Capulin Creek. All canopy and understory vegetation burned where the fire occurred, and subsequent flooding by a large precipitation event on 21 August 2011 drastically changed the geomorphology of Capulin Creek within the park. Large volumes of sediment were mobilized throughout the watershed, significantly altering channel morphology and physical habitat at our monitoring sites.

Due to the large flood events following the Dome Fire in 1996, native Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*) populations were extirpated from Capulin Creek. Although the New Mexico Department of Game and Fish, BAND and the Santa Fe National Forest collaborated to reintroduce this species to the creek in 2006, the large flood events following the Las Conchas Fire in 2011 extirpated all fish from both Capulin Creek and the Rito de los Frijoles. Data collected in this report will support future decisions about reintroduction of fish species into both streams.

1.2 Rito de los Frijoles

During 2014, the SCPN water resources field crew also collected one qualitative and three quantitative aquatic macroinvertebrate samples and physical habitat data from 2 monitoring sites on the Rito de los Frijoles:

Rito de los Frijoles near Visitor Center (BANDRIT01) is identified in this report as RIT01. The site was selected to be co-located with an SCPN water quality monitoring site and a streamflow gaging station. Riparian vegetation is dominated by narrowleaf cottonwood, box elder, and New Mexico olive.

Rito de los Frijoles at Upper Crossing (BANDRIT02), identified in this report as RIT02, is located at the intersection with Upper Crossing Trail. Riparian vegetation was scoured from the shores of the Rito de los Frijoles by flooding that occurred as a result of the Las Conchas Fire.

Rito de los Frijoles is a perennial stream that flows eastward from the Sierra de los Valles to the Rio Grande. The upper reaches of the watershed are a designated wilderness area, managed for recreational use within park boundaries. Because the BAND visitor center and numerous archeological sites are located near the stream in the lower portion of the watershed, it experiences a high level of visitor use.

In 1977 the La Mesa Fire burned about 6070 ha (15,000 acres) 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). Then, in 2011 the Las Conchas Fire burned a large part of the upper portion of the Rito de los Frijoles watershed. Subsequent to the fire, a large flood event on 21 August 2011 affected channel morphology and physical habitat at both SCPN monitoring sites on the stream.

This report documents SCPN's aquatic macroinvertebrate monitoring activities that occurred in streams in BAND in 2014, summarizes the data that were collected, and, as appropriate, places the data in the context of current environmental conditions.

2 Methods

2.1 Field methods

The state of New Mexico has identified the aquatic macroinvertebrate sampling window as August to mid-November (New Mexico Environment Department, Surface Water Quality Bureau 2007). From 15–18 October, 2014, SCPN collected aquatic macroinvertebrate samples and physical habitat data at CAP01 and CAP02 on Capulin Creek, and at RIT01 and RIT02 on the Rito de los Frijoles. Each monitoring site consists of a 150 m sampling reach, composed of 11 transects, spaced 15 m apart (Figure 2). A brief description of field methods is provided here, and a detailed description of sampling methods can be found in Brasher et al. (2011).

We collected 2 types of aquatic macroinvertebrate samples:

- Replicate quantitative samples collected from 3 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 collected to develop a comprehensive list of species present in the reach. We used a Slack sampler to collect samples from all habitat types within the monitoring site, which we then compiled into one composite sample.

We collected physical habitat data at 3 spatial scales—microhabitat, transect, and reach.

- For each of the targeted riffle micro habitats where quantitative samples are collected, we measured
    - velocity
    - depth
    - substrate particle size
    - substrate particle embeddedness
- For each of the 11 transects, we
    - measured wetted and active channel widths
    - estimated canopy closure at both ends and at the center of each transect

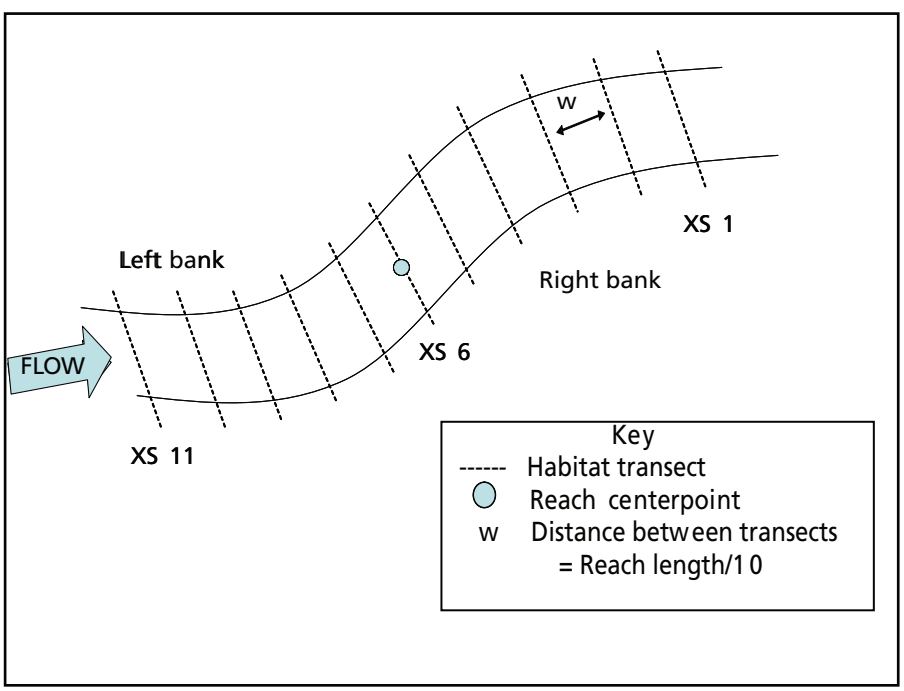

Figure 2. General aquatic macroinvertebrate sampling reach layout used by the Southern Colorado Plateau Network

- measured water depth and velocity at 5 equally spaced points along each transect
- observed and recorded the presence or absence, and types of aquatic macroinvertebrate habitats, represented by point data (5 points/transect) across the entire reach
- identified and recorded geomorphic channel units (GCU) at 5 equally spaced points along each transect

- For the entire reach, we
  - identified and measured the length of GCUs (the proportion of the reach representing each GCU)
  - identified the dominant vegetation and land cover
  - described flow conditions
  - recorded weather conditions
  - observed and recorded evidence of anthropogenic or natural disturbances
  - measured NPS core water quality parameters of temperature, specific conductance, pH, dissolved oxygen, turbidity, and stream discharge
  - 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 site (this reach-based pebble count method differs from transect-based methods conducted by SCPN in 2007–2008)

2.2 Hydrologic data collection

Hydrologic data presented in this report were collected from the streamflow gaging station, USGS # 08313350, *Rito de los Frijoles in Bandelier Nat Mon, NM*, on the Rito de los Frijoles, and from the group of weather stations installed in and near BAND in 2012. A previously existing gage (LANL-E350) that had been operated by Los Alamos National Laboratory (LANL) was destroyed by the large flood on 21 August 2011. The new streamflow gage (USGS # 08313350, *Rito de los Frijoles in Bandelier Nat Mon, NM*) was installed at the site by the USGS in 2012 (USGS 2013).

Also in 2012 an early warning system was installed in and near BAND. The system includes one weather station in the upper reaches of Capulin Canyon, known as *Headwaters of Cochiti and Capulin Canyon* (#31045), and two in the Rito de los Frijoles watershed—*Dome Road* (#31058) and *Ponderosa C.G.* (#31057) (OneRain Flood Early Warning System 2013).

2.3 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. Samples were sorted under a dissecting scope at 10X magnification; a 500-organism, fixed-count method was used for sub-sampling large samples. Ten percent of the sorted samples were re-sorted 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.

The contract laboratory will maintain quantitative and qualitative aquatic macroinvertebrate samples for at least 5 years to allow for repeat subsampling should any data questions arise. For a more detailed description of laboratory methods, see Brasher et al. (2011).

2.4 Data analysis

In this report we summarize aquatic macroinvertebrate data in terms of community structure and function. Data are presented by site in an upstream to downstream order for both streams in this report. Genera were classi-

fied 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.

For quantitative aquatic macroinvertebrate data, we calculate means and standard deviations from the 5 replicate samples collected, unless otherwise noted. For those parameters measured along transects (such as habitat characterization), we calculate means and standard deviations from the 7 to 11 transect values.

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 table 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

3.1 Capulin Creek

3.1.1 Aquatic macroinvertebrate community data for Capulin Creek

Figures 3–7 present key metrics calculated from qualitative sampling of aquatic macroinvertebrate communities on 16 October 2014 for CAP01 and 15 October 2014 for CAP02, with data collected from 2007 to 2012. Data were not collected during 2013 due to the U.S. federal government shutdown from October 1–16. All corresponding data values are available in Appendix D (Table D1). Appendix C lists all aquatic macroinvertebrate species detected from qualitative sampling at the site in 2014.

The large flood event that occurred at Capulin Creek in August 2011 altered channel morphology, depositing large volumes of fine sediments. Because the sites lacked riffle habitat, we were unable to collect a quantitative sample from CAP01 or CAP02 in 2014, and therefore will be reporting taxa richness, and not abundance for those sites.

Taxa richness. Qualitative richness equaled 13 taxa at CAP01 and 17 taxa at CAP02 in 2014 (Figure 3).

Stress tolerance. Taxa that are moderately tolerant to disturbance dominated samples collected from both monitoring sites on Capulin Creek in 2014 (Figure 4). Moderately tolerant taxa accounted for 69.23% of the taxa collected at CAP01 and 62.50% at CAP02. Tolerant taxa accounted for 23.08% of the taxa collected at CAP01 and 18.75% at CAP02. Only 7.69% of the taxa collected at CAP01 were intolerant to disturbance. Intolerant taxa accounted for 18.75% of the taxa found at CAP02 in 2014.

Functional feeding groups. Predators made up the largest proportion of functional groups from taxa collected at both CAP01 and CAP02 in 2014, accounting for 53.85% and 52.94% of the sample, respectively (Figure 5). Collector-gatherers were made up the next largest group, at 30.77% for CAP01, and 41.18% for CAP02. Collector-filterers and scrapers each accounted for 7.69% of the sample from CAP01. No shredders were collected from CAP01. At CAP02, collector-filterer taxa were found in the smallest proportion, at 5.88%. No scrapers or shredders were collected at CAP02 in 2014.

EPT taxa. EPT taxa (Ephemeroptera, Plecopter, Trichoptera) are sensitive to forms of aquatic degradation.

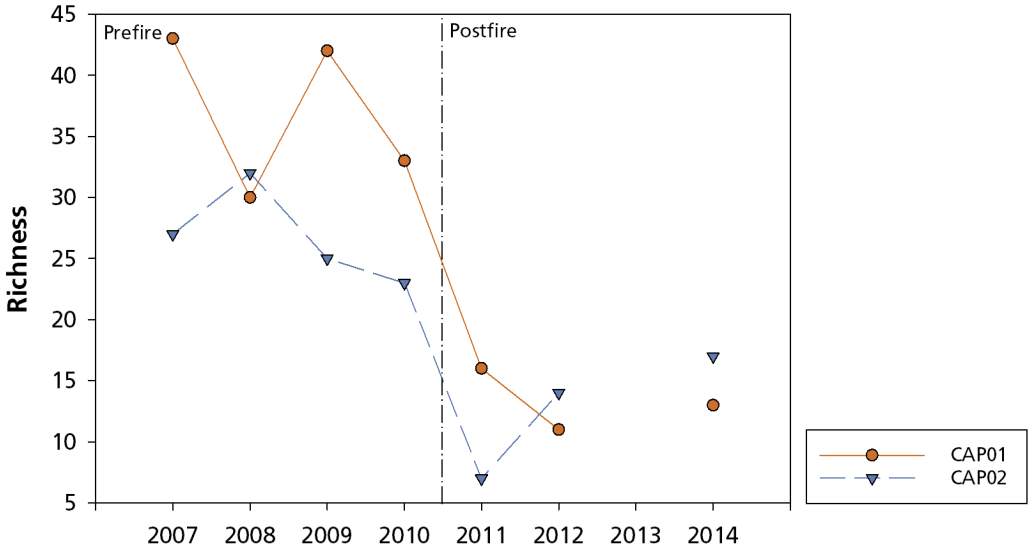

Figure 3. Aquatic macroinvertebrate taxa richness in qualitative samples from CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2007–2014. Data were not collected in 2013.

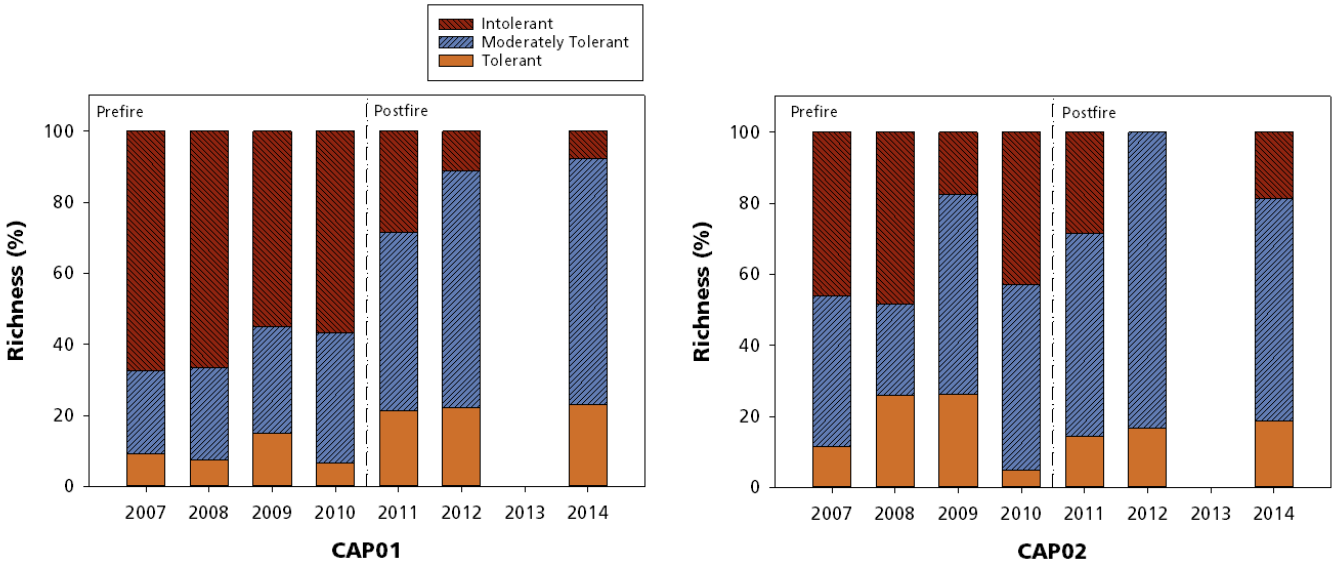

Figure 4. Percent taxa richness of aquatic macroinvertebrates by tolerance group in qualitative samples from CAP01 (left) and CAP02 (right) on Capulin Creek in Bandelier NM, 2007–2014. Data were not collected in 2013.

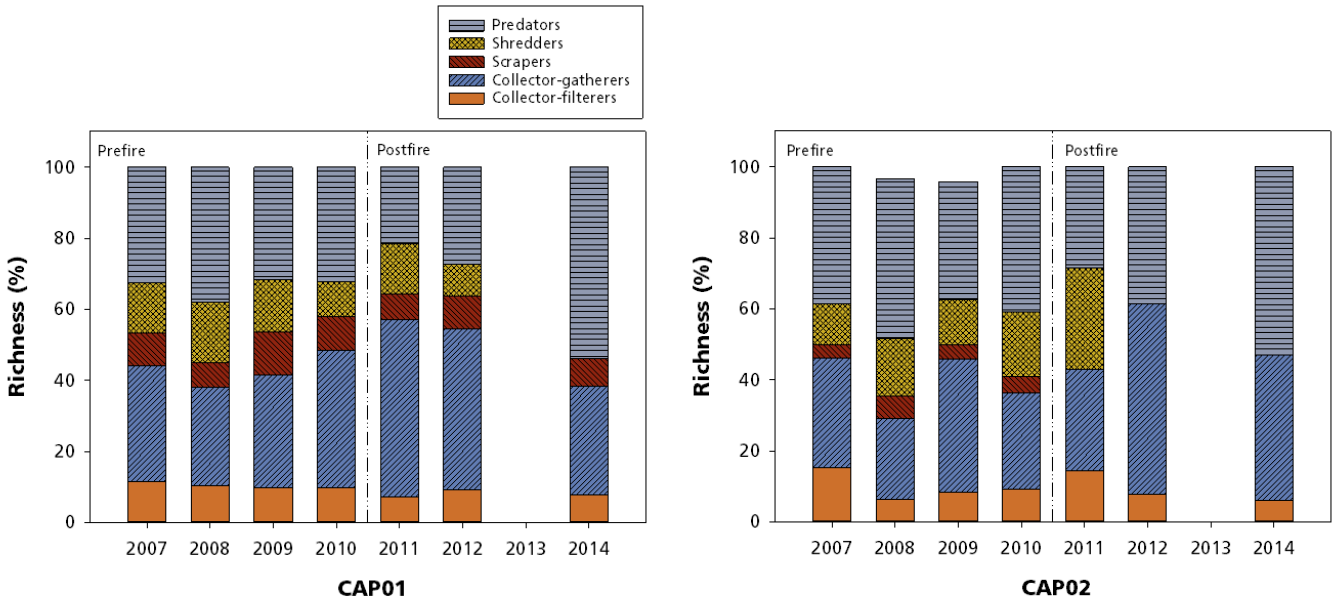

Figure 5. Percent taxa richness of aquatic macroinvertebrates by functional feeding group in qualitative samples from CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2007–2014. Not all taxa collected fit into one of our defined functional groups. Data were not collected in 2013.

Individuals representing EPT taxa accounted for 30.77% of the taxa collected at CAP01 and 23.53% of the taxa collected from CAP02 in 2014. Ephemeroptera (mayfly), were the largest EPT taxa represented at both CAP01 and CAP02. Ephmeroptera accounted for 23.08% of the taxa collected at CAP01 and 23.53% of the taxa collected at CAP02. Trichoptera (caddisfly) taxa represented 7.69% of the taxa collected from CAP01, and were not present at CAP02. No Plecoptera (stonefly) were collected from either site on Capulin Creek in 2014 (Figure 6).

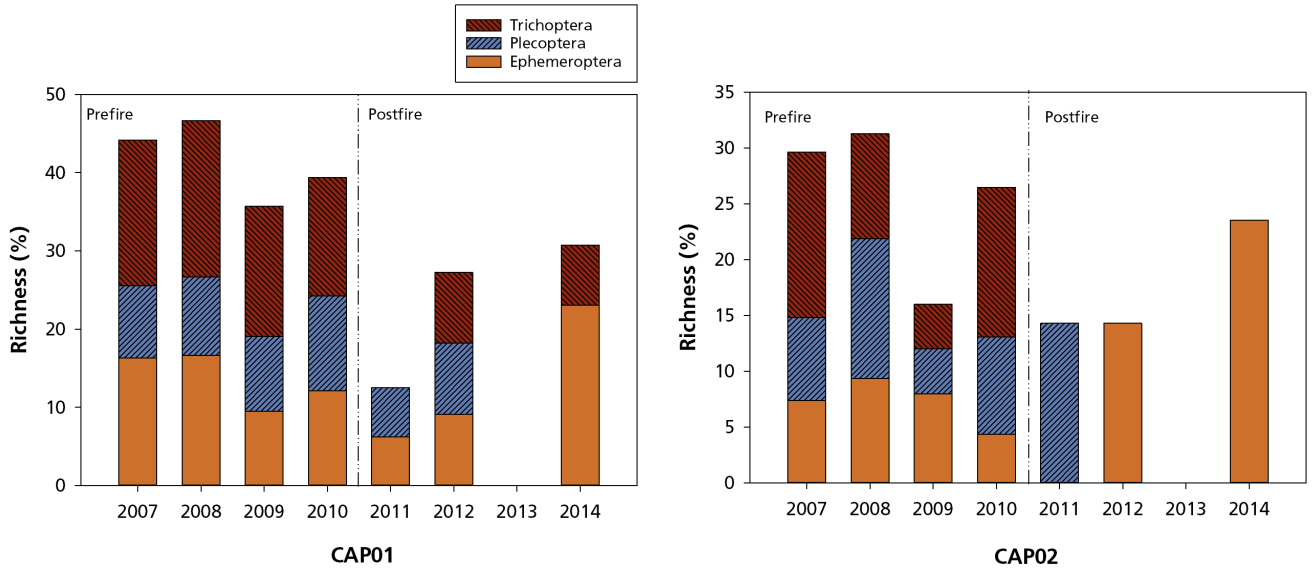

Figure 6. Percent richness of aquatic macroinvertebrates belonging to sensitive EPT orders in qualitative samples from CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2007–2014. Data were not collected in 2013.

Aquatic macroinvertebrate orders. Non-Chironomidae Diptera (flies) were the most represented taxa at both sites, and accounted for 46.15% of the taxa collected from CAP01 and 35.29% of the taxa collected from CAP02 in 2014 (Figure 7). At CAP01 Ephemeroptera were the second most represented taxa collected in 2014. Chironomidae (midges) were third at 15.38%, followed by non-insect taxa (worms and mites) at 7.70%. No Coleoptera (beetles) or Odonata (damselflies and dragonflies) taxa were collected at CAP01 in 2014. At CAP02, non-insect taxa accounted for 23.54% of the taxa collected, followed by chironomids (11.76%) and coleopterans (5.88%). No odonates were found at CAP02 in 2014.

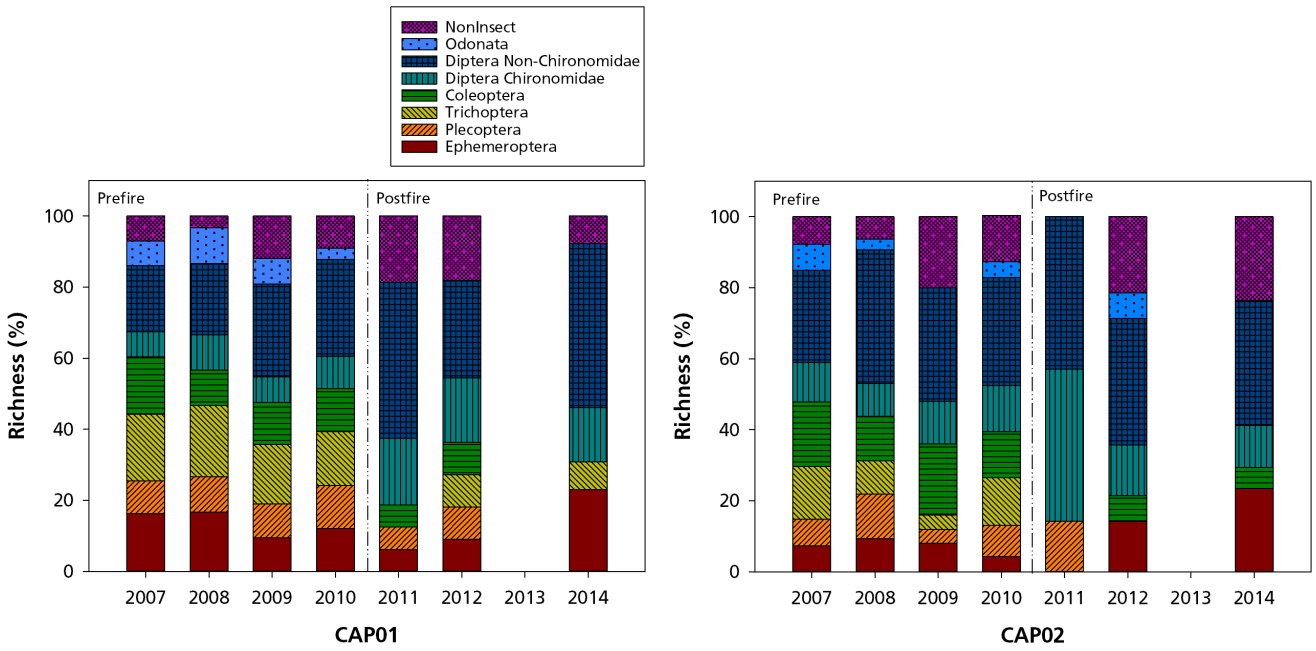

Figure 7. Percent richness of aquatic macroinvertebrates by taxonomic order in qualitative aquatic macroinvertebrate samples from CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2007–2014. Data were not collected in 2013.

3.1.2 Physical habitat characteristics for Capulin Creek

We report data in this section describing physical habitat characteristics at CAP01 and CAP02 from 2014 and present it with data collected from 2007 to 2012. These data are summarized in Appendix D (Tables D2, D3); additional transect data can be found in Table D4.

Microhabitat level. No microhabitat data were collected at Capulin Creek in 2014 because of a lack of riffle habitat.

Transect level. In 2014, average stream depths along our physical habitat transects were 0.03 m at CAP01 and 0.02 m at CAP02. Velocities were greatest upstream at CAP01, averaging 0.18 m/s. Velocity at CAP02 averaged 0.17 m/s in 2014. Wetted channel width averaged 3.4 m at CAP01 and 1.6 m at CAP02. Streamside riparian vegetation has not yet recovered along our sampling reaches at Capulin Creek; as such the active channel width at both sites was 0. Canopy closure at CAP01 and CAP02 was 0%. We believe our current measure for active channel width, as defined by our protocols (distance between streamside extent of vegetation), inadequately addresses post disturbance sites. We are currently researching methods that will allow us to measure active channel more accurately at disturbed sites.

Appropriate aquatic macroinvertebrate habitat was absent from much of both monitoring sites in 2014 (Figure 8). Substrate fitting the category "Absence" (lacking habitat that we define as appropriate for aquatic macroinvertebrates) occurred along 85.3% of CAP01 and 93.3% of CAP02. Rock made up 13.3% of CAP01 and 6.7% of CAP02. Root wads were found along 1.3% of CAP01.

Reach level. Channel structure dynamics are represented by particle size distributions. In Capulin Creek, finer sediments dominated both sites in 2014 (Figure 9). Sand and gravel were found along 92.0% of CAP01 and 95.3% of CAP02. Cobbles were found along 7.5% of CAP01 and 3.3% of CAP02. Cemented particles, pebbles that were too embedded to measure accounted for 3.3% of the particles in CAP01 and 1.0% of the particles at CAP02.

Runs were the dominant geomorphic channel units (GCU) at both monitoring sites in 2014 (Figure 10). Runs made up 92.9% of the sampling reach for CAP01 and 94.7% at CAP02. Riffles and scour pools each accounted for 3.5% of the GCU's at CAP01. Cascades accounted for 5.3% at CAP02.

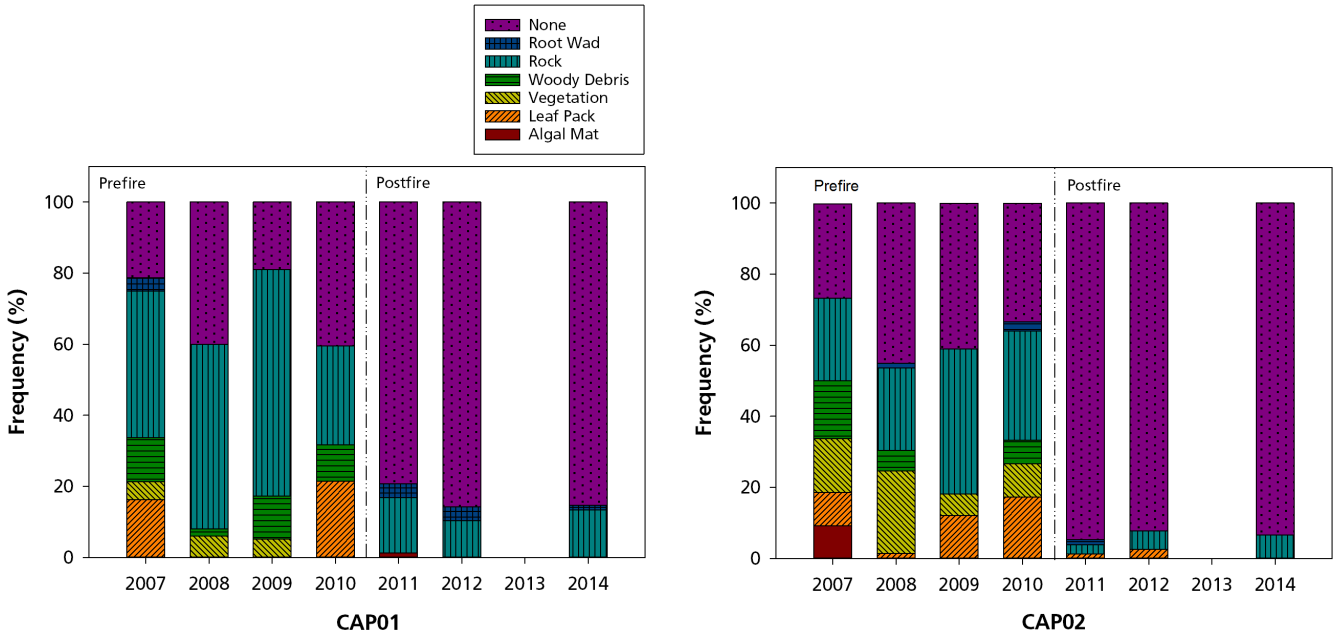

Figure 8. Habitat characterization along transects at CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2007–2014. Data were not collected in 2013.

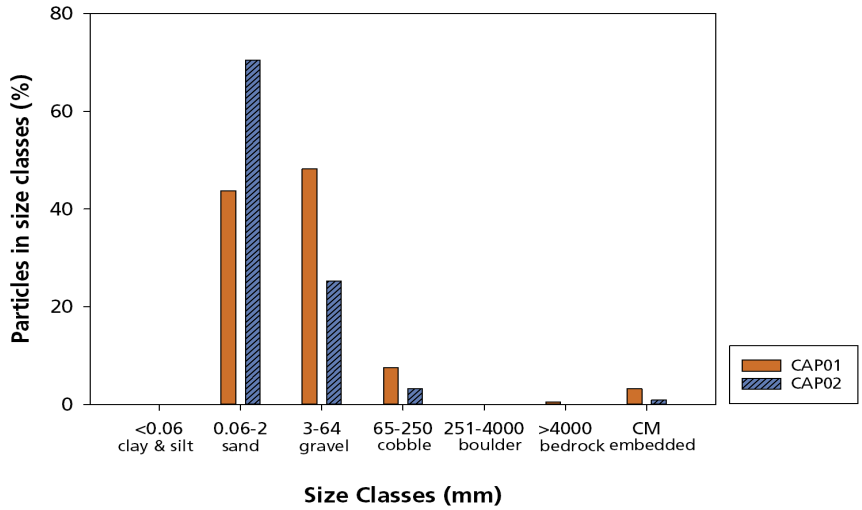

Figure 9. Particle size distribution along the CAP01 and CAP02 reaches on Capulin Creek in Bandelier NM, 2014.

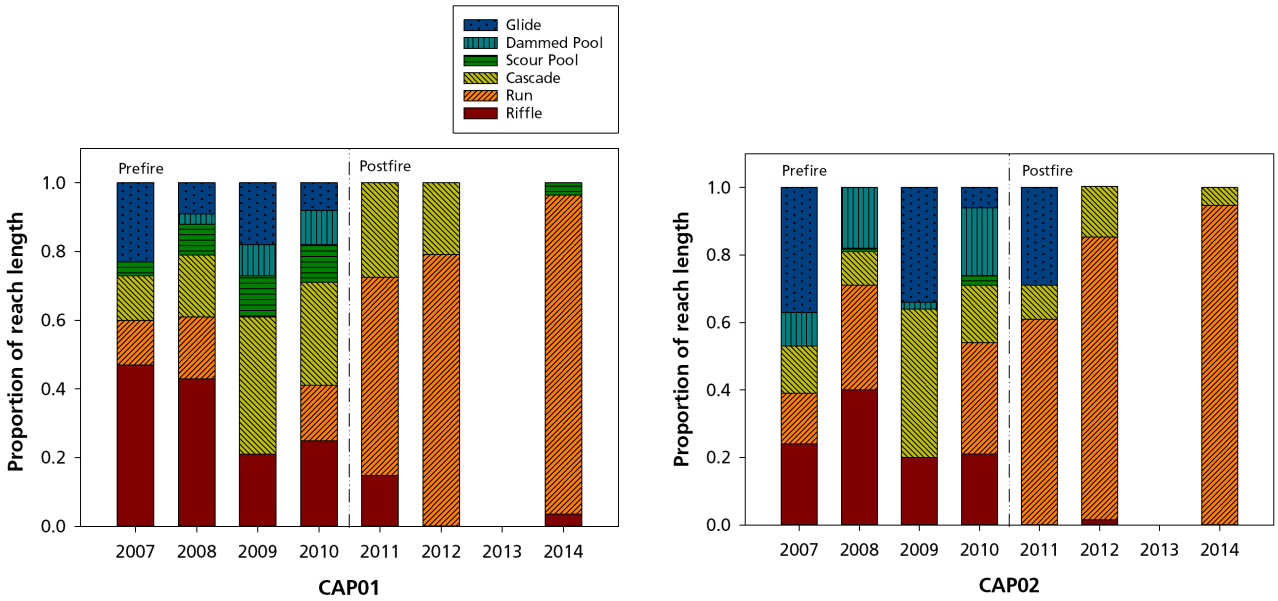

Figure 10. Geomorphic channel unit characterization of CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2007–2014. Data were not collected in 2013.

3.1.3 Hydrologic conditions for Capulin Creek

3.1.3.1 SCPN water quality core parameter data

We report hydrologic measurements for Capulin Creek collected at or near midday on 16 October 2014 for CAP01, and 15 October 2014 for CAP02. Data from all years of sampling at Capulin Creek (2007–2014) are in Appendix D (Tables D2, D3).

For CAP01, the midday water temperature was 14.5°C, and for CAP02, it was 23.4°C. The conductance sensor failed while at CAP01 and we were unable to collect data from that site. Specific conductance was 263 µS/cm at CAP02. At CAP01, pH was 8.0, and at CAP02 it was 8.2. Dissolved oxygen at CAP01 measured 98.6% saturation and 8.0 mg/L. Dissolved oxygen at CAP02 was 96.2% saturation and 6.6 mg/L. Turbidity was 9.8 NTU at CAP01 and 30.0 NTU at CAP02 (Figure 11). In addition to these water quality parameters, we measured stream discharge at both monitoring sites. Total discharge was 0.5 cfs at CAP01 and 0.2 cfs at CAP02.

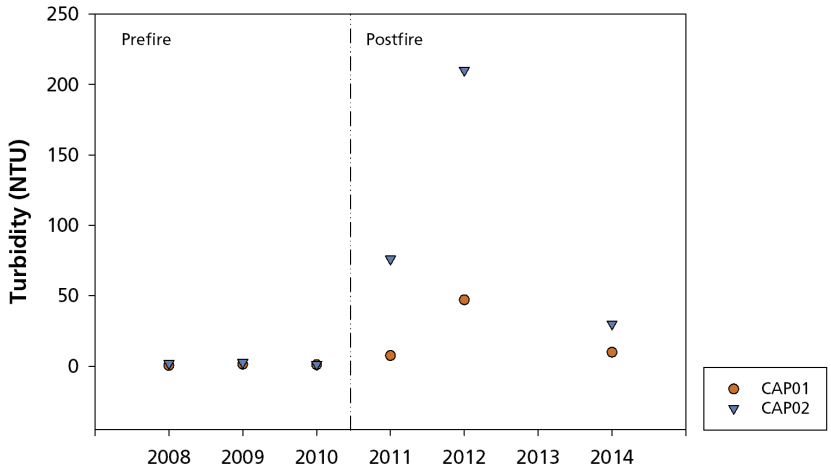

Figure 11. Turbidity at CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2014. Data were not collected in 2013.

3.1.3.2 USGS precipitation data

Data from the early warning system weather station Headwaters of Cochiti and Capulin Canyon (#31045) (OneRain 2013) are presented in Figure 12. These data show the majority of measurable events occurred during the mid-summer months (July-September), typical of the North American monsoon pattern.

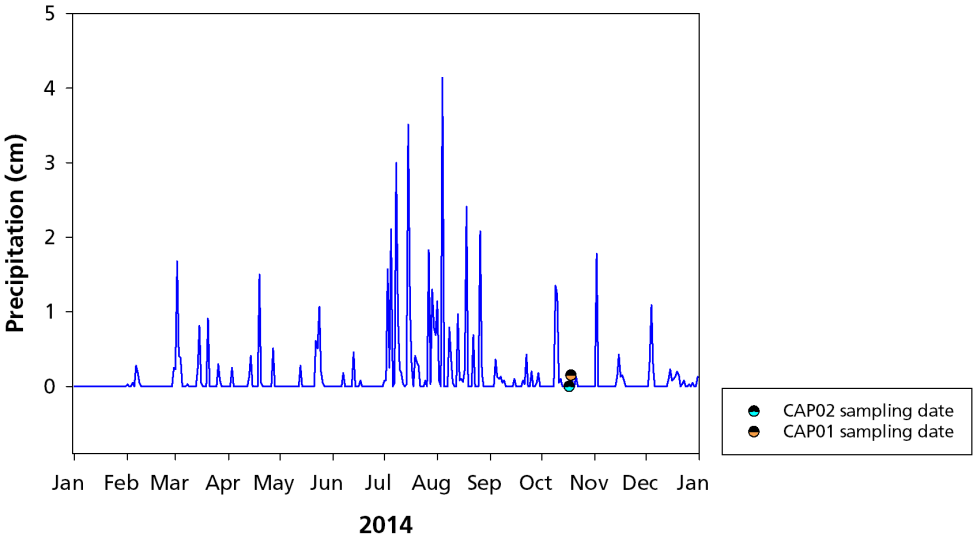

Figure 12. Total daily precipitation from the Headwaters of Cochiti and Capulin Canyon USGS rain gage (#31045) outside the western boundary of Bandelier NM, 2014.

3.2 Rito de los Frijoles

3.2.1 Aquatic macroinvertebrate community data for Rito de los Frijoles

In this section, we present key metrics calculated from aquatic macroinvertebrate community data collected on 18 October 2016 from RIT02 and on 17 October 2016 from RIT01, and present it with data collected from 2009 to 2012. Data were not collected during 2013 due to the U.S. federal government shutdown from October 1–16. Figures in this section refer to quantitative data unless otherwise noted. Due to the dynamic movement of large volumes of fine sediments through the Rito de los Frijoles, we were unable to collect 5 quantitative samples at each of our sampling sites in 2014. Data presented in this report represent means calculated from samples collected from 3 riffles instead of the standard 5 prescribed in the SCPN protocol. This prefire and postfire difference in sample sizes is shown in the graphs on either side of the vertical line representing the Las Conchas Fire. All data values are provided in Appendix E (Tables E1, E2, E3). Appendix C lists all aquatic macroinvertebrate

species detected at the site in 2014 from both quantitative and qualitative methods.

Abundance. As in 2013, mean abundance of aquatic macroinvertebrates was extremely low at both sites on the Rito de los Frijoles, with 56.00 individuals at RIT02 and 111.33 individuals at RIT01 in 2014 (Figure 13).

Taxa richness. Total taxa richness for quantitative targeted riffle samples averaged 6.00 taxa and 12.33 taxa at RIT02 and RIT01, respectively, in 2014 (Figure 14). Taxa richness for the qualitative sample was higher at both sites: we found 14 taxa at RIT02 and 23 taxa at RIT01.

Diversity. We measured both taxonomic and functional diversity using the Simpson's Diversity Index. Taxonomic diversity averaged 0.57 at RIT02 and 0.76 at RIT01 in 2014 (Figure 15). Functional diversity was lower at both sites, averaging 0.47 at RIT02 and 0.64 at RIT01 (Figure 16).

Stress tolerance. Individuals moderately tolerant to disturbance had the highest abundance at both sites in 2014 (Figure 17). An average of 54.33 moderately tolerant individuals were collected per sample at RIT02 and 101.63 at RIT01. Intolerant individuals averaged 0.33 at RIT02 and 5.58 at RIT01. One tolerant individual was collected at RIT02 and 3.79 at RIT01 in 2014.

Functional feeding groups. Collector-gatherers dominated samples collected from both monitoring sites on the Rito de los Frijoles in 2014 (Figure 18). Collectors-gatherers averaged 34.67 individuals per sample at RIT02

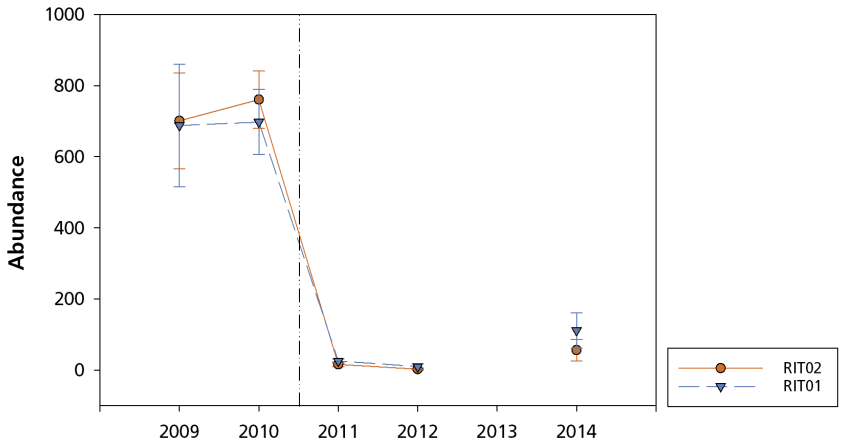

Figure 13. Aquatic macroinvertebrate abundance in quantitative samples from RIT02 and RIT01 at the Rito de los Frijoles in Bandelier NM, 2009–2014. Error bars represent one standard deviation from the mean. Data were not collected in 2013.

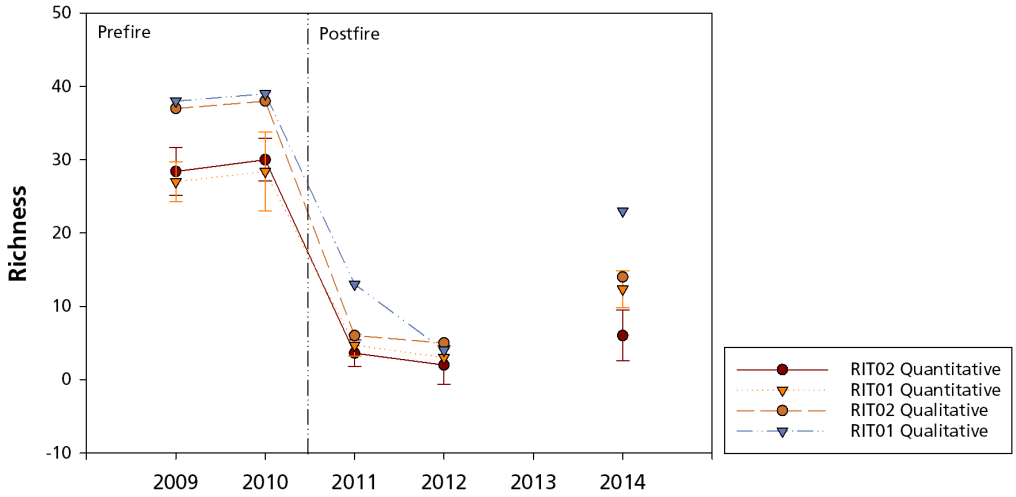

Figure 14. Taxa richness in quantitative and qualitative samples from RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM, 2009–2014. Error bars represent one standard deviation from the mean. Data were not collected in 2013.

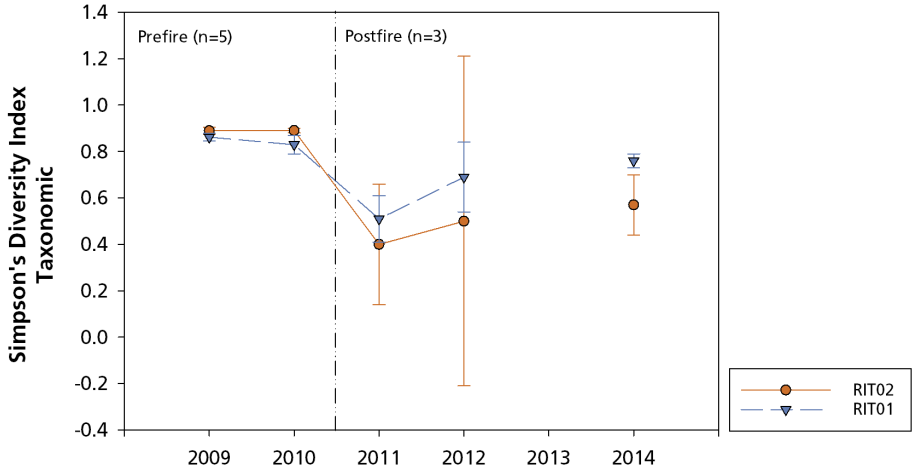

Figure 15. Taxonomic diversity in samples from RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM, 2009–2014. Error bars represent one standard deviation from the mean. No data were collected in 2013.

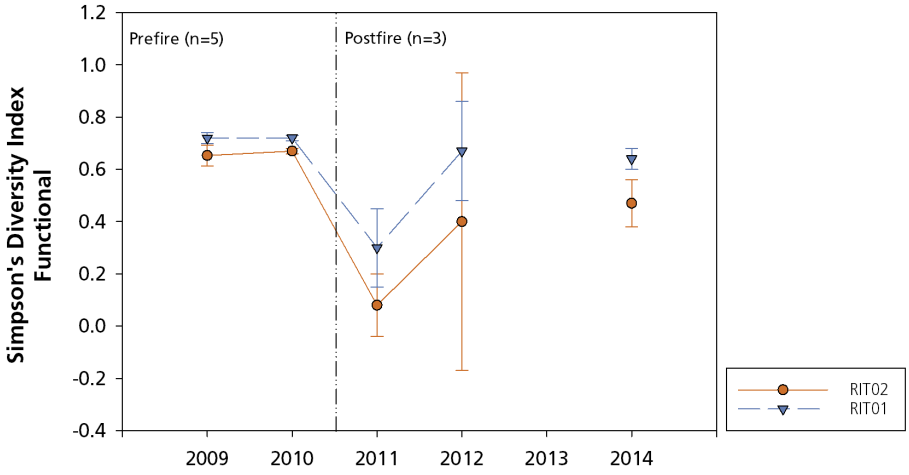

Figure 16. Functional diversity in samples from RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM, 2009–2014. Error bars represent one standard deviation from the mean. Data were not collected in 2013.

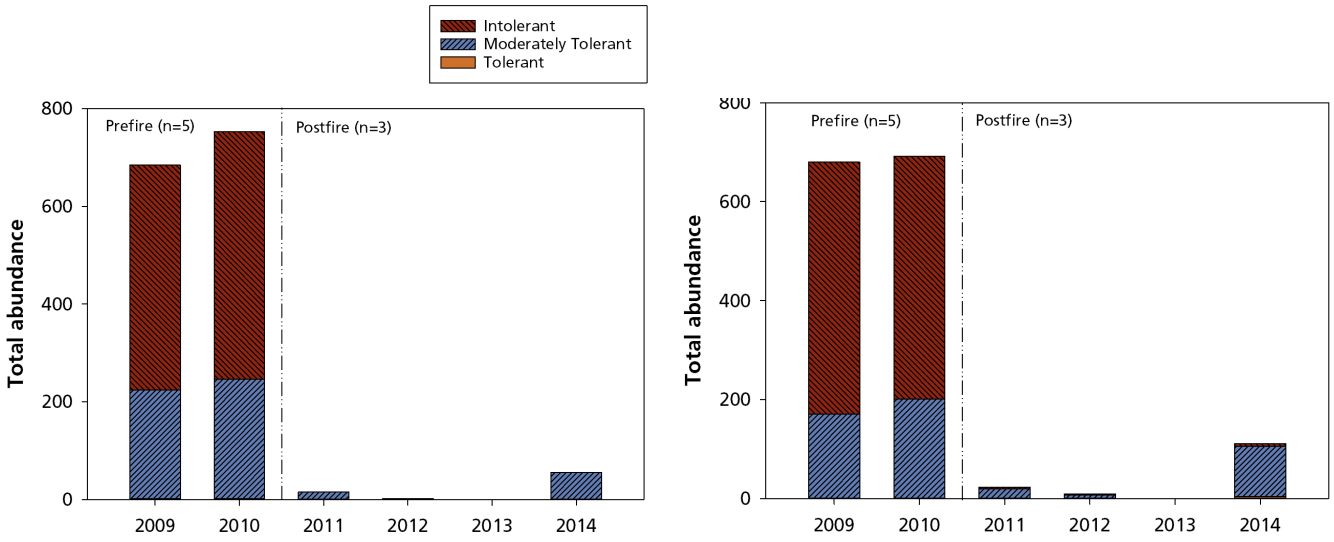

Figure 17. Mean total abundance by tolerance group in aquatic macroinvertebrate samples from RIT02 (left) and RIT01 (right) on the Rito de los Frijoles in Bandelier NM, 2009–2014. Data were not collected in 2013.

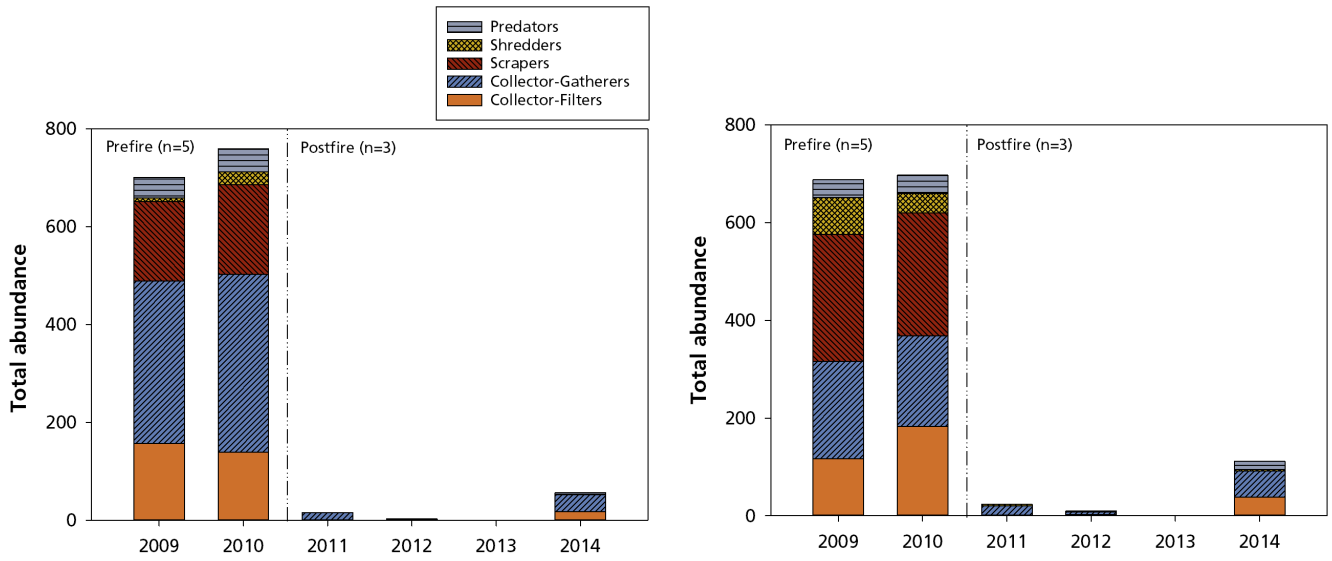

Figure 18. Mean total abundance by functional feeding group in aquatic macroinvertebrate samples from RIT02 (left) and RIT01 (right) on the Rito de los Frijoles in Bandelier NM, 2009–2014. Data were not collected in 2013.

and 54.36 individuals per sample at RIT01. At RIT02, collector-filterers averaged 17.67, predators averaged 2.33 , scrapers averaged 0.67 and shredders averaged 0.33 individuals per sample. At RIT01, collector-filterers averaged and 37.63 individuals per sample. Predators averaged 16.86 shredders averaged 2.48 individuals per sample. No scrapers were collected at RIT01 in 2014.

EPT taxa. Sensitive EPT taxa abundance averaged 30.33 individuals at RIT02 and 9.00 at RIT01 (Figures 19). At RIT02, Ephemeroptera and Trichoptera each averaged 29.67 and 0.67 individuals per sample, respectively. No Plecoptera were collected at RIT02 in 2014. At RIT01, Ephemeroptera averaged 7.67 individuals, Plecoptera 1.00 individual and Trichoptera 0.33 individuals per sample.

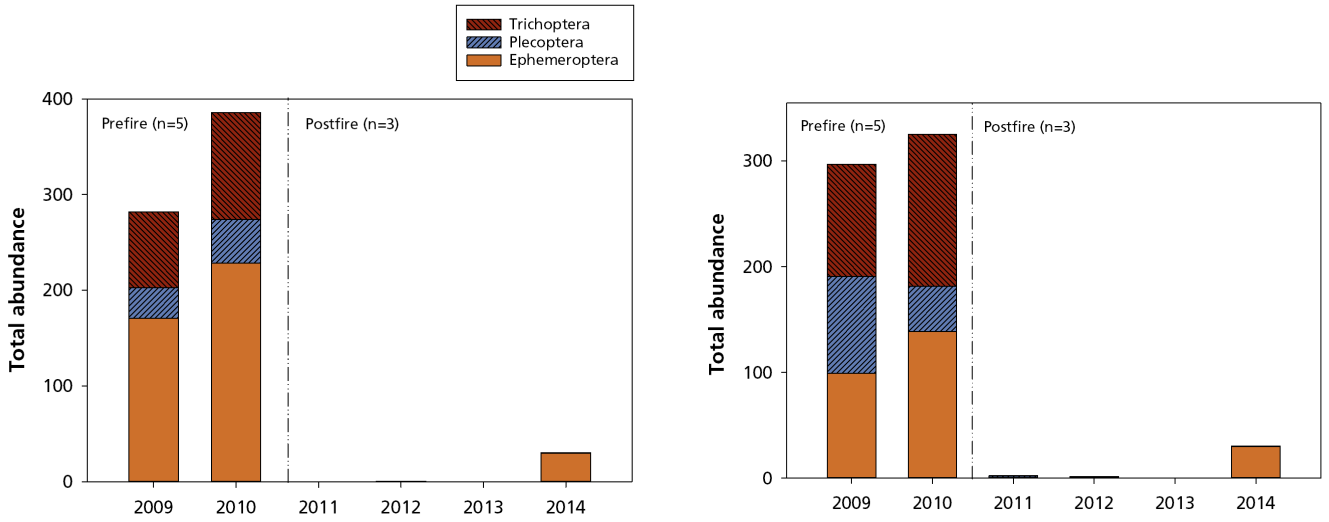

Figure 19. Mean total abundance of aquatic macroinvertebrates belonging to sensitive EPT orders in samples from RIT02 (left) and RIT01 (right) on the Rito de los Frijoles in Bandelier NM, 2009–2014. Data were not collected in 2013.

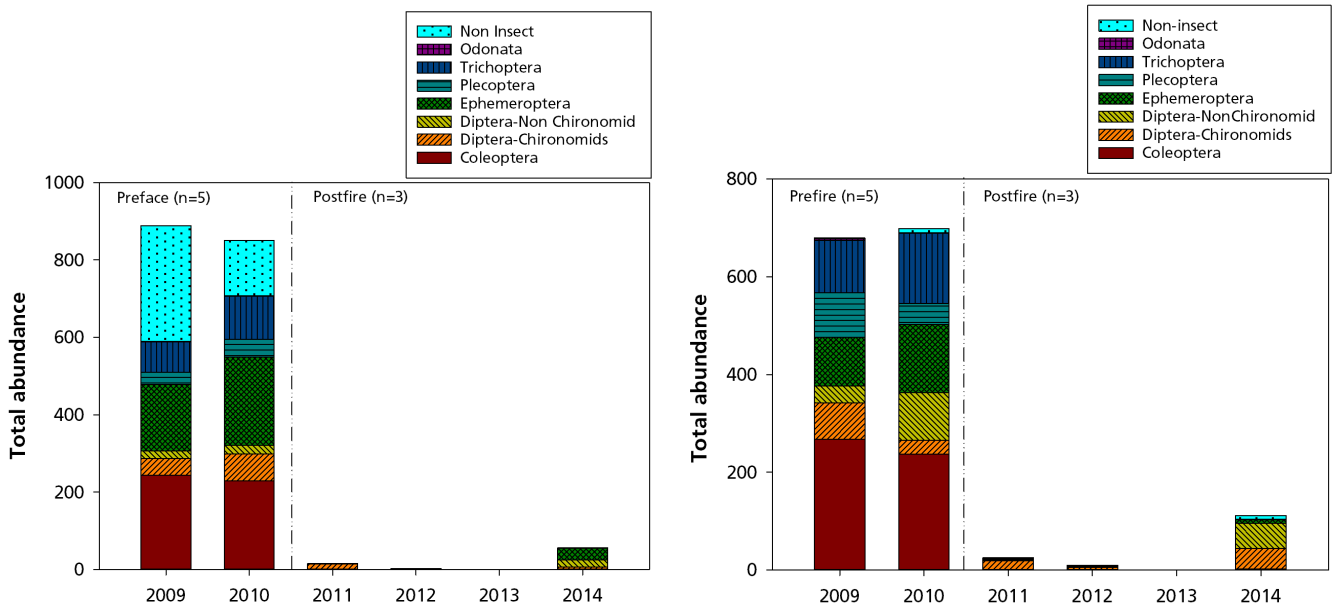

Figure 20. Mean total abundance by taxonomic order in samples from RIT02 on the Rito de los Frijoles in Bandelier NM, 2009–2014. Data were not collected in 2013.

Aquatic macroinvertebrate orders. After Ephemeroptera, non-Chironomid dipterans were the next most abundant group of organisms at RIT02, averaging 19.00 individuals per sample (Figure 20). Chironomids averaged 5.00 individuals at RIT02, Coleoptera averaged 1.00 individuals, and non-insect taxa averaged 0.67 individuals. At RIT01, non-Chironomid Diptera were the most abundant organisms collected averaging 50.56 individuals. Chironomids averaged 42.77 individuals, followed by non-insect taxa at 7.00, and Coleoptera at 2.00 individuals. No odonates were collected from either sampling location in 2014.

3.2.2 Physical habitat characteristics for the Rito de los Frijoles

This section reports the data describing physical habitat characteristics collected on 18 October 2014 from RIT02 and 17 October, 2014 at RIT01, and presents it with data collected from 2009 to 2012. These data are summarized in Appendix E (Table E4, E5); additional transect data can be found in Table E6 of Appendix E.

Microhabitat level. Microhabitat data are from 3 riffle habitats rather than the standard 5 riffles in 2014. Flow velocities averaged 0.73 m/s at RIT02 and 0.57 m/s at RIT01. The depth at riffles averaged 0.10 m at RIT02 and 0.07 m at RIT01. Substrate embeddedness was greater downstream at RIT01, where 23.0% of each particle was embedded on average, while an average of 4.7% of each particle was embedded at RIT02.

Transect level. Stream velocities along our physical habitat transects were greater upstream in 2014. Velocity averaged 0.41 m/s at RIT02 and 0.27 m/s at RIT01. Stream depth averaged 0.05 m at RIT02 and 0.03 m at RIT01. Wetted channel width averaged 3.1 m at RIT02 and 1.9 m at RIT01. Active channel width averaged 3.8 m at RIT01. Streamside riparian vegetation has not yet recovered along our sampling reach at RIT02; as such the active channel width at RIT02 was 0. Canopy closure averaged 65.8% at RIT01. Canopy cover at RIT02 was 0.

Rock was the most abundant aquatic macroinvertebrate habitat type at RIT02, and was found along 60.3% of the sampling reach (Figure 21). Substrate fitting the category “Absence”, meaning it lacked habitat that we define as appropriate for aquatic macroinvertebrates, occurred along 38.5 of RIT02, and root wads were found along 1.3% of RIT02. “Absence”, was the most common habitat type at RIT01, and was found along 80% of the sampling reach. Leaf packs and rock were both found along 7.7% of the reach and root wads were found along 3.9% of the reach.

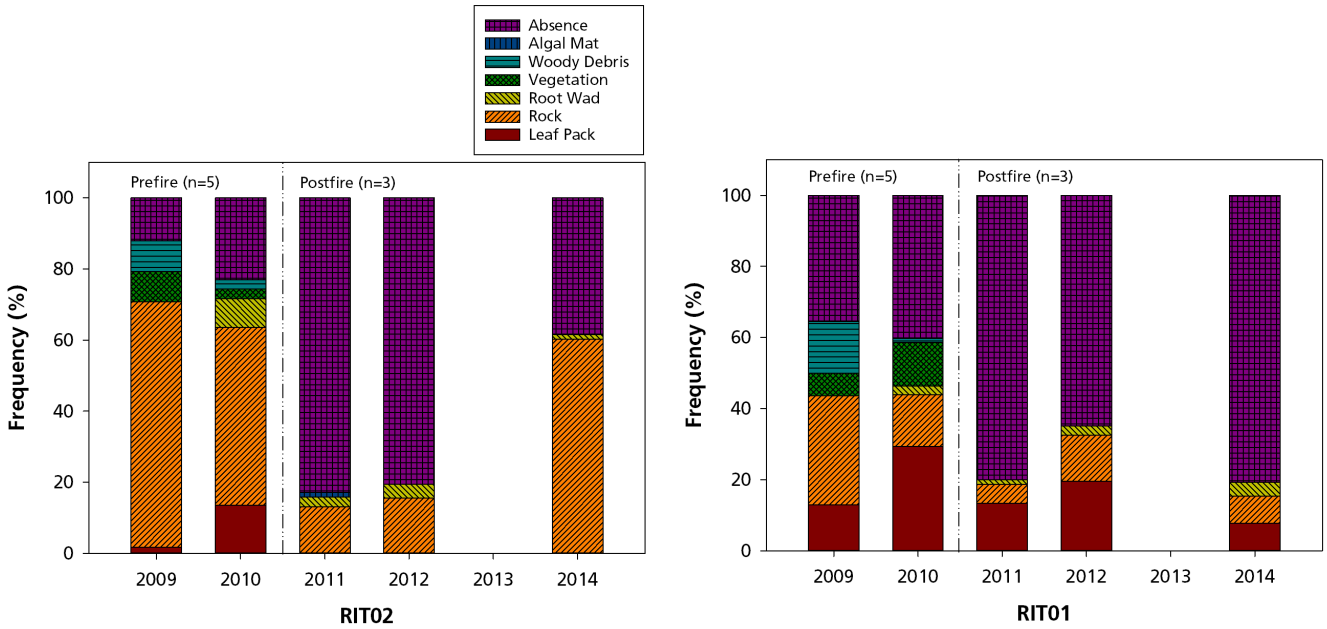

Figure 21 . Habitat characterization expressed as frequency of occurrence along transects at RIT02 (left) and RIT01 (right) on the Rito de los Frijoles in Bandelier NM, 2009–2014. Not all habitat structure types were observed. Data were not collected in 2013.

Reach level. Channel structure dynamics are represented by particle size distributions at RIT02 and RIT01. In 2014, particle size distributions were dominated by finer sediments at both monitoring sites (Figure 22).Clay and silt, and sand and gravels, combined, accounted for 79.5% of the particles measured at RIT02 and 96.6% of RIT01. Cobbles were found along 15.3% of RIT02 and 1.8% of RIT01. Cemented particles comprised 5.3% of RIT02 and 1.8% of RIT01.

Runs dominated both sites, accounting for 78.2% of RIT02 and 96.0% of RIT01 (Figure 23). Riffles were the only other GCU sampled in 2014, and were found along 21.2% of RIT02 and 4.5% of RIT01. For a complete description of GCUs, see Brasher et al. (2011).

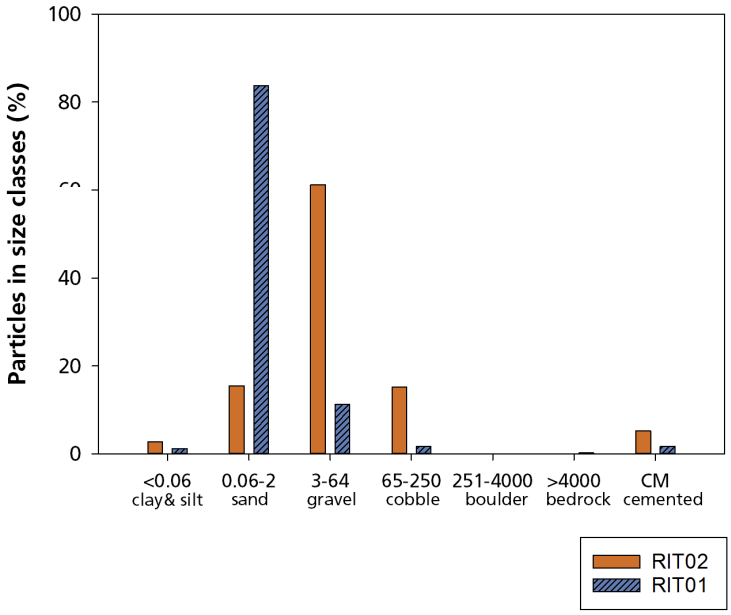

Figure 22. Particle size distribution along the reaches at RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM, 2014.

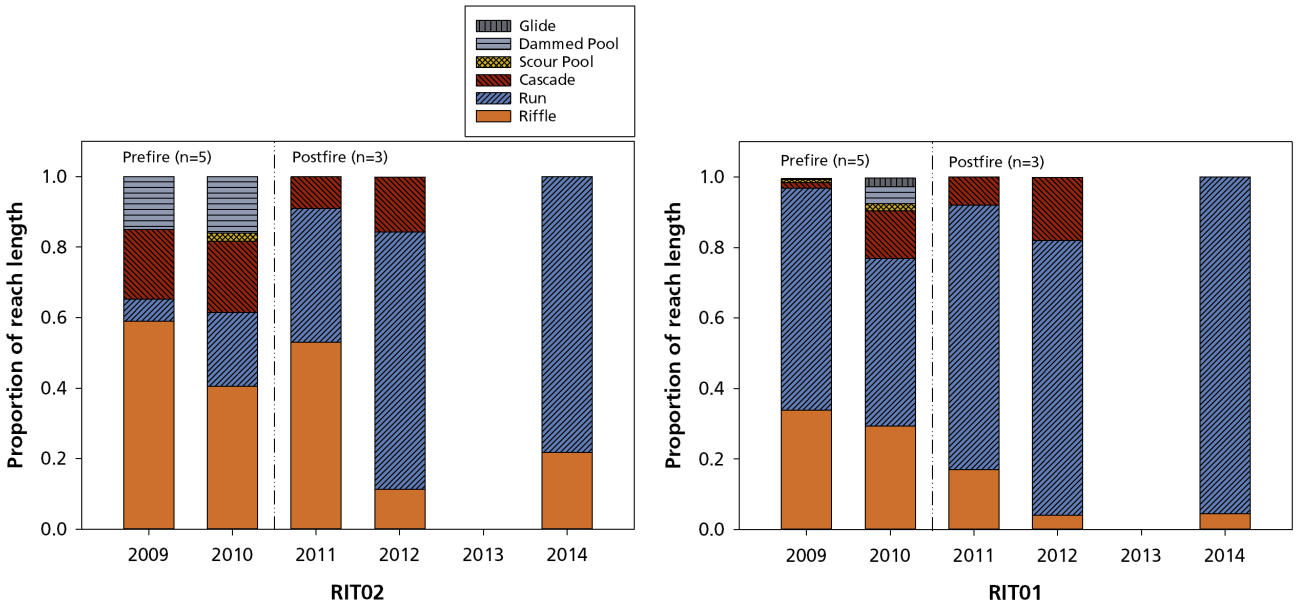

Figure 23. Geomorphic channel unit characterization of RIT02 (left) and RIT01 (right) on the Rito de los Frijoles in Bandelier NM, 2009–2014. No data were collected in 2013.

3.2.3 Hydrologic conditions for the Rito de los Frijoles

3.2.3.1 SCPN water quality core parameter data

We report hydrologic measurements collected at or near midday on 18 October 2014 for RIT02 and 17 October for RIT01 on the Rito de los Frijoles. Data from all years of sampling at the Rito de los Frijoles (2009–2014) are available in Appendix E (Table E4).

In 2014, the midday water temperature was 12.4°C at RIT02 and 11.8°C RIT01. Specific conductance was 147 µS/cm at RIT02, and 334 µS/cm at RIT01. At RIT02, pH was 7.5. Dissolved oxygen at RIT02 was 97.6% saturation and 8.1mg/L. Dissolved oxygen at RIT01 measured 97.3% saturation and 8.5 mg/L. Turbidity at RIT02 averaged 7.5 NTU and 85.5 NTU at RIT01 (Figure 24). In addition to these water quality parameters, we measured total discharge at RIT02 (1.2 cfs) and at RIT01 (0.6 cfs).

Temperature loggers were deployed at RIT01 to collect continuous stream and air temperature at the site through 2014. The maximum air temperature of 38.5°C occurred on 30 June 2014 (Figure 25). The minimum air temperature of -14.0°C occurred on 24 January 2014. The minimum water temperature was 0.01°C and occurred on 21 February 2014 (Figure 25). The maximum water temperature of 38.5 occurred on 30 June 2014 . Daily average and maximum temperature regularly exceeded the acute and chronic (dotted line) state water quality standards for aquatic biota between May and September of 2014.

3.2.3.2 USGS streamflow data

Streamflow data for 2014 from the gage maintained by USGS on the Rito de los Frijoles near the Bandelier NM Visitor Center (USGS 2013) are presented in Figure 26. The period of record for 2014 begins in May, and data is spotty and interrupted periodically throughout the year. The largest recorded event occurred on 19 July, with an estimated peak of 1040 cfs.

3.2.3.3 USGS precipitation data

Data from the early warning system weather stations Ponderosa C.G. (#31507) and Dome Road (#31508) (OneRain 2014) are shown in Figures 27 and 28. The pattern of rainfall events is similar at both stations.

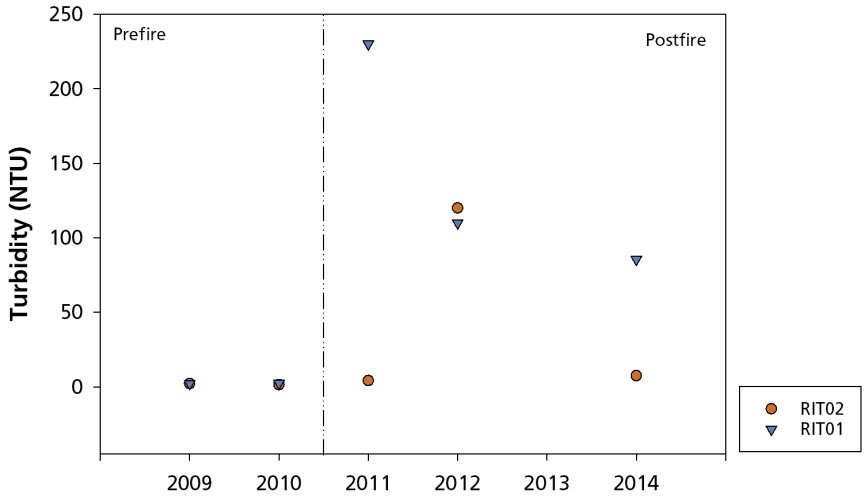

Figure 24. Turbidity at RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM, 2014. No data were collected in 2013.

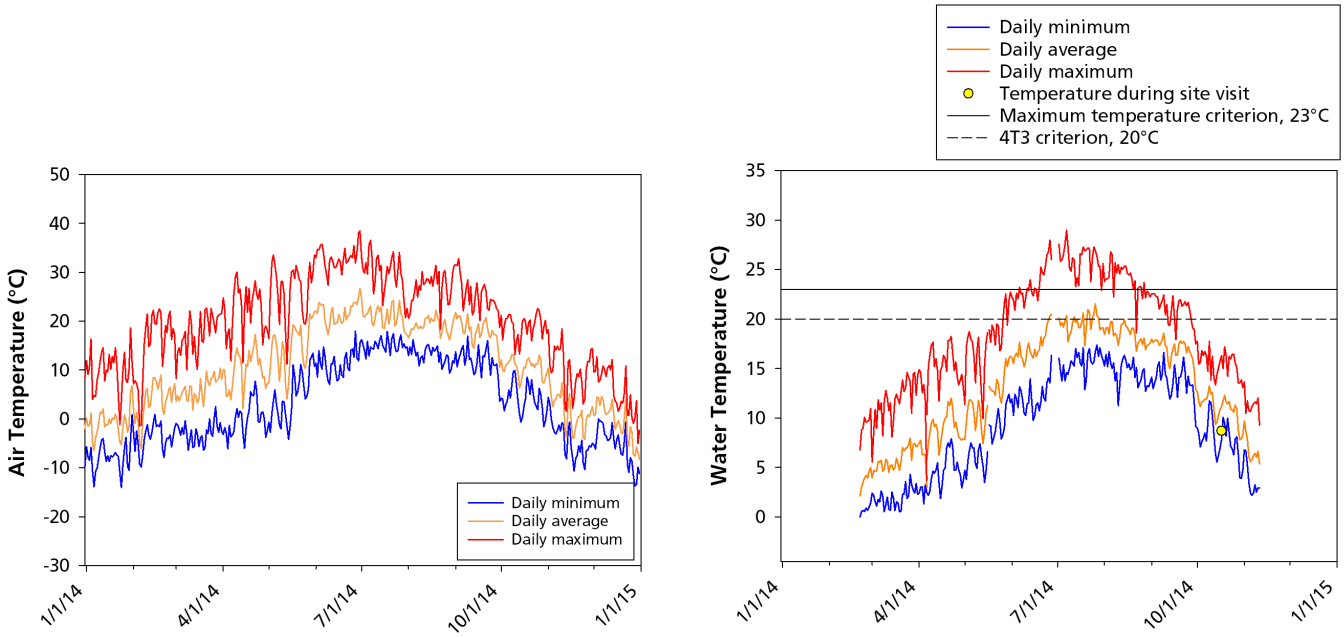

Figure 25. Daily air temperature statistics (left) and daily water temperature statistics (right) from RIT01 at the Rito de los Frijoles in BAND, 2014. Water quality standards for New Mexico are represented with a solid line for acute standards and a dotted line for chronic standards.

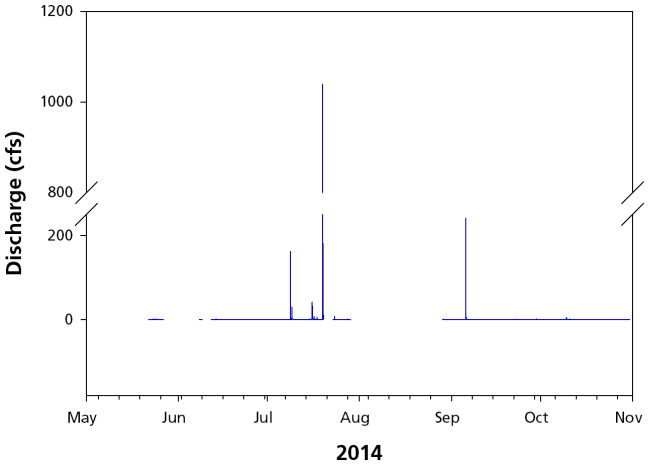

Figure 26. Discharge from the streamflow gage USGS 08313350 on the Rito de los Frijoles near the Bandelier Visitor Center in 2014.

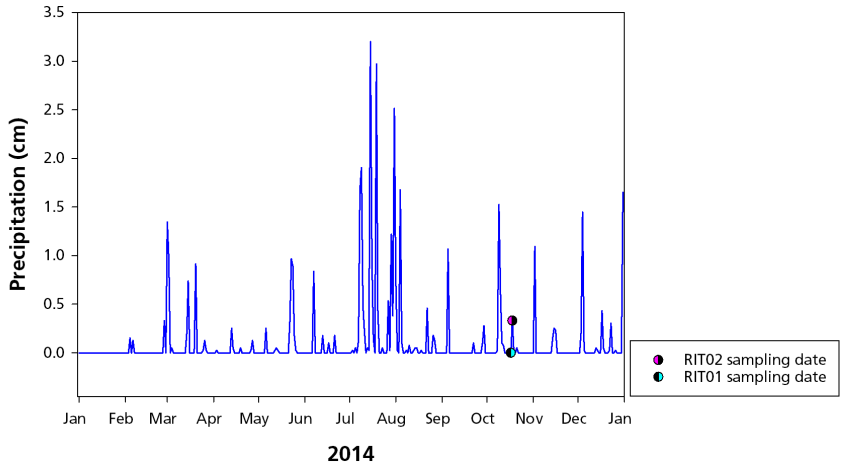

Figure 27. Total daily precipitation from the Ponderosa C.G. USGS rain gage (#31057) in Bandelier NM, 2014.

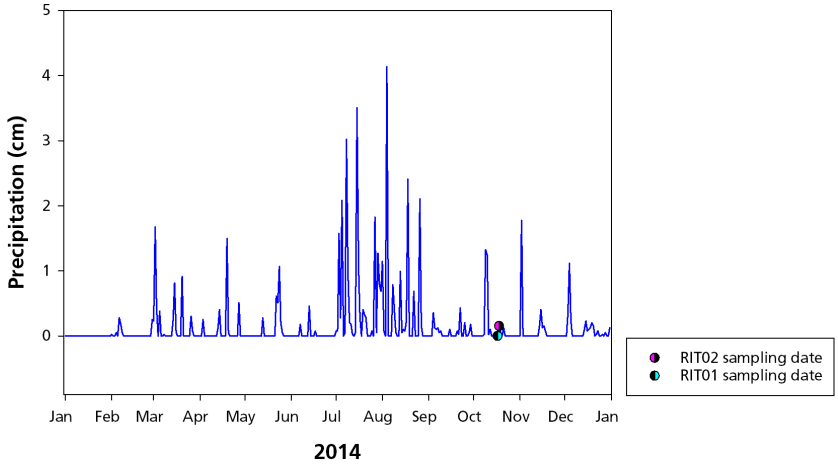

Figure 28. Total daily precipitation from the Dome Road USGS rain gage (#31058) in Bandelier NM, 2014.

Much like the weather station in the Capulin watershed, these data show the majority of measurable events occurred during the mid-summer months (July-September), typical of the North American monsoon pattern, and a large post-monsoon rainfall event in mid-October.

4 Discussion

This report presents data from SCPN's seventh year of monitoring aquatic macroinvertebrates and physical habitat at Capulin Creek, as well as data from our fifth 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 an ecologically significant trend, as trends cannot be determined with confidence by a few years of sampling data.

Differences may be attributed to multiple factors, including ecological variability, sampling error, and 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.

The effects of the Las Conchas Fire and subsequent flood events continue to impact the physical habitat, water quality, and aquatic macroinvertebrate communities in Capulin Creek and Rito de los Frijoles. In 2014 we were unable to collect any quantitative samples from Capulin Creek due to large volumes of fine sediments moving through the stream channel and loss of appropriate riffle habitat. Similar conditions were present at Rito de los Frijoles—riffles, while present, were in low abundance there in 2014, limiting us to 3 quantitative samples from each of the 2 monitoring sites. Both streams are geomorphically unstable and in a state of transition. Postfire flood events have scoured away much of the habitat required by the aquatic community. Habitat complexity is lacking across all of our monitoring sites, and habitats required by aquatic macroinvertebrates, including riffles, woody debris, leaf packs, root wad, algal mats, and vegetation all occurred in low abundances.

The lack of habitat heterogeneity and the increased turbidity and water temperatures since the Las Conchas fire across our monitoring sites have altered the aquatic macroinvertebrate communities at BAND. Diptera continue to dominate qualitative samples from Capulin Creek. A slight recovery in sensitive Ephemeropteras has occurred at sites on the Rito de los Frijoles, particularly at the upper site.

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 in this report are provisional and are subject to change. When sufficient data are available, SCPN plans to produce an interpretive report including trend analysis of aquatic macroinvertebrate metrics and physical habitat data for both Capulin Creek and the Rito de los Frijoles.

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Appendix A: Southern Colorado Plateau Network aquatic macroinvertebrate monitoring sites in Bandelier National Monument, New Mexico, 2014

Table A1. SCPN aquatic macroinvertebrate sites on Capulin Creek and the Rito de los Frijoles in Bandelier NM, 2014. Sites are listed in upstream to downstream order for each stream.

Site code	Common name	Report name	UTM Easting	UTM Northing	Elevation (m)
BANDCAP01	Capulin Creek at Base Camp Gaging Station	CAP01	379713	3958026	1904
BANDCAP02	Capulin Creek above Painted Cave	CAP02	380300	3955457	1791
BANDRIT02	Rito de los Frijoles at Upper Crossing	RIT02	377109	3964316	2151
BANDRIT01	Rito de los Frijoles near Visitor Center	RIT01	385363	3959889	1840

Note: Horizontal coordinates are reported in Universal Transverse Mercator (UTM) Projection, Zone 13, North American Datum of 1983 (NAD 83). Vertical (elevation) coordinates are referenced to the North American Vertical Datum of 1988 (NAVD 88).

Appendix B: Selected aquatic macroinvertebrate metrics

Table B1. List of selected aquatic macroinvertebrate metrics and their definitions.

Metric type	Metric	Definition
Abundance/Richness/ Diversity	Total abundance	Total number of individuals.
	Taxa richness	Total number of taxa (measures the overall variety of aquatic macroinvertebrates in a sample).
	Simpson's diversity	A measure of the variety of taxa that takes into account the relative abundance of each taxon. $D = \sum(n_i(n_i -1)/N(N-1))$
Tolerance	Dominant taxa	Measures the dominance of the most abundant taxa. Typically calculated as dominant 2, 3, 4, or 5 taxa.
	Relative abundance tolerant taxa	Percent of individuals considered to be sensitive to perturbation.
	Percent richness of tolerant taxa	Percent of taxa considered to be sensitive 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 fine substrates).
	Percent richness burrowers	Percent of taxa that move between substrate particles (typically fine 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.
	Hydroptilidae+ Hydropsychidae/Trichoptera	Percent of trichopteran individuals in Hydroptilidae plus Hydropsychidae (ratio of tolerant caddisfly abundance to total caddisfly abundance).
	Relative abundance noninsect taxa	Percent of individuals that are not insects.
	Relative abundance Chironomidae	Percent of individuals that are midges.

Source: Data from Brasher et al. (2011)

Appendix C: Aquatic macroinvertebrate species list from aquatic macroinvertebrate monitoring sites on Capulin Creek and Rito de los Frijoles in Bandelier National Monument, New Mexico, 2014

Table C1. List of aquatic macroinvertebrate species found in qualitative samples taken from monitoring sites CAP01 and CAP02 on Capulin Creek, and RIT02 and RIT01 on the Rito de los Frijoles in Bandelier National Monument in 2014. Sites are listed in upstream to downstream order.

Class	Order	Family	SubFamily	Genus	Species	Common name	Functional group[a]	Tolerance group[b]	CAP01	CAP02	RIT02	RIT01
Arachnida	Trombidiformes	Hydryphantidae		*Protzia* sp.		water mites	P	T				x
Arachnida	Trombidiformes	Sperchonidae		*Sperchon* sp.		water mites	P	T		x	x	
Arachnida	Trombidiformes					water mites	n/a	n/a				x
Entognatha	Collembola					springtails	P	T			***New***[c]	***New***
Insecta	Coleoptera	Dytiscidae	Agabinae	*Agabus* sp.		predaceous diving beetles	P	T		x	***New***	
Insecta	Coleoptera	Dytiscidae	Colymbetinae	*Rhantus* sp.		predaceous diving beetles	P	M				***New***
Insecta	Coleoptera	Dytiscidae	Laccophilinae	*Laccophilus* sp.		predaceous diving beetles	P	M				***New***
Insecta	Coleoptera	Dytiscidae				predaceous diving beetles	P	M			***New***	x
Insecta	Coleoptera	Dryopidae		*Helichus* sp.		long-toed water beetles	P	M				x
Insecta	Coleoptera	Elmidae		*Zaitzevia* sp.		riffle beetles	C-G	I				x
Insecta	Diptera	Dolichopodidae				longlegged flies	P	M	x	x		
Insecta	Diptera	Empididae	Hemerodromiinae	*Hemerodromia* sp.		dance flies	C-G	M				***New***
Insecta	Diptera	Empididae		*Neoplasta* sp.		dance flies	P	M	x			
Insecta	Diptera	Empididae		*Wiedemannia* sp.		dance flies	P	M		x		
Insecta	Diptera	Muscidae				house flies	P	M	x	x	x	x
Insecta	Diptera	Stratiomyidae		*Caloparyphus* sp.		solider flies	C-G	M				x

[a]Functional group abbreviations: C-G = collector-gatherer, C-F = collector-filterer, P = predator, Sc = scraper, Sh = shredder.

[b]Tolerance group abbreviations: T = tolerant, M = moderately tolerant, I = intolerant.

[c]"*New*" under the site column denotes a new record for this SCPN monitoring site.

Table C1 (*continued*) List of aquatic macroinvertebrate species found in qualitative samples taken from monitoring sites CAP01 and CAP02 on Capulin Creek, and RIT02 and RIT01 on the Rito de los Frijoles in Bandelier National Monument in 2014. Sites are listed in upstream to downstream order.

Class	Order	Family	SubFamily	Genus	Species	Common name	Functional group[a]	Tolerance group[b]	CAP01	CAP02	RIT02	RIT01
Insecta	Diptera	Tabanidae		*Tabanus* sp.		horse flies	P	M				*New*
Insecta	Diptera	Ceratopogonidae	Ceratopogoninae	*Ceratopogon* sp.		biting midges	P	M	x	*New*	*New*	*New*
Insecta	Diptera	Ceratopogonidae	Ceratopogoninae	*Probezzia* sp.		biting midges	P	M	x			
Insecta	Diptera	Ceratopogonidae	Forcipomyiinae			biting midges	P	M			*New*	
Insecta	Diptera	Ceratopogonidae				biting midges	P	M	x	x	x	x
Insecta	Diptera	Chironomidae	Chironominae			midges	C-G	M		x	x	x
Insecta	Diptera	Chironomidae	Orthocladiinae			midges	C-G	M	x	x	x	x
Insecta	Diptera	Chironomidae	Tanypodinae			midges	P	T	x		x	x
Insecta	Diptera	Chironomidae				midges	C-G	M	x		x	x
Insecta	Diptera	Dixidae		*Dixa* sp.		meniscus midges	C-Gr	I				x
Insecta	Diptera	Dixidae		*Dixella* sp.		meniscus midges	C-G	n/a		*New*		
Insecta	Diptera	Psychodidae		*Pericoma* sp.		moth flies	C-G	M				x
Insecta	Diptera	Simuliidae	Simuliinae	*Simulium* sp.		black flies	C-F	M	x	x	x	x
Insecta	Diptera	Simuliidae				black flies	C-F	M			x	x
Insecta	Diptera	Tipulidae	Tipulinae	*Tipula* sp.		crane flies	Sh	M			x	
Insecta	Diptera	Tipulidae				crane flies	Sh	I			x	x
Insecta	Diptera					flies	n/a	M	x			x
Insecta	Ephemeroptera	Leptohyphidae		*Tricorythodes* sp.		little snout crawler mayflies	C-G	M		x		x
Insecta	Ephemeroptera	Baetidae		*Acentrella* sp.		small minnow mayflies	C-G	I	x	x		x
Insecta	Ephemeroptera	Baetidae		*Baetis* sp.		small minnow mayflies	C-G	M	x	x	x	x
Insecta	Ephemeroptera	Baetidae		*Callibaetis* sp.		small minnow mayflies	C-G	T	*New*		*New*	*New*

[a]Functional group abbreviations: C-G = collector-gatherer, C-F = collector-filterer, P = predator, Sc = scraper, Sh = shredder.

[b]Tolerance group abbreviations: T = tolerant, M = moderately tolerant, I = intolerant.

[c]"*New*" under the site column denotes a new record for this SCPN monitoring site.

Table C1 (*continued*) List of aquatic macroinvertebrate species found in qualitative samples taken from monitoring sites CAP01 and CAP02 on Capulin Creek, and RIT02 and RIT01 on the Rito de los Frijoles in Bandelier National Monument in 2014. Sites are listed in upstream to downstream order.

Class	Order	Family	SubFamily	Genus	Species	Common name	Functional group[a]	Tolerance group[b]	CAP01	CAP02	RIT02	RIT01
Insecta	Ephemeroptera	Baetidae		*Fallceon*	*quilleri*	small minnow mayflies	C-G	n/a				x
Insecta	Ephemeroptera	Baetidae		*Fallceon* sp.		small minnow mayflies	C-G	n/a		*New*		
Insecta	Ephemeroptera	Baetidae				small minnow mayflies	C-G	I		x		
Insecta	Hemiptera	Corixidae	Corixinae	*Sigara* sp.		water boatmen	P	T				*New*
Insecta	Hemiptera	Corixidae	Corixinae	*Trichocorixa* sp.		water boatmen	P	M				*New*
Insecta	Hemiptera	Corixidae				water boatmen	P	T		*New*		*New*
Insecta	Hemiptera	Saldidae	Saldinae	*Saldula* sp.		shore bugs	P	T	*New*	*New*		*New*
Insecta	Hemiptera	Veliidae	Microveliinae	*Microvelia* sp.		small water striders	P	M		x		
Insecta	Odonata	Aeshnidae				darners	P	I				x
Insecta	Plecoptera	Capniidae	Capniinae			small winter stoneflies	Sh	I			x	x
Insecta	Trichoptera	Limnephilidae				northern caddisflies	Sh	I				x
Insecta	Trichoptera					caddisflies	n/a	n/a			x	

[a]Functional group abbreviations: C-G = collector-gatherer, C-F = collector-filterer, P = predator, Sc = scraper, Sh = shredder.

[b]Tolerance group abbreviations: T = tolerant, M = moderately tolerant, I = intolerant.

[c]"*New*" under the site column denotes a new record for this SCPN monitoring site.

Appendix D: Aquatic macroinvertebrate community and physical habitat data, stream velocity, and channel characteristics for aquatic macroinvertebrate monitoring sites on Capulin Creek in Bandelier National Monument, New Mexico, 2007–2014

Table D1. Qualitative aquatic macroinvertebrate community metrics from CAP01 and CAP02 on Capulin Creek in Bandelier NM. Richness-based metrics are expressed as the percentage of taxa in a given order, tolerance or functional feeding group. Site ordering from left to right in the table corresponds to upstream to downstream position. No data were collected in 2013 due to the U.S. federal government shutdown.

Qualitative metric:	CAP01							CAP02						
Taxa richness	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2014**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2014**
Tolerance group														
Richness of tolerant taxa (%)	9.30	7.41	15.00	6.67	21.43	22.22	23.08	11.54	25.81	26.09	4.76	14.29	16.67	18.75
Richness of moderately tolerant taxa (%)	23.26	25.93	30.00	36.67	50.00	66.67	69.23	42.31	25.81	56.52	52.38	57.14	83.33	62.50
Richness of intolerant taxa (%)	67.44	66.67	55.00	56.67	28.57	11.11	7.69	46.15	48.39	17.39	42.86	28.57	0.00	18.75
Functional group														
Richness of collector-filterers (%)	11.63	10.34	9.76	9.68	7.14	9.09	7.69	15.38	6.45	8.33	9.09	14.29	7.69	5.88
Richness of collector-gatherers (%)	32.56	27.59	31.71	38.71	50.00	45.45	30.77	30.77	22.58	37.50	27.27	28.57	53.85	41.18
Richness of scrapers (%)	9.30	6.90	12.20	9.68	7.14	9.09	7.69	3.85	6.45	4.17	4.55	0.00	0.00	0.00
Richness of shredders (%)	13.95	17.24	14.63	9.68	14.29	9.09	0.00	11.54	16.13	12.50	18.18	28.57	0.00	0.00
Richness of predators (%)	32.56	37.93	31.71	32.26	21.43	27.27	53.85	38.46	45.16	33.33	40.91	28.57	38.46	52.94
Taxonomic group														
Number of EPT taxa	19	14	15	13	2	3	4	8	10	4	6	1	2	4
Richness of EPT taxa (%)	44.19	46.67	35.71	39.39	12.50	27.27	30.77	29.63	31.25	16.00	26.09	14.29	14.29	23.53
Richness of Ephemeroptera (%)	16.28	16.67	9.52	12.12	6.25	9.09	23.08	7.41	9.38	8.00	4.35	0.00	14.29	23.53
Richness of Plecoptera (%)	9.30	10.00	9.52	12.12	6.25	9.09	0.00	7.41	12.50	4.00	8.70	14.29	0.00	0.00
Richness of Trichoptera (%)	18.60	20.00	16.67	15.15	0.00	9.09	7.69	14.81	9.38	4.00	13.04	0.00	0.00	0.00
Richness of noninsect taxa (%)	6.98[a]	3.33	11.90	9.09	18.75	18.18	7.70	7.67	6.25	20.00	13.04	0.00	21.43	23.54
Richness of Chironomidae Diptera (%)	6.98	10.00	7.14	9.09	18.75	18.18	15.38	11.11	9.38	12.00	13.04	42.86	14.29	11.76
Richness of non-Chironomidae Diptera (%)	18.60	20.00	26.19	27.27	43.75	27.27	46.15	25.93	37.50	32.00	30.43	42.86	35.71	35.29
Richness of Coleoptera (%)	16.28	10.00	11.90	12.12	6.25	9.09	0.00	18.52	12.50	20.00	13.04	0.00	7.14	5.88
Richness of Odonata (%)	6.98	10.00	7.14	3.03	0.00	0.00	0.00	7.41	3.12	0.00	4.35	0.00	7.14	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 D2. Physical habitat and hydrologic data from CAP01 on Capulin Creek in Bandelier NM. Particle embeddedness and canopy closure measurements are expressed as percentages. Data were not collected in 2013 due to the U.S. federal government shutdown. "nd" indicates that no data were collected. SD = standard deviation.

	CAP01													
	2007		2008		2009		2010		2011		2012		2014	
Physical habitat metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Microhabitat level (*n* = 5)														
Velocity (m/s)	0.23	0.10	0.35	0.20	0.33	0.17	0.36	0.19	0.38[a]	0.12	nd	nd	nd	nd
Depth (m)	0.07	0.02	0.09	0.02	0.08	0.02	0.08	0.03	0.07[a]	0.03	nd	nd	nd	nd
Embeddedness (%)	14.4	5.1	30.3	12.9	26.3	6.3	39.4	6.5	18.3[a]	16.6	nd	nd	nd	nd
Transect level (*n* = 11)														
Channel dimensions														
Velocity (m/s)	0.07	0.04	0.14	0.06	0.14	0.07	0.10	0.07	0.24	0.11	0.34	0.17	0.18	0.17
Depth (m)	0.07	0.05	0.06	0.05	0.06	0.03	0.06	0.03	0.04	0.02	0.03	0.01	0.03	0.02
Wetted channel width (m)	1.3	0.4	1.3	0.4	1.4	0.3	1.6	0.4	1.9	1.7	1.5	0.9	3.4	3.5
Active channel width (m)	2.3	0.9	5.5	2.3	9.6	5.1	10.1	4.4	0.0	0.0	0.0	0.0	0.0	0.0
Riparian cover														
Canopy closure (%)	87.4	21.0	91.1	20.8	92.0	11.1	94.7	10.3	0.0	0.0	0.1	0.8	0.0	0.0
Reach level (*n* = 1)														
Water quality														
Temperature (°C)	11.5		11.4		9.7		8.9		13.4		10.1		14.5	
Specific conductance (µS/cm)	nd		151		146		145		212		193		nd	
pH	nd		8.0		8.0		7.9		8.2		8.3		8.0	
Dissolved oxygen (% saturation)	nd		96.6		95.9		96.7		98.5		99.1		98.6	
Dissolved oxygen (mg/L)	nd		10.5		8.4		8.9		8.2		9.0		8.0	
Turbidity (NTU)	nd		0.5		1.2		0.9		7.5		47.0		9.8	
Discharge (cfs)	nd		nd		nd		0.4		0.6		0.3		0.5	

a Based on 3 riffles instead of the standard 5 riffles.

b Active channel and canopy closure could not be measured because of lack of riparian vegetation due to the Los Conchas Fire.

Table D3. Physical habitat and hydrologic data from CAP02 on Capulin Creek in Bandelier NM. Particle embeddedness and canopy closure measurements are expressed as percentages. Data were not collected in 2013 due to the U.S. federal government shutdown. "nd" indicates that no data were collected. SD = standard deviation.

	CAP02													
	2007		2008		2009		2010		2011		2012		2014	
Physical habitat metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Microhabitat level (*n* = 5)														
Velocity (m/s)	0.19	0.23	0.21	0.14	0.22	0.12	0.22	0.09	nd	nd	nd	nd	nd	nd
Depth (m)	0.06	0.03	0.05	0.02	0.07	0.01	0.06	0.02	nd	nd	nd	nd	nd	nd
Embeddedness (%)	9.2	6.1	29.5	10.6	29.4	11.4	21.2	8.4	nd	nd	nd	nd	nd	nd
Transect level (*n* = 11)														
Channel dimensions														
Velocity (m/s)	0.05	0.04	0.02	0.02	0.08	0.07	0.07	0.04	0.19	0.13	0.24	0.18	0.17	0.10
Depth (m)	0.06	0.03	0.07	0.05	0.04	0.05	0.06	0.04	0.02	0.01	0.02	0.01	0.02	0.01
Wetted channel width (m)	1.2	0.4	0.9	0.4	3.9	3.5	2.1	3.3	2.9	1.6	2.4	1.6	1.6	0.9
Active channel width (m)	1.7	0.4	4.2	1.9	13.6	6.8	12.5	6.0	0.0	0.0	0.0	0.0	nd	nd
Riparian cover														
Canopy closure (%)	70.6	15.2	97.9	7.0	96.3	6.2	98.6	3.5	0.2	1.0	0.1	0.8	0.0	0.0
Reach level (*n* = 1)														
Water quality														
Temperature (°C)	11.4		11.2		10.6		9.2		14.6		14.0		23.4	
Specific conductance (µS/cm)	nd		165		172		157		155		134		263	
pH	nd		7.8		7.8		7.7		8.3		8.3		8.2	
Dissolved oxygen (% saturation)	nd		96.4		97.1		95.1		99.8		95.9		96.2	
Dissolved oxygen (mg/L)	nd		10.6		8.4		8.7		8.2		8.0		6.6	
Turbidity (NTU)	nd		1.9		2.6		1.2		75.9		213.3		30.0	
Discharge (cfs)	nd		nd		nd		0.1		0.4		0.4		0.2	

a Based on 3 riffles instead of the standard 5 riffles.

b Active channel and canopy closure could not be measured because of lack of riparian vegetation due to the Los Conchas Fire.

Table D4. Stream velocity and channel characteristics of aquatic macroinvertebrate sites CAP01 and CAP02 on Capulin Creek in Bandelier NM, 2014. SD = standard deviation.

Transect	Depth (m) (*n* = 5) Mean	Depth (m) (*n* = 5) SD	Velocity (m/s) (*n* = 5) Mean	Velocity (m/s) (*n* = 5) SD	Wetted channel width (m)	Active channel width (m)
CAP01						
1	0.06	0.02	0.05	0.01	0.67	0.0
2	0.00	0.00	0.00	0.00	6.48	0.0
3	0.00	0.01	0.00	0.00	6.07	0.0
4	0.03	0.03	0.29	0.22	1.25	0.0
5	0.01	0.01	0.18	0.20	2.90	0.0
6	0.04	0.01	0.44	0.20	1.13	0.0
7	0.01	0.02	0.06	0.14	2.99	0.0
8	0.03	0.03	0.19	0.18	1.98	0.0
9	0.00	0.00	0.00	0.00	11.80	0.0
10	0.05	0.01	0.42	0.16	0.79	0.0
11	0.06	0.02	0.33	0.22	0.79	0.0
CAP02						
1	0.03	0.01	0.22	0.21	0.88	0.0
2	0.02	0.01	0.33	0.14	0.79	0.0
3	0.01	0.01	0.19	0.14	1.39	0.0
4	0.01	0.01	0.07	0.08	2.29	0.0
5	0.00	0.00	0.07	0.15	2.68	0.0
6	0.02	0.01	0.34	0.16	2.68	0.0
7	0.03	0.02	0.18	0.13	0.46	0.0
8	0.03	0.01	0.19	0.12	0.91	0.0
9	0.00	0.00	0.03	0.07	2.90	0.0
10	0.03	0.02	0.12	0.14	0.49	0.0
11	0.02	0.02	0.09	0.16	1.71	0.0

Appendix E: Aquatic macroinvertebrate community and physical habitat data and stream velocity and channel characteristics for aquatic macroinvertebrate monitoring sites on the Rito de los Frijoles in Bandelier National Monument, New Mexico, 2009–2014

Table E1. Quantitative aquatic macroinvertebrate community metrics from RIT02 on the Rito de los Frijoles in Bandelier NM, 2009–2014. For a given order, tolerance or functional feeding group, abundance-based metrics are expressed as the total number of individuals in the group, while richness-based metrics for all years are expressed as the percentage of taxa in the group. No data were collected in 2013 due to the U.S. federal government shutdown. For 2009-2011 n=5; for 2012 and 2014, n=3. SD = standard deviation.

	2009		2010		2011		2012		2014	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total abundance	700.90	134.75	760.60	80.43	15.80	6.22	2.33	2.52	56.00	30.33
Total richness	28.40	3.29	30.00	2.92	3.60	1.82	2.00	2.65	6.00	3.46
Simpson's Diversity—taxonomic	0.89	0.02	0.89	0.01	0.40	0.26	0.33	0.58	0.57	0.13
Simpson's Diversity—functional group	0.65	0.04	0.67	0.01	0.08	0.12	0.60	0.53	0.47	0.09
Dominant taxa	20.16	3.93	23.25	3.11	72.30	21.46	40.00	52.92	55.93	13.81
Tolerance group										
Total abundance of tolerant taxa	1.42	2.09	2.10	3.13	0.41	0.57	0.00	0.00	1.00	1.00
Total abundance of moderately tolerant taxa	222.59	89.09	244.51	45.43	15.19	5.89	2.00	2.00	54.33	17.62
Total abundance of intolerant taxa	459.89	51.45	505.89	71.41	0.00	0.00	0.33	0.58	0.33	0.58
Richness of tolerant taxa (%)	2.87	2.88	2.97	3.11	10.00	13.69	0.00	0.00	13.10	12.54
Richness of moderately tolerant taxa (%)	24.43	3.22	26.11	2.32	90.00	13.69	60.00	52.92	82.74	18.93
Richness of intolerant taxa (%)	72.7	5.44	70.92	2.65	0.00	0.00	6.67	11.55	4.17	7.22
Functional group										
Total abundance of collector-filterers	156.26	91.35	138.81	17.69	0.20	0.45	0.33	0.58	17.67	13.32
Total abundance of collector-gatherers	333.01	60.02	363.22	36.71	14.79	5.63	1.33	1.15	34.67	7.09
Total abundance of scrapers	161.64	19.73	183.82	57.69	0.00	0.00	0.00	0.00	0.67	1.15
Total abundance of shredders	8.09	6.09	26.20	13.69	0.00	0.00	0.00	0.00	0.33	0.58
Total abundance of predators	41.49	5.71	47.04	12.70	0.61	0.92	0.67	1.15	2.33	2.08
Richness of collector-filterers (%)	14.35	3.21	14.39	0.89	4.00	8.94	6.67	11.55	25.60	21.15
Richness of collector-gatherers (%)	38.53	2.95	36.31	5.44	82.00	24.90	46.67	50.33	43.45	6.27
Richness of scrapers (%)	18.71	3.16	14.43	1.46	0.00	0.00	0.00	0.00	4.76	8.25
Richness of shredders (%)	4.84	1.29	10.21	1.79	0.00	0.00	0.00	0.00	4.17	7.22
Richness of predators (%)	23.57	6.32	24.65	4.63	14.00	21.91	13.33	23.09	22.02	19.59
Taxonomic group										
Number of EPT taxa	14.4	1.52	15.80	0.84	0.00	0.00	0.67	1.15	1.67	0.58
Total abundance of EPT taxa	281.8	44.32	385.40	51.55	0.00	0.00	0.67	1.15	30.33	3.51
Total abundance of Ephemeroptera	170.8	23.75	228.40	26.97	0.00	0.00	0.33	0.58	29.67	2.52
Total abundance of Plecoptera	31.8	3.96	45.40	17.62	0.00	0.00	0.33	0.58	0.00	0.00
Total abundance of Trichoptera	79.2	30.33	111.60	13.69	0.00	0.00	0.00	0.00	0.67	1.15
Total abundance of noninsect taxa	299.5	256.57	143.60	59.37	0.20	0.45	0.00	0.00	0.67	1.15
Total abundance of Chironomidae Diptera	43.8	19.20	70.20	47.10	14.00	5.10	1.00	1.00	5.00	6.24
Total abundance of non-Chironomidae Diptera	19.8	9.34	22.00	9.92	1.40	1.52	0.67	1.15	19.00	13.00

Table E1. (continued) Quantitative aquatic macroinvertebrate community metrics from RIT02 on the Rito de los Frijoles in Bandelier NM, 2009–2014.

	2009		2010		2011		2012		2014	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total abundance of Coleoptera	243.4	40.72	228.60	76.60	0.20	0.45	0.00	0.00	1.00	1.00
Total abundance of Odonata	0.2	0.45	0.40	0.55	0.00	0.00	0.00	0.00	0.00	0.00

Table E2. Quantitative aquatic macroinvertebrate community metrics from RIT01 on the Rito de los Frijoles in Bandelier NM, 2009–2014. For a given order, tolerance or functional feeding group, abundance-based metrics are expressed as the total number of individuals in the group, while richness-based metrics for all years are expressed as the percentage of taxa in the group. No data were collected in 2013 due to the U.S. federal government shutdown. SD = standard deviation.

	2009 (*n* = 5)		2010 (*n* = 5)		2011 (*n* = 5)		2012 (*n* = 3)		2014 (*n*=3)	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total abundance	688.00	172.57	697.60	91.52	25.33	5.51	9.67	8.14	111.33	49.17
Total richness	27.00	2.74	28.40	5.41	4.67	1.53	3.00	0.00	12.33	2.52
Simpson's Diversity—taxonomic	0.86	0.02	0.83	0.04	0.51	0.08	0.69	0.15	0.76	0.03
Simpson's Diversity—functional group	0.72	0.02	0.72	0.01	0.30	0.15	0.40	0.57	0.64	0.04
Dominant taxa	26.42	4.22	31.65	7.42	69.06	6.12	54.39	7.60	36.71	3.48
Tolerance group										
Total abundance of tolerant taxa	0.83	0.85	0.87	0.87	0.00	0.00	0.00	0.00	3.79	3.10
Total abundance of moderately tolerant taxa	169.93	42.69	199.89	73.65	20.31	5.55	7.67	8.96	101.63	44.84
Total abundance of intolerant taxa	508.84	142.55	490.31	106.19	3.02	1.71	1.67	1.53	5.58	2.51
Richness of tolerant taxa (%)	2.33	2.15	3.20	3.35	0.00	0.00	0.00	0.00	13.25	7.13
Richness of moderately tolerant taxa (%)	30.01	4.85	27.58	4.40	58.89	8.39	77.78	19.25	61.27	4.89
Richness of intolerant taxa (%)	67.66	5.27	69.23	4.43	41.11	8.39	22.22	19.25	25.48	4.31
Functional group										
Total abundance of collector-filterers	116.30	29.55	182.37	19.78	0.71	1.24	2.56	2.99	37.63	16.87
Total abundance of collector-gatherers	199.82	57.16	185.33	43.59	19.60	6.79	5.44	6.55	54.36	28.53
Total abundance of scrapers	259.76	101.16	251.60	60.55	0.00	0.00	0.00	0.00	0.00	0.00
Total abundance of shredders	75.30	49.13	40.20	14.59	2.69	2.07	1.67	1.53	2.48	1.73
Total abundance of predators	36.63	27.22	37.39	17.27	0.33	0.58	0.00	0.00	16.86	4.89
Richness of collector-filterers (%)	11.29	1.20	13.46	3.68	8.33	14.43	33.33	0.00	8.33	1.67
Richness of collector-gatherers (%)	29.27	4.30	30.47	2.38	50.56	22.38	44.44	19.25	45.56	5.09
Richness of scrapers (%)	15.90	4.89	12.48	1.95	0.00	0.00	0.00	0.00	0.00	0.00
Richness of shredders (%)	14.67	4.66	15.99	3.53	34.44	15.03	22.22	19.25	13.89	5.85
Richness of predators (%)	28.86	4.84	27.59	6.60	6.67	11.55	0.00	0.00	32.22	1.92
Taxonomic group										
Number of EPT taxa	11.80	1.64	15.00	2.45	1.00	0.00	0.67	0.58	2.67	0.58
Total abundance of EPT taxa	297.00	62.86	325.40	31.26	2.33	2.31	1.67	1.53	9.00	5.20
Total abundance of Ephemeroptera	99.00	41.88	138.80	26.68	0.00	0.00	0.00	0.00	7.67	4.62
Total abundance of Plecoptera	91.60	42.94	42.60	14.54	2.00	2.65	1.67	1.53	1.00	1.00
Total abundance of Trichoptera	106.40	19.45	144.00	37.84	0.33	0.58	0.00	0.00	0.33	0.58

Table E2. (continued) Quantitative aquatic macroinvertebrate community metrics from RIT01 on the Rito de los Frijoles in Bandelier NM, 2009–2014.

	2009 (*n* = 5)		2010 (*n* = 5)		2011 (*n* = 5)		2012 (*n* = 3)		2014 (*n*=3)	
Quantitative metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Total abundance of noninsect taxa	1.60	1.60	9.20	8.67	2.00	1.73	0.33	0.58	7.00	2.65
Total abundance of Chironomidae Diptera	74.80	35.84	28.40	17.20	19.25	6.54	5.11	5.98	42.77	21.17
Total abundance of non-Chironomidae Diptera	34.60	22.90	98.00	27.30	1.42	1.64	2.56	2.99	50.56	24.22
Total abundance of Coleoptera	267.40	87.81	237.00	68.98	0.00	0.00	0.00	0.00	2.00	3.46
Total abundance of Odonata	3.60	6.94	0.60	0.89	0.33	0.58	0.00	0.00	0.00	0.00

Table E3. Qualitative aquatic macroinvertebrate community metrics from RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM. Richness-based metrics are expressed as the percentage of taxa in a given order, tolerance or functional feeding group. Site ordering from left to right in the table corresponds to upstream to downstream position. No data were collected in 2013 due to the U.S. federal government shutdown.

	RIT02					RIT01				
Qualitative metric	**2009**	**2010**	**2011**	**2012**	**2014**	**2009**	**2010**	**2011**	**2012**	**2014**
Taxa richness	37	38	6	5	14	38	39	13	4	23
Tolerance group										
Richness of tolerant taxa (%)	11.76	5.71	20.00	20.00	30.77	10.81	13.16	9.09	0.00	18.18
Richness of moderately tolerant taxa (%)	32.35	25.71	60.00	60.00	61.54	35.14	42.11	45.45	66.67	54.55
Richness of intolerant taxa (%)	55.88	68.57	20.00	20.00	7.69	54.05	44.74	45.45	33.33	27.27
Functional group										
Richness of collector-filterers (%)	10.81	10.81	0.00	20.00	7.14	10.53	10.53	9.09	0.00	4.55
Richness of collector-gatherers (%)	29.73	35.14	60.00	20.00	42.86	26.32	28.95	45.45	75.00	45.45
Richness of scrapers (%)	8.11	13.51	0.00	0.00	0.00	10.53	2.63	9.09	0.00	0.00
Richness of shredders (%)	10.81	10.81	20.00	20.00	14.29	18.42	13.16	18.18	25.00	13.64
Richness of predators (%)	40.54	29.73	20.00	40.00	35.71	34.21	44.74	18.18	0.00	36.36
Taxonomic group										
Number of EPT taxa	15	17	0	1	3	15	15	1	2	4
Richness of EPT taxa (%)	40.54	44.74	0.00	20.00	21.43	39.47	38.46	7.69	50.00	17.39
Richness of Ephemeroptera (%)	10.81	13.16	0.00	0.00	14.29	13.16	10.26	0.00	25.00	13.04
Richness of Plecoptera (%)	8.11	13.16	0.00	20.00	7.14	13.16	15.38	7.69	25.00	4.35
Richness of Trichoptera (%)	21.62	18.42	0.00	0.00	0.00	13.16	12.82	0.00	0.00	0.00
Richness of noninsect taxa (%)	13.51	10.53	16.67	0.00	14.29	10.53	7.69	15.38	25.00	17.40
Richness of Chironomidae Diptera (%)	8.11	7.89	33.33	40.00	21.43	7.89	7.69	23.08	25.00	13.04
Richness of non-Chironomidae Diptera (%)	18.92	28.95	50.00	40.00	35.71	26.32	30.77	38.46	0.00	34.78
Richness of Coleoptera (%)	13.51	5.26	0.00	0.00	7.14	13.16	10.26	15.38	0.00	13.04
Richness of Odonata (%)	5.41	2.63	0.00	0.00	0.00	2.63	5.13	0.00	0.00	4.35

Table E4. Physical habitat and hydrologic data from RIT02 on the Rito de los Frijoles in Bandelier National Monument, New Mexico, 2009–2014. Particle embeddedness and canopy closure measurements are expressed as percentages. Site ordering from left to right in the table corresponds to upstream to downstream position. No data were collected in 2013 due to the U.S. federal government shutdown. SD = standard deviation.

	RIT02									
	2009		2010		2011		2012		2014	
Physical habitat metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Microhabitat level (*n* = 5)										
Velocity (m/s)	0.50	0.18	0.40	0.16	0.67	0.29	0.73[a]	0.22	0.73[a]	0.09
Depth (m)	0.12	0.03	0.08	0.02	0.11	0.01	0.08[a]	0.03	0.10[a]	0.01
Embeddedness (%)	30.6	13.8	33.0	16.0	23.2	13.3	6.0[a]	6.0	4.7	6.4
Transect level (*n* = 11)										
Channel dimensions										
Velocity (m/s)	0.20	0.08	0.20	0.05	0.25	0.20	0.36	0.10	0.41	0.17
Depth (m)	0.09	0.05	0.09	0.05	0.04	0.03	0.06	0.02	0.05	0.03
Wetted channel width (m)	2.3	0.6	2.1	0.6	2.8	1.6	1.7	0.6	3.1	6.0
Active channel width (m)	4.2	0.8	5.8	1.4	0.0	0.0	0.0	0.0	nd	nd
Riparian cover										
Canopy closure (%)	73.9	15.0	63.0	17.7	0	0	0.0	0.0	0.00	0.00
Reach level (*n* = 1)										
Water quality										
Temperature (°C)	10.4		5.8		11.4		13.3		12.4	
Specific conductance (µS/cm)	107		108		228		166		147	
pH	8		7.9		8.1		8.1		7.5	
Dissolved oxygen (% saturation)	94.7		98.5		98.8		95.4		97.6	
Dissolved oxygen (mg/L)	8.2		9.6		8.4		7.7		8.1	
Turbidity (NTU)	2.2		1.4		4.2		123.0		7.5	
Discharge (cfs)	1.4		1.2		1.5		1.7		1.2	

[a]Based on 3 riffles instead of the standard 5 riffles.

Table E5. Physical habitat and hydrologic data from RIT01 on the Rito de los Frijoles in Bandelier National Monument, New Mexico, 2009–2014. Particle embeddedness and canopy closure measurements are expressed as percentages. Site ordering from left to right in the table corresponds to upstream to downstream position. No data were collected in 2013 due to the U.S. federal government shutdown. "nd" indicates that no data were collected. SD = standard deviation.

	RIT01									
	2009		2010		2011		2012		2014	
Physical habitat metric	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Microhabitat level (*n* = 5)										
Velocity (m/s)	0.46	0.13	0.39	0.15	0.46[a]	0.11	0.54[a]	0.18	0.57	0.07
Depth (m)	0.12	0.02	0.11	0.02	0.10[a]	0.02	0.11[a]	0.02	0.07	0.02
Embeddedness (%)	50.0	24.4	51.0	20.1	36.7[a]	6.7	20.7[a]	17.5	23.0	18.2
Transect level (*n* = 11)										
Channel dimensions										
Velocity (m/s)	0.23	0.15	0.19	0.09	0.37	0.09	0.29	0.12	0.27	0.14
Depth (m)	0.10	0.05	0.08	0.03	0.04	0.01	0.07	0.05	0.03	0.01
Wetted channel width (m)	2.3	2.4	1.5	0.7	1.9	1.5	1.5	0.7	1.9	0.8
Active channel width (m)	10.5	3.2	11.9	3.3	16.7	7.5	23.8	6.1	3.8	1.1
Riparian cover										
Canopy closure (%)	79.6	14.1	70.0	25.2	28.9	21.1	25.1	23.2	65.8	17.0
Reach level (*n* = 1)										
Water quality										
Temperature (°C)	12.3		5.8		9.1		13.4		11.8	
Specific conductance (µS/cm)	111		114		172		215		334	
pH	7.8		7.6		8.2		8.3		nd	
Dissolved oxygen (% saturation)	94.4		102.5		97.8		94.7		97.3	
Dissolved oxygen (mg/L)	7.8		10.1		9.1		7.9		8.5	
Turbidity (NTU)	2.2		2.4		230		114		85.5	
Discharge (cfs)	nd		0.7		0.6		0.5		0.6	

a Based on 3 riffles instead of the standard 5 riffles.

Table E6. Stream velocity and channel characteristics of aquatic macroinvertebrate sites RIT02 and RIT01 on the Rito de los Frijoles in Bandelier NM, 2014. SD = standard deviation.

Transect	Depth (m) (*n* = 5) Mean	Depth (m) (*n* = 5) SD	Velocity (m/s) (*n* = 5) Mean	Velocity (m/s) (*n* = 5) SD	Wetted channel width (m)	Active channel width (m)
RIT02						
1	0.00	0.00	0.00	0.00	21.04	0.0
2	0.03	0.04	0.23	0.38	3.22	0.0
3	0.04	0.05	0.38	0.35	1.48	0.0
4	0.05	0.01	0.53	0.17	1.31	0.0
5	0.05	0.01	0.52	0.24	1.37	0.0
6	0.05	0.03	0.49	0.30	1.25	0.0
7	0.11	0.02	0.53	0.19	0.61	0.0
8	0.07	0.02	0.54	0.23	1.10	0.0
9	0.06	0.03	0.47	0.29	1.04	0.0
10	0.07	0.02	0.50	0.19	1.01	0.0
11	0.06	0.02	0.36	0.11	1.04	0.0
RIT01						
1	0.03	0.01	0.32	0.15	1.52	3.14
2	0.04	0.01	0.45	0.16	0.98	6.22
3	0.02	0.02	0.12	0.20	2.96	3.66
4	0.03	0.01	0.43	0.09	1.16	2.23
5	0.01	0.01	0.04	0.09	2.98	4.51
6	0.04	0.04	0.22	0.13	1.13	3.72
7	0.03	0.00	0.27	0.13	2.19	2.51
8	0.02	0.01	0.11	0.11	2.01	4.58
9	0.03	0.00	0.33	0.07	2.32	4.21
10	0.02	0.03	0.22	0.34	2.62	3.46
11	0.06	0.04	0.42	0.23	0.90	3.44

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